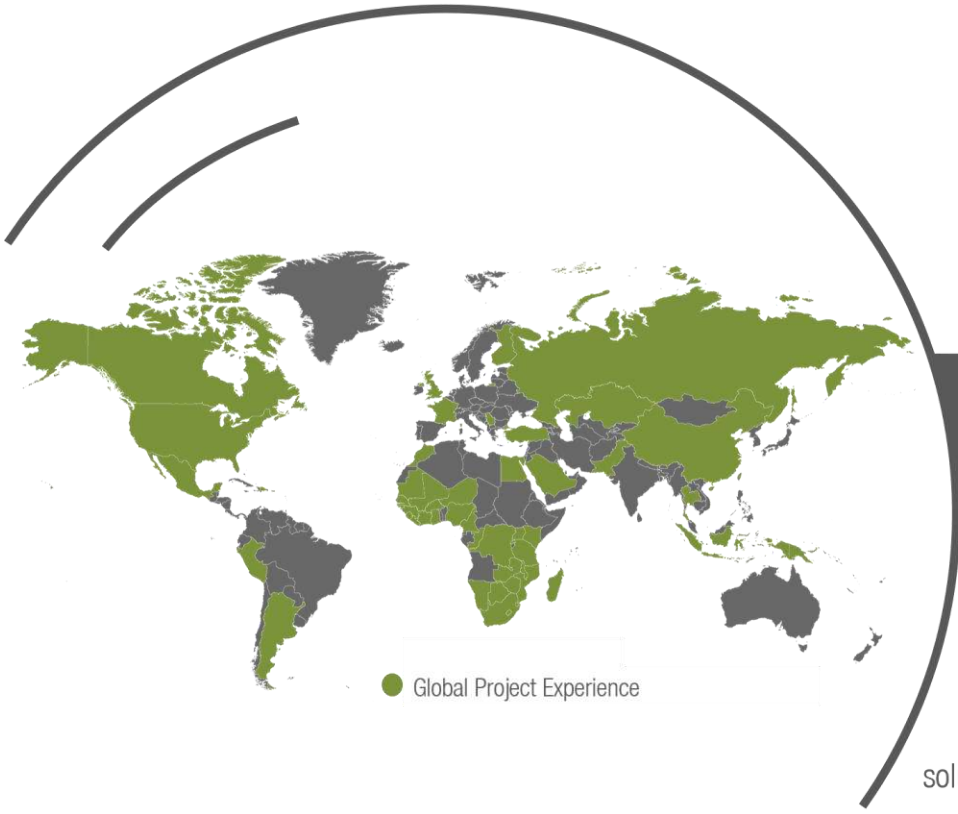

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Dorstfontein East Wetland Impact Assessment

Wetland Ecological Impact Assessment

Prepared for:
Exxaro Coal Central (Pty) Ltd

Project Number:
EXX5725

December 2019 (Updated July 2021)

Digby Wells and Associates
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This document has been prepared by Digby Wells Environmental.

Report Type:	Wetland Ecological Impact Assessment
Project Name:	Dorstfontein East Wetland Impact Assessment
Project Code:	EXX5725

Name	Responsibility	Signature	Date
Kieren Bremner	Field Assessment and Data Analysis	-	2019
Aamirah Dramat	Report Compilation		2020; updated 2021
Willnerie Janse van Rensburg	Report Compilation and Data Analysis		2020; updated 2021
Kathryn Terblanche	Technical Review		2020; updated 2021
Byron Bester	Senior Review		2020; updated 2021

DETAILS AND DECLARATION OF THE SPECIALIST

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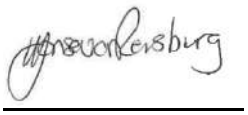
I, Willnerie Janse van Rensburg, declare that: –

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

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



August 2021

Signature of the Specialist *Date*

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

Exxaro Coal Central (Pty) Ltd (Exxaro) requested Digby Wells Environmental (Digby Wells) to compose an environmental regulatory process comprising of an amendment and consolidation of the Environmental Management Programme (EMPr) and Integrated Water Use License (IWUL) associated with the Dorstfontein East Mine located near Kriel, Mpumalanga. Exxaro holds an approved Mining Right with reference number **MP 30/5/1/2/3/2/1 (51) MR** for opencast and underground mining at the Dorstfontein East Coal Mine (DECM). Exxaro aims to extend the underground mining area of the 2 Seam and 4 Seam associated with the Mining Right. The Wetland Impact Assessment aimed to comply with the relevant legislation regulatory requirements listed in Section 4, while the objectives were met as presented in Section 9.

The Project Area consisted of a total of 547.6 hectares (ha) of wetland areas. Twenty-four (24) Hydrogeomorphic (HGM) units were identified and categorized based on terrain units. These included a pan, Hillslope Seep Wetlands (Seeps), Unchanneled Valley Bottom wetlands (UVBs), and Channelled Valley Bottom wetlands (CVBs). The wetlands were grouped into eight groups for ease of the assessment. These included:

- Pan;
- CVBs;
- CVBs (fragmented);
- UVBs;
- UVBs (fragmented);
- Hillslope Seep (Agriculture);
- Hillslope Seep (Fragmented); and
- Hillslope Seep (Unimpacted).

The Present Ecological State (PES) of each HGM unit varied from **'Moderately Modified'** to **'Largely Modified' (PES C to D)**. The dominant land use and impacts on the HGM units were agropastoral activities, including commercial cultivation, cattle grazing, dams, and infrastructure, as well as adjacent mining activities, associated infrastructure and impacts. Various HGM units have been fragmented by linear infrastructure, including roads, powerlines, and fence lines. Fragmentation of wetlands impact the natural habitat, functionality, and health of a wetland.

In terms of Ecosystem Services (ES), sediment trapping, phosphate assimilation, nitrate assimilation, and toxicant assimilation are the dominant services provided by the HGM units. The unimpacted Seeps and CVBs provide habitat to the biodiversity, supply water to cattle and other agropastoral activities. The Ecological Importance and Sensitivity (EIS) of the Pan, UVBs Fragmented, Seep Agriculture, and Seep Fragmented HGM units were regarded as **'Moderate (C)'**. The CVBs, CVBs Fragmented, UVBs, and Seep Unimpacted were **'High (B)'**.

This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows. These systems play an important role in moderating the quality and quantity of water in larger systems.

No wetlands will be directly impacted by the surface infrastructure, however, the surface infrastructure falls within the 100 m and 500 m Zone of Regulation of the Pan and Hillslope Seep (fragmented) (HGM 1 and 7). According to the Groundwater Impact Assessment Report (Digby Wells, 2021), dewatering of the groundwater will potentially occur, however due to the nature of the wetlands and dominant surface and subsurface water supply, the wetlands should not be impacted by the dewatering cone. It is however evident that decanting will potentially occur on the eastern side of the Project Area, adjacent of the Olifants River tributary that could potentially lead to soil, water and wetland contamination. Subsidence could potentially occur over time, affecting the natural topographies, hydrology and functionality of the wetlands.

The impact assessment revealed a spectrum of impacts ranging from **major** to **minor** before the implementation of suitable mitigations. Many of these impacts can be reduced to **minor** and **negligible** impacts after the implementation of the mitigation, monitoring, and the EMPr). Based on the Impact Assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. **However**, it is highly recommended that concurrent rehabilitation, management, mitigation measures, and wetland monitoring are correctly implemented to minimise potential impacts on the wetlands and associated catchments to maintain wetland health and functionality. Wetland management and monitoring requirements should form part of the conditions for environmental authorisation.

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LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITION

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
CVB	Channelled Valley Bottom
DEA	Department of Environmental Affairs

DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMPr	Environmental Management Programme
ES	Ecological Services
ESA	Ecological Support Area
Exxaro	Exxaro (Pty) Ltd
F	Facultative species
FD	Facultative dry-land species
FEPA	Freshwater Ecosystem Priority Areas
FW	Facultative Wetland species
Ha	Hectares
HGM	Hydrogeomorphic
IWRI	Integrated Water Resource Management
IWUL	Integrated Water Use License
m	Meters
m.a.m.s.l	Meters Above Mean Sea Level
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
mm	Millimetres
MTPA	Mpumalanga Tourism and Parks Agency
NBF	National Biodiversity Framework
NEM: BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)

OW	Obligate Wetland Species
PA	Protected Areas
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SFI	Soil Form Indicator
SWI	Soil Wetness Indicator
UVB	Unchannelled Valley Bottom
WET-Ecoservices	Wetland Ecological Services
WET-Health	Wetland Ecological Health Assessment
WMA	Water Management Areas
WRC	Water Resource Commission

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	xii
	(i) the specialist who prepared the report; and	xii
	(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;	xii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	3
cA	An indication of the quality and age of the base data used for the specialist report;	7
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	11
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	7
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	

Legal Requirement		Section in Report
(f)	Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternative;	1.1
(g)	an identification of any areas to be avoided, including buffers;	1.1
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	1.1
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	5
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	10
(k)	any mitigation measures for inclusion in the EMPr;	14
(l)	any conditions/aspects for inclusion in the environmental authorisation;	17
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	15
(n)	a reasoned opinion (Environmental Impact Statement) -	18
	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;	17
(o)	a description of any consultation process that was undertaken during preparing the specialist report;	16
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	N/A

1. Introduction

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

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

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

1.1. Terms of Reference

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

1.2. Study Areas

For the purpose of this report, the following applies:

- Project Area defines farm portions directly associated with DECM (red outlined areas on maps); and
- Study Area defines the zone of influence in terms of potential impact the Project will have on the wetlands. This includes the Project Area together with a 500 m Zone of Regulation. The Zone of Regulation is the 500m area surrounding a wetland in which activities must be authorised by a Water Use Licence (WUL).

1.3. Project Locality

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

The proposed Dorstfontein East Mine Underground expansion area is situated within the Olifants River Catchment (Primary Catchment B), within the B11B and B11D quaternary catchment (Table 1-1 and Figure 1-1 and Figure 1-2).

Table 1-1: Property Description

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

	T0IS00000000005500011 T0IS00000000005500013 T0IS00000000005500005

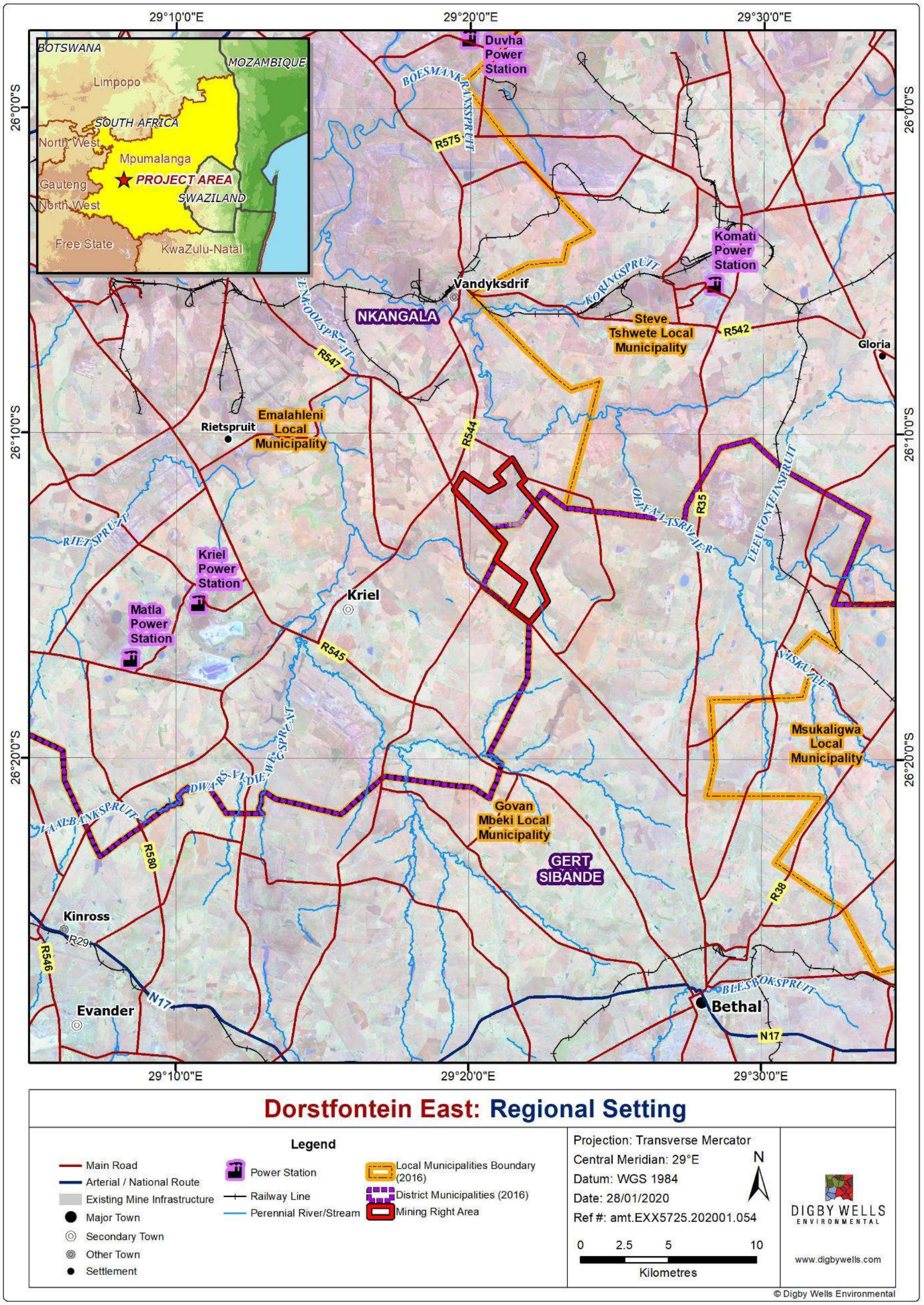


Figure 1-1: Regional Setting

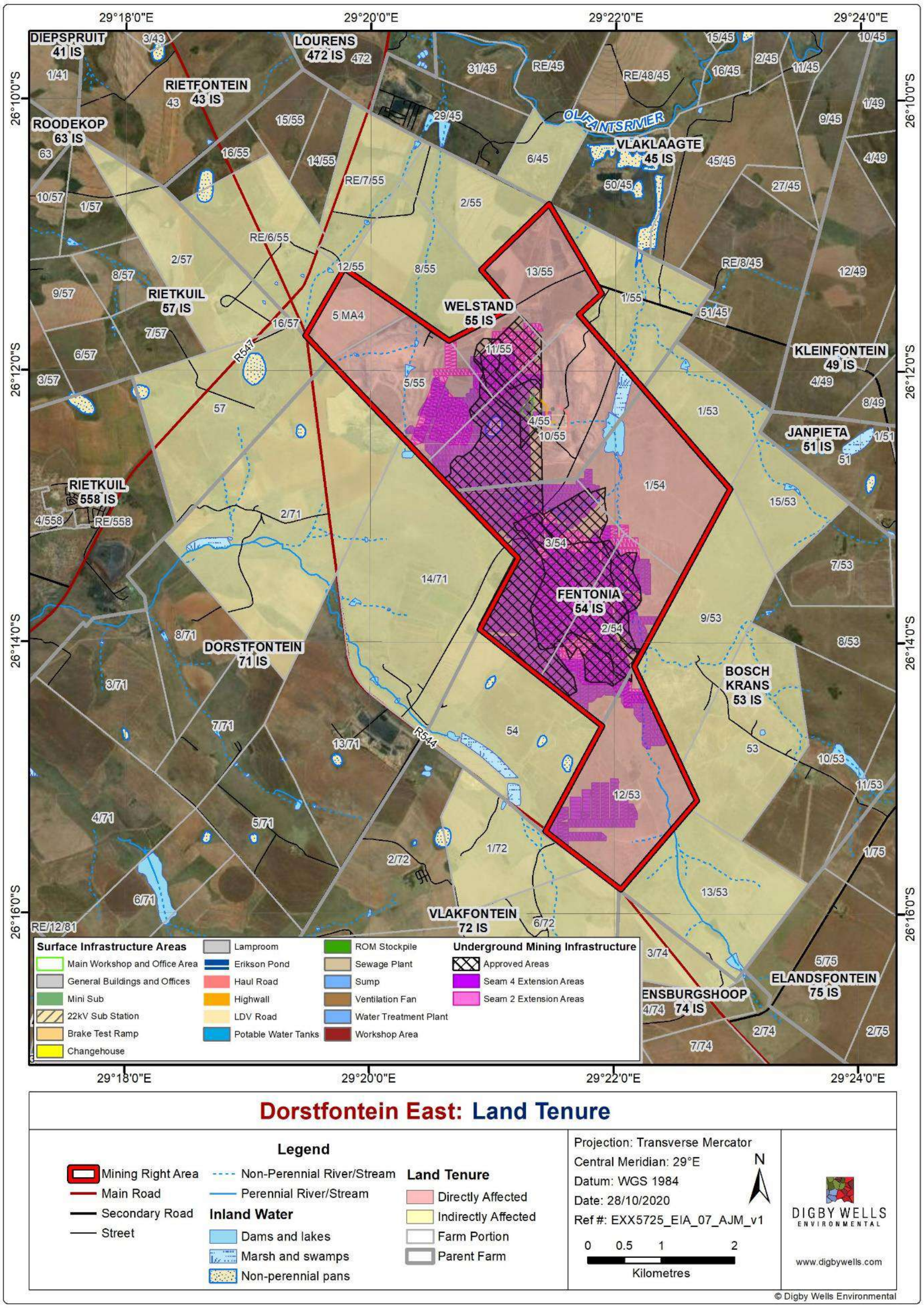


Figure 1-2: Land Tenure Map

1.4. Proposed Infrastructure and Activities

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

The required infrastructure proposed for the extension activities include:

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

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

Table 1-2: Project Phases and Associated Activities

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

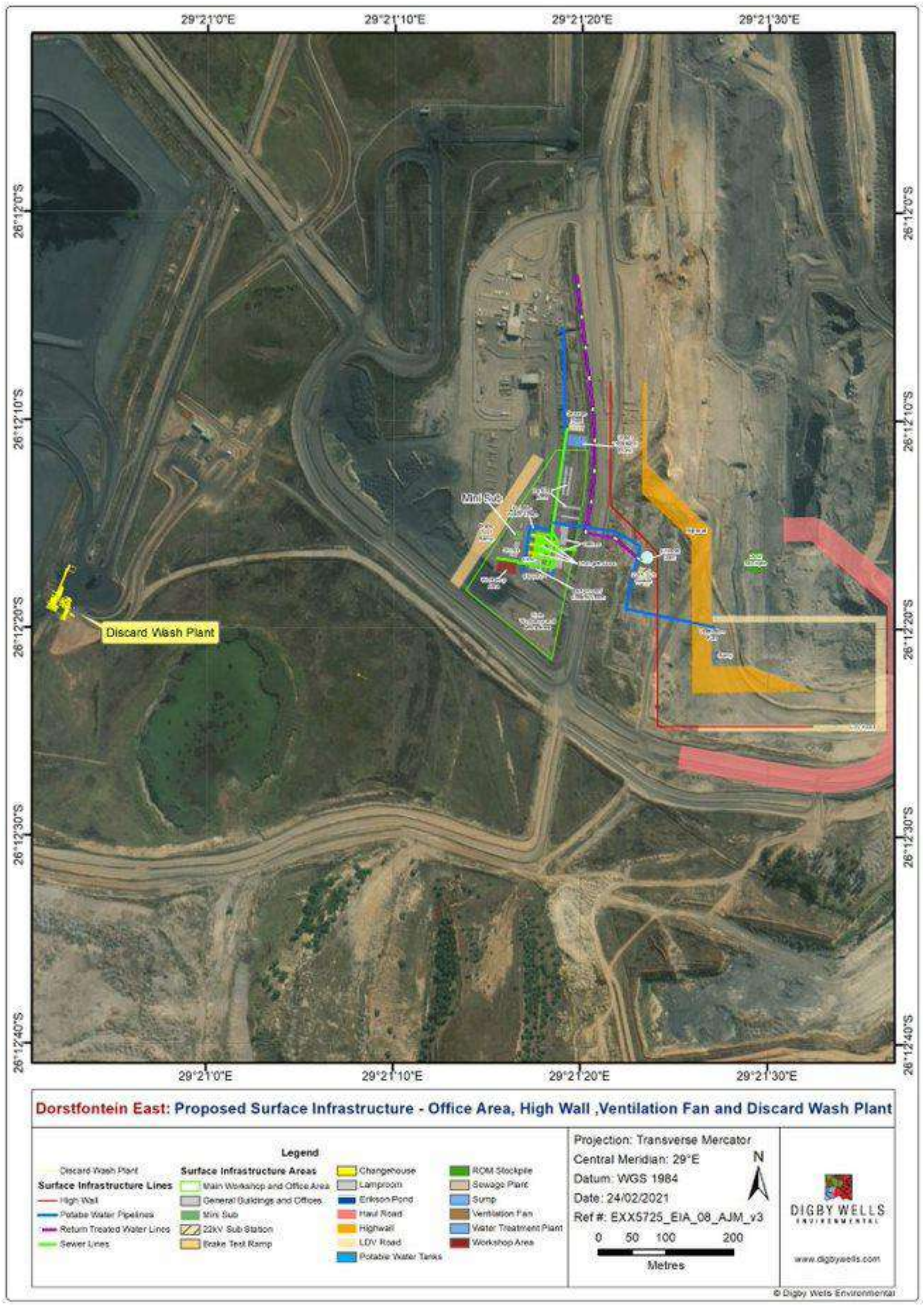


Figure 1-3: Proposed Surface Infrastructure Layout

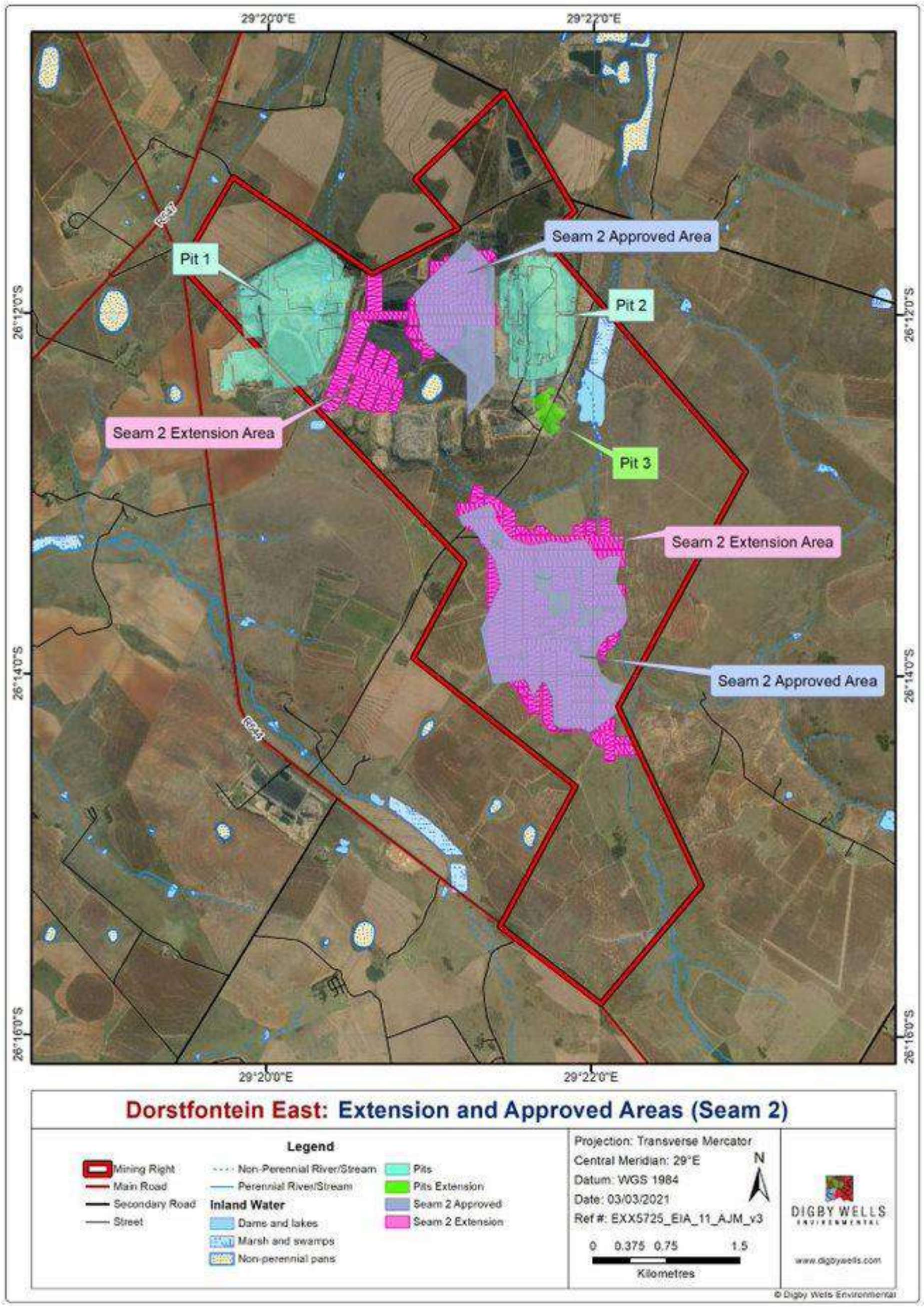


Figure 1-4: Seam 2 Existing and Approved Areas

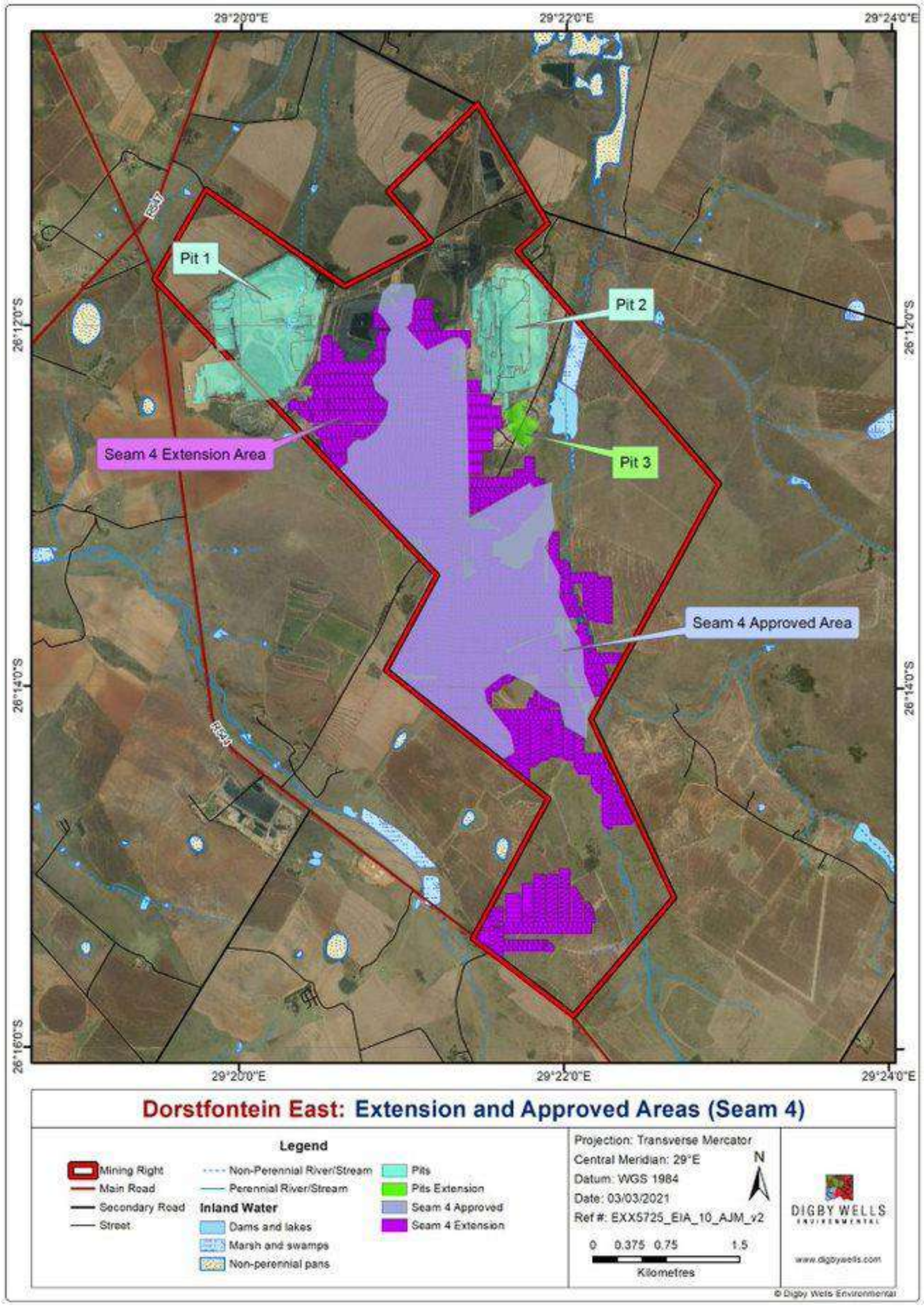


Figure 1-5: Seam 4 Extension and Approved Areas

2. Alternatives Considered

Alternatives to consider ensuring minimal impacts to the Wetlands include:

- Avoid mining in highly sensitive areas;
- Re-instate/re-introduce water pumped from the underground mining activities to the wetlands to avoid drying out of wetlands;
- Restrict surface infrastructure and associated footprint within wetlands and associated buffer zones (100 m and 500 m zone of regulation);
- Avoid construction and movement in wetlands and associated zone of regulation;
- Reduce the amount of water and land for operations and associated infrastructure;
- Clean wastewater and sewage before putting it back into the freshwater systems;
- Implement wetland monitoring to ensure maintenance and waste management plans are in place; and
- Reduce waste materials and waste outputs.

3. Scope of Work

The field assessment for the wetland ecology associated with the proposed expansion of the Dorstfontein East Mine was carried out 10 to 12 September 2019. The Scope of Work for the Wetland Impact Assessment comprised of the following:

- **Desktop investigation** of the catchments, regional context, and potential freshwater resources within the Project Area;
- **Wetland Delineations**, identification and characterisation of wetlands within the Project Area;
- **Wetland Health Assessment** including assessment of the Present Ecological State (PES), wetland service provision (ES), and Ecological Importance and Sensitivity (EIS);
- **Sensitivity mapping** and the recommendation of buffer zones according to the guidelines set out in 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** recommendations of the Project Area to develop a rehabilitation and management plan for the Life of Mine (LoM).

4. 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 Environmental Impact Assessment are detailed in Table 4-1.

Table 4-1: 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 GNR 1003 in GG 43726 dated 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 (GG 34809, GNR 1002, 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). • 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.
Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996) Wetlands are protected under the Act that states that everyone has the right to an environment that is not harmful to their health or wellbeing. It also states that the environment must be protected for the benefit of present and future generations through responsible legislative measures. The Act: • Prevents pollution and ecological degradation; • Promote conservation and secure ecological sustainability; and • Promote justifiable economic and social development using natural resources.	• A Wetland Impact Assessment was undertaken in accordance with the principles of Section 24 of the act for the EIA Phase; • 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; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed and provided.

Legislation, Regulation, Guideline or By-Law	Applicability
The National Water Act, 1998 (Act No. 36 of 1998) (NWA) • Section 19 of the National Water Act (NWA), 1998 (Act 36 of 1998) that include the prevention and remediation of the effects of pollution; and • Section 21 (c), (g) and (i) of the National Water Act (Act 36 of 1998) 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; • Environmental Management Programme 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 1.4 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 Department of Water Affairs and Forestry (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);	• 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

Legislation, Regulation, Guideline or By-Law	Applicability
• A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 centimetre (cm) of the soil; and • The presence, at least occasionally, of water-loving (hydrophilic) plants (i.e. hydrophytes).	classifying wetlands and human impacts on wetlands from desktop imagery and in the field.
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 Ecosystems Priority Areas (NFEPA, (Nel, et al., 2011)**)** 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'.	• Will help greatly 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.
SANBI, in collaboration with the DWS report on "Wetland offsets: a Best-Practice Guideline for South Africa" (SANBI and DWS, 2016) This guideline serves as a practical tool to aid in the	• The guideline provides practical guidance for determining the size and characteristics of a wetland offset and determining the

Legislation, Regulation, Guideline or By-Law	Applicability
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 application for a Water Use Licence under the National Water Act) 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 license or development of an Environmental Management Programme under the Mineral and Petroleum Resources Development Act). 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.	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.

5. Assumptions, Limitations, and Exclusions

The following limitations were encountered during this study:

- Findings, data analysis and the impact assessment are based on the wetland assessment completed in 2019, no updated wetland assessments were done by the author of this paper;

- As some areas assessed during 2019 have been approved for mining, some discrepancies might occur with the wetland delineations and PES, EIS and ES scores;
- 2019 Assessment:
    - Access to some of the systems was limited due to the areas being on Mine property. The systems that were not verified during the field survey were scrutinised at a desktop level and have been demarcated as such for transparency; and
    - Wetlands situated within the 500 m zone of regulation were assessed on a desktop level with very limited ground-truthing and some discrepancies within this zone may occur.
- This wetland study forms part of a larger EIA and should be read in conjunction with the EIA and other related specialist studies; and
- 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. 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.

6. Details of the Specialists

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

- **Kieren Jayne Bremner** was the Wetlands manager in the Ecology and Atmospheric Science Department at Digby Wells. She completed an MSc (Aquatic Health) from the University of Johannesburg and has 11 years of consulting experience. In her early career, she was exposed to various sectors of the Environmental Management field such as water use licensing, BAs, EIAs, and public participation. During this time, she was allowed to initiate and manage various aquatic biomonitoring programs within the mining and energy production sectors within South Africa. In 2009, Kieren began to focus largely on wetland and aquatic specialist assessments, gaining invaluable and extensive experience in the biomonitoring and water monitoring field in rivers and wetlands throughout South Africa. International countries of project experience include Botswana, the Democratic Republic of Congo, Malawi, Mali, Senegal, and Ghana. Kieren is registered by the South African River Health Programme (SA RHP) as an accredited aquatic biomonitoring specialist.
- **Byron Bester** has experience and a broad knowledge of various aspects of aquatic ecosystem assessment throughout South Africa and abroad, including water quality

assessment, sediment composition, fish biometric indices determination, histopathological fish health assessments and human health risk assessments via the consumptive pathway. He has completed numerous specialist aquatic biodiversity assessments in a wide range of sectors, including mining (e.g. coal, gold, platinum, titanium, etc.), industrial (e.g. smelters, brick-making projects, special economic zones, etc.), transport infrastructure upgrades (e.g. roads, airports, etc.), services infrastructure (e.g. powerline installations, bulk water pipelines, etc.), as well as mixed-use, residential and commercial developments.

- **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 MSc 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 8-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. Kathryn is also involved with both wetland and rehabilitation monitoring programmes. 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.

7. Methodology

A detailed methodology used in the compilation of the Wetland Impact Assessment is described in Appendix A and is summarized in Figure 7-1 below.

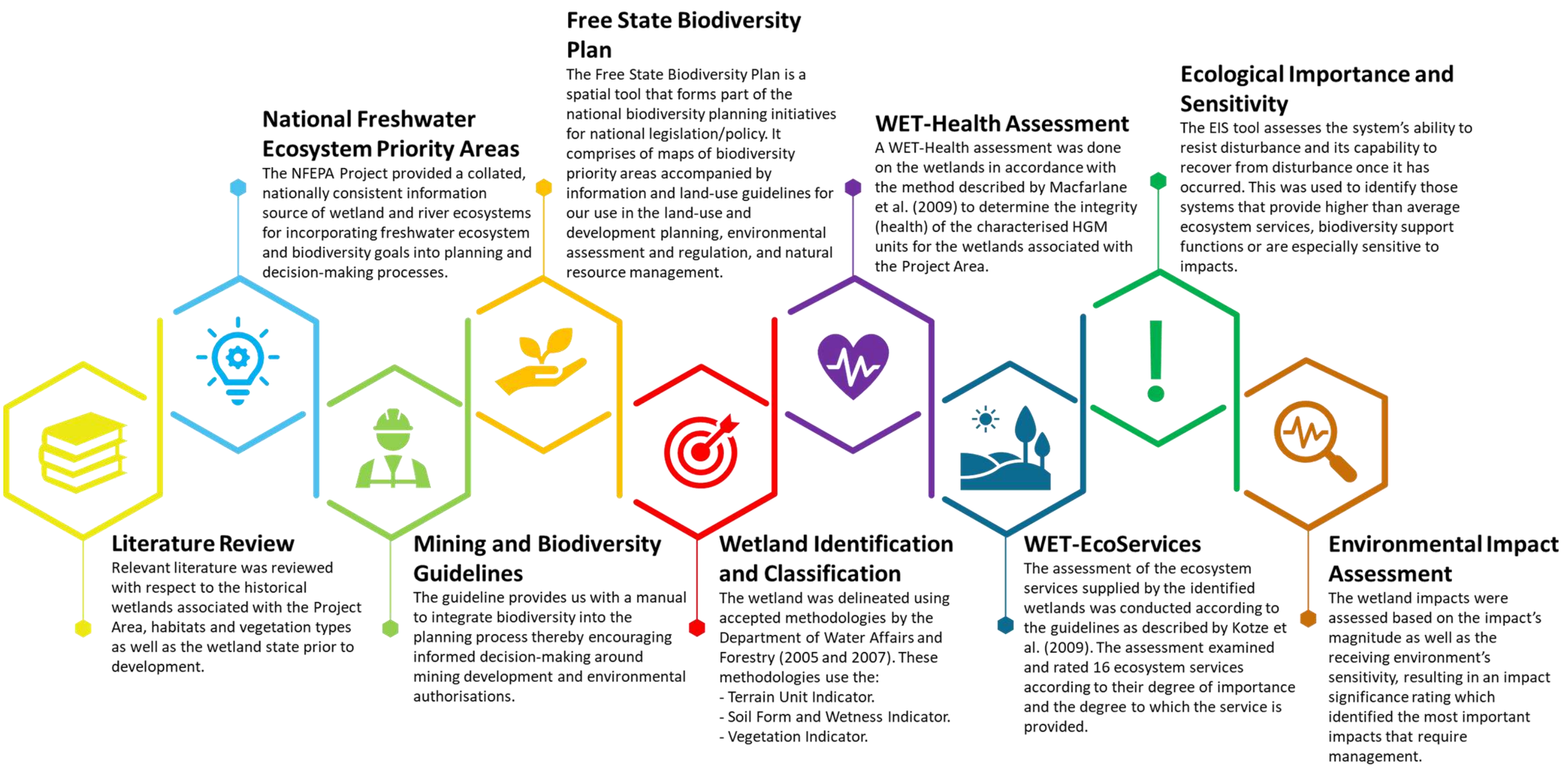


Figure 7-1: Methodology

8. Baseline Assessment

A desktop baseline environmental assessment was conducted and are discussed in Table 8-1 below.

Table 8-1: Baseline Assessment

Bioregional Context (Darwell, 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 8-1)**	
Political Region	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, 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; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).	Herb Species	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp. *latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Climate	The climate is characterised by a temperate climate with hot summers and cold, dry winters. During the summer months (December, January and February), the average daily temperature is 27°C. In winter (June, July and August), the daily average temperature is 4°C. Most (65%) of the rainfall in the area occurs during the summer, largely as thunderstorms. The rainfall averages between 700 and 750 mm per annum.			Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Freshwater Ecoregion	Southern Temperate Highveld	Altitude (m.a.m.s.l.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)		
Geomorphic Province	Mpumalanga Highlands	Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000	Succulent Herb Species	*Aloe ecklonis.*
Vegetation Type	Eastern Highveld Grassland	Coefficient of Variation (% MAP)	<20 to 35	Low Shrub Species	*Anthospermum rigidum* subsp. *pumilum, Seriphium plumosum.*
WMA	Olifants	Rainfall Seasonality	Early to late summer	Status	Vulnerable.
Sub-WMA	Upper Olifants	Mean Annual Temp. (°C)	12 to 20	**MBSP Category** (MTPA, 2014) **(**Figure 8-2**)**	
Secondary Catchment	B1	Mean Daily Summer Temp. (°C): February	10 to 32	• CBA irreplaceable;	

Quaternary Catchment (Figure 8-5)	B11B and B11D	Mean Daily Winter Temp. (°C): July	-2 to 22	• CBA optimal; • ESA local corridor; • Other natural areas; • Moderately modified and old lands; and • Heavily modified areas.	
Watercourse	Olifants and Steenkoolspruit Watershed	Median Annual Simulated Runoff (mm)	5 to >250	**NFEPA Wetland Classification** (Nel, et al., 2011) **(**Figure 8-3 **and** Figure 8-4**)**	
Mining and Biodiversity Guideline Category, DEA (2013) **(**Figure 8-6**)**				NFEPA Wetlands	Channelled valley bottoms, Unchanneled valley bottoms, floodplains and seeps.
B: **Highest Biodiversity Importance** – Highest Risk for Mining; and D. **Moderate Biodiversity Importance** – Moderate Risk for Mining.				River FEPA	Not a FEPA catchment, classified as a Sub-quaternary catchment.
Topography	The topography is that of undulating plains and gentle slopes. It is located on the Highveld plateau and the Project Area lies between 1515m and 1660m above sea level. Drainage occurs predominantly in a northern direction of the Project Area. Valley slopes are generally flat with gradients between 1:20 and 1:40. Slopes steeper than this gradient is found near rivers in the Project Area.			Geology	The Project Area is situated in the Witbank coalfield within the Karoo Supergroup. The Karoo Supergroup within the Project Area comprises the Ecca Group as well as the Vryheid Formation. The Ecca Group is where rich coal deposits are found. The lithology can be stratigraphically classified, and includes sandstone, shale and coal.

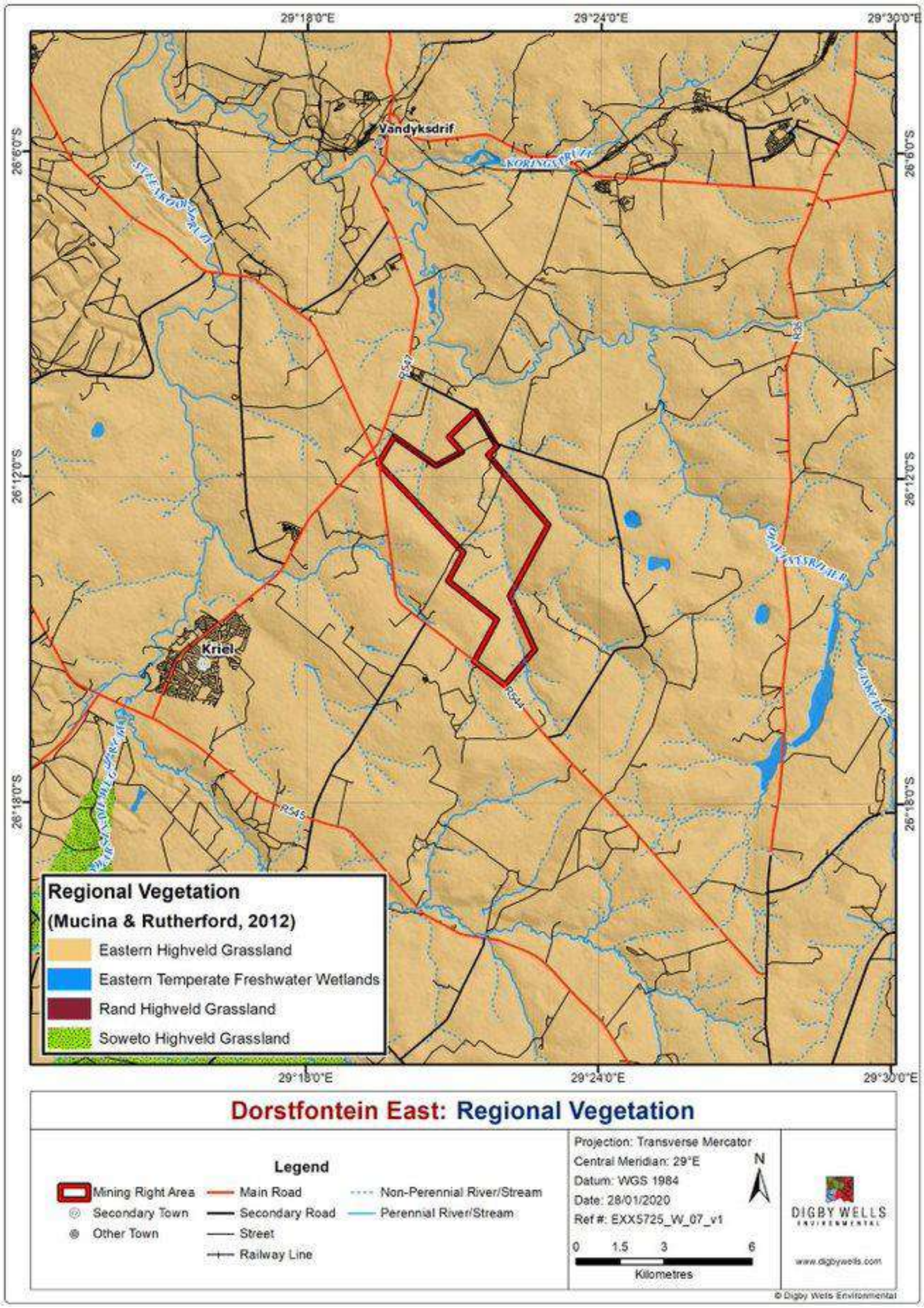


Figure 8-1: Regional Vegetation

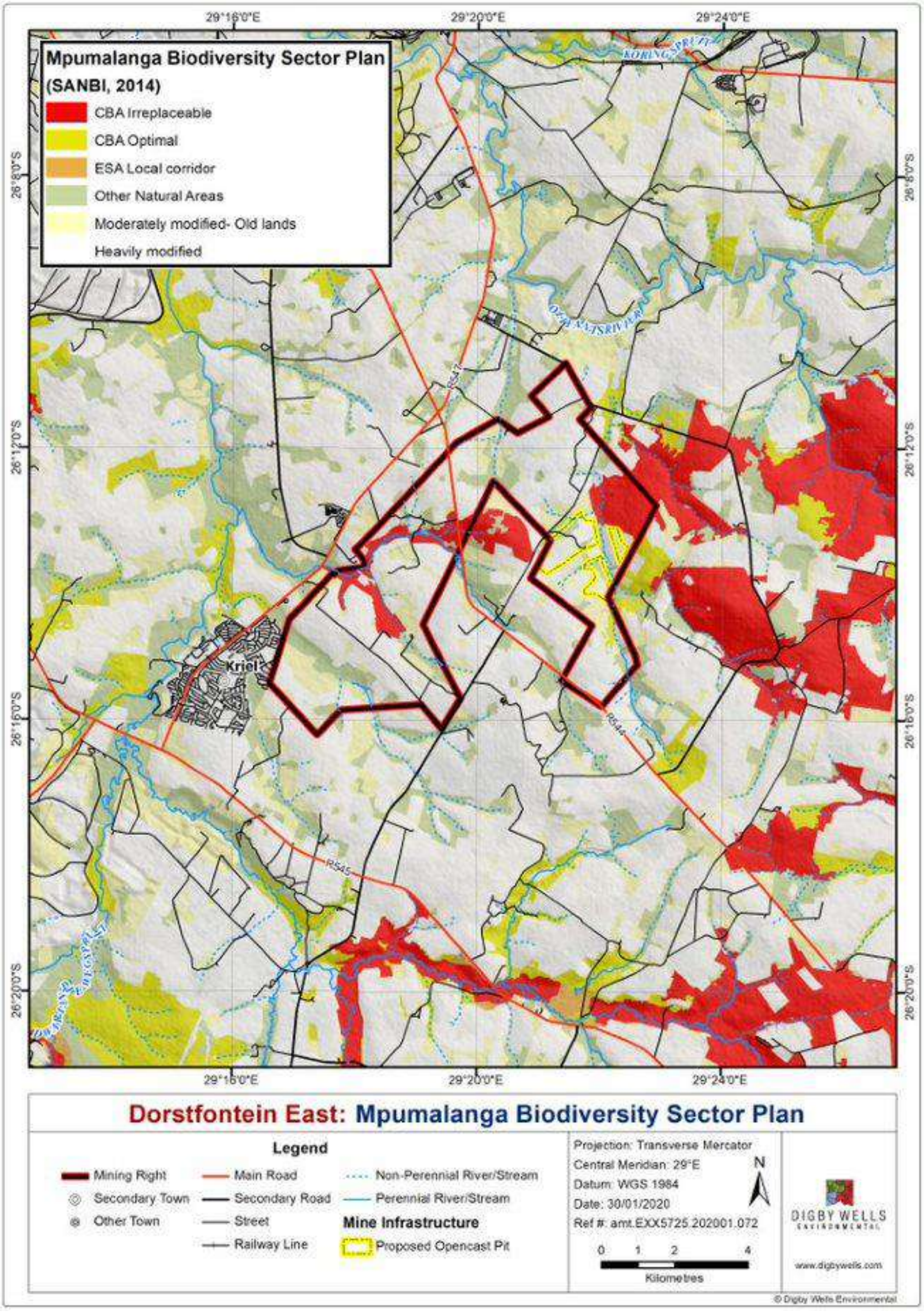


Figure 8-2: Mpumalanga Biodiversity Sector Plan

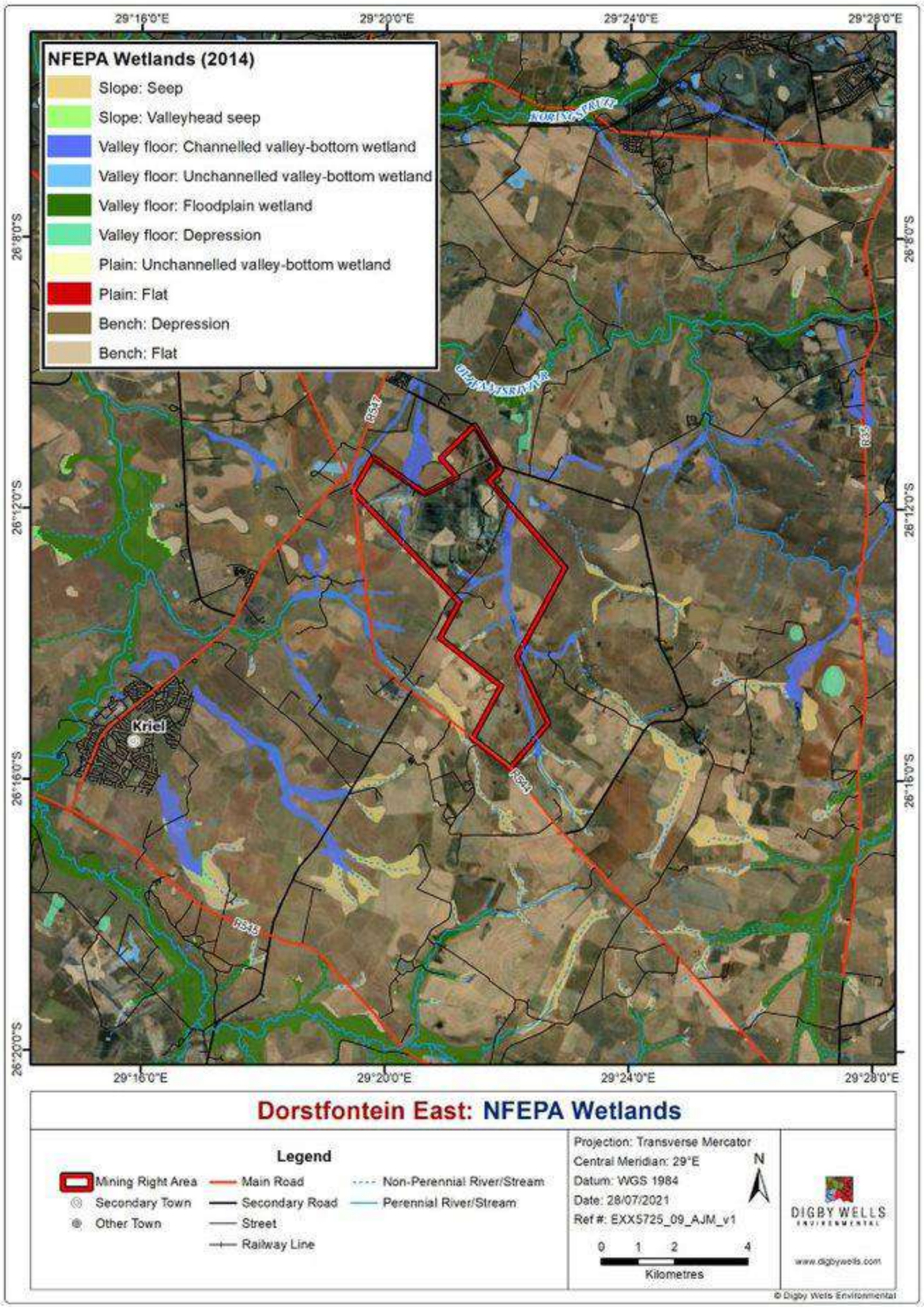


Figure 8-3: NFEPA Wetlands

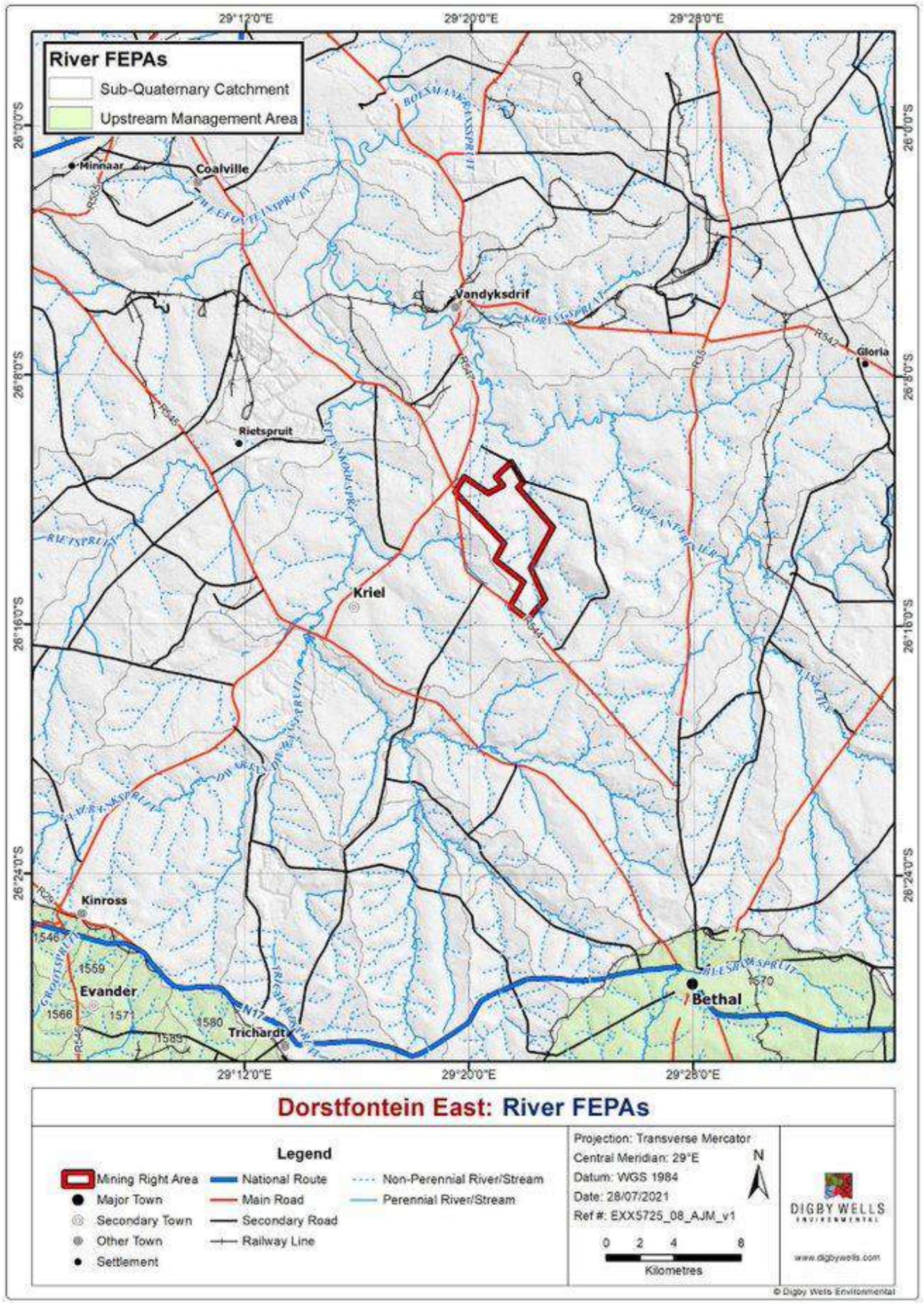


Figure 8-4: River FEPA's

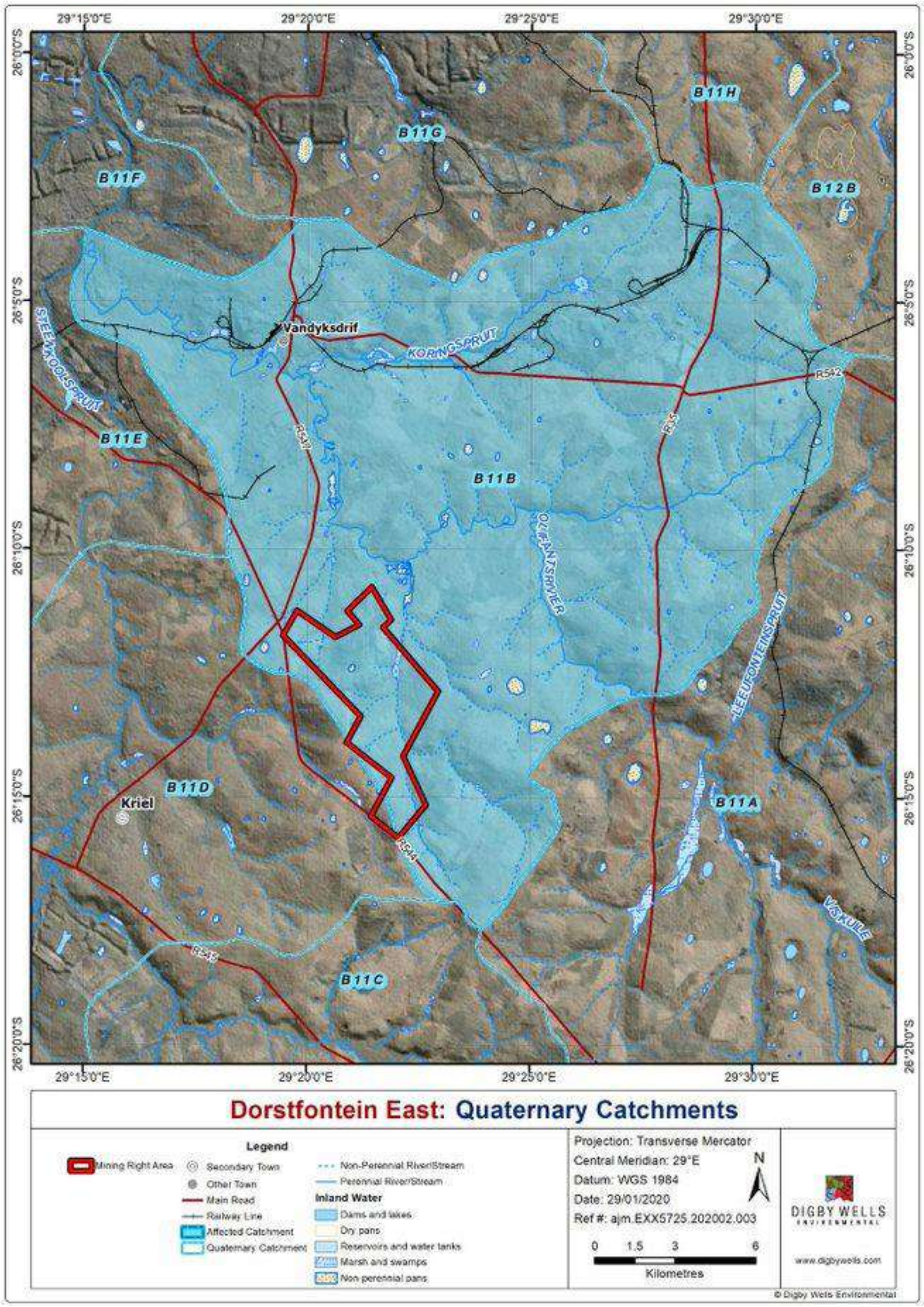


Figure 8-5: Quaternary Catchments

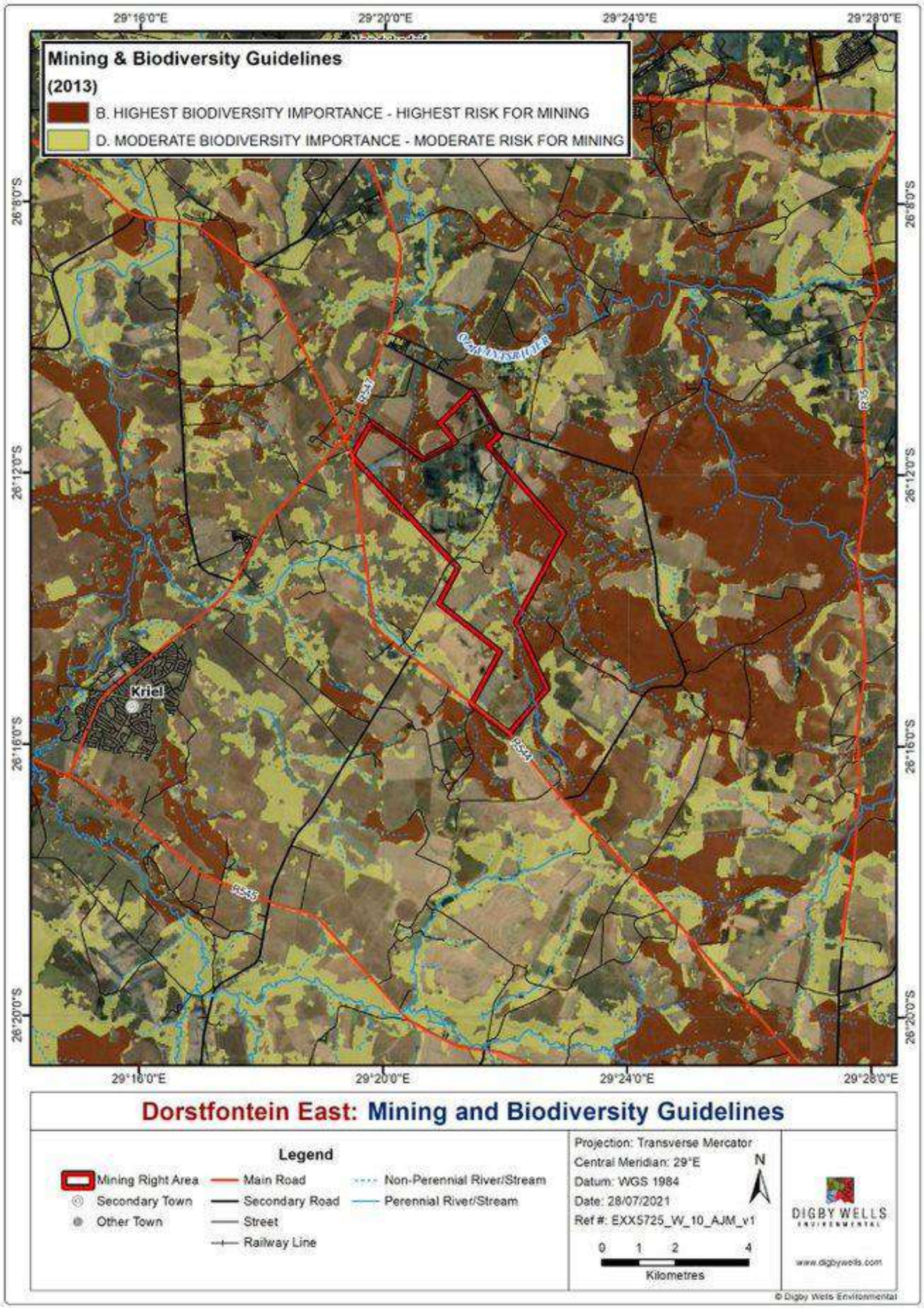


Figure 8-6: Mining and Biodiversity Guidelines

9. Results and Discussion

A site visit was conducted from 10th – 12th September 2019 to assess the ecological integrity, delineate the wetlands, and determine their PES, ES and EIS state. This report is based on these findings and available information, to identify the potential impacts the proposed Dorstfontein East Project will have on the wetlands associated with the Project Area.

9.1. Wetland Delineation and Hydrogeomorphic Unit Identification

During the desktop and field assessment, 565.8 ha of wetlands were identified and delineated within the Project Area using the approved methodology by the (Department of Water Affairs and Forestry, 2005). As per the most recent proposed surface infrastructure and underground mine plan, surface infrastructure is not planned within any delineated wetlands, however, are within 100 m of a wetland (HGM 1 and 7) (Figure 9-5). Twenty-four (24) HGM units and eight (8) dams were identified and categorized based on terrain units. These include depressions (pans), hillslope seep wetlands (Seeps), unchanneled valley bottom wetlands (UVBs), and channelled valley bottom wetlands (UVBs). Land use activities and in-field studies have shown that some of the systems are similar from a catchment management perspective as they would be subject to similar overall land uses impacts. Therefore, it was considered practical to group the HGM units by systems that have similar land use and impacts to calculate more accurate PES and EIS scores. Eight HGM units were identified and assessed. The extent of the combined HGM units together with the total percentage of wetlands within the Project Area are indicated below (Table 9-1).

Table 9-1: Combined HGM Units

No.	Name	Acronym	Area (Ha)
1	Pan	Pan	15.9
2	Channelled Valley Bottoms	CVBs	90.9
3	Channelled Valley Bottoms (fragmented)	CVBs Fragmented	4.4
4	Unchanneled Valley Bottoms	UVBs	17.0
5	Unchanneled Valley Bottoms (fragmented)	UVBs Fragmented	19.3
6	Hillslope Seep (Agriculture)	HS Agriculture	293.6
7	Hillslope Seep (Fragmented)	HS Fragmented	66.9
8	Hillslope Seep (Unimpacted)	HS Unimpacted	39.6
Total wetlands			**547.6**
*	Artificial wetlands, dams and borrow pits	Dams	18.2
Total area			**565.8**

* Artificial wetlands, dams and borrow pits are not regarded as HGM units, however, it is included in the calculations due to forming part of other HGM units and affecting the PES and EIS scores

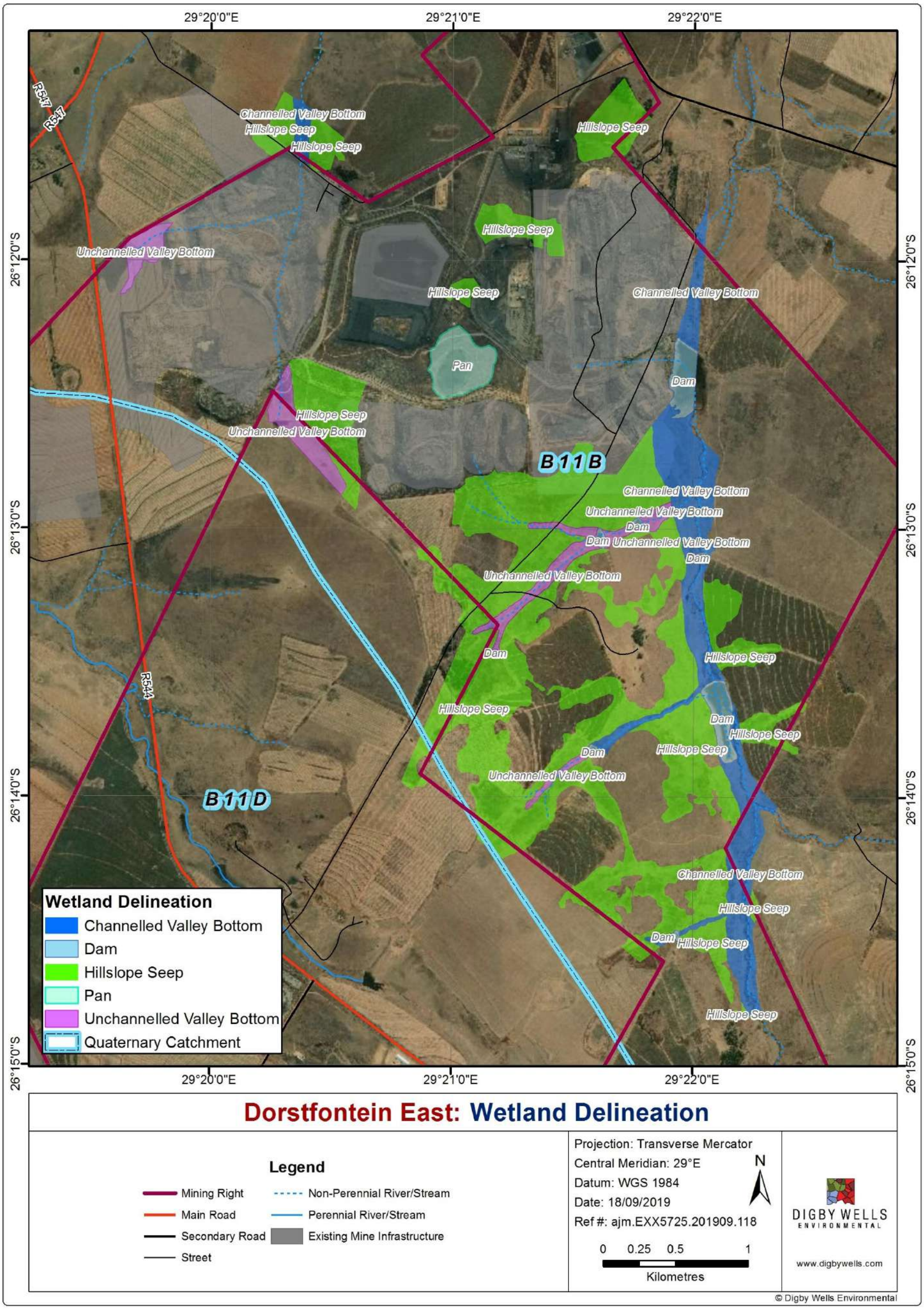


Figure 9-1: Wetland Delineations

9.1.1. Terrain Indicator

The terrain unit indicator was used extensively in the identification of wetlands and their various HGM units. Use was made of topographical maps and five-meter contours in the preliminary identification of wetland areas. Further to this, the underlying geology and geohydrology of the area were investigated to gain a greater understanding of the potential movement of subsurface water and potential areas of daylighting.

Wetlands in the crest and mid-slope were typically characterized as Seeps and UVBs. A pan wetland was identified within the currently mined area. Wetlands in the middle slope, foot-slope, and bottomland typically identified as VBs. Scattered dams and a large dam within the main CVB on the east of the Project Area were identified. These dams are typically used for irrigation, cattle watering, and domestic use.

Some of the wetlands were unimpacted by direct mining and agricultural activities, whereas some wetlands were almost completely mined out, fragmented, or cultivated.

Table 9-2: Terrain Indicators

9.1.2. Vegetation Indicator

Vegetation structures of the various wetlands and their respective HGM units were relatively variable. Large portions of the natural vegetation structures had been historically altered due to the predominant surrounding land use activities. These included areas of land cleared for crops and the use of the land for grazing and pastures.

Wetland plant species used in the identification and delineation of the various HGM units observed included the species listed in Table 9-3.

Table 9-3: Vegetation Indicators

Obligate wetland species	OWS	*Agrostis lachnantha*, *Leersia hexandra, Phragmites australis, Paspalum distichum*
Facultative wetland species	FWS	*Andropogon eucomis, Hemarrthria altissima, Hyparrhenia tamba, Paspalum urvillei*
Seasonal wetland species	SWS	*Setaria sphacelata; Aristida junciformis, Themeda triandra, Eragrostis gummiflua*
Temporary wetland species	TWS	*Imperata cylindrica; Paspalum dilatatum*
Mostly wetland dependant species	MWS	*Typha capensis, Juncus* sp., *Cyperus* sp., *Persecaria* sp.

Stands of *Euca*lyptus *grandis* and *Pinus patula* were identified within the Project Area. Isolated areas of *Acacia mearnsii* were also observed. It is regarded as likely that these areas may have resulted in serious modifications to historically wet or moist grasslands, VBs, pans, and seeps, thus influencing the wetland delineation at these points.

Table 9-4: Vegetation Indicators

9.1.3. Soil Indicator

Soil indicators including soil forms and soil wetness, such as mottling and gleying of soils, were used extensively throughout the Project Area to identify and confirm wetlands.

According to the Soil Study (Digby Wells, 2020), low-lying areas within the Project Area showed increased clay content and soil wetness (Table 9-5). These soils were identified as wetland soils (hydromorphic soils) and are saturated for long periods with a fluctuation water table, changing the morphology of the soils. The land use in these areas were generally

wetlands and used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

Hydromorphic soils are significant to the overall site sensitivity analysis. The low angled topographic slopes and resulting wide expansive drainage lines coupled with the presence of restrictive sedimentary layers (sandstone predominantly) have resulted in proportionately much larger areas of transition zone moist grasslands and wet based soils that meet the wetland classification both pedologically as well as ecologically.

Table 9-5: Soil Indicators

9.2. Wetland Ecological Health Assessment

The PES of the HGM units were assessed in 2019. The PES of the eight HGM units were rated to have an ecological state of **'Moderately Modified'** to **'Largely Modified'** (Table 9-6 and Figure 9-2). According to the integrity (health) method described by Kotze et al. (2007):

- A **category C** wetland has **Moderate** changes to its ecosystem processes, and loss of natural habitat has taken place; however, the natural habitat remains predominantly intact; and
- A **category D** wetland has **Large** modifications to the natural ecosystem processes and loss of natural habitat and biota.

Each HGM unit, PES score, and its health; hydrological, vegetation, and geomorphological health are tabulated below (Table 9-6) whereas the validations for the PES values are discussed below.

Table 9-6: Present Ecological State Scores

Number	HGM Unit Group	Hydrology	Geomorphology	Vegetation	Combined PES	PES Category
1	Pan	6.0	2.0	4.1	4.3	**D**
2	CVBs	7.0	1.4	5.9	5.1	**D**
3	CVBs Fragmented	4.0	4.0	5.4	4.4	**D**
4	UVBs	2.0	0.5	6.2	2.8	**C**
5	UVBs Fragmented	3.0	0.3	7.8	3.6	**C**
6	HS Agriculture	2.0	0.6	9.0	3.6	**C**
7	HS Fragmented	4.0	1.2	7.5	4.2	D
8	HS Unimpacted	1.0	0.2	7.0	2.5	C

9.2.1. Validation (2019)

Pan (D) – The pan is located within the mine operational area. The entire catchment as well as the pan has been impacted by mining activities, changes to the hydrological functioning, increased AIPs, and excavations, and dumping was evident within the pan. Ecological functioning has been highly impacted by dominantly mining activities.

Channeled Valley Bottoms (D) – The CVBs have mainly been impacted by agropastoral activities, including cattle grazing, dams, and cultivation. Large dams exist within the CVB, together with evidence of cattle trampling, erosion, and compaction. This impacted the natural hydrology, ground cover, and changes to the natural vegetation.

Channeled Valley Bottoms (fragmented) (D) – In addition to the aforementioned, some of the CVBs have been fragmented by linear infrastructure, including mining activities, agropastoral activities as well as roads, powerlines, and fence lines. Fragmentation of wetlands impacts the natural habitat, functionality, and health of a wetland. Linear infrastructure within wetlands is prone to creating erosion, channeling, drying out of wetlands, and increased AIPs.

Unchanneled Valley Bottoms (C) – The UVBs within the Project Area were dominantly used for cattle grazing. There were no clear signs of channeling, erosion, or extensive cattle trampling. The vegetation was stable with little changes to water inputs to the systems. The systems were in a stable condition, well-functioning, and creating habitat for various fauna and flora species.

Unchanneled Valley Bottoms (fragmented) (C) – Regardless of some of the UVBs being moderately impacted, some of the systems were fragmented by mining, agropastoral and linear infrastructure. Dams were also indicated in some of the systems. The fragmentation of the UVBs changes the natural habitat and health of the systems.

Hillslope Seep (Agriculture) (C) – The majority of the Hillslope Seep wetlands were used for agropastoral activities, including commercial cultivation and cattle grazing. The soils within Hillslope Seep wetlands (Hutton, Clovelly) are typically used for cultivation due do the decent water-holding-capacity, fertility, and soil depth. However, cultivation changes the natural vegetation, hydrological functioning as well as the geomorphology by ploughing, ripping, and tillage.

Hillslope Seep (Fragmented) (D) – Regardless of some Hillslope Seeps being impacted by agropastoral activities, some of the seeps have been impacted by mining activities and linear infrastructure, including roads, dams, and powerlines. Some sections of the seeps have almost completely been removed by these activities or completely separated and cut off from the rest of the system.

Hillslope Seep (Unimpacted) (C) – Unimpacted Hillslope Seep wetlands were recorded within the Project Area. These wetlands were mainly used for cattle grazing, however, was well regulated and little erosion and impacts on the vegetation and geomorphology were noted.

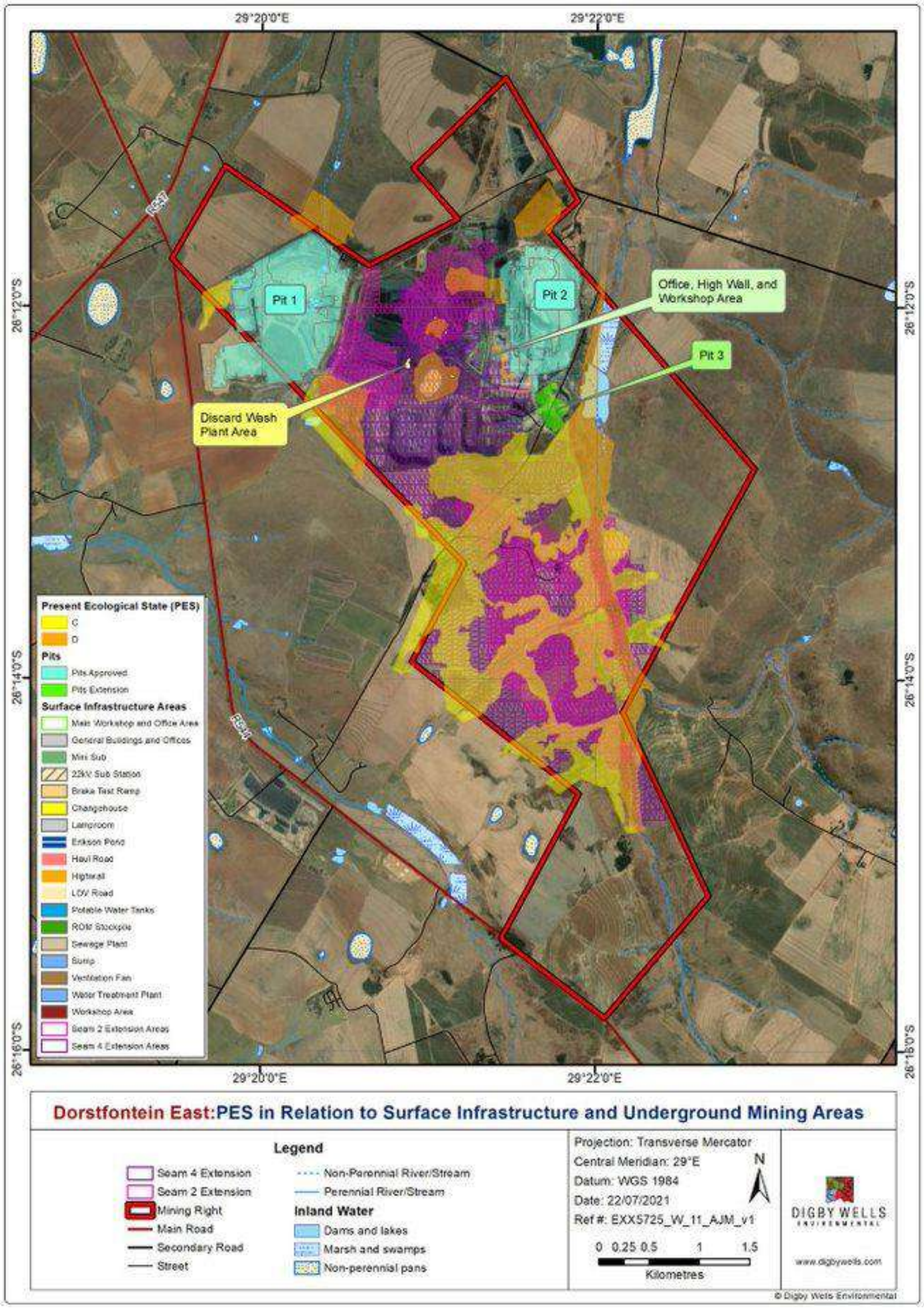


Figure 9-2: Wetland Present Ecological State

9.3. Wetland Ecological Services

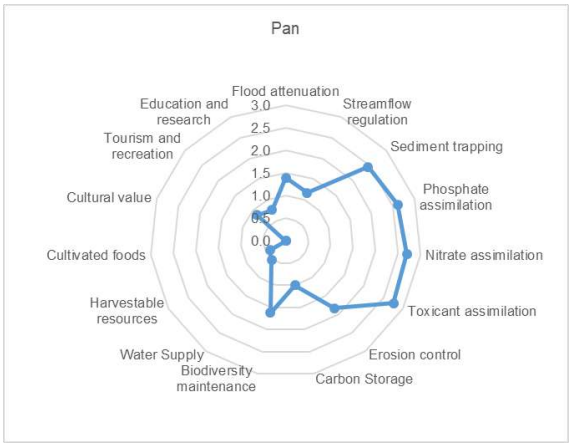
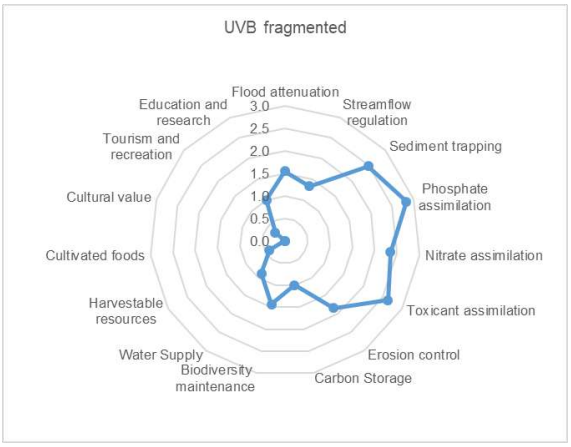
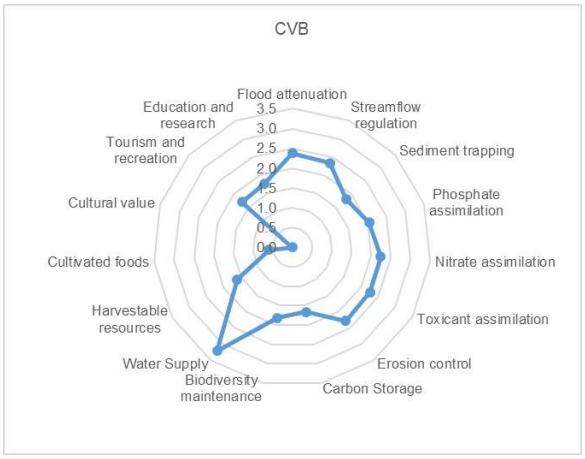
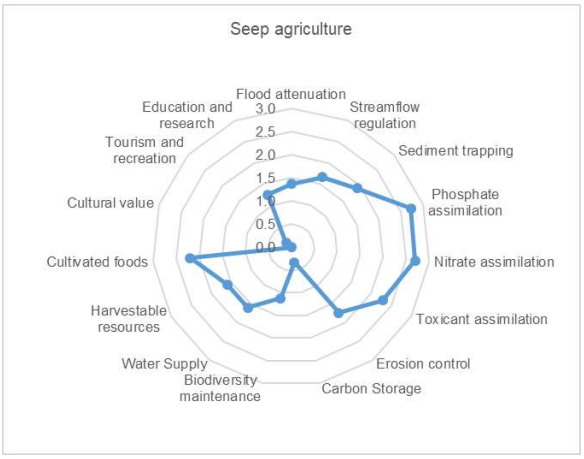
The general ES and natural features of the wetlands were assessed in terms of functioning and the overall importance of each HGM unit was determined at a landscape level.

Table 9-7 represents radial plots showing the relative importance of each ecosystem service and lists the summary of the scores obtained.

As indicated in Figure 9-3,

Table 9-7 and Table 9-8, sediment trapping, phosphate assimilation, nitrate assimilation, and toxicant assimilation are the dominant ecological services provided by the HGM units. The unimpacted Hillslope Seeps and CVBs are providing biodiversity maintenance due to the fauna and flora importance. The CVBs are important for water supply, supplying all agropastoral activities in the area (dams, cattle, irrigation, domestic use).

Table 9-7: Ecoservices Radial Plots

Pan	Unchanneled Valley Bottoms (fragmented)
	
Channeled Valley Bottoms	**Hillslope Seep (Agriculture)**
	

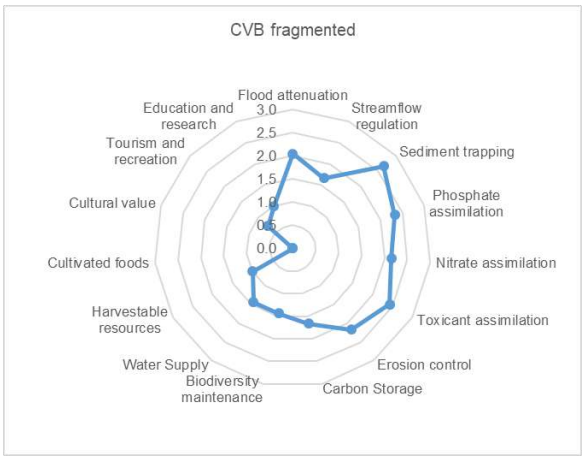
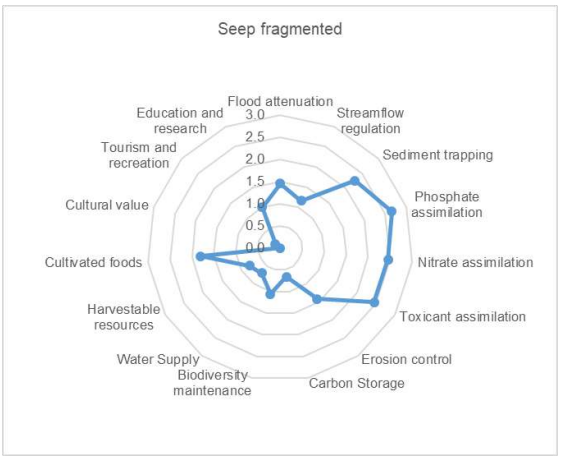
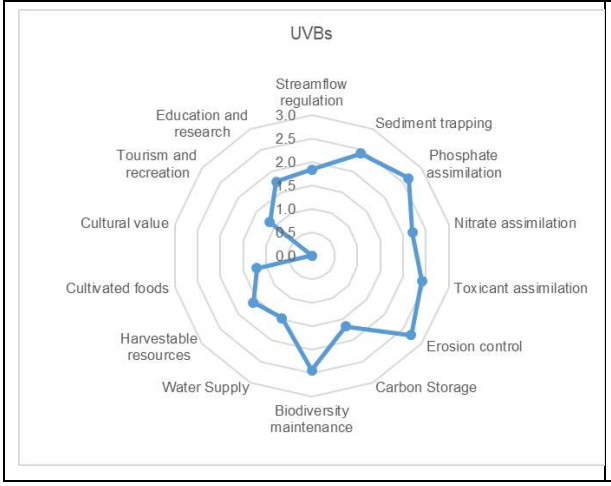
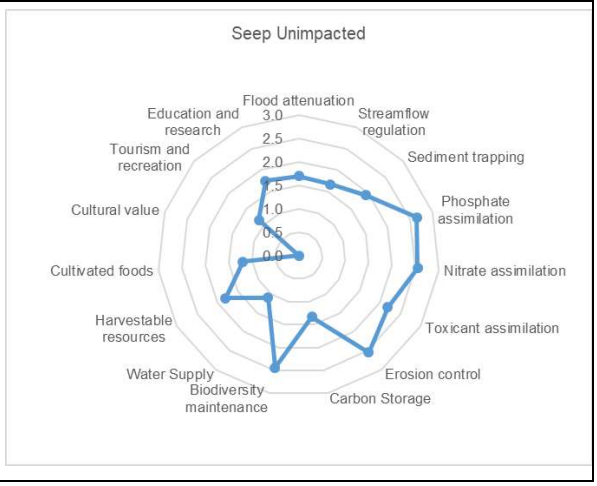
Channeled Valley Bottoms (fragmented)	Hillslope Seep (Fragmented)
	
Unchanneled Valley Bottoms	**Hillslope Seep (Unimpacted)**
	

Table 9-8: Ecological Services Scores

	1	2	3	4	5	6	7	8
Ecosystem service	**Pan**	**HS fragmented**	**UVB fragmented**	**CVB fragmented**	**HS agriculture**	**HS unimpacted**	**UVBs**	**CVB**
Flood attenuation	1.4	1.5	1.6	2.1	1.4	1.7	1.9	2.4
Streamflow regulation	1.2	1.2	1.3	1.7	1.7	1.7	1.8	2.3
Sediment trapping	2.5	2.3	2.5	2.7	1.9	1.9	2.4	1.8
Phosphate assimilation	2.6	2.7	2.8	2.3	2.7	2.7	2.6	2.0
Nitrate assimilation	2.7	2.5	2.4	2.2	2.7	2.6	2.2	2.3
Toxicant assimilation	2.8	2.5	2.6	2.4	2.3	2.2	2.4	2.3
Erosion control	1.8	1.4	1.8	2.2	1.8	2.5	2.7	2.3
Carbon Storage	1.0	0.7	1.0	1.7	0.3	1.3	1.7	1.7
Biodiversity maintenance	1.6	1.1	1.4	1.4	1.1	2.4	2.4	1.8
Water Supply	0.5	0.7	0.9	1.4	1.6	1.1	1.5	3.2
Harvestable resources	0.4	0.8	0.4	1.0	1.6	1.8	1.6	1.6
Cultivated foods	0.0	1.8	0.0	0.0	2.2	1.2	1.2	0.6
Cultural value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tourism and recreation	0.9	0.1	0.3	0.7	0.1	1.1	1.1	1.7
Education and research	0.8	1.0	1.0	1.0	1.3	1.8	1.8	1.8
SUM	**20.1**	**20.0**	**20.0**	**22.7**	**22.7**	**26.0**	**27.4**	**27.8**
Average score	**1.3**	**1.3**	**1.3**	**1.5**	**1.5**	**1.7**	**1.8**	**1.9**
	Intermediate	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**	**Intermediate**

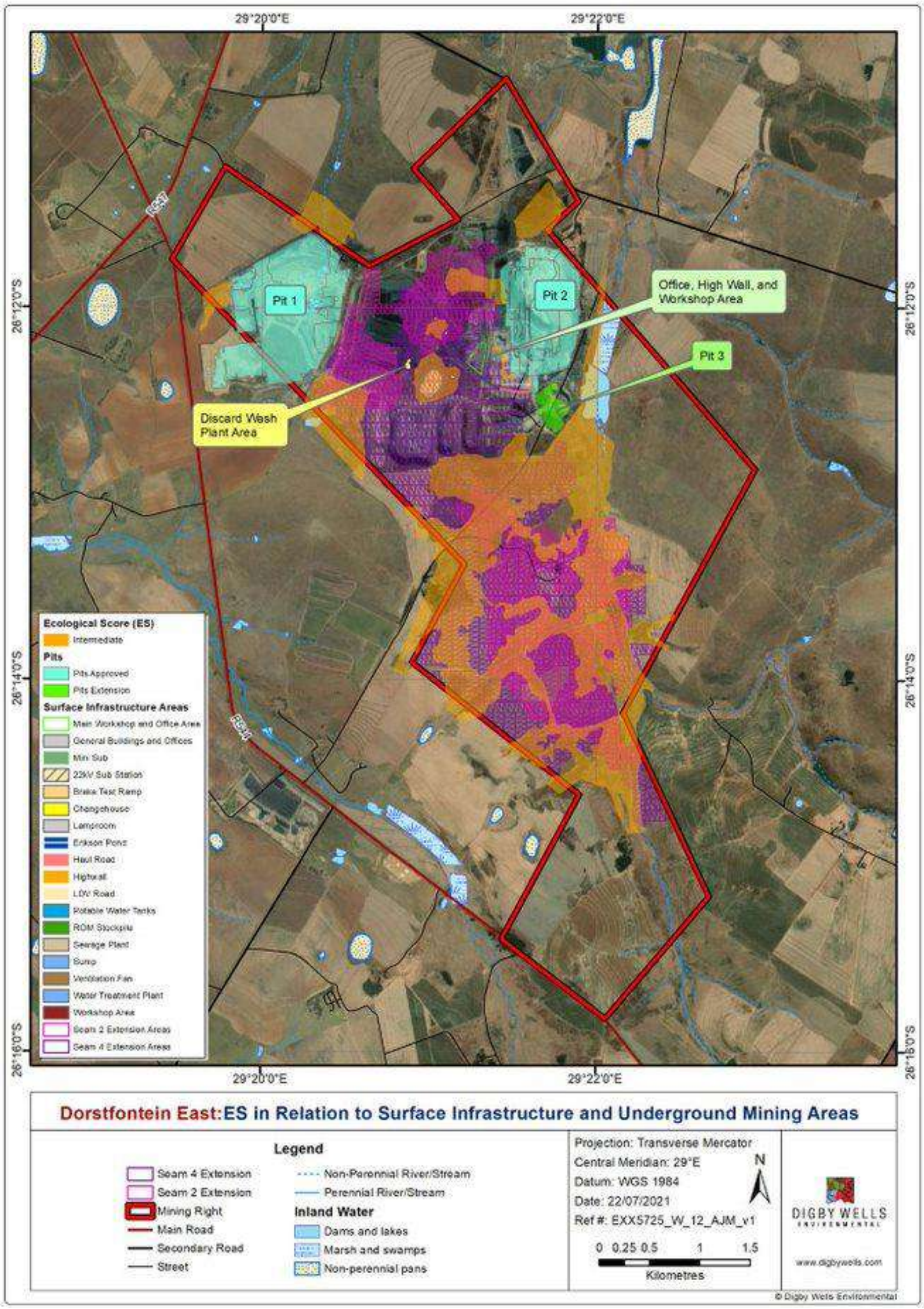


Figure 9-3: Wetland Ecological Services

9.4. Ecological Importance and Sensitivity

The EIS of a wetland is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the wetland's ability to resist disturbance and is the capability to recover from disturbance that has occurred (DWAF, 1999). Table 9-9 and Figure 9-4 indicates each HGM unit group and EIS Category.

The following was derived from the data:

- The Pan, UVBs Fragmented, HS Agriculture, and HS Fragmented were regarded as **'Moderate (C)'**. This specifies that the wetlands are ecologically important, however sensitive on a provincial and local scale. The integrity and biodiversity of these wetlands are sensitive to low flow and habitat modifications as a result of decades of mining, agriculture, and the introduction of AIPs. These wetlands play a small role in moderating the quantity and quality of water; and
- The CVBs, CVBs Fragmented, UVBs, and HS Unimpacted were considered **'High (B)'**. This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows. These systems play an important role in moderating the quality and quantity of water in larger systems.

The HGM units assessed play an important role in moderating the quantity and quality of water of major rivers and tributaries. However, the river system has been modified by anthropological activities, specifically mining and agropastoral activities. The outcomes are changes in the water input volumes and pattern as well as water distribution and retention patterns of water passing through the wetlands. Additionally, linear infrastructure, such as roads, power lines, and fences change runoff and stormwater as well as causing fragmentation of the natural habitat. Agricultural deposits in a form of phosphates and nitrates using fertilisers or pesticides decrease the quality of water in the wetlands. Roads that have been built within the wetlands increases run-off from these hardened surfaces.

Table 9-9: Ecological Importance and Sensitivity Scores

HGM Number	HGM Unit	Ecological Importance & Sensitivity	Hydrological/ Functional Importance	Direct Human Benefits	Final EIS	EIS Category
1	Pan	1.3	1.9	0.4	1.9	**Moderate (C)**
2	CVBs	1.8	2.1	1.5	2.1	**High (B)**
3	CVBs Fragmented	1.7	2.1	0.7	2.1	**High (B)**
4	UVBs	2.3	2.2	1.2	2.3	**High (B)**
5	UVBs Fragmented	2.0	2.0	0.3	2.0	**Moderate (C)**
6	HS Agriculture	1.3	1.8	1.1	1.8	**Moderate (C)**
7	HS Fragmented	1.7	1.8	0.7	1.8	**Moderate (C)**
8	HS Unimpacted	2.3	2.1	1.2	2.3	**High (B)**

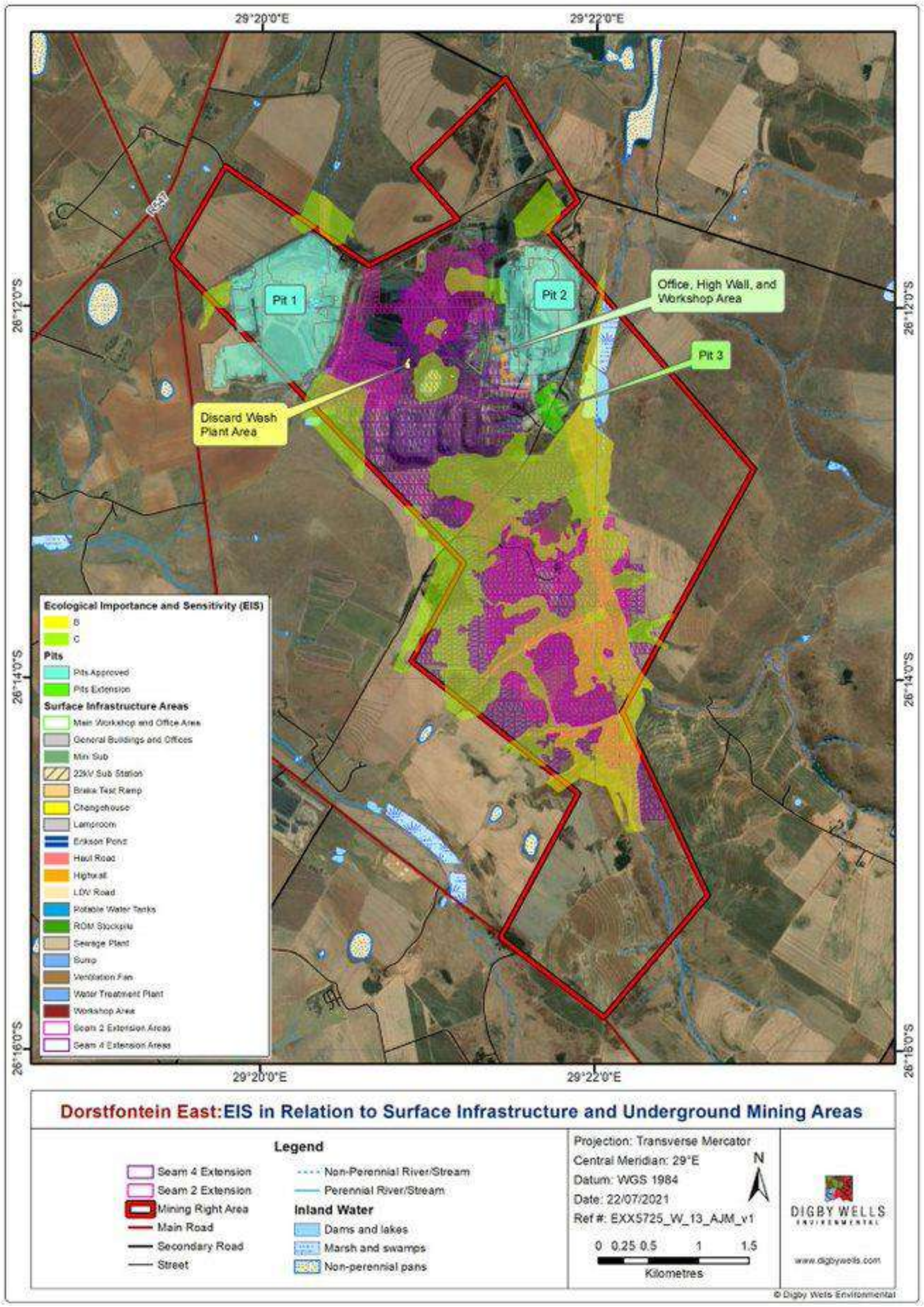


Figure 9-4: Wetland Ecosystem Importance and Sensitivity

9.5. Sensitivity Mapping

The NEMA (Act 107 of 1998) and the NWA (Act 36 of 1998) stipulates that no activity can take place within 32 m of a wetland without the relevant authorisation and no diversion, alteration of banks or impeding of flow in watercourses (including wetlands) may occur without a WUL. A WUL is required if any development or a water use (according to Section 21 (C) and (i)) takes place within 500 m of a watercourse.

The 100 m buffer and 500 m zone of regulation in terms of GN R.1199 were assessed to indicate sensitive areas that will require a WUL if any proposed infrastructure falls within these areas. Figure 9-5 indicated the existing infrastructure as well as proposed infrastructure areas.

According to the Dorstfontein East Mine Extension Layout Plan (Figure 9-5), no wetlands fall within the proposed surface infrastructure area, however the pan and Seep (HGM 1 and 7) fall within the 100 m Zone of Regulation. Figure 9-6 illustrates the wetlands in relation to the proposed underground mining activities and the surface infrastructure. All the wetlands delineated in the Project Area fall within the proposed underground mining activities areas.

Based on the PES, ES and EIS analysis of the wetlands, the following was derived (Table 9-10 and Figure 9-5, Figure 9-6 and Figure 9-7).

Table 9-10: Sensitive Area

HGM Unit Number	HGM Unit	PES	ES	EIS	Sensitivity
1	Pan	D	1.3	1.9	**Low**
2	CVBs	D	1.3	2.1	**Medium**
3	CVBs Fragmented	D	1.3	2.1	**Medium**
4	UVBs	C	1.5	2.3	**High**
5	UVBs Fragmented	C	1.5	2.0	**High**
6	HS Agriculture	C	1.7	1.8	**Medium**
7	HS Fragmented	D	1.8	1.8	**Low**
8	HS Unimpacted	C	1.9	2.3	**Medium**

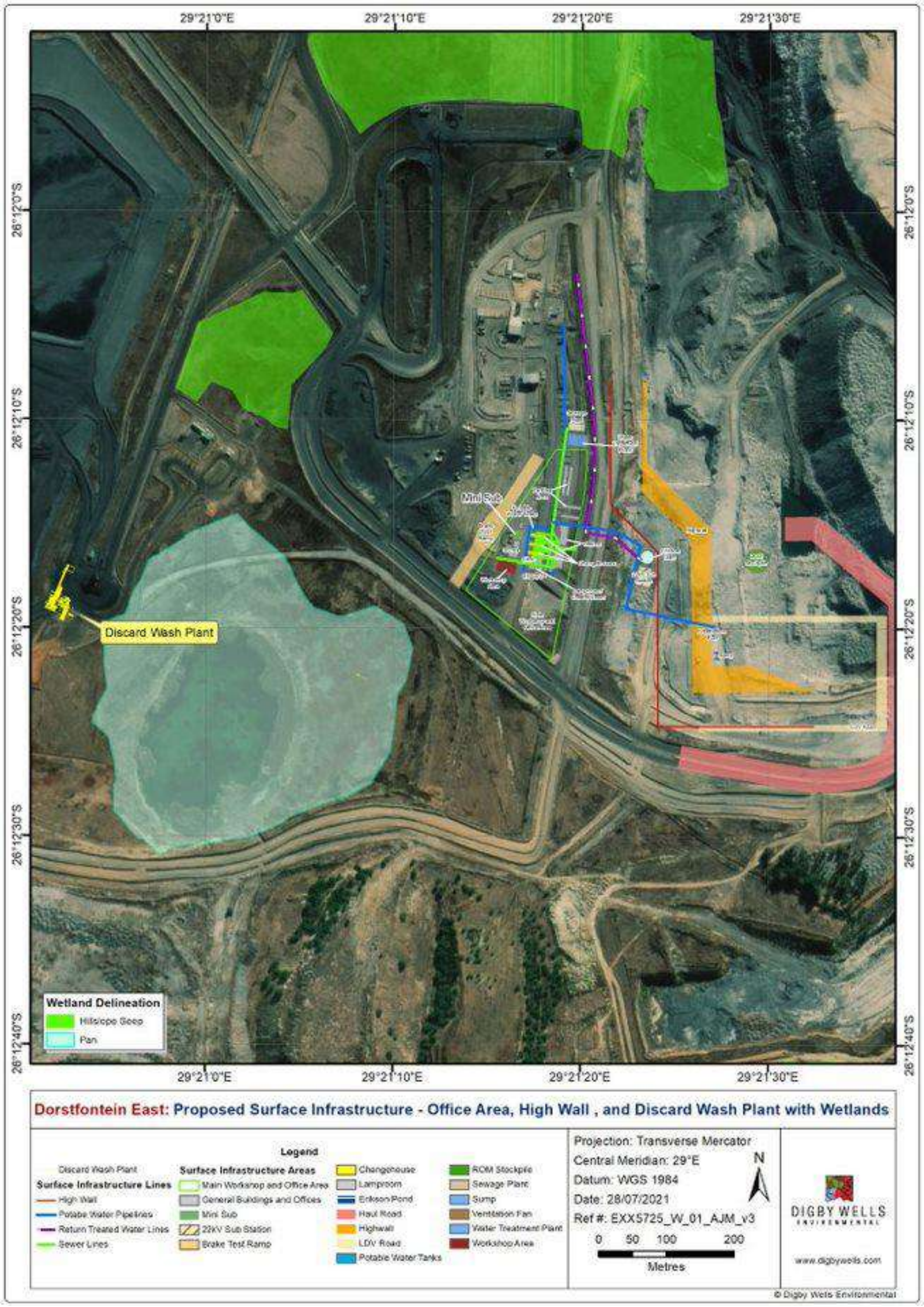


Figure 9-5: Wetland Delineation with Proposed Infrastructure

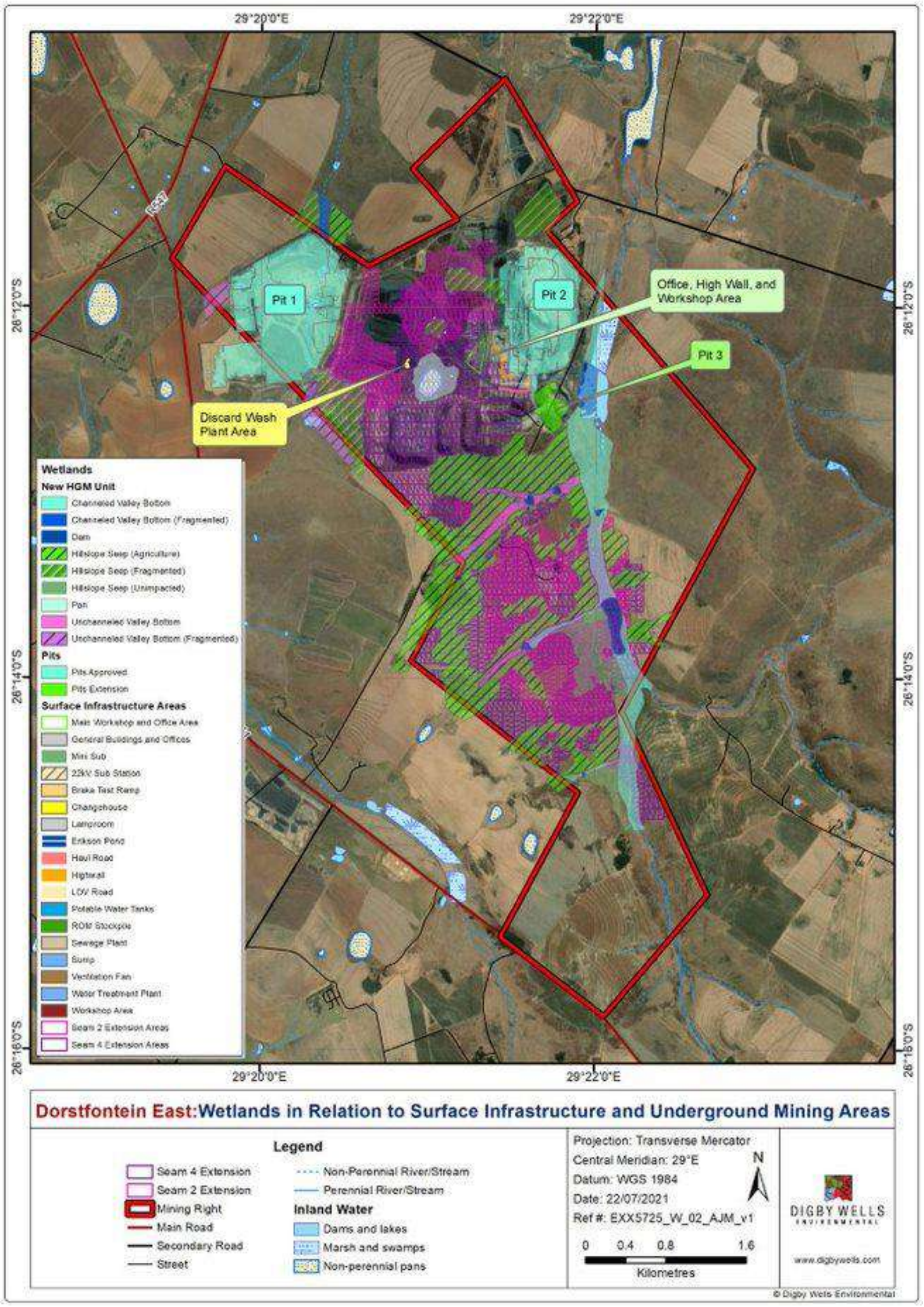


Figure 9-6: Wetlands in Relation to Proposed Surface Infrastructure and Underground Mining Areas

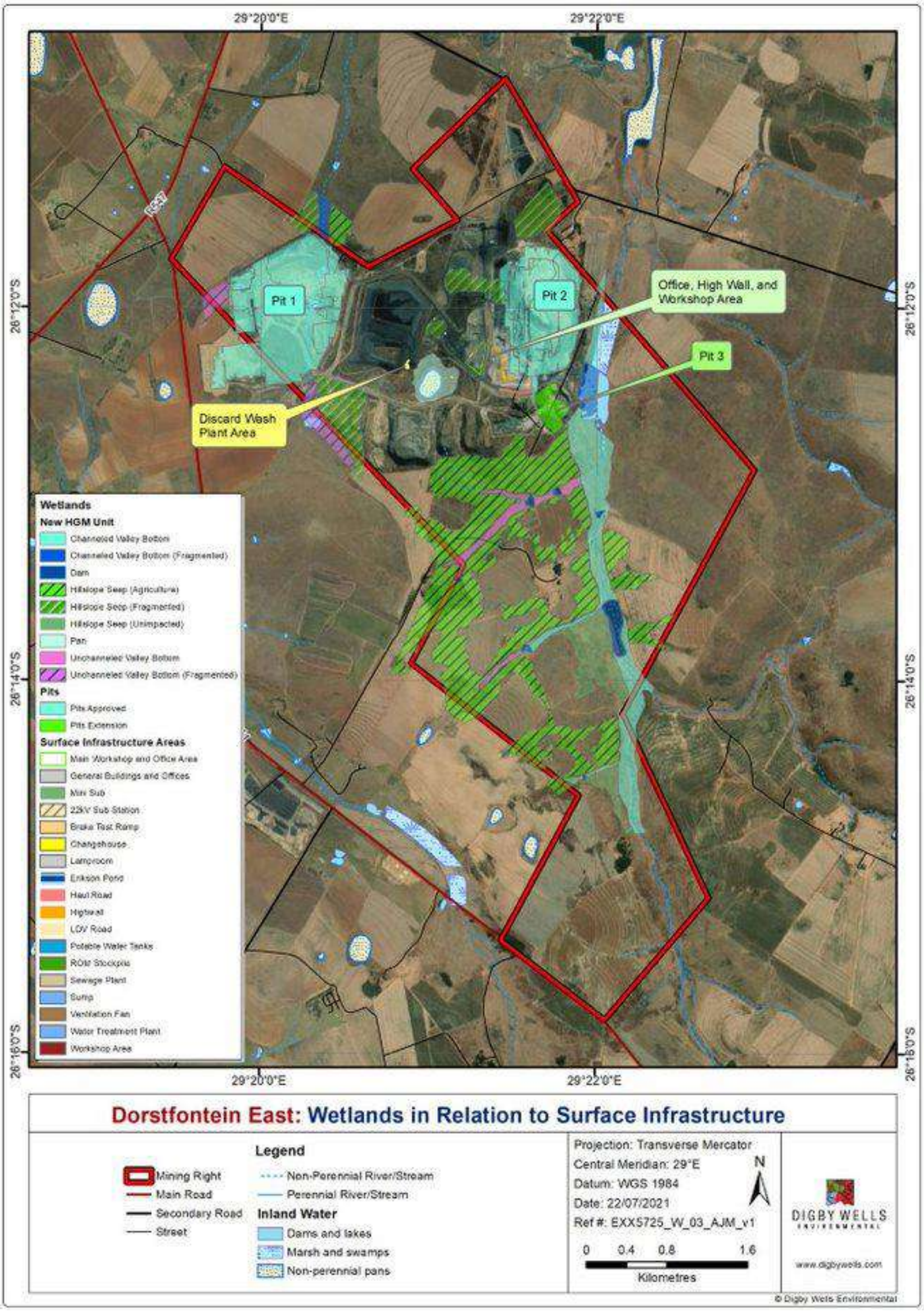


Figure 9-7: Wetland Delineations on Relation to Surface Infrastructure

10. Impact Assessment

This section aims to rate the significance of the identified potential impacts of 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 phase of the project including the Construction, Operational, and Decommissioning Phases.

The impact assessment considers that the proposed amendment of the EMPr and IWUL at Dorstfontein East Mine consists of Underground Mining activities with small areas of surface infrastructure. The proposed surface infrastructure together with the proposed underground workings is presented in Figure 9-5 above. This figure illustrates that no wetlands will be directly impacted by the surface infrastructure, however, falls within the 100 m and 500 m Zone of Regulation of the Pan and Hillslope Seep (fragmented) (HGM 1 and 7).

According to the Groundwater Impact Assessment Report (Digby Wells, 2021), dewatering of the groundwater will potentially occur, however due to the nature of the wetlands and dominant surface and subsurface water supply, the wetlands should not be impacted by the dewatering cone. It is however evident that decanting will potentially occur on the eastern side of the Project Area, adjacent of the Olifants River tributary that could potentially lead to soil, water and wetland contamination. Subsidence could potentially occur over time, affecting the natural topographies, hydrology and functionality of the wetlands.

The identified potential impacts that will negatively impact the wetlands ecology are discussed in the subsections below.

10.1. Summarised Impact Ratings

Table 10-1 summarizes the impacts to the wetlands and associated catchment as well as the impact score before and after mitigation. Appendix B comprises the detailed Impact Assessment for each Phase.

Table 10-1: Summarized Impact Scores

Phase	Activity	Impact Rating before Mitigation	Impact Rating after Mitigation
Construction	Access road construction, movement of vehicles, and heavy machinery.	Minor negative (-60)	Minor negative (-32)
	Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.	Negligible (-27)	Negligible negative (-10)
	Construction of surface infrastructure	Minor negative (-60)	Negligible negative (-33)

Phase	Activity	Impact Rating before Mitigation	Impact Rating after Mitigation
	Waste management activities	Moderate (negative) – 85	Minor negative (-65)
Operational	Blasting (only when dikes and other geological features are encountered)	Major negative (-119)	Moderate negative (-90)
	Underground mining machinery maintenance	Moderate (negative) – 75	Minor (negative) – 48
	Use of existing haul roads and vehicle movement	Minor negative (-65)	Minor (Negative) (-40)
	In-pit ROM Stockpiling	Minor negative (-56)	Negligible negative (-30)
	Operation of water and sewer reticulation. Waste management activities	Moderate negative (-75)	Minor negative (-44)
	Operation of the coal discard processing plant	Moderate negative (-96)	Minor negative (-65)
Decommissioning	Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation.	Minor negative (-78)	Minor negative (-36)
	Post-closure monitoring and rehabilitation.	Negligible negative (-32)	Negligible negative (-10)
	Post-mining decants into wetlands and streams	Major negative (– 119)	Moderate negative (– 105)

10.2. Construction Phase

Activities during the Construction Phase that may have potential impacts on the wetlands are described in Table 10-2 below.

10.2.1. Management Objectives and Actions

The main objective is to avoid impacts on wetlands by avoiding or limiting construction, movement, and disturbances to the wetlands and associated buffer zones. Areas that cannot be avoided must be mitigated and should be limited to the construction footprint.

The management actions are proposed in the Environmental Management Programme (EMPr) in Section 14.

Table 10-2: Activities, Impacts and Description

Activity	Impact	Description
Access road construction	• Fragmentation of wetlands and wetland habitat; and • Soil compaction and or disturbance.	Apart from the loss of vegetation and associated loss of biodiversity, vegetation clearing and disturbance of soils within wetland areas for the construction of the proposed surface infrastructure are likely to result in fragmentation of HS and UVBs and ultimately a loss of water quality and quantity to the downstream valley bottom wetland systems. Compaction of soils, the creation of preferential flow paths, and the onset of erosion have the potential to result in degradation and fragmentation of the wetlands present. The risk of sedimentation and increased sediment loads into wetlands is deemed likely. There is a risk of contaminants associated with construction activities and machinery entering wetlands from the access roads and the construction footprint, as well as organic waste and domestic litter, which has the potential to result in water quality impacts. Changes to the natural wetland habitat may lead to loss of wetland habitat as well as result in permanent loss or displacement of fauna, such as invertebrates, birds, and mammals. The impacts during the construction phase are expected to be high with permanent and definite impacts on the wetlands. However, impacts are expected to be limited to the Project Area.
Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.	• Loss of fauna and flora (biodiversity); • Increased erosion and sedimentation; • Quantity and quality changes to the hydrological functioning; • Destruction or complete removal of wetland habitat; • Increased AIPs; and • Fragmentation of wetlands and wetland habitat.	
Construction of surface infrastructure	• Fragmentation of wetlands and wetland habitat; • Partial or complete loss of wetland ecosystems; and • Increased erosion and sedimentation.	
Waste management activities	• Contamination from Hydrocarbon waste (lubricants, oils explosives, and fuels); • Contamination from sewage and wastewater; and • Changes to wetland health and biodiversity.	

10.3. Operational Phase

Activities during the Operational Phase that may have potential impacts on the wetlands are described in Table 10-3 below.

10.3.1. Management Objectives and Actions

Measures to prevent desiccation of the surrounding wetland areas and rivers due to the loss of upstream wetland habitat must be implemented to prevent the loss of water supply to the lower-lying wetland areas. Further to this, water should not be allowed to flow freely from the operational area to prevent water contamination and preferential flow paths forming. Contaminated water or water runoff from mine-related infrastructure should be stored in Pollution Control Dams (PCDs) and utilised as intended.

It is imperative that operational activities are limited to the operational area and no areas outside of the operational area should be disturbed.

The management actions are proposed in the EMPr in Section 14.

Table 10-3: Activities, Impacts and Description

Activity	Impact	Description
Blasting (only when dikes and other geological features are encountered)	• Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; and • Dewatering and drying out of wetlands.	Operational activities of the proposed underground mining activities have the potential to result in impacts on the water quality of the groundwater, local and downstream resources as well as the potential loss of water supply from the groundwater aquifer. Dewatering activities are likely to result in the loss of water supply to the wetlands, with special mention of the lower-lying wetlands and moisture stress to the surrounding wetland areas. Blasting has the potential for changing the surface strata (soils) and causing changes to the natural topography. This could lead to subsidence, areas of water ponding, waterlogging, and changes to the natural water table and wetlands. Contamination from heavy mining machinery containing large volumes of oils and diesel could spill into the soils and water, ending up in the wetlands and therefore changing the natural wetland functioning. Vehicle movement and machinery maintenance will also cause compaction, therefore increasing runoff and erosion potential. When roads cross watercourses and wetlands and culverts are installed and not maintained it could lead to head-cut erosion, wetland fragmentation, and channel forming. Erosion from stockpiling may lead to contaminants in the watercourses, directly impacting the natural biota and wetland integrity. Sedimentation may also lead to the suffocation of vegetation, reducing basal cover and infiltration. There are chances for contamination by hydrocarbons (oils, fuels, grease) from vehicles and machinery, sewage and
Underground mining machinery maintenance	• Contamination and deterioration of water quality and quantity; and • Loss or changes to the natural wetland integrity and biodiversity	
Use of existing haul roads and vehicle movement	• Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential into wetlands; • Loss of vegetation and habitat; and • Wetland fragmentation.	
In-pit ROM Stockpiling	• Potential runoff from stockpiles causing contamination into the wetlands; • Erosion and sedimentation of contaminants into the wetland areas.	
Operation of water and sewer reticulation. Waste management activities	• Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Contamination from sewage and wastewater; and • Changes to wetland integrity and biodiversity.	

Activity	Impact	Description
Operation of the coal discard processing plant	• Contamination of soil, water and wetlands; • Loss of wetland health and biodiversity; and • Loss of wetland functionality.	wastewater spillage which could lead to water pollution and wetland deterioration. Contaminants will impact the groundwater, vegetation growth, agricultural potential, and the wetlands. The operation of the coal discard processing may lead to soil and water contamination which would lead to contamination of the freshwater systems. Pollution is wetlands will lead to loss of wetland health (water, biodiversity, vegetation) and overall functionality.

10.4. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the wetlands are described in Table 10-4 below.

10.4.1. Management Objectives Actions

The main objective would be to rehabilitate the affected areas to near-natural conditions without resulting in additional impacts to the wetland ecology throughout the process.

The recommendations of the Groundwater Study (Digby Wells, 2020) should be consulted for the best measures to be put in place to mitigate the impacts of the possible decant to the wetland and aquatic ecology of the area.

The aim of the mitigation should be to limit sedimentation, erosion, and runoff from the infrastructure footprint during decommissioning as well as during rehabilitation.

The management actions are proposed in the EMPr in Section 14.

Table 10-4: Activities, Impacts and Description

Activity	Impact	Description
Rehabilitation and Demolition of infrastructure and rehabilitation of affected areas.	• Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; and • The proliferation of AIPs. • Exposure of soils and subsequent compaction, erosion, and sedimentation into the wetlands; • Deterioration of water quality; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of wetlands.	Upon decommissioning and mine closure, all surface mine infrastructure will be demolished and removed. The areas will be landscaped and rehabilitated. Impacts are therefore somewhat positive as rehabilitation will be implemented after deconstruction. If deconstruction is not properly controlled and managed, the activities could lead to impacts on the wetlands and freshwater systems. Impacts include loss of vegetation, compaction, and loss of topsoil through erosion due to exposed areas, soil and water contamination by hydrocarbon and sewage waste, reduce infiltration and increased runoff and increased AIPs. By enforcing Concurrent Rehabilitation, it will only be necessary for the surface infrastructure areas to be rehabilitated during the decommissioning phase. As a result, the impact may be reduced if mitigation measures are implemented early enough. After infrastructure removal and rehabilitation, the areas must be monitored for water contamination, increased AIPs, compaction, and possible erosion risk and sedimentation into the wetlands. Additionally, subsidence and cracking of soils must be monitored closely to avoid the dewatering and drying of wetlands. The rehabilitation and mitigation during the Decommissioning Phase will have a positive impact on the environment. After mine closure, old underground mines will start to fill up with water and eventually start to decant. Decanting water usually has very low pH, contain heavy metals and sulphates. The decant is likely to end up in the soil and water systems and high impact the wetlands and biodiversity.
Post-closure monitoring and rehabilitation.	• Minimal negative impacts on the environment; and • Wetland and AIPs Monitoring Plan.	
Post-mining decants into wetlands and streams	• Water and soil contamination; and • Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use.	

11. Mitigation Hierarchy

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.

The mitigation hierarchy for the wetlands within the Study Area are described in Table 11-1 below.

Based on similar projects within the area it is inevitable that the proposed activities will pose various impacts on the wetlands. Even when wetlands are avoided, impacts to the wetlands might still arise. 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 an impact and therefore minimization and rehabilitation should be considered. When it is found that it is not possible and feasible to avoid mining wetlands, Wetland Offset should be implemented where rehabilitation may be included as part of the Offset Plan. Wetland Offset are measures to compensate for residual negative effects on wetlands after effort have been made to minimize and avoid impacts.

Table 11-1: 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 underground mining and infrastructure within delineated wetlands and a 500 m zone of regulation as this will potentially impact the groundwater level and subsurface water supply to the wetlands (dewatering), drying out over time; and • Establishment of a 500 m buffer zone to protect wetlands from infrastructure and mining within the Project Area. This would require that development occur further than 500 m from a delineated wetland area.
Minimize	*Consider alternatives to minimise impacts on biodiversity and ecosystem services (e.g., project location, scale, technology and layout). In areas where the environmental and social constraints are not too high, minimising should still be taking place.*

Mitigation Step	Actions
	• Avoid surface infrastructure within wetlands with a high PES, EIS and ES rating; • Establishment of a 100 m zone of regulation to protect wetlands from infrastructure within the Project Area. This would require that development occur further than 100 m from a delineated wetland area; • Use pumped out, underground water for re-wetting wetlands that loss water due to the potential dewatering and the draw-down plume. However, the water must be tested prior using it, if the water quality is low, it must first be cleaned in a water treatment plant; • Consider moving infrastructure outside the 100 m and 500 m zone of the wetlands; • Only the designated access routes are to be used to reduce any unnecessary impacts to the wetlands; • Minimize the period of exposed areas to prevent erosion, loss of vegetation and sedimentation within the wetlands; and • Monitor and prevent decanting into the wetlands.
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 wetlands on-site; • Recreate/re-wet wetlands on-site after mining and decommissioning; • Ensure concurrent rehabilitation with special attention to re-wetting, re-shaping and re-vegetation where necessary; • Rip rehabilitated areas (surface infrastructure areas) to reduce compaction and reseed to increase vegetation cover; • Address areas of AIPs proliferation by utilizing a AIPs Program; • Allow underground dewatering to re-enter the system/catchment to reduce the impacts on the Olifants River system; • Monitor the wetlands in the Project Area to determine subsidence and assess the water level, when it is recognized that the wetlands are losing water and drying out, rehabilitate and mitigate as soon as possible; • Monitor and rehabilitate decanting and subsidence; • If erosion has occurred, topsoil should be sourced, replaced, vegetated and shaped to reduce the recurrence of erosion in wetlands; • Monitor the wetlands to identify and rectify any areas that have begun to erode; • Clean up spills immediately to prevent migration of contaminants into the wetlands;

Mitigation Step	Actions
	• Conduct pollution monitoring along the low-lying areas (wetlands) to detect any high levels of pollutants if spills have occurred; and • Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs.
Offset	*Compensating for remaining and residual (unavoidable) negative impacts on the biodiversity. Offset should be implemented when every effort has been made to 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.

12. Cumulative Impacts

The current impacts on the project area were related largely to agropastoral activities within the Project Area as well as mining activities adjacent to the Project Area. In addition to this were the linear infrastructures observed throughout the Project Area such as roads, dams, powerlines, and fences. The impacts can be described as:

- Agropastoral activities (commercial cultivation and cattle grazing) and the spread and proliferation of AIPs had resulted in impacts to the health and integrity of large portions of the wetlands present, which in turn had resulted in channelization and narrowing of the wetland areas within the proposed Project Area;
- Mining activities have the potential to result in a significant overall land use change and with this, the loss of sensitive habitats important for the maintenance of biodiversity, loss of catchment yields, and decreases in water quality, the latter being of special concern as the freshwater resources downstream of the Project Area. Many wetlands and the direct catchment of some wetlands have already been mined, partially mined or fragmented due to mining activities in the Project Area;
- The influx of people to the area as a result of mining activities have the potential to result in further impacts related to subsistence farming activities, informal settlements, and additional linear infrastructures. This may result in further degradation of the wetland systems and reflect greater modification of scores as indicated by the determined PES; and
- Impacts related to fragmentation, the creation of preferential flow paths, and compaction of soils due to the presence of existing roads and infrastructure had resulted in the loss of habitat, ecological activity, water retention, and erosion.

The cumulative impacts may therefore have a significant effect on the wetlands and associated catchments. Wetlands and the biodiversity thereof are both highly diverse and of great regional importance to local livelihoods as these valuable natural resources provide a broad array of goods and services to the communities. However, these freshwater systems are under threat and even small impacts may result in total loss of the wetlands.

13. Unplanned and Low-Risk Events

Wetlands associated with the proposed underground mining operations and associated surface infrastructure throughout the life of mine might be affected by the completed loss of wetlands due to dewatering, entry of hazardous substances, such as hydrocarbons, in the event of a spillage or unseen seepage from storage facilities and decanting. Wetlands may also be affected by the deterioration of surface infrastructures, including roads, bridges, road crossings, pipelines, and conveyor belt that may result in impacts on the wetland habitat, fragmentation, water quality, and water quantity.

Table 13-1 outlines unplanned risks and mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the project.

Table 13-1: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Chemical and (or) contaminant spills from mining activities, infrastructure, and associated activities.	• Ensure the correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons); • Storage units of chemicals and possibly harmful substances must be placed outside of wetlands and the 500 m buffer zone; • Ensure staff involved at the proposed project have been trained to correctly work with chemicals at the sites; • Ensure spill kits (e.g. Drizit) are readily available at areas where chemicals are known to be used; • Place drip trays where the leak is occurring if vehicles are leaking; and • Staff must receive the appropriate training in the event of a spill, especially near wetlands, watercourses, and/or drainage lines.
Structural deterioration along with surface infrastructure in the vicinity of wetlands	• Install safety valves and emergency switches that can be used to seal off leakages from pipelines when noticed or triggered; • Ensure that spill kits and trained staff capable of using the kits are available on-site in case of accidental spillages; • Maintenance of roadways, river crossings, and pipelines should be considered an ongoing process where leakages or issues with the pipe should be reporting to acting Environmental Control Officer (ECO) of the project immediately after notice.
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 Acid Mine Drainage (AMD) and implement management measures which include reverse osmosis or neutralisation and electrolytic treatment using a Water Treatment Plant (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.

14. Environmental Management Programme

The EMPr is described Table 14-1 below.

Table 14-1: Environmental Management Programme

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period Implementation
Construction	Wetlands	• Site/vegetation clearance and site establishment (construction of surface infrastructure; and • In-pit RoM Stockpiling.	• Loss of fauna and flora (biodiversity); • Increased erosion and sedimentation; • Quantity and quality changes to the hydrological functioning; • Destruction or complete removal of wetland habitat; • Increased AIPs; • Fragmentation of wetlands and wetland habitat; • Sedimentation of downstream and adjacent wetlands; and • Soil and water contamination leading to wetland contamination	• 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 and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; and • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • If spills have occurred, it should be cleaned up immediately; • RoM must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; and • RoM stockpiles must be located outside wetlands and at least a 100 m buffer zone.	*Modify, remedy, control, or stop* Concurrent rehabilitation through the life of mine	Life of Construction Phase
Operational	Wetlands	• Blasting (only when dykes and other geological features are encountered); • In-pit RoM Stockpiling; • Transportation of coal from pit for further processing; • Underground Mining Machinery Maintenance; • Operation of water and sewer reticulation; and • Use of existing haul roads.	• Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; and • Dewatering and drying out of wetlands. • Contamination and deterioration of water quality and quantity; and • Loss or changes to natural wetland integrity and biodiversity. • Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential into wetlands; • Wetland fragmentation;	• All areas of high ecological sensitivity should be designated as “No-Go” areas and avoided; this include the CVB on the east boundary of the Project Area; • 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 wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated; • A Storm Water Management Plan (SWMP) should already be implemented. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater and runoff away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible; • All vehicle maintenance must occur within designated areas; • All vehicles must be regularly inspected for leaks;	*Modify, remedy, control, or stop*	Life of Operational Phase

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period Implementation
			• Potential runoff from topsoil and subsoil stockpiles causing sedimentation into the wetlands; • Erosion and sedimentation of contaminants into the wetland areas; • Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Contamination from sewage and wastewater; and • Contamination of soil, water and wetlands.	• All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; • Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • The edge of the wetland and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • If it is unavoidable that any of the wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated; • No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Culverts, roads 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 to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • ROM must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • ROM stockpiles must be located outside wetlands and at least a 100 m buffer zone; • A Storm Water Management Plan (SWMP) should already be implemented. This should consider all wetlands and other watercourses associated with 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; • 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; • 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.		

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period Implementation
Decommissioning	Wetlands	• Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation of the final land rehabilitation; • Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation; and • Post-closure monitoring and rehabilitation.	• Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; • The proliferation of AIPs; • Exposure of soils and subsequent compaction, erosion, and sedimentation into the wetlands; • Deterioration of water quality; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of wetlands. • Water and soil contamination; • Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use; and • Decanting.	• Decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Stormwater must be diverted from decommissioning activities; • Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs and wastewater facilities; • The edge of the non-directly impacted freshwater resources, and at least a 100m buffer or 1:100 flood line buffer, should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the decommissioning phase; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • 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 Plan for the duration of the decommissioning 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 buffer areas. All vehicles must remain on demarcated roads; • Wetland monitoring must be carried out during the decommissioning phase into mine closure to ensure no unnecessary impact to wetlands takes place; • Decanting must be controlled by groundwater monitoring and by following the mitigation measures stipulated in the geohydrological report. Financial provision is made for the establishment of a Reverse Osmosis Water Treatment post mine closure to ensure that acid mine drainage water is treated and to discharge the treated water back into the natural environment; • Rehabilitation must be done as soon as any impacts are observed; • Monitor decant of AMD and implement management measures which include reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses; • Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant. • Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion.	*Modify, remedy, control, or stop* Concurrent rehabilitation through the life of mine	Life of Decommissioning and beyond

15. Wetland Monitoring Programme

As the proposed Project Area is comprised largely of wetland habitat, it is recommended that WET-health and WET-Ecoservices tools be used to re-evaluate PES, ES, and EIS on an:

- Once before the wetland Offset strategy is planned as the PES, EIS and ES might be different as presented in this report (2019 findings);
- Annual (yearly) basis by a suitably qualified wetland specialist for the duration of the Construction Phase;
- Annually (one-yearly) for the duration of the Operational Phase;
- Annually (one-yearly) upon closure and decommissioning for at least three years to ensure no emerging impacts are identified, which may need to be addressed.

Recommended transects for monitoring of the wetland health and localities are indicated in Table 15-1. A Wetland Monitoring Programme (Table 15-2) should be initiated before construction activities and continue for the duration of the proposed project and into post-closure.

Table 15-1: Wetland Monitoring Transects

Site	Co-Ordinates	Description
Transect 1	26°14'31.10"S;29°21'57.16"E 26°14'27.14"S;29°22'12.55"E	Transect crosses an unimpacted HS and UVB with high wetland integrity. Road crossing and dam present. Transect s upstream of the proposed mining activities.
Transect 2	26°13'51.43"S;29°21'50.57"E 26°13'47.80"S;29°22'5.93"E	Transect crosses an unimpacted HS with high wetland integrity. Road and cattle grazing present.
Transect 3	26°14'1.49"S;29°21'16.18"E 26°13'48.93"S;29°21'36.82"E	Transect crosses an HS Agriculture as well as a UCV with a dam used for agricultural activities.
Transect 4	26°13'29.52"S;29°22'5.51"E 26°13'26.69"S;29°22'14.92"E	Transect crosses an HS Agriculture that feeds into the main CVB. Sections of erosion present.
Transect 5	26°13'32.71"S;29°21'4.69"E 26°13'27.05"S;29°21'12.74"E	Transect crosses an HS Agriculture that feeds into a dam. Large stands of AIPs and road crossings present.
Transect 6	26°12'47.91"S;29°21'41.89"E 26°12'46.19"S;29°22'0.15"E	Transect crosses an HS that feeds into the large CVB. The transect is downstream of the proposed activities. Areas of erosion and head-cut erosion present.
Transect 7	26°12'4.22"S;29°21'3.10"E 26°12'22.25"S;29°20'58.04"E	Transect crosses an HS fragmented by mining as well as a pan within the current mining activities. The HS and pan have been highly impacted.

Site	Co-Ordinates	Description
Transect 8	26°11'36.01"S;29°20'13.71"E	Transect crosses an HS Agriculture that feeds into a CVB fragmented. The transect is upstream of the entire MRA.
	26°11'32.63"S;29°20'21.03"E	

NOTE: Proposed transect localities and parameters may require optimisation based on site conditions

Table 15-2: Wetland Monitoring Programme

Monitoring Element Wetlands	Comment	Requirements	Frequency	Responsibility
• Wetland Extent; • Wetland integrity; • Wetland functionality; • Soil disturbances; • Linear infrastructure; • Discharge points; • Erosion status; • Surface water quality and quantity; • Vegetation basal cover; • Vegetation species diversity; • Mine related infrastructure has been fully rehabilitated.	• Impacts such as damming and infilling can result in a loss of wetland area, whereas seepage from underground workings may cause an increase in wetland extent; • A basic level 1 health assessment is necessary to detect changes to the health of vegetation (including alien invasion), hydrology, and geomorphology of the wetlands associated with the site. This allows for the determination of the Present Ecological State (PES); • The EIS of the wetlands should be regularly determined to detect any alteration to functionality; •	• Inspect the area after a good rainfall event; • Control and remove weeds where necessary; • Define and establish the long-term land management system (grass needs regular defoliation if it is to be sustainable); • Leave pasture to allow natural grasses to become established; • Conduct annual monitoring (repeatable demarcated transect surveys) • There must be no planting of alien plants (e.g. black wattle, eucalyptus and pampas grass) anywhere within the Project Area; • Bi-annual (two-yearly) surveys, aimed at updating the AIPs list and establishing and updating the invasive status of each of the alien species, should be carried out (can be done by Exxaro staff); • The transportation of soils or other substrates infested with AIPs should be strictly controlled; • Benefits to local communities as a result of the alien plant control program should be maximised by not only ensuring that local labour is employed but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilised; • It is considered essential that appropriate veld management (particularly appropriate grazing levels and burning frequencies) should be applied to areas of secondary indigenous vegetation (e.g. secondary grassland of historically cultivated areas), and especially the grassland and wetland vegetation of untransformed habitats. Appropriate grazing levels and burning frequencies will not only ensure that good vegetation conditions and biodiversity levels are maintained but will also serve to control the spread and increase in cover of palatable AIPs such as Paspalum dilatatum. • Constant site surveys and monitoring should be incorporated to ensure no further erosion of the wetlands. If any changes to the landscape are observed immediate action need to be taken such as silt traps; • Continuous erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the specific location; • The functionality of the surface water drainage systems should be assessed on an annual basis. This should preferably be done after the first major rains of the season and then after any major storm. An assessment of the structures will ensure that the drainage on the recreated profile matches the rehabilitation plan as well as to detect early on when any drainage structures are not functioning efficiently. These must then be repaired or replaced before it causes significant erosion damage; and • The groundwater levels and quality should be measured and monitored in a similar way to the surface water to determine the impact of the mining activities on the groundwater resources. A hydrogeologist, together with the relevant authorities, should determine the locations of the monitoring boreholes. The monitoring frequency will be determined by the regulator.	• Annual (yearly) basis by a suitably qualified wetland specialist for the duration of the Construction Phase; • Annually (one-yearly) for the duration of the Operational Phase; • Annually (one-yearly) upon closure and decommissioning for at least three years to ensure no emerging impacts are identified, which may need to be addressed.	• A wetland specialist must conduct the wetland monitoring and provide a short memo to the Mine Manager (MM) and the Environmental Practitioner (EP); • The MM and the EP should ensure wetland monitoring on-site; • EP to give training to sub-contractors and all workers on the operational procedures and mitigation measures; and • The MM and the EP should be responsible to determine the effectiveness of erosion control structures.

16. 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.

17. Recommendations

The following actions are recommended to reduce adverse effects on the wetland resources of the Project Area (Table 17-1).

Table 17-1: Impacts and Recommendations

Possible Impacts	Recommendations	Person Responsible
Loss of wetland vegetation and habitat	500 m Buffer around the wetlands, when not possible at least a 100 m buffer around the wetlands triggered by GN 704. The establishment of hydrophytic plants and facultative hydrophytes that are native to the area	Wetland ecologist and Botanist
Soil disturbance, and decreasing biodiversity resulting in increased sedimentation and increased erosion	Improved vegetation cover and establish hydrophytic plants and facultative hydrophytes that are native to the area. Reduced risk of erosion and sedimentation	Wetland ecologist, Botanist and Soil Scientist

Possible Impacts	Recommendations	Person Responsible
Linear infrastructures resulting in fragmentation of wetlands, the creation of preferential flow paths, and the onset of erosion.	Reduced risk of erosion, compaction, and the creation of preferential flow paths. Maintain linear infrastructure	Wetland ecologist
The presence of dams/weirs in wetland areas promote flooding and prevent natural diffuse flow.	Natural diffuse flow through the wetland and reduced the occurrence of channelization.	Wetland ecologist and Botanist
Erosion/ Sedimentation	Reduced risk of erosion and sedimentation of downstream wetland areas by re-vegetation	Wetland ecologist
Increased run-off and sedimentation, the input of pesticides and fertilisers and reduced buffer capacity of wetlands due to crop farming and AIPs	Employment of a protective vegetated buffer strip around the wetland	Wetland ecologist and Botanist
Livestock impacts	Improved wetland integrity and functionality	Wetland ecologist
Water quality impacts	Improved water quality and prevention of pollution	Wetland ecologist, Aquatic ecologist, and EP
Decanting (wetland contamination)	Monitor decant of AMD and implement management measures which include reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses. Financial provision is made for the establishment of a Reverse Osmosis Water Treatment post mine closure to ensure that acid mine drainage water is treated and to discharge the treated water back into the natural environment. Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant.	Wetland ecologist, Aquatic ecologist, and EP
Subsidence	Stabilize the area and ensure the area is of no hazard to humans and animals.	Wetland ecologist and Soil Scientist

Possible Impacts	Recommendations	Person Responsible
	When the area is unstable, fence the area off and prevent access. Subsidence areas tend to form wetlands and should be left (if stable), then to reshape and landscape the area. A subsidence risk assessment was conducted for the specific area where mining will take place. The probability of subsidence is very low.	
Dewatering	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.	Wetland ecologist, Aquatic ecologist, and EP

18. Reasoned Specialist Opinion

Based on the impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. The proposed underground mining activities will have **Negligible to Moderate** impacts on the wetland environment when the proposed mitigation and management plans are considered. Only solitary sections of the wetlands will be impacted due to infrastructure related to underground workings, such as sewage and wastewater areas, access roads, RoM stockpiles, shafts, and office buildings and the potential of decanting which can be mitigated and planned.

However, it is highly recommended that concurrent rehabilitation, management, mitigation measures, and wetland monitoring are correctly implemented to minimise potential impacts on the wetlands and associated catchments (as set out in Section 17) to maintain the wetland health and functionality. Wetland management and monitoring requirements as set out in Section 14 and Section 15 should form part of the conditions for environmental authorisation. It is highly recommended that wetland areas and dams are not impacted on by keeping at least a 500 m zone of regulation buffer to any construction and infrastructure. Wetlands and natural water resources are a valuable natural asset, especially within the Highveld area.

Wetland management measures and monitoring requirements as set out in this report should form part of the conditions of environmental authorisation and be included in the EMPr.

19. Conclusion

The Project Area consisted of a total of 547.6 ha of wetland areas. Twenty-four (24) HGM units were identified and categorized based on terrain units. These included a pan, seeps, UVBs, and CVBs. The wetlands were grouped into eight groups for ease of the assessment.

The health and integrity of each of the HGM units varied from **'Moderately Modified'** to **'Largely Modified' (PES C** to **D)**. The pan is located within the mine operational area. The entire catchment as well as the pan has been impacted by mining activities. The CVBs have mainly been impacted by agropastoral activities, including cattle grazing, dams, and cultivation. In addition, some of the CVBs have been fragmented by linear infrastructure, including roads, powerlines, and fence lines. Fragmentation of wetlands impacts the natural habitat, functionality, and health of a wetland. The UVBs within the Project Area was dominantly used for cattle grazing. There were no clear signs of channeling, erosion, or extensive cattle trampling.

The vegetation was stable with little changes to water inputs to the systems. Regardless of some of the UVBs being moderately impacted, some of the systems were fragmented by mining, agropastoral, and linear infrastructure. Dams were also indicated in some of the systems. Most of the Hillslope Seep wetlands were used for agropastoral activities, including commercial cultivation and cattle grazing. Regardless of some Hillslope Seeps being impacted by agropastoral activities, some of the seeps have been impacted by mining activities and linear infrastructure, including roads, dams, and powerlines. Some sections of the seeps have almost completely been removed by these activities or completely separated and cut off from the rest of the system. Unimpacted Hillslope Seep wetlands were recorded within the Project Area. These wetlands were mainly used for cattle grazing, however, was well regulated and little erosion and impacts on the vegetation and geomorphology were noted.

In terms of ES sediment trapping, phosphate assimilation, nitrate assimilation, and toxicant assimilation are the dominant ecological services provided by the HGM units. The unimpacted Hillslope Seeps and CVBs are providing biodiversity maintenance and the CVBs are important for water supply.

The Pan, UVBs Fragmented, HS Agriculture, and HS Fragmented HGM units EIS were regarded as **'Moderate (C)'**. Whereas the CVBs, CVBs Fragmented, UVBs, and HS Unimpacted were considered **'High (B)'**. This suggests that these systems are of ecological importance and are sensitive. The biodiversity of the systems is sensitive to modifications to the habitat and low flows. These systems play an important role in moderating the quality and quantity of water in larger systems. The proposed mining activities will likely not have a immediate impact on the wetlands, however could potentially decrease the PES, EIS and ES over time as soon as dewatering and decanting starts. It is therefore recommended to follow the management and monitoring programme to prevent impacts to these wetlands.

The impact assessment revealed a spectrum of impacts ranging from major to negligible before the implementation of suitable mitigations. Many of these impacts can be reduced to minor and negligible impacts after the implementation of the mitigation, monitoring, and EMP.

Based on the impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. The proposed underground mining activities will have **Negligible to Moderate** impacts on the wetland environment when the proposed mitigation and management plans are considered. However, it is highly recommended that, mitigation measures, and wetland monitoring are correctly implemented to minimise potential impacts on the wetlands and associated catchments (as set out in Section 14) to maintain the wetland health and functionality. Wetland management and monitoring requirements as set out in Section 14 and Section 15 should form part of the conditions for environmental authorisation.

Wetland management measures and monitoring requirements as set out in this report should form part of the conditions of environmental authorisation and be included in the EMPr.

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Appendix A: Methodology

Literature Review

Relevant literature was reviewed concerning the historical wetlands associated with the Dorstfontein East Project Area. Habitats and vegetation types as well as the wetland state before development was assessed. This was done to obtain relevant information on the wetland ecology of the Project Area and its vicinity to acquire enough information to compile a Baseline Wetland Assessment Report.

Biodiversity within inland water ecosystems in South Africa is both highly diverse and of great regional importance to local livelihoods and economies, as these valuable natural resources (including any associated biota) provide a broad array of goods and services e.g. a source of water for domestic, industrial and agricultural purposes, as well as integral roles in the power generation and waste disposal industries (Darwall, Smith, Tweddle, & Skelton, 2009; Dudgeon et al., 2006). However, the fact that these freshwater systems may well be the most endangered ecosystems in the world threatens any of the 126,000 described species that depend upon freshwater habitats for any critical part of their life cycle, as well as any associated provisioning and/or regulatory ecosystem services (Dudgeon *et al.,* 2006).

Major global threats identified within these species-rich systems include ecosystem destruction, habitat alteration, changes in water chemistry, and direct additions and/or losses of aquatic biota (Malmqvist & Rundle, 2002). The magnitude of the threat to, and loss of, biodiversity in these vulnerable ecosystems is an indicator of the extent to which current practices are unsustainable. Hence, the importance of implementing conservation and management strategies that protect all elements of freshwater biodiversity, which in turn, also helps to guarantee water availability in the future (Dudgeon *et al.,* 2006).

The fact that South Africa is a water-scarce country makes these aquatic ecosystems even more susceptible to anthropogenic activities and their associated impacts. Consequently, the state (quality and quantity) of the county's water resources is fully dependant on good land management practices within catchments. Therefore, to achieve ecological and socio-economic sustainability, our natural water resources rely upon an integrated ecosystem-based approach to natural resource management (i.e., Integrated Water Resource Management, IWRI).

For 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 5m contours. Baseline and background information was researched and used to understand the area on a desktop level before fieldwork confirmation. This includes but is not limited to the following:

Table 1: Literature Review

National Freshwater Ecological Priority Areas (NFEPA; Nel et al., 2011) **Criteria** / **Rank** Wetlands that intersect with a RAMSAR site. — 1 • Wetlands within 500 m of an 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	The NFEPA project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The NFEPA data 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.
Mining and Biodiversity Guidelines (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.	The Mining and Biodiversity Guideline was developed collaboratively by the SANBI, the DEA, the Department of Mineral Resources (DMR), the Chamber of Mines, and the South African Mining and Biodiversity Forum in 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 and 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 risks of the proposed mining project. The country has been mapped into biodiversity priority areas including four categories each with associated risks and implications.
Mpumalanga Biodiversity Sector Plan (MTPA, 2014) **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.	The MBSP is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in 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. 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 6 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.

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

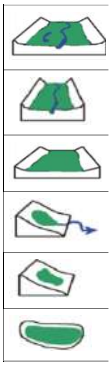
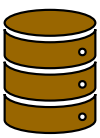
of South Africa (Mucina and Rutherford, 2012); and Fauna distribution and identification books of South Africa (Friedman and Daily, 2004; Skinner, and Chimimba, 2005) were some of the platforms used to identify and create a background study of the area.

Wetland Identification and Classification

Following the guidelines provided by the DWS wetlands are identified and classified into various hydrogeomorphic (HGM) units based on their characteristics. The HGM unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting.

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:

Wetland Identification and Classification

	**Terrain Unit Indicator (TUI)**	Helps to identify those parts of the landscape where wetlands are more likely to occur. 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 (DWAF, 2005). Wetlands are identified and classified into various hydrogeomorphic (HGM) units based on their 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.
	**Soil Form Indicator**	Identifies the soil forms, which are associated with prolonged and frequent saturation. Hydromorphic soils are characterized as soils that have undergone redox reactions due to the fluctuation of water and oxygen levels in the soil, creating precipitation of iron and manganese particles. Soils that are commonly associated with wetlands are Champagne, Rensburg, Arcadia, Katspruit, Kroonstad, Longlands, Fernwood, and Westley soil forms. These soils are associated with high clay content promoting waterlogging and low drainage, therefor waterlogging conditions. These soils are commonly associated with low-laying landscapes such as valley bottoms, foot-slopes, and mid-slopes.

	**Soil Wetness Indicator**	Identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation. Soil Wetness Indicator (SWI) is used as the primary indicator. Iron and manganese accumulation in a soil profile, termed mottles are some of the recognized ‘wet-indicators’. Recurrence of the cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Soil that is gleyed (leached) 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 (DWAF, 2005).
	**Vegetation Indicator**	Identifies hydrophilic vegetation associated with frequently saturated soils. Plant communities undergo distinct changes in species composition along the wetness gradient from the center 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 and Marneweck, 1999; DWAF, 2005). Areas, where soils are a poor indicator (black clay, vertic soils), vegetation, and species classification (as well as topographical setting), is relied on to a greater extent.

Wetland Ecological Health Assessment (WET-Health)

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 assessment was done on the wetlands following the method described by (Macfarlane et al., 2009) to determine the integrity (health) of the characterised HGM units for the study area. Level 1 was selected due to the large size of the study 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 approach is to quantify the impacts of human activity or visible impacts on wetland health, and then to convert the impact scores to a Present State 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 2 (Macfarlane et al., 2009).

Table 2: Impact Scores and Present Ecological State Categories used by WET-Health

Impact Category	Description	Combined Impact Score	PES Category
None	Unmodified, natural.	0-0.9	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	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	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	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	F

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 the 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 in Rountree, Malan, & Weston (2013) and (Rountree et al., 2013) was used for this study. In this method, there are three suites of important criteria.

Table 3: Interpretation of overall Ecological Importance and Sensitivity (EIS) Scores for biotic and habitat determinants

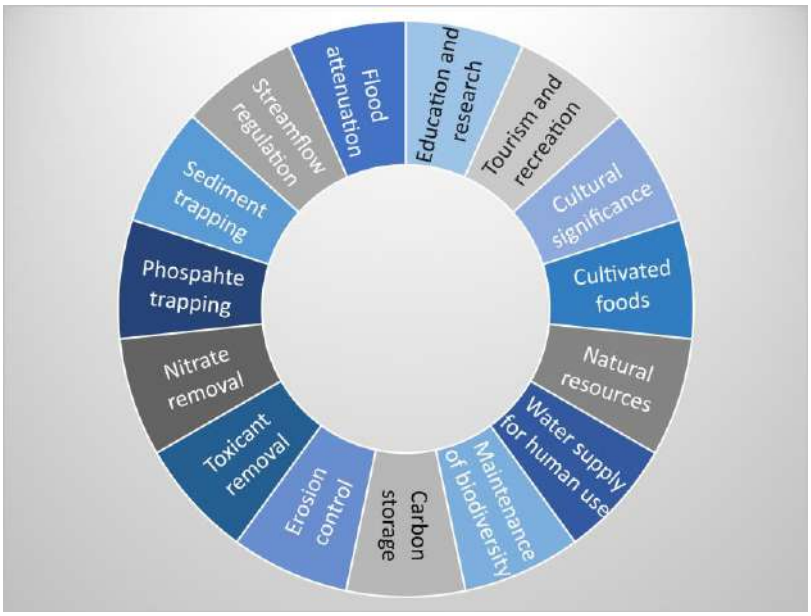
Criteria	EIS Category	Score
Ecological Importance and Sensitivity Incorporating the criteria used in the EIS assessments **Hydro-functional Importance** Considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland or freshwater resource may provide **Importance in terms of Basic Human Benefits** Considers the resources use and cultural benefits of the wetland or freshwater system	**Very High (A)**	>3 and <=4
	Wetlands 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 in major rivers.	
	High (B)	>2 and <=3
	Wetlands that are ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water in major rivers.	
	Moderate (C)	>1 and <=2
	Wetlands 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 in major rivers.	
	Low/Marginal (D)	>0 and <=1
	Wetlands 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 in major rivers.	

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' (DWA, 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.

Table 4: Classes for Determining the Extent of a Benefit Supplied



Score	Rating
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents 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 Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (FEPAs) to meet national biodiversity goals for freshwater ecosystems. Using systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity within the context of equitable social and economic development.
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers. This 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 aims 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).

Table 5 indicates the criteria that were considered for the ranking of each wetland. Whilst being an invaluable tool, it is important to note that the NFEPA's are delineated and studied

at a desktop and low-resolution level. Therefore, wetlands delineation via the ground-truthing work may vary from the NFEPA layers. The NFEPA assessment does, however, hold significance from a national perspective.

Table 5: NFEPA Wetland Classification Ranking Criteria

NFEPA Wetland Criteria	NFEPA Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority 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

Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in 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 NEMBA, 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 the 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). The management objectives of these areas are summarised below.

Table 6: Mpumalanga Biodiversity Sector Plan Categories

Map Category	Definition	Desired Management Objectives
PAs	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted 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 authorisation process that ensures the underlying biodiversity objectives are not compromised.

Map Category	Definition	Desired Management Objectives
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 prioritised 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.
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 prioritised 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 maximise ecological functionality, and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by the South African Biodiversity Institute (SANBI), the Department of Environmental Affairs (DEA), the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum in 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 guideline aims 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 listed in Table 7, each with associated risks and implications (DEA *et al.,* 2013).

Table 7: Mining and Biodiversity Categories

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 the significance of the biodiversity features that may be seen as 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 licenses, water use licenses, 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.

Source: (Department of Environmental Affairs *et al.,* 2013)

Impact Assessment

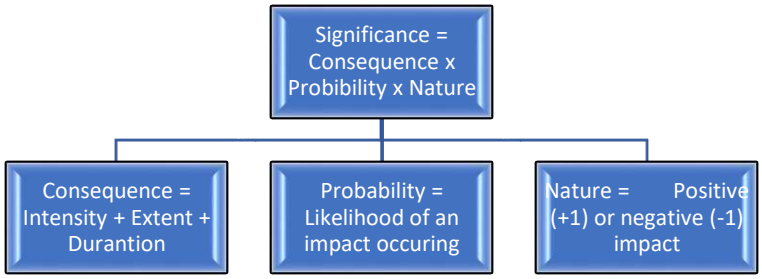
Impacts and risks have been identified based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to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

The severity of an impact is determined by taking the spatial extent, the duration, and the severity of the impacts into consideration. The probability of an impact is 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 will be incorporated into the EMPr.

Details of the impact assessment methodology used to determine the significance of physical, biophysical, and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:



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

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration, and Probability are each rated out of seven as indicated below. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts. Impacts are rated before mitigation and again after consideration of the mitigation measure proposed in this EIA/EMP Report. The significance of an impact is then determined and categorised into one of eight categories, as indicated below, which is extracted from the tables below.

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

Table 8: Impact Assessment Parameter Ratings

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

Table 9: Probability/Consequence Matrix

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

Table 10: Significance Rating Description

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

Appendix B: Impact Tables

Impact Assessment

Construction Phase Impact Ratings

Table 1 presents the impact ratings associated with the construction phase of the project.

Table 1: Potential Impacts Ratings

Activity and Interaction 1 **Access road construction**			
Impact Description: • Erosion and sedimentation; and • Soil compaction and or disturbance.			
Before Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The construction activities will result in the installation of permanent infrastructure, however, will be located outside wetlands. Secondary impacts might still arise, such as erosion and sedimentation from hardened surface.	Minor negative (-60)
Extent	Limited (2)	Proposed infrastructure are located outside wetlands, however, impacts might occur in wetlands adjacent of the infrastructure	
Intensity	Serious Loss (5)	Erosion and sedimentation could lead to loss of biodiversity and wetland functionality.	
Probability	Likely (5)	It is likely that impacts from the construction of the infrastructure might occur	
Nature	Negative		
Mitigation measures			
• 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 and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; and • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Duration	Long Term (4)	When mitigated and recommendations are implemented, impacts should last long-term	Minor negative (-32)
Extent	Very Limited (1)	Proposed infrastructure are located outside wetlands, and when recommendations are followed, impacts should only be in very limited areas.	
Intensity	Moderate Loss (3)	When mitigation and recommendations are followed, impacts should be moderate to low	
Probability	Probable (4)	It is still probably that impacts might occur from the construction of the infrastructure.	
Nature	Negative		

Activity and Interaction 2

Site clearing, including the removal of vegetation and disturbance of soils

Impact Description:

No wetlands will directly be impacted, however secondary impacts might occur as activities are proposed within 100 m and 500 m of wetlands. Secondary impacts include:

- Erosion and sedimentation;
- Loss of fauna and flora (biodiversity); and
- Increased AIPs.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	Impacts could occur through the life of mine if not mitigated and monitored.	Negligible (-27)
Extent	Limited (2)	Impacts to the wetlands will be limited to the areas directly adjacent of the proposed infrastructure.	
Intensity	Minor loss (2)	Impacts will be minor as the proposed infrastructure are at least 100 m away from the wetlands as well as the wetlands are already heavily impacted.	
Probability	Unlikely (3)	Impacts to the wetlands due to the activities are unlikely.	
Nature	Negative		

Mitigation measures

- Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area;

- Monitor and rehabilitate cleared and impacted areas where necessary;
- Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas; and
- Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist.

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Medium Term (3)	When recommendations are followed, impacts should only be medium-term (1-5 years).	Negligible negative (-10)
Extent	Very Limited (1)	Impacts to the wetlands will be limited to the areas directly adjacent of the proposed infrastructure, if any.	
Intensity	Minimal loss (1)	Impacts will be minimal due to construction and site clearing when mitigation recommendations are followed.	
Probability	Rare (2)	It is rare that impacts to the wetlands will occur due to site clearing more than 100 m from the closest wetland.	
Nature	Negative		

Activity and Interaction 3
Construction of mine related surface infrastructure

Impact Description:

- Increased hardened surface, runoff and onset of erosion and sedimentation;
- Decreased wetland habitat, functionality and integrity;
- Soil, water and wetland contamination.

Before Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	Impacts due to the construction of the infrastructure might have impacts to the adjacent wetlands beyond the project life	Minor negative (-60)
Extent	Local (3)	Impacts will be on site and the immediate surrounding area	

Intensity	Irreplaceable Loss (6)	Impacts, such as soil and water contamination could be irreplaceable and cause permanent impacts to the wetlands.	
Probability	Probable (4)	There is a possibility that impact might occur due to construction of the infrastructure	
Nature	Negative		

Mitigation measures

- Wherever possible, surface infrastructure and vehicle movement should be placed outside wetlands and the 100 m Zone of Regulation to prevent impacts such as increased hardened surfaces, runoff, contamination, erosion and sedimentation;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel;
- Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist;
- All spills must be cleaned up immediately to prevent contaminants to enter the wetlands; and
- Monitor rehabilitated areas to ensure successful re-establishment of vegetation and assess/prevent AIPs proliferation as well as monitor erosion, canalisation, and changes to the systems.

Post-Mitigation

Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Impacts due to the construction of the infrastructure might have impacts to the adjacent wetlands beyond the project life	Negligible negative (-33)
Extent	Limited (2)	Impacts should be in a limited area only when recommendations are implemented and followed.	
Intensity	Serious Loss (4)	Impacts might still be serious even after mitigation, such as contamination of soil, water and wetlands.	
Probability	Unlikely (3)	It is unlikely that impacts will occur from the construction of the infrastructure to the wetlands.	
Nature	Negative		

Activity and Interaction 4
Waste management activities

<table>
<tr><td colspan="4">Impact Description:
Contamination from Hydrocarbon waste (lubricants, oils explosives, and fuels);
Contamination from sewage and wastewater; and
Changes to wetland health and biodiversity.</td></tr>
<tr><td colspan="4">Before Mitigation/Management</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Soil, water and wetland contamination could be permanent</td><td rowspan="5">Moderate (negative) – 85</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Impacts will be local and the immediate area as the wetlands that could be affected is not connected to the rest of the downstream systems.</td></tr>
<tr><td>Intensity</td><td>Irreplaceable loss (7)</td><td>Contamination could lead to an irreplaceable loss of wetland PES, ES and EIS</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td>There is a possibility that impacts might occur from the waste management.</td></tr>
<tr><td>Nature</td><td colspan="2">Negative</td></tr>
<tr><td colspan="4">Mitigation measures</td></tr>
<tr><td colspan="4">A Storm Water Management Plan (SWMP) should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible;
The SWMP should convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses;
The SWMP should convey contaminated water away from wetlands and freshwater systems;
Freshwater resource monitoring must be carried out during the construction 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;
Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimized as far as possible;
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; and
All spills should be immediately cleaned up and treated accordingly.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
<tr><td>Duration</td><td>Beyond Project Life (6)</td><td>Impacts could last beyond the project life even after mitigation</td><td></td></tr>
</table>

Extent	Limited (2)	Impacts should only occur where spills have occurred	Minor (negative) – 56
Intensity x type of impact	Irreplaceable loss (6)	Contamination could lead to an irreplaceable loss of wetland PES, ES and EIS	
Probability	Probably (4)	There is a possibility that impacts might occur from the waste management.	
Nature	Negative		
Dimension	**Rating**	**Motivation**	**Significance**

Operational Phase Impact Ratings

Table 2: Potential Impacts Ratings

Activity and Interaction 1 Blasting (only when dikes and other geological features are encountered)			
Impact Description: • Movement of the strata causing potential subsistence, resulting in ponding and undulating topographies; and • Dewatering and drying out of wetlands.			
Before Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	Impacts from blasting could be permanent to the wetlands	Major negative (-119)
Extent	Local (3)	The impact from the blasting could have impacts to the wetlands in the Project Area and immediate surrounding areas	
Intensity	Irreplaceable loss and damage (7)	Impacts could lead to irreplaceable impacts to the wetlands and their PES, ES and EIS.	
Probability	Definite (7)	These impacts are highly probable.	
Nature	Negative		
Mitigation measures			
• Freshwater resource monitoring must be carried out during the operational and decommissioning phases 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; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas; and			

• If it is unavoidable that any of the wetlands be affected, the disturbance must be minimised and suitably rehabilitated.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	Impacts from blasting could last beyond project life even when managed and mitigated.	Moderate negative (-90)
Extent	Local (3)	The impact from the blasting could still extent to the local area even after mitigation and management	
Intensity	Irreplaceable loss and damage (6)	Impacts could still lead to irreplaceable impacts to the wetlands and their PES, ES and EIS.	
Probability	Highly probable (6)	It is highly probably that impacts from blasting will occur to wetlands of the entire project areas even after mitigation and recommendations are followed.	
Nature	Negative		
Activity and Interaction 2 Underground mining machinery maintenance			
Impact Description: • Contamination and deterioration of soil and water quality and quantity; and • Loss or changes to natural wetland PES, ES and EIS.			
Before Mitigation/Management			
Duration	Beyond Project Life (6)	Impacts to wetlands due to contamination could last beyond project life.	Moderate (negative) – 75
Extent	Local (3)	Impacts could extent to the local and surrounding areas, impacting downstream and adjacent wetlands	
Intensity	Irreplaceable Loss (6)	Soil and water contamination could lead to irreplaceable losses to the wetlands	
Probability	Likely (5)	It is likely that impacts might occur from vehicle maintenance	
Nature	Negative		
Mitigation measures			

- Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil;
- All spills must be cleaned up immediately to prevent contaminants to enter the wetlands;
- Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment;
- A SWMP should already be implemented. This should consider wetlands associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible;
- 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; and
- All vehicles must be regularly inspected for leaks.

Post-Mitigation			
Duration	Project Life (5)	Impacts to wetlands might still be during the project life even after mitigation and recommendations are followed	Minor (negative) – 48
Extent	Limited (2)	Impacts could only be in limited areas after recommendations and mitigation is followed	
Intensity	Serious Loss (5)	Contamination could still be serious even after remediation/mitigation	
Probability	Probable (4)	There is still a possibility that impacts might occur even after mitigation	
Nature	Negative		

Activity and Interaction 3

Use of existing haul roads and vehicle movement

Impact Description:

- Head cut erosion and channel forming from the roads (culverts);
- Increased erosion and consequently sedimentation into wetlands;
- Loss of vegetation and habitat; and
- Contamination.

Before Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project life (6)	The potential impacts caused during the operational phase will cease after the	Minor negative

		operational life, however, could last beyond the project life.	(-65)
Extent	Local (3)	Impacts could extend to the immediate area and surroundings	
Intensity	Serious Loss (5)	Impacts could be serious and lead to change in wetland PES, ES and EIS	
Probability	Likely (5)	It is likely that impact might occur from using haul roads	
Nature	Negative		
Mitigation measures			
• The edge of the wetlands and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase; • All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel; • If it is unavoidable that any of the wetland areas present will be affected, the disturbance must be minimised and suitably rehabilitated; • If spill occur, it must be cleaned up immediately and remediated; • No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Culverts, roads and river crossings must be maintained, cleared and monitored; and • 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.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project life (5)	The potential impacts caused during the operational phase will cease after the operational life, however, could last beyond the project life.	Minor (-40)
Extent	Limited (2)	Impacts could be restricted to limited areas of managed and mitigated	
Intensity	Moderate Loss (3)	Impacts could still be moderate even after recommendation are followed	
Probability	Unlikely (4)	It is unlikely that impact will occur from using haul roads	
Nature	Negative		
Activity and Interaction 4 In-pit ROM Stockpiling			

Impact Description:

- Potential runoff from stockpiles causing contamination into the wetlands;
- Erosion and sedimentation of contaminants into the wetland areas.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Beyond Project life (6)	The potential impacts could lead to impacts beyond project life	Minor negative (-56)
Extent	Local (3)	The impact could spread beyond the local development boundaries	
Intensity	Serious Loss (5)	These impacts are serious threats to important and sensitive freshwater resource habitats	
Probability	Probable (4)	These impacts are probable, and could occur	
Nature	Negative		

Mitigation measures

- The edge of the wetland and a 100m buffer or 1:100 flood line buffer should be demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas;
- No material is to be stockpiled or dumped within any wetlands, 100 m buffer or 500 m buffer zones of the wetlands, nor in rivers, tributaries or drainage lines;
- A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses;
- 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; and
- Ensure Soil Management and AIPs Plans are implemented and maintained to minimise erosion and sedimentation.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Long-Term (4)	Impacts could still have long-term effects, even after mitigation	Negligible negative (-30)
Extent	Limited (2)	Impacts can be limited to a small extent when mitigated and manged	

Intensity	Serious Loss (4)	Impacts can still be serious, even after mitigation and recommendations are followed	
Probability	Unlikely (3)	It is unlikely that impacts will occur to the wetlands if recommendation are followed	
Nature	Negative		

Activity and Interaction 5

Operation of water and sewer reticulation. Waste management activities

Impact Description:

- Contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels);
- Contamination from sewage and wastewater; and
- Changes to wetland integrity and biodiversity due to contamination, erosion, sedimentation, siltation and increased water supply to systems.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Beyond Project Life (6)	Impacts could last beyond project life and affect wetlands for a long time	Moderate negative (-75)
Extent	Local (3)	Impacts to the wetlands could be local and the immediate surrounding areas	
Intensity	Irreplaceable loss and damage (6)	Contamination of wetlands could lead to irreplaceable impacts to the PES, ES and EIS	
Probability	Likely (5)	There are not wetlands in the immediate surroundings, however there it is still likely that impacts will occur	
Nature	Negative		

Mitigation measures

- A SWMP should already be implemented. This should consider all wetlands and other watercourses associated with 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;
- Clean water must be separated from contaminated/dirty water. Clean water must be put back into the freshwater systems, whereas contaminated water must first be treated;
- 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; and

- Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible;
- 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;
- All spills should be immediately cleaned up and treated accordingly.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	When mitigation recommendations are followed, impacts should only last for the duration of the project	Minor negative (-44)
Extent	Limited (2)	Impacts should only occur in limited areas when mitigated and recommendations are followed	
Intensity	Serious Loss (4)	Impacts can still be serious to the wetlands even after mitigation	
Probability	Probably (4)	There is still a probability that impacts to the wetlands will occur even after mitigations and recommendations	
Nature	Negative		

Activity and Interaction 6
Operation of the coal discard processing plant

Impact Description:

- Contamination of soil, water and wetlands;
- Loss of wetland health and biodiversity; and
- Decreased wetland PES, ES and EIS.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Beyond Project Life (6)	The impacts could lead to impacts beyond the project life to wetlands and their functionality	Moderate negative (-96)
Extent	Local (3)	Impacts of spillage and contamination of the wetlands could be at a local level	
Intensity	Irreplaceable loss and damage (7)	Contamination may lead to irreplaceable loss of wetlands and wetland functionality	
Probability	Highly probable (6)	These impacts are highly probable.	
Nature	Negative		

Mitigation measures			
• 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; • 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 • Spillage from the coal processing plant must be cleaned up immediately to prevent pollutants entering the freshwater systems.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	Impacts will occur during the life of the project, even when mitigation and management recommendations are followed	Minor negative (-65)
Extent	Local (3)	Impacts will still have an impact to the local extent	
Intensity	Serious Loss (5)	Contamination and other impacts will still cause a serious loss to wetlands even after mitigation and management recommendations are followed	
Probability	Likely (5)	It is still likely that impacts will occur, even after mitigation	
Nature	Negative		

Decommissioning Phase Impact Ratings

The impact rating associated with activities related to the removal of surface infrastructure and rehabilitation of potentially affected areas has been predicted below.

Table 3: Potential Impacts

Activity and Interaction 1 Rehabilitation and demolition of infrastructure and rehabilitation of affected areas.
Impact Description: • Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology of the wetlands; • Erosion and sedimentation; • Contamination; and • The proliferation of AIPs.
Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	The impacts caused during the decommissioning activities will have a long-lasting effect if not mitigated.	Minor negative (-78)
Extent	Local (3)	The impacts could spread beyond the local development boundaries	
Intensity	Serious Loss (5)	Impacts due to decommissioning could be serious to the wetlands PES, EIS and ES	
Probability	Almost Certain (6)	It is highly possible that impacts will occur due to decommissioning	
Nature	Negative		

Mitigation measures

- Decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands;
- Stormwater must be diverted from decommissioning activities;
- Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs and wastewater facilities;
- 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 Plan for the duration of the decommissioning 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 buffer areas. All vehicles must remain on demarcated roads; and
- Monitor the decant of AMD and implement management measures which include for example an abstraction borehole placed down gradient of the decant point and reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, (Digby Wells, 2021).

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	The impacts will still be long term even after mitigation and recommendations are followed	Minor negative (-36)
Extent	Limited (2)	Impacts should be limited to small areas after mitigation and management	
Intensity x type of impact	Moderate Loss (3)	Impacts will still have moderate losses to the wetlands even after mitigation and management recommendations	

Probability	Probably (4)	Even after mitigation and management, it is still probable that impacts will occur	
Nature	Negative		

Activity and Interaction 2

Post-closure monitoring and rehabilitation.

- Onset of erosion and sedimentation; and
- AIPs proliferation.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Medium Term (3)	Impacts will have a medium-term duration effects to the wetlands	Negligible negative (-32)
Extent	Limited (2)	Impacts to the wetlands will be limited to specific areas	
Intensity	Moderate Loss (3)	Impacts will have moderate loss to the wetlands and its PES, EIS and ES	
Probability	Probable (4)	There is a probability that impacts will occur due to decommissioning and monitoring	
Nature	Negative		

Mitigation measures

- An AIPs Management Plan must be in place during the decommissioning phase. In this regard, special mention is made of *A. mearnsii, Eucalyptus grandis and Pinus patula* which is the dominant alien invasive tree species observed adjacent to the HGM units at the time of the assessment;
- 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;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into the topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the decommissioning phase and all waste must be removed to an appropriate waste facility; and
- Wetland monitoring must be carried out during the decommissioning phase into mine closure to ensure no unnecessary impact to wetlands takes place.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Short Term (2)	Impacts to the wetlands will only be for the short term	Negligible negative

Extent	Very Limited (1)	Impacts will be very limited	(-10)
Intensity	Minor Loss (2)	Impacts will have minor losses to the wetlands and their PES, EIS and ES	
Probability	Rare (2)	It is rare that impacts will occur from monitoring	
Nature	Negative		

Activity and Interaction 3

Post-mining decants into wetlands and streams

Impact Description:

- Water, soil and wetland contamination;
- Decreased PES, ES and EIS; and
- Loss of habitat integrity and ecosystem services such as toxicant removal and water for human use.

Before Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	Water quality will continue to deteriorate for several years, and the habitat/biodiversity will be permanently transformed.	Major negative – 119
Extent	Municipal (4)	The extent of the impact will affect the entire downstream reach of the watercourse.	
Intensity	Irreplaceable loss (6)	Contamination from decant can have irreplaceable losses to the wetlands and the PES, ES and EIS	
Probability	Definite (7)	The likelihood is assumed as definite until proven otherwise.	
Nature	Negative		

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Beyond Project Life (6)	Water quality will continue to deteriorate for several years, and the habitat will be permanently transformed.	Moderate negative – 105
Extent	Local (4)	The extent of the impact will affect the local area only when mitigated and managed.	
Intensity	Serious loss (5)	Impacts to the wetlands and downstream freshwater systems can be serious even after mitigation and management	

Probability	Definite (7)	The likelihood is assumed as definite until proven otherwise. Impacts will occur even after mitigation and management	
Nature	Negative		