

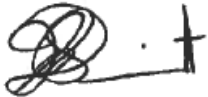
AQUATIC ASSESSMENT

WATERCOURSE REHABILITATION AND PLANT SPECIES PLAN FOR THE
GOLDFIELDS SOUTH DEEP GOLD MINE, SITUATED WITHIN WESTONARIA OF THE
GAUTENG PROVINCE, SOUTH AFRICA.



PREPARED FOR: South Deep Gold Mine
PREPARED BY: Environmental Assurance (Pty) Ltd.
DATE: April 2026
REPORT NUMBER: WET-REP-281-25_26 (Rehab)
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Accreditations	MSc Environmental Science. BSc Hons Environmental Science. Certified wetland delineation and assessment practitioner. Department of Water and Sanitation (DWS) accredited SASS5 aquatic biomonitoring practitioner.		
QUALITY CONTROL			
	Author and Fieldwork	Reviewer and Fieldwork	Sign-off
Name	Gareth Preen	Johannes Jurgens Pearson	Dawid Smith
Designation	Senior Aquatic Specialist	Divisional Head Aquatic and Wetland Services Cert. Sci. Nat. - 156536	Compliance Monitoring and Specialist Assessment Pr. Sci. Nat - 146281
Signature			
Date	22-04-2026	22-04-2026	22-04-2026
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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 compile a Watercourse Rehabilitation and Plant Species Plan for the watercourses within the mining right area.

ENVASS was appointed to compile a watercourse rehabilitation and plant species plan for the watercourses on the South Deep mining right area. The plan focused on the most prominent impacts and provided measures that will improve the overall integrity and functionality of the target watercourses, which were identified within the consolidated assessment (ENVASS, 2025).

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LIST OF ABBREVIATIONS AND ACRONYMS

TERM	EXPANSION
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

TERM	EXPANSION
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 compile a Watercourse Rehabilitation and Plant Species Plan for the watercourses within the mining right area.

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.

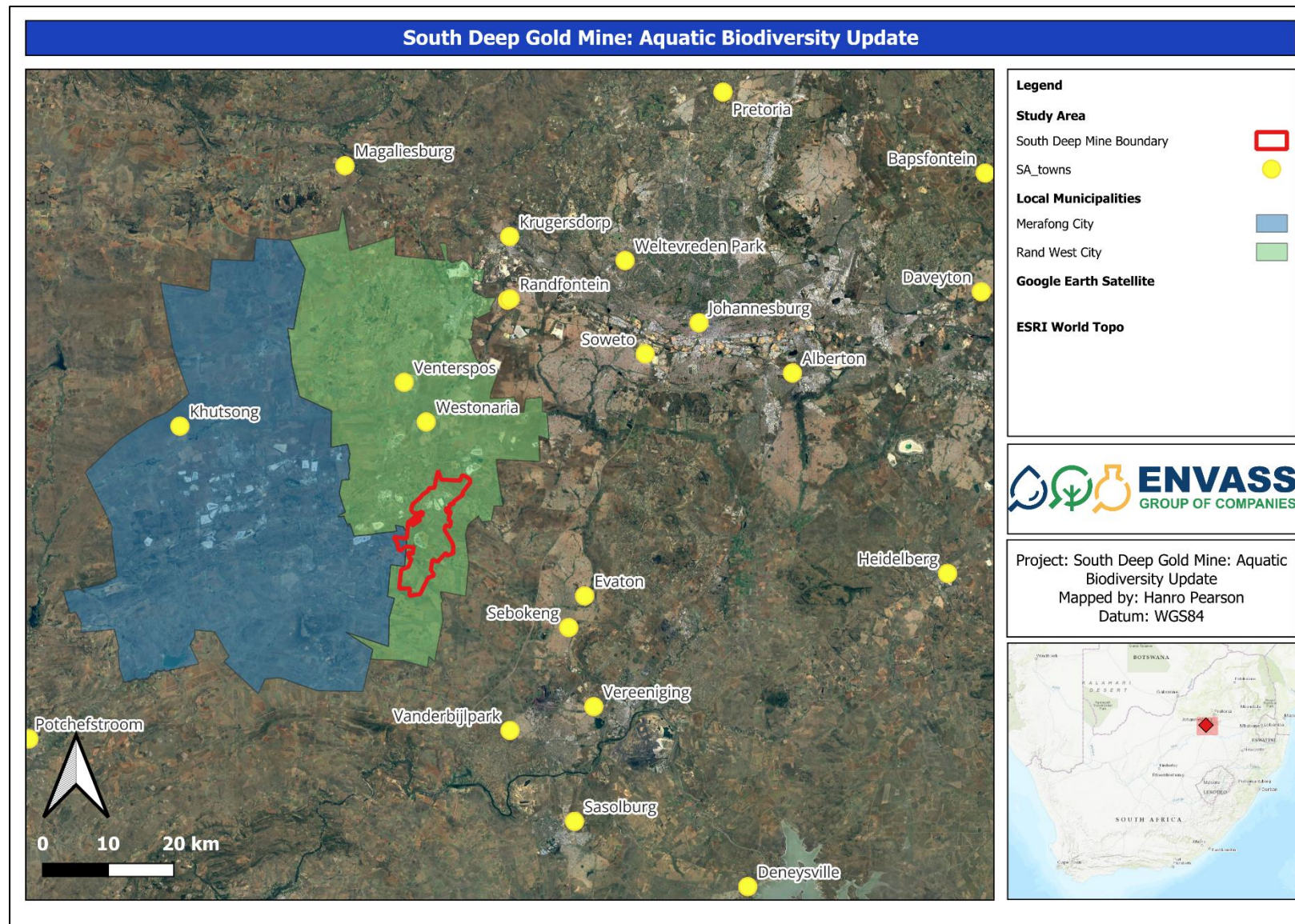


Figure 1-1: Locality map of the study area in relation to surrounding towns and municipal boundaries within the Gauteng Province, South Africa.

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.
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:

- A Watercourse Rehabilitation Strategy was drafted. The content of the Watercourse Rehabilitation Strategy is inclusive of the following:
- Rehabilitation goals, aims, objectives and targets to be met by the rehabilitation strategy. This was guided by a step-by-step rehabilitation work plan for the impacted watercourses, which guided the physical implementation of rehabilitation onsite. The desired outcome of the rehabilitation works is described.
- Formulation of a rehabilitation and management plan for the at-risk watercourses for implementation onsite to ensure that impacts to the receiving watercourses are mitigated and rehabilitated where necessary.
- Draft a comprehensive watercourse rehabilitation plan for the impacted watercourses and ascertain whether the project-specific aims and objectives can be achieved.

3 WETLAND REHABILITATION RATIONALE

Rehabilitation refers to the measures implemented in the process of returning an impacted area to a condition ecologically similar to its former (pre-mining reference state), or a desired ecosystem structure, function, biotic composition and to provide associated Ecosystem Services (ESS) (DWS, 2005). Rehabilitation thus entails undertaking certain remedial actions

to minimise the adverse impacts on the environment and to prevent further environmental degradation from occurring, continuing or recurring (DWS, 2022). Rehabilitation forms part of a hierarchical structure that was formulated by DEA *et al.* (2013) for dealing with negative impacts on biodiversity and ecosystems (**Figure 3-1**). This hierarchy was designed to be followed from top to bottom to ensure that all means are consulted to reduce the overall impact on the receiving environment. As it will not be deemed possible to avoid or minimise the impacts that may be caused by the activities associated with the proposed activity on the aquatic environment, this study attempts to investigate the feasibility of using rehabilitation measures to remediate the overall impacts on the at-risk watercourses. The result of this must be a 'no net loss' or gain in ecosystem integrity and functionality for this step to be the last to be implemented within the mitigation hierarchy.

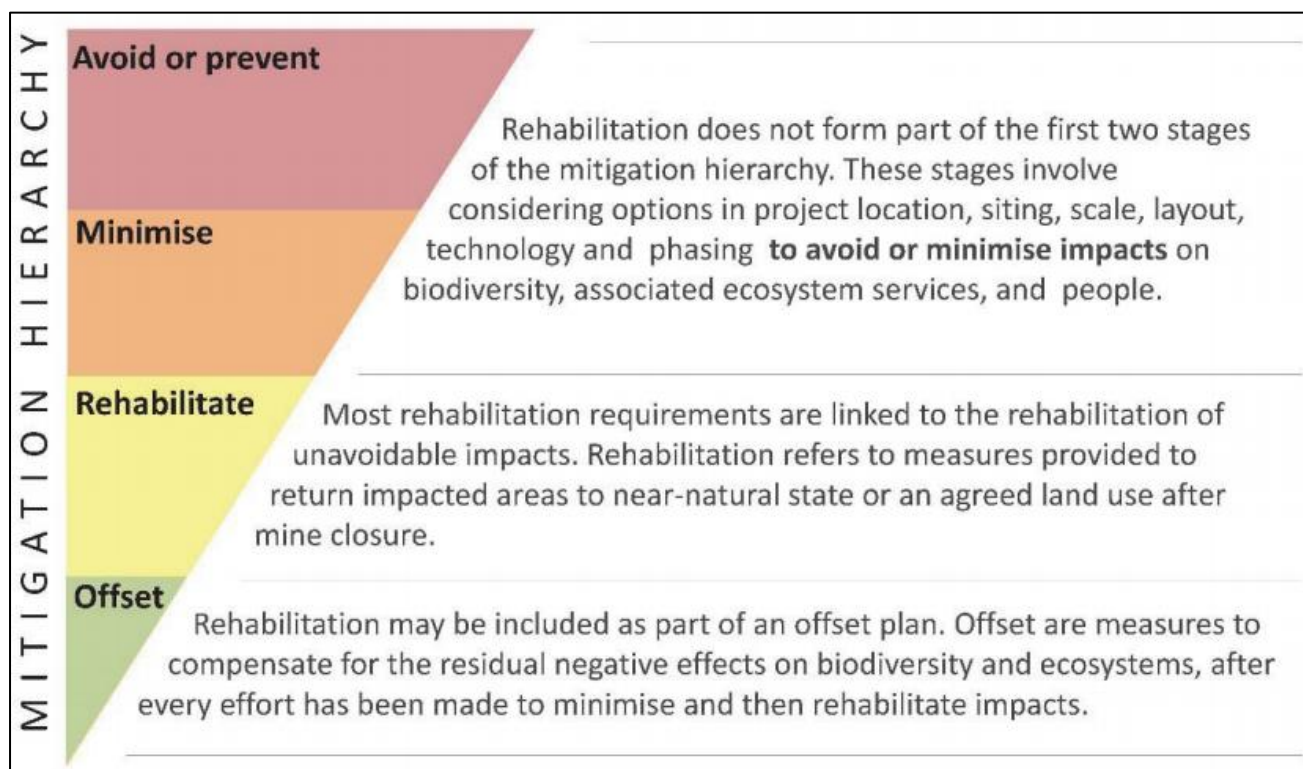


Figure 3-1: Rehabilitation mitigation hierarchy for dealing with negative impacts on biodiversity (DEA *et al.*, 2013).

Figure 3-2 illustrates an overview of the holistic rehabilitation process that encompasses the three primary phases, namely: 1) planning, 2) implementation and 3) monitoring and management. This study will form part of phase 3 as a strategic plan in which the project goals, objectives and targets are defined and the feasibility discussed.

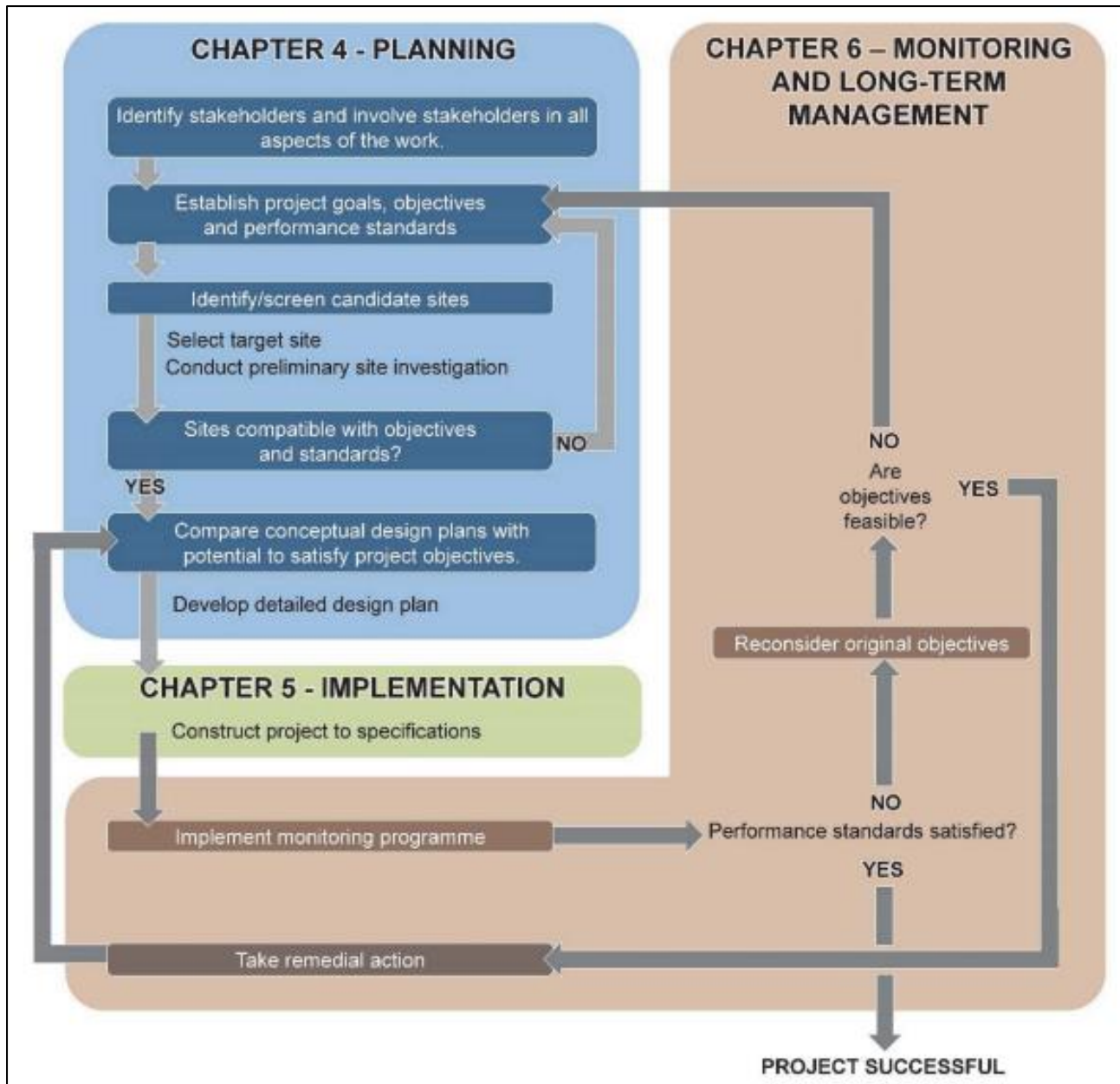


Figure 3-2: Rehabilitation, planning, implementation, monitoring and long-term management (Macfarland, 2016).

There are many forms of wetland rehabilitation, but there are two main schools of thought which encompass the majority of the wetland rehabilitation types, namely (taken from WRC (2016)):

1. On-site rehabilitation: This refers to the rehabilitation of areas owned or managed by the mine. It includes rehabilitation of wetlands (i) directly impacted by mining activities once mining activities have ceased and (ii) other degraded wetlands that can be rehabilitated to compensate for mining impacts. DWS generally stipulates the need for the rehabilitation of wetlands as part of Section 21 (c) and (i) Water Use License applications.
2. Rehabilitation as part of an offset requirement: This refers to situations where the need for an offset is identified as a last resort to address residual wetland impacts that cannot be addressed through on-site rehabilitation efforts. Under this scenario, the rehabilitation of certain wetlands may be included as part of a wetland offset plan. In some cases, this involves wetlands located within an alternative area owned or managed by the mine, but in most cases,

this involves wetlands located on land some distance away from the impacted site, often referred to as an 'offsite' area. Offsite wetland rehabilitation in cases where the rehabilitation sites are not owned by the mining house presents challenges in terms of securing and managing the site in the long term.

4 SUMMARY OF THE BASELINE ASSESSMENT

4.1 Watercourse Delineation Map

ENVASS (2025) undertook a consolidated aquatic biodiversity impact assessment and identified several watercourses within the mining boundary. 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). **Figure 4-1** presents the overall watercourse delineation map.

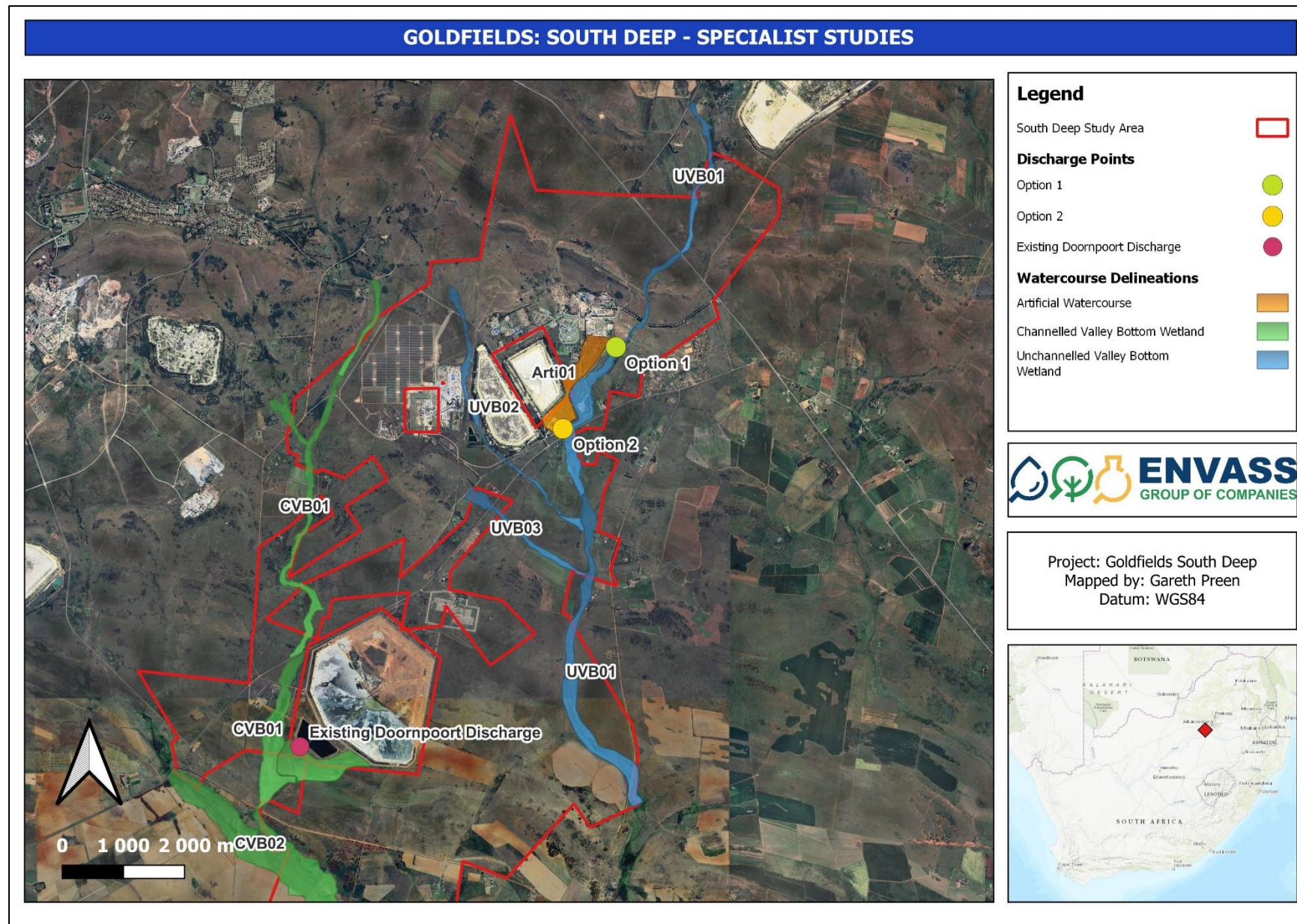


Figure 4-1: Map illustrating the overall watercourse delineation for the study area.

4.2 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 4-1** presents the results of the functional assessments relevant to the watercourses.

Figure 4-2 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. The aforementioned impacts will form the basis of this rehabilitation plan.

Table 4-1. 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 4-2: 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.

5 WATERCOURSE MANAGEMENT AND REHABILITATION STRATEGY

Rehabilitation is not the static endpoint of a recipe-like process (Kusler & Kentula, 1990). Rather, it is a process in its own right, whereby the wetland system is given an opportunity for a new beginning (Grenfell *et al.*, 2007). Rehabilitation requires an attempt to imitate natural processes and reinstate natural ecological driving forces in such a way that it aids the recovery (or maintenance) of dynamic systems so that, although they are unlikely to be identical to their natural counterparts, they will be comparable in critical ways so as to function similarly (Jordan *et al.*, 1987). It must be recognised that rehabilitation interventions may have different ecological starting points (ranging from totally degraded to slightly degraded) and different goal endpoints (ranging from a state that is close to pristine to one which is still far from pristine, but nonetheless an improvement on the state of the system without any rehabilitation intervention). The chosen goal endpoint depends on what is achievable, given the site conditions, and those ecosystem attributes and services that are considered most important. Any rehabilitation project should therefore be based on an understanding of both the ecological starting point and a defined goal endpoint, and should accept that it is not possible to predict exactly how the wetland system is likely to respond to the rehabilitation interventions.

With the implementation of wetland habitat rehabilitation, it is important to set aims and objectives for the planned rehabilitation in accordance with WET-RehabPlan (Kotze *et al.*, 2008). The following are the overall aims and objectives of this wetland rehabilitation strategy.

5.1 Overall Aim

The aim of this rehabilitation strategy is to:

- 1 Provide potential means and measures of remediating the perceived impacts on the watercourses.
- 2 Enhance the functionality and integrity of the remaining watercourse habitat.
- 3 Rehabilitate the watercourses to improve functional and habitat gains in order to achieve a 'no net-loss' of hectare equivalents in the post-rehabilitation state.

5.2 Rehabilitation Objectives

Effective rehabilitation of the watercourses will require achieving the following objectives:

1. Repair eroded and trenched areas.
2. Repair dilapidated culverts.
3. Infill excavated areas.
4. Remove AIPS from the watercourses.
5. Revegetate disturbed areas with indigenous hydrophytic vegetation.
6. Establish 80% indigenous hydrophytic vegetation cover within 18 months of planting.
7. Implementation of an appropriate watercourse "no-go" buffer zone.
8. Effectively manage the watercourse such that the rehabilitated state is maintained.

5.3 Work Plan

5.3.1 Repair of erosion features and infill of excavated areas

- Erosion features such as head-cuts and gullies will be backfilled using available eroded material. Where insufficient eroded material is available, suitable material must be sourced, where available, for use as infill.
- Any previously excavated areas must be backfilled using the appropriate material. It is essential that the infilled material is appropriately compacted. It is recommended that this be done during the dry season to limit the potential for further erosion from propagating.
- Backfilled areas must be shaped and/or landscaped to mimic the pre-disturbance landscape and topography.
- Revegetation of the repaired area must take place using indigenous wetland vegetation species using the methodology outlined further below.
- Any sinkholes within the system will need to be rehabilitated and managed. The sinkhole should be rehabilitated using the 'Inverted Filter Method' as follows:
 - The throat (lowest point) of the sinkhole must be blocked/packed with rockfill or boulders in combination with soilcrete.
 - Layers of progressively finer material ranging from cobbles to sand size and suitable for compacting must be put in place to create an impermeable capping.
 - The remaining space must then be backfilled using appropriate *in situ* material.
 - A suitably qualified environmental engineer must be consulted with regard to the best practice design of this rehabilitation measure.
 - Regular monitoring of the sinkhole must take place following the completion of the rehabilitation measures to ensure that no further erosion takes place.

Timeframe – This will need to be undertaken as an ongoing, concurrent rehabilitation measure during mining activities.

5.3.2 Watercourse Road Crossings/Replacement of Culverts

- Install low-level concrete crossings or grade crossings to match the natural base level to prevent flow impedance. Ensure that the crossings are robust to ensure it can handle the load of heavy machinery that may be required during mining.
- Implement erosion control (e.g., dense vegetation cover) upstream and downstream of crossings.
- Establish vegetated buffers at both ends using the methods described above.

Timeframe – This will need to be undertaken prior to the commencement of mining activities to enhance and reinstate the natural hydrological regime.

5.3.3 Removal and Management of AIPS

- AIPS within the delineated boundaries of the focus watercourse must be removed and managed for a period of six (6) months or until such time that the repropagation of target AIPS does not occur.
- Only environmentally friendly herbicides and those registered for use within aquatic systems should be used and personnel must be adequately trained on the safe application of these chemicals. Additionally, herbicides selected for control must be registered for use on that species under the conditions specified. According to the Working for Water (2002) 'Policy on the use of Herbicides for the Control of Alien Vegetation' only the following herbicides are approved for use:
 - Garlon 4 (triclopyr (butoxy ethyl ester) 480g/l)
 - Viroaxe (triclopyr (butoxy ethyl ester) 480g/l)
 - Timbrel 3A (triclopyr (amino salt) 360g/l)
 - Mamba 360 SL (glyphosate 360 g/l)
 - Chopper (imazapyr 100g/l)
 - MSMA (MSMA 720g/l)
- The following steps should be followed during the removal of woody species such as *Eucalyptus* and *Searsia* and similarly structured species:
 - Where young trees/saplings are concerned, manual methods such as hand pulling should be utilised. It is imperative that the rooting system is also pulled out of the soil to ensure efficacy. Soil disturbance must also be minimised to reduce the potential for seed germination.
 - For mature/large trees, it is recommended that mechanical and chemical methods are utilised. In this regard, the following steps must be followed:
 - Where it is safe to do so, large trees should be felled to a stump that is approximately 30cm above ground. Extreme care must be taken to ensure that the falling trunk does not damage any indigenous species in the surrounding area.
 - An approved herbicide must then be applied to the whole stump and exposed roots. It is recommended that Mamba 360 SL (glyphosate 360 g/l) is used in accordance with the Working for Water policy document.
 - If it is deemed unsafe to first cut large trees, it is recommended that the ring barking method be used. The bark must be removed from the bottom of the stem to a height of approximately 0.75 to 1m. All bark must be removed to below ground level where possible.
 - A second method which could be utilised is the frilling method. An approximately 25cm wide cut should be made into the bark near the base of the tree using either an axe or a bush knife. A suitable herbicide, such as Mamba 360 SL (glyphosate 360 g/l), must then be applied to the cuts.
- For AIPS such as *Verbena bonariensis*, *Tagetes minuta*, *Bidens pilosa*, *Cosmos bipinnatus* and similarly structured vegetation, foliar spraying should be utilised as per the following guidelines:
 - Pressure or flow regulators must be fitted to sprayers for overall application.

- Spraying should be restricted to AIPS that are waist height or lower. However, there should be sufficient foliage present to carry the herbicide down to the rooting system.
- Only selective herbicides should be utilised and which are regarded as safe to use within aquatic ecosystems.
- Foliar spraying should not be used if rain has been forecast.
- Clearing should commence within lighter infested areas, which comprise of younger AIPS species and less dense stands, which have smaller seed banks and a potentially higher rate of spread. Starting within these areas will require fewer resources and will have the greatest impact in the long-term. More dense, mature AIPS stands should be cleared last, as they have already been established and pose a limited threat of increasing in density or area beyond their current state.
- Follow-up control must take place according to the site-specific AIPS Management Plan.

Timeframe – This will need to be undertaken as an ongoing, concurrent rehabilitation measure during mining activities.

5.3.4 Implementation of a “no-go” buffer zone

- Following the completion of rehabilitation activities, this area should ideally be regarded as a “no-go” zone with appropriate “no-go” signage erected around the site to limit intrusion. Additionally, the conservation and importance of this area should be added to the induction programme.
- In accordance with this assessment, a 25m operational phase buffer zone should be implemented. However, this may need to be discussed further with the proponent and competent authority to refine this recommended buffer zone requirement.
- The final buffer zone should be pegged out using dropper poles and suitable netting. The ingress of any machinery or mining activities should be prohibited as far as reasonably practical.
- A robust vegetation cover must be established within the buffer zone using indigenous plant species to ensure that the hydrological, geomorphological and vegetation components of the wetland are not degraded any further. The indigenous vegetation mixture should be informed by the terrestrial biodiversity specialist.

Timeframe – This will need to be implemented following the commencement of rehabilitation measures during mining activities and followed through after the Life of Mine (LOM) has come to an end.

6 PLANT SPECIES PLAN

Following the implementation of the above aspects, it will be essential to revegetate the areas with a mixed indigenous, hygrophilous, herbaceous community. This will need to exert a competitive influence, thereby inhibiting the sprouting of AIPS and stabilising the soil prolife to encourage the natural process of succession to take place. Indigenous wetland vegetation removed and stored during the excavation of the mining pit can be utilised for rehabilitation activities. This removal of indigenous wetland vegetation from this area must be done under the supervision of a suitably qualified botanist.

Furthermore, additional plant material can be procured from local, reputable nurseries. Only healthy, genetically sound, locally sourced plant material must be utilised. Sufficient quantities of the required species should ideally be ordered at least 12 months (6 months minimum) prior to when planting is scheduled to commence. A list of species which can be utilised in revegetation activities, as well as the hydrological zones within which they can be introduced, is provided in **Table 6-1**. At least ten (10) of the listed species must be introduced to the watercourses.

- Seeding should be undertaken according to the following steps:
 - Till and loosen soils to a depth of 100mm with a hoe.
 - Spread the grass species seeds by hand at the recommended rates.
 - Rake a layer of soil over the seeds. The seeds should not be planted to a depth of more than 2.5 times their width.
 - Water seeded areas thoroughly once every four days for the first six months after seeding unless rain has fallen within the preceding 24 hours.
- Planting whole plants should be undertaken according to the following steps:
 - Planting must be done at a reasonable density of approximately 4 plants per square meter.
 - Dig a hole that is 2 times the width and 1.5 times the depth of the bag containing the plant.
 - Remove the plant as well as the associated soil from the bag/pot and loosen the soil gently with your hands, ensuring that damage to the roots is avoided.
 - Place the plant together with the soil into the hole.
 - Replace *in situ* soil and compress firmly by hand. Ensure that a slight depression is created in the soil around the plant, which will collect water.
 - Undertake thorough watering approximately once every four days for the first six months after planting unless rain has fallen within the preceding 24 hours.
- Planting propagules should be undertaken according to the following steps:
 - Divide healthy adult plants into propagules with the use of pruning shears.
 - Each propagule must have a sufficient root system.
 - Dig a hole that is deep enough and wide enough to ensure that at least half of the propagule is below ground and half is above ground.
 - Planting must be done at a reasonable density of approximately 4 plants per square meter.
 - Undertake thorough watering approximately once every four days for the first six months after planting unless rain has fallen within the preceding 24 hours.
- All Species of Conservation Concern (SCC) and protected species onsite should be clearly marked using an appropriate medium (such as danger tape).
- Where possible, any other activities taking place on site should avoid any disturbance or impacts to these species. Where this is not possible, the appropriate permits must be obtained and relevant relocation plans compiled by an independent botanist and implemented.

- Subsequent monitoring requirements of any translocation of these species must be outlined in the relocation plans.

Table 6-1: Species which can be utilised in revegetation activities as well as the hydrological zone of the wetland within which they should be planted.

SPECIES	HYDROLOGICAL ZONE
<i>Cyperus congestus</i>	Seasonal / Temporary
<i>Cyperus dives</i>	Permanent
<i>Cyperus esculentis</i>	Permanent / Seasonal
<i>Cyperus laevigatus</i>	Permanent
<i>Cyperus longus</i>	Permanent / Seasonal
<i>Cyperus nitidus</i>	Permanent
<i>Eleocharis limosa</i>	Permanent
<i>Juncus effuses</i>	Seasonal / Temporary
<i>Pycnus nitidus</i>	Permanent
<i>Alloteropsis semialata</i> subsp. <i>eckloniana</i>	Seasonal / Temporary
<i>Brachiaria serrata</i>	Seasonal / Temporary
<i>Cynodon dactylon</i>	Seasonal / Temporary
<i>Cymbopogon pospischilii</i>	Seasonal / Temporary
<i>Eragrostis curvula</i>	Seasonal / Temporary
<i>Hyparrhenia hirta</i>	Seasonal / Temporary
<i>Leersia hexandra</i>	Permanent / Seasonal
<i>Themeda triandra</i>	Seasonal / Temporary
<i>Crinum bulbispermum</i>	Permanent / Seasonal
<i>Hypoxis hemerocallidea</i>	Seasonal / Temporary

Timeframe – This will need to be undertaken as an ongoing, concurrent rehabilitation measure during mining activities and in conjunction with the removal and management of AIPS.

7 LANDSCAPE MANAGEMENT PLAN

7.1.1 Stormwater and Erosion Control

- Concentrated flow paths within the must be avoided and the necessary interventions implemented to reduce flow velocity and promote diffuse flow. Given that the area is characterised by low rainfall, major engineering interventions are not appropriate. Concentrated flow paths can be avoided by implementing a robust vegetation community on the bed of any stormwater channel in accordance with the plant species plan.

- Where possible, any maintenance and/or construction activities must be undertaken during the dry months to avoid erosion and sedimentation.
- Existing vegetation cover surrounding the site should be maintained. The unnecessary removal of groundcover must be prevented as far as reasonably practical.
- 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 downslope of active work areas (including soil stockpiles) as necessary to trap any excessive sediments generated during mining activities.
- 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 gully for additional protection until vegetation has re-colonised the rehabilitated area.
- Should excess dust be observed during the construction phase, adequate dust suppression should be applied to limit the sedimentation of the surrounding environment.

7.1.2 Disturbance of Habitat

- Clearly demarcate the mining and/or maintenance footprint using danger tape or netting to restrict the indiscriminate movement of heavy machinery, vehicles and personnel to designated areas.
- Where possible, rip compacted soil to approximately 50 mm in depth and reprofile the area according to the natural topography of the surrounding area.
- Locate laydown areas, stockpile areas, construction material, equipment storage areas, vehicle parking areas, bunded 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 EO.
- Limit the removal of indigenous vegetation to directly over the planned mining area.

- Dewatering of the trench lines must be conducted in such a manner that it does not result in any erosional features and does not result in unnecessary sedimentation downslope. Trenches should therefore be gradually sloped to reduce erosion potential.
- The handling and/or killing of any animal species present is strictly prohibited and all staff/personnel must be notified of such incidents.

7.1.3 Waste Management

- Wind and scavenger proof waste receptacles must be installed around the site. These must be emptied on a regular basis by a registered contractor and waste disposed of at a registered facility.
- Rubble and mining waste must be kept to a minimum where possible. Rubble and mining waste must be stockpiled in a previously disturbed and bunded area until it can be disposed of at a registered facility. Rubble and mining waste should not be stockpiled for extended periods of time.
- Hazardous waste should only be stored on site where provision for the storage of such waste has been made such as in a bunded area. Hazardous waste should be removed from site on a weekly basis and disposed of at a registered facility.

7.1.4 Fire Management

- Fires are not permitted on site unless as part of an approved burning schedule which is supervised by the appropriate authorities.
- No firewood is to be collected on site.
- Cigarette butts must not be thrown into the surrounding environment. Smoking should only be permitted in designated smoking areas and cigarette butts should be disposed of in the appropriate waste receptacle.
- Contractors must ensure that basic firefighting equipment and suitable trained personnel are available on site at all times.

8 CONCLUSION

ENVASS was appointed to compile a watercourse rehabilitation and plant species plan for the watercourses on the South Deep mining right area. The plan focused on the most prominent impacts and provided measures that will improve the overall integrity and functionality of the target watercourses, which were identified within the consolidated assessment (ENVASS, 2025).

APPENDIX A: 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.



hanro@envass.co.za | +27 74 893 5811
info@envass.co.za

138 Frikkie de Beer Street, Glen Manor Office Park,
Building 5, First Floor, Office 2, Menlyn, Pretoria 0042



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 2027



Chairperson

Chief Executive Officer



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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.



gareth@envass.co.za | +27 72 670 3751
info@envass.co.za

Glen Manor Office Park, Building 5, First Floor, Office 2
138 Frikkie de Beer Street, Menlyn Pretoria 0042



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

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

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

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).

DEVELOPMENTAL HIGHLIGHTS

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



dawid@envass.co.za | +27 76 955 5103
info@envass.co.za

Glen Manor Office Park, Building 5, First Floor, Office 2
138 Frikkie de Beer Street, Menlyn Pretoria 0042



herewith certifies that
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)

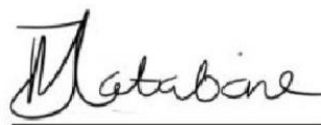
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President of Council



Chief Executive Officer



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