

AQUATIC ASSESSMENT

BIANNUAL AQUATIC BIOMONITORING FOR THE BIOMONITORING SITES ASSOCIATED WITH THE BALLENGEICH MINE: WET SEASON 2026



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PREPARED BY:

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- Acted as independent consultants on this project.
- Did not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act no. 107 of 1998.
- Have and will not have a vested interest in the proposed and/or existing activity, nor will I engage myself in any conflict of interest associated with this project.
- Undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of the National Environmental Management Act 107 of 1998.
- Based on the information provided by the client and information obtained during this study, the results and conclusions concerning this project have been presented to the best of their professional ability.
- Reserve the right to modify aspects of this study should additional information become available through ongoing research and further work in this field.
- They are duly qualified and experienced to undertake the work at hand.



Gareth Preen



Moné Oosthuizen

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EXECUTIVE SUMMARY

Environmental Assurance (Pty) Ltd, hereafter referred to as “ENVASS”, was appointed by GCS Water and Environmental Consultants (Pty) Ltd on behalf of Kangra Coal to undertake aquatic biomonitoring of the biomonitoring sites associated with the Ballengeich Mine located near Newcastle within the Newcastle Local Municipality, KwaZulu-Natal Province, for the 2026 wet season. The field survey relevant to this assessment was undertaken on 26 April 2026 within the South African National Biodiversity Institution (SANBI) prescribed wet season for the region. This report was drafted to comply with the site-specific Water Use License (WUL).

At the time of the infield assessment, it appeared as though there were no activities taking place at the mine.

This report aimed to determine the potential impacts of the Ballengeich Mine on the receiving watercourses surrounding the mine. In order to achieve this aim, six (6) predetermined biomonitoring points were investigated, the results of which have been presented within this report.

Based on the results of the infield assessment and those presented herein, it is unlikely that the Ballengeich Mine is impacting the receiving watercourses as highlighted in Section 8. Based on this, the following recommendations have been provided:

- An extensive revegetation programme should be implemented along the riparian zone of the receiving watercourses to limit further erosion from taking place.
- An Alien and Invasive Plant Species (AIPS) plan must be developed and implemented around the site to prevent the proliferation of such species from taking place in the riparian zone.
- If the site is in care and maintenance, a comprehensive Mine Closure plan must be developed with input from a suitably qualified aquatic ecologist to ensure the adequate rehabilitation of the receiving watercourses.

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LIST OF ABBREVIATIONS

TERM	EXPANSION
ASPT	Average Score Per Taxon
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
EN	Endangered
FEPA	Freshwater Ecosystem Priority Area
GIS	Geographic Information System
GN	General Notice
IHAS	Integrated Habitat Assessment System
NEMA	National Environmental Management Act (Act no. 107 of 1998)
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act (Act no. 36 of 1998)
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SASS5	South African Scoring System Version 5
TWQR	Target Water Quality Range
WMA	Water Management Area
WUL	Water Use Licence

1 INTRODUCTION

1.1 Background

Environmental Assurance (Pty) Ltd, hereafter referred to as “ENVASS”, was appointed by GCS Water and Environmental Consultants (Pty) Ltd on behalf of Kangra Coal to undertake aquatic biomonitoring of the biomonitoring sites associated with the Ballengeich Mine located near Newcastle within the Newcastle Local Municipality, KwaZulu-Natal Province, for the 2026 wet season. The field survey relevant to this assessment was undertaken on 26 April 2026 within the South African National Biodiversity Institution (SANBI) prescribed wet season for the region. This report was drafted to comply with the site-specific Water Use License (WUL).

At the time of the infield assessment, it appeared as though there were no activities taking place at the mine.

1.2 Locality

The Ballengeich Mine is located approximately 15 kilometres (km) to the south of the town of Newcastle at approximate centre geographic coordinates 27°53'28.56"S; 29°58'18.15"E within the Newcastle Local and Amajuba District Municipalities of the KwaZulu-Natal Province. The Ballengeich Mine and its associated biomonitoring sites will hereafter be referred to as “the study area”. Figure 1-1 presents a locality map of the study area.

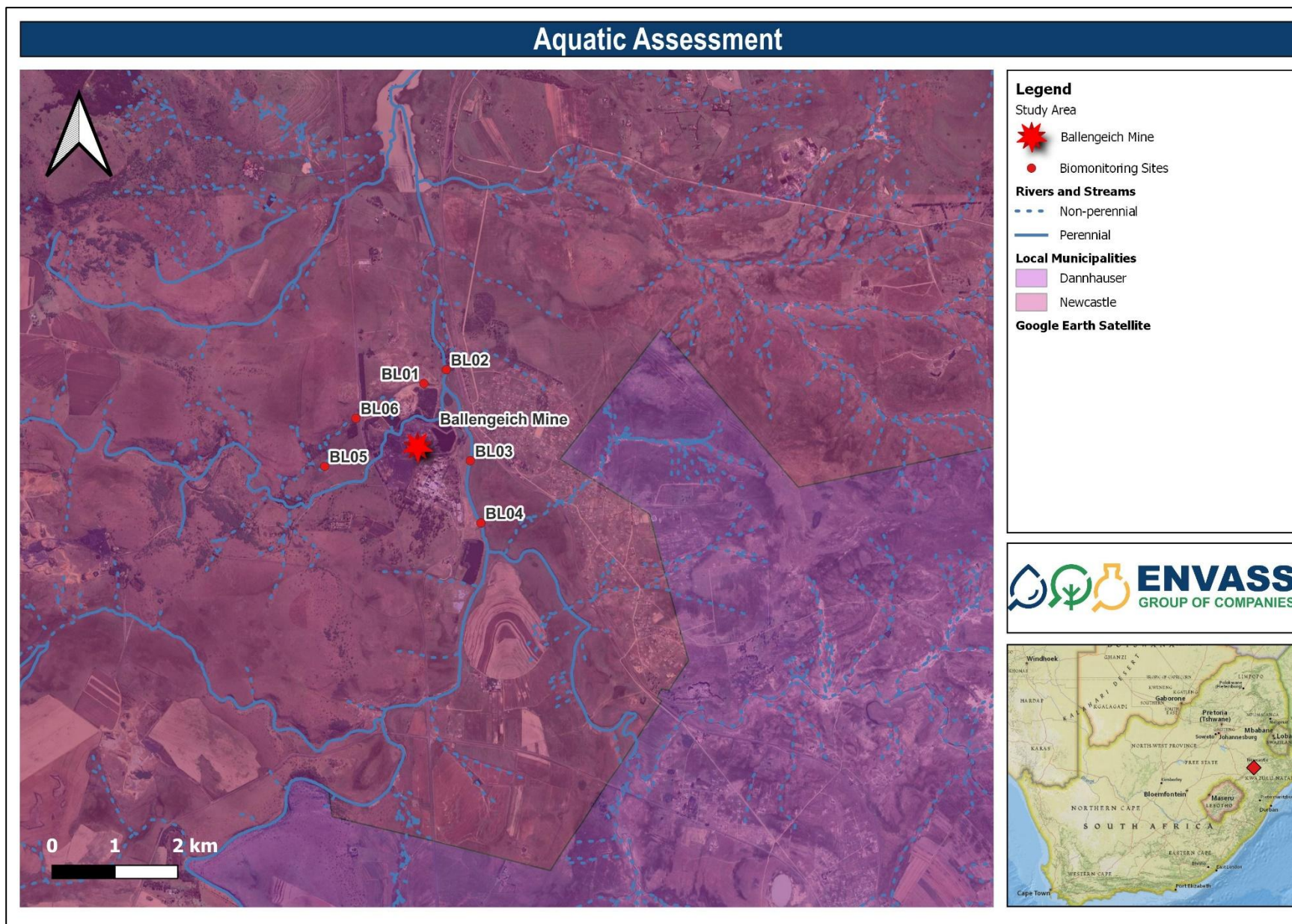


Figure 1-1: Locality map of the Ballengeich Mine and associated biomonitors sites within the Newcastle local municipality.

1.3 Objectives

The primary objective of this Aquatic Biomonitoring Assessment was to gather results from the potentially at-risk aquatic systems in the vicinity of the Ballengeich mine to ascertain whether the production and associated activities have had an impact on the Present Ecological State (PES) of the downstream systems. The quantitative data gathered by implementing best-practice and legislated methodologies and techniques were compared with the baseline conditions of the various assessed biomonitoring reaches to determine long-term PES (integrity) trends in the aquatic ecosystems. Based on the identified trends and any recorded impacts, mitigation and/or rehabilitation measures were recommended and must be implemented to maintain the Recommended Management Objectives (RMOs) set by the Department of Water and Sanitation (DWS) River Health Programme (RHP) for each system.

2 SCOPE OF WORK

The following Scope of Work (SoW) was undertaken during this aquatic assessment for the proposed activity:

- Undergo a desktop study, inclusive of a literature review of all available studies applicable to the study area.
- Assess the PES score of all the at-risk watercourses by implementing the required methodologies and tools.
- Implement the South African Scoring System Ver. 5 (SASS5) protocol (Dickens & Graham, 2002) and Integrated Habitat Assessment System (IHAS) at appropriate sites.
- Conduct in situ water quality measurements of Temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), and Dissolved Oxygen (DO) at all the aquatic biomonitoring sites.
- Draft one (1) wet season Aquatic Biomonitoring report, which encompasses the above SoW for submission to the client in electronic PDF format.

3 METHODOLOGY

This section summarises the different techniques and methods used during the biomonitoring study (**Table 3-1**). Detailed methodologies are provided in Appendix A.

Table 3-1: Methodologies applied during the study.

Assessment	Documents/Information
Desktop Assessment	• Aerial imagery (Google Earth Pro). • Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) per Sub Quaternary Reach (SQR) for Secondary Catchments in South Africa (DWS, 2014). • South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer <i>et al.</i>, 2019). • National Biodiversity Assessment (NBA) (SANBI, 2018). • The SANBI National Wetland Map 5 (SANBI, 2018).
Water Quality	• <i>In-situ</i> water quality (DWAF, 1996).
Habitat	• Integrated Habitat Assessment System (IHAS) (McMillan, 1998).

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Biotic indices	Aquatic Macroinvertebrate South African Scoring System: Version 5 (SASS5) (Dickens and Graham, 2002).
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4 LIMITATIONS

The following assumptions and limitations are relevant to this aquatic study:

- Only biomonitoring sites that were sampleable (i.e., had sufficient flow) in accordance with the International Organisation for Standardisation (ISO) certified South African Scoring System ver. 5 (SASS5) methodology have been assessed.
- This study did not include water quality analyses through a South African National Accreditation System (SANAS) accredited laboratory, and thus, a handheld Aqua probe AP-800, which was calibrated before use, was utilised to measure the *in-situ* water quality at each biomonitoring site.
- The assessment of impacts and recommendation of mitigation measures were informed by the site-specific ecological issues identified during the field survey and based on the assessor's working knowledge and experience with similar projects.
- Biomonitoring sites BL03 and BL04 were stagnant and too deep to safely sample. Biomonitoring site BL06 was located within a wetland, which is not suited for the implementation of the SASS5 protocol, and site BL05 could not be accessed.

5 DESKTOP ASSESSMENT

The following section presents information gathered during the desktop study of the study area and the surrounding aquatic environment (**Table 5-1**).

Table 5-1: Results of the desktop assessment associated with the study area.

Hydrological Setting (DWS, 2012) (Figure 5-1)			
Water Management Area (WMA)	The study area falls within the Pongola-Umzikhulu WMA.		
Quaternary Catchment Area	The Ballengeich Mine extends across three (3) Quaternary Catchments, namely V31F, V31G and V31K.		
Sub-Quaternary Reach (SQR)	V31F - 2600 PES: Class E (Seriously Modified) EI: Moderate ES: Very High REC: Class A (Natural)	V31G - 2618 PES: Class C (Moderately Modified) EI: High ES: High REC: Class B (Largely Natural)	V31K - 2541 PES: Class C (Moderately Modified) EI: High ES: High REC: Class B (Largely Natural)
Ecoregion (Kleynhans et al., 2005) (bold indicates most dominant attributes) (Figure 5-2)			
ATTRIBUTES	North Eastern Uplands (14)		
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Moderate Relief (limited); Lowlands; Hills and Mountains; Moderate and High Relief ; Open Hills; Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief .		
Vegetation types (dominant types in bold) (Primary)	Natal Lowveld Bushveld (limited); Natal Central Bushveld ; Coast Hinterland Bushveld; Coastal Bushveld/Grassland; Valley Thicket ; Short Mistbelt Grassland; North Eastern Mountain Grassland; Moist Upland Grassland Patches Afromontane Forest.		
Altitude (m.a.m.s.l.) (secondary)	0-100 (limited), 100-1500		
MAP (mm) (modifying)	600 to 1000		
Coefficient of Variation (% of annual precipitation)	<20 to 30		
Rainfall concentration index	15 to 65		
Rainfall seasonality	Early to late summer		

Mean annual temp. (°C)	14 to >22
Mean daily max. Temp. (°C): February	20 to 30
Mean daily max. Temp. (°C): July	16 to >24
Mean daily min. Temp. (°C): February	12 to >20
Mean daily min temp. (°C): July	0 to >10
Median annual simulated runoff (mm) for the quaternary catchment	40 to 250; >250 (limited)
National Wetland Map Version 5 (NWM5) and National Freshwater Ecosystem Priority Areas (NFEPA's) (Driver et al., 2011) (Figure 5-3)	
NWM5	Several wetland systems were modelled at a desktop level within the Ballengeich Mines' study area. The modelled wetlands consisted predominantly of several Channelled Valley-Bottom and Floodplain wetlands within close proximity to the Ballengeich Mine and the associated biomonitoring sites.
NFEPA Rivers	Based on the NFEPA River Dataset, two (2) rivers of ecological importance occur within the study areas of the Ballengeich Mine, including the respective biomonitoring sites. NFEPA systems are required to remain in good condition to conserve freshwater ecosystems, but also to protect water resources for human consumption (Nel et al., 2011). The systems must be supported by good planning, decision-making, and management in order to ensure that human use does not detrimentally impact the condition of the ecosystem (Nel et al., 2011).
NFEPA Wetlands	Similar to the NWM5, the NFEPA Wetlands project has modelled various Channelled Valley-Bottom and Floodplain wetlands within the Ballengeich operational areas. According to the NFEPA: Wetland dataset, not all the wetlands are considered of conservation importance.
Key: m a m s l: Metres Above Mean Sea Level PES: Present Ecological State EI: Ecological Importance ES: Ecological Sensitivity REC: Recommended Ecological Category NWM5: National Wetland Map Version 5 NFEPA: National Freshwater Ecosystem Priority Area FEPA: Freshwater Ecosystem Priority Area	

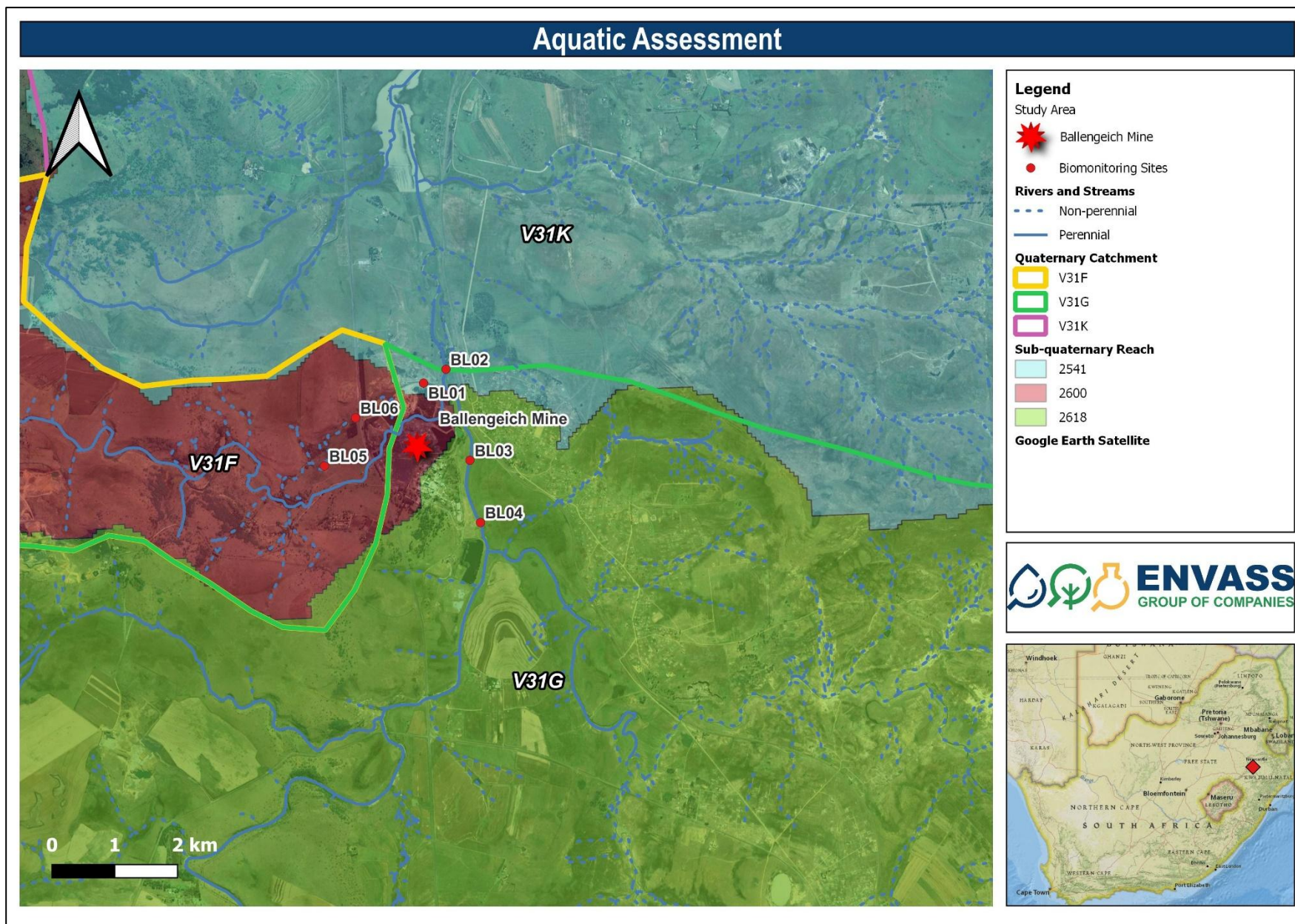


Figure 5-1: Hydrological setting of the Ballengeich Mine and associated biomonitoring sites.

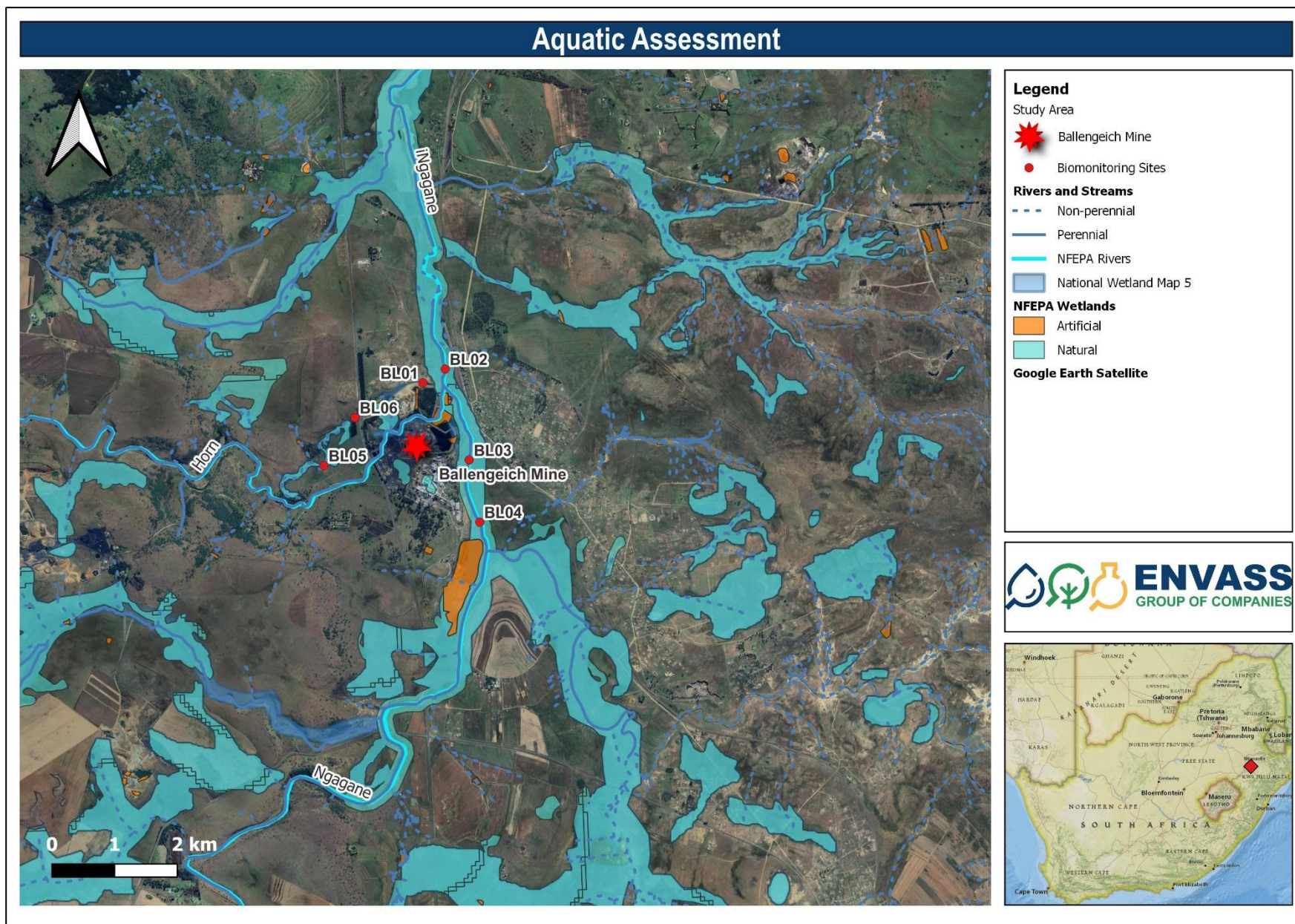


Figure 5-3: NFEPA Rivers, NFEPA Wetlands, and NWM5 relevant to the Ballengeich Mine and associated biomonitors sites.

6 BIOMONITORING SITES

Six (6) biomonitoring sites were selected from representative aquatic systems upstream and downstream of the study area (Figure 6-1). These sample sites were chosen due to 1) their vicinity to the Ballengeich Mine and 2) their ability to represent the various biotopes/habitats that are required for the SASS5 and IHAS methodologies. A summary of the points is presented below, followed by Table 6-1 to Table 6-5, which describe each site according to the observations made during the field survey.

The six (6) biomonitoring sites associated with the study sites were as follows:

BL01: This site is located on a right bank tributary of the iNgagne River near its confluence with the Horn River and downstream of the Ballengeich mine.

BL02: This biomonitoring point is located on the iNgagane river and downstream of BL01 and the Ballengeich Mine.

BL03: This biomonitoring point is located on the iNgagane River and upstream of the Ballengeich Mine.

BL04: This biomonitoring point is located on the iNgagane River and upstream of the Ballengeich Mine.

BL05: This biomonitoring point is located on a left bank tributary of the Horn River and upstream of the Ballengeich Mine.

BL06: This biomonitoring point is located on a left bank tributary of the Horn River, within a wetland system and upstream of the Ballengeich Mine.

Two (2) of the six (6) biomonitoring points were sampled using the SASS5 protocol. This was due to either stagnant water conditions, wetland characteristics, or no access.

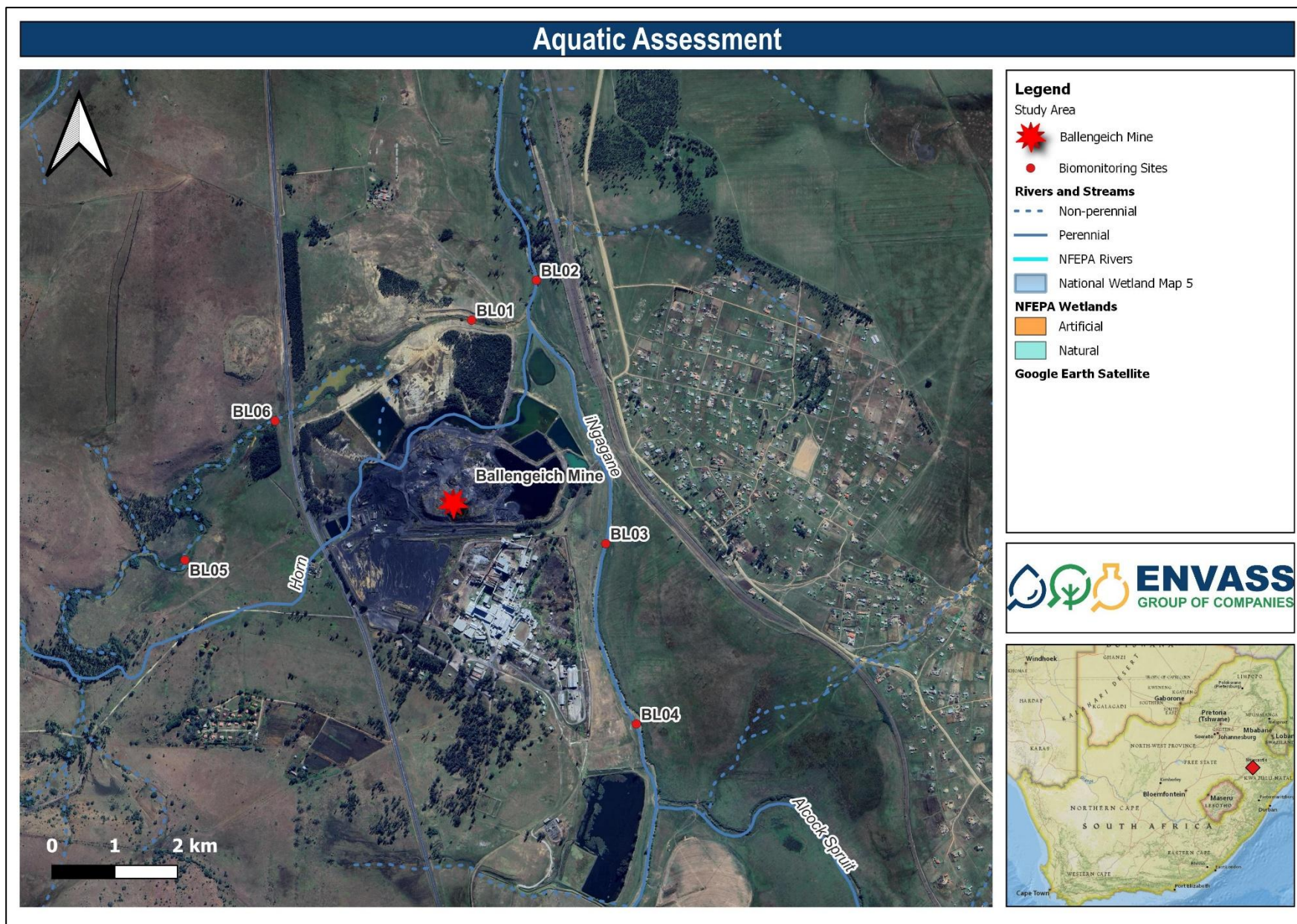


Figure 6-1: Map illustrating the aquatic biomonitoring points in relation to the Ballengeich Mine.

6.1 Description of Biomonitoring Sites

Biomonitoring Sites associated with the Ballengeich Mine.

Table 6-1: Site Characteristics recorded at BL01.

ATTRIBUTE	DESCRIPTION
Upstream	Downstream
	
IN FLOW DURING 2026 WET SEASON FIELD SURVEY	
GPS Coordinates:	Latitude: 27°53'6.02"S Longitude: 29°58'27.38"E
Site Description:	This site is located directly below a weir structure, which has presumably raised the base level upstream of said structure. The aquatic biotope comprised mainly of Gravel, Sand, and Mud (GSM) with scattered portions of grassy, marginal vegetation.
Description of the Riparian Zone:	No distinct riparian zone was recorded, presumably due to historical bank erosion, vegetation clearing, and cattle grazing.
Water Turbidity:	High.
Water Flow Velocity:	Medium.
Water Colour:	Brown.
Description of Disturbances:	– The weir structure has resulted in bed scour at the discharge point and acts as a migration barrier to aquatic species. – Extensive bank scour and erosion have taken place throughout the reach, resulting in severe sedimentation of the stream bed.

Table 6-2: Site Characteristics recorded at BL02.

ATTRIBUTE	DESCRIPTION
Upstream	Downstream
	
IN FLOW DURING 2026 WET SEASON FIELD SURVEY	
GPS Coordinates:	Latitude: 27°52'59.66"S Longitude: 29°58'31.70"E
Site Description:	This site is characterised by a stream channel that is over 1.5 m deep with limited aquatic habitat present. The most dominant habitat comprised marginal vegetation and mud on the embankments.
Description of the Riparian Zone:	No distinct riparian zone was recorded, presumably due to historical bank erosion, vegetation clearing, and cattle grazing.
Water Turbidity:	High.
Water Flow Velocity:	Moderate.
Water Colour:	Brown.
Description of Disturbances:	– Lateral bank scour as a result of vegetation clearing and grazing, resulting in the sedimentation and turbidity of the water column. – The clearing of surrounding vegetation had likely increased surface flow velocity into the assessed reach, resulting in a slight channel incision.

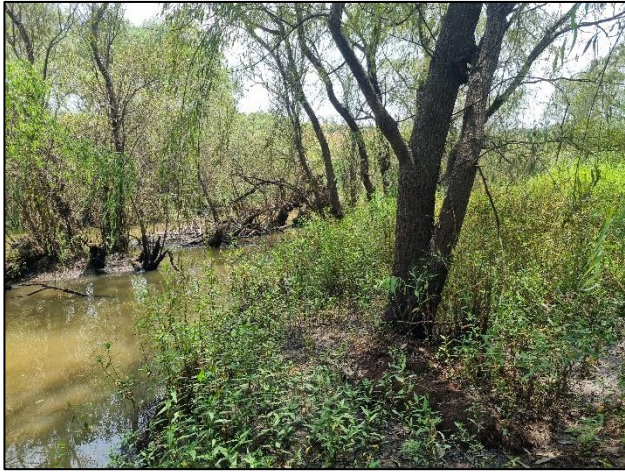
Table 6-3: Site characteristics recorded at BL03.

ATTRIBUTE	DESCRIPTION
Upstream	Downstream
	
IN FLOW DURING 2026 WET SEASON FIELD SURVEY	
GPS Coordinates:	Latitude: 27°53'35.94"S Longitude: 29°58'42.52"E
Site Description:	This site is characterised by a stream channel that is over 1.5 m deep with limited aquatic habitat present. The most dominant habitat comprised marginal vegetation and mud on the embankments. This site was stagnant, thus the SASS5 protocol could not be implemented at this site.
Description of the Riparian Zone:	No distinct riparian zone was recorded, presumably due to historical bank erosion, vegetation clearing, and cattle grazing.
Water Turbidity:	High.
Water Flow Velocity:	Stagnant.
Water Colour:	Brown.
Description of Disturbances:	– Lateral bank scour as a result of vegetation clearing and grazing, resulting in the sedimentation and turbidity of the water column. – The clearing of surrounding vegetation had likely increased surface flow velocity into the assessed reach, resulting in a slight channel incision.

Table 6-4: Site characteristics recorded at BL04.

ATTRIBUTE	DESCRIPTION
Upstream	Downstream
	
IN FLOW DURING 2026 WET SEASON FIELD SURVEY	
GPS Coordinates:	Latitude: 27°54'0.77"S Longitude: 29°58'47.29"E
Site Description:	This site is characterised by a stream channel that is over 1.5 m deep with limited aquatic habitat present. The most dominant habitat comprised marginal vegetation and mud on the embankments. The water at this site was stagnant and thus not suitable for the implementation of the SASS5 protocol.
Description of the Riparian Zone:	No distinct riparian zone was recorded, presumably due to historical bank erosion, vegetation clearing, and cattle grazing.
Water Turbidity:	High.
Water Flow Velocity:	Stagnant.
Water Colour:	Brown.
Description of Disturbances:	– Lateral bank scour as a result of vegetation clearing and grazing, resulting in the sedimentation and turbidity of the water column. – The clearing of surrounding vegetation had likely increased surface flow velocity into the assessed reach, resulting in a slight channel incision.

Table 6-5: Site characteristics recorded at B06.

ATTRIBUTE	DESCRIPTION
Upstream	Downstream
	
IN FLOW DURING 2026 WET SEASON FIELD SURVEY	
GPS Coordinates:	Latitude: 27°53'19.04"S Longitude: 29°57'50.95"E
Site Description:	This site is located within a floodplain wetland associated with the right bank tributary of the Horn River. The N11 is located approximately 60 m downstream of this point. Due to the wetland characteristics of this site, the SASS5 protocol could not be implemented.
Description of the Riparian Zone:	The riparian zone was comprised mainly of Pine Trees associated with historical forestry, with little to no indigenous riparian vegetation remaining.
Water Turbidity:	High.
Water Flow Velocity:	Stagnant.
Water Colour:	Brown.
Description of Disturbances:	– The N11 road, located approximately 60m downstream, had raised the base level of the watercourse, leading to the formation of a wetland upstream of the road crossing. – Evidence of cattle grazing was also noted both within and along the edges of the watercourse.

7 RESULTS

7.1 Water Quality

A calibrated handheld water quality meter was utilised to measure the *in situ* water quality parameters listed in Error! Reference source not found.. The *in situ* measurements were compared to the Target Water Quality Range (TWQR) limits for aquatic ecosystems set out by the DWS (1996). During the 2026 wet season study, biomonitoring site BL05 could not be accessed and was not sampled.

Table 7-1: *In situ* water quality results of the biomonitoring sites from 2025 to 2026.

SITE	WET SEASON	pH	EC (mS/m)	TDS	DO (Mg/l)	DO (%)	TEMPERATURE (°C)
TWQR	YEAR	6.5-9.0	<70	<1000	>5.00	80-120	5-30
BL01	2026	7.09	38.9	252	5.80	81.20	21.60
	2025	No data available.					
BL02	2026	7.17	36.9	239	5.30	80.39	23.5
	2025	No data available.					
BL03	2026	7.17	36.6	237	5.35	82.3	23.8
	2025	7.1	68.3	-	5.1	-	23.5
BL04	2026	6.88	36.4	237	5.4	81.20	23.53
	2025	7.3	65.1	-	5.2	-	24.2
BL05	2026	Inaccessible.					
	2025	No data available.					
BL06	2026	7.34	60.2	345	5.7	83.4	20.3
	2025	7.8	65.1	-	5.2	-	24.2

pH

Freshwater aquatic systems are well buffered with a pH range from 6.5 to 8.5, most rivers are slightly alkaline due to bicarbonates and alkalis associated with earth metals (Barbour et al., 1996). The TWQR for aquatic ecosystems is from 6.5-9.0.

The pH levels at all biomonitoring points were within the TWQR limits and reflected largely neutral waters.

Electric Conductivity (EC)

The Electrical Conductivity (EC) of a river is the ability of water to conduct an electrical current, this ability stems from the presence of carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium ions present in the water (DWS, 1996). The TWQR for Conductivity in freshwater systems is anything less than 70 mS/m. The EC readings were measured in μ S/cm, where 1 microsiemens/centimetre [μ S/cm] = 0.1 millisiemens/meter [mS/m].

EC levels were well below the acceptable TWQR limits aside from BL06 which indicated slightly elevated levels. The slightly elevated EC levels at BL06 could be the result of the wetland conditions, which result in stagnant water and build up of salts from the larger catchment. Nonetheless, all biomonitoring points were below the TWQR limits and indicated that there was no build up of salts.

Total Dissolved Solids (TDS)

The amount of suspended material in the water column, including anything from colloids (0.1 Femtometre (Fm)) to large organic and inorganic materials, is known as the Total Dissolved Solids (TDS) of a river. The increase of suspended solids occurs with the discharge of sediment during rainfall, as the flow returns to normal and the solids remain suspended in the water column. This parameter must be monitored closely in correlation with the EC reading captured at each point, as there is a strong correlation between the

conductivity and the cations and anions that are typically contained in the TDS within a system. The TWQR for aquatic systems is anything less than 1000 mg/l (DWS, 1996). Prolonged exposure may have an effect on the nutrient cycling of sensitive taxa within the reach (DWAF, 1996).

Similar to the EC levels, all TDS levels were within the TWQR limits. Again, TDS was slightly elevated at BL06.

Dissolved Oxygen (DO)

Dissolved Oxygen (DO) in the water column originates from the atmosphere through rainfall, turbulent water in fast-flowing streams, and as a byproduct of photosynthesis by hydrophilic flora, particularly microalgae. Since all aerobic organisms require oxygen to survive, DO is considered a reliable indicator of the health of an aquatic ecosystem. In moderate-to-large dams, DO levels may rise during the day due to photosynthesis but can decrease at night as plants undergo respiration. Furthermore, excessive growth of IAPS, algae, and aerobic bacteria can reduce DO levels, as these organisms consume large amounts of oxygen in eutrophic conditions. Such conditions are often caused by mining, sewage effluent, and agricultural runoff, which enrich the water and stimulate the overgrowth of these species. The optimal DO level for fish and macroinvertebrates, such as mayflies, stonefly larvae, and caddisflies, is >5 mg/l, or between 80 and 120%. When aerobic organisms are exposed to DO concentrations below 2 mg/l, severe fish deaths may occur over the medium to long term (DWAF, 1996).

All DO (mg/l and %) levels were within acceptable levels at all biomonitoring sites.

Temperature (°C)

The temperature of water affects the rates of chemical reactions, metabolic development, and reproductive rates of organisms and is thus an important variable to consider (DWAF, 1996). The TWQR for aquatic ecosystems ranges from 5-30 °C.

The temperature at all biomonitoring points was within the acceptable levels of the TWQR limits.

7.2 Integrated Habitat Assessment System (IHAS)

The Integrated Habitat Assessment Systems (IHAS) is used in conjunction with the SASS5 methodology to establish if low SASS scores may be attributed to limited habitat availability, or alternatively, modified water quality (**Table 7-2**).

Table 7-2: The IHAS scores that were calculated for the biomonitoring sites associated with the Ballengeich Mine.

BIOMONITORING POINT	IHAS SCORE	CATEGORY
BL01	40	Inadequate: Habitat is insufficient to support a diverse macroinvertebrate community.
BL02	26	Inadequate: Habitat is insufficient to support a diverse macroinvertebrate community.
BL03		STAGNANT
BL04		STAGNANT
BL05		NO ACCESS

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BIOMONITORING POINT	IHAS SCORE	CATEGORY
BL06	WETLAND CHARACTERISTICS	

7.3 South African Scoring System 5 (SASS5) Data

Table 7-3 presents the results of the 2026 wet season biannual assessment for the assessed biomonitoring points. Both biomonitoring points were classified as falling within ecological category D (Largely Modified).

Table 7-3: SASS5 results for the 2026 Wet Season Biannual Assessment.

SAMPLE POINT	WET SEASON	NO. OF TAXA	SASS5 SCORE	ASPT	ECOLOGICAL CATEGORY
BL01	2026	6	32	5,3	D
	2025	NO DATA AVAILABLE			
BL02	2026	14	63	4,5	D
	2025	NO DATA AVAILABLE			
BL03	2026	STAGNANT			
	2025	NO DATA AVAILABLE			
BL04	2026	STAGNANT			
	2025	NO DATA AVAILABLE			
BL05	2026	STAGNANT			
	2025	NO DATA AVAILABLE			
BL06	2026	WETLAND CHARACTERISTICS			
	2025	NO DATA AVAILABLE			

8 DISCUSSION

Six (6) biomonitoring points were assessed during this 2026 wet season assessment. However, only five (5) could be accessed. The majority of the sites were not suitable for the implementation of the SASS5 protocol, either due to stagnant water or wetland conditions.

Subsequent to undertaking the *in situ* water quality analysis, it was evident that all of the parameters tested for were within the acceptable TWQR limits with no exceedances. It was noted that there was a decrease in EC from the 2025 wet season survey, which could be the result of flushing of the system due to rainfall preceding the infield assessment. No significant changes in water quality parameters were observed during the spatial analysis from the upstream to the downstream points. This indicates that the Ballengeich Mine is not imparting an impact on the receiving watercourses in terms of water quality. Furthermore, based on the results of the *in situ* water quality analysis, no parameters were determined to have a limiting effect on aquatic macroinvertebrate diversity.

The IHAS assessment indicated that the aquatic habitat at both assessed sites was insufficient to support a diverse macroinvertebrate community. Site BL01 lacked marginal vegetation as the water level was below the rooting depth, and minimal SIC and stones out of current (SOOC) were present for sampling. Site BL02 comprised almost exclusively of marginal vegetation with scattered portions of GSM and no stones. This severely limited the available habitat that could be sampled.

The SASS5 assessment categorised both biomonitoring sites as falling within ecological category D (Largely Modified). This is presumably the result of the limited aquatic habitat, as indicated by the IHAS assessment. The Average Score Per Taxon (ASPT) at BL01 and BL02 was 5,3 and 4,5, respectively, which suggests that the overall macroinvertebrate assemblages at these sites are comprised of predominantly tolerant macroinvertebrate taxa.

9 CONCLUSION AND RECOMMENDATIONS

This report aimed to determine the potential impacts of the Ballengeich Mine on the receiving watercourses surrounding the mine. In order to achieve this aim, six (6) predetermined biomonitoring points were investigated, the results of which have been presented within this report.

Based on the results of the infield assessment and those presented herein, it is unlikely that the Ballengeich Mine is impacting the receiving watercourses as highlighted in Section 8. Based on this, the following recommendations have been provided:

- An extensive revegetation programme should be implemented along the riparian zone of the receiving watercourses to limit further erosion from taking place.
- An Alien and Invasive Plant Species (AIPS) plan must be developed and implemented around the site to prevent the proliferation of such species from taking place in the riparian zone.
- If the site is in care and maintenance, a comprehensive Mine Closure plan must be developed with input from a suitably qualified aquatic ecologist to ensure the adequate rehabilitation of the receiving watercourses.

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APPENDIX A: METHODOLOGY

A1 Aquatic Assessment

Assessment of the freshwater ecosystem entails the characterisation of the aquatic environment, aquatic habitat and associated biota. In order to enable an adequate description of the aquatic environment and determination of the PES, the following stressor, habitat, and response indicators will be evaluated:

- Current and potential threats to water quality and watercourse condition;
- Information regarding upstream and downstream conditions, point and non-point pollution sources, water usage, etc., and translate it into information that may be used to measure the compliance against WUL conditions and the integrity of the watercourses;
- Baseline data with regard to PES, resource water quality objectives, and the desired future system condition;
- Isolate point source impacts and assess the nature and significance of these impacts;
- Implement the most up-to-date best practice methodologies and techniques (e.g., SASS5 (Dickens & Graham, 2002)) to accurately assess the current and change in condition within each reach using macroinvertebrates as a response indicator;
- Expand on the baseline condition at each watercourse against which future studies and monitoring works may be measured;
- Provide specialist recommendations that may be implemented to mitigate and/or rehabilitate the identified and quantified impacts; and
- Develop a comprehensive report containing result analyses and specialist recommendations that will assist with decisions and the development of management objectives.

A2 Desktop Assessment

A desktop assessment was undertaken, in which all the relevant and available data (e.g., government records and previous studies) pertaining to the study area were sourced and subsequently utilised to determine the theoretical importance and sensitivity of the freshwater ecosystems involved. Additionally, the study area was digitally illustrated and mapped utilising Geographical Information Systems (GIS) (e.g., QGIS and/or ArcGIS) to better understand the layout and structure of the surrounding environment and plant site. During this process, all the relevant GIS shapefiles were overlain onto Google Earth Satellite imagery to provide the reader with a holistic view of the study area. **Table A-0-1** below presents the datasets that were utilised, their references, and their date of publication.

Table A-0-1: Presentation of the datasets and available information that was utilised during the desktop study associated with this assessment.

DATASET/TOOL	SOURCE	RELEVANCE
Catchment data	DWS (2012)	Determine the regional hydrological characteristics of the site (e.g., Mean Annual Precipitation (MAP), Mean Annual Simulated Runoff (MASR), Mean Annual Temperature (MAT), and the general flow direction into, through, and out of the study area.
Google Earth Pro™ Imagery	Google Earth Pro™ (2023)	Survey the current and historical imagery of the study area to determine the change in land-use practices, and thus identify potential impacts.
DWS Ecoregions (Geographic Information System (GIS) data)	DWS (2005)	Determine the characteristics of the freshwater resources within the study area.
National Freshwater Ecosystem Priority Areas (NFEPA) river and wetland inventories (GIS coverage)	Council for Scientific and Industrial Research (CSIR) (2011)	Ascertain which freshwater resources have been categorised as important and/or sensitive habitats at a national scale, and thus those that will require conservation.

A3 Visual Inspection

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

A4 *In situ* Water Quality Analyses

During this field survey, *in situ* water quality analyses were conducted by a suitably qualified ENVASS specialist who was fully trained in implementing the below presented SANAS and ISO protocols and guidelines. At each of the biomonitoring points, the ENVASS specialist made use of a hand-held Aquaprobe AP-800 to measure *in situ* water quality parameters such as pH, DO, Temperature, EC, and TDS.

The water sampling that was conducted at the biomonitoring sites was done in accordance with the following guidelines:

1. Guidance on the preservation and handling of water samples:
2. **SANS 5667-3:2006/ISO 5667-3:2003 (SABS ISO 5667-3)**
3. Guidance on sampling of rivers and streams:
4. **SANS 5667-6:2006/ISO 5667-6:2005 (SABS ISO 5667-6)**
5. Guidance on quality assurance of environmental water sampling and handling:
6. **SANS 5667-14:2007/ISO 5667-14:1998**

Other Documents that were used are as follows:

1. ENVASS – Standard Operation Procedure (SOP) for the sampling, handling, and preservation of surface, ground, potable, and sewage water samples.
2. DWAF best practice guideline – G3 – Water Quality Monitoring Programs.

A5 Integrated Habitat Assessment System (IHAS)

The Integrated Habitat Assessment System (IHAS) was applied according to the protocol of McMillian (1998), which was modified by Dallas (2005). This provided an indication of the habitat potential/suitability for aquatic macroinvertebrates within the study site.

IHAS is not a standalone tool, and the results need to be interpreted according to the following guidelines in order to aid with data dissemination. The IHAS index scores were interpreted according to the following guidelines (**Table A-0-2**).

Table A-0-2: Presentation of the classes used to interpret the IHAS results.

IHAS SCORE	INTERPRETATION
<65%	Insufficient for supporting a diverse aquatic macroinvertebrate community.
65%-75%	Acceptable for supporting a diverse aquatic macroinvertebrate community.
>75%	Highly suited for supporting a diverse aquatic macroinvertebrate community.

A6 South African Scoring System Ver. 5 (SASS5)

The SASS5 methodology is a rapid bioassessment method used to identify changes in the species composition of aquatic invertebrates to indicate relative water quality (Dickens & Graham, 2002). SASS5 requires the identification of invertebrates at a family level in the field.

The methodology is based on the principle that some invertebrate taxa are more sensitive than others to pollutants. In particular, macroinvertebrate assemblages are good indicators of localized conditions in rivers. Many macroinvertebrates have limited migration patterns or are not free-moving, which makes them well-suited for assessing site-specific impacts of upstream/downstream land-use practices. Benthic macroinvertebrates are abundant in most streams. Even small streams (1st and 2nd order), which may have a limited fish population, will support a diverse macroinvertebrate population. These groups of species constitute a broad range of trophic levels and pollution tolerances, and thus SASS5 is a useful tool for interpreting the cumulative effects of impacts on aquatic environments.

Using a 'kick net', the SASS5 method prescribes specific time-periods and spatial areas for the kicking of in- and out-of-current stones and bedrock (Stones biotope); sweeping of in- and out-of-current marginal and aquatic vegetation, as well as the kicking of the Gravel, Sand and Mud (GSM) biotope, followed by visual observations via hand-picking. The results of each biotope are kept separate until all observations are noted. The entire sample is then returned to the river, retained alive, or preserved for further identification.

In a SASS5 analysis, species abundance is recorded on an SASS5 score sheet, which weighs the different taxa common to South African rivers from 1 (pollutant-tolerant) to 15 (pollution sensitive). The SASS5 score will be high at a particular site if the taxa are pollution sensitive and low if they are mostly pollution tolerant.

The endpoint of any biological or ecosystem assessment is a value expressed either in the form of measurements (data collected) or in a more meaningful format by summarising these measurements into one or several index values (Cyrus *et al.*, 2000). On the SASS5 score sheet, organisms in the trays are identified up to family level; they are then ticked off under the appropriate biotope on the score sheet, and the abundance for each taxon is indicated. The results are calculated thereafter. The main indices derived and calculated from the score sheet (to be utilised for data interpretation) are:

- Number of taxa: The total number of different taxa identified within the assessed reach.
- SASS5 score: Obtained by adding the quality or sensitivity scores from each identified taxon on the score sheet; and
- Average Score Per Taxon (ASPT): Obtained by dividing the SASS5 score by the number of taxa identified at the site.

To determine the overall Ecological Category (EC) of each site, the indices calculated for each site were plotted on the standard SASS interpretation guideline graphs relevant to the ecoregion in which each biomonitoring site was recorded to fall. These interpretations were modelled for each ecoregion using available SASS data, which was extracted from the River Health Programme (RHP) database and other external sources. Ecoregions were broken down further into simplified longitudinal zones based on differentiation into upland and lowland sites (Dallas, 2007). These interpretation guidelines were utilised as a reference condition during the analyses of the data gathered during the field survey.

APPENDIX B: CURRICULUM VITAE



Gareth Preen

Senior Business Unit Manager
Aquatic Ecologist

QUALIFICATIONS

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

MEMBERSHIPS

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

CRITICAL SKILLS

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

PROFESSIONAL HISTORY

- Gareth holds a BSc Honours Degree in Geography and Environmental Science from the University of KwaZulu-Natal.
- He is a certified wetland delineation and assessment practitioner through the Department of Water and Sanitation (DWS).
- Gareth is a certified South African Scoring System Version 5 (SASS5) practitioner.
- Currently has over eight (8) years' experience in the environmental sector with experience in conducting wetland assessments, aquatic assessments, alien and invasive plant removal monitoring, soil erosion monitoring, wetland auditing, and various aspects of Water Use License Applications.

CURRENT HIGHLIGHTS

- Lead Aquatic specialist for the South Deep Mine, South Africa.
- Springfield Mine Wetland Rehabilitation and Offset Strategy, South Africa.
- KwaXimba Housing Development Aquatic Biodiversity Impact Assessment.
- Springbok Wind Energy Facilities Aquatic Biodiversity Impact Assessments.

DEVELOPMENTAL HIGHLIGHTS

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



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Water and Sanitation

KZN2024/06/01



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Commission

CERTIFICATE OF ACCREDITATION

This is to certify that

Gareth Preen

has met the requirements of the
River Health Programme as a SASS5 Practitioner



COMPETENCY IN THE FOLLOWING AREAS HAVE BEEN DEMONSTRATED:

UNDERSTANDING OF THE SCOPE AND APPLICATION OF THE SASS5 METHOD.

DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS

DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS

IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

07 June 2024

DATE



Moné Oosthuizen
Environmental Scientist

QUALIFICATIONS

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

DEVELOPMENTAL HIGHLIGHTS

- SACNASP registration: Candidate Natural Scientist
- SASS5 Aquatic Biomonitoring Training
- First Aid Level 2
- Snake Awareness - First Aid and Venomous Snake Handling - African Snakebite Institute
- Snake Handling Bootcamp - African Snakebite Institute

PROFESSIONAL HISTORY

- Moné holds a BSc honors degree in Environmental Management from the University of South Africa and graduated cum laude BSc Life Sciences in Genetics and Physiology.

CURRENT HIGHLIGHTS

- Experience in environmental compliance monitoring, including ambient air quality, groundwater, surface water, and drinking water assessments, as well as terrestrial biodiversity impact studies involving flora and fauna surveys, data collection, and technical reporting.
- Training and practical experience in biomonitoring, including SASS 5 aquatic assessments, with the ability to interpret results and contribute to scientifically robust monitoring reports.
- Strong environmental fieldwork skills, including site inspections, in-field plant species identification, and the compilation of clear, defensible air and water quality reports with actionable recommendations to support regulatory compliance and environmental management.

CRITICAL SKILLS

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



herewith certifies that

Mone Oosthuizen

Registration Number: 177592

is a registered scientist

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

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

Environmental Science (Candidate Natural Scientist)

Effective **11 June 2025**

Expires **31 March 2026**



A handwritten signature in black ink, appearing to read 'A. Nkomo', is written over a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. Maseko', is written over a horizontal line.

Chief Executive Officer



To verify this certificate scan this code



Water and Sanitation

GP2026/03/05



Water Research
Commission

CERTIFICATE OF ACCREDITATION

This is to certify that

Moné Oosthuizen

has met the requirements of the
River Health Programme as a SASS5 Practitioner



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DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS

DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS

IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

13 March 2026

DATE



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

QUALIFICATIONS

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

CRITICAL SKILLS

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

MEMBERSHIPS

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

PROFESSIONAL HISTORY

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

CURRENT HIGHLIGHTS

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

DEVELOPMENTAL HIGHLIGHTS

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

PUBLICATIONS

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



herewith certifies that
Johannes Jurgens Pearson
Registration Number: 156536
is a registered scientist

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

Effective **20 April 2023**

Expires **31 March 2026**



Chairperson

Chief Executive Officer



To verify this certificate scan this code



Water and Sanitation

GP2024/04/01



Water Research
Commission

CERTIFICATE OF ACCREDITATION

This is to certify that

Hanro Pearson

has met the requirements of the
River Health Programme as a SASS5 Practitioner



COMPETENCY IN THE FOLLOWING AREAS HAVE BEEN DEMONSTRATED:

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DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS

DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS

IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

12 April 2024

DATE