

AQUATIC ASSESSMENT

CONSOLIDATED AQUATIC BIODIVERSITY ASSESSMENT FOR THE GOLDFIELDS
SOUTH DEEP GOLD MINE, SITUATED WITHIN WESTONARIA OF THE GAUTENG
PROVINCE, SOUTH AFRICA.



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PREPARED BY: Environmental Assurance (Pty) Ltd.
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SPECIALIST DECLARATION:

I, Johannes Jurgens Pearson and Gareth Preen declare that:

- We acted as independent specialists;
- The assessment results were interpreted objectively, even if the conclusions were not favourable to the client;
- We have the relevant expertise required to conduct a specialist assessment of this nature in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA) and the National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- The contents of this report comply with the relevant legislative requirements, specifically Appendix 6 of the NEMA: EIA Regulations (2014, as amended in 2017);
- We understand that any false information published in this document is an offence in terms of Regulation 71 and is punishable in terms of Section 24(f) of the Act;
- Gareth Preen and Johannes Jurgens Pearson are South African Scoring System Version 5 (SASS5) aquatic biomonitoring practitioners accredited by the national Department of Water and Sanitation (DWS).



Johannes Jurgens Pearson



Gareth Preen

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EXECUTIVE SUMMARY

Environmental Assurance (Pty) Ltd (hereafter referred to as ENVASS) was appointed by Gold Fields Operations Limited (GFO) and GFI Joint Venture Holdings (Pty) Limited (GFI Holdings) acting jointly in their capacities as participants in an unincorporated joint venture (JV) known as South Deep JV: South Deep Gold Mine (hereafter referred to as “the client”), , to undertake an updated Aquatic Biodiversity Assessment of the watercourses within the mining right area. The client is in the process of applying for an update and consolidation of all water uses onsite. The client has proposed two (2) discharge points, namely Discharge of treated water from the Reverse Osmosis (RO) Plants (Option 1) and Discharge of treated water from the RO plants via a pipeline (Option 2). Option 1 is the preferred alternative; therefore this report will focus on this proposed discharge point. There is an existing discharge point associated with the Doornpoort Tailings Storage Facility (TSF) which will also be assessed within this report.

The primary purposes of this specialist study will be to 1) update the aquatic biodiversity assessment for the site and 2) provide specialist input into the application for Environmental Authorisation (EA) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA)) and associated Environmental Impact Assessment (EIA) Regulations of 2014, as amended, as well as the Water Use License Application (WULA) in accordance with the National Water Act (Act No. 36 of 1998) (NWA) for the discharge points, which also consolidates all the previously approved water uses, and new water uses which had previously been omitted. The specialist study will comply with the Species Protocol Guidelines for the aquatic biodiversity theme, as stipulated within Government Notice (GN) 320 (DEA, 2020), and Department of Water and Sanitation (DWS) requirements to ensure that all Departmental needs are met on submission. In accordance with the Species Protocol Guideline, a Project Area of Influence (PAOI) must be assessed around the development site. A 500 Metre (m) PAOI around the proposed development (hereafter known as “the study area”) for the aquatic biodiversity impact assessments was therefore deemed acceptable for this purpose based on the type of development required.

Several watercourses were delineated and verified infield. These include two (2) Channelled Valley Bottom (CVB01 and CVB02) wetlands, three (3) Unchannelled Valley Bottom (UVB01 to UVB03) wetlands, and one (1) Artificial Watercourse (Arti01) associated with the study area. Of these, Arti01 and CVB01 were determined to be at **high** risk of impact by the Option 1 and existing Doornpoort discharge point. However, the functionality of all watercourses was assessed in order to satisfy the requirements of the updated Aquatic Biodiversity Assessment.

The Present Ecological State (PES) of the assessed watercourses ranged from **Class C (Moderately Modified)** to **Class E (Seriously Modified)**. Significant alterations to the bed and channels have occurred due to road, powerline, and pipeline crossings, along with illegal mining activities and ongoing construction within the stream channels. Wetlands have been adversely affected by the deposition of infill materials, waste rock dumping, trenching, and channelling, leading to diverted water systems and diminished flow, which have altered the natural vegetation. Soil disturbances have facilitated the spread of alien and invasive plant species (AIPs) within the marginal and riparian zones. Notable species include *Eucalyptus* spp.,

Acacia sp. (wattle), scattered *Agave sisalana* (sisal), and *Cortaderia selloana* (Pampas grass) infestations. Some of these plants, initially introduced for rehabilitation, are now encroaching upon the wetland systems. The watercourse has been rerouted around the old TSF; however, ongoing soil excavation and dumping continue to impact the diverted areas. Additionally, litter and waste disposal from upstream informal communities have degraded downstream regions. Leaks from sewage treatment plants (STPs) and seepage from mining activities have further compromised downstream water quality.

Following the undertaking of the Risk Assessment Matrix (RAM) (DWS, 2023) for the activities associated with the discharge of wastewater and treated water from the Reverse Osmosis (RO) plants at Option 1 (preferred option) into the receiving watercourses were determined to present a **low** risk of impact in a post-mitigation scenario. The most significant impacts to the receiving watercourses were determined to be alteration of hydrological flows and water quality impacts.

3. This Notice does not apply-

(c) in instances where an application must be made for a water use license (WUL) for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity.

Considering the above, it is the specialist's opinion, substantiated by the project-specific RAM and GN4167, that the activity applies for Sections 21(c) and (i) water use authorisation via a WULA process. However, this is subject to discussion with the DWS case officer, who will provide finality on the authorisation path to be followed by the client.

It is important to note that the RAM was undertaken with the assumption that all mitigation and rehabilitation measures as outlined in the RAM and Section 9 of this report will be adhered to. Should there be any changes to the project layout, a revised RAM will need to be undertaken.

Based on the findings of the analysis, it is recommended that Option 1 is utilised as this will create a larger area of hydrological zonations across the watercourse. Based on the wetland assimilation assessment, the maximum discharge should not exceed 2 MI/day.

Based on the results obtained during this study and presented herein, it is the specialist's substantiated opinion that the proposed development continues, provided that all mitigation and rehabilitation measures proposed in this report and the site-specific WUL be strictly implemented and subsequently monitored. This conclusion is subject to the following conditions, as well as all mitigation and rehabilitation measures presented within Section 9, being strictly implemented and subsequently monitored:

- Implementation of all design measures recommended within **Sub-Section 10.4.**

AQUATIC BIODIVERSITY ASSESSMENT REQUIREMENTS

The following lists the requirements of an Aquatic Biodiversity Impact Assessment Report as stipulated within the protocol for specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity and the sections within this report where each can be found [Department of Environmental Affairs (DEA), 2020].

No.	REQUIREMENT	SECTION OF REPORT
2.7 The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:		
2.7.1	contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Document Control (pg. ii) & Appendix B: CV (pg. 85)
2.7.2	a signed statement of independence by the specialist.	Specialist Declaration (pg. iii)
2.7.3	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Document Control (pg. ii)
2.7.4	the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Methodology (Appendix A (pg. 67)
2.7.5	a description of the assumptions made, any uncertainties or gaps in knowledge or data.	Assumptions and Limitations (pg. 7)
2.7.6	the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	Buffer zone determination (pg. 30) & Impact Assessment (pg. 36)
2.7.7	additional environmental impacts expected from the proposed development.	Impact Assessment (pg. 36)
2.7.8	any direct, indirect and cumulative impacts of the proposed development on site.	Impact Assessment (pg. 36) & Cumulative and Residual Impacts (pg. 43)
2.7.9	the degree to which impacts and risks can be mitigated.	Cumulative and Residual Impacts (pg. 43) & Impact Statement (pg. 36)
2.7.10	the degree to which the impacts and risks can be reversed.	Cumulative and Residual Impacts (pg. 43) & Impact Statement (pg. 36)
2.7.11	the degree to which the impacts and risks can cause loss of irreplaceable resources.	Cumulative and Residual Impacts (pg. 43) & Impact Statement (pg. 36)
2.7.12	a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Buffer zone determination (pg. 30)

2.7.13	proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Impact Assessment (pg. 36) and Mitigation Section (pg. 43)
2.7.14	a motivation must be provided if there were development footprints identified as per paragraph 2.4 above that were identified as having a “low” aquatic biodiversity sensitivity and that were not considered appropriate.	N/A
2.7.15	a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Conclusion (pg. 64)
2.7.16	any conditions to which this statement is subjected.	Conclusion (pg. 64)

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LIST OF ABBREVIATIONS AND ACRONYMS

AIPS	Alien and Invasive Plant Species
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CR	Critically Endangered
DAFF	Department of Agriculture, Forestry and Fisheries
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EN	Endangered
ESS	Ecosystem Services
FEPA	Freshwater Ecosystem Priority Area
GA	General Authorisation
GG	Government Gazette
GIS	Geographic Information System
GN	Government Notice
GPS	Geographic Positioning System
HGM	Hydrogeomorphic
LT	Least Threatened
MAMSL	Meters Above Mean Sea Level
MAP	Mean Annual Precipitation
MASR	Mean Annual Surface Runoff
MAT	Mean Annual Temperature
MIG	Municipal Infrastructure Grant
NGL	Natural Ground Level
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended

NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NWM5	National Wetland Map 5
PES	Present Ecological State
PU	Planning Unit
REC	Recommended Ecological Category
RMO	Recommended Management Objective
RWQO	Resource Water Quality Objectives
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SWMP	Stormwater Management Plan
SWSA	Strategic Water Source Area
TOPS	Threatened and/or Protected Species
TWQR	Target Water Quality Range
VU	Vulnerable
WMA	Water Management Area
WWTW	Wastewater Treatment Works
WULA	Water Use Licence Application

1 INTRODUCTION

1.1 Background

Environmental Assurance (Pty) Ltd (hereafter referred to as ENVASS) was appointed by Gold Fields Operations Limited (GFO) and GFI Joint Venture Holdings (Pty) Limited (GFI Holdings) acting jointly in their capacities as participants in an unincorporated joint venture (JV) known as South Deep JV: South Deep Gold Mine (hereafter referred to as “the client”), , to undertake an updated Aquatic Biodiversity Assessment of the watercourses within the mining right area. The client is in the process of applying for an update and consolidation of all water uses onsite. The client has proposed three (3) discharge points, namely Discharge of treated water from the Reverse Osmosis (RO) Plants (Option 1). Discharge of treated water from the RO plants via a pipeline (Option 2) and Discharge of excess underground water (Option 3). Option 1 is the preferred alternative; therefore this report will focus on this proposed discharge point. There is an existing discharge point associated with the Doornpoort Tailings Storage Facility (TSF) which will also be assessed within this report.

The primary purposes of this specialist study will be to 1) update the aquatic biodiversity assessment for the site and 2) provide specialist input into the application for Environmental Authorisation (EA) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA)) and associated Environmental Impact Assessment (EIA) Regulations of 2014, as amended, as well as the Water Use License Application (WULA) in accordance with the National Water Act (Act No. 36 of 1998) (NWA) for the discharge points, which also consolidates all the previously approved water uses, and new water uses which had previously been omitted. The specialist study will comply with the Species Protocol Guidelines for the aquatic biodiversity theme, as stipulated within Government Notice (GN) 320 (DEA, 2020), and Department of Water and Sanitation (DWS) requirements to ensure that all Departmental needs are met on submission. In accordance with the Species Protocol Guideline, a Project Area of Influence (PAOI) must be assessed around the development site. A 500 Metre (m) PAOI around the proposed development (hereafter known as “the study area”) for the aquatic biodiversity impact assessments was therefore deemed acceptable for this purpose based on the type of development required.

1.2 Locality

The mining lease area constituted as “the study area” within this report. According to the Gold Fields Limited Mineral Resources and Mineral Reserves Supplement to the Integrated Annual Report (IAR) (2021), the total mining area is approximately 4,268 Hectares (ha). The study area is situated in the Westonaria suburb of the Rand West and Merafong Local Municipalities of the Gauteng Province, South Africa at geographic centre coordinate 26° 24' 53.17" S, 27° 40' 28.64" E (**Figure 1-1**). The site is accessed via the National Route 12 road between Johannesburg and Potchefstroom.

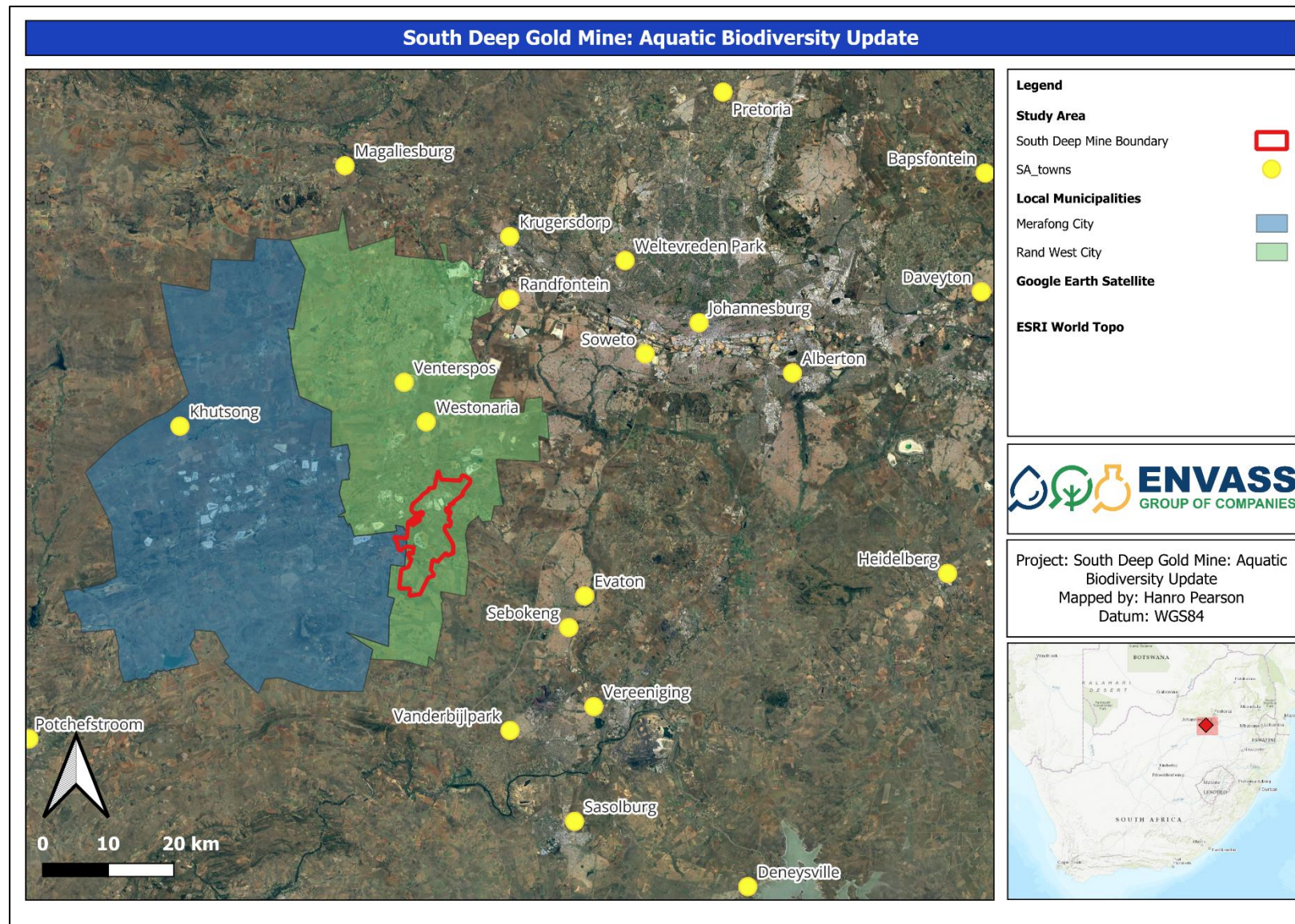


Figure 1-1: Locality map of the study area in relation to surrounding towns and municipal boundaries within the Gauteng Province, South Africa.

1.3 Applicable Legislation

This study was conducted in accordance with consideration to the following legislation (**Table 1-1**).

Table 1-1: Description of the legislation that was considered when drafting this report.

LEGISLATION	DESCRIPTION
South African Constitution (Act No. 108 of 1996)	The constitution is the overarching framework of South African law. It provides a legal foundation for the existence of the republic, outlines the rights and responsibilities of South African citizens and defines the structure of government. Section 24(a) states that every person has a right to an environment that is not harmful to their health or well-being and an environment that is protected through reasonable legislation or other measures for the benefit of present and future generations. Section 24(b) directs the state to take reasonable action to prevent pollution, promote conservation and ensure sustainable development that secures ecological integrity and the use of natural resources. Section 27 states that the National government is the custodian of all the country's water resources. As such, the state is required to protect and conserve water resources to ensure safe access to water.
Department of Water and Sanitation (DWS) General Notice 4167 Government Gazette no. 49833 (2023)	In order to understand and interpret GN 4167 (2023) the following definitions must be presented and expanded upon (DWS, 2023): <u>Characteristics of a watercourse</u>: the resource quality of a watercourse within the extent of a watercourse; <u>Diverting</u>: To, in any manner, cause the instream flow of water to be rerouted temporarily or permanently; <u>Extent of a watercourse</u>: (a) The outer boundary of the 1:100year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse; and (b) Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan. <u>Flow-altering</u>: To, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently. <u>Impeding</u>: to, in any manner, hinder or obstruct the instream flow of water temporarily, or permanently, but excludes the damming of flow to cause storage of water. <u>Rehabilitation</u>: The process of reinstating natural ecological driving forces within part or the whole of a degraded watercourse to recover former or desired ecosystem structure, function, biotic composition and associated ecosystem services. <u>Regulated area of a watercourse</u>: For Section 21 (c) and (i) of the NWA water uses in terms of GN 4167 means: (a) The outer boundary of the 1:100year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse; (b) In the absence of a determined 1:100year flood line or riparian area the area within 100m from the edge of a watercourse (excluding floodplains) where the edge of the watercourse is the first identifiable annual bank fill flood bench; or (c) A 500 m radius from the delineated boundary of any wetland or pan.

LEGISLATION	DESCRIPTION
	<u>Riparian Habitat</u>: The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation species with a composition and physical structure distinct from those of adjacent land areas. <u>Rehabilitation</u>: The process of reinstating natural ecological driving forces within part or the whole of a degraded watercourse to recover former or desired ecosystem structure, function, biotic composition and associated Ecosystem Services (ESS). <u>Watercourse</u>: (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette declares to be a watercourse. <u>Wetland</u>: Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil. According to GN4167 (2023), water use in terms of Section 21 (c) and (i) of the NWA may be granted under a General Authorisation (GA) as opposed to a full Water Use License (WUL) if all activities within the regulated area of a watercourse are calculated to be of low risk utilising the DWS Risk Assessment Matrix (RAM).
DWS Regulation No. R. 267, Government Gazette no. 40713 (2017)	The purpose of this regulation is to prescribe the procedure and requirements for Water Use License Applications (WULAs) as contemplated in Section 41, as well as an appeal in terms of Section 41(6) of the NWA. Within Section 6 of Regulation No. R. 267 the content required within a Wetland Delineation Report are stipulated and thus were considered by the author when drafting this report. Additionally, the standardised and DWS-accepted methods that must be used for determining the various aspects of assessments during the WULA process related to wetlands are presented and their sources are referenced.
DFFE Government Notice No.320, Government Gazette No. 43110 (2020)	GN 320 (DFFE, 2020) defines the procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(a) and (h) and 44 of the NEMA, when applying for EA. The minimum criteria for high-sensitivity aquatic biodiversity features were utilised to guide the implementation and presentation of this study report.
NEMA: EIA Regulations (2014, as amended in 2017)	As the primary purpose of this assessment is to provide specialist input into the environmental management process, including the WULA, associated with the activity, the author has drafted this specialist report following the requirements listed under Appendix 6 of the NEMA: EIA Regulations (2014, as amended).

LEGISLATION	DESCRIPTION
NWA	The purpose of the NWA is to ensure that the national water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors: (g) protecting aquatic and associated ecosystems and their biological diversity; (h) reducing and preventing pollution and degradation of water resources; In terms of the NWA, water use is broadly defined as, and includes taking and storing water, activities which reduce stream flow, waste discharges and disposals, controlled activities (activities which impact detrimentally on a water resource), altering a watercourse, removing water found underground for certain purposes, and recreation. In general, water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a GA, or if a responsible authority waives the need for a license. The water uses, as listed under Section 21 of the NWA, that apply to this project are: (c) impeding and diverting the flow of water in a watercourse; (f) discharging waste or water containing waste into a water resource and (i) altering the bed, banks, course or characteristics of a watercourse.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM: BA)	The objectives of the NEM: BA are (within the framework of NEMA to provide for: (i) the management and conservation of biological diversity within the Republic and of the components of such biological diversity; (ii) the use of indigenous biological resources in a sustainable manner; and (iii) the fair and equitable sharing among stakeholders of benefits arising from bioprospecting involving indigenous biological resources.

2 SCOPE OF WORK

The following Scope of Work (SoW) was undertaken in drafting the Updated Aquatic Biodiversity Report:

- Conduct a desktop study inclusive of a literature review of all available studies applicable to the study area.
- Conduct a field survey to delineate the watercourses (rivers and wetlands) within the study area using 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' [Department of Water Affairs and Forestry (DWAF), 2008].
- Classify all watercourses within the study area using the 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al.*, 2013).
- Assess the Present Ecological State (PES) score of all the at-risk watercourses by implementing the required methodologies and tools.
- Determine the Ecological Importance and Sensitivity (EIS) of all the watercourses by implementing the required methodologies and tools, as presented below.

- Calculate the functionality of the at-risk wetlands by determining the level to which each system supplies valuable Ecosystem Services (ESS) using the WET-EcoServices tool (Kotze *et al.*, 2020).
- Determine scientific buffer zones for the at-risk watercourses using the 'Buffer Zone Guidelines for Rivers, Wetlands and Estuaries' (Macfarlane & Bredin, 2016).
- Calculate the Recommended Management Objective (RMO) of each at-risk watercourse by implementing the DWAF (2007) management objectives matrix.
- Provision of mitigation and/or rehabilitation measures to reduce the impacts of the proposed discharges.
- Provision of design recommendations, in consultation with representative engineers, to ensure that the functioning of the receiving wetlands is not negatively impacted.
- Conduct a quantitative impact assessment in accordance with the DEA (2014) methodology in which the perceived direct, indirect, cumulative and residual (if any) impacts of the proposed activities and associated infrastructure on the receiving aquatic environment are analysed and reported on.
- Undertake a DWS RAM to determine whether the proposed activities must be subject to a GA, or a WULA process.
- Conduct a wetland assimilation assessment on the proposed discharge point.
- Draft a single updated Aquatic Biodiversity report for submission to the client in electronic PDF format.

Further to the above, the following SoW was provided by Manyabe Consulting which will be addressed within this report:

- The study took cognisance of the recently published Government Notice 320 (dated 20 March 2020) and Government Notice 1150 (dated 30 October 2020) in terms of NEMA: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation".
- The study includes a checklist with reference to the section of the report that addresses how the report conforms to Government Notice Regulation (GNR) No. 982 of Appendix 6 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) i.e. Requirements for Specialist Studies.
- The infrastructure to be developed [at all discharge points) should discharge water in a dispersive/ slow manner, with energy dissipators. At all discharge points, there should not be a channel that is forming towards the watercourse.
- Advise on how the wetland will change due to the proposed discharges. PES and the EIS should be improved upon by the proposed changes. Should the PES and EIS be reduced, proper mitigation measures must be prescribed.
- Recommend remedial actions based on the findings of the assessments.

3 METHODOLOGY

Table 3-1 below presents the methodologies and tools that were utilised in conducting this aquatic biodiversity report. A detailed description of these methodologies and tools is presented in **Appendix A**.

Table 3-1: Methodologies applied during the study.

ASPECT	METHODOLOGY/TOOL
Desktop Assessment	- Aerial imagery (Google Earth Pro). - Vegetation and climate information (Mucina & Rutherford, 2006). - PES, Ecological Importance (EI) and Ecological Sensitivity (ES) per Sub Quaternary Reach (SQR) for Secondary Catchments in South Africa (DWS, 2014). - The National Freshwater Ecosystem Priority Areas (NFEPA) (Nel <i>et al.</i>, 2011). - The Gauteng Conservation Plan [Gauteng Department of Agriculture, Rural Development and Environment (GDARDE), 2015]. - South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer <i>et al.</i>, 2019). - National Biodiversity Assessment (NBA) (Van Deventer <i>et al.</i>, 2019). - The South African National Biodiversity Institute (SANBI) National Wetland Map 5 (Van Deventer <i>et al.</i>, 2019).
Watercourse delineation	A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas (DWAF, 2008).
Watercourse classification	National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis <i>et al.</i>, 2013).
Wetland PES assessment	WET-Health (Version 2) (MacFarlane <i>et al.</i>, 2020).
Wetland ESS assessment	WET-EcoServices (Level 2) (Kotze <i>et al.</i>, 2020).
Buffer zone determination	Buffer Zone Guidelines for Rivers, Wetlands and Estuaries (MacFarlane & Bredin, 2016).
Risk Assessment	Section 21 (c) and (i) water use RAM (DWS, 2023).
Impact Assessment	Quantitative Impact Assessment (DEA, 2014).

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations were relevant to this study:

- A transitional gradient occurs within wetlands from the saturated permanent zone to dry terrestrial areas. This gradient makes it difficult to determine the exact boundary of wetland features and some differences in opinion on wetland boundaries may therefore occur. The delineation as presented in this report is, however considered to be a best estimate of the outer boundary of the temporary zone as determined by a wetland specialist with extensive experience in the wetland delineation techniques advocated by the DWS.
- The field survey relevant to this study was a once-off assessment that was conducted in July 2024 and therefore does not cover seasonal variations in freshwater habitat characteristics. Ecosystems vary both temporally and spatially.

Once-off assessments such as this may potentially miss certain ecological information, specifically trends and floral species that do not flower within the field survey season.

- Wetland boundaries are essentially based on Geographic Positioning System (GPS) coordinate waypoints taken on-site of soil sampling points and of important morphological features. The variations experienced in GPS precision will ultimately affect the accuracy of the GPS waypoints and consequently will affect the accuracy of the recorded freshwater resource boundaries. All sampling waypoints were recorded using a Garmin Montana 650 GPS (estimated accuracy rating of 3-5 metres) and captured, analysed and geo-processed utilising a Geographic Information System (GIS) (i.e. QGIS and ArcGIS).
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological issues identified during the field survey and was based on the assessor's working knowledge and experience with similar projects.
- Evaluation of the significance of impacts with mitigation took into account mitigation measures provided in this report and standard mitigation measures included in the project-specific WUL.
- This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

5 DESKTOP ASSESSMENT

This section consists of information obtained during the desktop study of the study area (**Table 5-1**) and the surrounding terrestrial and aquatic environment. The information obtained at a desktop level was ground-truthed and used to provide input into the perceived changes that may have occurred to the presumed natural state of the receiving environment.

Table 5-1: Desktop study attributes and descriptions relevant to the study area.

Hydrological Setting (DWS, 2012; 2016) (Figure 5-1)						
Water Management Area (WMA)	The study area is situated within the Vaal WMA (DWS, 2016). Major Rivers include the Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts, Molopo and Vaal. None of the major rivers is situated within the study area.					
Quaternary Catchment Area	The study area falls within the C22J Quaternary Catchment Area (DWS, 2012).					
Sub-Quaternary Reach (SQR)	C22J- 1466 PES: Class D (Largely Modified) EI: Moderate ES: Moderate REC: Class C (Moderately modified)	C22J- 1468 (Leeuwspruit) PES: Class E (Seriously Modified) EI: Moderate ES: High REC: Class B (Near natural)	C22J- 1557 (Leeuwspruit) PES: Class E (Seriously Modified) EI: Low ES: Moderate REC: Class C (Moderately modified)			
Ecoregion (Kleynhans <i>et al.</i> , 2005) (Figure 5-2)						
ATTRIBUTES	Highveld Ecoregion (11)					
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to High Relief; Closed Hills. Mountains; Moderate and High Relief.					
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sand Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).					
Altitude (m.a.m.s.l) (secondary)	1,100-2,100; 2,100-2,300 (very limited)					
MAP (mm) (modifying)	400 to 1,000					
Coefficient of Variation (% of annual precipitation)	<20 to 35					
<table><tr><td></td><td>Environmental Assurance (Pty) Ltd Aquatic Division www.envass.co.za</td><td>Client Restricted ENVASS 9</td></tr></table>					Environmental Assurance (Pty) Ltd Aquatic Division www.envass.co.za	Client Restricted ENVASS 9
	Environmental Assurance (Pty) Ltd Aquatic Division www.envass.co.za	Client Restricted ENVASS 9				

Rainfall concentration index	45 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	20 to 32
Mean daily max. temp. (°C): July	14 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	5 to >250

National Wetland Map Version 5 (NWM5) and National Freshwater Ecosystem Priority Areas (NFEPA's) (Driver *et al.*, 2011) (Figure 5-3–Figure 5-4)

National Wetland Map 5 (NWM5)	Several wetland systems were modelled at a desktop level within the Goldfields South Deep Site (GFSD). These included: seven (7) Channelled Valley Bottom (CVB), five (5) Unchannelled Valley Bottom (UVB), one (1) Depression and one (1) Hillslope Seepage wetlands. At a desktop level, their PES scores ranged from Class A/B (Near natural) to Class D/E/F (Largely to seriously modified). Onsite, the eight (8) systems previously delineated and assessed were classified as UVB and CVB wetlands with Hillslope Seepage wetlands following into them at the head of the systems.
Fish sanctuary	None of the three (3) SQRs relevant to GFSD were classified as Fish Sanctuaries or Fish Corridors.
FEPA's	None of the three (3) SQRs relevant to GFSD were classified as Freshwater Ecosystem Priority Area (FEPA) catchment areas.
NFEPA Rivers	One (1) NFEPA River, an unnamed tributary of the downstream NFEPA Leeuwspruit River locally named Leeu East River (Nel <i>et al.</i> , 2011), flows to the east of the GFSD surface infrastructure, with the closest interaction being with the old South Shaft Return Water Dams (RWDs), which was constructed in its natural course. The desktop PES score modelled for the unnamed tributary (Leeu East River) falls within Class D (Largely modified) (Nel <i>et al.</i> , 2011). No other NFEPA rivers are situated within the GFSD site, however, the NFEPA Leeuwspruit River flows approximately 2.5 km downstream of the Doornpoort TSF RWD. NFEPA systems are required to remain in good condition to conserve freshwater ecosystems, but also to protect water resources for human consumption (Nel <i>et al.</i> , 2011). The systems must be supported by good planning, decision-making and management in order to ensure that human use does not detrimentally impact the condition of the ecosystem (Nel <i>et al.</i> , 2011).
NFEPA Wetlands	A total of three (3) natural NFEPA wetlands were modelled within the GFSD site. These included two (2) Depressions and one (1) Hillslope Seep wetland, which were both determined at a desktop level to be in modified condition (Nel <i>et al.</i> , 2011). The desktop delineation and classification of these wetland systems were determined to be incorrect during the field investigation. In addition to the natural wetland systems, a total of fourteen (14) artificial watercourses, including farm dams, wastewater storage facilities and RWDs, were modelled at a desktop level within the GFSD site.

Wetland Vegetation (WetVeg) Types	The study area was observed to be dominated by the Mesic Highveld Grassland (Group 4) Wetland Vegetation (WetVeg) type, with the Central Bushveld (Group 1) WetVeg unit covering the northern extent and the Mesic Highveld Grassland (Group 3) covering the southern extent of the study area. These WetVeg units are classified as Critically Endangered (CR) at a national scale (Nel <i>et al.</i> , 2011). Remnants of the presumed natural state of the WetVeg unit were recorded within the delineated wetland systems during the field investigation, however, the current condition of the wetland vegetation was determined to be degraded in comparison to the reference state. This was primarily attributed to disturbance from historic and current land uses such as but not limited to: agriculture, rural settlement development and expansion, servitudes (e.g. roads, pipelines and powerlines) livestock grazing and mining activities.
Geology and Soils (MacFarlane & Bredin, 2016) (Figure 5-5–Figure 5-6)	
Lithostratigraphic unit	The majority of the study area is underlain by the Pretoria Group of the Transvaal Supergroup, which is typically comprised of the Timeball Hill Formation quartzite, shale, siltstone, conglomerate, breccia and diamictite in the northern half of the study area, and Hekpoort andesite in the mid- and southern portions (Council for Geoscience, 2008). A small section in the northernmost portion of the study area was observed to be underlain by the Malmani Subgroup of the Chuniespoort Group, which is typically comprised of dolomite, subordinate chert, minor carbonaceous shale, limestone and quartzite. The southern portion of the study area was observed to be underlain by the Silverton Subgroup, which is typically comprised of shale, dolomite and limestone as well as basalt and tuff.
Soil type	The majority of the site was observed to be situated within the Ba1 land type, with the northernmost portion to the north of the surface infrastructure located within the Fb5 land type (Memoirs on the Agricultural Natural Resources of South Africa, Department of Agriculture, 1984). More than 80 % of the land types have slopes less than 8 % through the GFSD study area. As shale, diamictites and quartzite of the Timeball Hill Formation underlie the majority of the GFSD study area, the soils are mainly shallow and stony (e.g. Mispah and Glenrosa soil forms). Soils in the vicinity of the Doornpoort TSF were recorded by EcoPartners (2011) to be dominated by the Hutton, Avalon and Clovelly soil forms. At a desktop level, the entire extent of the study area was observed to contain soils exhibiting Class C hydrological soil group properties (Schultze, 2010; Schultze <i>et al.</i> , 1992). These soils typically have a Moderately High Inherent Runoff Potential (IRP) with slow infiltration rates or infiltration that deteriorates rapidly. The permeability of these soils is considered restricted.
Conservation Attributes (Compaan, 2011; SANBI, 2011; SANBI, 2006-18; DFFE, 2021) (Figure 5-7–Figure 5-9)	
Biodiversity Conservation Plan	One (1) Critical Biodiversity Area (CBA), an irreplaceable unit is situated within the GFSD study area in the vicinity of the ridge habitat located to the northwest of the South Shaft surface infrastructure. The remaining ridge habitat in the northern portion of the GFSD study area, aside from all disturbance associated with the GFSD mine, was classified as CBA: Important Areas or Ecological Support Areas (ESAs). In addition to this, large areas located in the southern portion of the GFSD study area, to the northwest of the Doornpoort TSF, were observed to be classified as CBA: Important Areas. Scattered CBA: Important Areas were also observed in the western and northeastern sections of the study area. CBA: Irreplaceable Areas are considered critical for meeting provincial biodiversity targets and are required to ensure the persistence of species and the functioning of ecosystems. CBA: Important Areas have a lower irreplaceability but collectively, incorporate the most biodiversity in the smallest area, and therefore provide the most cost-effective options for biodiversity conservation.

	The rivers flowing through the study area, including the locally named Leeu East, Kariega and Leeu West (Leeuspruit) Rivers, were all observed to fall within ESAs. Additional ESAs were scattered within the study area, situated primarily adjacent to CBA: Important Areas. ESAs are not essential for meeting biodiversity targets but play an important role in supporting Irreplaceable and Important areas and/or in delivering ecosystem services. In Gauteng, ESAs include dolomite outcrops, rivers, wetlands, pans, corridors for climate change and species migration, rocky ridges, and low-cost areas for Johannesburg and Tshwane.
Threatened Ecosystems	The majority of the study area was observed to fall within the Rand Highveld Grassland Threatened Ecosystem, which is classified as Vulnerable. The northern portion of the study area falls within the Gauteng Shale Mountain Bushveld, classified as Least Concern, while the south falls within the Soweto Highveld Grassland, classified as Vulnerable.
Protected Areas	No Protected Areas (PAs) were situated within the study area. The closest PA was observed to be the Tweefontein Private Nature Reserve to the south and the Johanna Jacobs Private Nature Reserve to the west.
Vegetation Types	The majority of the study area falls within the Rand Highveld Grassland, which is classified as Vulnerable. The northern portion of the study area falls within the Gauteng Shale Mountain Bushveld, classified as Least Concern, while the south falls within the Soweto Highveld Grassland classified as Vulnerable.

Key:

m a m s l: Metres Above Mean Sea Level

PES: Present Ecological State

EI: Ecological Importance

ES: Ecological Sensitivity

REC: Recommended Ecological Category

NWM5: National Wetland Map Version 5

NFEPA: National Freshwater Ecosystem Priority Area

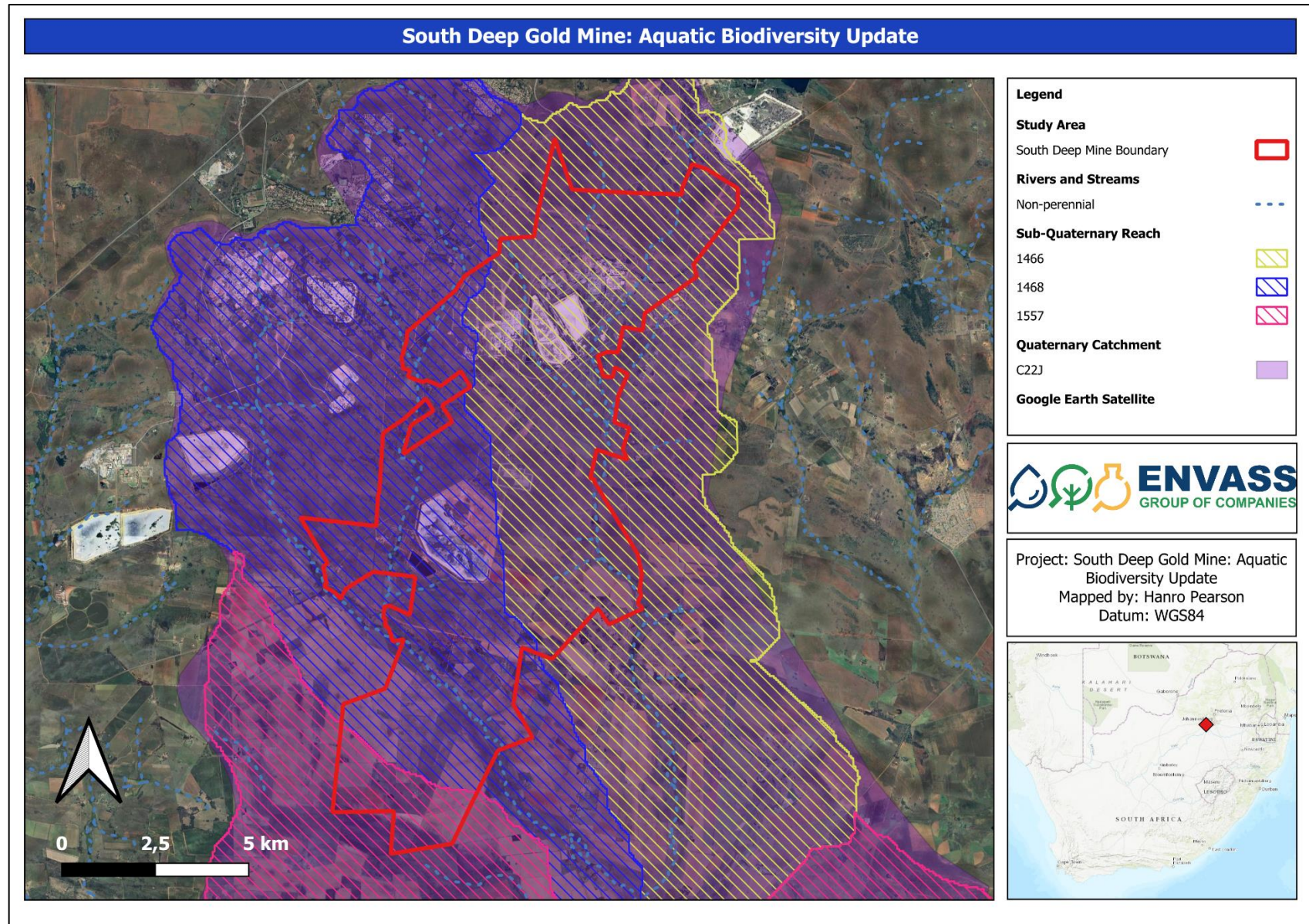


Figure 5-1: Hydrological setting of the study area.

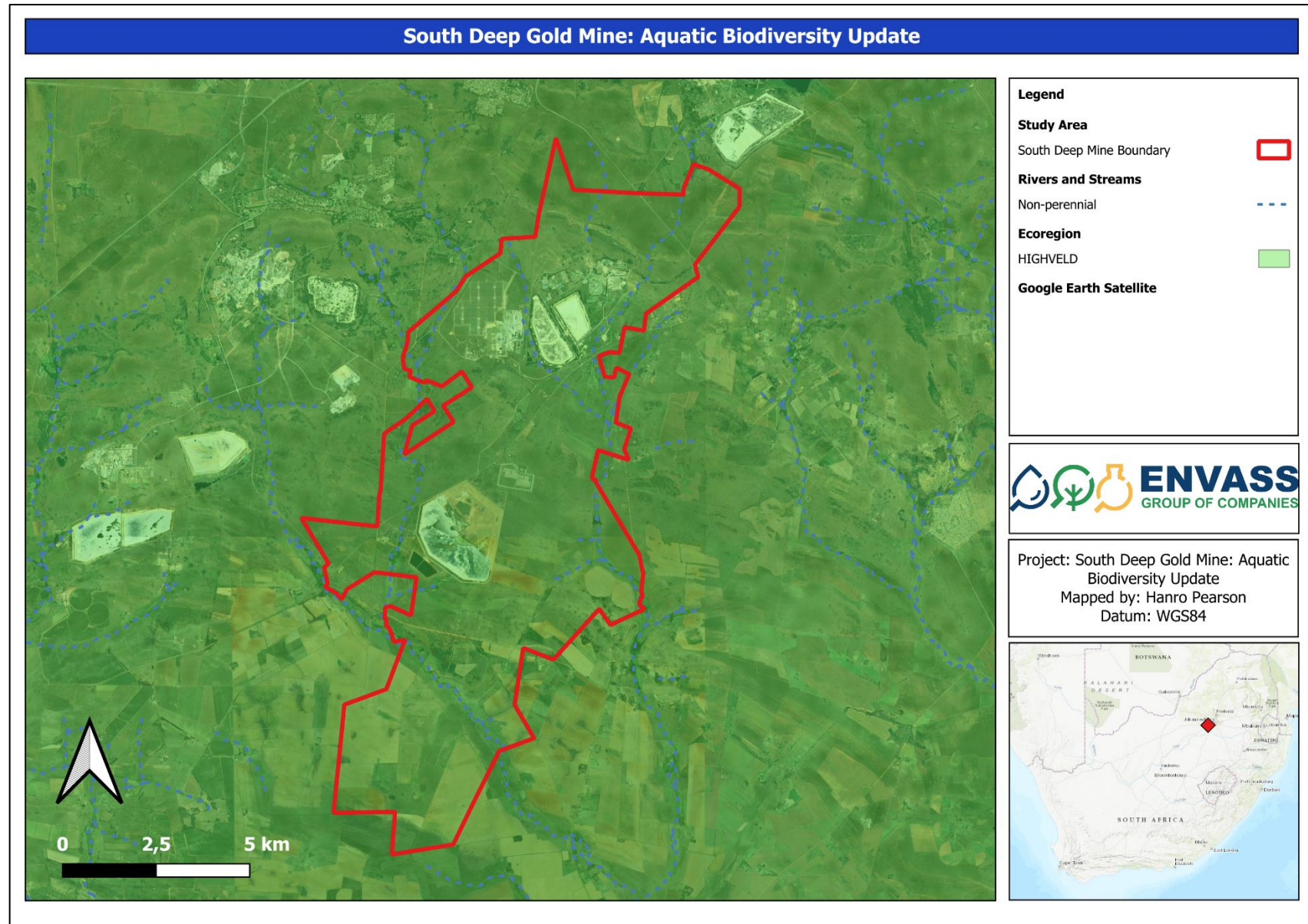


Figure 5-2: Ecoregion relevant to the study area.

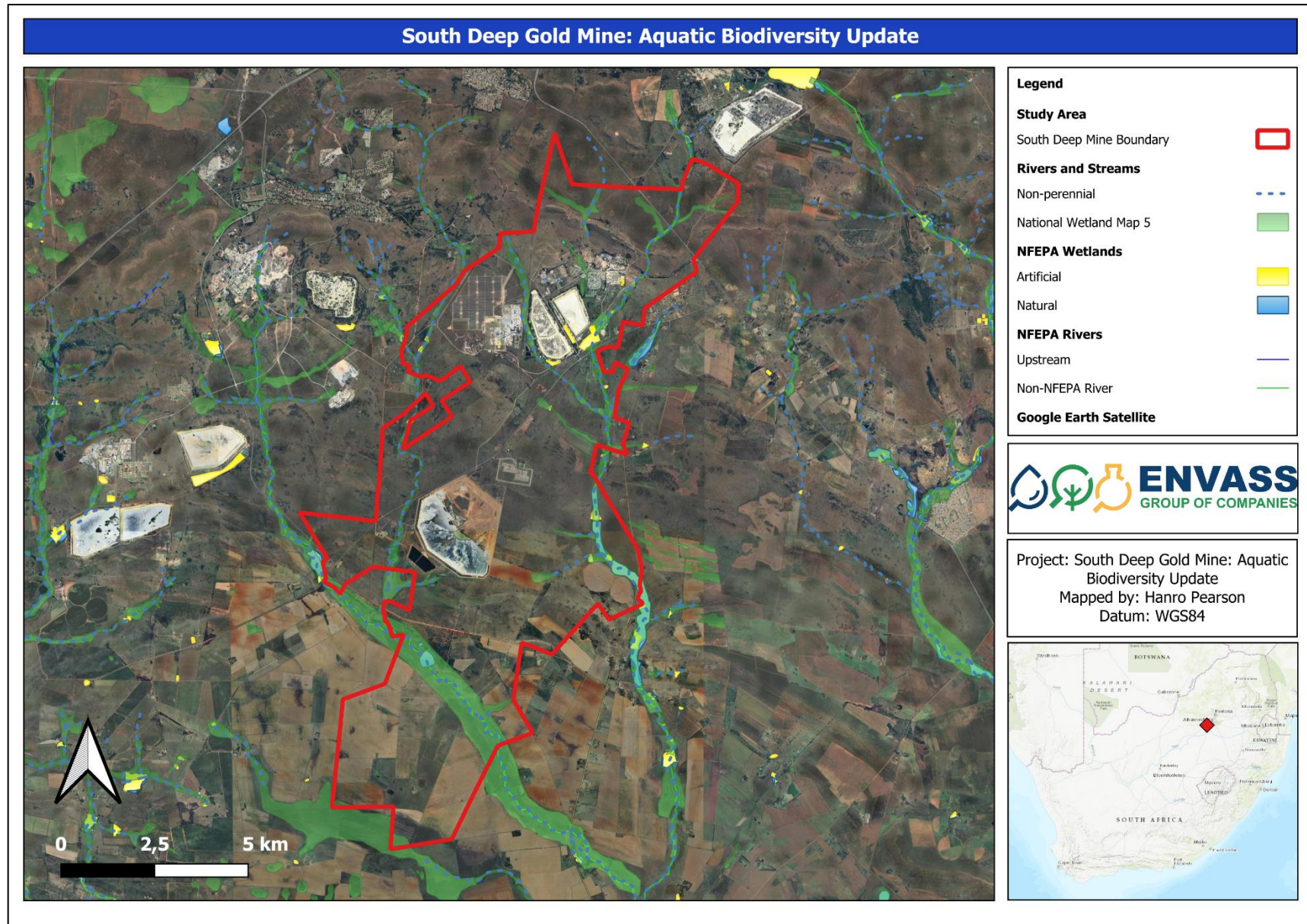


Figure 5-3: NFEPA wetlands and rivers and National Wetland Map 5 relevant to the study area.

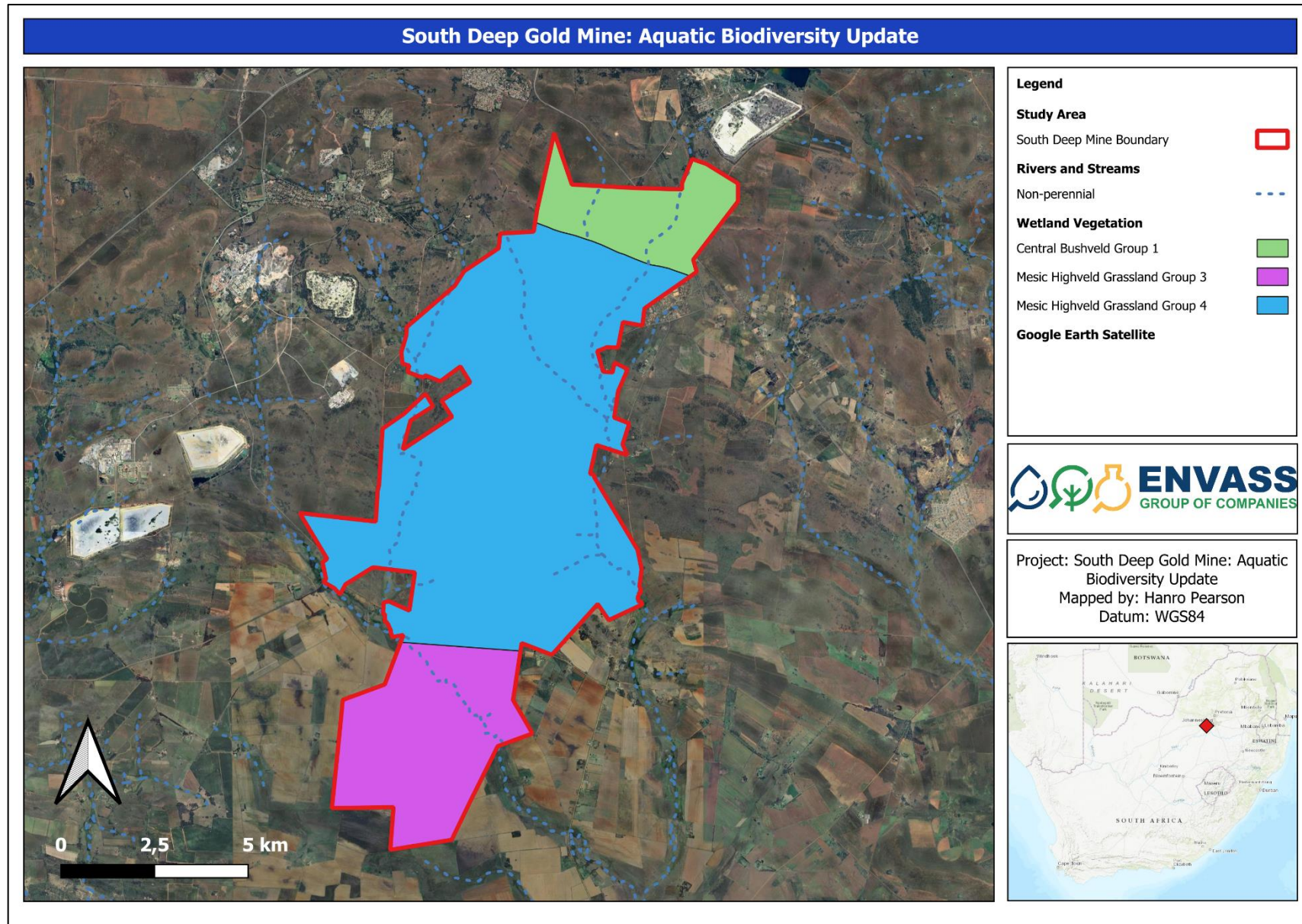


Figure 5-4. Wetland vegetation types situated within the study area.

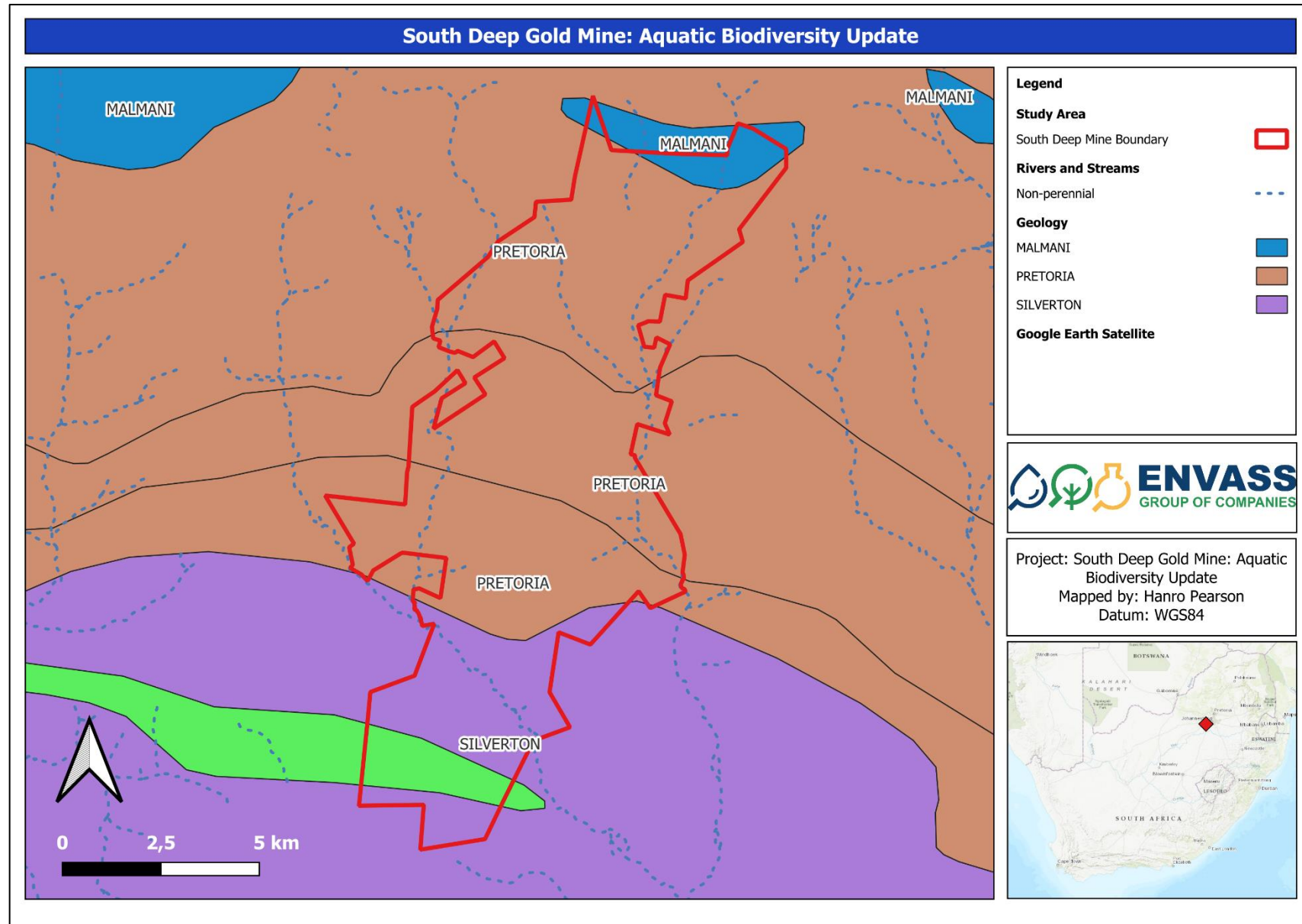


Figure 5-5: Lithostratigraphic unit situated within the study area.

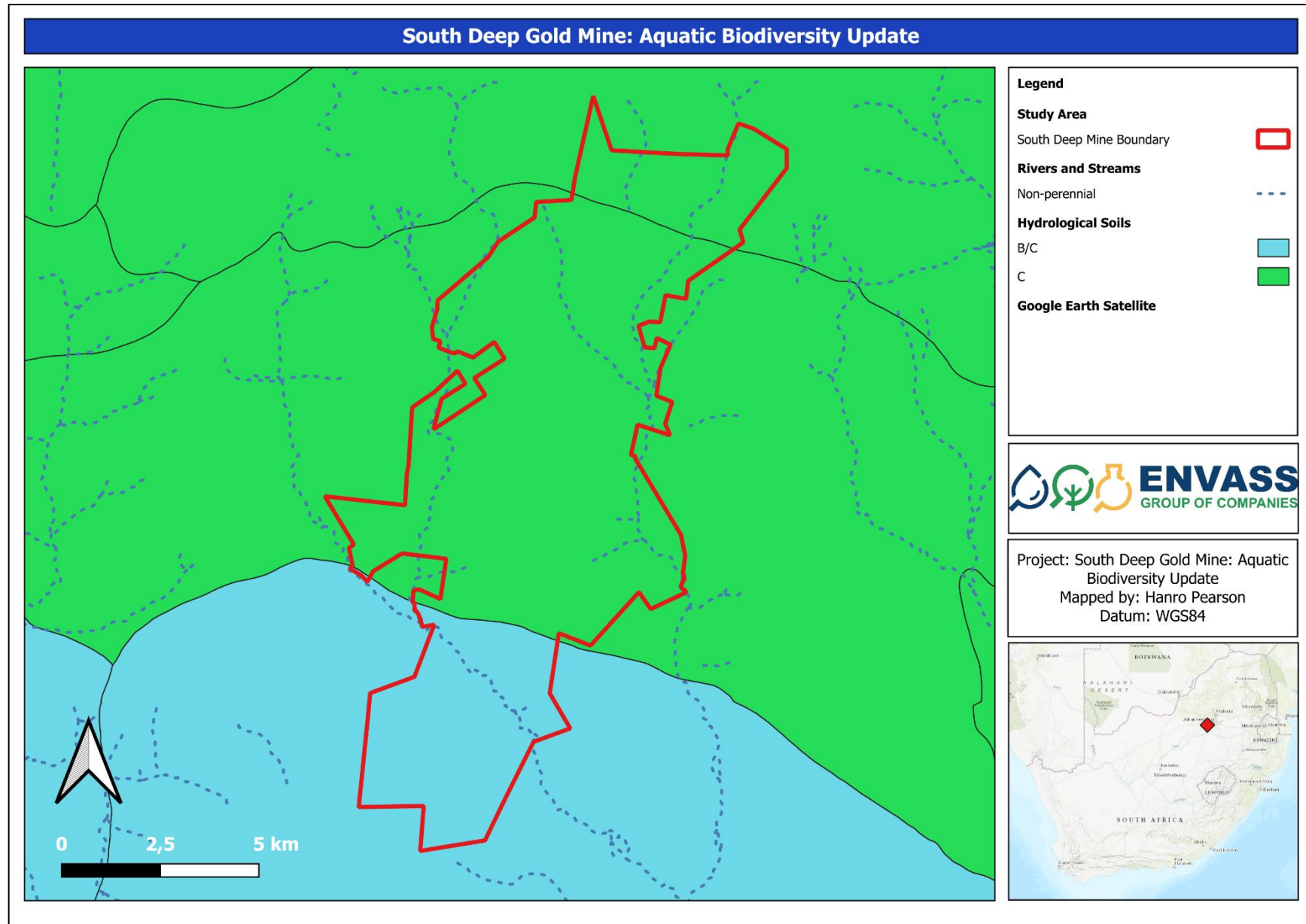


Figure 5-6: IRP of the soils within the study area.

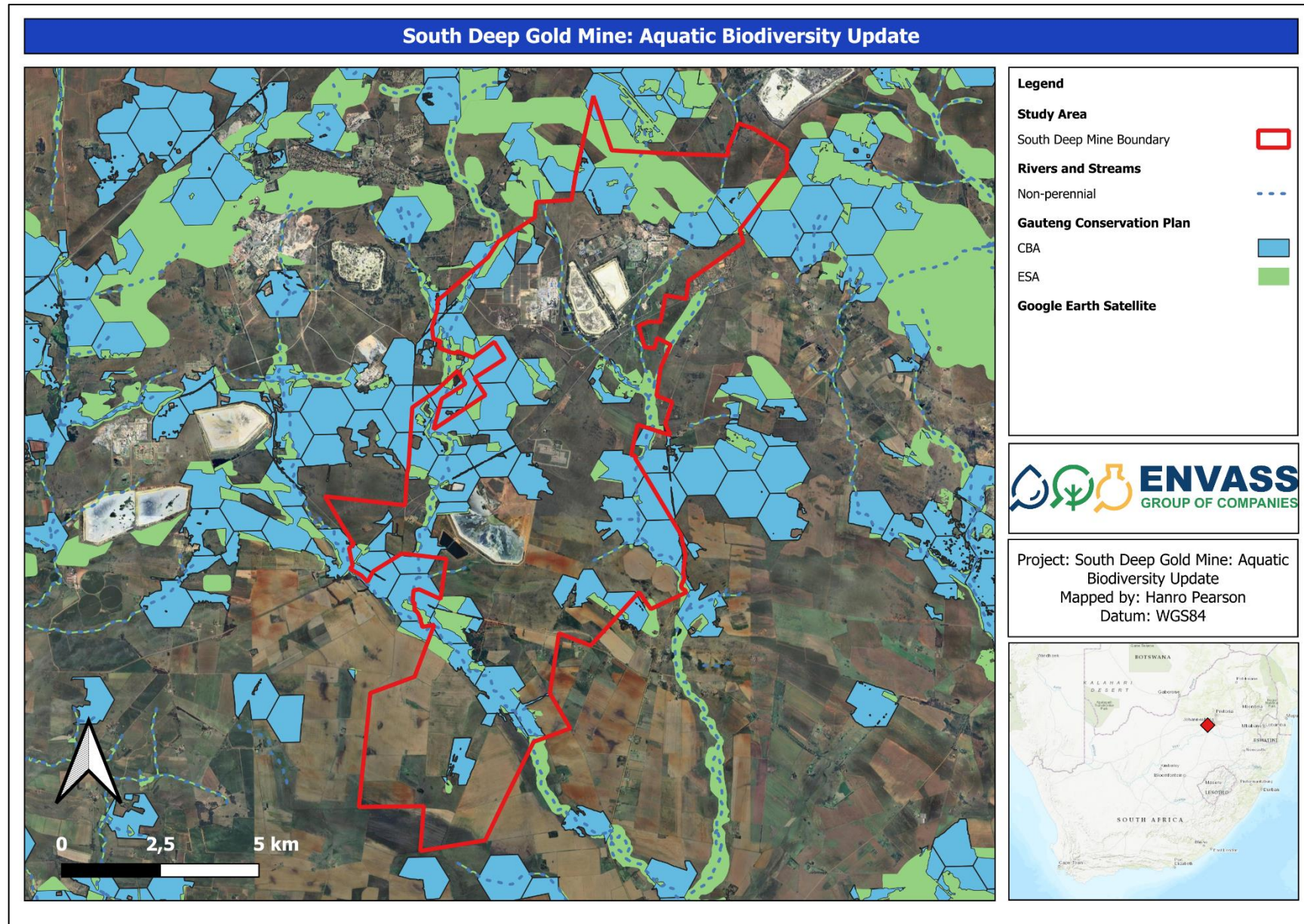


Figure 5-7: Gauteng Biodiversity Conservation Plan units relevant to the study area.

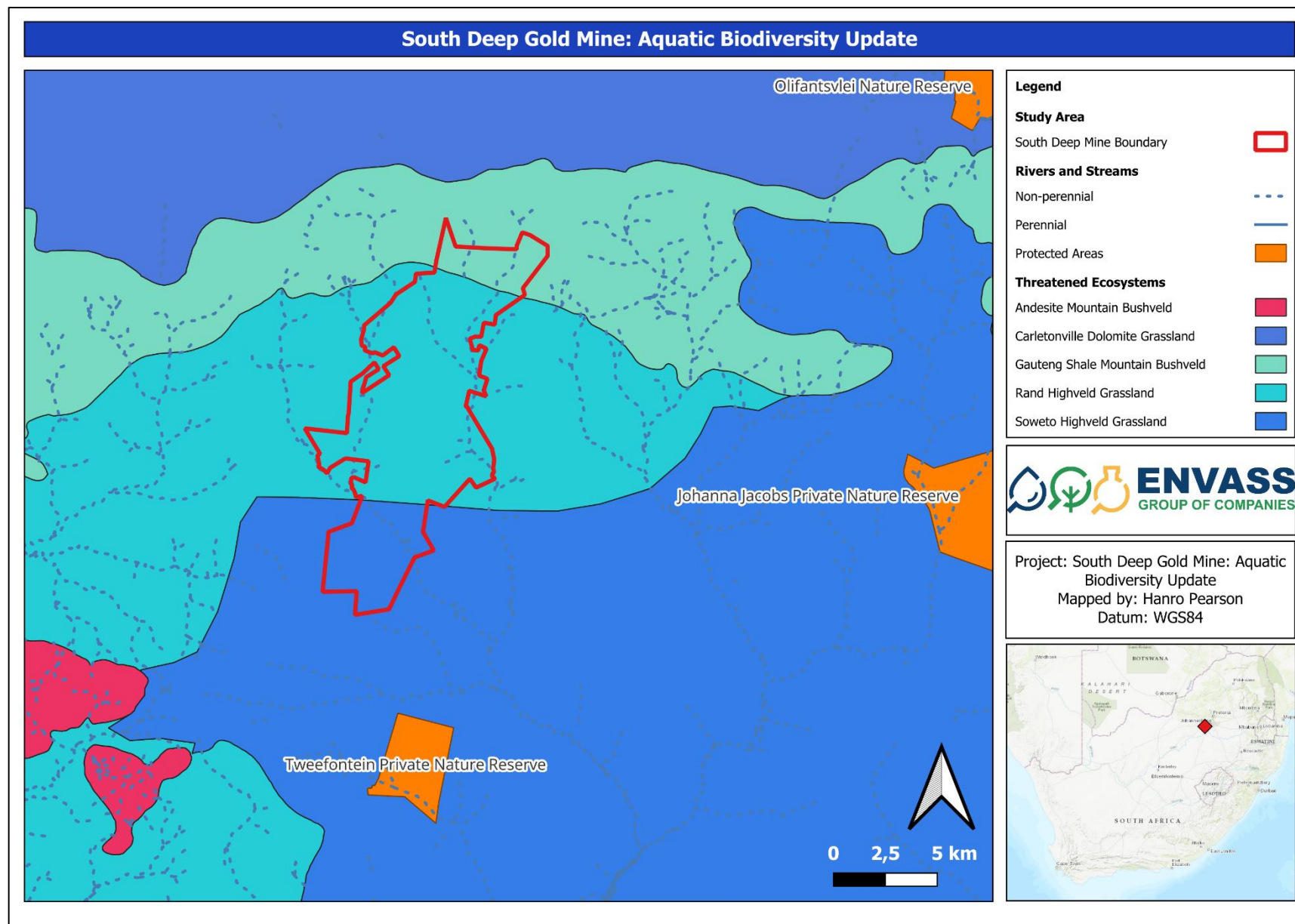


Figure 5-8: Threatened Ecosystems and Protected Areas within and surrounding the study area.

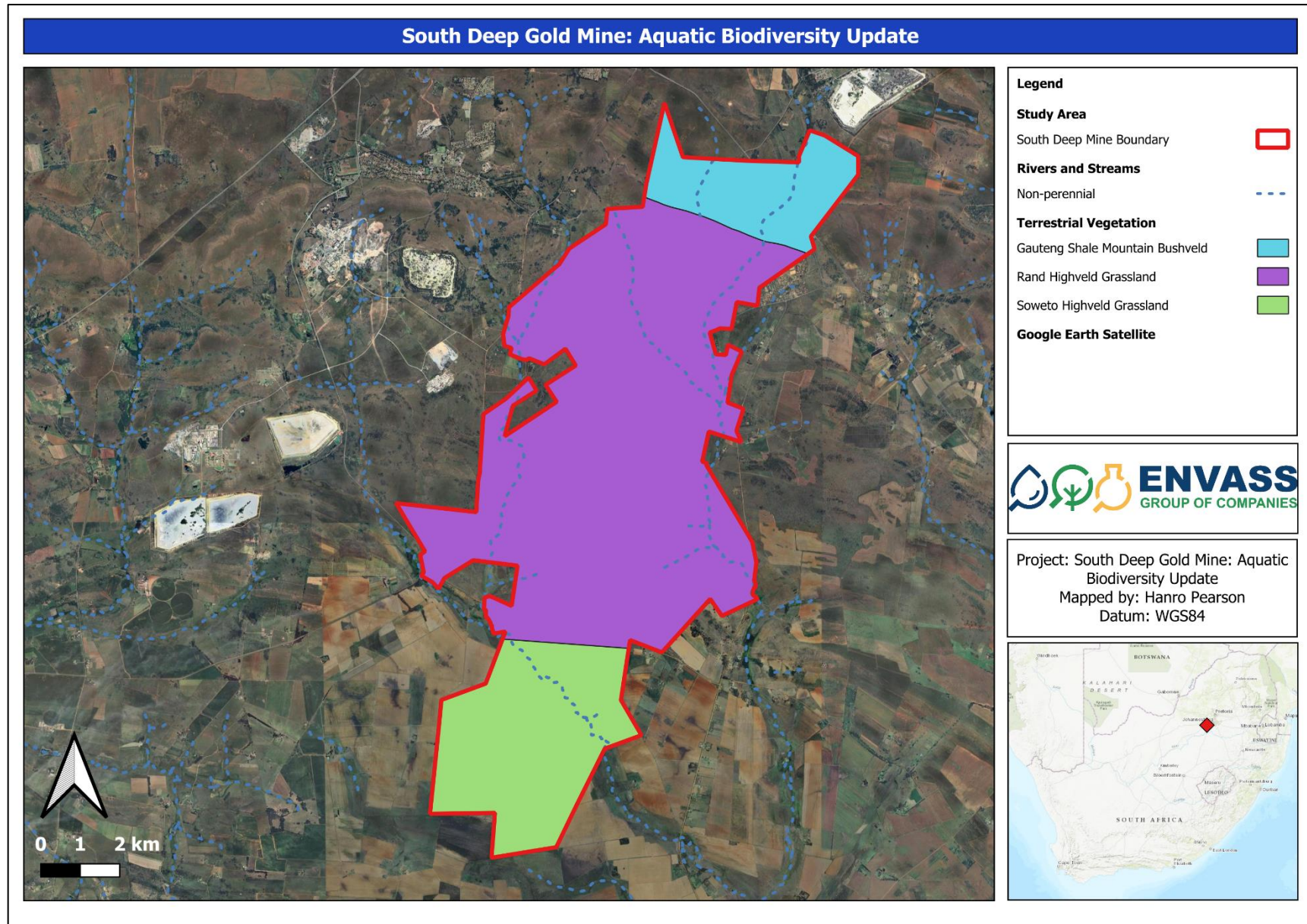


Figure 5-9: Terrestrial vegetation types situated within the study area.

6 RESULTS

6.1 Delineation and Classification of Watercourses

6.1.1 Watercourse Delineation Map

The watercourses within the study area were identified at a desktop level, classified and delineated in-field and subsequently mapped utilising GIS (QGIS and Google™ Earth Pro) and available spatial data. The delineation was developed with the presumed natural flow of water through the site in mind and based on wetness indicators (i.e. terrain unit, soil, vegetation and hydrology) recorded onsite.

The following legislated definitions have specific relevance to this section, as they were utilised in justifying the classification of each Hydrogeomorphic (HGM) unit as a watercourse:

“**watercourse**” means-

- (a) a river or spring;
- (b) a natural channel in which water flows regularly or intermittently: *(specifically relevant to drainage lines)*
- (c) a wetland, lake or dam into which, or from which, water flows; and
- (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes where relevant, its bed and banks:

“**riparian habitat**” includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas;

“**wetland**” means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Several watercourses were delineated and verified infield. These include two (2) Channelled Valley Bottom (CVB01 and CVB02) wetlands, three (3) Unchannelled Valley Bottom (UVB01 to UVB03) wetlands, and one (1) Artificial Watercourse (Arti01) associated with the study area. **Figure 6-1** presents the overall watercourse delineation map.

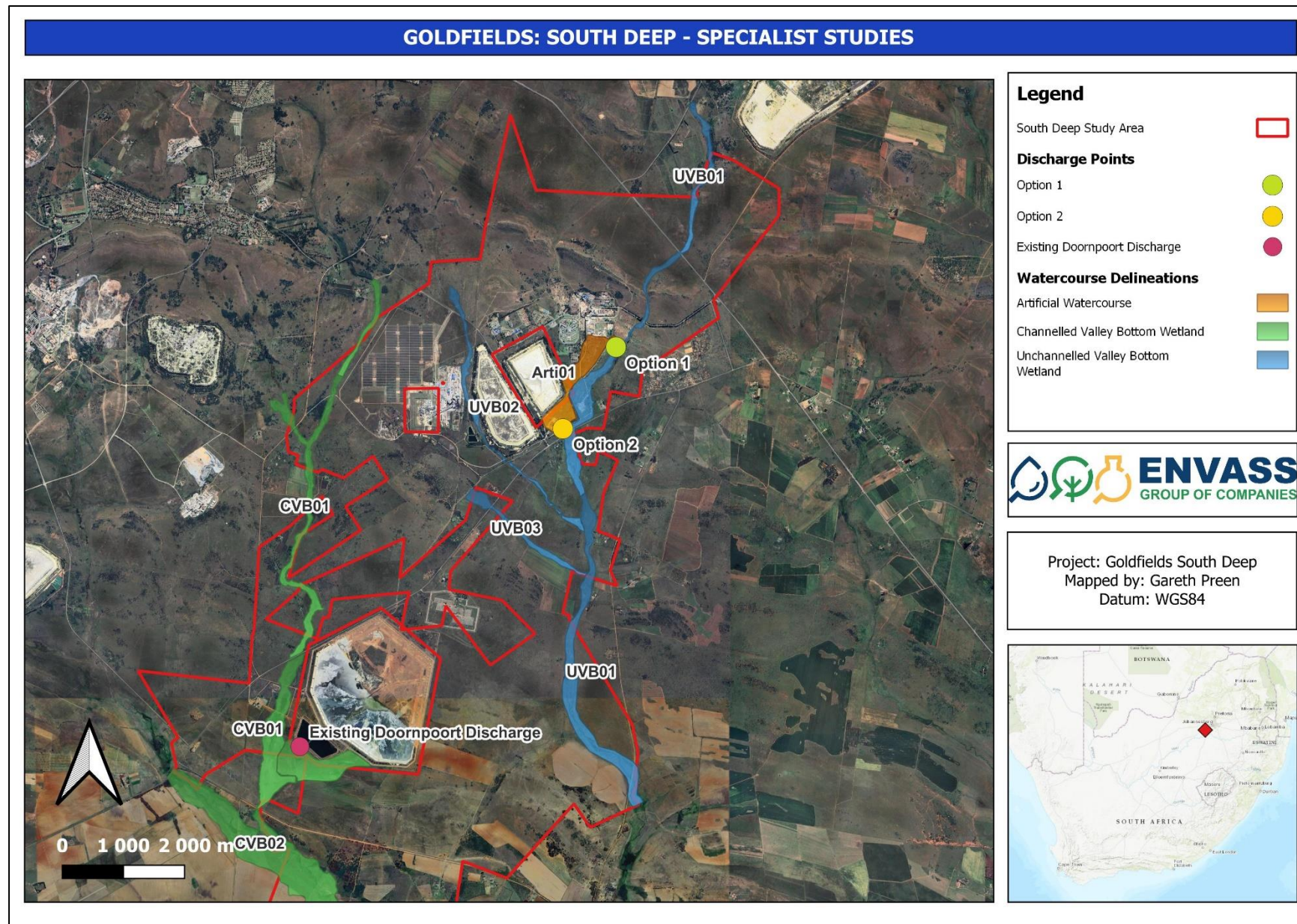


Figure 6-1: Map illustrating the overall watercourse delineation for the study area.

6.1.2 Risk Screening

Based on the in-field watercourse delineations, the activities associated with the activity (discharge points), as well as the location of the watercourses in relation to the activities, the risk categories were determined for each HGM unit. Several factors were considered when determining whether and to what degree a watercourse may be impacted by the activities associated with the development. These factors, among others, include 1) Type of watercourse, 2) Position of the watercourse within the landscape in comparison to the development and associated infrastructure, 3) Surface and sub-surface hydrological flow regime and 4) Other land-use practices within the minor catchment area. The risk screening criteria outlined in **Table 6-1** were utilised to determine those watercourses at risk of impact by the development.

Table 6-1: Presentation of the risk categories used to analyse the delineated watercourses within the study area.

RISK CATEGORY	CRITERIA
High	The watercourse is situated directly within or in close proximity (0 m to 15 m) to the activity footprint. Therefore, the aquatic habitat, biota present within, the water quality of and/or the hydrological regime through the watercourse are highly likely to be impacted by aspects of the development.
Medium	The watercourse is situated directly upstream, or within a medium distance (15 m to 25 m) downstream of the activity within the same minor catchment area. This may result in the aquatic habitat, biota present within, the water quality of and/or the hydrological regime through the watercourse being indirectly impacted by aspects pertaining to the activity (e.g. sedimentation, pollution and/or a change in the hydrological characteristics of the system).
Low	The watercourse/wetland is a distance (>25 m) upstream or downstream of the development, or within a landscape that prevents any direct/indirect impacts that have been determined to originate from the activity from reaching it, and thus is not likely to be impacted on by the development.

The risk screening determined that one (1) Channelled Valley Bottom wetland (CVB01) and one (1) Artificial Watercourse (Arti01) were determined to be at **High** risk of impact by the discharge points. The results of the risk screening assessment are provided in **Table 6-2** and illustrated in **Figure 6-2**. Despite only CVB01 and UVB01 being at risk of impact by the Doorpoort discharge points and Option 1, respectively, all other watercourses were assessed further in terms of functionality to ensure compliance with the requirements of this updated aquatic biodiversity assessment.

Table 6-2: The risk categories of each HGM unit and the activity aspects concerned.

HGM UNIT CODE	RISK RATING	RATIONALE
Unchannelled Valley Bottom wetland: UVB01	HIGH	The activity results in water discharges directly into these watercourses and is therefore likely to impart direct impacts.
Channelled Valley Bottom wetland: CVB01		
All remaining watercourses within the study area	LOW	The activity is located far from or downstream from these watercourses and will therefore not impact these systems.

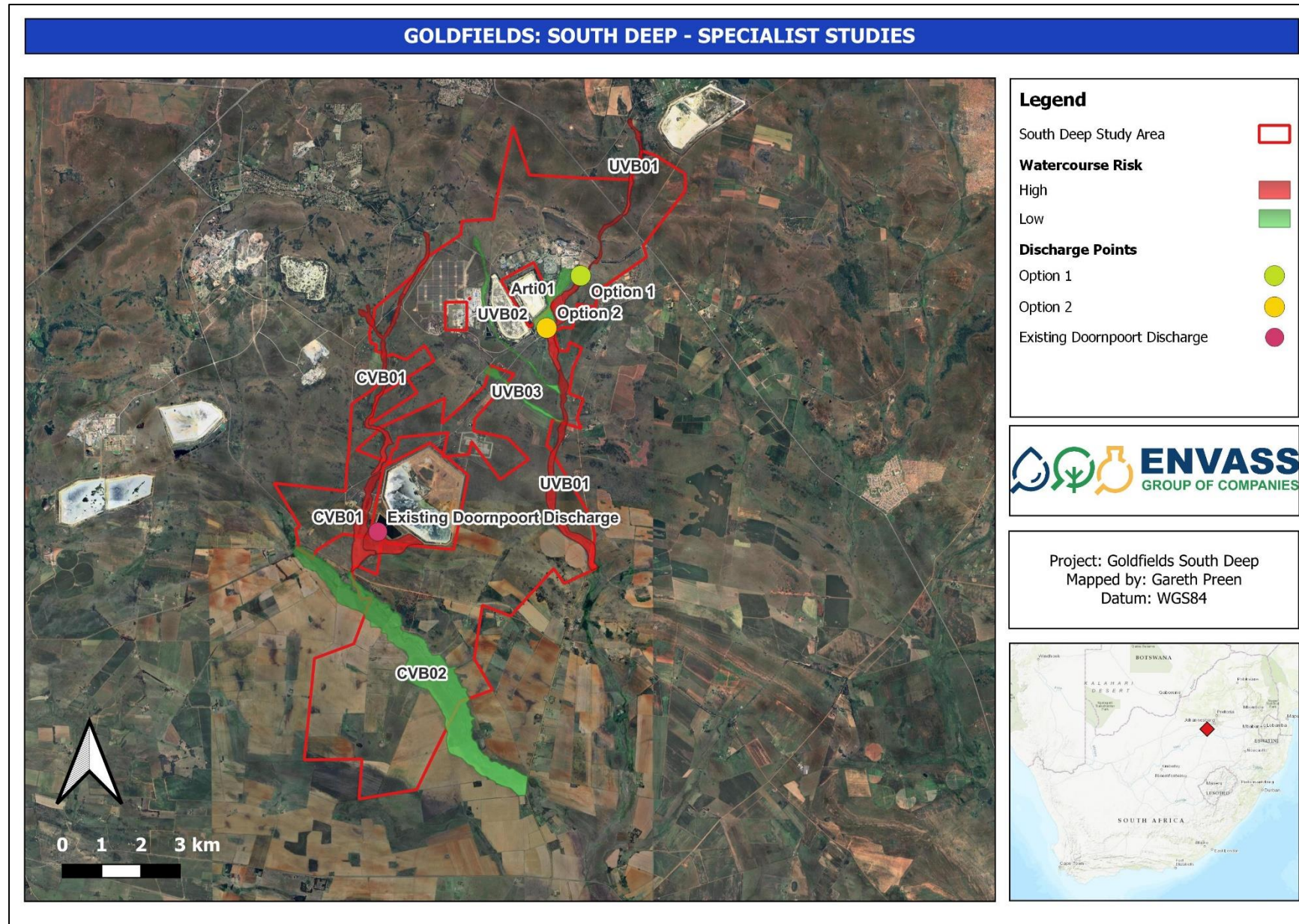


Figure 6-2: At-risk watercourses and those not at-risk situated within the study area.

6.2 Functionality, Integrity and Ecological Importance and Sensitivity

The following section provides a summary of the PES score, ESS demand and supply, EIS and Recommended Ecological Category (REC) for each delineated watercourse within the study area. **Table 6-3** presents the results of the functional assessments relevant to the watercourses.

Figure 6-3 presents some of the most prominent impacts observed to have resulted in the deterioration of the ecological condition of the watercourses. Alterations have occurred due to road, powerline, and pipeline crossings, along with illegal mining activities and ongoing construction within the watercourses. Wetlands have been adversely affected by the deposition of infill materials, waste rock dumping, trenching, and channelling, leading to diverted water systems and diminished flow, which have altered the natural vegetation. Soil disturbances have facilitated the spread of alien and invasive plant species (AIPs). Notable species include *Eucalyptus* spp., *Acacia* sp. (wattle), scattered *Agave sisalana* (sisal), and *Cortaderia selloana* (Pampas grass) infestations. Some of these plants, initially introduced for rehabilitation of the site, are now encroaching upon the wetland systems. The UVB01 watercourse has been rerouted around the old TSF; however, ongoing soil excavation and dumping continue to impact the diverted areas. Additionally, litter and waste disposal from upstream informal communities have degraded downstream regions. Leaks from sewage treatment plants (STPs) and seepage from mining activities have further compromised downstream water quality.

Table 6-3. Results of the functional assessments for the watercourses within the study area.

INDEX OF HABITAT INTEGRITY (IHI) ASSESSMENT					
PRESENT ECOLOGICAL STATE					
HGM UNIT	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION	OVERALL PES SCORE
ARTI01	NO PES COULD BE DETERMINED DUE TO NO PRESUMED NATURAL STATE.				
UVB01	5,5 (Class D)	5,7 (Class D)	7,2 (Class E)	7,0 (Class E)	6,2 (Class E)
UVB02	5,5 (Class D)	5,5 (Class D)	7,2 (Class E)	5,0 (Class D)	5,8 (Class D)
UVB03	3,7 (Class C)	4,0 (Class C)	2,4 (Class C)	6,0 (Class E)	4,0 (Class C)
CVB01	4,3 (Class D)	3,6 (Class C)	7,8 (Class E)	6,0 (Class E)	5,3 (Class D)
CVB02	2,8 (Class C)	3,2 (Class C)	4,3 (Class D)	6,5 (Class E)	4,0 (Class D)
ECOSYSTEM SERVICE PROVISION					

		Arti01		CVB01		CVB02		UVB01		UVB02		UVB03	
ECOSYSTEM SERVICE		Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low
	Stream flow regulation	0,0	Very Low	0,9	Low	2,2	Moderate	0,7	Very Low	0,4	Very Low	1,0	Low
	Sediment trapping	0,1	Very Low	2,5	Moderately High	3,5	Very High	1,5	Moderately Low	2,3	Moderate	2,3	Moderate
	Erosion control	0,0	Very Low	1,2	Low	0,6	Very Low	0,1	Very Low	0,0	Very Low	0,0	Very Low
	Phosphate assimilation	0,4	Very Low	2,9	High	3,2	High	2,3	Moderate	2,8	High	1,8	Moderate
	Nitrate assimilation	0,3	Very Low	2,8	High	2,8	High	2,0	Moderate	2,5	Moderately High	1,1	Low
	Toxicant assimilation	0,4	Very Low	2,9	High	3,1	High	2,2	Moderate	2,7	Moderately High	1,1	Low
	Carbon storage	1,9	Moderate	1,8	Moderate	1,7	Moderate	0,4	Very Low	2,0	Moderate	1,4	Moderately Low
	Biodiversity maintenance	0,0	Very Low	3,0	High	2,5	Moderately High	2,5	Moderately High	0,8	Very Low	0,3	Very Low
PROVISIONING SERVICES	Water for human use	0,0	Very Low	1,1	Low	1,1	Low	0,7	Very Low	0,0	Very Low	0,0	Very Low
	Harvestable resources	0,5	Very Low	0,0	Very Low	0,0	Very Low	0,2	Very Low	0,7	Very Low	0,0	Very Low
	Food for livestock	0,0	Very Low	1,4	Moderately Low	0,9	Low	1,2	Low	0,0	Very Low	0,0	Very Low
	Cultivated foods	1,5	Moderately Low	0,8	Very Low	1,8	Moderate	0,8	Very Low	1,3	Low	1,0	Low
CULTURAL SERVICES	Tourism and Recreation	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low
	Education and Research	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,0	Very Low

	Cultural and Spiritual	0,0	Very Low	0,0	Very Low	0,0	Very Low	0,5	Very Low	0,0	Very Low	0,0	Very Low
ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)													
DETERMINANT		ARTI01	CVB01	CVB02	UVB01	UVB02	UVB03						
Ecological Importance and Sensitivity		0,80	2,40	2,40	2,20	2,20	2,17						
Hydrological/Functional Importance		0,39	1,88	2,14	1,15	1,59	1,09						
Importance of Direct Human Benefits		0,33	0,32	0,32	0,28	0,33	0,17						
Overall Importance		0,80 (Low)	2,40 (Moderately High)	2,40 (Moderately High)	2,20 (Moderate)	2,20 (Moderate)	2,17 (Moderate)						
RECOMMENDED MANAGEMENT OBJECTIVE (RMO) AND RECOMMENDED ECOLOGICAL CATEGORY (REC)													
• Arti01 stream: The RMO and REC for this watercourse could not be determined due to the artificial nature of this watercourse. There is no presumed natural state for an artificial watercourse, therefore, no PES can be determined. • CVB01: According to the DWAF (2007) matrix, the RMO for CVB01 should be to Maintain the current integrity which falls within PES Class D (Largely modified). The REC for the CVB01 is Class D (Largely modified). Therefore, it is important that any impacts to this watercourse do not result in the deterioration of the PES. • CVB02: According to the DWAF (2007) matrix, the RMO for CVB02 should be to Maintain the current integrity which falls within PES Class D (Largely modified). The REC for the CVB02 is Class D (Largely modified). Therefore, it is important that any impacts to this watercourse do not result in the deterioration of the PES. • UVB01: According to the DWAF (2007) matrix, the RMO for UVB01 should be to Maintain the current integrity which falls within PES Class E (Seriously modified). The REC for the UVB01 is Class E (Seriously modified). Therefore, it is important that any impacts to this watercourse do not result in the deterioration of the PES. • UVB02: According to the DWAF (2007) matrix, the RMO for UVB02 should be to Maintain the current integrity which falls within PES Class D (Largely modified). The REC for the UVB02 is Class D (Largely modified). Therefore, it is important that any impacts to this watercourse do not result in the deterioration of the PES. • UVB03: According to the DWAF (2007) matrix, the RMO for UVB03 should be to Maintain the current integrity which falls within PES Class C (Moderately modified). The REC for the UVB03 is Class C (Moderately modified). Therefore, it is important that any impacts to this watercourse do not result in the deterioration of the PES.													



Figure 6-3: Some of the impacts observed during the 2025 survey, A) geomorphological modifications due to road crossings, B) invasive *Eucalyptus* sp. proliferation and trenching, C) additional water inputs, D) *Acacia* sp. encroachment, E) channel, bed and flow modification, F) channel, bed and flow modification due to rock dumping for crossings.

6.3 Buffer Zone Determination

Buffer zones are defined as a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another (DWA, 2005). Due to the increasing stress from anthropogenic pressures impacting the ecological condition of freshwater resources throughout South Africa, it is vital that measures to prevent further degradation be implemented. Thus, buffer zones can play a meaningful role in reducing impacts on aquatic resources and, in doing so, protect the ecosystem services they provide to the communities and ecosystems which surround them. The following points summarise the essential importance of the implementation of relevant buffer zones, these include:

- Maintaining basic ecosystem services and aquatic processes.
- Reducing impacts on water resources from adjacent land-use practices and upstream activities.
- Providing habitats for fauna and flora, including rare and endangered species.
- Meeting life need requirements for aquatic and semi-aquatic species.
- Providing several ancillary societal benefits.

With consideration of the above, a standard buffer zone was determined for each HGM unit type using the Buffer Zone Guideline Tool (Macfarlane & Bredin, 2016), which was drafted for the Water Research Commission (WRC) and the national DWS, as a guide. **Table 6-4** indicates the calculated buffer zones that must be applied to the watercourses. **Figure 6-4** illustrates the recommended aquatic buffer zones around the watercourses.

Table 6-4: Calculated no-go buffer zones relevant to the at-risk watercourses within the study area.

WATERCOURSE	CALCULATED NO-GO BUFFER ZONES
	OPERATIONAL PHASE
Arti01, CVB01 and UVB01	25 m
Remaining Wetlands	25 m

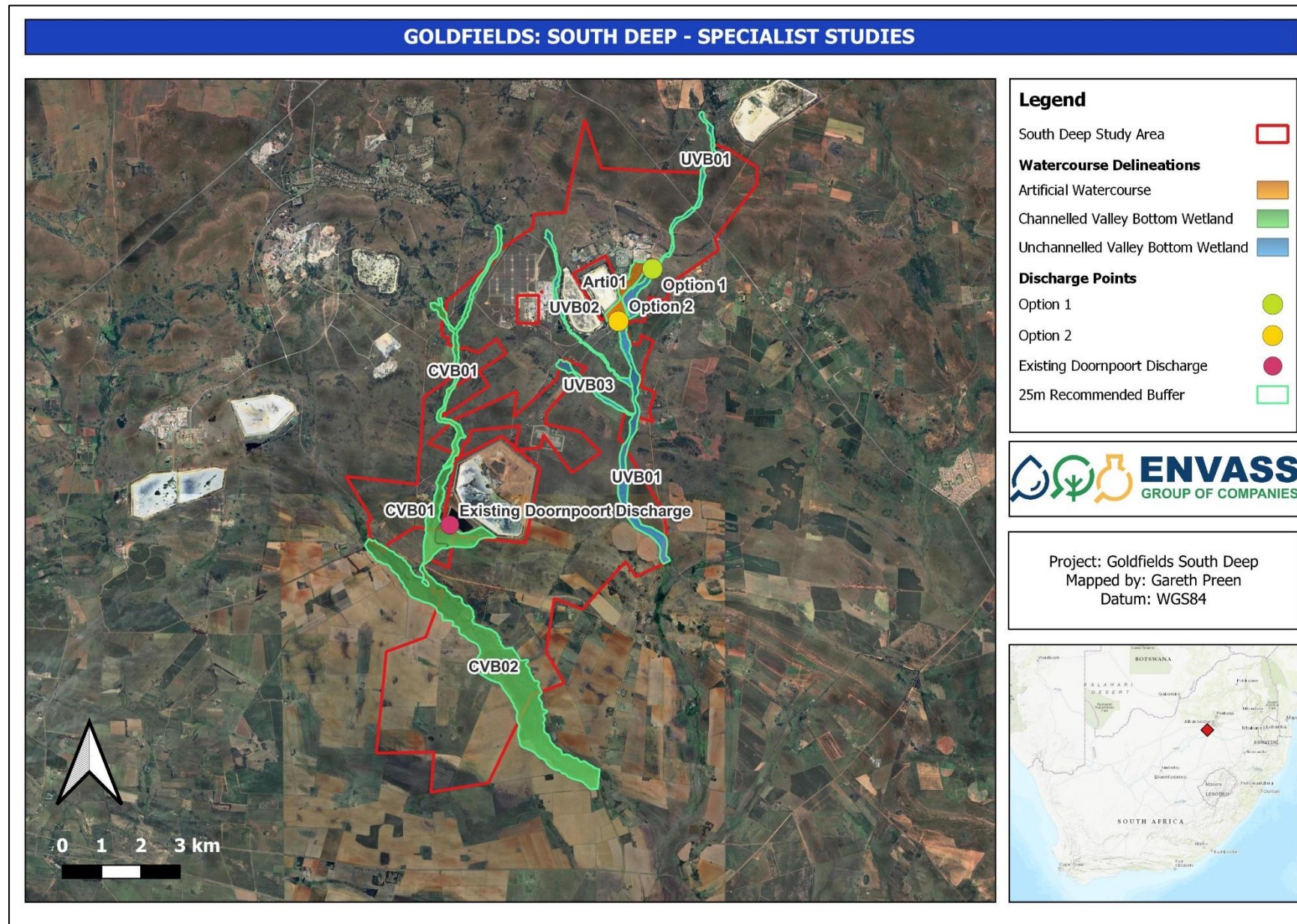


Figure 6-4. Map illustrating the recommended Aquatic Buffers around the associated watercourses.

7 RISK ASSESSMENT MATRIX

As a result of the proposed activities falling within the Regulatory Area of several watercourses, further investigation in terms of Section 21(c) and (i) water uses were required. To accurately assess the perceived risks to the delineated watercourses within the study area in terms of Section 21(c) and (i) water uses, a DWS RAM was conducted in accordance with GN4167 (DWS, 2023). The outcome of the RAM will be an impact statement (**Section 7.2**) providing clarity on whether the proposed development must be authorised for Section 21(c) and (i) water uses through a GA or WULA process, in line with the NWA. A GA is triggered if all aspects associated with the activities relating to the proposed activities are determined to be of Low impact significance in a post-mitigation state. However, if several aspects are determined to be of Medium or High significance, the proposed activities will trigger the need for a WULA process. The DWS RAM assesses all aspects of the perceived activities in a post-mitigation state, therefore the overall significance scores presented below are in the post-mitigation state.

"Regulated area of a watercourse" for section 21(c) or (i) of the Act water uses in terms of this Notice means (DWS, 2023):

- a) The outer edge of the 1 in 100-year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
- c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

7.1 Perceived Activities

The following section presents a summary of the activities that are perceived to take place within each phase associated with the proposed development. These activities guided the aspects that were considered within the RAM of the development.

7.1.1 Construction Phase

The following are the activities that are perceived to be conducted during the construction phase associated with the proposed activities:

- Removal of topsoil and clearing of vegetation.
- Bulk earthworks, platforming and construction of the discharge structure.
- Management of fuels, chemicals, and potential spills from vehicles, equipment and containers.
- Bulk earthworks, clearing and disturbance of vegetation and human activities in the vicinity of wetland habitats

7.1.2 Rehabilitation Phase

The following are the activities that are perceived to be conducted during the rehabilitation phase of the proposed activities:

- Landscaping of all disturbed areas, including temporary access routes, to natural ground level and application of topsoil prior to tillage and revegetation with a mixture of indigenous grass species.
- Topsoil dressing of the embankments, slight tillage, and revegetation with a mixture of indigenous grass species.
- Decommissioning and rehabilitation of the site camp, laydown areas and temporary stockpile areas to a pre-construction state.

7.1.3 Operational Phase

The following are the activities that are perceived to be conducted during the operational phase of the proposed development:

- Discharge of “clean/treated” wastewater into the receiving aquatic areas.
- Maintenance of discharge points, pipelines and pump stations.
- Expanded/more intense edge impacts due to buffer zone encroachment.

Table 7-1 presents the RAM applicable to the activity. All significance scores were determined considering the general and essential mitigation measures that will need to be implemented to realise the post-mitigation scores.

Table 7-1: DWS Risk Assessment Matrix (DWS, 2023) for the activity.

Activity	Impact		Intensity of Impact on Resource Quality						Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)		Severity (max = 20)	Importance rating (max = 5)		Consequence (max = 100)		Likelihood (Probability) of impact		Significance (max = 100)	Risk Rating
			Abiotic Habitat (Drivers)			Biota (Responses)															
			Hydrology	Water Quality	Geomorph	Vegetation	Fauna														
CONSTRUCTION PHASE																					
Removal of topsoil and clearing of vegetation.	Exposure of bare soils to the elements following vegetation clearing, bulk excavations and trenching resulting in erosion and sedimentation.		1	1	2	2	1		4	1	1		6	2		12		40%		4,8	L
Bulk earthworks, platforming and construction of discharge structures and RO Plants.	Loss of and disturbance to aquatic habitat.		1	1	2	2	1		4	1	1		6	3		18		40%		7,2	L
	Alteration of the catchment landscape and hydrological flows into and through downslope watercourses.		1	1	1	1	1		2	1	1		4	4		16		20%		3,2	L
Management of fuels, chemicals and potential spills from vehicles, equipment and containers.	Water quality impacts associated with the management of fuels, chemicals, concrete, and potential spills from vehicles, equipment and containers.		0	1	0	1	0		2	1	1		4	3		12		20%		2,4	L
Bulk earthworks, clearing and disturbance of vegetation and human activities in the vicinity of wetland habitats	Construction activities taking place within a close proximity to a watercourse resulting in the disturbance of aquatic habitat.		1	0	1	1	1		2	1	2		5	3		15		20%		3	L
OPERATIONAL PHASE																					

Controlled release of "treated" wastewater into the receiving watercourse s	Alteration of hydrological flows into and through the watercourse.		3	2	1	2	2		6	2	4		12	3		36		80%		28,8	L
	Water quality impacts from controlled release of "treated" wastewater into downstream watercourse.		1	3	1	2	2		6	2	4		12	3		36		80%		28,8	L
	Erosion and sedimentation downstream of the discharge point.		1	1	2	1	1		4	1	1		6	3		18		20%		3,6	L
Maintenance of all onsite infrastructure	Water quality impacts associated with the management of fuels, chemicals, concrete, and potential spills from vehicles, equipment and containers.		0	1	0	0	0		2	1	1		4	3		12		20%		2,4	L
	Maintenance activities taking place within a close proximity to a watercourse resulting in the disturbance of aquatic habitat.		1	1	1	1	1		2	1	1		4	3		12		20%		2,4	L
REHABILITATION PHASE																					
Reshaping and reprofiling of all disturbed areas to resemble pre-development terrain units. Application of topsoil prior to tillage and revegetation with a mixture of indigenous grass species.	Increased surface roughness and reduction of surface water runoff velocity. Decrease erosion potential. Increase biodiversity.		-1	-1	-1	-2	-1		-4	1	4		-9	3		-27		60%		-16,2	+

7.2 Risk Assessment Matrix Statement

Following the undertaking of the RAM (DWS, 2023) for the activities associated with Option 1 into the receiving watercourses were determined to present a **low** risk of impact in a post-mitigation scenario. The most significant impacts to the receiving watercourses were determined to be alteration of hydrological flows and water quality impacts.

Although the results of the RAM indicate that the activity presents a **low** risk of impact in terms of Section 21 (c) and (i) water uses, it requires authorisation in terms of Section 21 (f) of the NWA. In terms of Section 3 of GN4176, the following must be considered:

3. This Notice does not apply-

(c) in instances where an application must be made for a WUL for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity.

Considering the above, it is the specialist's opinion, substantiated by the project-specific RAM and GN4167, that the activity applies for Section 21(c) and (i) water use authorisation via a WULA process. However, this is subject to discussion with the DWS case officer, who will provide finality on the authorisation path to be followed by the client.

It is important to note that the RAM was undertaken with the assumption that all mitigation and rehabilitation measures as outlined in the RAM and Section 9 of this report will be adhered to. Should there be any changes to the project layout, a revised RAM will need to be undertaken.

8 IMPACT ASSESSMENT

The perceived impacts associated with the proposed activities were assessed using a quantitative impact assessment methodology, which was formalised to comply with Regulation 31(2)(l) of the NEMA (Act No. 107 of 1998). This assessment aimed to identify and assess the significance of all the perceived impacts, which may arise as a result of the proposed development. The methodology employed makes use of the following procedure:

1. Identification and assessment of potential impacts;
2. Prediction of the nature, duration, extent, likelihood and significance;
3. Identification of mitigation measures that could be implemented to reduce the significance of the potential impact;
- and
4. Evaluation of the significance of the potential impacts following the implementation of mitigation measures.

The NEMA (Act No 107 of 1998), specifies the following under Chapter 1, Section 2(4) regarding sustainable development and the management of sensitive ecosystems:

(a), "Sustainable development requires the consideration of all relevant factors including the following:

- (i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- (vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;
- (vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- (viii) That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied."

(r) Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Therefore, to encourage the above to become a reality the precautionary principle was applied within this study to ensure that cost-effective measures are implemented to proactively prevent degradation of the region's watercourses and the social systems that depend on these ecosystems and habitats. To further guide the preservation of the environmental sensitivities within the proposed activities site, the mitigation hierarchy was applied (**Figure 8-1**). The hierarchy is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA, 2013). The tier relevant to the proposed development was determined to be "rehabilitation".

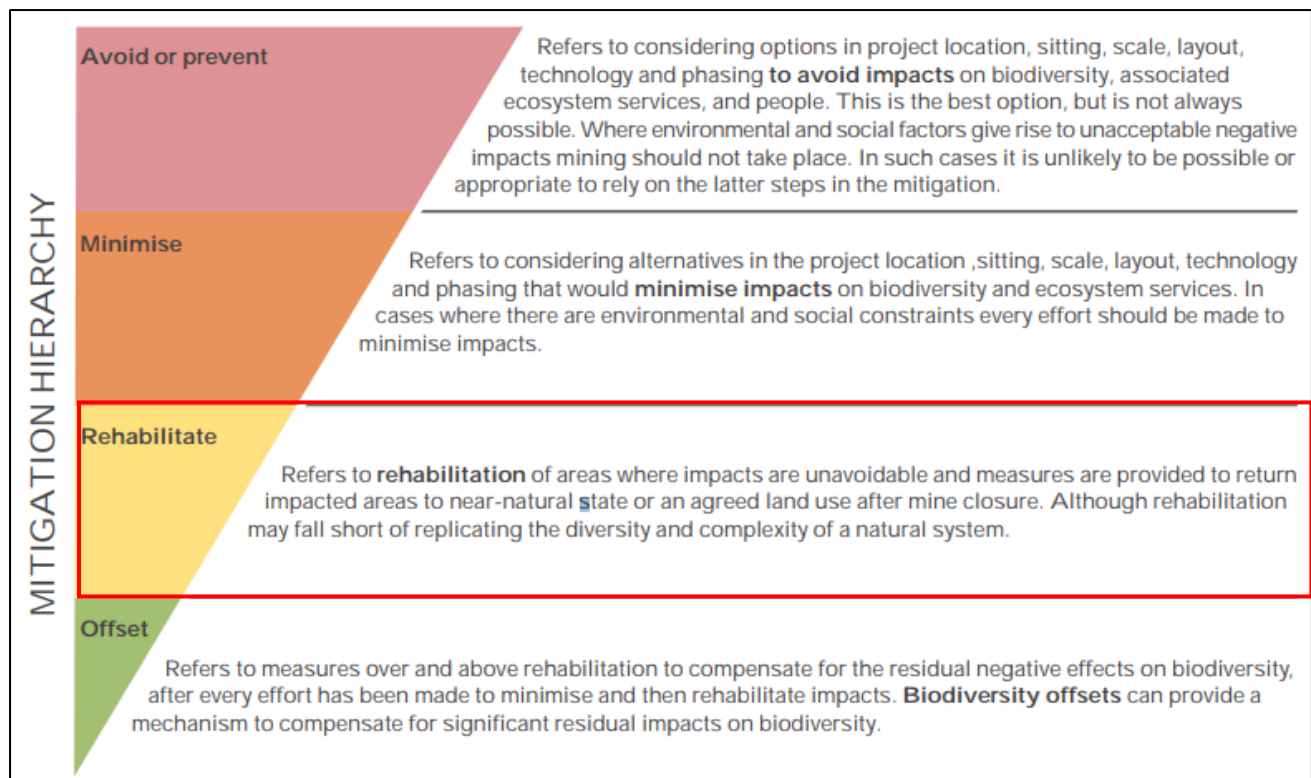


Figure 8-1: The mitigation hierarchy for dealing with negative impacts on biodiversity (DEA, 2013).

8.1 Quantitative Impact Assessment (DEA, 2014)

The following section presents the quantitative impact assessment of each phase of the activity, as well as the mitigation and rehabilitation measures that must be implemented to realise the post-mitigation significance scores.

8.1.1 Construction Phase

This section presents the quantitative impact assessment of the activities and perceived impacts assumed to occur within the construction phase of the proposed activities.

8.1.1.1 Direct Loss of Aquatic Habitat and Ecological Connectivity

Table 8-1 below presents the pre- and post-mitigation significance scores calculated for the direct disturbance of aquatic habitat and ecological structure. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-1: Assessment of the significance of the direct disturbance of aquatic habitat and ecological structure as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Direct disturbance of aquatic habitat and ecological structure within the catchment area of the at-risk watercourses associated with the proposed activities.	
NATURE	The activities are located within the regulated area of two (2) watercourses, namely UVB01 and CVB01. No construction activities are expected to take place within CVB01. Construction activities within UVB01 will likely disturb the current habitat structure and functionality and may result in the proliferation of Alien Invasive Plant Species (AIPS) encroaching into the disturbed area if not managed appropriately, which presents a risk of reduced biodiversity and ecosystem functionality.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	1 Limited to site	1 Limited to site
DURATION	4 Long Term (>15years)	2 Short duration (2-5years)
MAGNITUDE	6 Moderate	2 Minor
PROBABILITY	4 Highly probable	2 Improbable
SIGNIFICANCE	44 MODERATE (-)	10 LOW (-)
REVERSIBILITY	1 Completely reversible	

8.1.1.2 Alteration of Water Quality

Table 8-2 below presents the pre- and post-mitigation significance scores calculated for the indirect alteration of water quality. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-2: Assessment of the significance of the indirect alteration of water quality as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Indirect alteration of the water quality within the at-risk and downstream watercourses.	
NATURE	Excess bare soil and sedimentation created from construction activities may enter the adjacent watercourses and deteriorate the water quality in comparison to the baseline conditions presented herein. The introduction of hydrocarbon sources and concrete mix poses a risk of contamination occurring if mitigation measures are not implemented.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	2 Local area	1 Limited to site
DURATION	1 Very short (0-1year)	1 Very short (0-1year)
MAGNITUDE	6 Moderate	2 Minor
PROBABILITY	4 Highly Probable	2 Improbable
SIGNIFICANCE	36 MODERATE (-)	8 LOW (-)
REVERSIBILITY	1 Completely reversible	

8.1.1.3 Alteration of Catchment Landscape and Hydrological Flows

Table 8-3 below presents the pre- and post-mitigation significance scores calculated for the direct alteration of the catchment landscape and hydrological flows. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-3: Assessment of the significance of the direct alteration of the catchment landscape and hydrological flows as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Direct alteration of the catchment landscape and hydrological flows.	
NATURE	The hardened surfaces created by the construction of the proposed activities will reduce the area of vegetation and infiltration surface, as well as alter the current hydrological flow regime within the catchment area. This could lead to erosion features developing downslope of the structures if adequate flow management systems are not integrated into the overall design of the proposed activities.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	1 Limited to site	1 Limited to site
DURATION	5 Permanent	1 Very short (0-1year)
MAGNITUDE	4 Low	2 Minor
PROBABILITY	4 Highly Probable	2 Improbable
SIGNIFICANCE	40 MODERATE (-)	8 LOW (-)
REVERSIBILITY	1 Completely reversible	

8.1.1.4 Alteration to Ecosystem Service Provision

Table 8-4 below presents the pre- and post-mitigation significance scores calculated for the indirect alteration of the ecosystem services provided by the freshwater ecosystems within the study area. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-4: Assessment of the significance of the indirect alteration of the ecosystem services provided by the freshwater ecosystems as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Indirect alteration of the ecosystem services provided by freshwater ecosystems within the study area.	
NATURE	The disturbance of freshwater ecosystems as a result of construction activities and associated infrastructure may alter the ability of the freshwater ecosystems to provide valuable regulating and supporting, as well as cultural and provisioning, benefits to the surrounding anthropogenic and natural environments.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	1 Limited to site	1 Limited to site
DURATION	2 Short duration (2-5years)	1 Very short (0-1year)
MAGNITUDE	4 Low	2 Minor
PROBABILITY	3 Probable	2 Improbable

SIGNIFICANCE	21 LOW (-)	8 LOW (-)
REVERSIBILITY	2 Moderately reversible	

8.1.2 Rehabilitation Phase

During this phase, all construction-related infrastructure will be decommissioned and all material and equipment removed from the site prior to all disturbed areas being rehabilitated to pre-construction (and better) condition. This section presents the quantitative impact assessment of the activities and perceived impacts assumed to occur within the rehabilitation phase of the activity.

8.1.2.1 Improvement of Aquatic Habitat and Ecological Structure

Table 8-5 below provides the pre- and post-mitigation significance scores calculated for the improvement of aquatic habitat and ecological structure. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-5: Assessment of the significance of the improvement of aquatic habitat and ecological structure as a result of the proposed development.

CRITERIA	DESCRIPTION	
IMPACT	Positive impact: Improvement of the aquatic habitat and ecosystem structure adjacent to the proposed activities site.	
NATURE	Subsequent to the end of the construction phase, the disturbed areas around the proposed activities footprint will be rehabilitated to pre-construction (or better) conditions. This may result in an improvement of the condition of the downstream watercourses if all mitigation measures presented herein and the site-specific EMPs are strictly implemented and subsequently monitored.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	1 Site	1 Site
DURATION	1 Short term (2-5years)	1 Short term (2-5years)
MAGNITUDE	4 Low	4 Low
PROBABILITY	2 Improbable	5 Definitive
SIGNIFICANCE	12 LOW (+)	30 LOW (+)
REVERSIBILITY	1 Completely reversible	

8.1.3 Operational Phase

This section presents the quantitative impact assessment of the activities and perceived impacts assumed to occur within the operational phase of the proposed development. The distribution and use of treated water by community members, as well as the maintenance of the proposed development infrastructure, are envisioned to be conducted during the operational phase.

8.1.3.1 Alteration of Water Quality

Table 8-6 below presents the pre- and post-mitigation significance scores calculated for the direct alteration of water quality. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-6: Assessment of the significance of the direct alteration of water quality as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Direct alteration of the water quality within the at-risk and downstream watercourses.	
NATURE	The discharge of treated wastewater into the receiving watercourse may result in deteriorated water quality if appropriate mitigation and monitoring measures are not implemented.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	2 Local area	2 Local area
DURATION	2 Short term (2-5years)	1 Very short (0 -1 years)
MAGNITUDE	6 Moderate	4 Low
PROBABILITY	4 Highly probable	2 Improbable
SIGNIFICANCE	40 MODERATE (-)	14 LOW (-)
REVERSIBILITY	1 Completely reversible	

8.1.3.2 Alteration of Catchment Landscape and Hydrological Flows

Table 8-7 below presents the pre- and post-mitigation significance scores calculated for the direct alteration of the catchment landscape and hydrological flows. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-7: Assessment of the significance of the direct alteration of the catchment landscape and hydrological flows as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Direct alteration of the catchment landscape and hydrological flows.	
NATURE	The hardened surfaces created by the proposed activities may result in altered land cover and the discharge of treated wastewater may result in additional alteration of the hydrological regime.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	2 Site area	2 Site area
DURATION	4 Long term (>15years)	4 Long term (>15years)
MAGNITUDE	6 Moderate	4 Low
PROBABILITY	4 Highly Probable	3 Probable
SIGNIFICANCE	48 MODERATE (-)	30 LOW (-)
REVERSIBILITY	2 Moderately reversible	

8.1.3.3 Alteration to Ecosystem Service Provision

Table 8-8 below presents the pre- and post-mitigation significance scores calculated for the direct and indirect alteration of the ecosystem services provided by the freshwater ecosystems within the study area. The essential mitigation measures that will need to be implemented to realise the post-mitigation significance score are presented under **Section 9**.

Table 8-8: Assessment of the significance of the direct and indirect alteration of the ecosystem services provided by the freshwater ecosystems as a result of the proposed activities.

CRITERIA	DESCRIPTION	
IMPACT	Direct and indirect alteration of the ecosystem services provided by freshwater ecosystems within the study area.	
NATURE	Direct and indirect disturbance of watercourses may result in AIPS encroaching into the disturbance footprint during the operational phase of the proposed development. This will reduce the biodiversity within the catchment area and alter the current water balance within the systems. In addition to this, if adequate rehabilitation is not conducted, erosion features may develop resulting in loss of soils from watercourses. The above will reduce the ability of the watercourses to provide ESS to the natural and anthropogenic environments.	
	PRE-MITIGATION	POST-MITIGATION
EXTENT	2 Local region	1 Limited to site
DURATION	3 Medium term (5-15years)	1 Very short (0-1year)
MAGNITUDE	6 Moderate	4 Low
PROBABILITY	3 Probable	2 Improbable
SIGNIFICANCE	33 MODERATE (-)	12 LOW (-)
REVERSIBILITY	1 Completely reversible	

8.2 Cumulative and Residual Impacts

In accordance with the EIA Regulation, 2014 (as amended), Chapter 3(i) and (j) of the NEMA (Act No. 107 of 1998), cumulative impacts of a proposed development must be assessed. In the case of the proposed activities, the cumulative impact on the water quality of the receiving watercourses was assessed. The cumulative impact in this regard was determined to be **moderate** in the pre-mitigation state due to the direct discharge of treated wastewater into the receiving watercourse. However, by implementing a Watercourse Rehabilitation and Monitoring Programme in conjunction with the mitigation and monitoring measures presented within this report, the significance of the cumulative impact can be reduced to **low**.

9 MITIGATION AND REHABILITATION MEASURES

9.1 Proposed Activities

The following sections present the recommended mitigation and/or rehabilitation measures relevant to the proposed activities. It is essential that these be implemented to ensure that the post-mitigation impact significance scores presented

herein are realised. It is advised that the below be included in the project-specific EMP document and should be considered by the DWS case officer for inclusion in the project WUL.

9.1.1 Pre-Construction Phase

Stormwater Management

- An in-depth Stormwater Management Plan (SWMP), which must be driven by a risk-averse approach, must be drafted for all aspects of the proposed activities and over different hydrological cycles.
- Stormwater management infrastructure such as cut-off trenches and small vegetated earthen berms should be considered around the construction footprint for all aspects of the project to reduce the risk of erosion features developing downslope of the structure and contamination of the at-risk watercourses.
- The access road must contain mitre drains every 20 m or less depending on the topography to control the stormwater wash down the road. All stormwater infrastructure must contain flow dissipation structures/measures, as the reduced ground cover within the study area is prone to high-velocity surface wash that may encourage preferential flow-paths to form, and thus rill/gully erosion occurs.
- No stormwater infrastructure must be directed directly into a watercourse, but instead towards a section of vegetated land, or flow dissipators, adjacent to the watercourse.

Site Layout

- Locate site camps, laydown areas, stockpile areas, construction material, equipment storage areas, vehicle parking areas, banded vehicle servicing areas and re-fuelling areas in designated areas of already hardened surface or disturbed areas on site. These areas should preferably be located on level ground in a previously disturbed area of vegetation approved by the Environmental Control Officer (ECO). Cut and fill must be avoided where possible during the set-up of the construction site camp.
- No temporary infrastructure must be situated within delineated watercourses and their associated no-go buffer zones.
- Fuel, chemicals and other hazardous substances should preferably be stored offsite, or in suitable secure weather-proof containers with impermeable and banded floors onsite to limit pilferage, spillage into the environment, flooding or storm damage. No contaminated runoff or grey water is allowed to be discharged from the construction site camp.
- The SWMP should detail how stormwater runoff from cleared and compacted surfaces will be controlled. Clearly defined clean and dirty systems must be developed and maintained around the site camp.
- Erosion control measures including silt fences, low vegetated soil berms and/or shutter boards should be put in place around the temporary site camp and laydown areas to limit sediment laden runoff and contaminants travelling into the surrounding environment.

- Restrict the movement of construction vehicles and personnel to the designated access road to avoid soil disturbance. It is recommended that the footprint of the final site camp be fenced, or marked to avoid indiscriminate movement of construction personnel.
- Hazardous material storage areas must not be within 50 m of any watercourse or within the 1:100-year flood line. The furthest threshold must be adhered to. Hazardous storage areas are to be hard surfaced and bunded with an impermeable liner to protect groundwater quality and undercover. The bunded catch pit must have at least 110% of the storage capacity of the total stored quantity.
- The design of all sections of primary and secondary haulage and access roads must attempt, at all times and as far as feasible, to avoid the outer boundary and associated buffer zones associated with the delineated watercourses.
- All delineated watercourses and other no-go areas must be demarcated with danger-tape and dropper poles to ensure that site works and external parties do not traverse within the no-go area.

9.1.2 Construction Phase

Runoff, erosion and sediment control

- Where possible, construction activities, particularly within watercourses, must be undertaken during the dry months to avoid erosion and sedimentation.
- Existing vegetation cover surrounding the proposed activities site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Sediment barriers (e.g. silt fences/sandbags/hay bales) must be installed immediately downstream of active work areas (including soil stockpiles) as necessary to trap any excessive sediments generated during construction.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2 m) to break the energy of surface flows.
- Once shaped, all exposed/bare surfaces and embankments must be landscaped and revegetated immediately.
- If revegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that revegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas (i.e. >75 % coverage).

- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.

Hazardous substances management

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 30m of any watercourse.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.
- Vehicle maintenance should not take place on-site unless a specific bunded area is constructed for such a purpose.
- Hazardous storage and refuelling areas must be bunded prior to their use on-site during the construction period following the appropriate SANS codes. The bund wall should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.

Alien Invasive Plant Management

- All alien invasive vegetation that colonises the construction site must be removed, preferably by uprooting. The contractor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for AIPs every two weeks and AIPs removed by hand pulling/uprooting and adequately disposed of.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authorities are to be used. The ECO must be consulted in this regard. The herbicide contractor must be certified to apply/utilise the herbicide in question.

Wildlife Management

- The handling and/or killing of any animal species present is strictly prohibited and all staff/personnel must be notified of such incidents.

- Wetland fauna (e.g. snakes, frogs, small mammals) that are encountered during the construction phase must be relocated to other parts of the wetland under the guidance of the EO or ECO.
- Poaching/snaring is strictly prohibited.

General Site Management

- All construction activities should take place within the dry season for the region (Mid-April to September).
- For every indigenous woody tree species cut down from within watercourses, specifically riparian habitat, three (3) indigenous tree species relevant to the region should be planted in the same vicinity to compensate for the loss of biodiversity. No Threatened and/or Protected Species (TOPS) should be cut or disturbed without a permit being granted from the DFFE.
- Sediment netting or similar should be erected around all open excavations to avoid sediment travelling into the surrounding environment. These should be inspected by the ECO on a daily basis to ensure that they are fit for purpose.
- Concurrent rehabilitation of the construction footprint should be conducted. All disturbed areas should be tilled and revegetated with a mixture of indigenous grass species subsequent to backfilling.
- All excavation of hydric soil within the outer boundaries of watercourses must be done by hand using spades and picks as far as possible to avoid unnecessary disturbance of the watercourse by heavy machinery. The hydric soil removed must be placed in a designated spoil site in sequence, and replaced in inverted sequence directly after each section has been laid.
- All hydrophilic plant species within the direct path of the proposed development must be dug up at the roots and placed within a designated storage area and watered on a daily basis using commercially sourced water (unless an existing abstraction WUL has been obtained) until the species are transplanted back post-construction.

General

- All site personnel must undergo environmental induction prior to construction commencing. The watercourse delineation and associated buffer zones should be presented therein and it should be communicated that these areas should be considered no-go, aside from when within the pegged out footprint.
- A preconstruction walkthrough should be conducted by a suitably qualified botanist to mark any TOPS within the pegged out construction footprint. These species should be translocated if possible.
- Excess dust observed in the vicinity of the proposed activities must be noted and the appropriate dust suppression techniques implemented to ensure no excess sediment input into the surrounding freshwater resources.
- The digging of pit latrines is not allowed under any circumstances.
- None of the open areas or the surrounding environment may be used as ablution facilities.
- No open fires are permitted on site.
- Adequate waste receptacles which are both wind and scavenger proof must be placed throughout the site

9.1.3 Rehabilitation Phase

- Concurrent rehabilitation should be implemented. All disturbed areas must be rehabilitation within 30 days of the end of each construction activity.
- It is the responsibility of the developer to appoint a suitably experienced wetland/aquatic/rehabilitation specialist to compose and implement an approved Watercourse Rehabilitation and Monitoring Plan. The specialist must have a sound knowledge of the watercourses and vegetation within the study area and his/her appointment must be approved by the ECO. The plan shall include (but not limited to):
 - Rehabilitation goals and objectives within the at-risk watercourses;
 - Detailed rehabilitation methodology;
 - Details for potential structures proposed within watercourses to assist with the prevention of erosion and improve the throughflow of watercourses;
 - Methods for the removal and control of AIPS within the wetland and riparian areas;
 - List of proposed plant species to be used during the rehabilitation of watercourses; and
 - Monitoring requirements to assess how successful the rehabilitation techniques are within the systems.
- All post-construction building material and waste must be cleared in accordance with the GA/WUL before revegetation of the disturbed footprints takes place.
- Erosion features that have developed as a result of construction related disturbances are required to be stabilised. This may also include the need to deactivate any erosion head cuts/rills/gullies that may have developed by either compacted soil infill, rock plugs, gabions or any other suitable measures.
- Slopes that have been altered due to construction/operation must be reshaped to replicate the original condition and contours.
- If the gradient of the banks is greater than 1:1.75, the banks must be stabilised with a biodegradable cover such as Geojute which must be secured to the steep slope with wooden (biodegradable) pegs. This will reduce soil erosion potential.
- Any areas, which fall outside the site, that have been compacted are required to be ripped to allow for the establishment of vegetation. This ripping must not result in the mixing of sub- and topsoil.
- No imported soil material may be utilised for rehabilitation unless it can be ensured that it is free of any alien vegetation seeds. *In situ* earthen material is preferred.
- Additional stabilisation of cleared areas to prevent and control erosion must be actively managed. The method of stabilisation should be determined in consultation with the ECO and engineer. The following methods (or a combination) may be considered, depending on the specific conditions of the site:
 - Brush packing
 - Mulch or chip cover
 - Terracing
 - Straw stabilising (at the rate of one bale/m² and rotated into the top 100mm of the completed earthworks)
 - Watering

- Planting/sodding
- Hand-seeding / Hydro-seeding
- Mechanical cover or packing structures (Geofabric, Hessian cover, Armourflex, Log/pole fencing)
- A suitably qualified ECO/botanist/horticulturist must supervise the handling, maintenance and planting of the plant/trees. No AIPS may be utilised during the rehabilitation process.
- Rapidly germinating indigenous species (e.g. fast growing, deep rooting, rhizomatous, stoloniferous) known to bind soils in terrestrial, riparian and/or wetland areas must be utilised where there is a strong motivation for stabilisation over reinstating similar plant communities to that being disturbed. This should be informed by a suitably qualified specialist.
- Exposure of plant root systems to drying winds, high temperatures or waterlogging must be avoided.
- Where possible, revegetation must take place at the start of the spring rains to maximise water availability and minimise the need for irrigation. This will ensure optimal conditions for germination and rapid vegetation establishment.
- If this is not possible, watering of planted areas may be necessary during dry periods (external sources of water must be utilised e.g. Jo-Jo tanks).
- Water utilised for irrigation must be free of any chlorine or contaminants that may negatively affect the plant species.
- All alternative roads, tracks and footpaths created during the construction phase should be appropriately rehabilitated (e.g. tillage and revegetation of the affected areas). This rehabilitation should result in improved surface roughness and increased infiltration along with reduced stormwater flow and consequently reduced rill erosion.
- All construction waste materials must be removed, and temporary structures (e.g. offices, workshops, storage containers, ablution facilities) dismantled, from the site and the surrounding environment, this will need to be checked by the ECO and the various contractors.
- All banks where there is exposed soil, with the potential for rill/gully erosion to take place, must be stabilised. Gabion structures or geotextiles must be implemented upslope of the proposed development.

9.1.4 Operational Phase

- A Maintenance and Monitoring Programme should be composed for all infrastructure and implemented by a suitably qualified professional to ensure that all defects or leakages are identified timeously.
- Monitoring for erosion and AIPS encroachment within watercourses should be conducted during routine monitoring of the infrastructure components. Any erosion features observed to have been created as a result of the proposed development should be stabilised and revegetated in consultation with a suitably qualified environmental scientist or engineer (if required).
- The control of AIPS should be guided by an AIPS control plan to ensure compliance with the NEM:BA (Act No. 10 of 2004). This act states that all landowners must control listed AIPS on their property according to the NEMBA:

Alien and Invasive Regulations (2014, as amended) and associated Alien Species List (2020). A contractor must be appointed by the landowner to control all AIPS within the proposed development site. The clearing should take place in a phased manner, starting with the initial clearing and then follow-up and lastly maintenance clearing. The clearing processes typically take 3 years with annual updates of the site-specific AIPS control plan.

9.2 General Watercourse Protection and Rehabilitation Measures

- The watercourse delineation and associated no-go buffer zones presented herein should be included in the environmental induction and all site personnel and contractors must be made aware of these zones. These areas should ideally be pegged out and protected against from future mining or infrastructure.
- An AIPS plan should incorporate aquatic habitats with input from a suitably qualified aquatic ecologist. Subsequent revegetation using indigenous hydrophytic species should be undertaken.
- Erosion control measures, particularly within UVB01 at geographic coordinates 26°24'23.08"S; 27°41'38.27"E, must be implemented. This should be informed through a system specific Watercourse Rehabilitation Strategy.
- A trench was observed through UVB02 at approximate coordinates 26°25'35.95"S; 27°40'16.18"E. This trench should be backfilled in the same sequence it was excavated and revegetated using an indigenous grass mixture.

10 DISCHARGE DESIGN RECOMMENDATIONS

This section presents the findings of the assessment of the discharge points. The client requested that three (3) discharge points be considered by the specialist which will be discussed further below.

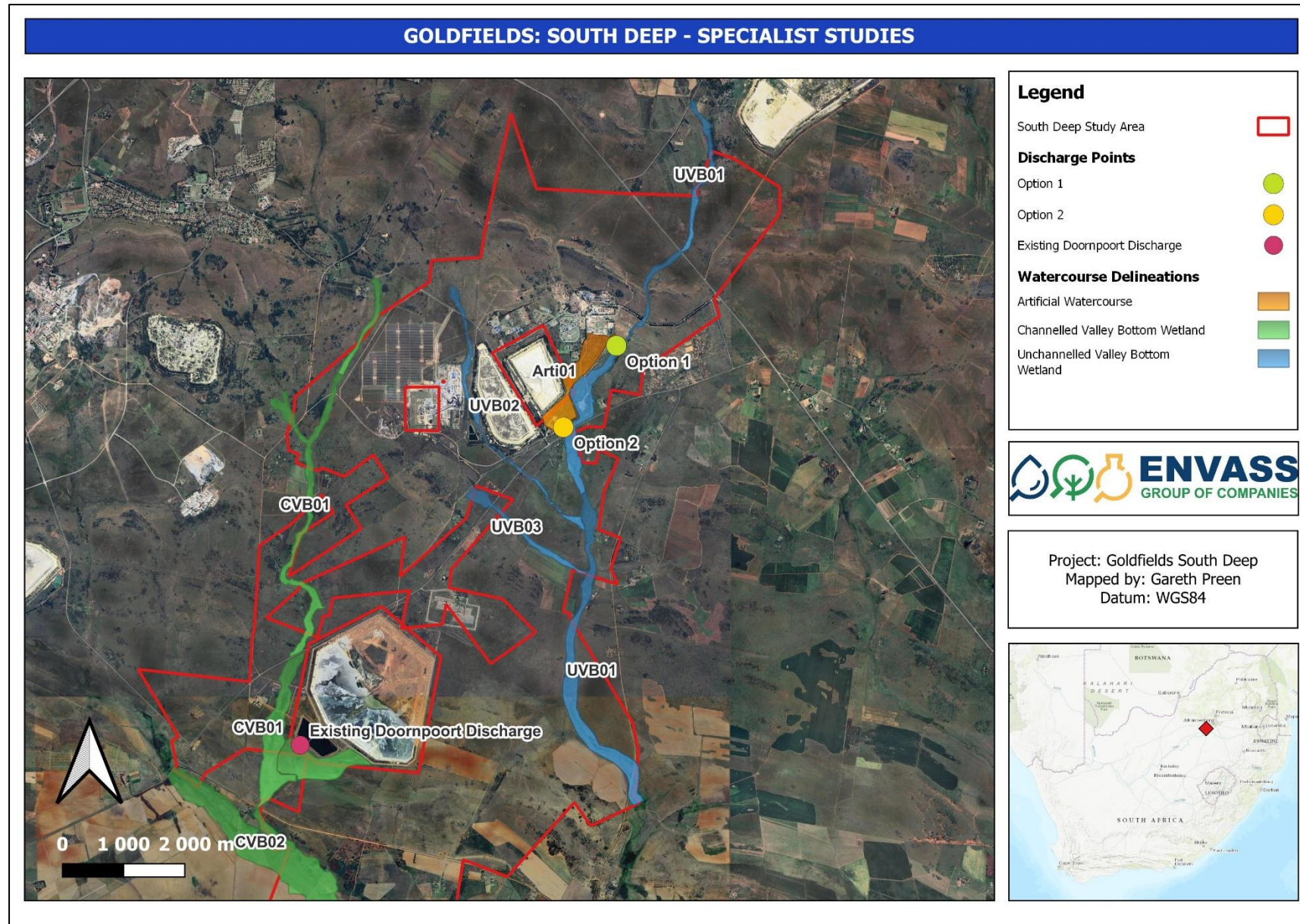


Figure 10-1: Map illustrating the proposed discharge points which will be discussed further in the section to follow.

10.1 Option 2

Option 2 is located at approximate geographic coordinates 26°25'18.87"S; 27°40'51.06"E and below the Return Water Dam and between an artificial watercourse and unchannelled valley bottom wetland.

Table 10-1 presents the key observations made during the infield investigation of Option 2.

Table 10-1: Observations and photographic references at Option 2.

Photographic Reference	Observations
	Observations: - A large two (2) box culvert was observed downstream and is associated with one of the main roads. During discharge events, this may result in back flooding and sedimentation of the watercourse particularly because the culvert is confined in extent. - During the infield assessment majority of the hydrophytic vegetation had been burnt which provided minimal velocity dissipation thereby promoting the potential for erosion to occur. - No erosion protection or flow dissipators were observed at the inlets or outlets of the culverts.
	Observations: A large earthen berm and pipeline are present at Option 2. Should a discharge point be established here, the discharge pipeline will either need to be established underneath or above the existing pipeline. The earthen berm may also need to be modified to allow for the spread of water. Again, the earthen berm lacked vegetation cover, which could increase the potential for erosion.

10.2 Doornpoort Discharge

The Doornpoort Discharge is located at approximate geographic coordinates 26°28'8.17"S; 27°38'14.79"E. During the infield investigation, existing discharge infrastructure was present in the form of a four (4) culvert outlet and an approximately 8 to 10 m wide by 50 m long vegetated apron/channel. **No water was being discharged at the time of the infield assessment.**

Table 10-2 presents the key observations made during the infield investigation of Discharge Point 2.

Table 10-2: Observations and photographic references at Doornpoort Discharge.

Photographic Reference	Observations
	Observations: - The outlets of the culverts are slightly above the base level of the channel. If water were to be discharged in large volumes in its current state, undercutting and bed scour may result if the culverts are above the base level of the beds. - No erosion protection or flow dissipators were observed at the outlets of the culverts.
	Observations: - The culverts have not been keyed into the side walls of the embankments which presents the risk of erosion around the side of the culverts. - The culverts were not concreted into place. - Undercutting was observed beneath the concrete fence within the Doornpoort TSF boundary (see red box in the image).

**Observations:**

- A robust vegetation cover was present throughout the discharge outlet channel with minimal erosional features present. This promoted a largely diffuse and laminar flow further downstream into the receiving watercourse. A variety of hygrophilous grasses and sedges were observed. Further downstream of the channel outlet, increased soil wetness was evident with dense hydrophytic vegetation.

10.3 Option 1

Option 1 is located at approximate geographic coordinates 26°24'35.73"S; 27°41'22.36"E. **Table 10-3** presents the findings that were observed at proposed discharge point 3.

Table 10-3: Observations and photographic references at Option 1.

Photographic Reference	Observations
	Observations: • The general area lacked hydrophytic vegetation and was heavily overgrazed. The vegetation comprised mainly of grasses with a few shrubs and no reeds.

	Observations: • Dilapidated boundary walls were observed through the watercourse. These will have to be removed.
	Observations: • A historical road was present across the watercourse. This provides an opportunity for water to be discharged and spread across the watercourse. • This point is also located near to the head of the watercourse which will provide a variety of hydrological zonation.
	Observations: • The geomorphology of the watercourse was highly disturbed and will need to be rehabilitated as part of the proposed discharge activity.

10.4 Proposed Discharge Design Measures

Based on the findings presented in **Table 10-2** to **Table 10-3**, the following should be considered by the site engineer in the design of this discharge point:

- It is recommended that Option 1 be utilised as this will create a larger area of hydrological zonations across the watercourse (**Figure 10-2**). This discharge point is also located closer to the head of the wetland, which means that a greater area will be positively impacted.
- Certain rehabilitation measures, informed by a rehabilitation plan, may need to be implemented prior to the discharge point being implemented such as the following:
 - The residue stockpiles of soil will need to be removed.
 - The dilapidated fence will either need to be removed or repaired.
- The feasibility of a grass-lined chute should be investigated as opposed to culvert outlets. If appropriately designed and constructed, a chute will reduce the potential for the development of preferential paths and dissipate flow. In contrast, culverts have a tendency to promote concentrated flow paths due to the confined surface area and generally result in erosion downstream if suitable control measures are not implemented. It would also be recommended that an energy dissipator be incorporated near the toe of the chute to further reduce erosion potential. **Figure 10-3** provides an illustration of a typical chute design.
- If culvert outlets are the preferred option, it is essential that the existing culverts be upgraded and repositioned at the base level of the outlet channel. In addition, erosion control and flow dissipators must be established at the culvert outlets either in the form of vegetated gabion mattresses or rock packing. It is essential that the culverts be keyed into the side wall and bed using an appropriate medium (concrete). This will improve the structural integrity and reduce the potential for any undercutting beneath and scouring around the culverts.
- The current vegetation cover must be maintained and a wider spread of water discharge across the wetland must be promoted to enhance soil wetness and promote increased hydrophytic biodiversity.

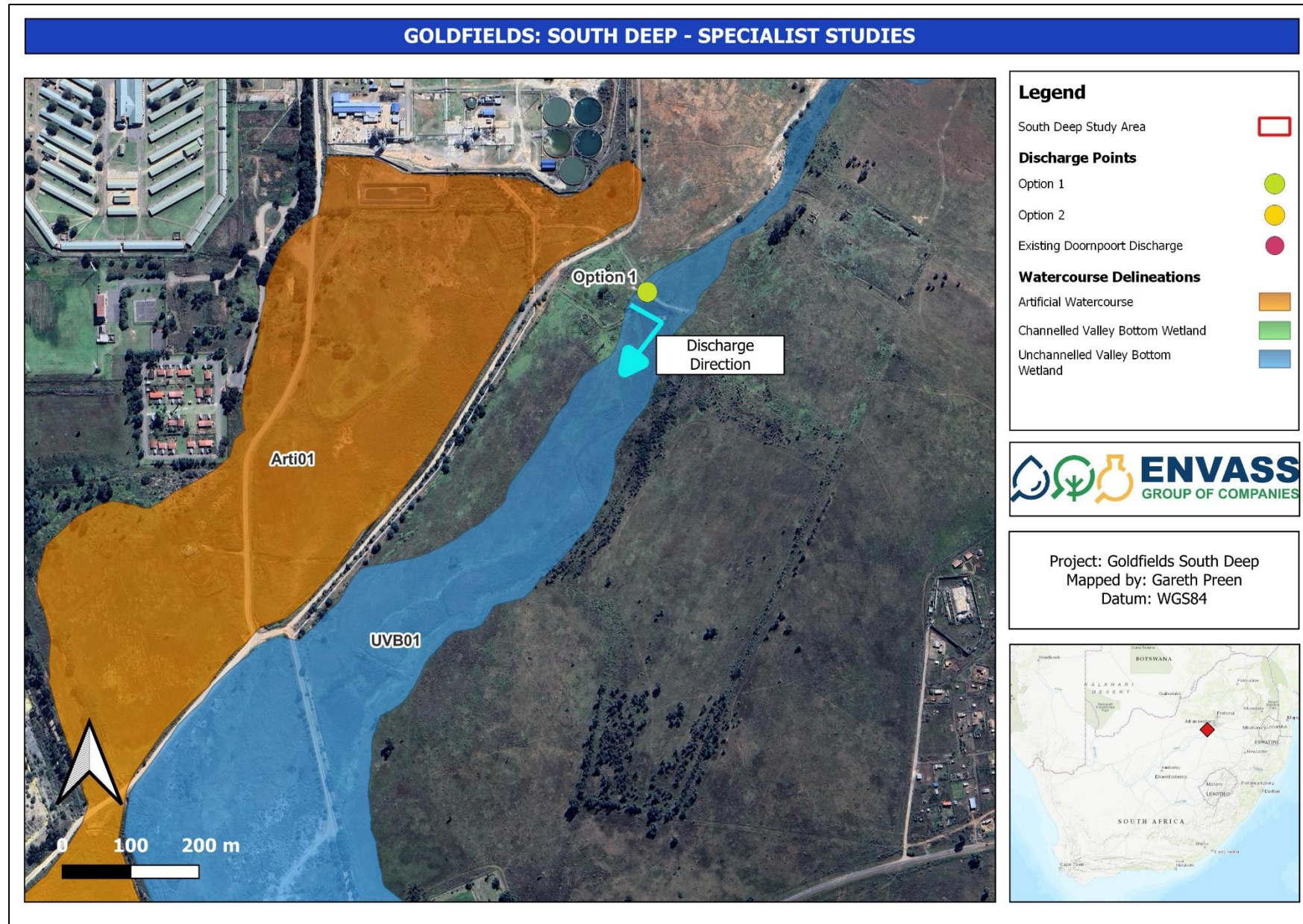


Figure 10-2: Proposed discharge direction and spread.

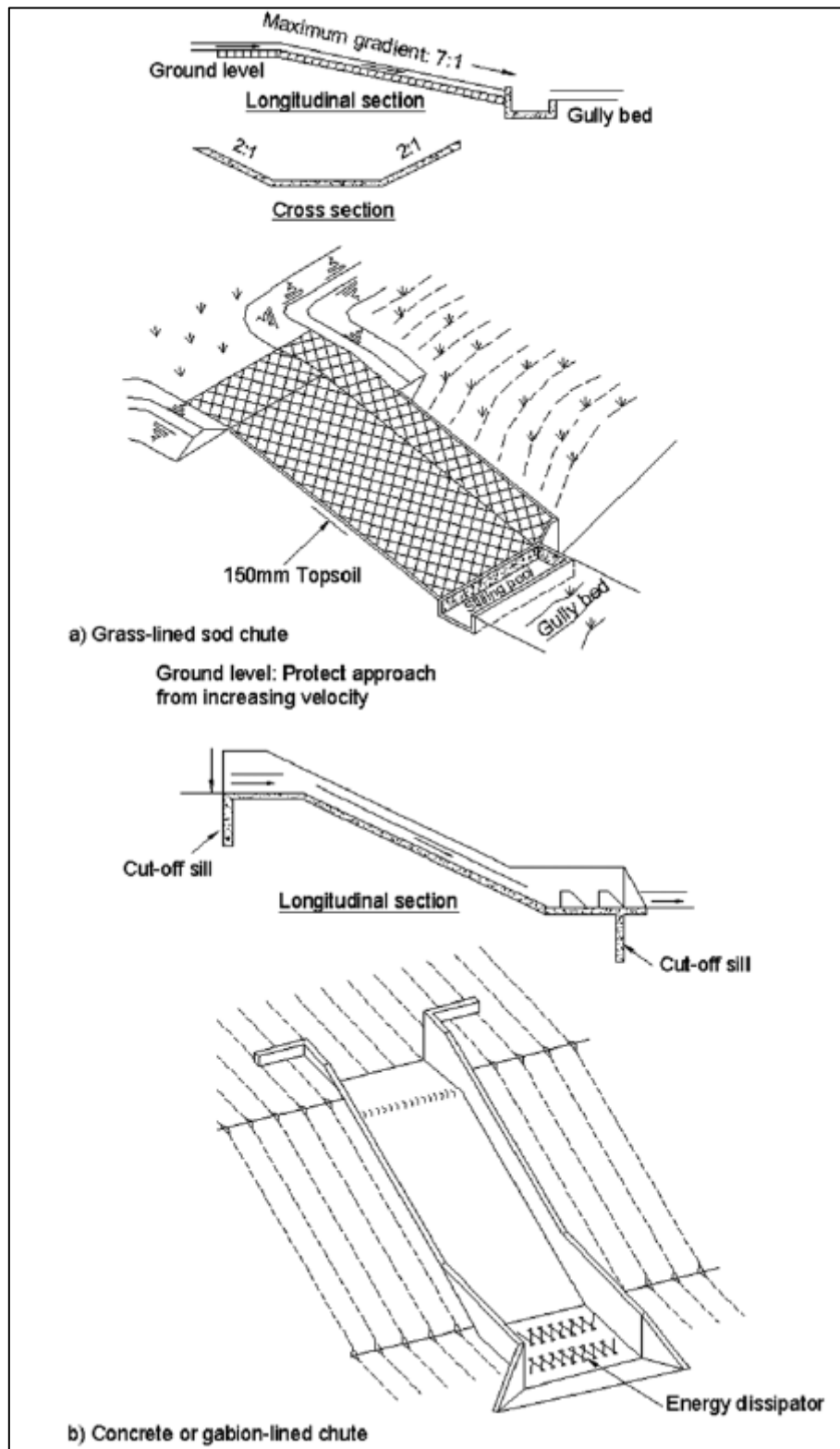


Figure 10-3: Typical chute design (Russel, 2009).

10.5 Impact on the PES and EIS of the receiving watercourses

The PES of UVB01 was determined to fall within **Class D (Largely Modified) Moderate** and the EIS was determined to be **Moderate**.

Subsequent to a review of the impact assessment in relation to the above highlighted results of the functional assessment, it was determined that the discharge of treated wastewater will not have a detrimental impact on the PES and/or EIS of the receiving watercourses. Instead, the proposed discharge is expected to have a positive impact on the PES and EIS of the watercourse through additional water inputs thereby creating an array of hydrological zonations and niche habitats within the area. However, this will only be realised if all mitigation, rehabilitation and monitoring requirements stipulated within this report are implemented.

11 DISCHARGE LIMIT RECOMMENDATIONS

The maximum discharge limits at the proposed discharge point were calculated to be 2 Mega Litres per day (ML/day) without exceeding ecological or hydraulic thresholds (Elemental Water Services, 2025). Furthermore, the existing degraded condition of the watercourses suggest that the discharge may enhance hydrological functionality while maintaining compliance with the ecological water reserve (Elemental Water Services, 2025). The aforementioned statements support the statements made within **Sub-section 10-3**.

12 MONITORING REQUIREMENTS

The monitoring of the watercourses will be essential for the maintenance and/or improvement of the PES scores that were calculated for the at-risk watercourses and the natural terrestrial biodiversity of the study area. The rehabilitation mitigation/rehabilitation recommendations stated above must be incorporated into the project-specific WUL/GA and compliance with the requirements/recommendations must be audited by a suitability-qualified independent ECO. The key to a successful WUL/GA is appropriate monitoring and review to ensure the effective functioning of the WUL/GA and to identify and implement corrective measures in a timely manner. Monitoring for non-compliance must be undertaken on a daily basis during the construction phase by the contractors under the guidance of the Project Manager / ECO / Engineer. An appropriately timed audit report should be compiled by the independent ECO. Paramount to the reporting of non-conformance and incidents is that appropriate corrective and preventative action plans are developed and adhered to. Photographic records of all incidents and non-conformances must be retained. This is to ensure that the key impacts on the receiving aquatic and terrestrial habitats are adequately managed, and mitigated and that the rehabilitation of any disturbed areas within any system is successful.

A monitoring programme must be in place not only to ensure compliance with the WUL/GA throughout the construction phase but also to monitor any environmental issues and impacts during the rehabilitation and operational phases. Compliance against the WUL/GA must be monitored during the construction phase monthly by an ECO. The period and

frequency of monitoring required post-construction must be determined by a suitably qualified specialist and approved by the ECO. Once the initial transplants/plugs/seeds are planted during the rehabilitation phase, a suitably qualified professional, or the ECO must conduct weekly site visits to remove AIPS (in accordance with the latest revised NEM: BA requirements) and address any revegetation concerns until revegetation is considered successful (i.e. >80% indigenous cover). A generally accepted monitoring period of revegetated areas after this initial period is monitoring every 3 months for the first 12 months and every 6 months thereafter until the vegetation has successfully been established. If the revegetated areas have inadequate surface coverage (less than 30% within 9 months after re-vegetation) the disturbed areas should be prepared and revegetated again.

The cost-effective qualitative monitoring of the rehabilitation area may be time-based through the use of periodic photographs taken from permanent photo viewpoints. These points are required to be established during site inception. The timeline created between the pre-and post-rehabilitation photos will provide an invaluable visual representation of the progress that is conveyed in a straightforward manner. The photographer should be an environmental scientist (may be the site ECO), therefore allowing an expert assessment of the site adding to the qualitative information gathered from the photographs.

The below-mentioned criteria must be adhered to, to ensure the quality of the information collected:

- Establishment of the photo points must be completed during site inception/establishment. This will allow for pre-rehabilitation imagery spanning more than a once-off photograph.
- These points should be permanently marked and assigned a unique identifying number to ensure continual relocation and accuracy of the photographs. GPS coordinates should be recorded for each site. This is to ensure if any markers are removed or vandalised then they can be replaced.
- Photo point locations should be easily relocated and accessible and must not be obscured by future vegetation growth.
- The level of detail captured must be appropriate to the area that has undergone rehabilitation.
- Photo record forms must be developed and utilised for every photo taken. The information required will be the project name, location, unique identity number, directional point (e.g. North, South), date, time, photographer's name and additional comments.
- Qualitative ecological information that must be visually interpreted and recorded at the same time as taking the photograph include:
 - The extent of the site vegetation ground cover.
 - General level of plant growth, substrate levels, and water levels.
 - General observations of water quality such as clarity and presence of litter.
 - Evidence of anthropogenic presence and bird species.
 - Vegetation condition, extent of AIPS; and
 - Evidence of erosion and close monitoring of the post-construction erosion-control measures must be implemented.

This is to ensure that the key impacts on the aquatic and terrestrial habitats are adequately managed and mitigated and that rehabilitation of any disturbed areas within the study area is successful.

Table 12-1 provides a detailed outline of the proposed aquatic monitoring requirements.

Table 12-1: Proposed aquatic monitoring requirements associated with the proposed development.

ASPECT	SITE	METHODOLOGY	FREQUENCY	COMPLIANCE LIMITS/ COMPARISON
Water Quality	UVB01: <i>Discharge Point 3:</i> 26°24'35.73"S; 27°41'22.36"E	- Whole Effluent Toxicity Analysis. - SANAS Accredited Laboratory Water Quality Testing	Monthly during operation.	- Baseline results and long-term averages over seasons. - TWQR for Aquatic Ecosystems (DWAF, 1996). - WUL limits.
Aquatic habitat	CVB01	-WET-Health Version 2 -WET-EcoServices Version 2	Annually during operation.	- Baseline results and long-term averages.
Aquatic habitat	UVB01 UVB02 UVB03 CVB02	-WET-Health Version 2 -WET-EcoServices Version 2	Every five (5) years unless new development or mining activities are planned.	- Baseline results and long-term averages.
Vegetation	AIPS control at all sites	- Fixed-point photography (FPP).	Monthly FPP during initial clearing and annually during follow-up and maintenance phases.	- Visual baseline (i.e. FPP and aerial images prior to implementation of AIPS control).
Geomorphology	Erosion control at all sites	- FPP.	Following heavy rainfall events and annually during follow-up and maintenance phases.	- Visual baseline (i.e. FPP and aerial images prior to implementation).
	Engineering structures	- As determined by the design engineer. - FPP.	As determined by the design engineer	- Visual baseline (i.e. FPP and aerial images prior to implementation).

13 CONCLUSION

ENVASS was appointed to compile a consolidated Aquatic Biodiversity Assessment of the watercourses within the Goldfields Mining Right and an impact assessment associated with two (2) discharge points with one preferred alternative. Several watercourses were delineated and verified infield. These include two (2) Channelled Valley Bottom (CVB01 and CVB02) wetlands, three (3) Unchannelled Valley Bottom (UVB01 to UVB03) wetlands, and one (1) Artificial Watercourse (Arti01) associated with the study area. Of these UVB01 and CVB01 were determined to be at **high** risk of impact by Option 1 and Doornpoort discharge points. However, the functionality of all watercourses was assessed in order to satisfy the requirements of the updated Aquatic Biodiversity Assessment.

The PES of the assessed watercourses ranged from **Class C (Moderately Modified)** to **Class E (Seriously Modified)**. Significant alterations to the bed and channels have occurred due to road, powerline, and pipeline crossings, along with illegal mining activities and ongoing construction within the stream channels. Wetlands have been adversely affected by the deposition of infill materials, waste rock dumping, trenching, and channelling, leading to diverted water systems and diminished flow, which have altered the natural vegetation. Soil disturbances have facilitated the spread of AIPs within the marginal and riparian zones. Notable species include *Eucalyptus* spp., *Acacia* sp. (wattle), scattered *Agave sisalana* (sisal), and *Cortaderia selloana* (Pampas grass) infestations. Some of these plants, initially introduced for rehabilitation, are now encroaching upon the wetland systems. The watercourse has been rerouted around the TSF; however, ongoing soil excavation and dumping continue to impact the diverted areas. Additionally, litter and waste disposal from upstream informal communities have degraded downstream regions. Leaks from STPs and seepage from mining activities have further compromised downstream water quality.

Following the undertaking of the RAM (DWS, 2023) for the activities associated with the discharge of wastewater into the receiving watercourses were determined to present a **low** risk of impact in a post-mitigation scenario. The most significant impacts to the receiving watercourses were determined to be alteration of hydrological flows and water quality impacts.

3. This Notice does not apply-

(c) in instances where an application must be made for a WUL for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity.

Considering the above, it is the specialist's opinion, substantiated by the project-specific RAM and GN4167, that the activity applies for Section 21(c) and (i) water use authorisation via a WULA process. However, this is subject to discussion with the DWS case officer, who will provide finality on the authorisation path to be followed by the client.

It is important to note that the RAM was undertaken with the assumption that all mitigation and rehabilitation measures as outlined in the RAM and Section 9 of this report will be adhered to. Should there be any changes to the project layout, a revised RAM will need to be undertaken.

It is recommended that Option 1 is utilised as this will create a larger area of hydrological zonations across the watercourse. Based on the wetland assimilation assessment, the maximum discharge should not exceed 2 Ml/day.

Based on the results obtained during this study and presented herein, it is the specialist's substantiated opinion that the proposed development continues, provided that all mitigation and rehabilitation measures proposed in this report and the site-specific WUL/GA are strictly implemented and subsequently monitored. This conclusion is subject to the following conditions, as well as all mitigation and rehabilitation measures presented within Section 9, being strictly implemented and subsequently monitored:

- Implementation of all design measures recommended within **Sub-Section 10.4**

14 REFERENCES

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APPENDIX A: METHODOLOGY

This section details the different techniques and methods used to obtain the data for this report in order to finally assess the overall ecological integrity of the at-risk watercourses and identify appropriate mitigation and/or rehabilitation measures to implement to reduce the potential impact (if any) on the receiving aquatic environment.

Desktop Assessment

A desktop assessment was undertaken, in which all the available data (e.g. government records and previous studies) pertaining to the study area was sourced and subsequently utilised to determine the theoretical importance and sensitivity of the freshwater ecosystems involved. Additionally, the study area was digitally illustrated and mapped utilising GIS (e.g. QGIS and/or ArcGIS) to better understand the layout and structure of the surrounding environment and study area. During this process, all the relevant GIS shapefiles were overlain onto satellite imagery to provide the reader with a holistic view of the study area. **Table 14-1** below presents the datasets that were utilised, their references and their date of publication.

Table 14-1: Presentation of the datasets and available information that was utilised during the desktop study associated with this assessment.

DATASET/TOOL	SOURCE	RELEVANCE
Catchment data.	DWS (2012).	Determine the regional hydrological characteristics of the site (e.g. Mean Annual Precipitation (MAP), Mean Annual Simulated Runoff (MASR), Mean Annual Temperature (MAT) and the general flow direction into, through and out of the study area.
Google Earth Pro™ Imagery.	Google Earth Pro™ (2023).	Survey the current and historical imagery of the study area to determine the change in land-use practices, and thus identify potential impacts.
DWS Ecoregions (GIS) data.	DWS (2005).	Determine the characteristics of the freshwater resources within the study area.
National Freshwater Ecosystem Priority Areas (NFEPA) river and wetland inventories (GIS coverage).	Council for Scientific and Industrial Research (CSIR) (2011).	Ascertain which freshwater resources have been categorised as important and/or sensitive habitats at a national scale, and thus those that will require conservation.
National Wetland Map Version 5 (NWM5).	SANBI (2018).	National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the SAIIE 2018. This dataset was therefore used as a guideline for the location and extent of the wetlands within the study area.
South African Geological Map (GIS coverage).	Council for Geoscience (2008).	Determine the underlying lithostratigraphic units to extrapolate the sub-surface flow movements and the parent material of the hydric soils.
South African national land cover (GIS coverage).	DEA (2020).	To conduct a comparison of what is presented in the dataset against what is currently observed on-site, and thus identify potential disturbance/impacts.

DATASET/TOOL	SOURCE	RELEVANCE
Wetland Vegetation Dataset of South Africa.	SANBI (2011).	Determine the presumed natural hydrophilic vegetation communities within the study area to ascertain the degree to which the natural cover has been altered by changes in land-use practices.
South African National Vegetation Map.	SANBI (2006-18).	Used as a broad baseline against which the on-site land cover and vegetation condition were compared to determine whether changes had occurred on-site.
National Biodiversity Assessment (NBA, 2018) Ecosystem Threat Status and Protection Level.	SANBI (2018).	These two metrics indicate the current status and protection level of South Africa's ecosystems as determined by the National Biodiversity Assessment 2018 Process. The data forms the foundation for many land use decision processes including conservation planning.

Visual Inspection

During the fieldwork, a visual investigation of the study area was conducted to identify any on-site and upstream impacts, from both the surrounding land-use activities and environmental processes which may have influenced the overall health and functionality of the impacted watercourses. The impacts observed and conditions of the study area were photographed, documented and related to professional experience. This essentially provided a baseline for further studies and justified the PES of the impacted watercourses.

Field Survey

The primary objectives of the field survey were to; 1) Verify and accurately delineate the watercourses that were deemed to be at high or medium risk of being impacted by the proposed activities, 2) Record the current ecological integrity of the surrounding catchment areas by identifying disturbances and areas of degradation in relation to the reference, or natural state, 3) Conduct an in-depth analysis of the PES of the at-risk watercourses and determine the potential of, and level to which, the systems supply valuable ESS to the surrounding natural and anthropogenic environments.

Delineation of Wetland Areas

The wetlands deemed to be at high or medium risk were delineated in detail during the field assessment utilising the methodology and techniques outlined within the wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWA, 2008). The permanent, seasonal and temporary (outer boundary) zones of wetness were determined by infield investigation of the wetness indicators, namely (**Figure 14-1**):

1. The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
2. The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991-2018), which are associated with prolonged and frequent saturation.
3. The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
4. The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

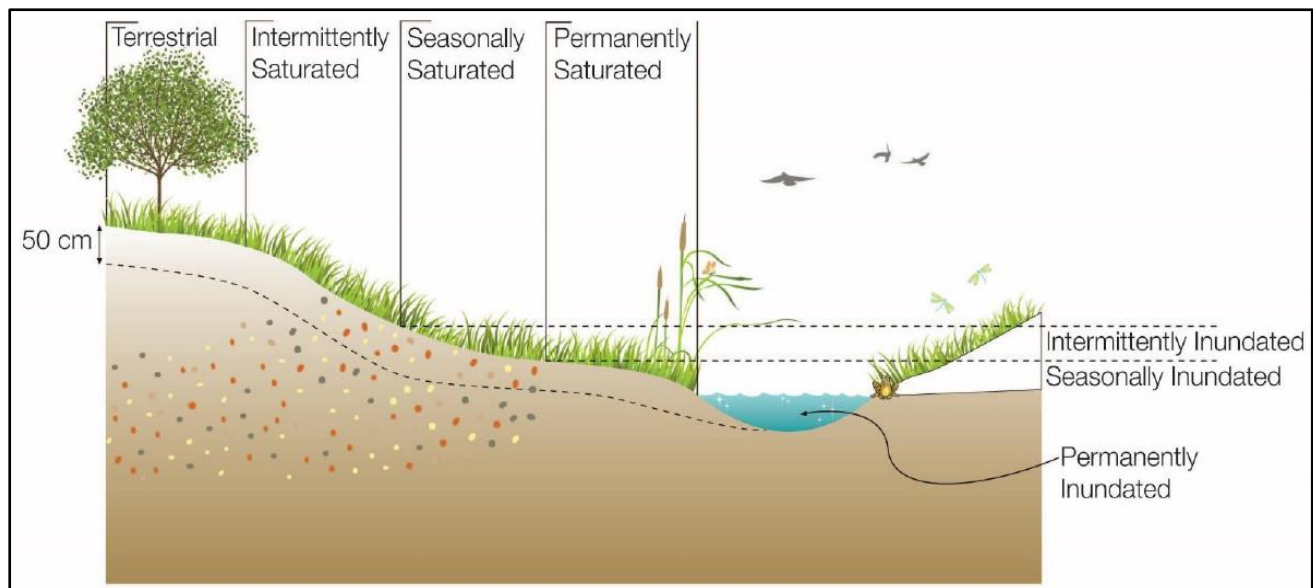


Figure 14-1: Illustration of the wetness zones typically present through a wetland system (Ollis *et al.*, 2013).

According to the wetland definition used in the NWA (Act No. 36 of 1998), vegetation is the primary indicator of wetness, which must be present under normal circumstances. However, in practice, the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained. The permanent, seasonal and temporary wetness zones can be characterised to some extent by the soil wetness indicators that they display.

Delineation of Riparian Areas

Riparian habitat is defined as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas” (Republic of South Africa, 1998). Riparian zones can thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (**Figure 14-2**).

Riparian zones are usually not saturated for a long enough duration for redoximorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel. A good indicator of a riparian zone is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised macro-channels. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area. Vegetation associated with riparian areas should be distinctive from the adjacent terrestrial land. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs in species composition relative to the

adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or number of individual plants.

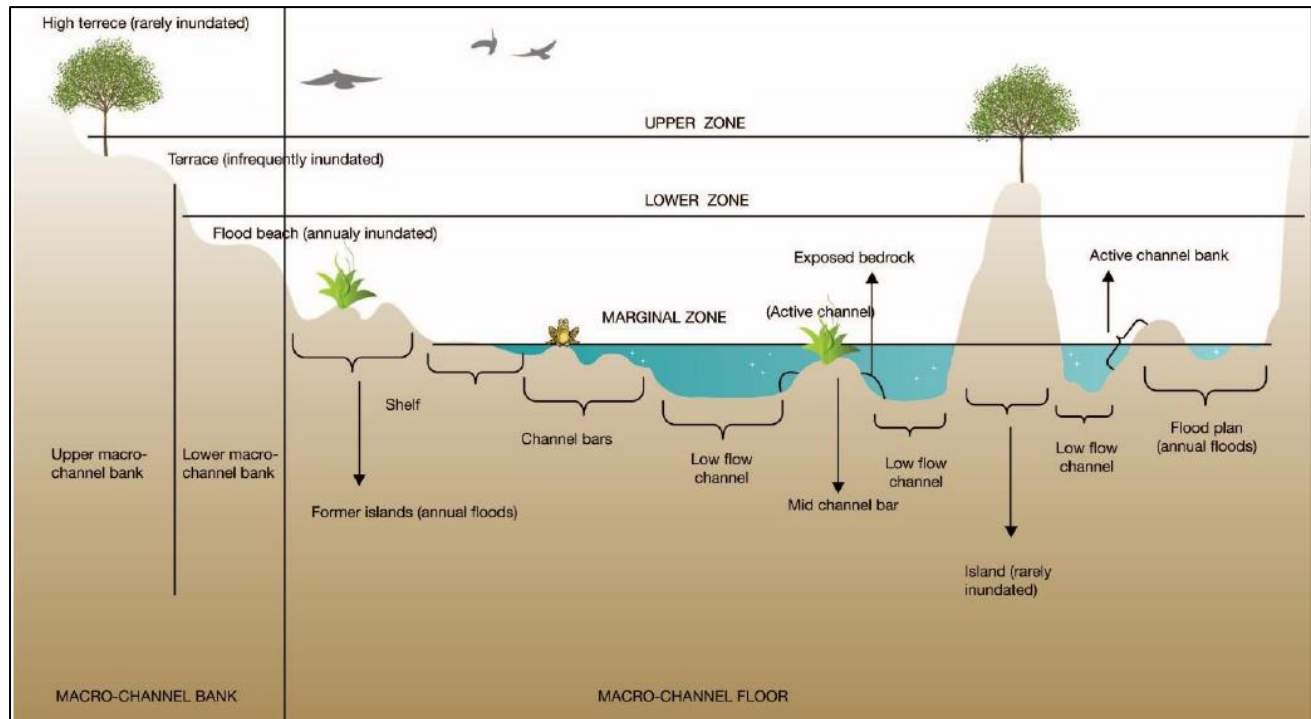


Figure 14-2: A schematic diagram illustrating the typical dissection of a river system (Kleynhans *et al.*, 2007).

Wetland Integrity: WET-Health Assessment

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology, and vegetation modules. The technique compares the presumed natural state of a wetland to the current condition observed on-site to ascertain what impacts/disturbances may have occurred within and surrounding the wetland, and thus determine the PES of the system by evaluating this in terms of the three modules. After determining the impacts that were recorded to have acted, or are acting, on the wetlands, specific mitigation and/or rehabilitation measures can be formulated and implemented to reduce the impact with the end goal of obtaining the Recommended Management Objective (RMO) of each wetland.

There are two levels of complexity, namely: Level 1 which is used for assessment at a broad catchment level, and Level 2 which provides detailed and confident analyses of individual wetlands based on in-field survey of the three WET-Health modules. Level 2 was utilised for the assessment of the wetlands that may be impacted by the proposed development. The following will briefly describe the three modules, followed by a presentation of the overall PES score categorisation that is used to represent the overall integrity/health of an assessed wetland.

The PES is assessed by evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four (4) inter-related components of wetland health, as follows:

- **Hydrology** is defined in this context as the distribution and movement of water through a wetland and its sediments. This module focuses on (i) changes in water inputs that result from human alterations to the catchment which affect water inflow quantity and pattern, and (ii) modifications within the wetland itself that alter the water distribution and retention patterns of the wetland (e.g. artificial drainage channels). These aspects are then integrated into a composite score that reflects the overall change in wetland hydrology.
- **Geomorphology** in this context is assessed by assessing changes to (i) geomorphic processes and (ii) the geomorphic structure of the wetland. Geomorphic processes in this context, refer to those physical processes that are currently shaping and modifying wetland form and evolution, whilst geomorphic structure refers to the three-dimensional shape of sediment deposits on which wetland habitat is established. Whilst catchment drivers (similar to those assessed in the hydrology module) are integrated as part of the assessment, impacts are ultimately assessed based on an understanding of the degree to which within-wetland geomorphic processes and the associated structure of the wetland have been altered by anthropogenic activities. The module also accounts for differences in geomorphic processes in wetlands characterised by clastic (minerogenic) sedimentation and those characterised by organic sediment accumulation (peat).
- **Water quality** is defined as the physicochemical attributes of the water in a wetland. It is assessed based on considering both potential diffuse runoff from land uses within the wetland and from the areas surrounding the wetland, together with point-source discharges of pollution entering directly into the wetland and/or into streams that flow into that wetland.
- **Vegetation** is defined in this context as the structural and compositional state of the vegetation within a wetland. This module evaluates changes in vegetation composition and structure because of current and historic on-site transformation and/or disturbance. Whilst the assessor needs to have some knowledge of vegetation in a particular region, the method does not require the assessor to be able to identify all wetland plant species. The emphasis is rather on identifying alien and ruderal (weedy) species that indicate disturbance and assessing their occurrence relative to common naturally occurring indigenous species, including those that are naturally dominant in the wetland.

Whilst scores for each component of wetland PES are calculated separately, individual scores from each component may also be combined into an overall PES score by weighting the component scores according to a pre-defined formula, as follows:

$$[\text{Overall (Combined) PES Score}] = [(\text{Hydrology score}) \times 3] + [(\text{Geomorphology score}) \times 2] + [(\text{Water Quality score}) \times 2] + [(\text{Vegetation score}) \times 2] \div 9).$$

This formula is refined by doubling the weighting for hydrology in situations where the wetland's hydrology has been seriously or critically modified (Ecological Category E/F). This reflects the overriding importance of hydrology in maintaining wetland processes.

The impact scores that are generated are translated into PES scores, which reflect the similarity to the natural reference condition. The PES scores are then used to place a wetland into one of several Ecological Categories that are consistently applied across all freshwater assessments in South Africa. These categories (and associated ranges of PES scores) are presented in **Table 14-2** below (MacFarlane *et al.*, 2020).

Table 14-2: Guideline for interpreting the magnitude of impacts on wetland integrity (Macfarlane *et al.*, 2009).

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE	PES SCORE (%)
A	Unmodified, natural.	0 – 0.9	90 – 100
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	80 – 89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	60 – 79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4 – 5.9	40 – 59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9	20 – 39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	0 – 19

WET-Ecoservice Assessment

WET-EcoServices (Kotze *et al.*, 2020) is used to assess the potential and effectiveness of a wetland at providing ESS (regulatory and supporting, and cultural and provisional benefits) to the surrounding anthropogenic and natural environment, thereby quantifying the value of the wetland, and thus aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ESS (e.g. flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydrogeomorphic setting (e.g. floodplain or unchannelled valley-bottom wetland). ESS delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on an in-field assessment of key descriptors (e.g. flow pattern through the wetland). The tool assists the practitioner in determining what ESS are currently being supplied, and to what degree/level, and thereafter identifies any threats acting on the benefits and if/what opportunities are available for enhancing the benefits.

The overall goal of WET-EcoServices is to assist decision-makers, government officials, planners, consultants, and educators in undertaking quick assessments of wetlands, specifically to reveal the ESS that they supply. This allows for

more informed planning and decision-making. **Table 14-3** presents the ESS/benefits that are utilised within the WET-Ecoservice assessment, followed by **Table 14-4** and **Table 14-5** overleaf which illustrates the categories used to rank the ability of a wetland to provide each ESS.

Table 14-3: Ecosystem Services that are used in the WET-Ecosystems assessment.

Ecosystem services supplied by wetlands				
Indirect benefits		Regulating and supporting benefits		
Water quality enhancement benefits		Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
		Streamflow regulation		Sustaining streamflow during low flow periods
		Sediment trapping		The trapping and retention in the wetland of sediment carried by runoff waters
		Phosphate assimilation		Removal by the wetland of phosphates carried by runoff waters
		Nitrate assimilation		Removal by the wetland of nitrates carried by runoff waters
		Toxicant assimilation		Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
		Erosion control		Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
		Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
Direct benefits		Biodiversity maintenance ²		
Provisioning benefits		Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
		Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
		Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
Cultural benefits		Cultural heritage		Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
		Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
		Education and research		Sites of value in the wetland for education or research

Table 14-4: The classes for determining the likely extent to which a benefit is being supplied based on the overall score for that benefit (Kotze et al., 2020).

INTEGRATING SCORES FOR SUPPLY & DEMAND TO OBTAIN AN OVERALL IMPORTANCE SCORE						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0,0	0,0	0,5	1,5	2,5
Low	1	0,0	0,0	1,0	2,0	3,0
Moderate	2	0,0	0,5	1,5	2,5	3,5
High	3	0,0	1,0	2,0	3,0	4,0
Very High	4	0,5	1,5	2,5	3,5	4,0

Table 14-5: Description of the ESS demand and supply categories (Kotze et al., 2020).

IMPORTANCE CATEGORY		DESCRIPTION
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

Wetland: Ecological Importance and Sensitivity (EIS)

The EIS of the wetlands was determined by utilising a rapid scoring system that was developed by Rowntree (2013), which incorporates aspects of the WET-Ecoservices tool (Kotze *et al.*, 2007) and earlier DWS EIS assessment tools. The purpose of assessing the EIS of a watercourse is to identify those watercourses that are of high conservation concern, primarily as a result of their ability to provide ESS at an above-average level, biodiversity function or are specifically susceptible to impacts/disturbances within the catchment area.

Water resources with higher ecological importance may require managing such systems in a better condition than the present to ensure the continued provision of ESS in the long term (Rowntree, 2013).

Three (3) proposed suites of criteria for assessing the EIS of wetlands form the basis of this tool, namely (**Table 14-6**):

- EIS, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest score out of the three abovementioned suites is then used to determine the overall EIS category of the wetland system (Table 14-7).

Table 14-6: Template used to calculate the overall Ecological Importance and Sensitivity of a wetland (Rowntree, 2013).

ECOLOGICAL IMPORTANCE AND SENSITIVITY			
Ecological Importance	Score (0-4)	Confidence (1-5)	Motivation for site
Biodiversity support			
Presence of Red Data species			
Populations of unique species			
Migration/breeding/feeding sites			
Landscape-scale			
Protection status of the wetland			
Protection status of the vegetation type			
Regional context of the ecological integrity			
Size and rarity of the wetland type/s present			
Diversity of habitat types			
Sensitivity of the wetland			
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
ECOLOGICAL IMPORTANCE & SENSITIVITY			
HYDROLOGICAL/FUNCTIONAL IMPORTANCE			
IMPORTANCE OF DIRECT HUMAN BENEFITS			
OVERALL IMPORTANCE			

Table 14-7: Presentation of the categories used to rank the EIS of each wetland system (Rowntree, 2013).

ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY	RANGE OF EIS SCORE
<u>Very High:</u> Wetlands that are considered ecologically important and sensitive on a national or even international scale . 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 from major rivers.	>3 and ≤4

ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY	RANGE OF EIS SCORE
<u>High:</u> Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water from major rivers.	>2 and ≤3
<u>Moderate:</u> Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water from major rivers.	>1 and ≤2
<u>Low/Marginal:</u> Wetlands that are not ecologically important or sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and ≤1

Present Ecological State (PES) – Riverine Systems

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (instream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physicochemical and habitat characteristics on a temporal and spatial scale that is comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

The site-specific habitat integrity was assessed utilising the Index of Habitat Integrity Assessment (IHIA), which was developed by Kleynhans (1996) and modified by Kemper (1999) and the DWS (2012). The riparian and instream habitats of each site were scored separately according to twelve (12) different criteria, which attempt to quantify the anthropogenically induced impacts on the relevant system (**Table 14-8**). This tool compares the current state of the instream and riparian habitats (with existing impacts) relative to the presumed natural, or reference state (in the absence of anthropogenic impacts). The overall integrity of each zone is thus based on the deviation from the natural or reference condition, expressed as a percentage where 100 % is the unmodified natural state. To obtain the overall habitat Integrity score for each site the mean of the instream and riparian habitat scores was calculated. The overall Habitat Integrity score was then classified into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F) (**Table 14-9**). This class/score describes the PES of both the instream and riparian habitats of each site.

Table 14-8: Criteria and relevance to the assessment of riverine habitat integrity (Kleynhans, 1996).

CRITERIA	RELEVANCE
Water Abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in the duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed Modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon <i>et al.</i> , 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included.
Channel modification	May be the result of a change in flow which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon <i>et al.</i> , 1992).
Exotic macrophytes	Alteration of habitat by obstruction of flow may influence water quality. Dependent upon the species involved and the scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter the habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon <i>et al.</i> , 1992). Refers to physical removal for farming, firewood and overgrazing. Includes both exotic and indigenous vegetation.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 14-9: Description of the Present Ecological State (PES) score categories of the IHIA model (DWS, 2008).

HABITAT INTEGRITY CATEGORY	DESCRIPTION	RATING (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitats and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

Ecological Importance & Sensitivity – Riverine Systems

The ecological importance of a river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh, *et. al.*, 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (**Table 14-10**).

Table 14-10: Components considered for the assessment of the ecological importance and sensitivity of a riverine system. An example of the scoring has also been provided.

ECOLOGICAL IMPORTANCE AND SENSITIVITY ASSESSMENT (RIVERS)		
DETERMINANTS		SCORE (0-4)
BIOTA (RIPARIAN & INSTREAM)	Rare & Endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4 very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	2
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0

ECOLOGICAL IMPORTANCE AND SENSITIVITY ASSESSMENT (RIVERS)		
DETERMINANTS		SCORE (0-4)
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	2,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		LOW, EC=D

The scores assigned to the criteria in **Table 14-10** were used to rate the overall EIS of each mapped unit according to **Table 14-11** below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007).

Table 14-11: The ratings associated with the assessment of the EIA for riparian areas.

RATING	DESCRIPTION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

Aquatic Assessments

Assessment of the aquatic ecosystem entails the characterisation of the aquatic environment, aquatic habitat and associated biota during two seasons (i.e. wet and dry). In order to enable an adequate description of the aquatic environment and determination of the PES the following stressor, habitat and response indicators were evaluated:

- Current and potential threats to water quality and stream condition;
- Information regarding upstream and downstream conditions, point and non-point pollution sources, water usage etc. and translate it into information that may be used to measure the compliance against WUL conditions and the integrity of the aquatic systems;
- Baseline data with regard to PES resources water quality objectives and the desired future aquatic condition;
- Isolate point source impacts and assess the nature and significance of these impacts;
- Provide specialist recommendations that may be implemented to mitigate and/or rehabilitate the identified and quantified impacts;
- Identify or expand on the baseline condition at each biomonitoring site against which future studies and monitoring works may be measured;
- Implement the most up-to-date best practice methodologies and techniques (e.g. SASS and IHAS) to accurately assess the current and change in condition within each reach; and
- Develop a comprehensive report with result analysis and specialist recommendations.

Risk Assessment Matrix (RAM) Methodology (DWS, 2023)

The following tables present and explain the scoring within the DWS required RAM for at-risk watercourses within the regulated areas around a Section 21(c) and (i) water use. This was used to assess the perceived impacts on the at-risk watercourses.

Table 14-12: Intensity - The intensity of the impact on the resource quality (hydrology, water quality, geomorphology, biota).

Negative Impacts	
Negligible / non-harmful; no change in PES	0
Very low / potentially harmful; negligible deterioration in PES (<5% change)	+1
Low / slightly harmful; minor deterioration in PES (<10% change)	+2
Medium / moderately harmful; moderate deterioration in PES (>10% change)	+3
High / severely harmful; large deterioration in PES (by one class or more)	+4
Very high / critically harmful; critical deterioration in PES (to E/F or F class)	+5
Positive Impacts	
Negligible; no change in PES	0
Very low / potentially beneficial; negligible improvement in PES (<5% change)	-1
Low / slightly beneficial; minor improvement in PES (<10% change)	-2
Medium / moderately beneficial; moderate improvement in PES (>10% change)	-3
Highly beneficial; large improvement in PES (by one class or more) and/or increase in protection status	-4
Very highly beneficial; improvement to near-natural state (A or A/B class) and/or major increase in protection status	-5
*PES of affected watercourses must be considered when scoring Impact Intensity NOTE: Positive Impacts must be given a negative Intensity Score	

Table 14-13: Spatial scale - How big is the area that the aspect is impacting, relative to the size of the impacted watercourse?

Very small portion of watercourse/s impacted (<10% of extent)	1
Moderate portion of watercourse/s impacted (10-60% of extent)	2
Large portion of watercourse/s impacted (60-80%)	3
Most or all of watercourse/s impacted (>80%)	4
Impacts extend into watercourses located well beyond the footprint of the activities	5

Table 14-14: Duration - How long does the aspect impact the environment and resource quality?

Transient (One day to one month)	1
Short-term (a few months to 5 years) OR repeated infrequently (e.g. annually) for one day to one month	2
Medium-term (5 – 15 years)	3
Long-term (ceases with operational life)	4

Permanent	5
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Table 14-15: Likelihood of the impact – What is the probability that the activity will impact the resource quality?

Improbable / Unlikely	20%
Low probability	40%
Medium probability	60%
Highly probable	80%
Definite / Unknown	100%

Table 14-16: Calculations and maximum values.

Intensity = Maximum Intensity Score (negative value for positive impact)	MAX = 5
Severity = Intensity + Spatial Scale + Duration (<Intensity - Spatial Scale - Duration> for positive impact)	MAX = 15 (MIN = -15 for +ve impacts)
Consequence = Severity X Importance rating	MAX = 75
Significance/Risk = (Consequence X Likelihood) X (100/75)	MAX = 100

Table 14-17: Rating classes.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 29	(L) Low Risk OR (+) Positive (+ +) Highly positive	Acceptable as is or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
30 – 60	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and requires specialist input. Licence required.
61 – 100	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.
A low-risk class must be obtained for all activities to be considered for a GA (GN4167, 2023).		

Impact Assessment Methodology (DEA, 2014)

The perceived impacts associated with the activities were assessed using a quantitative impact assessment methodology, which was formalised to comply with Regulation 31(2)(l) of the NEMA (Act No. 107 of 1998). This assessment aimed to identify and assess the significance of all the perceived impacts, which may arise as a result of the activities. The methodology employed makes use of the following procedure:

1. Identification and assessment of potential impacts;
2. Prediction of the nature, duration, extent, likelihood and significance;

3. Identification of mitigation measures that could be implemented to reduce the significance of the potential impact; and
4. Evaluation of the significance of the potential impacts following the implementation of mitigation measures.

Potential impacts were assessed using the following factors and associated score ratings (**Table 14-18**).

Table 14-18: The various factors considered when determining the significance of each potential impact associated with the activities.

CRITERIA	INDICATOR										
The nature	A description of what causes the effect, what will be affected and how it will be affected.										
The physical extent (spatial scale)	Wherein it is indicated whether: <table border="1"> <tr> <td>1</td><td>The impact will be limited to the site</td></tr> <tr> <td>2</td><td>The impact will be limited to the local area</td></tr> <tr> <td>3</td><td>The impact will be limited to the region</td></tr> <tr> <td>4</td><td>The impact will be national</td></tr> <tr> <td>5</td><td>The impact will be international</td></tr> </table>	1	The impact will be limited to the site	2	The impact will be limited to the local area	3	The impact will be limited to the region	4	The impact will be national	5	The impact will be international
1	The impact will be limited to the site										
2	The impact will be limited to the local area										
3	The impact will be limited to the region										
4	The impact will be national										
5	The impact will be international										
The duration (temporal scale)	Wherein it is indicated whether the lifetime of the impact will be of: <table border="1"> <tr> <td>1</td><td>A very short duration (0–1 years)</td></tr> <tr> <td>2</td><td>A short duration (2-5 years)</td></tr> <tr> <td>3</td><td>Medium-term (5–15 years)</td></tr> <tr> <td>4</td><td>Long-term (> 15 years)</td></tr> <tr> <td>5</td><td>Permanent</td></tr> </table>	1	A very short duration (0–1 years)	2	A short duration (2-5 years)	3	Medium-term (5–15 years)	4	Long-term (> 15 years)	5	Permanent
1	A very short duration (0–1 years)										
2	A short duration (2-5 years)										
3	Medium-term (5–15 years)										
4	Long-term (> 15 years)										
5	Permanent										

CRITERIA	INDICATOR
The intensity/magnitude of the impact on ecological processes (severity)	Impacts quantified on a scale from 0-10, where a score is assigned:
	0 Small and will have no effect on the environment
	2 Minor and will not result in an impact on processes
	4 Low and will cause a slight impact on processes
	6 Moderate and will result in processes continuing but in a modified way
	8 High (processes are altered to the extent that they temporarily cease)
	10 Very high and results in complete destruction of patterns and permanent cessation of processes
The probability of occurrence/likelihood of the impact (Likelihood of occurring)	Probability is estimated on a scale where:
	1 Very improbable (probably will not happen)
	2 Improbable (some possibility, but low likelihood)
	3 Probable (distinct possibility)
	4 Highly probable (most likely)
	5 Definite (impact will occur regardless of any prevention measures)

Subsequent to the abovementioned factors being ranked for each identified impact, the ecological significance of each impact was calculated utilising the following formulae:

Significance = (Intensity + Duration + Extent) x Probability. The maximum value is 100 Significance Points.

- The significance, which is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
- The status, which is described as either positive, negative or neutral;
- The degree to which the impact can be reversed;
- The degree to which the impact may cause irreplaceable loss of resources;
- The degree to which the impact can be mitigated;

The significance classes for each potential impact are outlined in **Table 14-19**.

Table 14-19: The significance weighting that can be allocated to each impact significance score.

SIGNIFICANCE VALUE	SIGNIFICANCE WEIGHTING	DESCRIPTION
< 30	Low	This impact has a Low ecological significance and does not impact the decision to develop within the area
31-60	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60	High	Where the impact must have an influence on the decision process to develop in the area

APPENDIX B: SPECIALIST CVs



Hanro (J.J.) Pearson
Divisional Head Aquatics & Wetlands
Environmental Scientist

QUALIFICATIONS

- MSc. Environmental Science – *Cum Laude*
North-West University – 2022.
- BSc Hons. in Environmental Science with
Aquatic Ecosystem Health
North-West University – 2018.
- BSc Environmental and Biological Science
Zoology and Botany
North-West University – 2017.

CRITICAL SKILLS

- Project Management
- Strategic Planning
- Alien and Invasive Plant Species Management Plans
- Rehabilitation Plans
- Environmental Impact Assessments
- Scientific Research
- Aquatic Biomonitoring Assessments
- QGIS Mapping
- Watercourse Delineations
- Water Quality Analysis

MEMBERSHIPS

- SACNASP – 156536.
- South African Society of Aquatic Scientists (SASAqS).
- Golden Key International Honour Society.
- South African Scoring System Version 5 (SASS5)
Accredited.

PROFESSIONAL HISTORY

Hanro earned his MSc in Environmental Science *Cum Laude* from the North-West University. His research project focused on Aquatic Ecosystem Health and Invasion Biology. He has three years of professional experience as an Environmental Scientist and has contributed to various projects, including Alien and Invasive Plant Species Management Plans, Rehabilitation Plans, Basic Assessments, Environmental Impact Assessments, Environmental Management Plans, Research Projects and Aquatic Biomonitoring Assessments.

CURRENT HIGHLIGHTS

Hanro is a published academic author and has recently contributed to several publications and research projects focusing on aquatic ecosystem health and invasion biology. Hanro is currently the Divisional Head of Aquatics & Wetlands at ENVASS, where he also serves as an Environmental Scientist. He is involved in the Aquatic, Biodiversity and Environmental Auditing divisions.

DEVELOPMENTAL HIGHLIGHTS

- Research Integrity and Animal Research Ethics Course
North-West University – 2021.
- Marine Fish Parasite Identification and Bio-Tagging
University of Cape Town – 2019.
- Ectothermic Vertebrate Handling and Ethics SANS training
for research with animals
North-West University – 2019.

PUBLICATIONS

- **Pearson, J.J.,** Gerber, R., Malherbe, W., Smit, N.J. and de Necker, L., 2024. A review of the reported and future potential ecological impacts of the invasive freshwater snail *Tarebia granifera* in South Africa. *African Journal of Aquatic Science*, 49(3), pp.179-195.
- Gerber, R., **Pearson, J.J.,** Kock, A., Malherbe, W. and de Necker, L., 2025. Evaluating the ecological consequences of *Tarebia granifera* density on benthic diatom communities in South African river systems. *Biological Invasions*, 27(6), pp.1-23.
- Gerber, R., **Pearson, J.J.,** Wepener, V., Malherbe, W. and de Necker, L., 2024. Distribution, abundance, population structures, and potential impacts of the invasive snail, *Tarebia granifera* in aquatic ecosystems of north-eastern South Africa. *Ecology and Evolution*, 14(6), p.e11544.
- de Necker, L., **Pearson, J.J.,** Le Roux, M.H., Smit, N.J. and Wepener, V. 2023. Chapters 1 to 5. (In de Necker, L. *et al. ed.* Current status and future predicted distribution patterns of bilharzia-transmitting snails under climate change and implications for vector-borne diseases in South Africa. Report to the Water Research Commission (WRC). WRC Report No C2019/2020-00151).
- **Pearson, J.J.,** 2022. *The role of Tarebia granifera as an invasive in freshwater ecosystems of Southern Africa.* MSc. dissertation, North-West University, South Africa.



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herewith certifies that
Johannes Jurgens Pearson

Registration Number: 156536

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)

in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Certificated Natural Scientist)

Effective **20 April 2023**

Expires **31 March 2026**



Chairperson

Chief Executive Officer



To verify this certificate scan this code



Gareth Preen

Senior Business Unit Manager &
Aquatic Ecologist

QUALIFICATIONS

- BSc Honours in Geography and Environmental Science
University of KwaZulu-Natal - 2015.
- BSc in Geography and Environmental Science
University of KwaZulu-Natal - 2014.
- Matriculation (IEB Examination)
St. Benedict High School - 2010.

MEMBERSHIPS

- Wetland Society of South Africa.
- International Association for Impact Assessment South Africa (7433).

CRITICAL SKILLS

- Aquatic biodiversity (rivers and wetlands) delineations, functional and impact assessments.
- SASS5 biomonitoring.
- DWS Risk Assessment Matrix (RAM).
- Rehabilitation and Offset Plans.
- Invasive Alien Plant Species Plans.
- Watercourse Audits and Compliance Monitoring.
- Project Management.
- Strategic planning.

PROFESSIONAL HISTORY

- Gareth holds a BSc Honours Degree in Geography and Environmental Science from the University of KwaZulu-Natal.
- He is a certified wetland delineation and assessment practitioner through the Department of Water and Sanitation (DWS).
- Gareth is a certified South African Scoring System Version 5 (SASS5) practitioner.
- Currently has over nine (9) years' experience in the environmental sector with experience in conducting wetland assessments, aquatic assessments, alien and invasive plant removal monitoring, soil erosion monitoring, wetland auditing, and various aspects of Water Use License Applications.

CURRENT HIGHLIGHTS

- Lead Aquatic specialist for the South Deep Mine, South Africa.
- Springfield Mine Wetland Rehabilitation and Offset Strategy, South Africa.
- Royal Bafokeng Nation Bulk Water Supply Reticulation Project.

DEVELOPMENTAL HIGHLIGHTS

- Wetland Rehabilitation Short Course (WetRest) (2023).
- First Aid Level 3 (First Aid Training Academy) (2022).
- WET-Health Version 2, WET-EcoServices Version 2 & Wetland Delineation Short Course (Rhodes University) (2021).
- South African Scoring System Version 5 Short Course (Groundtruth and DWS) (2021).
- Advanced/Defensive Driving Course (Travis Duggan Advanced Driving) (2021).
- Tools for Wetland Assessment Version 1 (Rhodes University) (2018).
- Soil Classification and Land Capability (Department of Agriculture, Forestry and Fisheries (DAFF), Cedara College) (2017).
- Wetland Management: Introduction and Delineation (University of the Free State) (2017).
- Various short courses and quarterly legal updates.



PROFESSIONAL HISTORY

- Dawid holds a MSc in Environmental Science from the North-West University and is a registered professional scientist with 8 years' experience.
- He has a comprehensive experience and knowledge on compliance monitoring, project management, sub-contractor management, and specialist reporting.
- As an environmental consultant, Dawid has provided several environmental monitoring, environmental compliance audits and specialist assessment services.



Dawid Smith

Business Unit Head: Compliance Monitoring and Specialist Studies

CURRENT HIGHLIGHTS

- Develop and maintain environmental compliance monitoring programmes in conjunction with site audits and assessments.
- Compile and overseeing reports on water-, soil-, air-quality and site findings, with interpretation of results and recommendations.
- Conduct and report on specialist requirements, that includes visual, noise and soil impact assessments, maintain and build customer relationships with guidance on environmental matters and updates on environmental legislation.
- Conduct and report on environmental compliance audits (EMPr, WUL, WML, EA).

QUALIFICATIONS

- MSc. Environmental Science; North-West University - 2016
- BSc. Honours Environmental Science; North-West University - 2012
- BSc. Environmental and Biological Science; North-West University - 2011

DEVELOPMENTAL HIGHLIGHTS

- Quarterly Legal Update Training
- EAP, ESO & ECO Online Training (ETAZA)

MEMBERSHIPS

- SACNASP – 146281
- IAIAsa # 7439

CRITICAL SKILLS

- Project Management
- Environmental Compliance Auditing
- Specialist Impact Assessment
- Monitoring programme design
- Data management and data evaluation
- Quality control and management
- Scientific Reporting
- Management of project finances, including quoting, invoicing and budgeting



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Dawid Cornelius Smith

Registration Number: 146281

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)

Effective **2 November 2022**

Expires **31 March 2026**



Chairperson

Chief Executive Officer



To verify this certificate scan this code



Moné-Oosthuizen

Environmental Scientist

QUALIFICATIONS

- → SACNASP registration: Candidate Natural Scientist, Registration number 177592 – 2025
- → University of South Africa: BSc (Hons) Environmental Management – 2024
- → University of South Africa: BSc Life Sciences – 2023
- → The TEFL Academy: Qualifi Level 5 certificate in Teaching English as a Foreign Language – 2020
- → Oos-Moot – National Senior Certificate – 2014

DEVELOPMENTAL HIGHLIGHTS

- → SACNASP registration: Candidate Natural Scientist
- → First Aid Level 2
- → Snake Awareness – First Aid and Venomous Snake Handling – African Snakebite Institute
- → Snake Handling Bootcamp – African Snakebite Institute
- → CrossFit Level 1 Trainer

PROFESSIONAL HISTORY

- → Moné holds a BSc honors degree in Environmental Management from the University of South Africa and graduated cum laude BSc Life Sciences in Genetics and Physiology.
- → Moné is currently expanding her knowledge in the Environmental Consulting Industry, at ENVIASS.

CURRENT HIGHLIGHTS

- → Gaining practical experience in environmental compliance monitoring, including assessments of ambient air quality, groundwater, surface water, and drinking water, as well as terrestrial biodiversity impact studies (flora and fauna – data collection and technical reporting).
- → Compiling and interpreting air and water quality reports, with clear, actionable recommendations for environmental management and regulatory compliance.
- → Developing core competencies in environmental fieldwork, including conducting site visits.
- → Infield plant species identification training.

CRITICAL SKILLS

- → Environmental compliance monitoring, including accurate data collection and professional report writing.
- → Environmental data management and technical report compilation aligned with industry standards.
- → Biodiversity impact assessments, with a focus on evaluating ecological implications for both fauna and flora.
- → Aquatic biomonitoring and the preparation of scientifically sound assessments for freshwater ecosystem health.



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Registration Number: 177592

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)

in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Candidate Natural Scientist)

Effective **11 June 2025**

Expires **31 March 2026**



Chairperson

Chief Executive Officer



To verify this certificate scan this code