FRESHWATER ECOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED THE PROPOSED RYST KUIL MINING RIGHT APPLICATION PROJECT

Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape Province, South Africa

01/12/2025

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Report Name	**FRESHWATER ECOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED THE PROPOSED RYST KUIL MINING RIGHT APPLICATION PROJECT**	
Specialist Theme	Aquatic Biodiversity Theme	
Project Reference	Ryst Kuil Uranium and Molybdenum Ore MRA	
Report Version	Version 2 | 01/12/2025	
Environmental Assessment Practitioner	Aquatox Consulting Pty Ltd	
Fieldwork	Chelsea Withfield (*MSc.Env.Sci*)	
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Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principles of science.	

Abbreviations

Abbreviation	Definition
ASPT	Average Score per Recorded Taxon
CBA	Critical Biodiversity Area
DO	Dissolved Oxygen
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EN	Endangered
ESA	Ecological Support Area
ETS	Ecosystem threat status
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
LC	Least Concerned
MASL	Meters Above Sea Level
NEMA	The National Environmental Management Act
NFEPA (FEPA)	National Freshwater Ecosystem Priority Areas
NT	Near Threatened
NWA	National Water Act
NWBEST	National Web-Based Environmental Screening Tool
PAOI	Project Area Of Influence
PES	Present Ecological State
RQO's	Resource Quality Objectives
SAIIAE	South African Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SQR	Sub Quaternary Reach
TBC	The Biodiversity Company
TWQR	Target Water Quality Range
VU	Vulnerable
WMA	Water Management Area

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1 Introduction

1.1 Background

The Biodiversity Company (TBC) was appointed to undertake a freshwater ecological assessment for the proposed Ryst Kuil Uranium and Molybdenum Ore MRA project. Lukisa Invest 100 (Pty) Ltd (Applicant) (hereafter referred to as Lukisa) proposes the establishment a Uranium and Molybdenum Ore Mine located across various farm portions in Beaufort West in the Central Karoo District Municipality, Beaufort West Local Municipality, Western Cape Province, South Africa.

In order to achieve this an aquatics survey was conducted between the 19th and 23rd of May 2025. A 500 m area has been demarcated for the project to facilitate the identification of water resources within the regulatory zone. This area is referred to as the project area of influence (PAOI) (Figure 1-1).

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations (2014) (amended by GNR 326, 7 April 2017 and GNR 517, 11 June 2021) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices (GN) 320 (20 March 2020) and GN 1150 (30 October 2020) in terms of NEMA, dated 20 March and 30 October 2020: “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” (Reporting Criteria).

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 4167 by the Department of Water and Sanitation (DWS) (previously GN 509 of 2016 and GN 3139 of 2023). The said notice was published in the Government Gazette (no. 49833) under Section 39 of the National Water Act (Act no. 36 of 1998) in December 2023, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 4167 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 4167 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), provided the identified risks are all considered low risk and/or the applicant is listed under Appendix D1 or Appendix D2 of the same notice. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

The purpose of the specialist assessment is to provide relevant input into the EA process and provide a report for the activities associated with the project. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision-making with regard to the ecological viability of the proposed development and related activities.

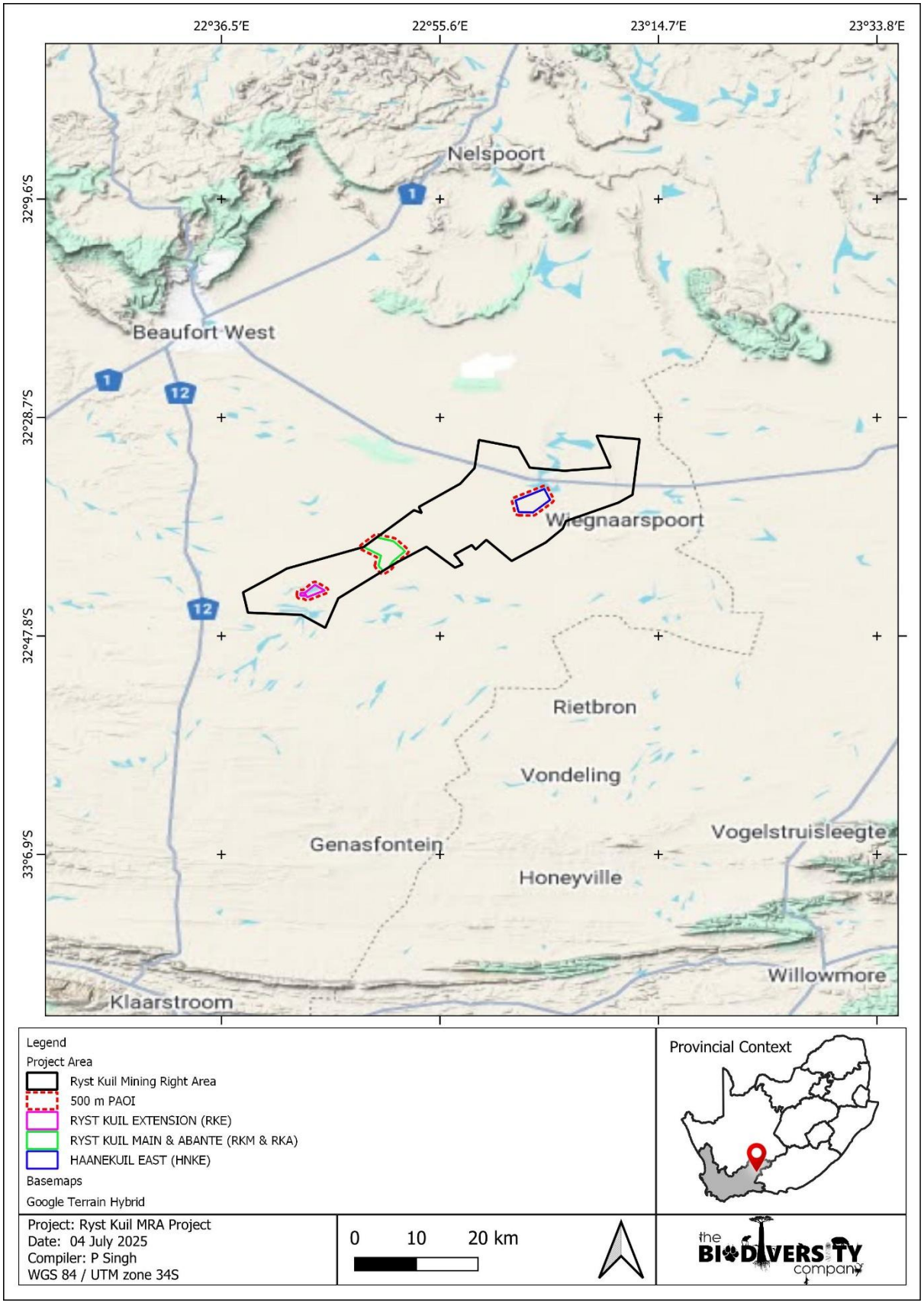


Figure 1-1 Locality map illustrating the project area in relation to the general setting.

1.2 Project Description

1.2.1 Description of the scope of the proposed overall activity

1.2.1.1 Listed and specified activities

Figure 1-2 and Table 1-1 shows the location, and/or area (hectares) as far as possible of the listed activities and amended infrastructure which can be seen in Figure 1-4 to Figure 1-8.

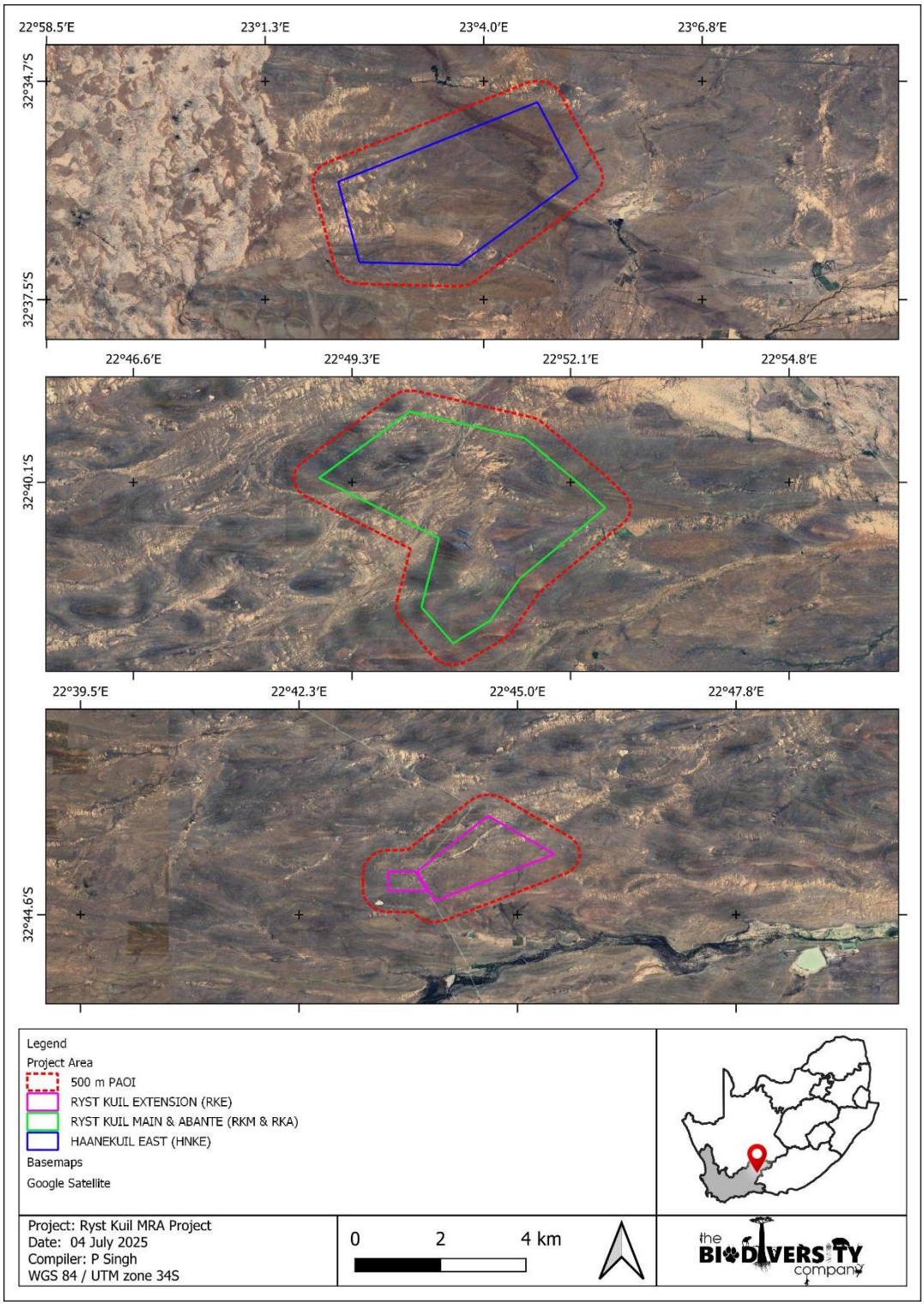


Figure 1-2 Locality map illustrating the project area in relation to the general setting.

Table 1-1 A list of key legislative requirements

NAME OF ACTIVITY (All activities including activities not listed)	Aerial extent of the Activity Ha or m²	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
Ryst Kuil 351 RD ptn RE: Central Processing Plant (CPP)			
Land use: Agriculture to Mining	7251,9003 Ha	X	GN R983 Activity 28
Chemicals at the CPP - Sulphuric Acid (24 634t) - Pyrolusite (1080t) - Flocculant (66t) - Alamine (10m³) - Isodecanol (10m³) - Kerosene (54m³) - Sodium Carbonite (106t) - Ammonium Hydroxide (148t) - Burnt Lime (1038t) - Diesel (~75m³) - Oil (~25m³) - Hydraulic fluid (tbd)	Combined >500m³(tbd)	X	GN R984 Activity 4
CPP; TSF	217ha	X	GN R984 Activity 15 NWA S21g
Mining and mining related infrastructure: Open pit and underground operations CPP, TSF, Milling, Crushing	217 Ha	X	GN R983 Activity 12 GN R983 Activity 19 GN R984 Activity 15 GN R984 Activity 17 NWA S21j, S21a, S21g
Beneficiation plant	24Ha	X	GN R984 Activity 6 GN R984 Activity 21 GNR893 Category 4.1
Tailings Stockpile	193ha	X	GN R984 Activity 15 GN R984 Activity 6 GN R 632 & GN R633 GN R921 Category B(11) NWA S21g
ROM Stockpiles;	51ha	X	GN R984 Activity 15 GN R984 Activity 6 GN R921 Category B(11) NWA S21g
Water storage-reservoir; silt traps; Pollution control dam.	Volumes t.b.d	X	GN R983 Activity 12 GN R921 Category B(11) NWA: S21 a, b, g
Haul road (Mining operation not for public use)		X	GN R984 Activity 15 GN R984 activity 17

			GN R983 activity 19 GN R 985 activity 4
Ryst Kuil (351 RD Ptn 2) pit complex (RKA): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Land use: Agriculture to Mining	698,2151Ha	X	GN R983 Activity 28
Pit RKA1; RKA 2; RKA 3; RKA 4; RKA 5,	2.8ha; 46.72ha; 3.9ha; 2.8 ha; 3.1ha	x	GN R984 Activity 15 GN R 983 activity 21 GN R 984 activity 15 GN R 984 activity 17 GN R 984 activity 21
Back fill of most pits	~53ha	X	GN R984 Activity 6 NWA S21g
3 x stockpiles	19.5; 6.4; 3.5ha	X	GN R984 Activity 6 GN R921 Category B(11)
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Kat Doorn Kuil ptn RE: (RKM): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Land use: Agriculture to Mining	6033,6398 Ha	X	GN R983 Activity 28
Pit RKM1; RKM 2; RKM 3	17.5ha; 7.4ha; 6.5ha;	x	GN R 983 activity 21 GN R 984 activity 15 GN R 984 activity 17 GN R 984 activity 21
Back fill of most pits	~24ha	X	GN R984 Activity 6 NWA S21g
1 x stockpiles	36.8ha	X	GN R984 Activity 15 GN R984 Activity 6 GN R921 Category B(11)
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Kant Kraal ptn RE: (RKE): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Land use: Agriculture to Mining	6905,8035 Ha	X	GN R983 Activity 28
Pit RKE1; RKE 2; RKE3; RKE4; RKE5; RKE6; RKE7; RKE8; RKE9	2.2; 2.7; 3.6; 3.2; 8.2; 3.4; 10.2; 5.5; 2.4	x	GN R 983 activity 21 GN R 984 activity 15 GN R 984 activity 17 GN R 984 activity 21
Back fill of most pits	~35ha	X	GN R984 Activity 6 NWA S21g
5 x stockpiles	9.3ha; 5.6ha; 4.2ha; 13ha; 13ha.	X	GN R984 Activity 15 GN R984 Activity 6 GN R921 Category B(11) NWA S21g
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Haanekuil ptn 7: (HNK):): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Land use: Agriculture to Mining	5572,09 Ha	X	GN R983 Activity 28
Pit HNK3;	14.8ha;		GN R 983 activity 21

HNK6; HNK7; HNK8; HNK9; HNK10; HNK11; HNK12; HNK13; HNK14; HNK15; HNK16; HNK17,	2.1ha; 2.2ha; 3.9ha; 8ha; 2.1ha; 3.4ha; 2.3ha; 4.4ha; 2.3ha; 5.7ha; 2.2ha; 2.1ha;	X	GN R 984 activity 15 GN R 984 activity 17 GN R 984 activity 21
Stockpiles	52.3ha	X	GN R984 Activity 6 GN R921 Category B(11) NWA S21g
Back fill of most pits	~57ha	X	GN R984 Activity 6 NWA S21g
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Haanekuil ptn 7 & RE: (HNK): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Pit HNK1; HNK2,	2.7; 2.2	X	GN R983 activity 21 GN R983 Activity 27 GN R 984 activity 17 GN R 984 activity 21
Back fill of most pits	~4ha	X	GN R984 Activity 6 NWA S21g
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Haanekuil ptn RE: (HNK): Excavation, blasting, loading hauling, Equipment storage, berms, crushing.			
Land use: Agriculture to Mining	4007,9273Ha	X	GN R983 Activity 28
Pit HNK4; HNK5	1.8; 1.9;	X	GN R 983 activity 21 GN R983 Activity 27 GN R 984 activity 17 GN R 984 activity 21
Back fill of pits	~3ha	X	GN R984 Activity 6 NWA S21g
Stockpile	3	X	GN R984 Activity 6 GN R921 Category B(11)
Haul road (Mining operation not for public use)		X	GN R984 activity 17 GN R983 activity 19 GN R 985 activity 4
Transportation road			
Development (4.5m x 51.5km) and widening (by 1.5m) and upgrade (9.9km) of tracks to roads	24.66 ha	X	GN R983 activity 12 GN R983 activity 19 GN R 985 activity 4
Bridges/culverts crossing drainage lines	>100m²	X	GN R983 activity 12 NWA: S21 c & i.

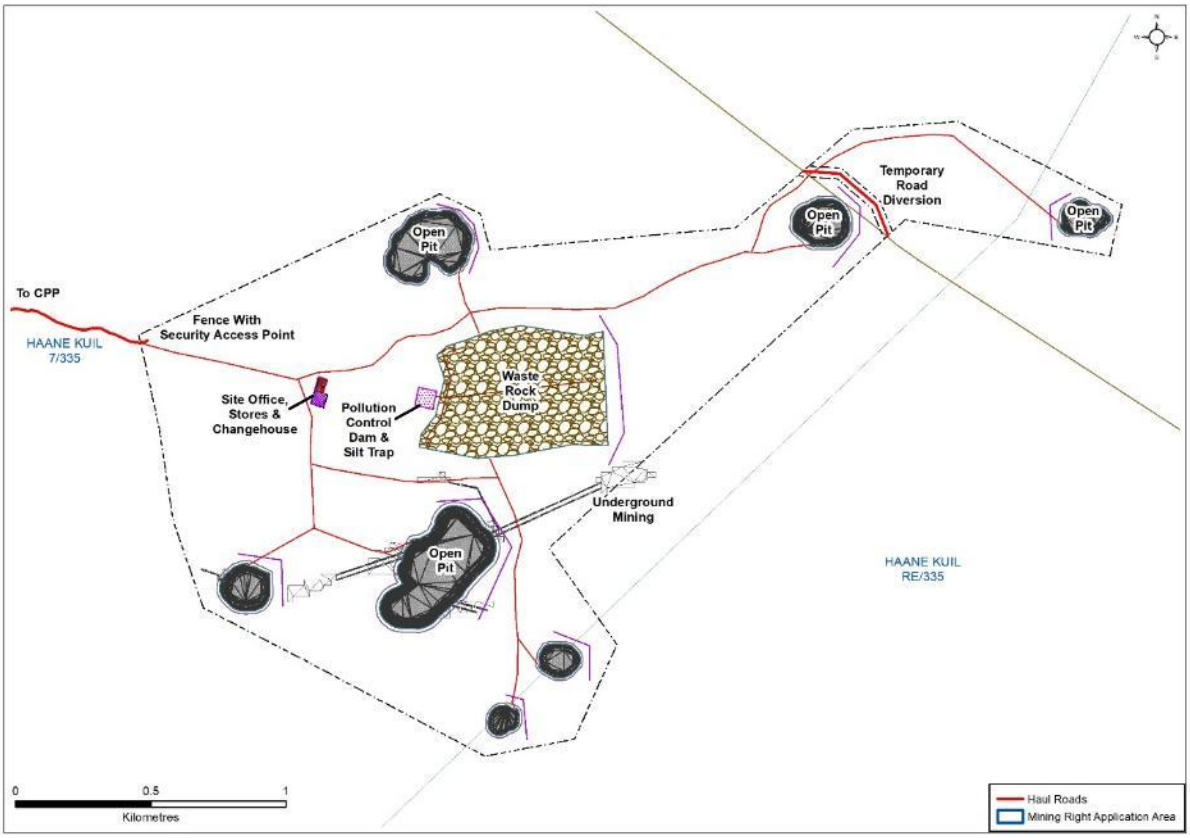


Figure 1-3 Map illustrating the Hannekuil project layout.

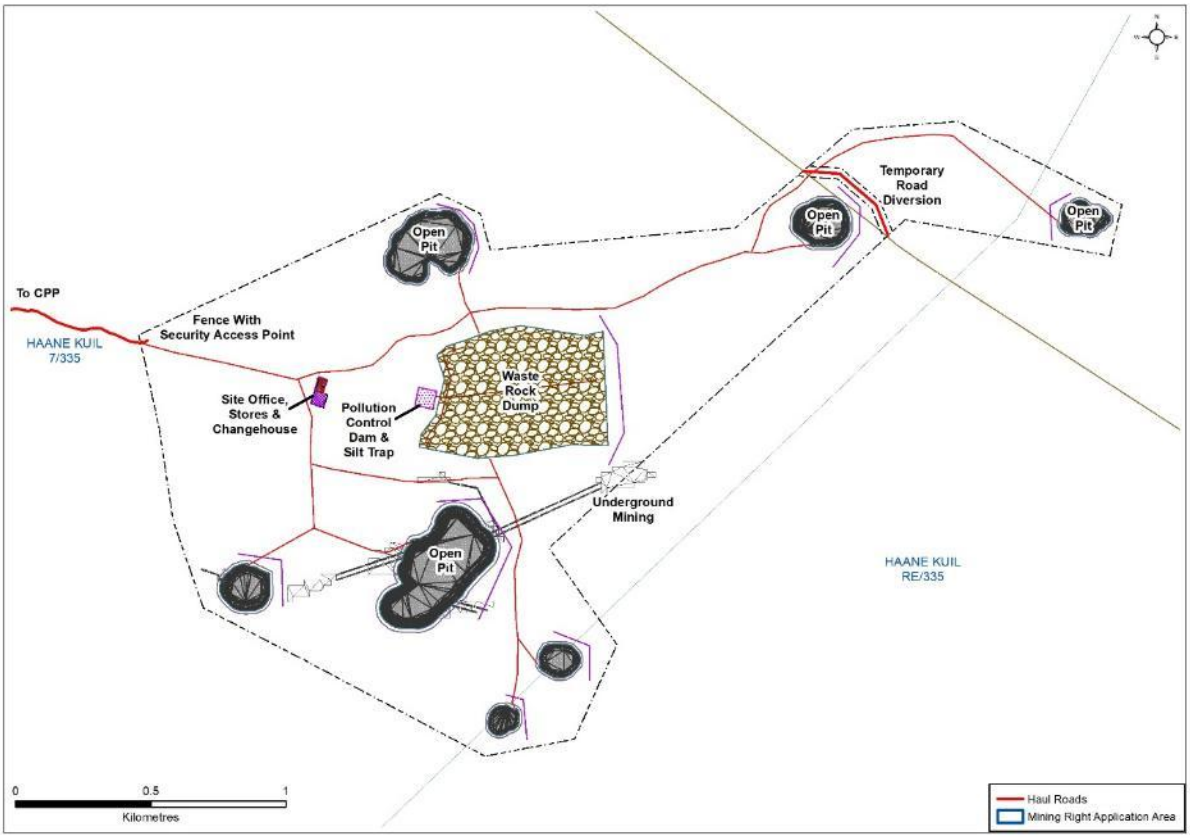


Figure 1-4 Map illustrating the Hannekuil project layout.

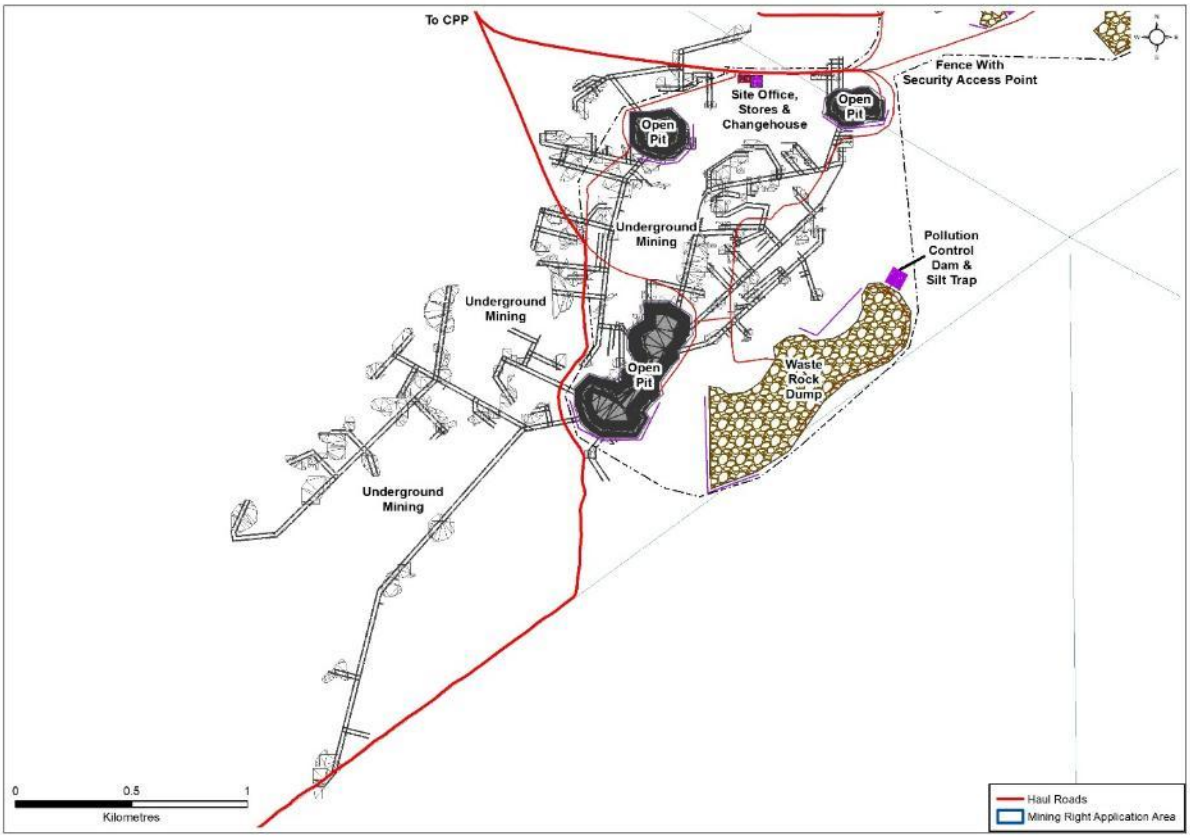


Figure 1-5 Map illustrating the Ryst Kuil Main (RKM) project layout.

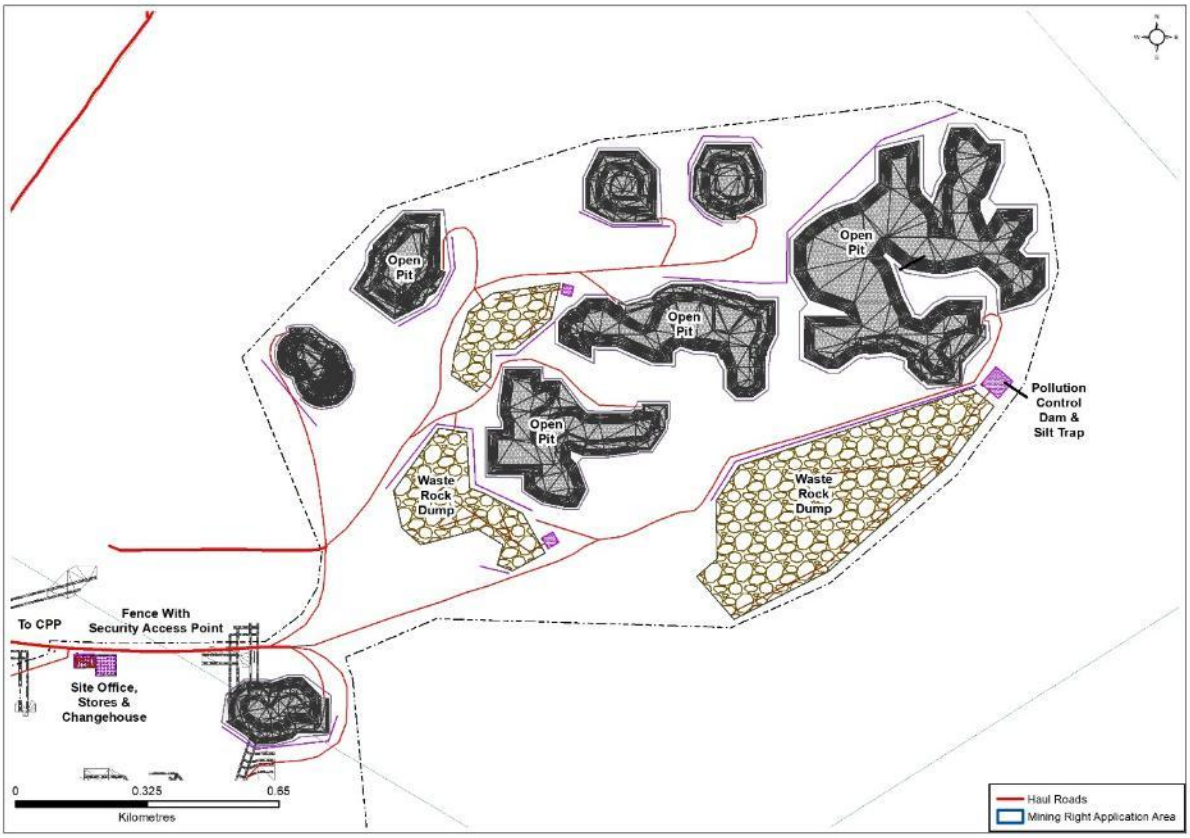


Figure 1-6 Map illustrating the Ryst Kuil Abante (RKA) project layout.

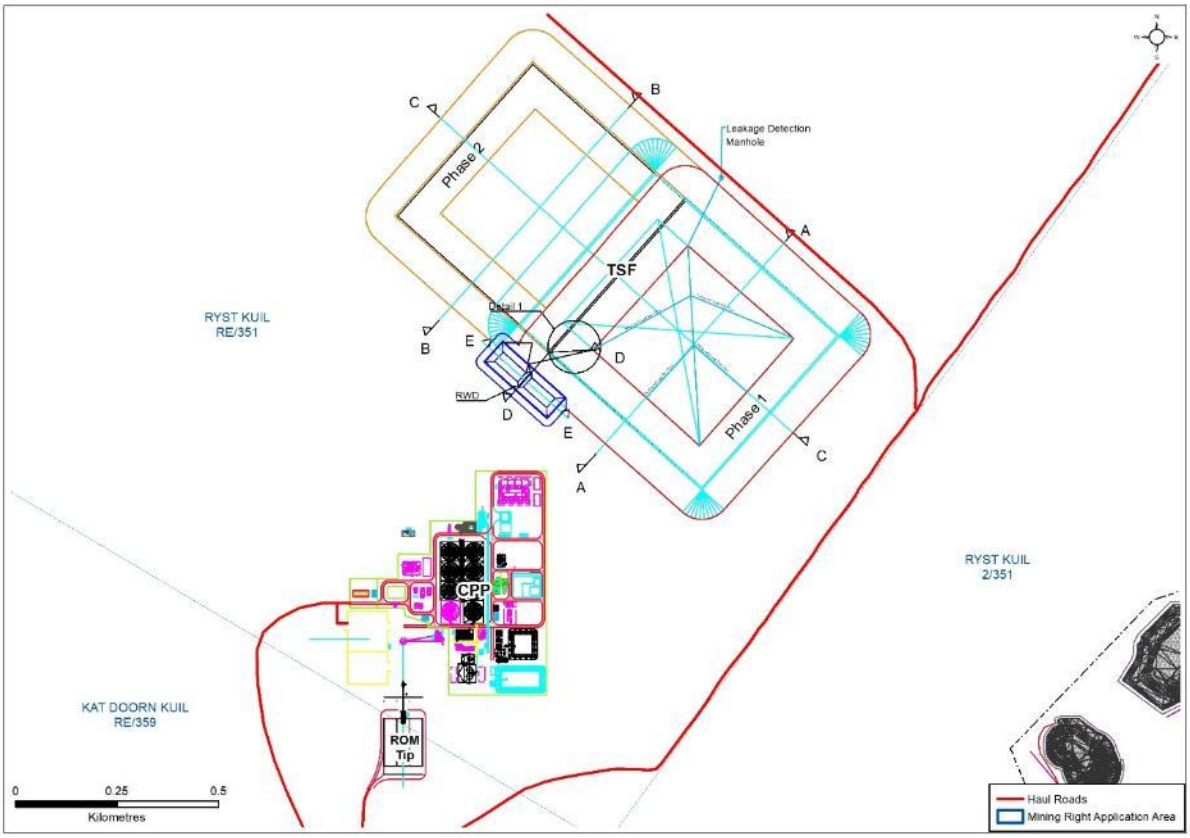


Figure 1-7 Map illustrating the RKA Tailings Storage Facility (TSF) and CPP project layout.

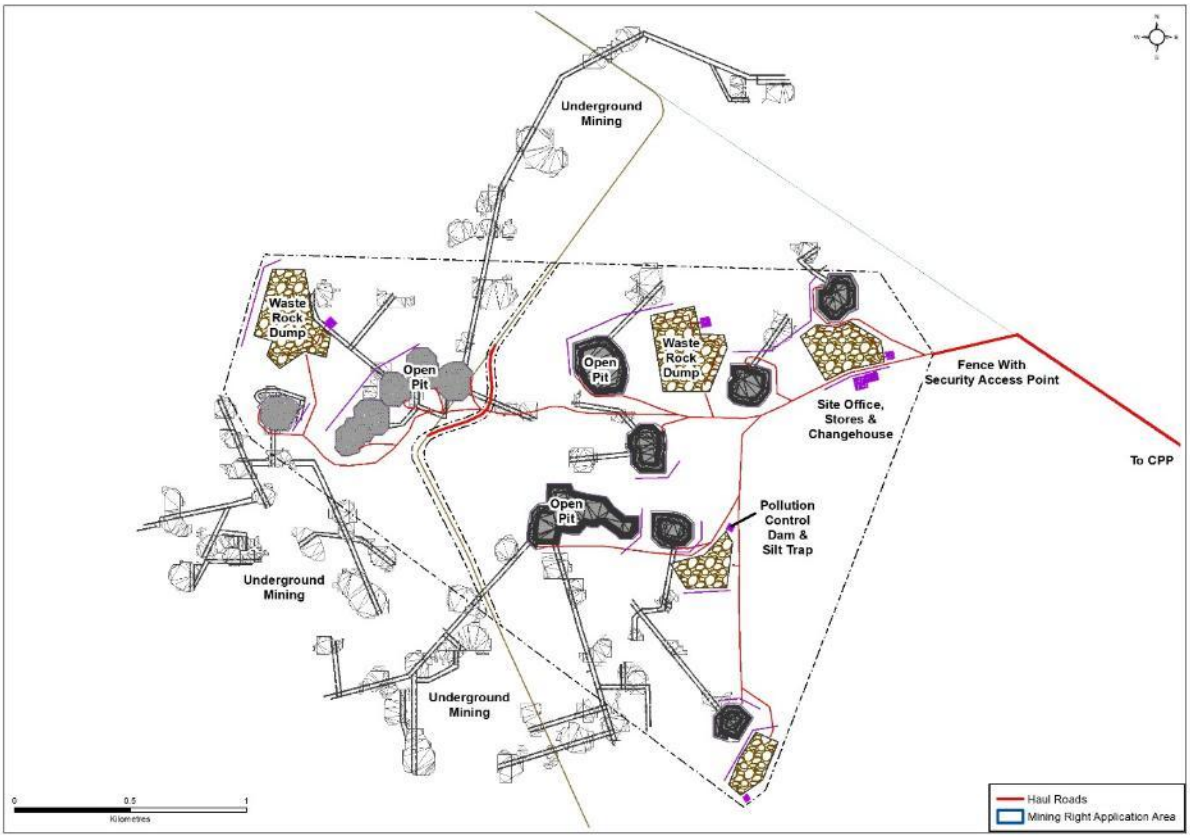


Figure 1-8 Map illustrating the RKE project layout.

1.3 Assessment Scope of Work

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- A desktop assessment of all available and related datasets;
- GIS processing to preliminary identify water accumulation areas;
- The delineation of water resources in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified; and
- A functional and integrity assessment of the water resources.

1.4 Assumptions and Limitations

The following aspects were considered as limitations:

- It is assumed that the client has provided the specialist with all available data and information surrounding the project at the time of writing and it is assumed that all this information is relevant and accurate, including the extent of the project area;
- No alternatives were provided at the time of the survey and compilation of this report;
- Standard aquatic methodologies that require presence of water could not be conducted due to the ephemeral nature of the watercourses within the PAOI. As a result, the focus of the assessment was the preservation of sensitive habitat/features;
- A single-season survey was conducted for the respective study, which would constitute a dry season/low flow survey. Thus, temporal trends were not investigated. Despite this it is the specialist's opinion that the findings are conclusive, and no further fieldwork would be required; and
- The GPS used for water resource delineations is accurate to five meters. Therefore, the delineation plotted digitally may be offset by a maximum of five meters to either side.

1.5 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-2 applies to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-2 A list of key legislative requirements

Region	Legislation / Guideline	Comment
National	NEMA	Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), Appendix 6 requirements
	The National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), Threatened or Protected Species Regulations	The protection of species and ecosystems that warrant protection
	Assessment Protocol (March 2020)	The minimum criteria for reporting.
	Assessment Protocol (October 2020)	Protocol for the specialist assessment and minimum report content requirements.
	NEMWA;	The regulation of waste management to protect the environment.
	NWA	The regulation of water use.
	GN 1003 of GG 43726 of 18 Sept 2020	The regulation and management of alien invasive species.

	GN4167 of GG 49833 of 8th Dec 2023	General Authorisations in term of Section 39 of the National Water Act 36 of 1998 for Water Uses as defined in Section 21 (c) and (i)
	GN704 of GG 20119 of 4th June 1999	Regulations on use of water for mining and related activities aimed at the protection of water resources
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	To provide for control over the utilisation of the natural agricultural resources, including the vegetation and the combating of weeds and invader plants.
Provincial	Draft Western Cape Biodiversity Bill, 2019	To provide for the management and conservation of the province's biophysical environment and protected areas
	Western Cape Environmental Management Framework (EMF) (2013)	This framework guides sustainable development and environmental protection in sensitive areas like the Cape Winelands, coastlines, and wetlands by setting out requirements for environmental impact assessments (EIAs) and zoning.
	Western Cape Nature Conservation Ordinance (1974 as amended)	To manage the protection of fauna and flora within the province, regulate activities like hunting, fishing, and camping, and ensure the conservation of protected areas and nature reserves.
	Western Cape Biodiversity Act (Act 6 of 2021)	The Western Cape Biodiversity Act was signed into law in 2021. It marks a key milestone in the rationalisation and modernisation of the regulatory framework for biodiversity governance in the Western Cape Province and supports alignment with national and international policy and strategic frameworks.
	Western Cape Biodiversity Sector Plan 2023	To inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management.

1.6 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way.
- The prevention of the degradation of the water resource.
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake, or dam into which, or from which, water flows.
- 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.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

1.7 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, state that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

1.8 Legislative Framework

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on freshwater biodiversity, as per Government Notice 320 published in terms of NEMA, dated 20 March 2020: "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 following has been assumed:

- An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of:
    - "very high sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment.

An Aquatic / Freshwater Biodiversity Specialist Assessment Report must contain the information as presented in Table 1-3 below.

Table 1-3 Aquatic Biodiversity Specialist Assessment information requirements as per the relevant protocol, including the location of the information within this report.

Information to be Included (as per GN 320, 20 March 2020)	Report Section
The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of aquatic sciences	9.3
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	9.4
A signed statement of independence by the specialist(s)	9.3
The assessment must be undertaken on the preferred site and within the proposed development footprint	3.2.1
A baseline description of the aquatic biodiversity and ecosystems on the site, including: aquatic ecosystem types; presence of aquatic species, and composition of aquatic species communities, their habitat, distribution, and movement patterns.	3
The threat status of the ecosystem and species as identified by the screening tool	3.4.1
An indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub-catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area)	3.1
A description of the ecological importance and sensitivity of the aquatic ecosystem including: (a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g., movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and (b) the historic ecological condition (reference) as well as the present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater)	3.1.8 and 3.2.5.3
The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate	-
Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions:	4

Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? How will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding, or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub-catchment (e.g. sand movement, meandering river mouth or estuary, flooding, or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water use and related activities change.	
How will the proposed development impact on the functioning of the aquatic feature? This must include: (a) base flows (e.g., too little, or too much water in terms of characteristics and requirements of the system); (b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over-abstraction or instream or off stream impoundment of a wetland or river); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland); (d) quality of water (e.g., due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g., road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and (f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g., waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.)	4
How will the proposed development impact on key ecosystems regulating and supporting services especially: (a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	4
How will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	-
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment	2
The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant	9.1
A description of the assumptions made any uncertainties or gaps in knowledge or data	1.4
The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant	
Additional environmental impacts expected from the proposed development	-
Any direct, indirect, and cumulative impacts of the proposed development on-site	-
The degree to which impacts and risks can be mitigated	-
The degree to which the impacts and risks can be reversed	-
The degree to which the impacts and risks can cause loss of irreplaceable resources	-
A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies	3.3
Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr)	4 and 4.8
A motivation must be provided if there were development footprints identified as having a “low” aquatic biodiversity sensitivity and that were not considered appropriate	-
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; and	7.3
Any conditions to which this statement is subjected	7.3

A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

2 Fieldwork

In line with the minimum requirements for aquatic biodiversity surveys a single field survey for the project area was undertaken between the 19th and 23rd of May 2025 to identify the presence and condition of freshwater resources and to delineate their spatial extents. The survey constituted a dry season/low flow assessment. Seasonality is not considered to be a limiting factor to the assessment of which the results are conclusive. All sites were dry and some sites that had water were inaccessible, therefore no standard aquatic methodologies could have been conducted.

3 Results & Discussion

3.1 Desktop Dataset Assessment - Ecologically Important Landscape Features

The following spatial features describe the general area and associated freshwater resources (ecologically important landscape features). This assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the South African National Biodiversity Institute (SANBI). The desktop analysis and their relevance to these project areas[1] are summarised in Table 3-1.

Table 3-1 Summary of the relevance of the proposed project to ecologically important landscape features

Desktop Information Considered	Relevance	Reasoning	Section
Strategic Water Source Areas	No	The PAOI are not located within any SWSAs for groundwater or surface water.	3.1.1
Conservation Plan	Yes	The PAOI and project areas overlap with Aquatic ESA1 areas, Terrestrial CBA2 areas and Other Natural Areas (ONAs).	3.1.2
National Biodiversity Assessment (NBA)	Yes	None of the project areas overlap with NBA aquatic features and only the 500 m PAOI for the Ryst Kuil Extension project falls within an NBA depression wetland.	3.1.3
Aquatic Ecosystem Threat Status	No	The 500 m PAOI does not overlap with threatened NBA rivers or wetlands.	3.1.4
Aquatic Ecosystem Protection Level	No	The 500 m PAOI does not overlap with threatened NBA rivers or wetlands.	3.1.5
Protected Areas	No	The 500 m PAOI does not overlap with Protected or Conservation Areas.	3.1.6
National Freshwater Ecosystem Priority Areas (NFEPA)	No	The 500 m PAOI does not overlap with Priority NFEPA rivers or wetlands.	3.1.7

3.1.1 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying ≥ 50% of South Africa's water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (Lotter & Le Maitre, 2021). According to the SWSAs of South Africa, Lesotho and Swaziland, the project area is not located within a SWSA for surface water.

3.1.2 Conservation Plan

The Western Cape Biodiversity Spatial Plan (WCBSP) classifies areas into Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) to ensure the conservation of biodiversity and the

[1] The term "project areas" does not refer to the Mining Rights Area (MRA) but rather to the three (3) projects namely, Ryst Kuil Main & Abante, Ryst Kuil Extension and Hanne Kuil East which are earmarked within the MRA for mining activities.

maintenance of ecosystem services. CBAs are areas in a natural or near-natural state that are essential for meeting biodiversity targets for species, ecosystems, or ecological processes. These areas should be maintained with no further loss of habitat, and degraded areas should be rehabilitated. ESAs, on the other hand, are not essential for meeting biodiversity targets but play a crucial role in supporting the functioning of CBAs and delivering ecosystem services. They should be maintained in a functional state, allowing some habitat loss as long as the underlying biodiversity objectives and ecological functioning are not compromised (CapeNature, 2024).

CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species (SANBI, 2017). Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI, 2017).

Ecological Support Areas (ESAs) are areas that are not essential for meeting biodiversity representation targets but play an important role in supporting the ecological functioning of ecosystems as well as adjacent Critical Biodiversity Areas, and/or in delivering ecosystem services that support socio-economic development (SANBI, 2017).

Figure 3-2 presents the project area superimposed on the 2023 Western Cape Biodiversity Spatial Plan. The project areas overlap with Aquatic ESA1 areas, Terrestrial CBA2 areas and Other Natural Areas (ONAs).

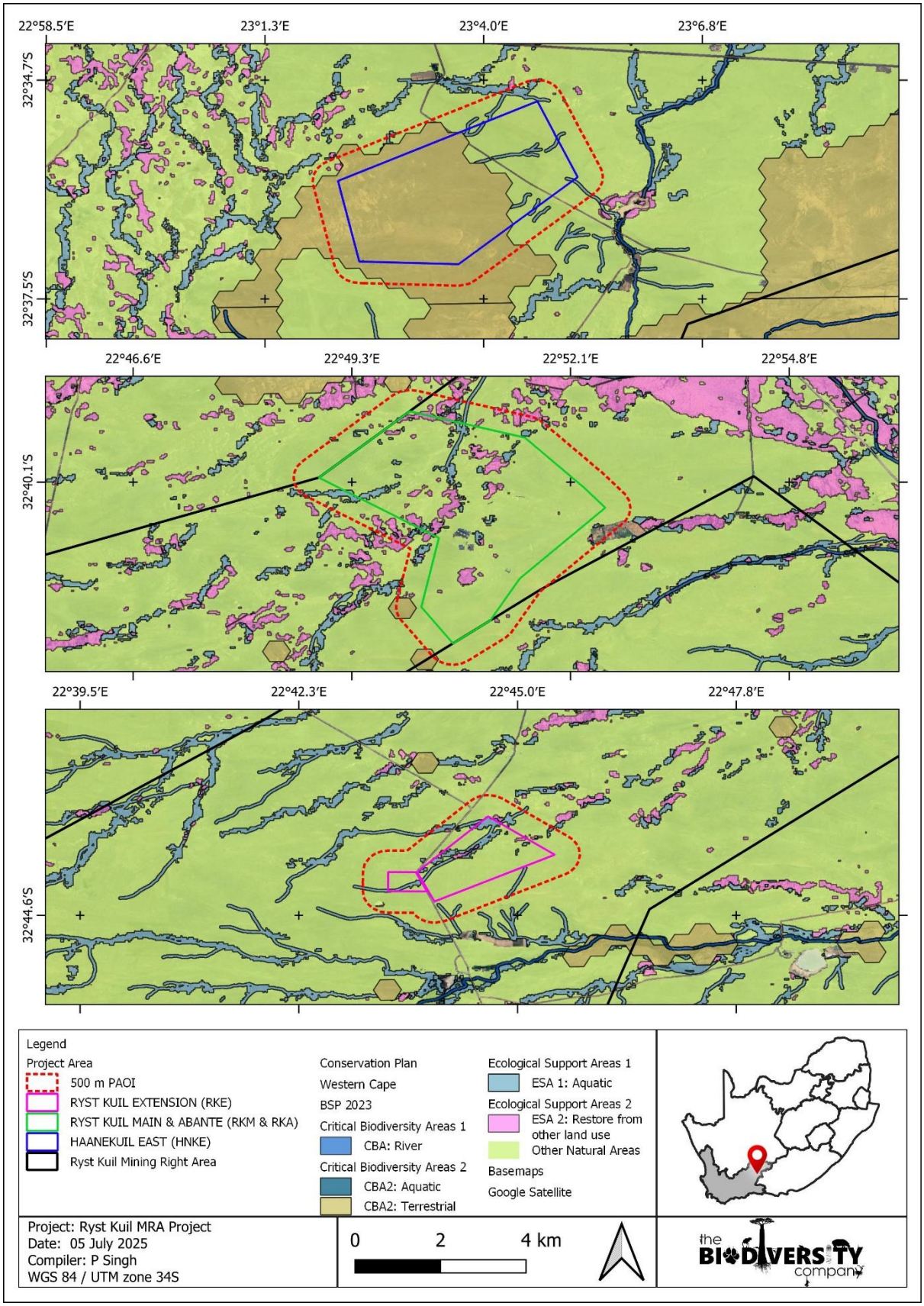


Figure 3-1 Map illustrating the conservation plan in relation to the project area.

3.1.3 The National Biodiversity Assessment

The National Biodiversity Assessment (NBA) was completed as a collaboration between the SANBI, the DEA and other stakeholders, including scientists and biodiversity management experts throughout the country over a three-year period (Van Deventer *et al*., 2019). The purpose of the NBA is to assess the state of South Africa's biodiversity to understand trends over time and inform policy and decision-making across a range of sectors (Van Deventer *et al*., 2019). This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the NBA (2018). National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (2018).

According to this database, none of the project areas overlap with NBA aquatic features and only the 500 m PAOI for the Ryst Kuil Extension project falls within an NBA depression wetland (Figure 3-2).

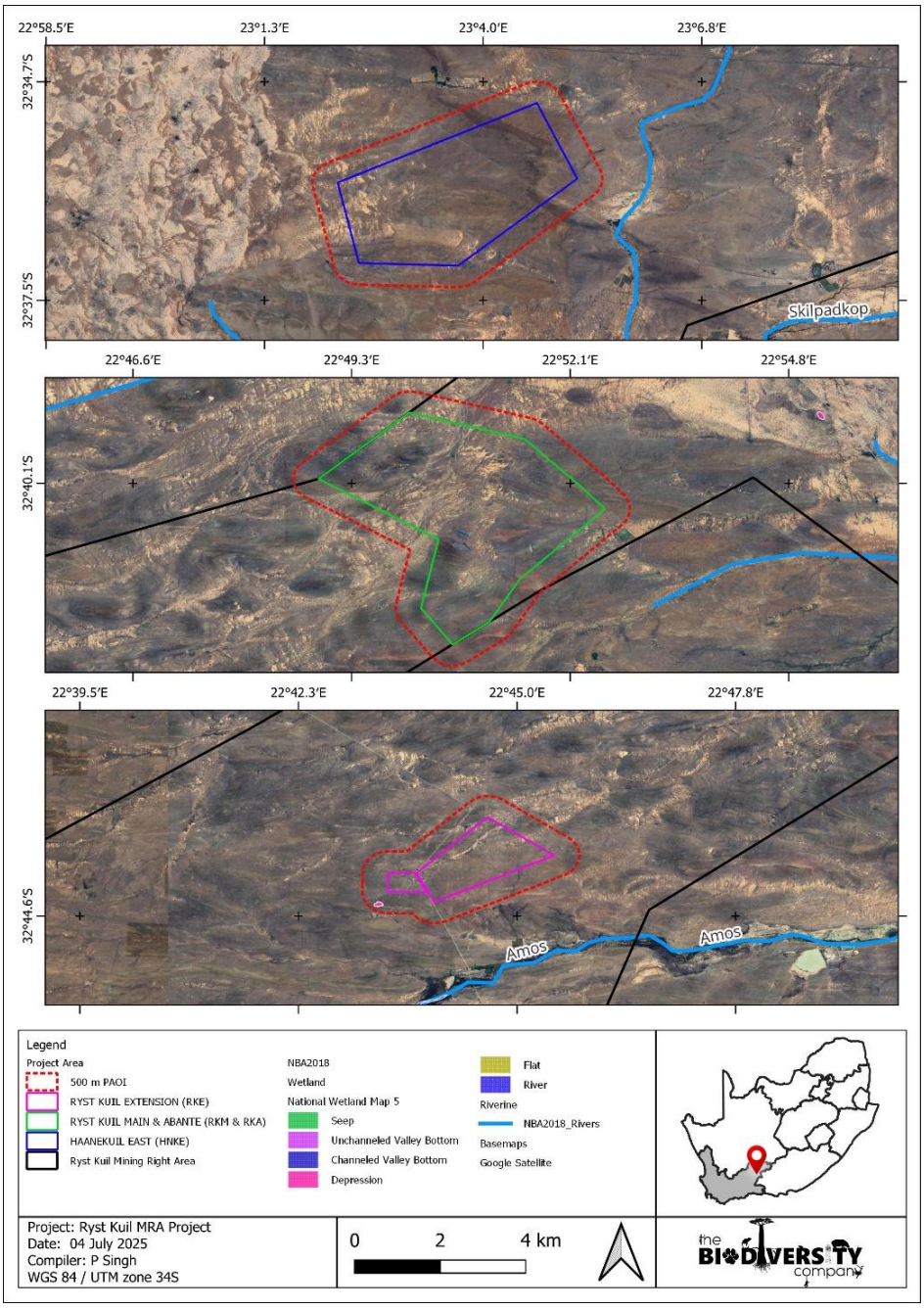


Figure 3-2 Illustration of wetlands and rivers within the project area (NBA, 2018)

3.1.4 Aquatic Ecosystem Threat Status

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the NBA in 2018. The Ecosystem threat status of river and wetland ecosystem outlines the degree to which the ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Van Deventer et al., 2019). Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in a good ecological condition (Van Deventer et al., 2019). The Ecosystem Threat Status (ETS) of each river assessed was based on the extent to which the system had been modified from its natural condition (SANBI, 2017).

According to the SAIIAE dataset, the project areas do not overlap with threatened NBA rivers or wetlands (Figure 3-3).

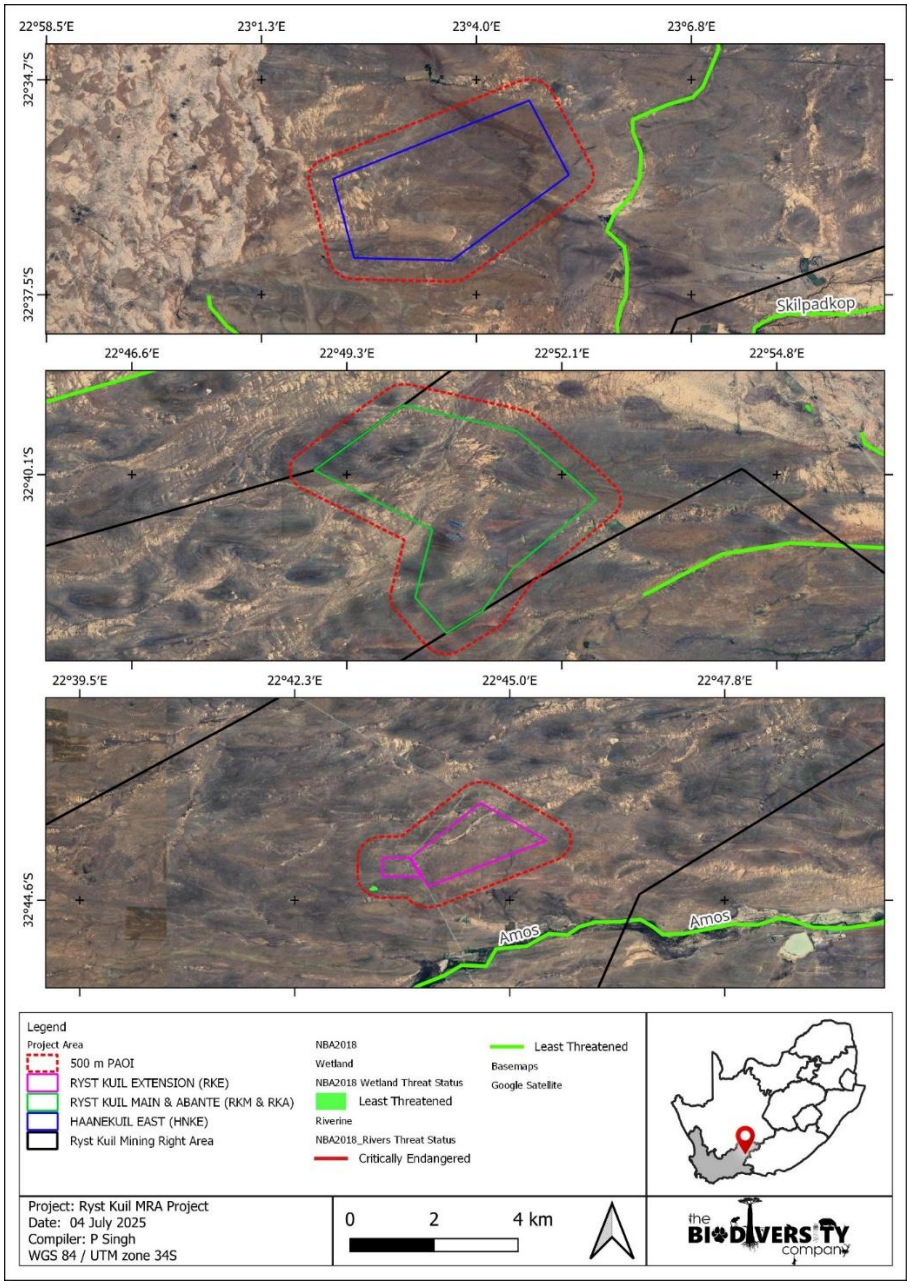


Figure 3-3 The project area in relation to the threat status of aquatic ecosystems, SAIIAE dataset (NBA, 2018).

3.1.5 Aquatic Ecosystem Protection Level

Ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Van Deventer et al., 2019). The Ecosystem Protection Level (EPL) of each river assessed was based on the extent (expressed as a percentage) to which the system has their biodiversity target located within protected areas and are in a natural or near-natural ecological condition. Rivers in protected areas need to be in good condition (A or B ecological category) to be considered as protected. Well protected rivers have 100% of their extent located within protected areas, while moderately protected and poorly protected river ecosystem types have at least 50% and 5% of their biodiversity target in protected areas, respectively. Not protected rivers are characterised by less than 5% (SANBI, 2022).

The project area was superimposed on the ecosystem protection level map to assess the protection status of aquatic ecosystems associated with the development (Figure 3-4). According to the SAIIAE dataset, the project does not overlap with protected NBA rivers or wetlands.

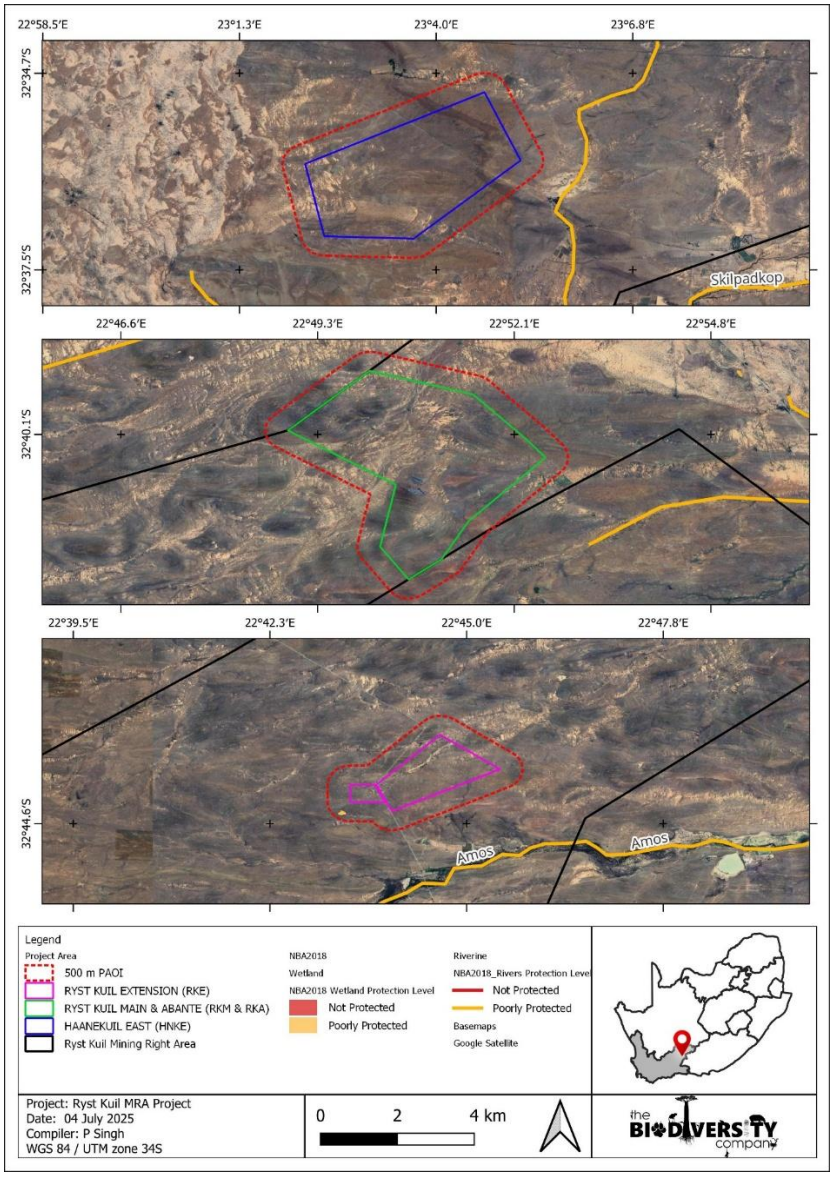


Figure 3-4 The project area showing the regional level of protection of aquatic ecosystems (NBA, 2018)

3.1.6 Protected Areas

The Department of Environmental Affairs maintains a spatial database of Protected Areas and Conservation Areas. The Protected Areas and Conservation Areas (PACA) Database scheme is used for classifying protected areas (South Africa Protected Areas Database-SAPAD) and conservation areas (South Africa Conservation Areas Database-SACAD) into types and sub-types in South Africa. The definition of protected areas used in these documents follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas: Special nature reserves, National parks, Nature reserves, Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003), World heritage sites declared in terms of the World Heritage Convention Act, Marine protected areas declared in terms of the Marine Living Resources Act, Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998), and Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970). The types of conservation areas that are currently included in the database include: Biosphere reserves, Ramsar sites, Stewardship agreements (other than nature reserves and protected environments), Botanical gardens, Transfrontier conservation areas, Transfrontier parks, Military conservation areas, and Conservancies.

According to the protected area spatial datasets from SAPAD (2024) and SACAD (2024), the project does not overlap with Protected or Conservation Areas.

3.1.7 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM: BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

Therefore, conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated catchments, will aid in the protection of riverine habitat supporting fish species occurring within the entire catchment and water quality for the aquatic and terrestrial biota downstream of the project area. The catchments in which human activities occur need to be managed to maintain water quality and prevent further degradation of local and downstream water resources in order to contribute to national biodiversity goals and support sustainable use of water resources. According to the NFEPA dataset (Figure 3-5), the PAOI does not overlap with Priority NFEPA rivers or wetlands (Nel *et al.,* 2011).

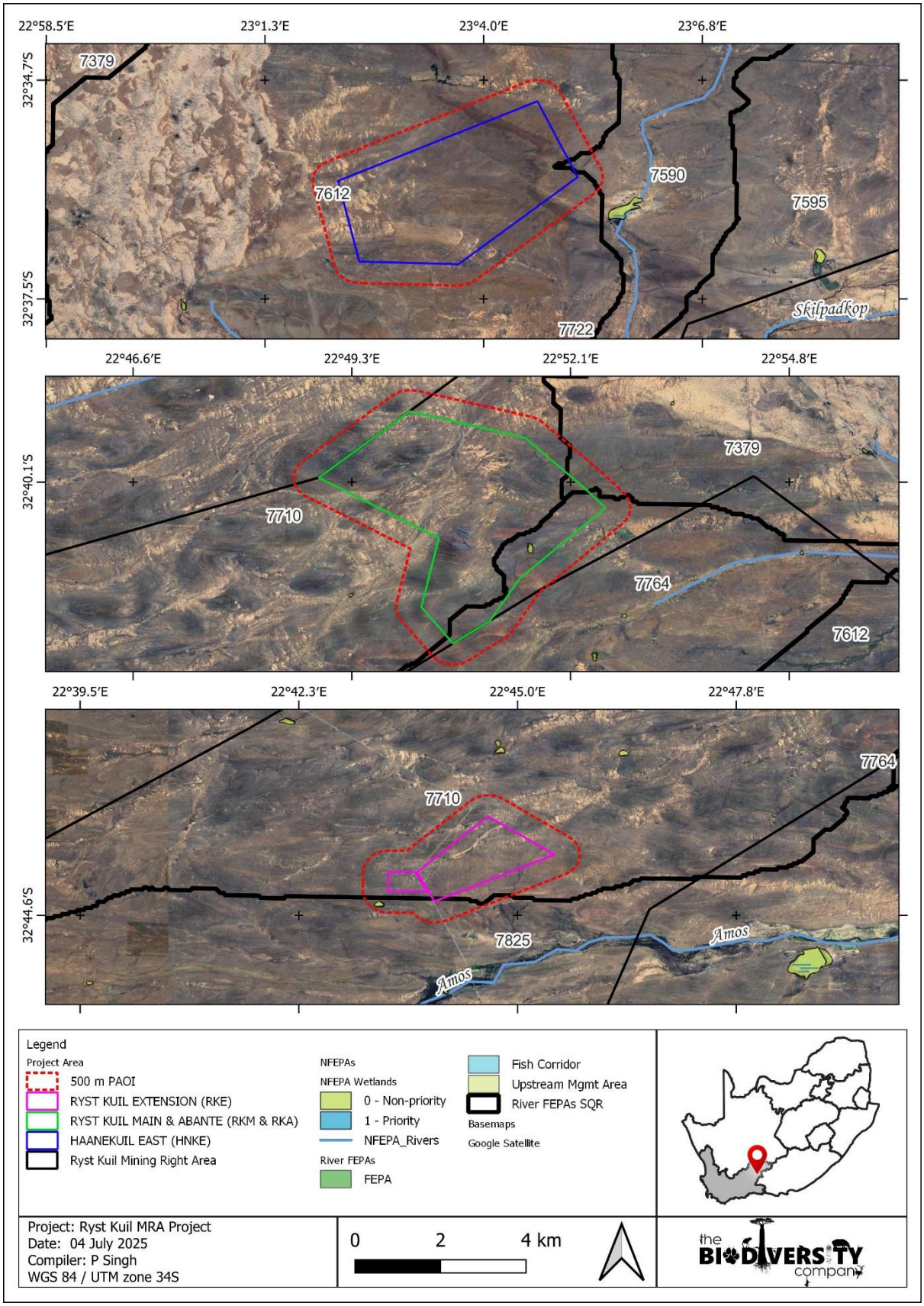


Figure 3-5 Illustration of NFEPAs and SAIIAE wetlands in relation to the project area.

3.1.8 Freshwater Ecology

The project areas fall within the Mzimvubu_Tsitsikamma (WMA) (DWS, 2023), the Great Karoo Level 1 Ecoregion, and within the L11G, L12A and L12B quaternary catchments (Figure 3-6). Desktop information for the Sub-Quaternary Reaches (SQRs) associated with the PAOI was obtained from the DWS (2014). The PAOI falls within L11G-07710, L11G-07612, L11G-07764, L11G-07379, L12A-07825 and L12B-07590 SQRs. The Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) for the SQRs are summarised in Table 3-2. The SQR impacts and activities include agriculture and cultivation, cleared riparian areas, alluvium and erosion, water quality impacts, instream dams, bush encroachment and anti-erosion berms. Ultimately the receiving system from the project areas is the Sout River, which confluences with the Groot River, and finally the Gamtoos River which drains into the Indian Ocean.

Table 3-2 PES of systems and the SQR associated with the project (DWS, 2014)

Component/SQR	L11G-07710	L11G-07612	L11G-07764	L11G-07379	L12A-07825	L12B-07590
River name	-	-	-	-	Amos	-
Present Ecological Status	Largely Natural (B)	Largely Natural (B)	Moderately Modified (C)	Largely Natural (B)	Moderately Modified (C)	Moderately Modified (C)
Ecological Importance (EI)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Ecological Sensitivity (ES)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

PES – Present Ecological State | REC – Recommended Ecological Category | TEC – Target Ecological Category

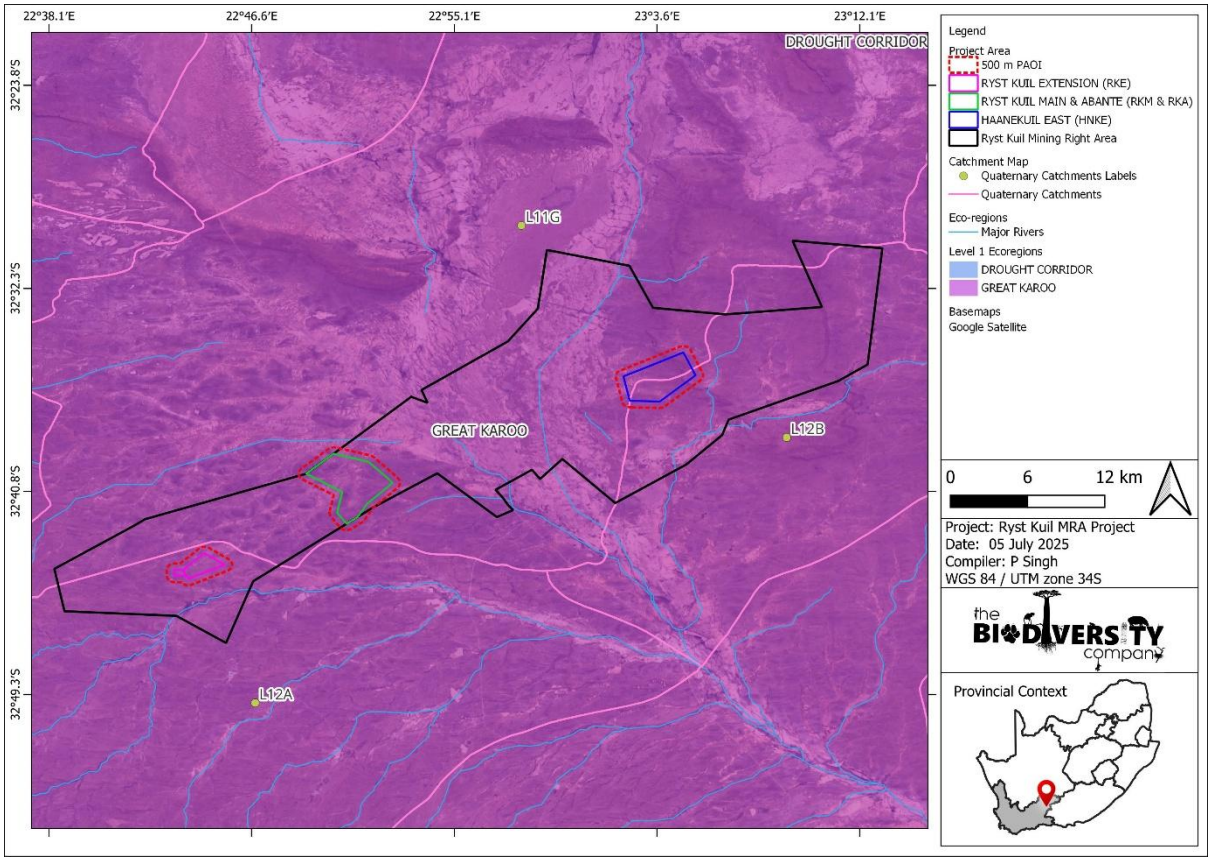


Figure 3-6 Hydrological aspects associated with the project area

3.1.9 Resource Quality Objectives

The NWA sets out to ensure that water resources are used, managed and controlled in such a way that they benefit all users. To achieve this, the Act has prescribed a series of measures such as Resource

Quality Objectives (RQOs) to ensure comprehensive protection of water resources so that they can be used sustainably (DWA, 2011b). Results from the riverine assessment are ideally compared to the Resource Quality Objectives (RQOs) for the WMA and at a finer level for specific catchments (where available). RQOs provide numerical and/or descriptive statements about the biological, chemical, and physical attributes that characterise a resource for the level of protection defined by its class. “Resource Quality Objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota”. The PAOI falls within the Mzimvubu_Tsitsikamma WMA which was considered for this assessment (DWS, 2021). At the time of writing this report, no RQOs were available for the L11G, L12A or L12B catchments.

3.2 Survey Results

3.2.1 Investigation Sites

A single low flow survey was conducted between the 19th and 23rd of May 2025. Sampling points (Figure 3-7) were selected for the study to assess the current state of the associated watercourses and identify potential risks that may result from the project. Only watercourses at an appreciable level of risk in relation to the proposed project and related activities were considered for assessment. Site investigations were conducted on systems presenting adequate surface water to conduct biological assessments. Photographs and Global Positioning System (GPS) coordinates pertaining to the sites are presented in Figure 3-7 and Table 3-3.

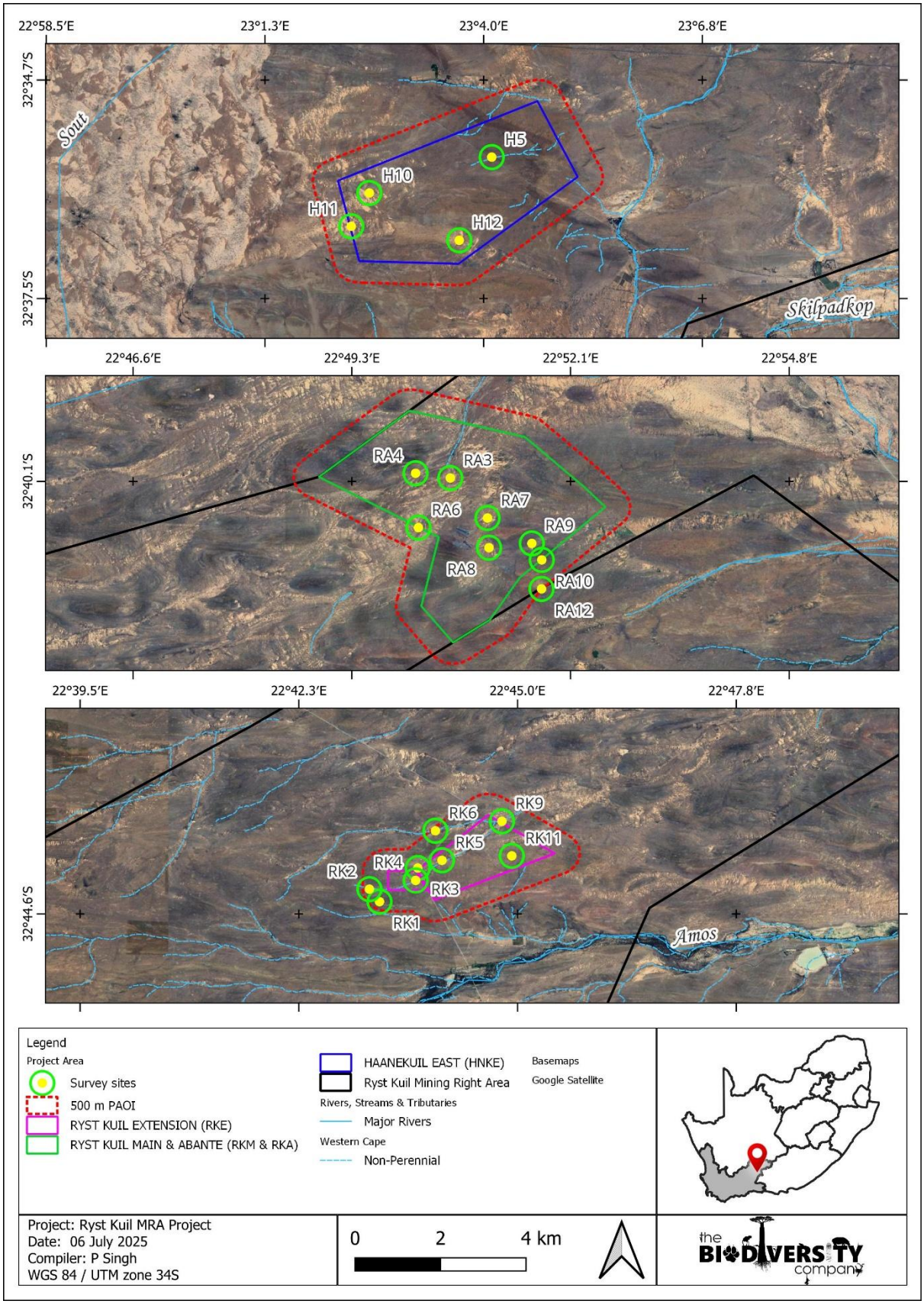
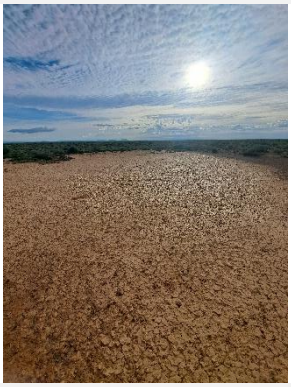
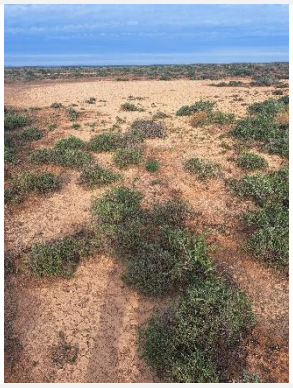


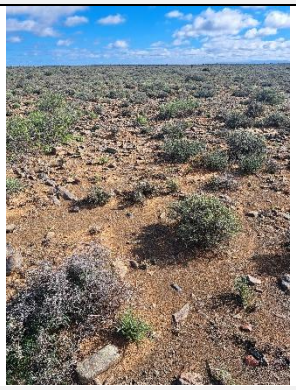
Figure 3-7 Locality map of the sampling sites within the PAOI

Table 3-3 Photos and coordinates for the sites sampled (May 2025)

Site	Upstream View	Downstream View
Hannekuil East		
H5		
GPS	32°35'41.65"S 23° 4'7.32"E	
H10		
GPS	32°36'8.81"S 23° 2'34.75"E	
H11		
GPS	32°36'34.02"S 23° 2'21.08"E	
H12		

Site	Upstream View	Downstream View
GPS	32°36'44.58"S 23° 3'42.76"E	
Ryst Kuil Main & Abante		
RA3		
GPS	32°40'4.26"S 22°50'33.64"E	
RA4		
GPS	32°40'0.65"S 22°50'7.32"E	
RA6		
GPS	32°40'41.87"S 22°50'9.52"E	
RA7		

Site	Upstream View	Downstream View
GPS	32°40'34.58"S 22°51'1.82"E	
RA9		
GPS	32°40'53.82"S 22°51'35.38"E	
RA10		
GPS	32°41'6.31"S 22°51'42.91"E	
Ryst Kuil Extension		
RK1 (Pan 1)		
GPS	32°44'28.29"S 22°43'16.30"E	
RK2		

Site	Upstream View	Downstream View
GPS	32°44'18.82"S 22°43'8.64"E	
RK4		
GPS	32°44'12.19"S 22°43'43.67"E	
RK5		
GPS	32°43'56.92"S 22°44'3.64"E	
RK6		
GPS	32°43'34.49"S 22°43'58.68"E	
RK9		
GPS	32°43'27.32"S 22°44'49.10"E	

Site	Upstream View	Downstream View
RK10 (Pan 3)	No Access	No Access
GPS	32°43'29.63"S 22°45'6.83"E	
RK11 (Pan 2)		
GPS	32°43'53.57"S 22°44'56.56"E	

3.2.2 Index of Habitat Integrity

The condition of the watercourses and associated aquatic biodiversity are largely dependent on the condition and degree of modification of the surrounding catchment. The more intact and natural the catchment is, the greater the watercourse condition and ecosystem functioning, and the more services there will be with an associated high aquatic and terrestrial biodiversity presence. An altered catchment compromises the watercourse condition, ecosystem functioning, and services offered, with deleterious effects depending on the degree and type of catchment modification. The more modified catchment will ultimately have a low ecological value watercourse offering limited services with an absence of key services such as phytoremediation (cleaning of water by vegetation) with the cumulative loss of its original biodiversity with only the most tolerant biota remaining in the most negatively modified catchments. The IHI was completed for selected reaches of the drainage areas. These watercourses are functioning as a connected ecosystem within the catchment however they are slightly different from each other due to variation in vegetation composition, hydropedological functioning and dominant land uses occurring in the unit and thus they were assessed per project area.

The results for the instream and riparian Index of Habitat Integrity (IHI) assessment for the associated watercourse reaches are presented in Table 3-4. According to the IHI results, the instream and riparian habitat integrity of the drainage areas were rated as ‘Largely natural’ (Class B) for Haanekuil and Ryst Kuil Extension projects, and ‘Moderately Modified’ for the Ryst Kuil Main and Abante project area. Notable impacts included farm tracks that transverse some areas, crossings, agricultural activities and abstraction. Wildlife and livestock trampling and grazing were noted within all three (3) project areas.

Table 3-4 Results for the Instream Habitat Integrity assessment for the associated reaches of the watercourses (May 2025)

Instream Criteria	Haanekuil (Drainage Areas 1-5)	Ryst Kuil Main & Abante (Drainage Areas 10-12)	Ryst kuil Extension (Drainage Areas 6-9)
Water abstraction	5	10	3
Flow modification	8	8	5
Bed modification	6	6	5
Channel modification	6	8	5

Phys-chem modification	2	2	2
Inundation	5	5	5
Alien macrophytes	0	0	0
Introduced aquatic fauna	0	0	0
Rubbish dumping	2	2	2
Instream Habitat Integrity Score	**83**	**79**	**87**
Instream Habitat Integrity Category	**B**	**C**	**B**
Riparian Criteria	**Haanekuil (Drainage Areas 1-5)**	**Ryst Kuil Main & Abante (Drainage Areas 10-12)**	**Ryst kuil Extension (Drainage Areas 6-9)**
Vegetation removal	3	8	3
Exotic vegetation	1	5	1
Bank erosion	4	6	4
Channel modification	6	8	6
Water abstraction	6	10	6
Inundation	2	5	2
Flow modification	5	3	5
Phys-chem	1	2	1
Riparian Zone Integrity Score	**86**	**76**	**86**
Riparian Zone Integrity Category	**B**	**C**	**B**

3.2.3 Aquatic Macroinvertrebrates

Biological SASS5 assessments could not be completed as the watercourses did not qualify for assessment according to the method (Dickens and Graham, 2002). Although no vernal biota were observed in the Pans (Ryst Kuil Extension) during the May 2025 survey, vernal biota (tadpole shrimp, fairy shrimp, clam shrimp and seed shrimp) should be expected as they are the dominant macroinvertebrates known to inhabit ephemeral systems, and form an integral part of the arid and semi-arid ecosystems. Vernal biota are significant because these organisms are adapted to the unique, seasonal conditions of vernal pools, which are sensitive and often protected habitats. Certain mining activities can disrupt or destroy these temporary waterbodies by altering hydrology, removing soil, or causing contamination, leading to the loss of specialized species and biodiversity which is not easily reversable once destroyed. Therefore, it is recommended that these systems be avoided for mining activities.

3.2.4 Fish Community Structure

No ichthyofauna assessment could be done at the time of the survey due to the ephemeral nature of the project areas. Due to periodic connectivity with riverine systems and the absence of suitable habitat, no fish species are expected within the project or PAOI.

3.2.5 Wetland Assesment

During the May 2025 survey three (3) depression wetland (ephemeral pans) were identified within the Ryst Kuil Extension project area/PAOI only: Pan 1, Pan 2 and Pan 3. These wetlands are classified as ephemeral, only flooding/inundated during high rainfall events, and are highly sensitive to disturbance due to their slow natural recovery rates.

3.2.5.1 General Functional Description

Ephemeral pans are shallow, seasonally or intermittently inundated depressions, often found in arid and semi-arid regions such as the Karoo. They are a type of depressional wetland that is characterised by:

- **Temporary inundation**: Water is present only after rainfall events, often for short periods.
- **High variability**: Both the extent and duration of inundation can vary greatly between years.
- **Salinity**: Many pans are saline or brackish due to high evaporation rates and limited outflow.
- **Vegetation**: Dominated by salt-tolerant and drought-adapted species, with vegetation often forming concentric zones around the pan margin.
- **Biodiversity**: Provide critical habitat for specialized flora and fauna, including migratory birds and unique invertebrates.

It should be noted that these characteristics are representative of ideal wetland features and may not necessarily represent the characteristics of all wetlands. The functionality of wetlands and the provision of benefits is largely dependent on wetland size and influence from abiotic drivers.

3.2.5.2 Ecosystem Services

The ecosystem services provided by the relevant wetland units on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The results of the assessment are presented in Table 3-5. The systems provide services with an overall moderately high and high level of benefit.

Table 3-5 Summary of the average ecosystem scores of the assessed wetland units

Project Area	Wetland Unit Name	EcoServices
Ryst Kuil Extension	Pan 1 – Ephemeral Pan	High
	Pan 2 – Ephemeral Pan	Moderately High
	Pan 3 – Ephemeral Pan	Moderately High

Ephemeral pans supply a range of ecosystem services, though these may be limited by their temporary nature. Ecosystem services are sensitive to changes in hydrology, overgrazing, and land use. Services include:

- **Biodiversity support**: Important breeding and feeding sites for birds and amphibians.
- **Water regulation**: Temporary storage of surface water, contributing to groundwater recharge.
- **Resource provision**: Grazing for livestock, especially after rain.
- **Cultural value**: Some pans have local cultural or historical significance.

3.2.5.3 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) assessment was applied to the HGM units in conjunction with the ecosystem service scores in the preceding sections, to assess the levels of sensitivity and ecological importance of the wetland. Various components pertaining to the protection status of a wetland is considered for the EIS, including Strategic Water Source Areas (SWSA), the NFEPA wet veg protection status and the protection status of the wetland itself considering the NBA wetland dataset (Table 3-6). All of the wetlands scored an average EIS within the “High” class.

Table 3-6 Aspects considered in the Ecological Importance and Sensitivity assessment

Project Area	Wetland Unit Name	EIS
Ryst Kuil Extension	Pan 1 – Ephemeral Pan	High
	Pan 2 – Ephemeral Pan	High
	Pan 3 – Ephemeral Pan	High

The pans have a 'High' Ecological Importance and Sensitivity, serving as a critical habitat for specialized aquatic biota and supporting terrestrial species, especially during wet periods. The valley floor depressions have a High EIS, important for biodiversity and hydrological functions. The primary ecosystem service is the maintenance of biodiversity. Other important services include sediment trapping, erosion control, flood attenuation, and provision of natural resources. The wetlands are particularly important as ecological stepping-stone corridors in an arid landscape. Soils in the pans are high in clay, with deep cracks and a crust layer; organic content increases with depth, and calcite is present. The pan centres are mostly devoid of vegetation except for sparse shrubs; edges and drainage areas have higher species diversity.

3.2.6 Present Ecological Status

The PES assessment for the sampled watercourse is based on the data collected during the May 2025 survey and the results are provided in Table 3-7. The PES assessment indicated that the Drainage Areas within the Haanekuil and Ryst Kuil Extension project areas were in a 'Largely Natural' (Class B) state whilst the Drainage Areas within the Ryst Kuil Main and Abante project area were in a 'Moderately Modified' (Class C) state. The wetland pans within the Ryst Kuil Extension project area were rated 'Largely Natural' (Class B). Therefore, all watercourses were compliant with the REC of class C (Moderately Modified). It should be noted that the PES results represent a single survey conducted during the May 2025. Therefore, these results should be interpreted accordingly.

Table 3-7 Present Ecological Status

Component/Aspect Assessed	Haanekuil	Ryst Kuil Main & Abante	Ryst Kuil Extension		
	Drainage Areas 1-5	Drainage Areas 10-12	Drainage Areas 6-9	Pan 1	Pan 2 & Pan 3
RIPARIAN COMPONENT					
Instream Habitat Integrity	B	C	B	-	-
Riparian Habitat Integrity	B	C	B	-	-
WETLAND COMPONENT					
Hydrology	-	-	-	B	B
Geomorphology	-	-	-	B	B
Vegetation	-	-	-	B	B
Present Ecological State	B	C	B	B	B
Recommended Ecological Category (DWS, 2014)	C	C	C	C	C
Recommended Management Objective	Maintain	Maintain	Maintain	Maintain	Maintain
DWS Ecostatus (DWS, 2014)	B/C	B/C	B/C	B/C	B/C

3.3 Watercourse Delineations and Buffer Requirements

The riparian areas along the assessed watercourses were delineated according to DWAF (2005), 5 m contour data, the SAIIAE dataset (NBA National Wetland Map, 2018), and the latest Google Earth aerial imagery (2024) as well as a site visit. The project areas include a vast drainage network that eventually drains to the Sout River. The drainage network is also associated with valley floor depression wetlands within the Ryst Kuil Extension project area (Pans 1-3). The delineated watercourses are presented in Figure 3-8 below.

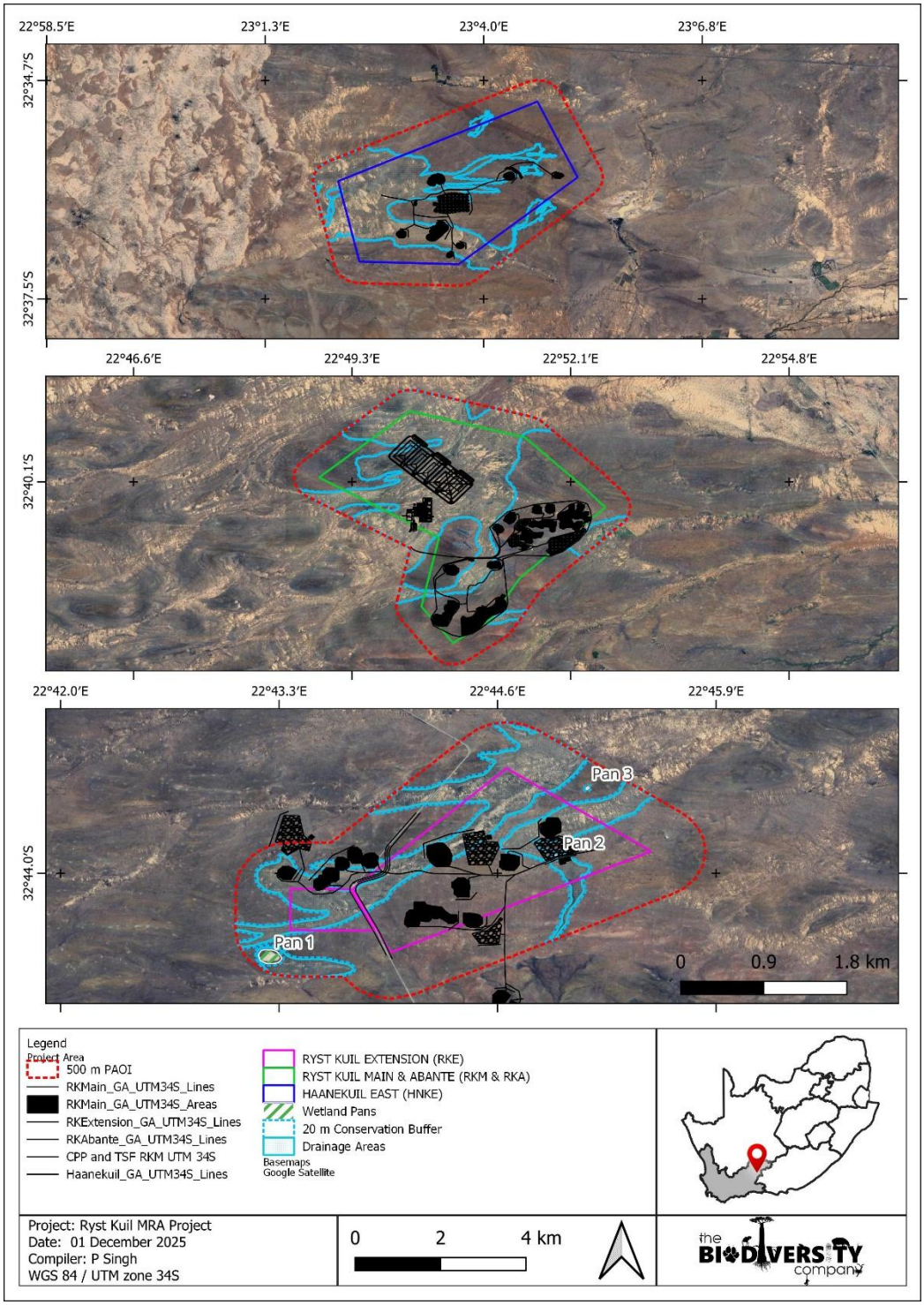


Figure 3-8 Watercourses and their assigned ecological protection buffers and ZoR with the PAOI

3.3.1 General Buffer Requirements and Development Setbacks

According to the buffer guidelines the maximum required buffer should be applied to a system (Macfarlane, *et al*., 2014). Riparian areas have high conservation value and can be considered the most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals (livestock). The vegetation they contain are an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore and Beschta, 1987). The implementation of a buffer zone ensures the ecological requirements needed to maintain both the ecosystem functioning and services offered by the watercourses are maintained. Additionally, the watercourses potentially influenced by the project have sensitivity to further disturbance, requiring protection from the project activities.

Therefore, buffer areas are considered high priority areas and should be avoided at all costs. A minimum buffer zone strip of at least 32 meters wide is required for rivers as per NEMA (Act no. 107 of 1998). The buffer zone tool was used to calculate the appropriate post-mitigation buffers required for the project. A **20 m** buffer would be applicable to the drainage areas and wetland pans. These buffer areas serve as **No-go** zones for unauthorised activities. The site development plan/mine works programme should therefore be created accordingly. Ensuring buffers are intact increases the resilience of a watercourse to future disturbances.

3.3.2 Mining Buffer Requirements and Development Setbacks

The Department of Water Affairs and Forestry (DWAF), now the Department of Forestry, Fisheries, and the Environment (DFFE) and the Department of Water and Sanitation (DWS) recognises the role of the Department of Mineral Resources and Energy to co-ordinate environmental management within the mining industry. In this regard, Government Notice (GN) 704, of Government Gazette 20119 of the 4th of June 1999 of the NWA summarises the regulations on the use of water for mining and related activities aimed at the protection of water resources.

Section 4 of GN704 places the following locality restriction on mining infrastructure:

No person in control of a mine or activity may-

(a) Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

(b) Except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;

(c) Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or

(d) Use any area or locate any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year flood-line of any watercourse or estuary.

Section 10 of GN704 summarises the following with respect to the winning of sand and alluvial minerals from a watercourse or estuary:

(1) *No person may-*

(a) *Extract sand, alluvial mineral or other materials from the channel of a watercourse or estuary, unless reasonable precautions are taken to-*

(i) Ensure that the stability of the watercourse or estuary is not affected by such operations;

(ii) Prevent scouring and erosion of the watercourse or estuary which may result from such operations or work incidental thereto;

(iii) Prevent damage to in-stream or riparian habitat through erosion, sedimentation, alteration of vegetation or structure of the watercourse or estuary, or alteration of the flow characteristics of the watercourse or estuary; or

(b) *Establish any slimes dam or settling pond within the 1:50 year flood-line or within a horizontal distance of 100 metres of any watercourse or estuary.*

(2) *Every person winning sand, alluvial minerals or other materials from the bed of a watercourse or estuary must-*

(a) Construct treatment facilities to treat the water to the standard prescribed in Government Notice No. R.991 dated 26 May 1984 as amended or by any subsequent regulation under the Act before returning water to the watercourse or estuary;

(b) Limit stockpiles or sand dumps established on the banks of any watercourse or estuary to that realised in two days of production, and all other production must be stockpiled or dumped outside of the 1:50 year flood-line or more than a horizontal distance of 100 metres from any watercourse or estuary; and

(c) Implement control measures that will prevent the pollution of any water resource by oil, grease, fuel or chemicals.

3.3.3 Regulation Zones

Table 3-8 presents the legislated zones of regulation that would be applicable to the PAOI. In accordance with General Notice (GN) 4167 of 2023 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means **100 m** from the edge of a watercourse or a **500 m** radius from the delineated boundary (extent) of any wetland or pan. Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a **32 m** zone of regulation. The proposed boundaries overlap and/or are proximal to ephemeral drainage areas and pans, and therefore the project falls within the NEMA Act 107 and DWS GN 4167 regulated zones.

Table 3-8 The legislated zones of regulation

Regulatory authorisation	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). **Department of Water and Sanitation (DWS)**	Government Notice 4167 as published in the Government Gazette 49833 of 08 December 2023 as it relates to the National Water Act, 1998 (Act No.36 of 1998) as amended. In accordance with GN4167, a regulated area of a watercourse in terms of water uses as listed in Section 21(c) and 21(i) is defined as: • the outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake, or dam; • in the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or

	• In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans.
	Activities of Listing Notice 1 (GN 983) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended): **Activity 12:** The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres;or (j) infrastructure or structures with a physical footprint of 100 square metres or more. where such development occurs: a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse. Excluding – …(dd) where such development occurs within an urban area…
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. **Department of Environmental Affairs and Development Planning (DEA&DP)**	**Activity 19:** The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or estuary, whichever distance is the greater— but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies. **Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)** **Activity 14** *The development of—* *(xii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback has been adopted, within 32 metres of a watercourse,*

3.4 Site Sensitivity Verification

3.4.1 Ecological Sensitivity

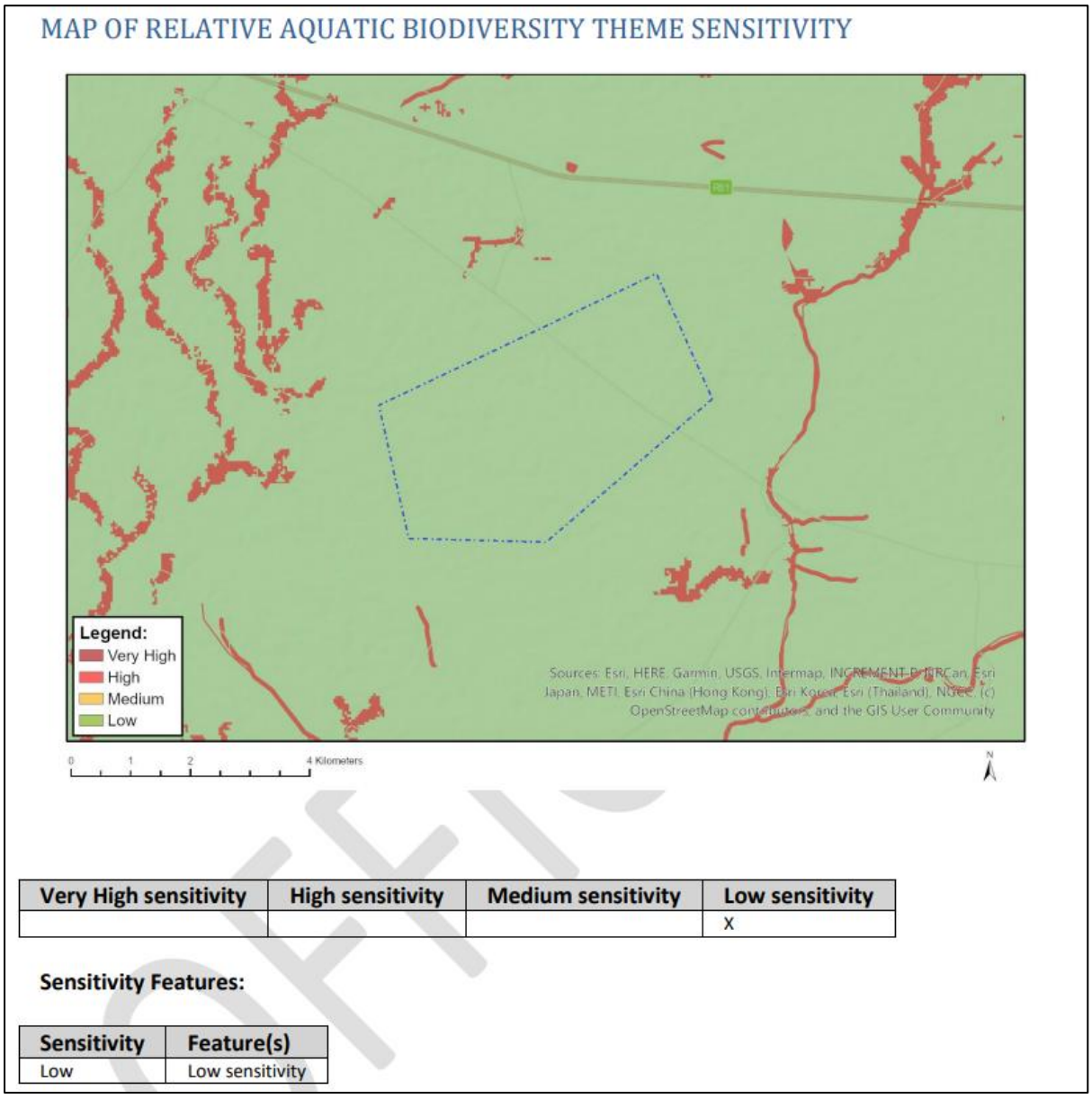
The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended) and the current assessment:

- The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI and footprint development as “Low” and “High” (Figure 3-9 to Figure 3-11).

- The desktop assessment and site visit disputed these ratings. The reaches are susceptible to further impacts, particularly on water quality and physical disturbances to instream and riparian

habitat. The freshwater ecology of the immediate project area is considered sensitive to disturbance from a hydrological and biological perspective. This will include the depression adjacent to the project area, which is considered sensitive due to the ecosystem services that these watercourse features provide. The construction and operational activities must take cognizance of this and avoid any unnecessary disturbance of the watercourse and adjacent habitat.

- 'High' freshwater sensitivities were assigned to all delineated wetlands. 'Medium' sensitivities were assigned to the drainage and buffer areas, and 'Low' sensitivities were assigned to the remainder of the area within the PAOI. The 'High' sensitivity areas would be deemed 'No go' areas for high impact activities such as mining, whilst the 'Low' and 'Medium' sensitivity areas can be considered as mining areas in terms of aquatic sensitivity and subject to environmental authorisation and suitable mitigation (including rehabilitation). The specialist aquatic sensitivity map is provided below in Figure 3-12.

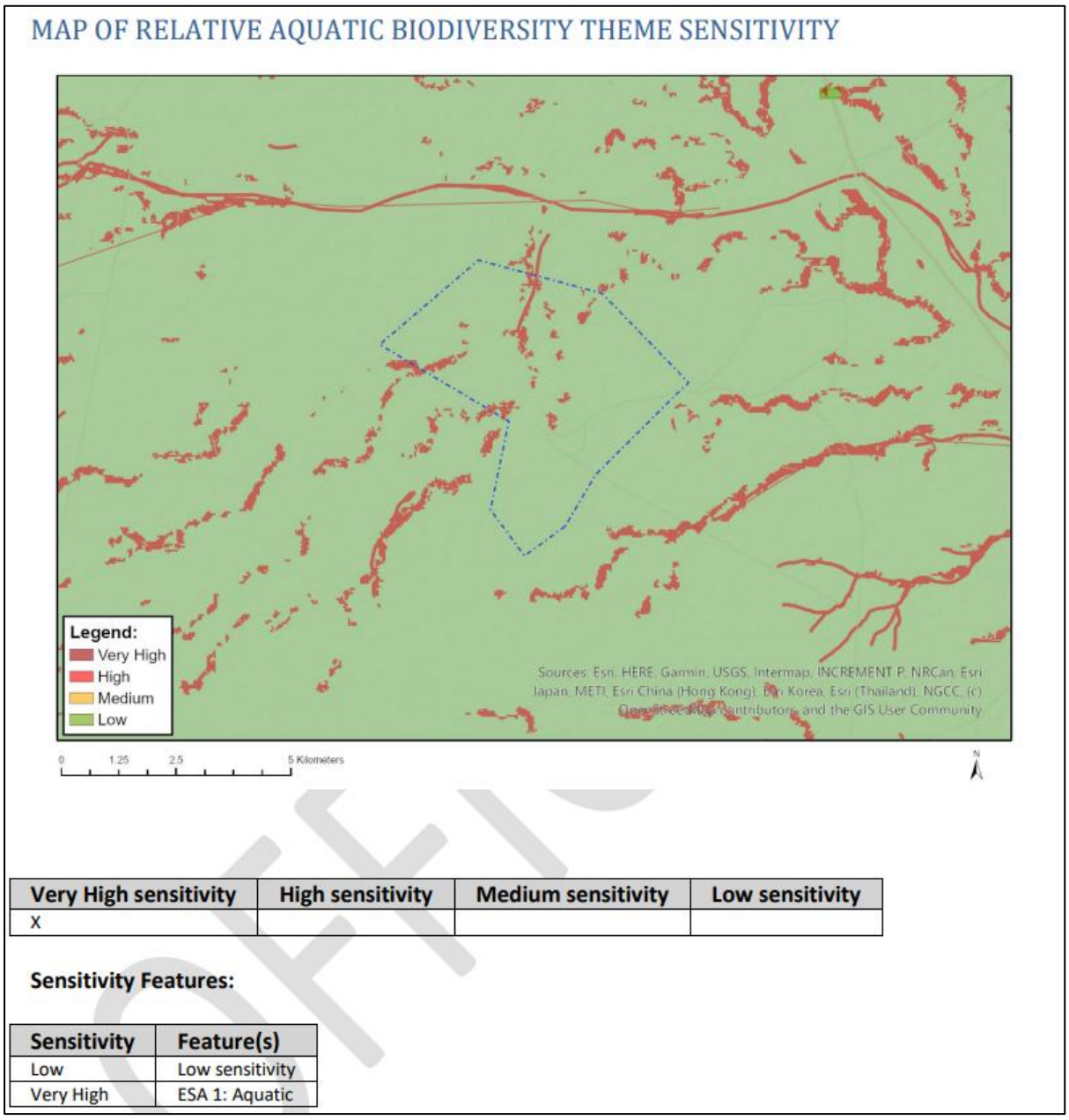


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

Figure 3-9 Aquatic Biodiversity Theme Sensitivity for the PAOI – Hannekuil project Area

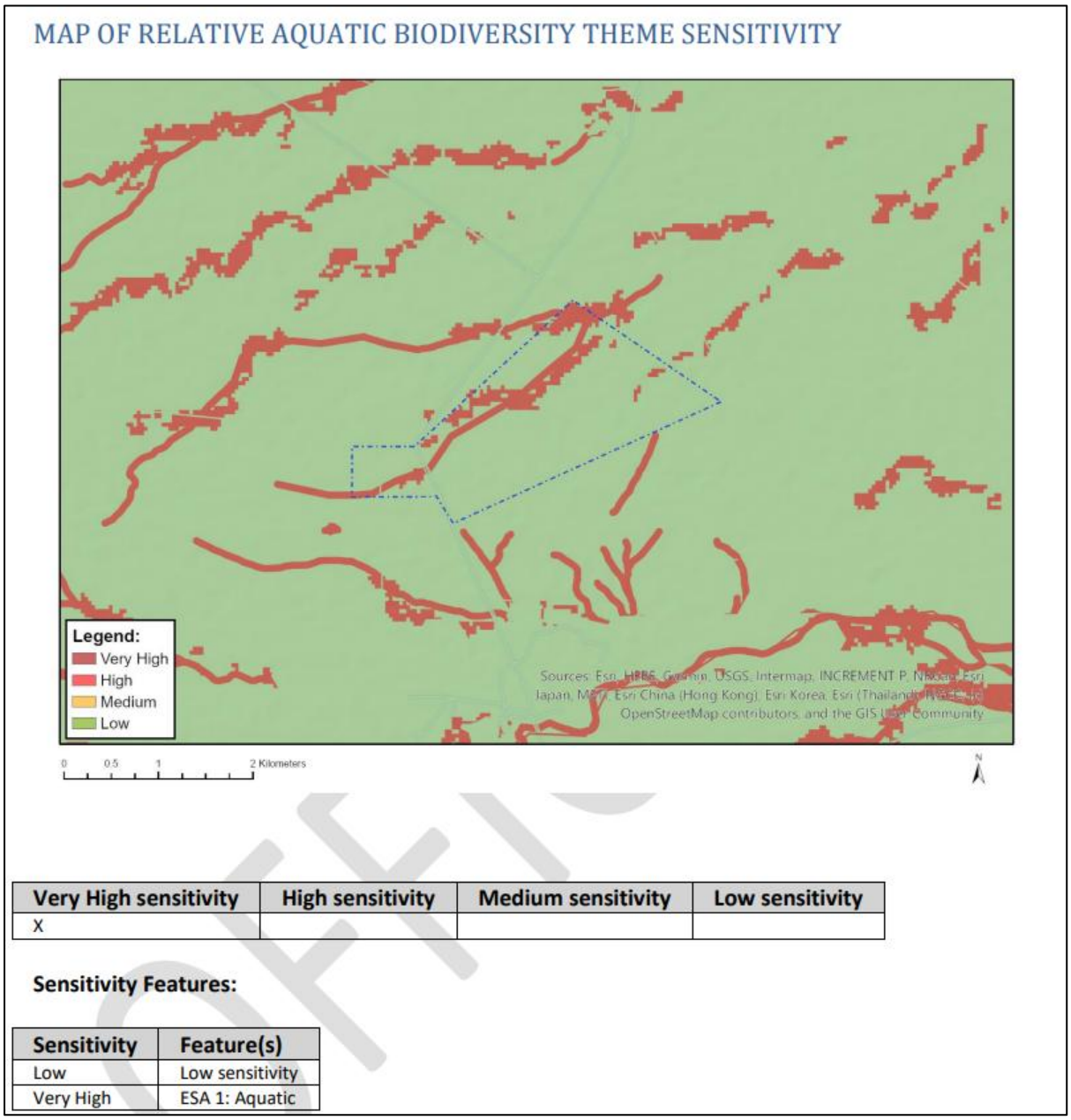


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1: Aquatic

Figure 3-10 Aquatic Biodiversity Theme Sensitivity for the PAOI – Ryst Kuil Main and Abante project Area



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1: Aquatic

Figure 3-11 Aquatic Biodiversity Theme Sensitivity for the PAOI – Ryst Kuil Extension project Area

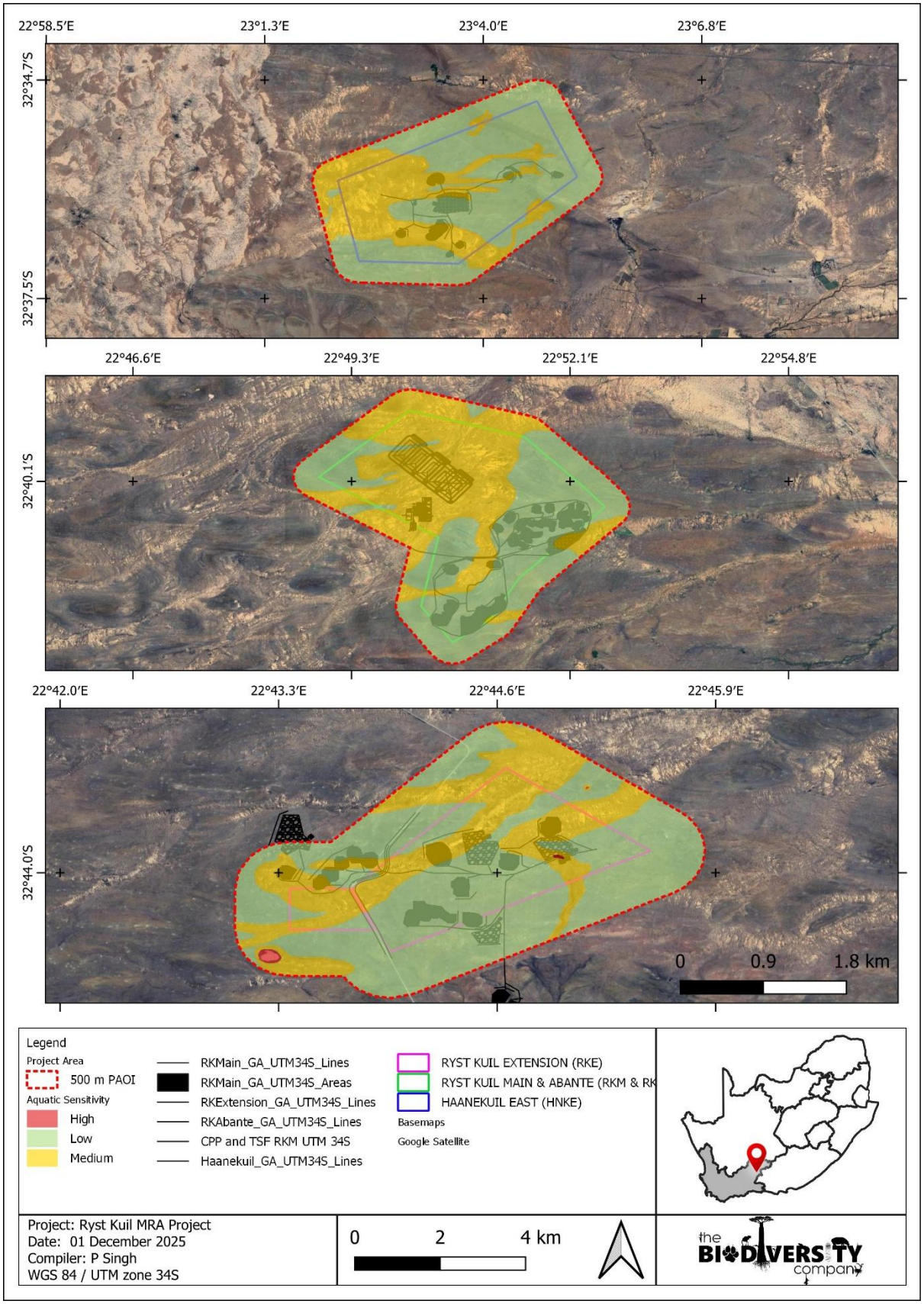


Figure 3-12 Specialist aquatic delineated sensitivity for the PAOI

4 Risk and Impact Assessment

4.1 Risk Screening

Table 4-1 provides the results of risk screening for the delineated watercourses identified to be at risk and provides motivation for each of the determined categories.

Table 4-1 Risk status of the delineated water resources

Activity	Drainage Feature	Risk Status	Rational
Uranium and Molybdenum Mine	Drainage areas	At Risk	In the absence of avoidance mitigation, the proposed mining will remove/alter drainage areas. Therefore, direct impacts are anticipated.
	Pan 1	At Risk	In the absence of avoidance mitigation, the proposed mining may alter wetland areas. Therefore, direct impacts are anticipated.
	Pan 2	At Risk	In the absence of avoidance mitigation, the proposed mining may alter wetland areas. Therefore, direct impacts are anticipated.
	Pan 3	At Risk	In the absence of avoidance mitigation, the proposed mining may alter wetland areas. Therefore, direct impacts are anticipated.

4.2 Current Impacts on Freshwater Biodiversity

The assessed watercourse exhibits impacts on both the catchment and local scale. These impacts result from present and historical land use relating to transport infrastructure development and agricultural practices in proximity to water resources which have transformed their habitats and altered their natural hydrological regime as well as species composition. The list below refers to the present-day local impacts associated with the assessed freshwater areas:

- Wildlife, livestock, grazing, trampling;
- Agricultural Activities;
- Previous Uranium Mining activities;
- Soil Erosion;
- Fences and existing roads and crossings;
- Modified Areas; and
- Edge Effects.

4.3 Alternatives Considered

Alternatives were not presented at the time of report compilation. As a result, any mitigation or management efforts were focused on the current proposed project within the proposed setup/footprint.

4.4 Loss of Irreplaceable Resources

The freshwater ecology of the project area is considered highly sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the wetland pans and drainage areas. Construction phase and operational phase activities must take cognisance of this and avoid any unnecessary disturbance of these areas. Activities within these sensitive areas will lead to modifications to the present ecological state and therefore ecosystem degradation.

4.5 Quantitative Risk and Impact Assessment

The Risk/Impact Assessment considered the direct and indirect impacts of the activity(ies) on the freshwater systems associated with the project area. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 4-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in the project location, setting, scale, layout, technology, and phasing to avoid impacts. For this assessment, the specialist was provided with the project footprint and the study focussed on the watercourses within and close to the project area. Mitigation measures should be implemented to negate potential impacts on the watercourses associated with the project area.

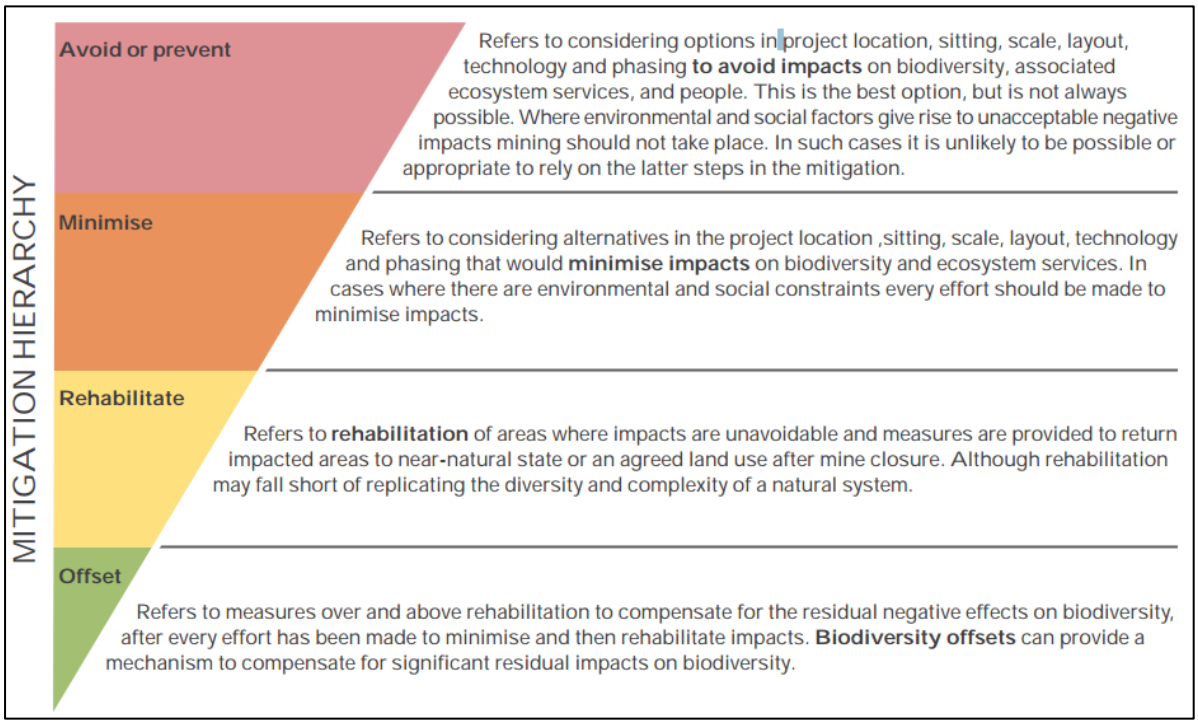


Figure 4-1 The mitigation hierarchy as described by the DEA (2013)

4.6 Assessment of Impact Significance (DWS and NEMA)

A single risk assessment was compiled for the project, which relates to open-pit and underground Uranium and Molybdenum mining and associated activities post-mitigation. The DWS Risk Assessment Matrix (GN 4167) was used to assess both risks and impacts anticipated from the proposed activities for WUL and EA as it is in the specialist's opinion that the risk matrix is suitable and sufficient to assess risks to associated water resources and can be used to apply for the full EIA. Table 4-2 illustrates the DWS risk ratings associated with the project. The potential direct and indirect impacts are expected to threaten the integrity of sensitive receptors during the project activities if unmitigated. The post-mitigation significance ratings have been calculated considering various parameters, these results are presented in the subsequent tables.

Table 4-2 Summative results of the DWS Risk Assessment Matrix compiled by Prasheen Singh (Pr. Sci. Nat. 116822)

Phase	Activity	Impact	Potentially affected watercourses	Significance (max = 100)	Risk Rating
CONSTRUCTION	<1> Earthworks, clearing of terrestrial and freshwater areas. Construction of mining laydown yards, stockpiling and stormwater management systems. Construction of basic infrastructure	<1a> Increase in sediment inputs & turbidity and associated smothering and loss of instream habitat.	Pan 1, Pan 2 and Pan 3	26.4	L
			Drainage Areas 1 - 9	44	M
			Drainage Areas 10 - 12	26.4	L
		<1b> Inputs of toxic organic contaminants.	Pan 1, Pan 2 and Pan 3	11.2	L
			Drainage Areas 1 - 9	11.2	L
			Drainage Areas 10 - 12	11.2	L
		<1c> Loss of aquatic biota and habitat	Pan 1, Pan 2 and Pan 3	48	M
			Drainage Areas 1 - 9	56	M
			Drainage Areas 10 - 12	16	L
		<1d> Excess rubble and construction material in watercourse areas.	Pan 1, Pan 2 and Pan 3	7.2	L
			Drainage Areas 1 - 9	7.2	L
			Drainage Areas 10 - 12	7.2	L
	<2> Excavating and levelling of existing roads to surveyed levels. New access roads and associated laydown yards.	<2a> Increased sedimentation	Pan 1, Pan 2 and Pan 3	21.6	L
			Drainage Areas 1 - 9	21.6	L
			Drainage Areas 10 - 12	21.6	L
		<2b> Increased erosion from exposed surfaces	Pan 1, Pan 2 and Pan 3	16	L
			Drainage Areas 1 - 9	16	L
			Drainage Areas 10 - 12	16	L
		<2c> Erosion in key areas (steep and/or exposed areas)	Pan 1, Pan 2 and Pan 3	21.6	L
			Drainage Areas 1 - 9	21.6	L
			Drainage Areas 10 - 12	14.4	L
		<2d> Alteration of hydro-dynamics and reduced dispersal/ migration of fauna	Pan 1, Pan 2 and Pan 3	14.4	L
			Drainage Areas 1 - 9	21.6	L
			Drainage Areas 10 - 12	14.4	L
OPERATIONAL	<1> Open-pit Mining (Excavations, drilling, crushing and stockpiling). Operation and maintenance of roads. Waste Rock Dumps. PCDs. Underground mining.	<1a> Increased erosion from exposed surfaces and sedimentation. Alteration of hydro-dynamics and reduced dispersal/ migration of fauna.	Pan 1, Pan 2 and Pan 3	38.4	M
			Drainage Areas 1 - 9	64	H
			Drainage Areas 10 - 12	38.4	M
		<1b> Habitat destruction and fragmentation. Loss of watercourse habitat (irreplaceable resources)	Pan 1, Pan 2 and Pan 3	38.4	M
			Drainage Areas 1 - 9	72	H
			Drainage Areas 10 - 12	38.4	M
		<1c> Contamination associated with vehicles and heavy machinery (hydrocarbons)	Pan 1, Pan 2 and Pan 3	38.4	M
			Drainage Areas 1 - 9	51.2	M
			Drainage Areas 10 - 12	38.4	M
		<1d> Contamination associated with acidic mine water, tailings	Pan 1, Pan 2 and Pan 3	76	H
			Drainage Areas 1 - 9	76	H

		waste, and introduction and spread of radioactive materials.	Drainage Areas 10 - 12	76	H
	<2> Concurrent rehabilitation. Re-shaping, revegetation and contouring.	<2a> Increased erosion from exposed surfaces, erosion and alteration of flow patterns. Alien vegetation encroachment.	Pan 1, Pan 2 and Pan 3	26.4	L
			Drainage Areas 1 - 9	26.4	L
			Drainage Areas 10 - 12	26.4	L
		<2b> Re-shaping of landscape. Re-vegetation of terrestrial and watercourse habitat.	Pan 1, Pan 2 and Pan 3	-48	+
			Drainage Areas 1 - 9	-48	+
			Drainage Areas 10 - 12	-48	+
DECOMMISSIONING	<1> Backfilling of the excavations.	<1a> Increased erosion from exposed surfaces.	Pan 1, Pan 2 and Pan 3	35.2	M
			Drainage Areas 1 - 9	35.2	M
			Drainage Areas 10 - 12	35.2	M
		<1b> Increased sedimentation. Alteration of patterns of flows (increased flood peaks).	Pan 1, Pan 2 and Pan 3	26.4	L
			Drainage Areas 1 - 9	35.2	M
			Drainage Areas 10 - 12	35.2	M
	<2> Final rehabilitation. Re-shaping, revegetation and contouring.	<2a> Increased erosion from exposed surfaces, erosion and alteration of flow patterns. Alien vegetation encroachment.	Pan 1, Pan 2 and Pan 3	26.4	L
			Drainage Areas 1 - 9	26.4	L
			Drainage Areas 10 - 12	26.4	L
		<2b> Re-shaping of landscape. Re-vegetation of terrestrial and watercourse habitat.	Pan 1, Pan 2 and Pan 3	-48	+
			Drainage Areas 1 - 9	-48	+
			Drainage Areas 10 - 12	-48	+

(L) Low Risk (+) Positive (+ +) Highly positive
(M) Moderate Risk
(H) High Risk

Uranium mining in semi-arid environments poses significant risks to ephemeral water resources, which, despite their intermittent nature, can support diverse aquatic life during periods of flow or pooling. The extraction and processing of uranium often lead to the mobilization of radioactive elements and heavy metals, which can contaminate surface water and shallow groundwater through leaching, runoff, or accidental spills. In semi-arid regions, the limited and sporadic water availability means that contaminants can become highly concentrated during dry periods, posing acute toxicity risks to aquatic organisms when water is present. These water bodies, though temporary, serve as critical habitats for various species, and contamination can disrupt local ecosystems, reduce biodiversity, and impair the ecological functions of these habitats (Winde, 2010; Brugge & Buchner, 2011).

Furthermore, uranium and its decay products can enter the food chain through bioaccumulation in aquatic plants and invertebrates, which are then consumed by primary and secondary consumers such as fish, amphibians, birds, and mammals. This trophic transfer can lead to the biomagnification of radioactive substances and heavy metals, increasing exposure risks for higher-order consumers, including humans who may rely on these water sources for drinking or fishing. Chronic exposure to uranium and its byproducts can cause a range of health effects, including kidney damage and increased cancer risk, highlighting the importance of stringent environmental monitoring and management in uranium mining operations, especially in sensitive semi-arid regions (Sheppard et al., 2005; Winde, 2010).

The proposed mining activities pose ‘Low’ to ‘High’ pre-mitigation and post-mitigation risks during the construction, operational and decommissioning phases. High risks are the resultant of mining out watercourse areas (drainage areas and valley floor depression wetlands) and contamination of watercourses and ecosystems with radioactive materials. Moderate risks are associated with the

activities proximal to the watercourses, including the drainage patterns change due to road extent and crossings, clearing of riparian (and terrestrial) vegetation, stormwater management, excavation of wetland and riparian areas, bed and/or banks, operation of heavy machinery adjacent/within the watercourse, alien vegetation encroachment, conducting road and crossings maintenance, sedimentation and erosion, and hydrocarbon contamination. Impacts associated with mining out watercourses are deemed difficult to manage and impractical to mitigate against, given the proposed mining pit locations and waste rock dumps, and that both wetland and drainage areas (riparian habitat) will be mined.

The implementation of mitigation measures as well as the avoidance of watercourse areas for any mining activities will reduce the risks/impacts of some activities, if done effectively. If not done effectively, the activities will not reduce the risks of aspects/activities such as clearing watercourse areas, deep excavation when mining, drilling and crushing, changes to drainage patterns due to road extent and crossings, dust precipitation (from backfilling), change in topography (from backfilling), dust precipitation (from shaping/contouring), change in topography (from shaping/contouring) and surface structures as well as stormwater, as these activities will result in direct loss of riparian vegetation, channel-, bed- and bank modification, and have a direct impact on the wetland and riparian areas. Liquid radiological and acid leachate pathways are a key residual risk warranting a detailed water and waste management design (TSF lining, PCDs, zero-release or acceptable discharge), and monitoring uranium and relevant radionuclides in surface and groundwater.

The disturbance of land poses a risk for alien invasive plants (AIP) proliferation. AIPs were observed on site, and these species would likely spread post construction (along with the introduction of other AIPs). Therefore, a site management plan is required, including an AIP control plan. Furthermore, the increase in surface runoff from the activities can be expected due to altered topographies and mining activities, posing a risk to the watercourses through bank erosion, water quality contamination, and instream sedimentation. A stormwater management plan should be implemented during construction and during the operational phase. Sensitive areas should be clearly demarcated by an appropriately qualified person, and these areas should be avoided by all unauthorised activities.

The rehabilitation of the wetland and riparian habitat will have a positive impact on the ecological integrity of the existing watercourse areas and it is suggested that rehabilitation of any given area within the proposed MRA be affected as soon as possible to limit disturbance to the environment in terms of contamination, bank erosion and sedimentation of the water column. The project should feature concurrent as well as final rehabilitation of disturbed areas.

4.7 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. Table 4-3 is a summary of the findings from a watercourse ecology perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases of the project.

Table 4-3 Unplanned Events, Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Leaks and spills of contaminants into watercourse	Contamination of sediments and water resources associated with the spillage, with associated negative biological effects (reduction in ecological integrity).	A spill response kit and protocol must be available at all times. The incident must be reported on and if necessary, an aquatic specialist must investigate the extent of the impact and provide rehabilitation recommendations. Berms must be created between the facility and the watercourse to limit/ contain the spill from entering the watercourse.
Uncontrolled erosion	Sedimentation of downstream watercourse.	Erosion control measures must be put in place. These should be adaptive to on-site conditions.

Introduction of radioactive materials into the environment.	Contamination of sediments and water resources associated with the introduction of radioactive isotopes, with associated negative biological effects (reduction in ecological integrity).	All mining activities should be placed outside of the watercourse and buffer areas. There should be no interaction between mined products, decant and mining materials with watercourses. Strict controls should be in place that prevent the introduction of radioactive materials into the environment, and should introduction occur then there should be effective mitigation to prevent and reduce the impacts.

4.8 Cumulative Impact

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for terrestrial fauna and flora.

Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers. These include dust deposition, noise and vibration, disruption of wildlife corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport. The overall cumulative impact is expected to be High (Table 4-4).

Table 4-4 Cumulative impact assessment for the development

Impact Nature: Loss / Degradation to Local Ecology		
	Overall impact of the proposed development considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Low (2)	High (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Highly probable (4)
Significance	**High**	**High**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

5 Mitigation Measures

Uranium mining can have significant adverse effects on riverine and wetland systems, including the serious health risks, alterations to biotic communities, depletion of surface water, disturbance to groundwater, loss of inundated riparian and instream habitats, physical destruction of sensitive ecological zones, degradation of water quality, alterations to channel morphology, increased flood risks, and the decline of aquatic biota (Choudhary 2023).

Mitigation measures for Uranium and Molybdenum mining are designed to promote responsible extraction practices by controlling the rate, volume, and area of mining activities, protecting and rehabilitating instream and riparian habitats, and proactively monitoring both abiotic and biotic components of the receiving environment.

These mitigation measures should aim to avoid or reduce potential negative impacts on air, water, land, ecology, and human health, or to introduce positive aspects to the mining operation that would not otherwise occur in the absence of the proposed development.

Given that mitigation can most practically focus on minimizing impacts from the proposed mining operations—particularly where mining occurs within or adjacent to watercourses including wetlands—the following measures are recommended to reduce the intensity of impacts on the ecological integrity of the affected water resources:

5.1.1 Overarching Design and Planning Principles

The following mitigation measures are aimed to protect and conserve watercourses during the life of mine:

- Apply the mitigation hierarchy as follows:
    - Avoid: Keep open pits, waste rock dumps, TSFs and process plants outside delineated pans, wetlands, drainage lines and their buffers.
    - Minimise: Where complete avoidance is impossible, minimise the spatial footprint and duration of disturbance and use the most benign technologies available.
    - Rehabilitate/Restore: Implement concurrent and progressive rehabilitation; avoid deferring all rehabilitation to closure.
    - Offset: If any irreplaceable features (e.g. high-EIS pans) are unavoidably lost, commit to like-for-like or better offsets.
- Respect legal buffers and regulated areas:
    - No residue deposits, dams or sanitary facilities within the 1:50/1:100 year floodline or 100 m of watercourses and pans, in line with GN 704.
    - Treat the 500 m zone around pans/wetlands as a regulated area for NWA Section 21(c) & (i) activities; motivate any infrastructure within this zone carefully in the WUL.
- Design for semi-arid extremes:
    - Use site-specific water balance models that include: very low average rainfall, extremely high evaporation, and occasional intense storm events with high runoff.
    - Size containment and diversion structures for rare but intense storms (e.g. ≥1:50 or 1:100 year events, depending on authority requirements).
- Protection of pans and ephemeral systems:
    - Treat pans and high-EIS wetlands as No-go areas for excavation, infilling or waste placement.
    - Maintain natural micro-catchments feeding pans; avoid intercepting or concentrating flow away from them.
    - Where pans are close to disturbed areas, install low berms and silt fences to prevent sediment and contaminated runoff entering the basins.
- Ephemeral drainage lines:

- Do not straighten, canalise or infill valley-bottom drainage lines; preserve their natural morphology where possible.
- Only use armouring or gabions where necessary to protect critical infrastructure; otherwise maintain natural substrates and roughness.

5.1.2 Mine Layout and Infrastructure Siting

- Avoidance of sensitive freshwater features:
  - Place pits, underground portals, waste rock dumps and TSFs outside all mapped pans, valley-bottom depressions and ephemeral drainage lines.
  - Maintain ecological conservation buffers from the edge of drainage lines and pan basins.
  - Locate haul roads and conveyors parallel to, and upslope of, drainage lines, not across them, wherever possible.
- Crossings and access routes:
  - Where crossings of drainage lines are unavoidable, use single, consolidated crossings instead of multiple small ones.
  - Design crossings as low-impact structures (e.g. culverts with natural bed material, armoured drifts) that maintain hydrological connectivity and do not impede flow during storm events.
  - Avoid any crossings over pans; re-route around basins.
- Processing plant and ancillary facilities:
  - Place leach plants, reagent storage, fuel depots and workshops on high-lying, geotechnically stable ground, outside regulated areas.
  - Ensure all such areas drain to engineered pollution control dams (PCDs), not directly into natural drainage.

5.1.3 Water and Tailings Management

- Clean–dirty water separation:
  - Implement a fully separated stormwater system:
    - Clean water (up-gradient catchment) diverted around the mine via lined diversion channels and berms.
    - Dirty water (contact water from pits, TSFs, plant, haul roads) collected and routed to PCDs.
  - Avoid any long-term channel diversions unless absolutely necessary; if required, design them as geomorphologically stable and lined or armoured.
- Pollution control dams (PCDs):
  - Design PCDs with:
    - Adequate freeboard for design storm events.

        - Liners (synthetic and/or compacted clay) to minimise seepage.
        - Emergency spillways routed to low-risk receivers, never directly into pans or high-EIS wetlands.
    - Operate PCDs to maintain sufficient capacity prior to the wet season; incorporate water reuse to reduce freshwater abstraction.

- Tailings Storage Facility (TSF) design:
    - Use double-lined TSFs with leak-detection and under-drain systems where feasible, especially for uranium-bearing tailings and acidic leach residues.
    - Design TSF paddocks, embankments and return water dams to:
        - Prevent overtopping under extreme rainfall.
        - Minimise wind erosion and dust emissions from dry beaches.
    - Incorporate seepage cut-off trenches or cut-off walls down-gradient where sensitive aquifers or receptors occur.

- Process water and leach circuits:
    - Fully contain sulphuric acid leach circuits within bunded, concreted areas draining to PCDs.
    - Avoid any unlined channels for process water; use piped systems with leak detection.
    - Implement closed-loop water recycling as far as practicable to approach zero-liquid discharge, subject to geochemical and radiological constraints.

5.1.4 Radiation and Contamination Control

- Source and pathway control:
    - Minimise the volume of material with elevated radioactivity stored above ground by:
        - Optimising cut-off grades to reduce low-grade stockpiles.
        - Returning low-grade, non-economic ore to backfilled pits where geochemically acceptable.
    - Prevent any direct discharge of mine water or tailings supernatant into natural watercourses or pans.

- Containment of radioactive materials:
    - Store all uranium-bearing concentrates, reagents and contaminated consumables in bunded areas with lined floors.
    - Maintain double containment for any pipelines or tanks carrying highly contaminated or acidic solutions (e.g. pipe-in-pipe, leak trays, sumps with alarms).
    - Implement strict housekeeping and spill control so that contaminated solids and sludges do not accumulate in unlined areas.

- Radiation protection for workers and public:

- Apply ALARA principles (As Low As Reasonably Achievable) to exposure via:
  - Engineering controls (enclosed handling of concentrates, local extraction ventilation).
  - Administrative controls (time limits in high-dose areas, restricted zones).
  - PPE (respiratory protection, dosimetry).

- Fence and signpost all TSFs, ore stockpiles and process areas as controlled radiation zones, with access restricted.

5.1.5 Air Quality: Dust, Radon and Wind-Blown Contaminants

- Dust control on semi-arid sites:
  - Keep ore and tailings surfaces moist where feasible and environmentally safe to do so, avoiding excessive ponding that increases seepage risk.
  - Use chemical dust suppressants or surface armouring (gravel, vegetation) on long-term exposed areas.
  - Apply graded wind breaks and berms on dominant wind directions around TSFs and stockpiles.

- Radon and radioactive particulates:
  - Minimise exposed surfaces of high-grade ore and tailings; keep them in covered or enclosed storage where practicable.
  - Use enclosed conveyors or transfer points for high-uranium materials to limit dust and radon release.
  - Monitor ambient radon levels and gamma dose rates at site boundaries and in worker areas; implement additional shielding or ventilation as thresholds approach licence limits.

5.1.6 Open-pit and Underground Mining Mitigation

The following mitigation measures are aimed to protect and conserve watercourses during the excavation of the mine pits and underground mining:

- The extent of the mine pits should not differ from the extent of the approved and authorised shapefile shared with the consultants and Competent Authority;
- Install groundwater monitoring wells around mining sites to allow for early detection of contamination plumes. Grouting and sealing of underground mine shafts and boreholes can prevent the migration of contaminated water into aquifers that may intermittently recharge surface water systems;
- Implement measures to prevent the formation of acid mine drainage by isolating sulphide-bearing waste from oxygen and water, such as through dry covers, encapsulation, or underwater storage of reactive waste in the event that sulphide bearing rocks are discovered/encountered;
- Use active or passive water treatment systems (e.g., constructed wetlands, lime neutralization, ion exchange) to remove uranium, heavy metals, and radionuclides from mine-impacted water before discharge or reuse;

- Employ controlled blasting and excavation techniques to minimize the disturbance of surrounding rock and reduce the generation of fine particulate matter that could be transported to water bodies;
- Apply dust suppression methods, such as water sprays, chemical stabilizers, or covering of ore and waste piles, to prevent wind-blown contaminants from entering ephemeral streams during rainfall events;
- Design and maintain stormwater management systems to capture and treat runoff from mine sites, especially during infrequent but intense storms common in semi-arid regions;
- Constructing lined tailings storage facilities and water retention ponds is essential to prevent seepage and runoff of contaminated water into ephemeral streams and groundwater. The use of impermeable barriers and regular inspection of containment structures can minimize the risk of leaks, especially during rare but intense rainfall events typical of semi-arid climates;
- Implement water-efficient mining and ore processing techniques, such as dry stacking of tailings and closed-loop water recycling systems. This reduces the demand for scarce water resources and limits the volume of contaminated water requiring treatment and disposal;
- Only if applicable and authorised then diverting clean surface water away from mining areas using diversion channels and berms to prevent the mixing of uncontaminated water with mine-impacted water may be practiced.
- Erosion control measures, such as revegetation of disturbed areas and the use of sediment traps, further reduce the transport of sediments and associated contaminants into ephemeral water bodies;
- All infrastructure components (i.e., stockpiles, haul roads, buildings etc) associated with the mining activities must be located within the extent of the proposed MRA shared with the consultant;
- Backfill underground mine voids with inert material to reduce the risk of subsidence and limit pathways for water movement and contaminant migration;
- Segregate and selectively handle potentially acid-generating or uranium-rich waste rock to ensure it is stored in lined, contained facilities away from watercourses;
- Basic rock cladding must be applied to areas characterised by signs of erosion within and around the relevant watercourses and drainage lines;
- Develop and regularly update emergency response plans for accidental spills, leaks, or extreme weather events to minimize the risk and impact of acute contamination incidents;
- Continuous monitoring of water quality in both surface and groundwater, especially during and after rainfall events, ensures that any contamination is detected early and can be addressed promptly. Adaptive management strategies should be in place to respond to monitoring results and changing environmental conditions;
- Implement long-term post-closure water management strategies, including ongoing monitoring, maintenance of containment structures, and periodic assessment of water quality to ensure the continued protection of aquatic resources after mining ceases; and
- Involve local communities and stakeholders in water management planning, monitoring, and decision-making to ensure transparency and address site-specific concerns.

5.1.7 Processing Plant

- Full Containment and Bunding of Acid and Process Circuits:
    - All sulphuric acid storage tanks, leach tanks, reagent make-up areas and pipelines must be located on impervious, bunded surfaces draining to a sump.
    - Bunds must be sized to contain at least 110% of the volume of the largest tank plus 25% of the total volume of all other containers in the bunded area.
    - Floors should be constructed of acid-resistant concrete with sealed joints to prevent seepage into soil and groundwater.
- Double-Containment for High-Risk Pipelines and Transfer Lines:
    - All pipelines conveying concentrated sulphuric acid or uranium-bearing leach solutions must be double-contained (e.g. pipe-in-pipe systems) over any area where leaks could reach soil, pans, drainage lines or PCDs.
    - Install leak-detection systems (e.g. pressure monitors, sump alarms) in interstitial spaces, with automatic shutdown protocols for abnormal readings.
- Dedicated, Lined Pollution Control Dams (PCDs) for Plant Effluents:
    - All process water, floor washings, spillage collection and stormwater from the plant footprint must drain to lined PCDs (synthetic liner and/or compacted clay) with leak detection and sufficient freeboard.
    - No direct discharge of plant effluents to natural drainage lines or pans may occur; all water must be recycled to the plant or treated to an agreed standard under the WUL before any controlled release.
- Strict Acid and Reagent Handling Procedures:
    - Implement standard operating procedures (SOPs) for the delivery, storage, transfer and dilution of sulphuric acid and other reagents (oxidants, flocculants, extractants).
    - Off-loading areas must be bunded, with drive-on/drive-off containment and quick-connect couplings to reduce spill risk.
    - Only trained and authorised personnel may handle bulk acid; regular refresher training and competency assessments must be conducted.
- Spill Prevention, Contingency Planning and On-Site Spill Response Capacity:
    - Equip the processing plant with appropriately sized spill kits (acid-neutralising materials, absorbents, PPE) at all transfer and storage points.
    - Develop and test a plant-specific Spill Response Plan, including clear internal reporting lines, immediate containment procedures, and requirements for clean-up, disposal and incident investigation.
    - Maintain an incident register and implement corrective and preventive actions following any spill.
- Air Emission, Ventilation and Worker Exposure Controls:

  - Provide adequate local exhaust ventilation over leach tanks, acid storage and transfer points to capture acid mists and any volatile process components.
  - Install scrubbing systems where necessary to treat off-gases before release to atmosphere.
  - Implement a personal exposure monitoring programme (e.g. sulphuric acid mist, radionuclides in air) and enforce the use of appropriate PPE where engineering controls alone are not sufficient.

- Segregation and Management of Solid and Liquid Wastes:
  - All solid wastes and sludges contaminated with acid or uranium (e.g. filter cakes, spent resins, maintenance wastes) must be handled as hazardous waste and routed to the TSF, a lined hazardous waste cell, or licensed off-site facilities as appropriate.
  - Segregate radioactive and chemically hazardous wastes from general waste to prevent dilution and uncontrolled disposal.
  - Maintain a waste inventory and tracking system to demonstrate proper handling, storage and disposal in line with NEMWA and WUL conditions.
- Stormwater Management and Clean–Dirty Water Separation at the Plant:
  - Implement clean–dirty water separation across the plant platform:
    - Upslope clean runoff diverted around the plant via lined channels.
    - Plant area and any potentially contaminated zones drain to PCDs.
  - Design stormwater systems for semi-arid intense-storm events, ensuring that bunds and drains cannot be overtopped by infrequent but severe rainfall, which could otherwise flush acid or radionuclides into nearby pans or drainage lines.
- Emergency Power and Instrumentation for Critical Safety Systems:
  - Provide backup power (e.g. diesel generators or UPS) for critical containment and safety systems: pumps returning contaminated water to PCDs, scrubbers, leak-detection alarms and control valves.
  - Implement automated interlocks to shut down acid dosing, leach circuits and relevant plant sections in the event of loss of power, pump failure or detected major leaks.
- Comprehensive Monitoring and Integration with WUL and Radiation Licence:
  - Establish a monitoring programme for plant-related impacts, including:
    - pH, EC, sulphate and metals/uranium in plant PCDs and down-gradient groundwater.
    - Ambient air quality (dust and acid mist) and radiation (gamma dose rates, radionuclides in dust).
- Link monitoring results to predefined trigger thresholds with corresponding responses (operational changes, increased treatment, temporary shutdowns).

- Ensure all plant design, operational controls and monitoring are aligned with EA, WUL and nuclear/radiation licence conditions, with regular reporting to authorities.

5.1.8 Operation of Vehicles, Heavy Machinery and Equipment

- Vehicles, heavy machinery and equipment are only permitted within the no-go areas when being actively operated under supervision of the ECO, and otherwise must be stored outside of the no-go areas on level impervious ground. The same applies to the servicing thereof. This is best practice as it limits their duration within sensitive freshwater areas and thereby minimising impacts. Any activity within an unauthorised area must first seek the prior approval of the ECO, except under emergency procedures;

- The operation activities must be subjected to seasonal restrictions to support aquatic wildlife breeding periods;

- Existing access roads/jeep tracks/haul roads must be used as far as possible to prevent additional disturbance to the riparian zone and overall upgradient catchment. New routes must be carefully planned and advised by the ECO so as to avoid freshwater and generally sensitive habitats as far as feasibly possible. In the event of a new access route traversing a riparian zone, the proponent must look into using machinery with low ground pressure to minimise soil compaction and damage to riparian vegetation. Tracked vehicles or specialised low-ground-pressure tyres can be used if feasible/available;

- Non mobile machinery must be equipped with attachments like swamp mats or bog mats to distribute weight and minimise disturbance to the watercourse areas;

- Vehicle and heavy machinery must be equipped with drip trays to prevent the spill of hydrocarbons and other contaminants into the environment. An emergency spill remediation response plan must be in place in the event of an unforeseen spill, as affected through the training of operational staff and the acquisition of spill contaminant materials that must be readily available on-site. It is the responsibility of the contractor to immediately action spill cleanups and remove hazardous material off site;

- Operators must be trained in operating machinery in wetland/sensitive environments and be aware of the sensitivity of the area;

- Sensitive areas must be demarcated so as to guide operators, labourers and contractors;

- Use machinery with low ground pressure to minimise soil compaction and damage to wetland/riparian vegetation. Tracked vehicles or specialised low-ground-pressure tyres can be used if feasible/available;

- Implement sediment and erosion control measures such as silt fences, erosion control blankets, or sediment traps to prevent soil runoff into water bodies associated with vehicular movements and disturbed/hardened surfaces;

- Servicing, washing and refuelling of vehicles may not take place within the no-go areas;

- All Hazardous Chemical Substances (HCS) should be stored within suitable secondary containment structure and may not be stored within the watercourses or their buffer zones;

- Develop spill prevention and response plans to address potential leaks or spills of fuels, oils, or other hazardous substances;

- Have spill containment materials readily available on-site and train personnel in proper spill response procedures;
- The contractor is responsible for cleaning up any spillages (e.g. concrete, oil, fuel), immediately;
- Leaking equipment shall be removed from site immediately to facilitate repair;
- Contaminated soils and waste materials must be removed and disposed of in accordance with local regulations and guidelines;
- Properly manage waste generated during operations, including fuel, lubricants, and construction debris, to prevent contamination of the wetland/riparian areas;
- Implement an Incident Register to report any incidents or deviations from the planned operations to the ECO;
- Tarpaulins must be used to cover the loaded material to prevent the spill and spread of sand during transport; and
- Develop a restoration and rehabilitation plan to mitigate any long-term impacts of operating heavy machinery in wetlands and/or riparian areas.

5.1.9 Water Quality Impairment

- All contractors and employees must undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Vehicle washing and refuelling must take place outside of the no-go area to avoid the runoff of hydrocarbons and other contaminants into watercourses;
- No radioactive materials should be introduced into the aquatic environment;
- A Remediation Plan should be commissioned for accidental and/or prolonged introduction of acidic waters and/or radioactive isotopes into the aquatic environment;
- All chemicals and toxicants must be stored in bunded areas; and
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly.
- Baseline and predictive studies:
    - Conduct baseline groundwater quantity and quality surveys (including radionuclides, major ions, metals) prior to mining.
    - Use numerical groundwater models to predict drawdown cones, seepage plumes from TSFs/PCDs, and potential connectivity with pans and drainage lines.
- Monitoring network:
    - Install up-gradient and down-gradient monitoring boreholes around pits, TSFs and PCDs.
    - Monitor key indicators: water level, pH, EC, sulphate, uranium and other relevant radionuclides, metals, and major ions.

- Define action levels and trigger-based responses (e.g. increased pumping, barrier installation, treatment) if trends exceed thresholds.

5.1.10 Erosion, Sediment and Soil Management Measures

The following erosion, sediment soil management measures are applicable to semi-arid Karoo conditions and soil types.

5.1.10.1 Stockpiling and Topsoil Management

- Location of stockpiles:
  - Do not place any soil, overburden or waste stockpiles within watercourses, pans, wetlands, or their buffer zones/regulation areas.
  - Locate stockpiles on flat or gently sloping ground, outside natural drainage paths, to minimise runoff concentration and erosion.
- Protection of stockpiles:
  - Surround stockpiles with low earth bunds, rock berms or sandbags to prevent eroded material entering ephemeral channels or pans.
  - Protect longer-term stockpiles using mulch, straw, or brush-packing; where feasible, seed with indigenous, drought-tolerant grasses to stabilise surfaces.
- Topsoil stripping, storage and reuse:
  - Strip topsoil separately from subsoil and waste rock, and store in designated, low-slope, bunded stockpiles outside regulated areas.
  - Keep topsoil stockpiles low (preferably <2–3 m) to reduce compaction and preserve seed banks and soil biota.
  - Record and document the soil profile (topsoil/subsoil horizons) during stripping, and re-apply soils in the same horizon order during rehabilitation.
  - Ensure topsoil is appropriately stored and re-applied as the uppermost layer during backfilling and rehabilitation.

5.1.10.2 Earthworks, Backfilling and Compaction

- Backfilling practices:
  - Backfill excavated areas with suitable material and compact to geotechnical specifications appropriate for local Karoo soils, avoiding over-compaction that inhibits revegetation.
  - Re-establish natural micro-topography where possible to avoid creating artificial flow paths that channel runoff into sensitive pans or drainage lines.
- Immediate response to erosion:
  - Inspect exposed earthworks and stockpiles regularly, especially after storm events.
  - Address any signs of erosion immediately (e.g. rills, gullies, slope failures) using appropriate stabilisation measures to prevent further degradation of soils and infrastructure.

5.1.10.3 Erosion and Energy Dissipation Structures

- Stabilisation of fine-textured Karoo soils - stabilise all new embankments, cut slopes, TSF walls and drain banks using a combination of:
    - Rock armouring or riprap on steeper/lower slopes or outlets.
    - Geotextile or erosion control blankets on critical surfaces.
    - Fast-establishing indigenous grasses or shrubs suited to semi-arid conditions for longer-term stability.
- Energy dissipation at outlets:
    - Install energy dissipaters (e.g. riprap aprons, drop structures, stilling basins) where clean or dirty water is discharged from pipes, culverts or spillways to prevent scouring and undercutting.
    - Avoid concentrating runoff from large catchments onto small, unarmoured outlets that can rapidly erode and incise into ephemeral drainage lines or pans.
- Targeted structural measures:
    - Use gabions, rock check dams or brush-packed barriers at key access points through vegetation or across minor drainage lines to slow flows and trap sediment.
    - Where appropriate, use silt fences or small sediment traps below disturbed areas and along drainage lines around stockpile zones; design them for short-term use and maintain regularly.

5.1.10.4 Stormwater Management (Construction and Operation Phases)

- Temporary stormwater controls:
    - Install temporary stormwater management systems (e.g. diversion berms, interceptor ditches, small retention/detention basins) around active work areas and stockpiles to capture and slow runoff.
    - Where preferential runoff channels form downslope of disturbed areas, infill or line them with aggregate, brush-packing, or logs/branches to dissipate energy and limit erosion and sediment delivery.
- Drainage line protection:
    - Keep natural ephemeral drainage lines intact; do not infill or straighten them.
    - Where runoff must cross drainage lines, use armouring (rock, gabions) and small sediment trapping berms to protect the channel bed and banks and to trap coarse sediment before it enters downstream pans or wetlands.

5.1.11 Rehabilitation and Vegetation

- Rehabilitation must be done concurrently and progressively with the mining operations, and according to a Rehabilitation Plan approved by the Competent Authority.
- Rapid stabilisation of exposed soils:

- Any exposed earth (cut slopes, backfilled areas, old tracks) should be rehabilitated promptly with:
  - Mulching or brush-packing immediately after construction to protect soil from raindrop impact and wind erosion.
  - Seeding or planting of vigorous, indigenous, drought-tolerant grasses and shrubs as soon as seasonal conditions allow.

- Landscape and re-vegetate all cleared and disturbed areas as soon as practically possible, prioritising areas upslope of drainage lines and pans.
- Use locally sourced indigenous species and, where possible, soil with an intact seed bank to accelerate recovery and reduce the risk of invasive species.
- Monitor revegetation success; re-seed or re-plant areas where vegetation cover remains inadequate to control erosion.
- An alien invasive plant management plan needs to be compiled and implemented by the ECO prior to the authorisation of the MRA to control and prevent the spread of invasive alien vegetation due to disturbance of the wetland and riparian zones;
- Vegetation should be removed sparingly and must be overseen by an ECO, who must prioritise the removal of alien invasive species over indigenous vegetation; and
- Alien vegetation must be removed to a registered facility as soon as possible and must not be stockpiled, burned or mulched on site, ultimately to prevent the spread of alien invasive vegetation.

5.1.12 Operational Monitoring, Reporting and Adaptive Management

- Integrated monitoring programme:
  - Regularly monitor surface water, groundwater, sediments, air quality (PM10/PM2.5 and radionuclides) and biota (where water is present) against WUL and EA conditions.
  - Include targeted sampling at pans, ephemeral channels, and down-gradient receptors.
- Adaptive management:
  - Establish early-warning indicators (e.g. rising uranium in down-gradient boreholes, decreased pH in PCDs, increased gamma dose at boundary).
  - Pre-define contingency measures: increased treatment, changes to TSF operation, further containment, temporary shutdowns if necessary.
- Transparency and governance:
  - Report monitoring results to regulators and stakeholders at agreed intervals.
  - Maintain an on-site Environmental/Radiation Management Plan that integrates EA, WUL and nuclear/radiation licence requirements.

5.1.13 Decommissioning of the Mine

To ensure that overland flow is not increased during the proposed decommissioning phase of the quarry, the following mitigation measures have been recommended:

- An annual monitoring must be completed for the first three years upon the completion of the decommissioning phase. This must be followed up by a thorough rehabilitation strategy as per the recommendations of these reports;
- Restore natural drainage patterns and topographies. Re-contour land to natural profiles and pre-mining topography.
- Monitor for erosion and sedimentation post-closure and remove temporary erosion controls only after stabilization (if necessary);
- Restore native vegetation and habitat structure. Re-vegetate with deep-rooted local indigenous species;
- Remove artificial barriers to flow and monitor for gully formation;
- Adaptive management for post-closure erosion;
- Remove all infrastructure and invasive plant species;
- Prevent access to rehabilitated areas;
- Use erosion control during revegetation;
- Monitor for habitat recovery and report on habitat restoration outcomes;
- Contamination remediation strategies must be recommended if contamination is identified.

5.1.14 General

- Wetland areas (and associated buffers) must be avoided, and where avoidance is not feasible then all disturbed areas and sensitive habitats must be offset and/or rehabilitated;
- An Ecological Compliance Officer (ECO) that is a competent freshwater ecologist must be appointed to ensure compliance to the mitigation measures listed below;
- The ECO must clarify the sensitive areas with all operational staff, notwithstanding providing overall environmental awareness training of the catchment and general high importance of estuarine environments, as is particularly relevant to this project;
- Mining activities must be limited to the proposed MRA, with the bounding coordinates demarcated on the ground using wooden poles. The areas outside of the demarcated MRA are to be treated as a no-go area for all aspects of the mining operation. The non-definitive list, comprises the operation of machinery, vehicles and equipment, construction camps/laydown yards and staff pedestrian movement to name some;
- Mining activities must avoid the watercourse areas as far as possible, considering these habitats provide ecosystems services to aquatic biota;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- All domestic and general waste that is produced daily must be contained and may not be buried of burned on site. Waste containers must be emptied regularly and removed from site to the nearest official waste disposal site to prevent littering on site;

- Access routes and other infrastructure areas must be rehabilitated;
- Measures must be implemented where environmental alterations are made (including at existing structures or activities) to 1) prevent detrimental changes to the breeding, nesting or feeding patterns of aquatic biota, including migratory species (if present), 2) allow for the free up and downstream movement of aquatic biota, including migratory species (if present), and 3) prevent a decline in the composition and diversity of the indigenous and endemic aquatic biota;
- All link roads from the mining area to the main road must be continuously sprayed to suppress dust and prevent the potential smothering of aquatic vegetation in the form of wind-blown dust. Regular compaction and grading of the haul roads to clear accumulation of loose material will further assist to suppress dust.

5.1.15 Mine Closure and Long-Term Stewardship

- Progressive rehabilitation:
    - Backfill pits where feasible, re-contour to approximate natural topography, and re-establish indigenous vegetation adapted to semi-arid conditions.
    - Re-shape TSFs to landforms compatible with long-term stability; cover with low-permeability layers and a growth medium to reduce infiltration and radiation exposure.
- Post-closure water and radiation management:
    - Continue groundwater and surface water monitoring for an agreed post-closure period (often decades for uranium mines).
    - Maintain any necessary passive treatment systems (e.g. constructed wetlands) and ensure they do not themselves become secondary sources of contamination.
- Preventing legacy impacts:
    - Decommission and remove all unnecessary infrastructure, including pipes, tanks, and temporary dams, leaving no uncontrolled radioactive materials on site.
    - Secure and signpost any residual high-risk areas, ensuring responsibilities and funding for long-term care are clearly allocated.

6 Recommendations

The following recommendations are pertinent to ensure the adequate protection of the freshwater resource:

- Wetland and riparian areas (and associated buffers) must be avoided, and where avoidance is not feasible then all disturbed areas and sensitive habitats must be offset and/or rehabilitated;
- A stormwater management plan must be incorporated for the mining operation (including pollution control facilities, attenuation ponds, separation of clean and dirty water etc.);
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase. This will include the monitoring all stormwater discharge points, energy dissipation structures, and stability of watercourse banks in the project footprint which must include the river reach below any discharge points.
- It is critical that a competent ECO in the freshwater ecological discipline is appointed to ensure that the mitigation measures as listed in this report, including the mining operational conditions that are drafted by the authorities are adequately exercised on the ground;
- Liquid radiological and acid leachate pathways are a key residual risk warranting a detailed water and waste management design (TSF lining, PCDs, zero-release or acceptable discharge), and monitoring uranium and relevant radionuclides in surface and groundwater.
- A Remediation Plan should be commissioned for accidental and/or prolonged introduction of acidic waste and/or radioactive isotopes into the aquatic environment;
- An alien invasive plant management plan must be drafted and implemented to prevent the establishment and spread of alien invasive vegetation as a result of site disturbance; and
- A rehabilitation plan must be implemented in concurrently with the operation of the mine, and look to rehabilitate areas in a phased approach as the mining operation moves along the planned areas.

7 Conclusion

7.1 Baseline Ecology

The National Web-based Environmental Screening Tool has characterised the aquatic sensitivity of the project area (mining area, infrastructure and access route) as “Low” and “Very High”. A single dry season survey was conducted between the 19th and 23rd of May 2025 for the proposed project. The drainage areas and pans were dry during the survey. The PES assessment indicated that the wetland pans and drainages areas within the PAOI are in a ‘Largely Natural’ to ‘Moderately Modified’ condition (class B to class C), with existing impacts from agricultural activities, historic uranium mining activities, wildlife and livestock grazing and trampling. The watercourses are susceptible to further impacts, particularly on water quality and physical disturbances to wetland, instream and riparian habitat. During periods of inundation the pans would support vernal biota which play an important role in ephemeral food chains. The specialist assigned ‘High’ freshwater/aquatic sensitivities to all delineated wetland pans, ‘Medium’ sensitivities to the drainage and buffer areas, and ‘Low’ sensitivities to the remainder of the area within the PAOI.

7.2 Impact Statement

The proposed mining activities pose ‘Low’ to ‘High’ pre-mitigation and post-mitigation risks during the construction, operational and decommissioning phases. High risks are the resultant of mining out watercourse areas (drainage areas and valley floor depression wetlands) and contamination of watercourses and ecosystems with radioactive materials. Moderate risks are associated with the activities proximal to the watercourses, including the drainage patterns change due to road extent and crossings, clearing of riparian (and terrestrial) vegetation, stormwater management, excavation of wetland and riparian areas, bed and/or banks, operation of heavy machinery adjacent/within the watercourse, alien vegetation encroachment, conducting road and crossings maintenance, sedimentation and erosion, and hydrocarbon contamination. Impacts associated with mining out watercourses are deemed difficult to manage and impractical to mitigate against, given the proposed mining pit locations and waste rock dumps, and that both wetland and drainage areas (riparian habitat) will be mined.

7.3 Specialist Opinion

Considering the assessment findings, it is the opinion of the specialist that the project may be considered for authorisation with caution. This is on condition that all prescribed mitigation measures and recommendations are implemented, all medium and high-impact mining activities are relocated outside watercourse and buffer areas, and surety is given that there will be no introduction of acidic water and/or radioactive materials into the environment. This therefore includes the avoidance of sensitive freshwater habitats and their buffer zones (as far as is feasible), a Remediation Plan, methods that prevent the introduction of contaminants into watercourses, rehabilitation of disturbed watercourses, wetland offsets (if applicable) as well as the minimisation of development/disturbances within these areas. The ‘High’ sensitivity areas would be deemed ‘No go’ areas for high impact activities such as mining, whilst the ‘Low’ and ‘Medium’ sensitivity areas can be considered as mining areas in terms of aquatic sensitivity and subject to environmental authorisation and suitable mitigation (including rehabilitation and offsets).

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9 Appendices

9.1 Appendix A: Methodology

9.1.1 Desktop Spatial Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- The inland water dataset;
- Topographical river line data;
- Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) per Sub Quaternary Reaches (SQR) for Secondary Catchments in South Africa (DWS, 2014);
- The National Freshwater Ecosystem Priority Areas (NFEPA) (Nel *et al*., 2011);
- Provincial Conservation Plans;
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer *et al*., 2019);
- National Biodiversity Assessment (NBA) (Van Deventer *et al*., 2019);
- The SANBI National Wetland Map 5 (Van Deventer *et al*., 2019); and
- Contour data (5 m).

9.1.2 Desktop Dataset Assessment

The desktop assessment was undertaken using Geographic Information System (GIS) to access, view and overlay the latest available related datasets with the project area. The information represented within the datasets was used to develop the relevant digital maps used to identify potentially environmentally sensitive areas. These datasets and their respective dates of publishing are provided below:

9.1.2.1 Topographical River Lines and Inland Water Areas

Topographical Inland Water Areas and River Lines for South Africa are based on the topographic maps dated 1994 as per the National Geo-spatial Information. These datasets are used in this report to provide insight into potential wetland areas and serve to highlight the location and extent of rivers, drainage features, dams, wetlands, reservoirs, and other relevant inland waterbodies.

9.1.2.2 Ecologically Important Landscape Features

The datasets listed below were incorporated to establish the relation between the project and ecologically important or sensitive freshwater entities. Emphasis was placed on the following spatial datasets:

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE), NBA 2018 Rivers and Wetlands (Van Deventer *et al.,* 2019).
- National Freshwater Priority Areas (Nel *et al.,* 2011).
- Strategic Water Source Areas, 2021 (Lötter & Le Maitre, 2021); and

9.1.2.2.1 The South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the 2018 NBA, the SAIIAE is a collection of spatial data layers that represent the extent of river and inland wetland ecosystem types as well as the pressures on these systems. The same two headline indicators, and their associated categorisations, are applied as with the terrestrial ecosystem NBA, namely Ecosystem Threat Status and Ecosystem Protection Level. The Ecosystem Threat Status of river and wetland ecosystem types are based on the extent to which each ecosystem type has been altered from its natural condition.

9.1.2.2.2 National Freshwater Ecosystem Priority Areas, Rivers, and Wetlands

To better conserve aquatic ecosystems, South Africa has categorised its inland aquatic systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs). The FEPAs are intended to be conservation support tools and it is envisioned that they will guide the effective implementation of measures to achieve the National Environment Management: Biodiversity Act's biodiversity conservation goals (Nel *et al.,* 2011).

9.1.3 Water Quality

Water quality was measured *in-situ* using a handheld calibrated multi-parameter water quality meter. The constituents considered that were measured included: pH, electrical conductivity (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

9.1.4 Habitat Assessments

Habitat availability and diversity are major attributes of the biota found in a specific ecosystem, and thus knowledge of the quality of habitats is important in an overall assessment of ecosystem health. Habitat assessment can be defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour *et al*., 1996). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities (USEPA, 1998). Habitat quality and availability play a critical role in the occurrence of aquatic biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations to facilitate the interpretation of results.

9.1.4.1 Index of Habitat Integrity

The Index of Habitat Integrity (IHI) model was used to assess the integrity of the habitats from a riparian and instream perspective as described in Kleynhans (1996) v1. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity is obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physicochemical conditions and how these changes would impact the natural riverine habitats.

The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 9-1 and Table 9-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse(s).

Table 9-1 Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	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 *et al*., 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.
Phys-chem 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 *et al*., 1992).
Alien macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Introduced 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.
Rubbish dumping	A direct anthropogenic impact which may alter 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 *et al*., 1992). Refers to physical removal for farming, firewood, and overgrazing.
Exotic vegetation	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	Decrease in bank stability will cause sedimentation and possible collapse of the riverbank 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 9-2 Descriptions used for the Ratings of the Various Habitat Criteria

Impact Category	Description	Impact Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size, and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size, and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size, and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size, and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size, and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size, and variability in almost the whole of the defined section are influenced detrimentally.	21-25

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 9-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 9-3 Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996)

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Vegetation removal	13
Flow modification	13	Exotic vegetation	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Phys-chem modification	14	Water abstraction	13
Inundation	10	Inundation	11
Alien macrophytes	9	Flow modification	12
Introduced aquatic fauna	8	Phys-chem	13
Rubbish dumping	6		
Total	100	Total	100

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight subtracted from the provisionally determined integrity to arrive at a final habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific habitat integrity category (DWS, 1999). These categories are indicated in Table 9-4.

Table 9-4 Intermediate habitat integrity categories (From Kleynhans, 1996)

Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A 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	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level, and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0

9.1.5 Riparian Delineation

The riparian delineation was completed according to DWAF (2005). Typical riparian cross-sections and structures are provided in Figure 9-1. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Elevation data obtained from topography spatial data was also utilised to support the infield assessment.

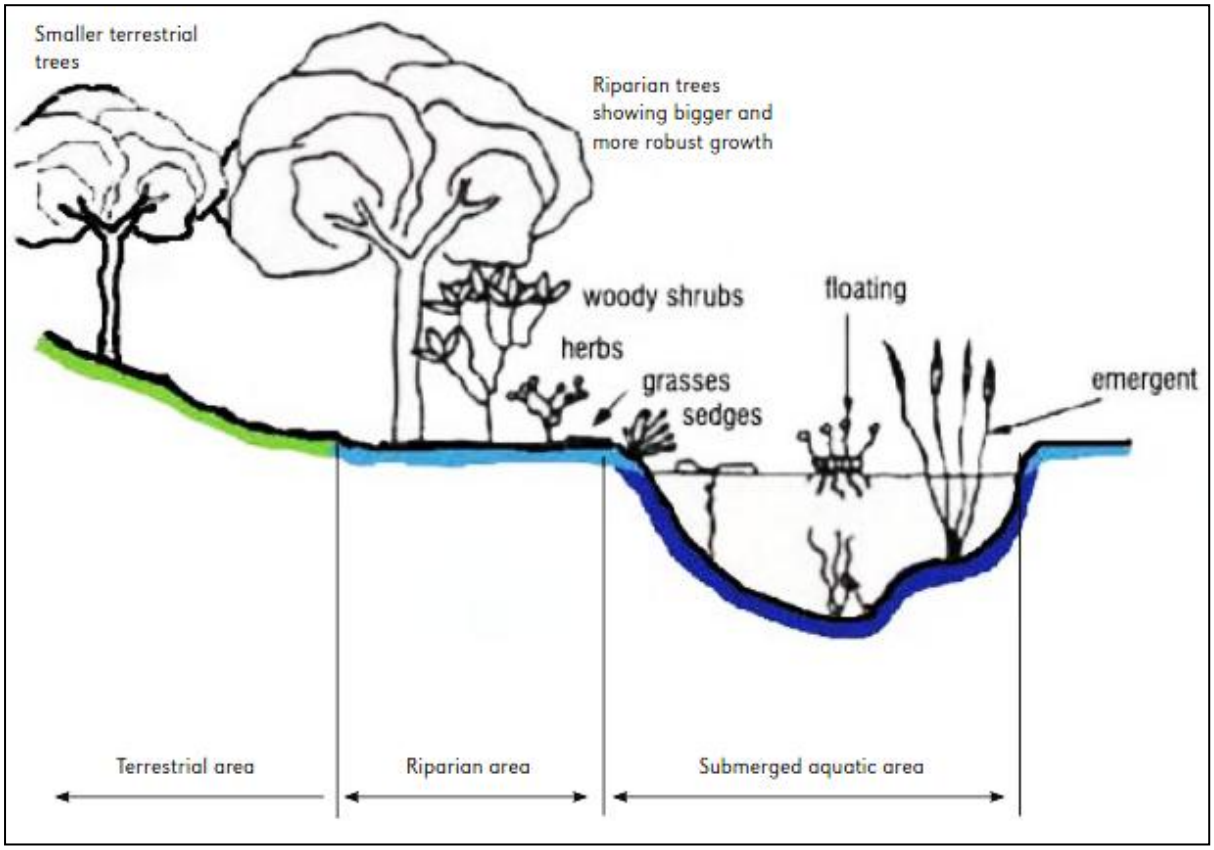

Figure 9-1 Riparian Habitat Delineations (DWAF, 2005)

9.1.6 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities form an integral part of the monitoring of the health of an aquatic ecosystem.

9.1.6.1.1 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made at the family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002, Fry, 2022).

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. These reference conditions are used as a benchmark against which field data can be compared. All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007). This method seeks to develop biological

bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database. Ecological categories for the project area are based on biological banding presented in Table 9-5.

Table 9-5 Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)

Class	Ecological Category	Description
A	Natural	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely natural	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately modified	Moderately impaired. Moderate diversity of taxa.
D	Largely modified	Considerably impaired. Mostly tolerant taxa present.
E/F	Seriously Modified	Severely impaired. Only tolerant taxa present.

9.1.7 Fish Community Assessment

Fish species information can be used to develop the Fish Response Assessment Index (FRAI), which gives an indication of the PES of the river based on the fish assemblage structures observed. Ideally, fish would be captured through electroshocking techniques. Approximately, 50 m up and 50 m downstream of each sampling point would be assessed by sampling representative habitat. All fish would be identified in the field and released at the point of capture. Fish species would be identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001; 2016). The identified fish species would be compared to those expected to be present for the quaternary catchment. The expected fish species list was developed from a literature survey and included sources such as DWS (2014), (Kleynhans *et al.,* 2007) and Skelton (2001; 2016). Fish have different sensitivities or levels of tolerance to various aspects that they are subjected to within the aquatic environment. These tolerance levels are rated with a sensitivity score as presented in Table 9-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physicochemical modifications.

Table 9-6 Intolerance rating and sensitivity of fish species.

Sensitivity Score	Tolerance/Sensitivity Level
0-1	Highly tolerant = Very low sensitivity
1-2	Tolerant = Low sensitivity
2-3	Moderately tolerant = Moderate sensitivity
3-4	Moderately intolerant = High sensitivity
4-5	Intolerant = Very high sensitivity

9.1.8 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007) (Table 9-7) . For this study ecological classifications have been determined for biophysical attributes for the associated water course. This was completed using the river Ecoclassification manual by Kleynhans and Louw (2007). The areas considered in the PES assessment are outlined in the description of the project area section. The combined categories were assessed to determine the reach-based PES.

Table 9-7 Present Ecological State (PES) Categories

Category	Descriptions (Modifications)	Descriptions (Taxa)
A	**Natural**	
	Unmodified, natural.	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	**Largely Natural**	
	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	**Moderately Modified**	
	A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	Moderately impaired. Moderate diversity of taxa.
D	**Largely Modified**	
	A large loss of natural habitat, biota and basic ecosystem functions has occurred.	Considerably impaired. Mostly tolerant taxa present.
E	**Seriously Modified**	
	The loss of natural habitat, biota and basic ecosystem functions is extensive.	Severely impaired. Only tolerant taxa present.
F	**Critically Modified**	
	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	Severely impaired. Only tolerant taxa present.

9.1.9 Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

9.1.10 Site Sensitivity Verification

The baseline aquatic / freshwater sensitivity of the project area was obtained using the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended). The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas based on the specialist-assigned Ecological Importance and Sensitivity of the different systems (where applicable), with consideration being given to the presence of observed or likely sensitive fauna and flora.

9.2 Appendix B: Risk and Impact Assessment

The Department of Water and Sanitation (DWS) risk matrix assesses impacts in terms of consequence and likelihood. The significance of the impact is rated according to the classes presented in Table 9-8.

Table 9-8 Significance ratings matrix

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 require specialist input. License 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. License required.

9.3 Appendix C – Specialist Declaration of Independence

DECLARATION

I, Chelsea Withfield, declare that:

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements 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 (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
- any decision to be taken with respect to the application by the competent authority; and;
- the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence and is punishable in terms of the NEMA Act.

Chelsea Withfield

Aquatic Ecologist

The Biodiversity Company

09/06/2025

DECLARATION

I, Prasheen Singh, declare that:

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements 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 (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
- any decision to be taken with respect to the application by the competent authority; and;
- the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence and is punishable in terms of the NEMA Act.

Prasheen Singh

Aquatic Ecologist

The Biodiversity Company

07/07/2025

9.4 Appendix D – Specialist CVs

Prasheen Singh

M.Sc Aquatic Health (*Pr. Sci. Nat.*)

Cell: +27 69 206 9440
Email: prasheen@thebiodiversitycompany.com
Identity Number: 8904255091089
Date of birth: 25 April 1989

Profile Summary

Prasheen Singh is a SACNASP registered Professional Scientist in the field of Aquatic Science.

He is an Aquatic Ecologist and Water Quality Specialist whose 11 years' experience comprises numerous Aquatic Scientific Studies, Peer Reviews, Research, and served as a SANAS accredited Technical Signatory at an Ecotoxicology Laboratory. He is also a Steering Committee Member for the Water Research Commission

Prasheen attained his MSc in Aquatic Health at the University of Johannesburg, and completed training courses for wetlands, river eco-status monitoring, hydropedology, and ecosystem restoration. He is also an accredited SASS5 Practitioner with the Department of Water and Sanitation.

He has working experience throughout South Africa, specialising in water quality studies, aquatic biomonitoring, compliance audits, rehabilitation plans, monitoring plans and risk assessments. Prasheen is experienced in project management and strives to achieve and maintain scientific excellence in all specialist work.

Areas of Interest

Terrestrial and Aquatic Biodiversity.

Ecosystem Restoration, Protection and Conservation.

Environmental Awareness.

Key Experience

- Freshwater Ecological Studies
- SASS5 Macroinvertebrate Assessments, IHAS & MIRAI
- FRAI & Fish Population Structure Assessments
- Instream and Riparian Integrity Assessments
- Aquatic Impact and Risk Assessments
- DWS Risk Assessments
- Environmental Impact Assessments
- Surface water Quality
- Groundwater Quality
- Wastewater Quality
- SANS241 Drinking Water Quality
- Compliance Monitoring
- Water Use License Audits
- Aquatic Resources Rehabilitation Plans
- Aquatic Resources Monitoring Programs
- Ecotoxicity Testing
- GIS and Sensitivity Mapping (ArcGIS, QGIS)

Provincial Experience

Gauteng, Mpumalanga, Eastern Cape, Western Cape, Northern Cape, North West Province, Free State Province, Limpopo, KwaZulu-Natal

Nationality

South African

Languages

English – Proficient

Afrikaans – Basic

Qualifications

- MSc (University of Johannesburg) – Aquatic Health (*Cum Laude*).
- BSc Honours (University of Johannesburg) – Biodiversity and Conservation
- BSc (University of Johannesburg) – Life and Environmental Sciences
- Pr. Sci. Nat. (116822) – Aqua Science
- SASS 5 (2017-2024) – Department of Water Affairs and Sanitation River Health Programme
- River Ecostatus Monitoring Programme Training
- Wetland Management: Introduction and Delineation · University of Free State
- Official DWS Section 21(c) a (i) Water Use Authorisation Training Course – Departme of Water and Sanitation
- Hydropedology and Wetland Functioning – Water Busines Academy
- Ecosystem Restoration (Part and 2) – Learning for Nature

Chelsea Withfield

MSc Environmental Sciences

Cell: +27 66 287 9993
Email: chelsea@thebiodiversitycompany.com
Identity Number: 0006140104081
Date of birth: 14 June 2000

Profile Summary

Aquatic Ecologist Intern at The Biodiversity Company.

Specialist expertise includes Environmental Management, Aquatic Ecology and Water Quality.

Areas of Interest

Aquatic Ecology

Water quality

Aquatic Ecosystem Health

Ecosystem Rehabilitation

Habitat and Biodiversity Conservation

Sustainable Development

Key Experience

- Water quality analyses
- Metal detection
- DNA extraction, Polymerase Chain Reaction
- Microscopy
- Biomarker analyses
- The use of biological indicators such as fish and macroinvertebrates
- GIS with training in QGIS
- Statistical analyses

Provincial Experience

Limpopo

Mpumalanga

Gauteng

North West

Free State

Nationality

South African

Languages

Afrikaans – Proficient

English – Proficient

Qualifications

- BSc in Environmental Science with Zoology and Tourism (North-West University, 2021)
- BSc Honours in Environmental Science with Biodiversity and Conservation Ecology (North-West University, 2022)
- MSc in Environmental Sciences with Aquatic Ecosystem Health (North-West University, 2025)

-End of Report-