THE AQUATIC BIODIVERSITY COMPLIANCE STATEMENT FOR THE PROPOSED TETRA4 CLUSTER 2 PROJECT

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27/02/2026

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Report Name	**THE AQUATIC BIODIVERSITY COMPLIANCE STATEMENT FOR THE PROPOSED TETRA4 CLUSTER 2 PROJECT**	
Specialist Theme	Aquatic Biodiversity Theme	
Project Reference	Tetra4 Cluster 2 - 3D Seismic Survey	
Report Version	27/02/2026	
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Declaration	The Biodiversity Company and its associates act as independent consultants in accordance with the requirements of the South African Council for Natural Scientific Professions. We confirm that we have no affiliation with, or vested financial interest in, the proponent, other than remuneration for professional services rendered in terms of the Environmental Impact Assessment Regulations. We have no conflicting interest in the proposed activity or any secondary developments arising from the authorisation of the project, and our work has been undertaken objectively and in accordance with accepted scientific principles.	

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1 Introduction

1.1 Background

The modification of land use within a river catchment has the potential to degrade local water resources (Wepener *et al*., 2005). Primary activities such as mining thus have the potential to negatively impact on local water resources and ecosystem services. In order to effectively manage the potential impacts to watercourses, the establishment of the baseline condition of a watercourse is required. The Biodiversity Company (TBC) was appointed to undertake a wetland compliance statement for the proposed TETRA4 3-D Seismic Survey of Cluster 2 Project located near Virginia, in the Free State province (Figure 1-1). A 500 m area has been demarcated for the project to facilitate the identification of wetlands within the regulatory zone; this area is referred to as the Project Area of Influence (PAOI). In addition, a map highlighting the project components are shown in Figure 1-2.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) 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): “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). The National Web based Environmental Screening Tool has characterised the aquatic theme sensitivity as “Very High” and “Low” for the Project Footprint (Figure 3-5).

A field survey for the general area was undertaken on the 2nd of February 2026 (wet season survey) in order to determine the presence of any additional aquatic features and Species of Conservation Concern (SCCs) that may have been missed during the first survey (14th till the 18th of March 2022), to determine the presence of aquatic features and likelihood of SCC occurring within the PAOI. Both the desktop assessment and field surveys involved the detection, identification, and description of any locally relevant sensitive receptors. The potential risks that the proposed development would have on the sensitive features was also investigated.

The purpose of conducting the specialist study is to provide relevant input into the overall Environmental Authorisation application process, with a focus on the proposed project activities and their associated impacts. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Registered Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making as to the ecological viability of the proposed project.

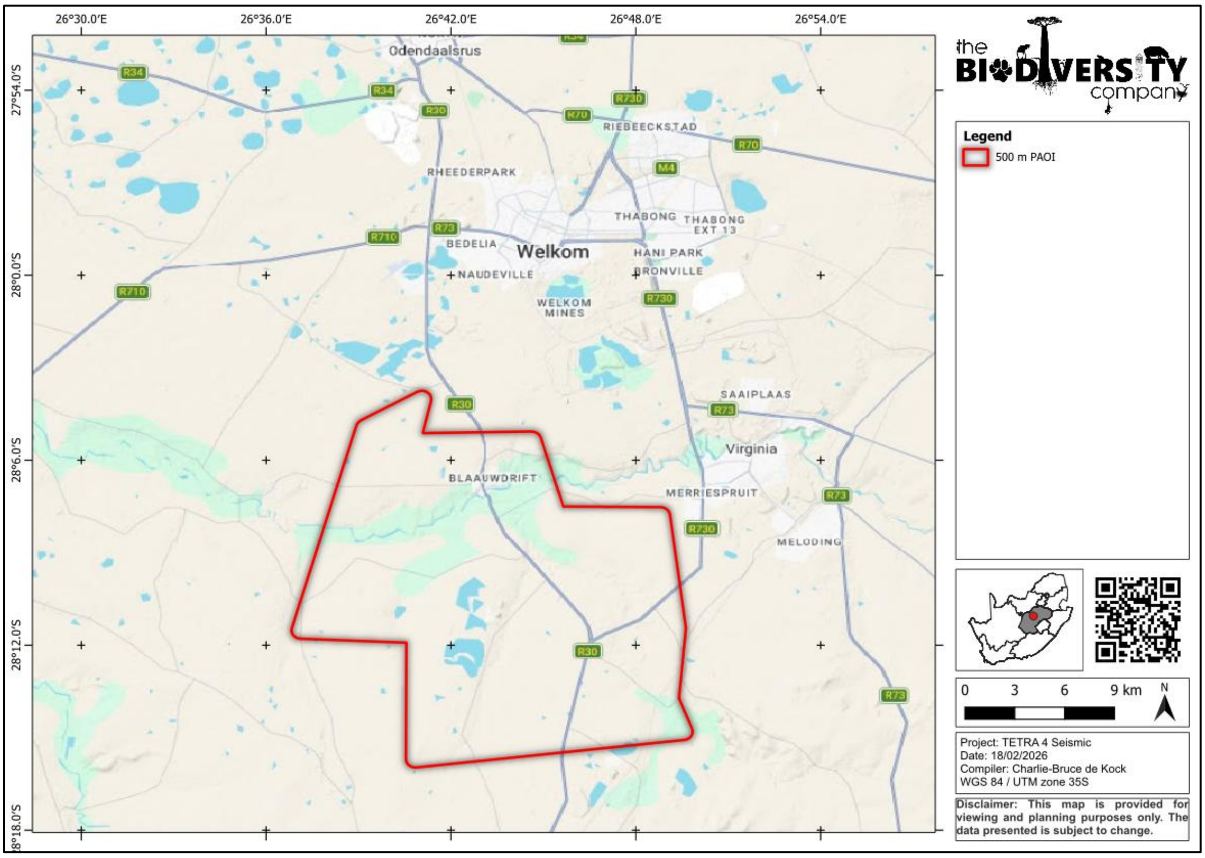


Figure 1-1 The project area of influence in proximity to the nearby towns

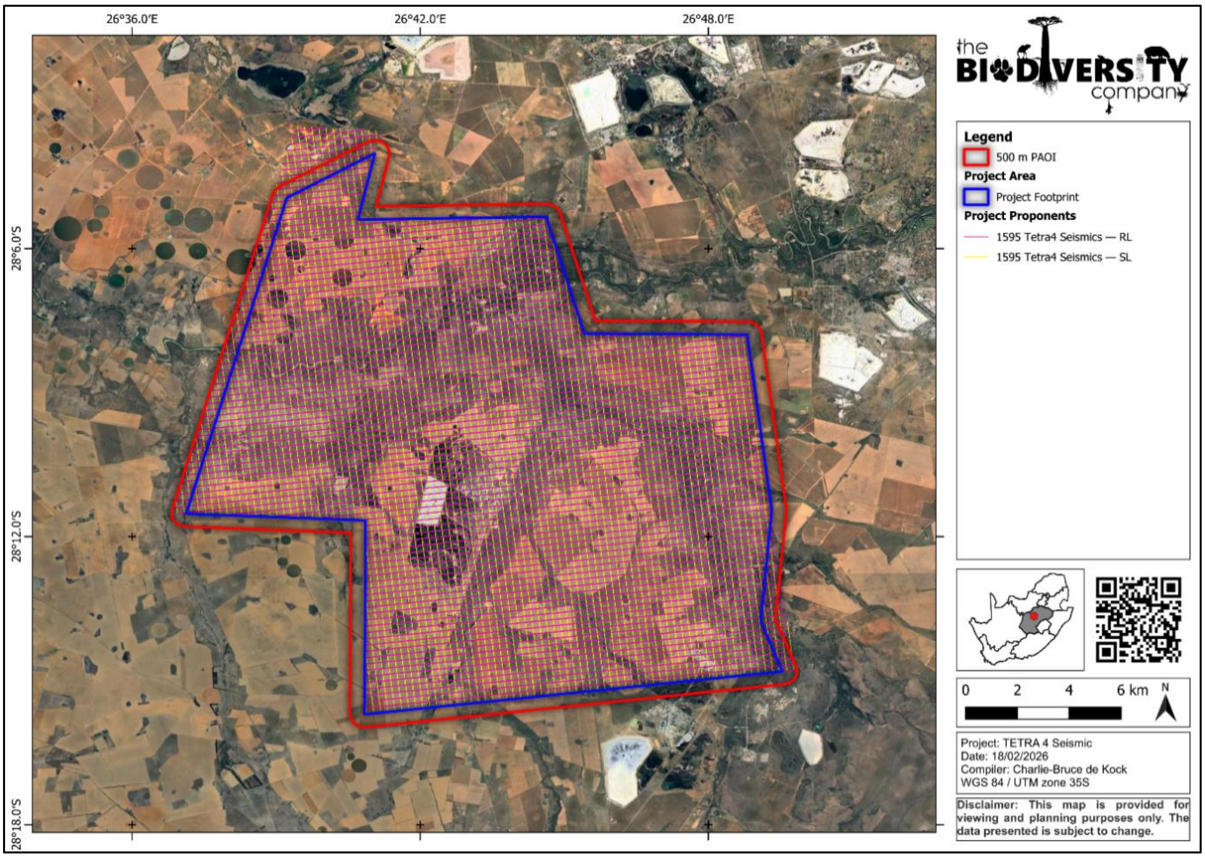


Figure 1-2 Map of project layout components and project area of influence

1.2 Scope of Work

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

- A desktop assessment of available and related datasets to provide context of the freshwater biodiversity of the project area and to indicate potential riverine areas;
- A field survey to identify potential riverine areas;
- The delineation, classification and assessment of riverine features within 500 m of the project area of influence;
- The provision of recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

1.3 Project Description and Technical Information

Following the successful commencement of Cluster 1 gas production in 2022, Tetra4 applied for relevant environmental approvals to expand natural gas operations within the approved production right area and around the Cluster 1 project, designated as Cluster 2. The Cluster 2 application area *ca.* 27 500 hectares, overlaps with a large part of the Cluster 1 area (Figure 1-3). The expansion involves up to 300 new production wells, *ca.* 480 km of gas transmission pipelines and associated infrastructure, three compressor stations, and an additional new combined Liquefied Natural Gas (LNG) and Liquid Helium (LHe) plant (LNG/LHe Plant) as part of the Cluster 2 expansion to meet future production requirements. The Environmental Authorisation (EA) for the Cluster 2 expansion was granted on 19th of May 2023 (Ref: 12/4/007) by the Department of Mineral Resources and Energy (DMRE).

The Cluster 2 EA authorised various production well transects where drilling could occur, but did not specify exact drilling locations, resulting in some uncertainty and concerns from landowners. To address this, Tetra4 proposes conducting a 3D seismic survey across the Cluster 2 area. The primary objective of this survey is to collect detailed subsurface geological data, enabling Tetra4 to accurately identify optimal drilling locations for new natural gas wells and to address landowner concerns regarding well placement. The survey will be carried out using vibrosis/vibrator trucks and geophones (Figure 1-6 and Figure 1-6), with fieldwork planned to be completed within three months and an estimated 425 source points surveyed per day. This high-resolution subsurface geological profile will allow Tetra4 to visualise gas placement in the sub-surface and more accurately identify points of interest on properties.

Onshore seismic surveys are a listed activity in terms of the National Environmental Management Act (Act 107 of 1998 - NEMA) and therefore require a separate EA from the DMRE. The 2023 Cluster 2 EA did not include the listed activity for onshore seismic surveys, nor was an assessment of this activity undertaken during the associated Environmental Impact Assessment. As such, a new EA application is required for the proposed seismic survey. The data obtained from this survey will guide the future development of up to 300 new wells, associated pipelines, compressor stations, and the LNG/LHe plant within the approved production area, ensuring responsible and efficient resource extraction.

Tetra4 holds a natural gas production right over a large area in the Free State Province, near Virginia, and has existing environmental authorisation and a water use licence for current production activities (Cluster 1). The planned expansions will include (Figure 1-3):

- Expansions to the current LNG and Helium production plant on the Farm Mond van Doorn Rivier, increasing production capacities significantly (by ca. 30-fold) and expanding the plant footprint by ca.10 ha;
- Drilling of ca. 300 new gas wells across the Cluster 2 study area (ca. 27 500 ha);

- Installation of trenched pipelines connecting wells to booster compressors, then to in-field compressor stations (about three sites), and subsequently to the main plant area; and

- Short powerline and water connections to the compressor sites.

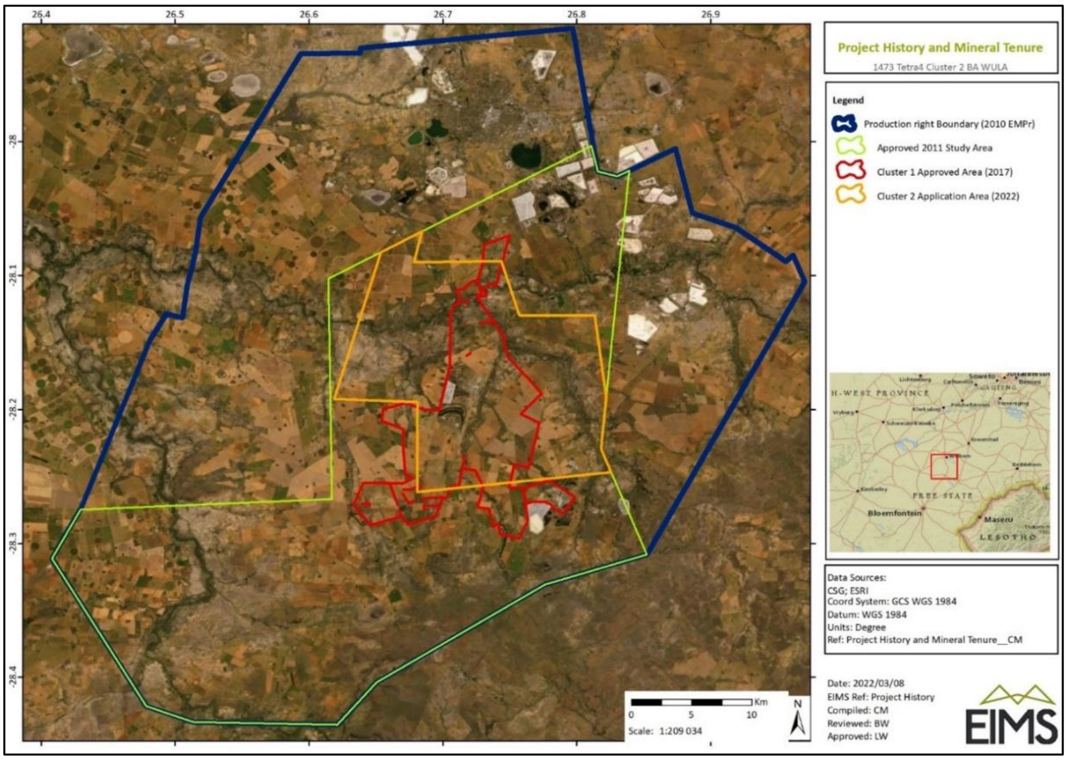


Figure 1-3 Project history and mineral tenure provided by EIMS (2023).

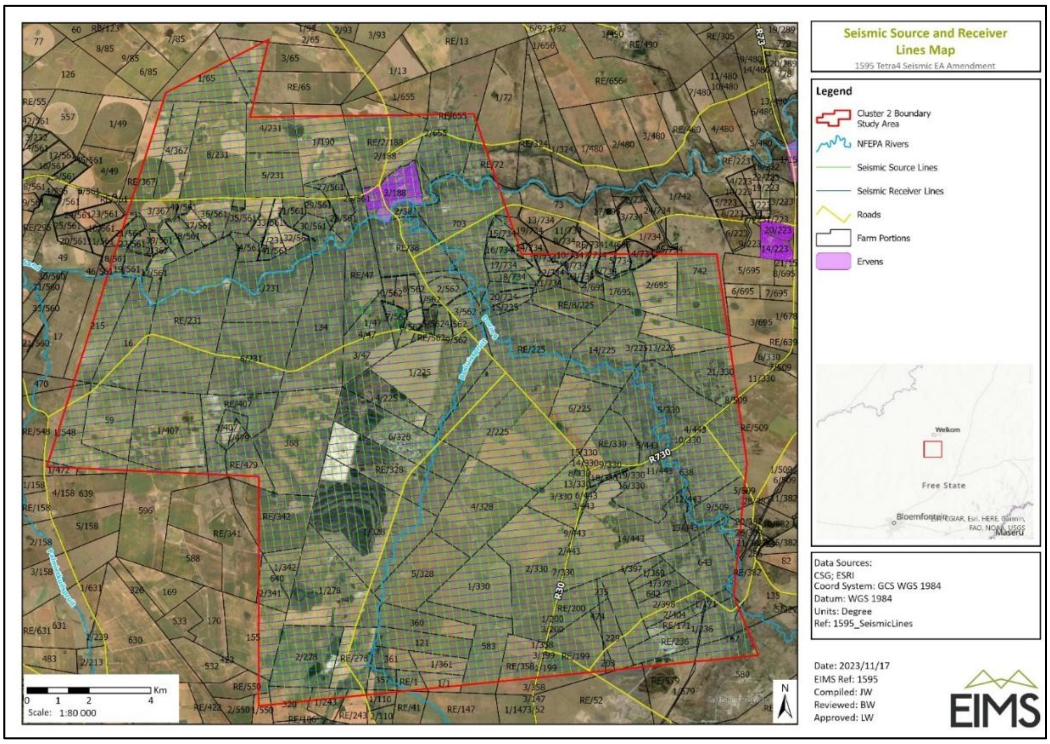


Figure 1-4 Source and Receiver Lines

Figure 1-5 Images of 12-ton source truck (minivibrator) provided by EIMS (2023).

Figure 1-6 Geophone unit to be utilised for seismic acquisition provided by EIMS (2023)

1.4 Assumptions and Limitations

The following limitations should be noted for the assessment:

- It has been assumed that the spatial files provided to the specialist are accurate;
- The assessment area was based on the spatial file provided by the client and any alterations to the development area may affect the results;
- Standard rapid assessment protocols were applied during the study, and therefore a low confidence is provided in the assessment of the biotic community and a snapshot of water quality conditions. As the survey protocols are rapid, it is likely that the biotic community is underestimated, and that additional studies would yield additional species. Despite the rapid nature of the survey, the results do provide informative data of the general biotic community;
- Flooding conditions within the Sand River reduced the efficacy of sampling instream habitat for aquatic biota during the 2022 survey. Additionally, water quality results do not reflect stable conditions within the region; and
- Access to several sites was limited during the survey, and therefore no sampling was conducted at sites T2, TS2, and limited access to S3 during both 2022 and 2026 surveys. Additionally, several ephemeral systems were dry. These sites remain critical to ecosystem services and are regarded as highly sensitive.
- The seasonality of the site survey is not considered to be a limiting factor for this project.

1.5 Legislative Framework

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial 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:
- "Low Sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.
- Where the information gathered from the site sensitivity verification differs from the screening tool designation of "very high" aquatic biodiversity sensitivity, and it is found to be of a "low" sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted.

Based on the proposed project description (TETRA4 PROPOSED 3-D SEISMIC SURVEY OF CLUSTER 2 APPLICATION AREA, Ref: BW/bw/1595) provided by EIMS, which states that **'existing infrastructure or environmental sensitivities will be considered in the final placement of the source and receiver placement'**, it is assumed that the delineated riverine sensitivity areas will be considered and avoided. Taking into account that the proposed activity will pose low to no impacts to the riverine areas within the PAOI and the avoidance of delineated sensitive areas, it is therefore a specialist's opinion that an Aquatic Biodiversity Compliance Statement will suffice for this application.

An Aquatic Biodiversity Compliance Statement must contain the information as presented in Table 1-1 below.

Table 1-1 Aquatic Biodiversity Compliance Statement 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
contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae	7
a signed statement of independence by the specialist	7.1
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 / 3.2
a baseline profile description of biodiversity and ecosystems of the site	3.2
the methodology used to verify the sensitivities of the aquatic biodiversity features on the site including the equipment and modelling used where relevant;	2
where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr	4.2
a description of the assumptions made as well as any uncertainties or gaps in knowledge or data	1.4
any conditions to which this statement is subjected	5

2 Methodology

A single aquatic sampling survey was conducted on the 14th to 18th of March 2022, and a second survey was conducted on the 2nd and 3rd of February 2026. Both surveys constituted a wet season/ high flow/ summer assessment. Standard methods were implemented to establish the baseline conditions of the considered river reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

2.1 Aquatics Assessment

2.1.1 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).

2.1.2 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.

2.1.3 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.

2.1.3.1 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) v2. 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 2-1 and Table 2-2 respectively. The spatial framework for each IHI was 5 km upstream and downstream of the respective sampling points within the watercourse(s).

Table 2-1 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. Allochtonous 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 2-2 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 2-3). The relative weighting of criteria remains the same as for the assessment of habitat integrity (DWS, 1999).

Table 2-3 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

Instream Criteria	Weight	Riparian Zone Criteria	Weight
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 2-4.

Table 2-4 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

2.1.4 Riparian Delineation

The riparian delineation was completed according to DWAF (2005). Typical riparian cross-sections and structures are provided in Figure 2-1. 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.

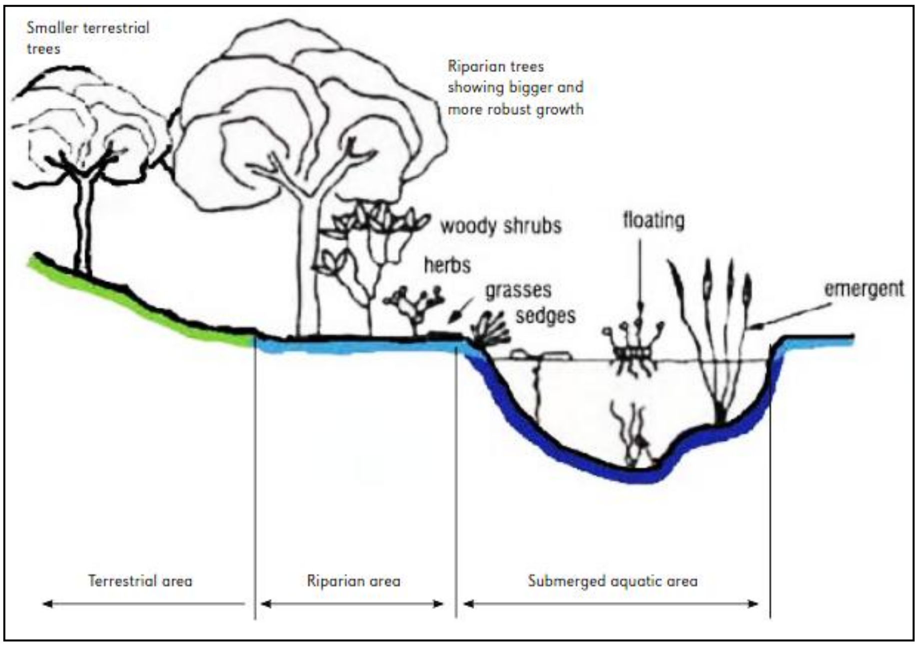


Figure 2-1 Riparian Habitat Delineations (DWAF, 2005)

2.1.5 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.

2.1.5.1 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 2-5.

Table 2-5 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.

2.1.6 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 2-6. These tolerance levels are scored to show each fish species' sensitivity to flow and physicochemical modifications.

Table 2-6 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

2.1.7 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). 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).

2.1.8 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.

3 Receiving Environment

3.1 Desktop Dataset Assessment

3.1.1 South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) wetland dataset is a recent outcome of the National Biodiversity Assessment (NBA, 2018) and, was a collaborative project by the South African National Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR). The SAIIAE dataset provides further insight into wetland occurrences and extents building on the information from the NFEPA, as well as other datasets. Multiple systems were identified within the 500 m PAOI of the project footprint (see Figure 3-1). These systems were identified as being depression wetlands.

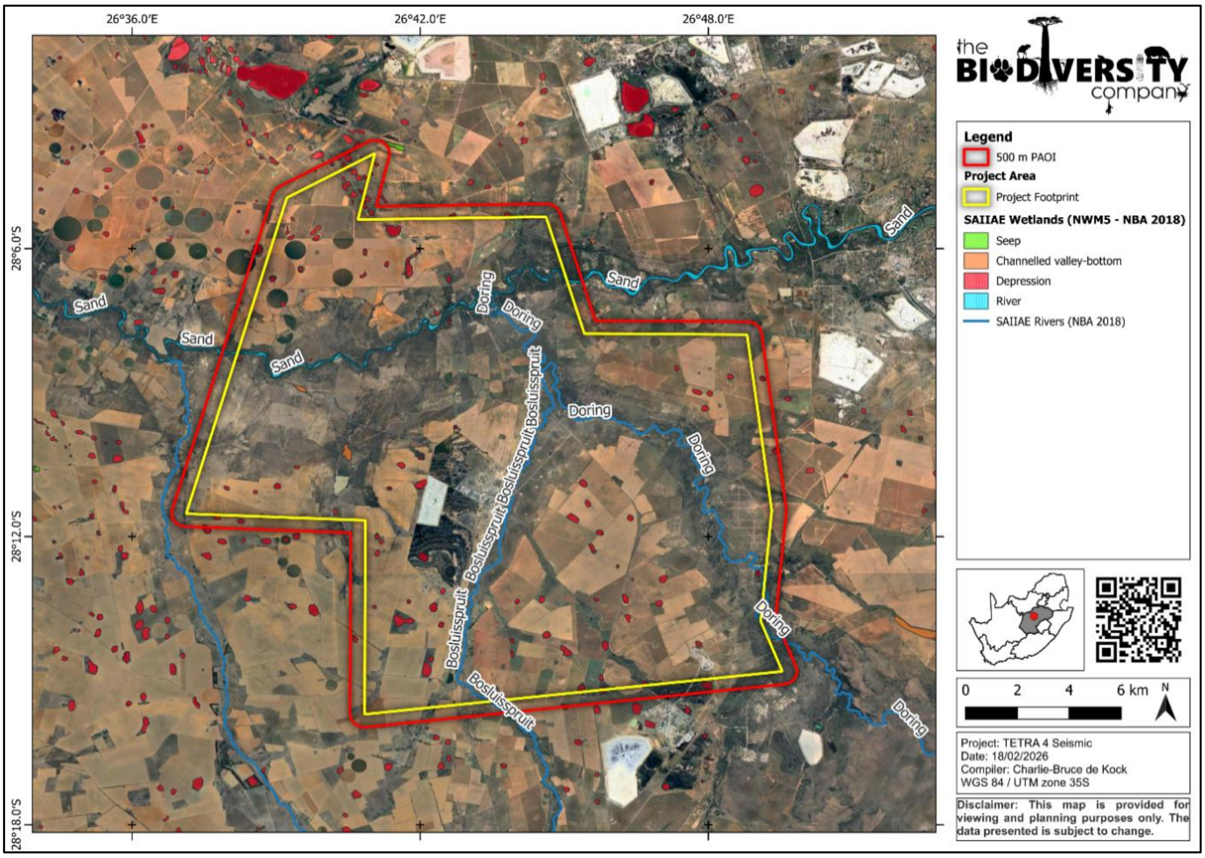


Figure 3-1 Wetland features identified within the project area of influence according to the South African Inventory of Aquatic Ecosystems dataset

3.1.2 National Freshwater Ecosystem Priority Area Status

The 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 NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of RQOs (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 NEMBA, informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

The project area falls across five SQRs with several NFEPAs listed within the project area (Table 3-1). These FEPAs are associated with wetland type ecosystems and NFEPA River status designated to the watercourses within the project area (Figure 3-2).

Conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated SQRs, 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 SQR's in which human activities occur need to be managed to maintain water quality and prevent further degradation of downstream water resources in order to contribute to national biodiversity goals and support sustainable use of water resources.

Table 3-1 NFEPAs listed for the project area

Type of FEPA map category	Biodiversity features
Doring River C42K-2754	
Wetland ecosystem type	3 WetCluster FEPAs
Wetland ecosystem type	Dry Highveld Grassland Group 3_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 3_Depression
Wetland ecosystem type	Dry Highveld Grassland Group 3_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 3_Seep
Wetland ecosystem type	Dry Highveld Grassland Group 3_Unchannelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 4_Seep
Wetland ecosystem type	Dry Highveld Grassland Group 4_Unchannelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 4_Valleyhead seep
Boschluispruit C42K- 2764	
Wetland ecosystem type	Dry Highveld Grassland Group 3_Channelled valley-bottom wetland
Wetland ecosystem type	Dry Highveld Grassland Group 3_Depression
Wetland ecosystem type	Dry Highveld Grassland Group 3_Flat
Wetland ecosystem type	Dry Highveld Grassland Group 3_Seep

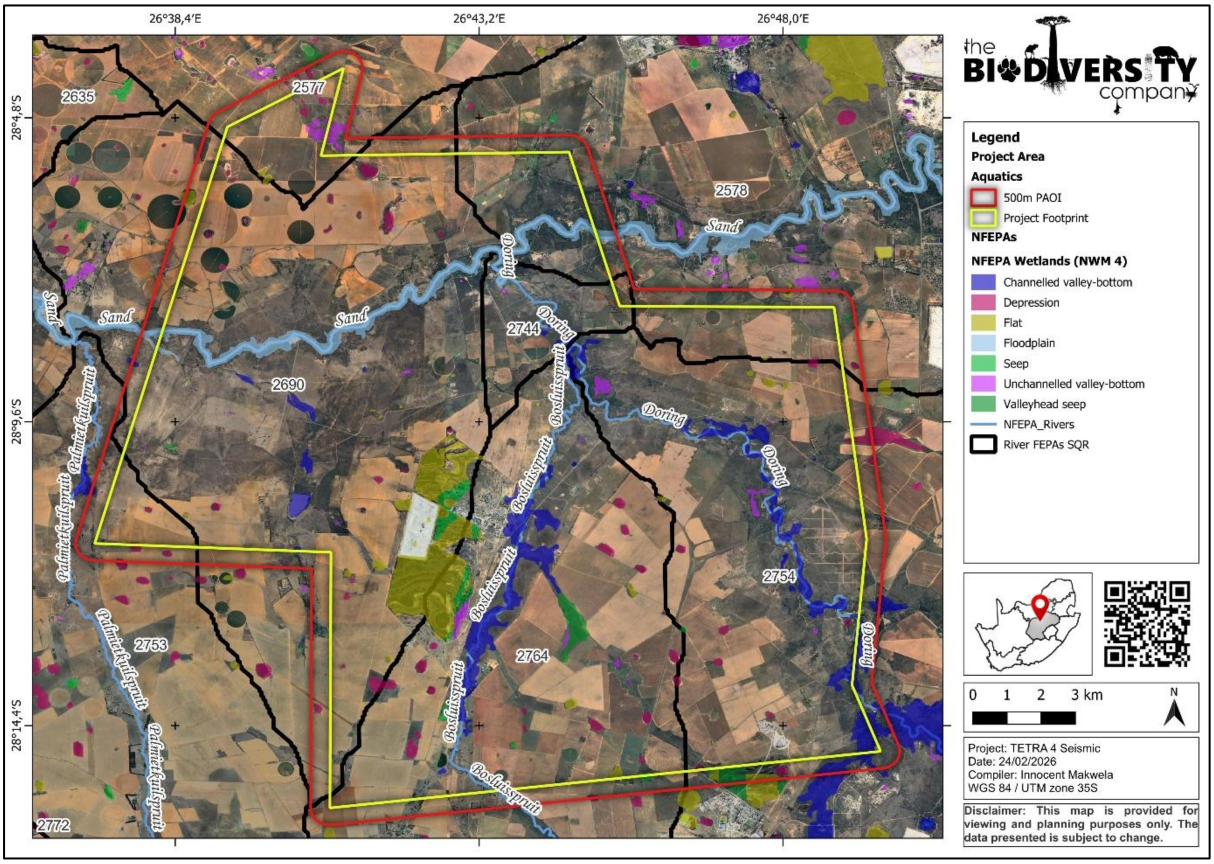


Figure 3-2 NFEPA map for the PAOI (Nel et al., 2011)

3.1.3 Riverine Ecology

Tetra4 Cluster 2 is located within the Matjhabeng Local Municipality, approximately 17 km south of Welkom and 11 km west of Virginia in the Free State Province. The project area is drained by several ephemeral and perennial watercourses, which fall within the C42J, C42L and C42K quaternary catchments, and the Vaal_Orange WMA (DWS, 2023). The eastern portion of the project area falls within the C42K quaternary catchment and ephemeral systems drain into the Boschluisspruit and Doring Rivers which eventuate into the Sand River at the catchment boundary. The eastern portion of the project area falls within the C42L quaternary catchment and consists of several small ephemeral systems which drain into the Sand River. The Sand River flows west into the Vet River, which has its confluence with the Vaal River 87 km west within the Bloemhof Dam. The elevation ranges between 1338 meters above sea level (masl) in the upper reaches of the Doring River to 1282 masl on the Sand River at the outlet of the project area. The spatial framework for the PES assessment of the watercourses falls within the Vaal WMA and includes the Boschluispruit, Doring River and Sand River, as well as several unnamed tributaries.

The spatial framework for the PES assessment of the watercourses falls within the Vaal_Orange WMA and includes the perennial systems Boschluispruit, Doring River and Sand River, as well as several unnamed ephemeral tributaries. The Sand River is classified as a lowland river, with a low gradient alluvial fine bed and meandering channel. A distinctive macro-channel is visible with sand and silt deposits occurring throughout the reach. Riparian zone is well developed. The upper reaches of the Boschluispruit are characteristic of upper foothills geoclass and develop into lower foothills. The riparian zone is poorly defined, and wetland delineations provide a more robust delineation of the watercourse. The Doring River is classed as lower foothills, with incised channels, limiting the lateral movement of water.

The Sand River is represented by two Sub-Quaternary Reaches (SQRs), namely the C42J-2716 and C42L-2690. The Doring is represented by the C42K-2754 and C42K-2744 SQRs. The Boschluispruit is represented by a single SQR, C42K- 2764. The Present Ecological State (PES) of the rivers range from largely natural (class B) to moderately modified (class C) within the region. Impacts to the watercourses are attributed to runoff from mining, agricultural activities, urban areas (Virginia) and flow modifications. The activities have contributions to water quality perturbations and impacts to instream habitat, erosion of channel and banks, and proliferation of alien vegetation.

A summary of the PES, stream orders, and Ecological Importance (EI) and Ecological Sensitivity (ES) for the relevant SQRs are presented in Table 3-2. The freshwater features within the region are presented in Figure 3-3 and additional water source points are in Figure 3-4.

Table 3-2 Desktop Ecological summary for the relevant quaternary catchments

SQR	Stream order	Length (km)	PES (DWS, 2014)	ES	EI	Default Ecological Category
Sand River						
C42J-2578	**3**	**27**	E	High	Moderate	C
PES-EIS Justification		Large impacts to instream habitat and connectivity. Serious water quality perturbations and large flow modifications. Low to moderate instream and wetland integrity class. Moderate to high sensitivity of aquatic biota to changes in flow and physicochemical modifications. Impacts include urban runoff from Virginia, mining, roads and instream dams, Waste Water Treatment Works (WWTW), and slimes dams.				
C42L-2690	**3**	**16**	**C**	Moderate	High	B
PES-EIS Justification		Moderate to large impacts to instream habitat and connectivity. Serious water quality perturbations and moderate flow modifications. Moderate instream and wetland integrity class. High sensitivity of aquatic biota to changes in flow and physicochemical modifications. Impacts include urban runoff from agriculture, instream weirs and low water crossings.				
Doring River						

SQR	Stream order	Length (km)	PES (DWS, 2014)	ES	EI	Default Ecological Category
C42K-2754	**2**	**32**	**B**	Moderate	High	B
PES-EIS Justification		Minor impacts to instream habitat and connectivity, water quality and flow modifications are small. Very high instream and wetland integrity class and connectivity. Moderate to High sensitivity of aquatic biota to changes in flow and physicochemical modifications. Impacts within the reach are attributed to mining, slimes dams, agriculture, small dams, and roads.				
C42K-2744	**2**	**6**	**C**	Moderate	Moderate	C
PES-EIS Justification		Small to moderate impacts to the ecological state of the system, with moderate impacts to water quality and instream habitat. High instream migration link class, and very high instream habitat integrity. Moderate to high intolerance of aquatic biota to flow and water quality modifications. Roads and weirs contribute to modifications to ecological state.				
Boschluispruit						
C42K- 2764	**1**	**28**	**C**	Moderate	Moderate	C
PES-EIS Justification		Small to moderate modifications to instream and riparian habitat and moderate impacts to water quality. Very high migration class, and high riparian habitat integrity class. Moderate to high sensitivity of aquatic biota to changes in flow and water quality. Impacts within the reach include mining, chicken farm, agriculture and roads.				

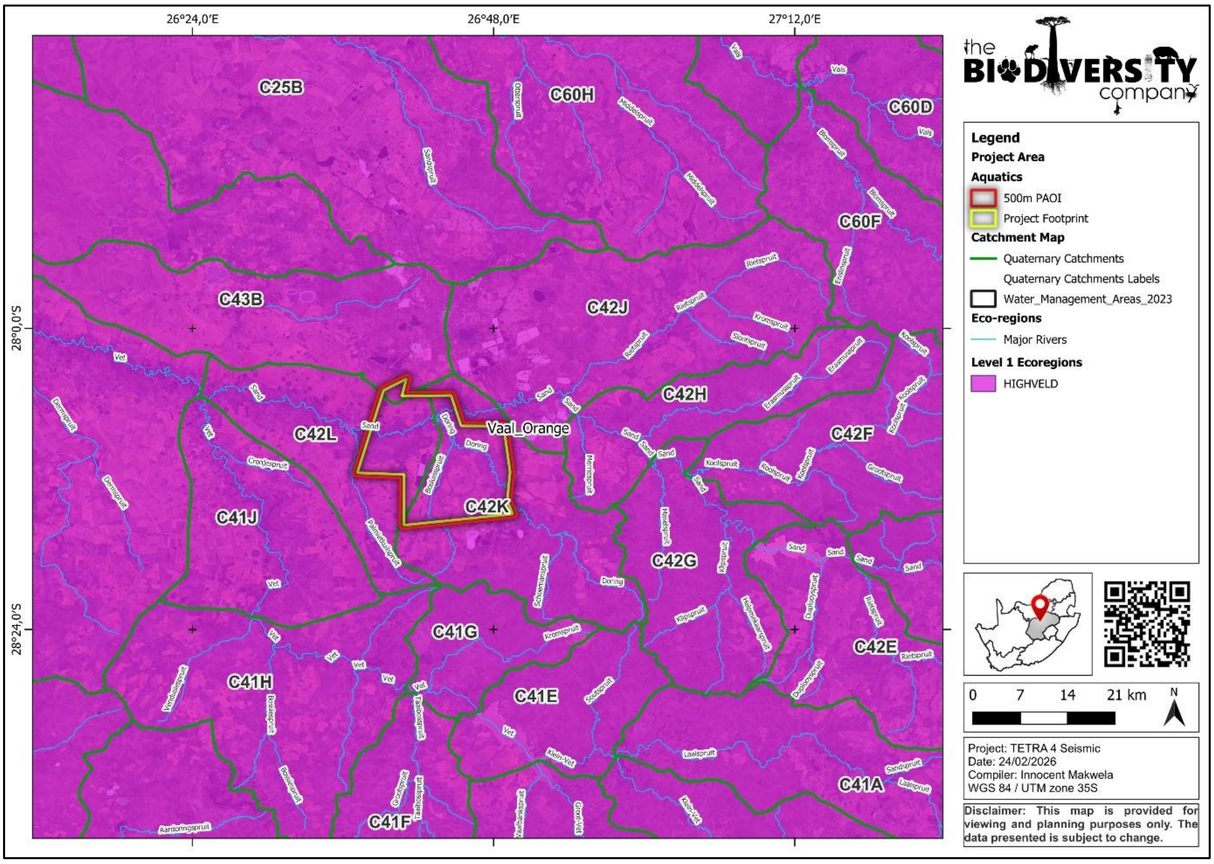


Figure 3-3 Hydrological aspects associated with the project area

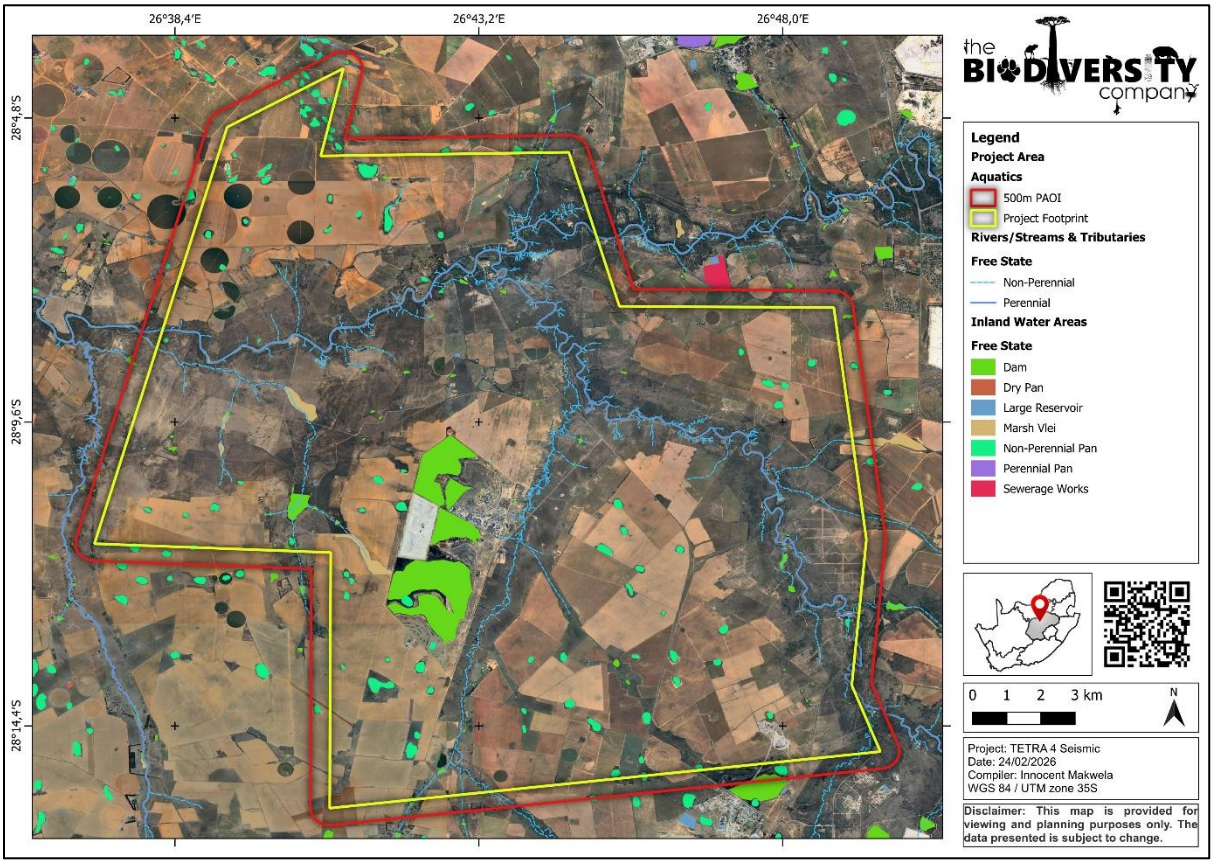


Figure 3-4 Additional water source points associated with the project area

3.1.4 Expected Fish Species

An expected species list was generated from DWS (2014), and Skelton (2011, 2016, and 2024) for the C23H-01653 SQR's. A total of 10 fish species are expected to occur in the Sand River region which are presented in Table 3-3. The conservational status of fish species was assessed against the latest IUCN database (IUCN, 2025).

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists of different habitats which are present along a reach. The Sand River reach does however have limited habitat diversity and cover features which would likely limit the diversity of the fish community. A single species of conservational concern is expected within the reach and downstream systems, *Labeobarbus kimberleyensis* (Largemouth yellowfish) which is listed as Near Threatened (NT). The species is on decreasing population trend and is threatened by deterioration in water quality including eutrophication (nutrient enrichment through poor farming practices and inefficient wastewater treatment), loss of habitat and habitat fragmentation due to weirs and dams, loss of spawning grounds due to instream sedimentation (related to erosion), flow modifications due to drought and dam releases, and threats from exotic species, namely Common Carp (*Cyprinus carpio*) and Grass Carp (*Ctenopharyngodon idella*) (IUCN, 2025).

Table 3-3 Expected fish species for the SQRs sampled for the project

Species	Common Name	IUCN (2025)	C42L-2690 (Sand)	C42K-2754 (Doring)	C42K- 2764 (Boschluispruit)
Austroglanis sclateri	Rock-catfish	LC	1	1	
Clarias gariepinus	Sharptooth catfish	LC	1	1	
Enteromius anoplus	Chubby head barb	LC	1	1	1
Enteromius paludinosus	Straightfin barb	LC	1	1	1

Species	Common Name	IUCN (2025)	C42L-2690 (Sand)	C42K-2754 (Doring)	C42K- 2764 (Boschluispruit)
Labeo capensis	Mudfish	LC	1	1	1
Labeo umbratus	Moggel	LC	1	1	1
Labeobarbus aeneus	Smallmouth yellowfish	LC	1	1	1
Labeobarbus kimberleyensis	Largemouth yellowfish	NT	1	1	
Pseudocrenilabrus philander	Southern mouthbrooder	LC	1	1	
Tilapia sparrmanii	Banded tilapia	LC	1	1	
Total expected species	**10**		**10**	**10**	**5**
LC - Least concern **NT - Near Threatened** **NA - Not assessed**					

3.1.5 Resource Quality Objectives

Results from the aquatic assessment are compared to the Resource Quality Objectives (RQOs) for the Vaal WMA, Integrated Unit of Analysis MD2 Lower Sand, Resource Unit LS3 (DWS, 2016). The Resource Units (RU) are presented in Table 3-4 and the RQOs for the units are presented in Table 3-5. The stipulated RQOs should be considered for the Environmental Management Plan and monitoring protocols should EA be granted for this project. Each aspect of the aquatic assessment will be presented along with relevant RQOs.

Table 3-4 Summary of resources assigned RQOs for the relevant Sand River region

Integrated Unit of Analysis (IUA)	RU	Water Resource Class for IUA	Quaternary Catchment	Mean Annual Runoff (MAR)	Present Ecological State	Recommended Ecological Category
Lower Sand River (MD2)	LS3	III	C42L	180.27	C	C

Table 3-5 Resource Quality Objectives for the sand River Resource Unit (RU) LS3

RU	Quaternary Catchment	Component	Component Sub-	Resource Quality Objective	Indicator/measure	Numerical limit
LS3	C42K, C42L, C43B	Quality	Salts	Salinity levels are significantly high. Instream salinity must be improved to support the aquatic ecosystem and the water quality requirements of the water users.	Electrical conductivity	≤ 85 milliSiemens/metre
LS3	Lower Sand (C42J) (Downstream Rietspruit tributary to confluence with the Vet River)	Quality	System variables	pH must be maintained at present state.	pH range	6.5 - 9.2
		Habitat	Instream Habitat	Instream and Riparian habitat must be in a moderately modified condition or better.	The Rapid Habitat Assessment Method must be implemented.	Instream and Riparian habitat Integrity category ≥ C (≥ 62)
		Biota	Fish	Instream biota must be in moderately modified condition or better through maintenance of habitat, flows, water quality.	A baseline assessment to determine the integrity and health of the fish community should be conducted to determine the current state and potential impacts to the population. Fish Response Assessment Index	Fish ecological category: ≥ C (≥ 62) Macro-invertebrate ecological category: ≥ C (≥ 62) Instream Ecostatus category ≥ C (≥ 62) With monthly flow requirements as specified. Water Quality category: ≥ C (≥ 62)

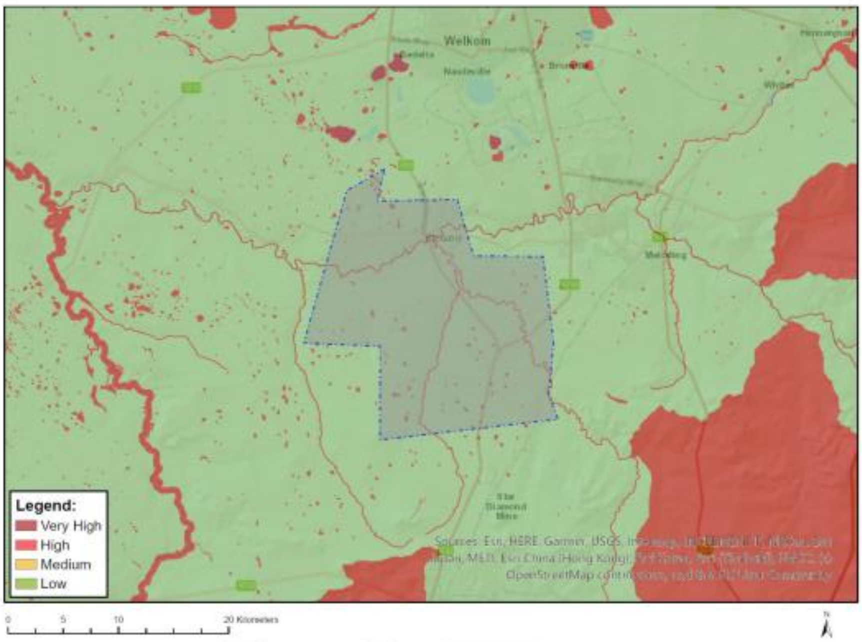
			(FRAI) must be utilized.	
	Aquatic Invertebrates	The integrity of the macroinvertebrate community within the system must be maintained.	The integrity of the invertebrate community should be determined using the Macroinvertebrate Response Assessment Index. Conduct aquatic biomonitoring annually using the South African scoring System 5 methodology.	Maintain the D ecological category by ensuring that the Average Score Per Taxon is >5

3.1.6 Ecological Sensitivity

The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the EIA 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 as “Very High”. (Figure 3-5).

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Wetlands_Channelled valley-bottom
Very High	Wetlands_Depression
Very High	Wetlands_River
Very High	Rivers

Figure 3-5 Aquatic Biodiversity Theme Sensitivity for the PAOI

3.2 Survey Results

3.2.1 Riverine Survey Points

A single riverine sampling survey was conducted on the 14th of March 2022 to 18th of March 2022. The survey constituted a wet season/ high flow/ summer assessment. Figure 3-6 illustrates the sampling points for the study, and Table 3-6 presents site photographs, Global Positioning System (GPS) coordinates. It should be noted that several sites were dry and access to two sites was limited at the time of the survey.

A follow up riverine sampling survey was conducted on the 2nd of February 2026. The survey also constituted a wet season assessment. The surveys were completed to support the compliance statement. Due to the numerous systems intersected by the proposed project area, selected rivers systems are presented below to illustrate the various freshwater features and riparian zones encountered (Table 3-7).

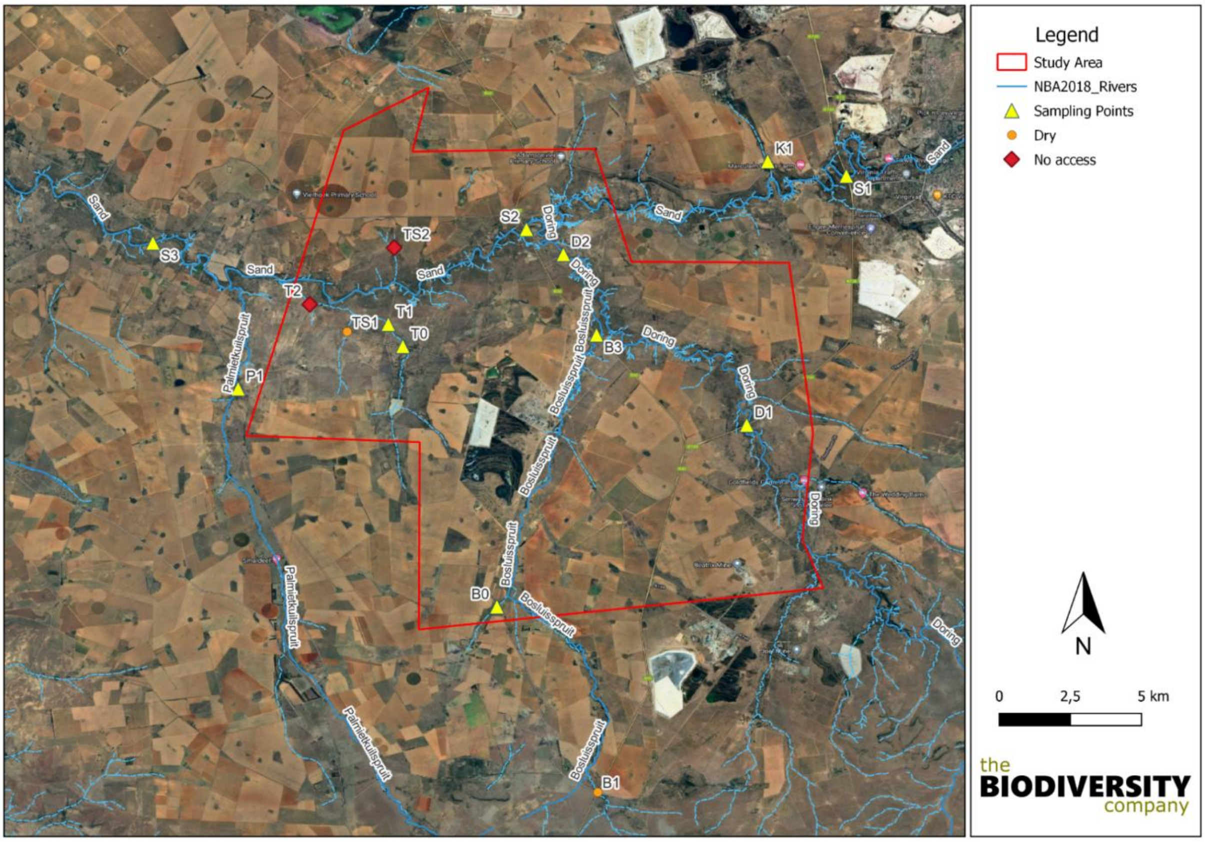


Figure 3-6 Study sampling points

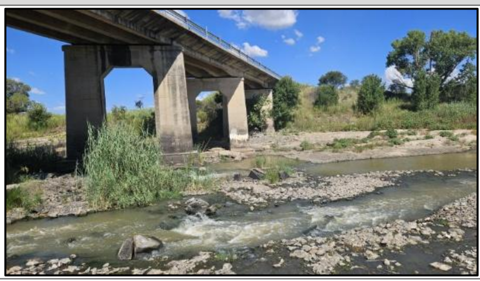
Table 3-6 Investigation site photographs and coordinates (March 2022)

Site	Upstream View	Downstream View
Sand River		
S1		
Comments	Upstream Sand River site. Substrate dominated by sand and scattered stones of current. Debris within the channel provides cover features for aquatic biota. Flooding conditions during sampling.	
GPS-coordinates	28° 5'55.27"S 26°50'2.40"E	
S2		
Comments	Midstream Sand River site. Flooding conditions during sampling. Substrate dominated by sand and portions of bedrock.	
GPS-coordinates	28° 7'4.26"S 26°43'9.48"E	
S3		
Comments	Downstream Sand River site. Flooding conditions during sampling. Instream habitat limited, predominantly sand substrate.	
GPS-coordinates	28° 7'21.92"S 26°35'7.29"E	
Doring River		
D1		
Comments	Upstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28°11'17.45"S 26°47'53.81"E	

Site	Upstream View	Downstream View
D2		
Comments	Downstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28° 7'36.76"S 26°43'57.13"E	
Palmietkuilspruit		
P1		
Comments	Reference site on the Palmietkuilspruit. Diverse habitat including stones and marginal vegetation.	
GPS-coordinates	28°10'30.53"S 26°36'57.33"E	
Boschluispruit		
B0		
Comments	Upstream site on Boschluispruit, characteristic of wetland system.	
GPS-coordinates	28°15'12.51"S 26°42'31.37"E	
B3		
Comments	Wetland system in downstream reaches of Boschluispruit	
GPS-coordinates	28° 9'20.92"S 26°44'39.94"E	
Ephemeral Tributaries		

Site	Upstream View	Downstream View
K1		
Comments	Site downstream of mining activities, outside of project area. Flows into the Sand River upstream of project area.	
GPS-coordinates	28° 5'36.28"S 26°48'20.94"E	
T0		
Comments	Ephemeral tributary. Site limited to a standing pool.	
GPS-coordinates	28° 9'35.66"S 26°40'29.93"E	
T1		
Comments	Ephemeral tributary with limited surface water	
GPS-coordinates	28° 9'6.98"S 26°40'11.16"E	

Table 3-7 Investigation site photographs and coordinates (February 2026)

Site	Upstream	Downstream
Sand River		
S2		
Comments	Midstream Sand River site. Substrate dominated by sand and portions of bedrock.	
GPS-coordinates	28° 7'4.26"S 26°43'9.48"E	

Site	Upstream	Downstream
S3		
Comments	Downstream Sand River site. Instream habitat limited, predominantly sand substrate.	
GPS-coordinates	28° 7'21.92"S 26°35'7.29"E	
	Doring River	
D1		
Comments	Upstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28°11'17.45"S 26°47'53.81"E	
D2		
Comments	Downstream Doring River site. Limited instream habitat diversity and hydraulic biotopes.	
GPS-coordinates	28° 7'36.76"S 26°43'57.13"E	
	Boschluispruit	
B1-NEW		
Comments	Upstream site on Boschluispruit, characteristic of wetland system.	
GPS-coordinates	28°13'7.16"S 26°43'10.59"E	

Site	Upstream	Downstream
B3		
Comments	Wetland system in downstream reaches of Boschluispruit	
GPS-coordinates	28° 9'20.92"S 26°44'39.94"E	
	Impoundment	
Dam		
Comments	Impoundment on the upper reaches of one of the Ephemeral Tributaries of the Sand River	
GPS-coordinates	28°11'2.48"S 26°40'13.24"E	
	Ephemeral Tributaries	
T0		
Comments	Ephemeral tributary of the Sand River. Site was dry at the time of the survey.	
GPS-coordinates	28° 9'35.66"S 26°40'29.93"E	
T1 NEW		
Comments	Ephemeral tributary of the Sand River with limited surface water	
GPS-coordinates	28° 5'40.48"S 26°44'5.72"E	

3.2.2 Results Summary

Table 3-8 Summary of the results from the 2022 and 2026 surveys

Site	Period	pH	Conductivity (µS/cm)	DO (mg/l)	Temp (°C)	Water Quality Compliance vs Guidelines	Habitat Integrity Category	Macroinvertebrates		Fish Richness (10 Species Expected)	Ecological Interpretation
	RQOs* TWQR**	6.5-9.2*	850*	>5.00 **	5-30**			^Biotope Diversity	(SASS / Class)		
Palmietkuilspruit (P1)	2022	7.0	1 305	9.1	20.0	Non-compliant (high conductivity)	-	Moderate (50%)	72 / C	5	Fair condition with moderate habitat support
Sand River (S1)	2022	6.6	342	5.3	20.6	Compliant	C (Instream & Riparian)	-	-	-	Acceptable baseline condition
Sand River (S2)	2022	6.4	736	6.3	22.5	Compliant (pH slightly low)		Moderate (47%)	96 / B	8	Good biological integrity
Sand River (S2)	2026	7.98	1 160	5.0	28.1	Non-compliant (conductivity; marginal DO)		Moderate (40%)	56 / C	6	Signs of increasing stress
Sand River (S3)	2022	6.6	735	5.4	23.8	Compliant		-	-	-	Stable reach
Sand River (S3)	2026	8.40	9 360	10.9	28.3	Non-compliant (extreme conductivity)		-	-	-	Severe water quality concern
Boschluispruit (BO)	2022	6.9	833	4.3	19.3	Non-compliant (low DO)	D (Instream & Riparian)	-	-	-	Oxygen limitation evident
Boschluispruit (B1)	2022	-	-	-	-	Dry / No data		-	-	-	Intermittent reach
Boschluispruit (B3)	2022	7.02	411	6.7	19.5	Compliant		Low (20%)	42 / E-F	0	Poor ecological condition despite compliant WQ
Boschluispruit (B1-New)	2026	8.07	867	7.8	29.5	Non-compliant (conductivity)		-	-	-	Persistently degraded system
Doring River (D1)	2022	7.1	1 495	7.2	21.1	Non-compliant (conductivity)	D (Instream & Riparian)	Low (36%)	94 / B	5	Biological resilience under pressure
Doring River (D1)	2026	7.59	2 790	7.1	27.1	Non-compliant (conductivity)		-	-	-	Increasing chemical stress
Doring River (D2)	2022	6.8	1 845	6.5	22.8	Non-compliant (conductivity)		-	-	-	Chemically stressed reach
Doring River (D2)	2026	7.87	2 520	7.8	28.1	Non-compliant (conductivity)		-	-	-	Persistent stress signal
Ephemeral Tributary (K1)	2022	6.9	313	4.5	20.6	Non-compliant (low DO)	-	-	-	-	Intermittent oxygen stress
Ephemeral Tributary (T1)	2022	6.0	346	4.8	19.3	Non-compliant (low pH & DO)	-	-	-	-	Stress-prone ephemeral system
Ephemeral Tributary (TO)	2022	6.3	434	7.7	19.4	Compliant (pH slightly low)	-	-	-	-	Generally functional reach

Ephemeral Tributary (TS1)	2022	-	-	-	-	Dry / No data	-	-	-	-	Dry
Ephemeral Tributary (T2)	2022	-	-	-	-	No data	-	-	-	-	Inaccessible
Ephemeral Tributary (TS2)	2022	-	-	-	-	No data	-	-	-	-	Inaccessible

*TWQR – Target Water Quality Range (DWAF, 2006); ** Resource Quality Objective (DWS, 2016); Levels exceeding guideline levels are indicated in red

^Diversity rating: High (61-100); Moderate (40 - 60); and Low (<40)

3.2.2.1 Water Quality

In situ water quality analysis was conducted during the study at multiple points along the watercourses in the project area which contained water. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996). Water quality results show pH values largely within RQOs and the TWQR, ranging from 6.0 (T1) to 7.1 (D1), with acidic conditions in the Sand River (6.4–6.6) and at unnamed tributary sites (T0 and T1) that could adversely affect aquatic biota, especially where marked pH changes occur. Electrical Conductivity (EC) ranged from 313 µS/cm (K1) to 1845 µS/cm, with elevated EC in the Doring and Palmietkuilspruit likely limiting aquatic diversity; dissolved solids from the Doring increased Sand River EC by 46%, potentially disrupting osmotic balance and respiration, with mining and agricultural runoff contributing. Low Dissolved Oxygen (DO) was recorded in tributaries (K1, T1) and upper Boschluispruit, linked to limited surface water and flow at T1 and B0, which would further constrain sensitive aquatic biota, while water temperatures were within expected summer ranges for the highveld ecoregion.

3.2.2.2 Index of Habitat Integrity

The IHI, applied over 5 km reaches of the Sand River, Doring River and Boschluispruit in March 2022 and February 2026, found the Boschluispruit and Doring River to be in a class D (largely modified) instream and riparian habitat condition, below the recommended class C (>62) RQOs for the C42K catchment, thereby contributing to deterioration of the downstream Sand River. In contrast, the Sand River was rated class C and within RQOs, reflecting comparatively lower anthropogenic pressure within the assessed reach. Across the study watersheds, land use is predominantly dryland agriculture and livestock, with groundwater abstraction likely reducing baseflows and landcover change increasing short-duration flood peaks; additional pressures include direct discharges (including treated sewage) and mine-water inputs that alter flows and degrade water quality through increased dissolved salts and eutrophication. Instream habitat modification was evident at all sites, particularly elevated sediment deposition in the Doring and Sand Rivers driven by eroding, highly erodible channel banks and intensified by agricultural activities, leading to channelisation, reduced lateral connectivity to the riparian zone, and compromised riparian integrity.

3.2.2.3 Aquatic Macroinvertebrates

3.2.2.4 Macroinvertebrate Habitat Assessment

A biotope rating of available habitat was conducted at each macroinvertebrate sampling site assessed to determine the diversity of habitat available for macroinvertebrate communities. A rating system of 0 to 5 was applied, 0 being not available and 5 being abundant and diverse. The results of the biotope assessment for the March 2022 and February 2026 surveys are presented in Table 3-8. The biotope rating assessment found the most diverse instream habitat at site P1, with a mixed substrate of stones in and out of current, gravel, sand and mud, but marginal and aquatic vegetation was limited across sites, likely reducing expected macroinvertebrate orders (Odonata, Hemiptera and Coleoptera). Site S2 (Sand River) showed moderate biotope diversity dominated by sand with patches of stones, although sedimentation and erosion have smothered and reduced stone biotopes. Site B3 had poor habitat diversity, largely reflecting the system's naturally wetland character, which would constrain taxa preferring flow and stone habitats, while site D1 (Doring River) had moderate diversity dominated by stones (in and out of current) and mud, with no aquatic vegetation recorded. Overall, all sites except B3 were considered capable of supporting only a moderate macroinvertebrate diversity, limiting the potential for a highly diverse assemblage.

3.2.2.5 South African Scoring System (Version 5)

The aquatic macroinvertebrate results for the survey are presented in Table 3-8. According to RQOs, the ASPT for the Sand River must above 5 for the Sand River. The 2022 high-flow SASS5 assessment recorded total sensitivity scores from 42 (B3) to 96 (S2), with taxa richness ranging from 11 (B3) to 16

(P1 and S2) and ASPT values from 3.8 (B3) to 6.7 (D1), yielding ecological classes from E/F at B3 to class B at S2 and D1. Site B3 was dominated by largely tolerant taxa (including Gerridae, Ceratopogonidae and Dytiscidae), with 5 of 11 taxa being air-breathers consistent with low DO conditions. The Palmietkuilspruit showed a moderately tolerant assemblage (ASPT 4.5) but included flow-sensitive taxa (Hydropsychidae and >2 spp. Baetidae) and moderately sensitive taxa (Ancylidae and Atyidae). Site S2 supported a moderately diverse community with largely natural biotic integrity and a moderately tolerant ASPT of 6.0, including sensitive taxa (Elmidae, Atyidae and Ecnomidae) and exceeding the RQO ASPT target of 5. The Doring River (D1) showed a moderately intolerant assemblage (ASPT 6.7) and largely natural biotic integrity, although instream habitat and water-quality modifications were reflected in changes to the macroinvertebrate community.

3.2.2.6 Fish Community Structure

Sampling at sites S2, P1, B3 and D1 recorded nine of the eleven expected native fish species, with the highest community representation at S2 (73% of expected), and 50% at P1 and D1, while no fish were collected in the Boschluispruit. *Enteromius trimaculatus* was collected at S2 despite not being expected in this reach based on available references, likely representing a new distribution record, although it is listed as Least Concern and not of conservation concern. Sand River habitat was moderately diverse, with a weir artificially increasing habitat diversity, and the assemblage was dominated by cyprinids (*Enteromius*, *Labeo* and *Labeobarbus*) that are generally moderately intolerant to moderately tolerant of flow modification and moderately tolerant of altered physico-chemical conditions. Limited cover features in the Doring and Palmietkuilspruit likely explain the absence of several species, while instream impoundments in the Boschluispruit would restrict migration and species occurrence upstream; additional surveys are recommended to strengthen confidence in the assessment. Overall, the Palmietkuilspruit and Doring were classed as moderately to largely modified, with limited hydraulic biotope and cover diversity constraining fish communities, and water-quality perturbations in the Doring further reducing biotic integrity.

3.2.3 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. The buffer size for the delineated water resources has been calculated according to the various water resources, and are as follows:

Riparian zones of lower foothill rivers – **32 m** post-mitigation measures

The allocated post-mitigation buffers consider the high erodibility of the soils within the catchment. Areas associated with the watercourses that are eroded should be avoided or stabilised to minimise additional channel and bank erosion and subsequent sedimentation to downstream systems.

Provided the proposed development is situated outside all delineated buffers and executed in accordance with best practices, low to no impacts to the riverine habitat and biota are expected.

3.3 Site Sensitivity Verification

As noted in the geomorphological description of the project area, the watercourses considered in this assessment represented characteristic source zone waterbodies with wetlands. As can be observed in Figure 3-7, riparian vegetation was limited to features characteristic of wetlands. Given the wetland nature of the riparian vegetation, and relationships between wetland integrity within catchments and stable riverine conditions, the delineated wetlands were used to derive the sensitive habitats. Riparian zones within the lower foothills of the Doring and Sand River were well defined and comprised of woody species Figure 3-8.

Figure 3-7 ***Typical headwater zone in the upper reaches of the Boschluispruit***

Figure 3-8 ***Typical lower foothills zone and well defined riparian zone within the Sand River***

The ecological sensitivity of the watercourses was determined to be largely uniform across the project area. Limited presence sensitive riverine biota was noted during the assessment, which is attributed to water quality and habitat degradation. Overall, the macroinvertebrate communities were made up of tolerant taxa with limited sensitivities. Taxa such as Atyidae (Freshwater shrimp), Hydropsychidae, Elmidae (Riffle beetles), and Ecnomidae (caddis fly) were determined to be the most sensitive aquatic invertebrates observed during the baseline assessment. Ichthyofauna communities were also found to be dominated by tolerant/adaptable taxa and largely consisted of cyprinids from the genera *Enteromius* sp., *Labeo* sp., and *Labeobarbus* sp. which are moderately intolerant to moderately tolerant to flow modifications, and moderately tolerant to modified to physico-chemical parameters.

Given the assessments that have been conducted in the region, the above taxa are likely to occur only in isolated populations. Considering the presence of such taxa, the watercourses in the project area are regarded as sensitive environments in relation to changes in flow and water quality.

The overall Ecological Importance and Sensitivity (EIS) of the river reaches in this study were assessed according to Kleynhans (1999). The results of the EIS assessment are provided in the table below (Table 3-9). The results of the EIS assessment derived a moderate EIS for the river reaches assessed in this study from the Vaal WMA.

Table 3-9 Ecological Importance and Sensitivity Ratings for the Watercourses in the project area located Sand River, Doring River, and Boschluispruit

Biological Determinants		
Determinant	**Rating**	**Comment**
Rare and endangered biota	3	More than one taxon rare or endangered at a local scale
Unique biota	2	The aquatic fauna are distributed widely throughout the Middle Vaal WMA
Intolerant biota	2	Source zone conditions make the presence of flowing water rare. Therefore, flow intolerant taxa make up only a small portion of the aquatic fauna
Species richness	2	On a local scale the species richness is moderate
Habitat Determinants		
Diversity of aquatic habitat	2	Impacted system, most of which are permanent impacts (erosion)
Refuge value of habitat types	2.5	Limited refuge areas
Sensitivity of habitat to flow modification	3	Moderate sensitivity to flow modifications
Sensitivity to flow related water quality changes	2	Low number of impoundments within the project area
Migration route corridor for instream and riparian biota	2	The watercourses are in the mid to upper reaches of the river systems
National parks and wilderness areas	0	No NFEPA listing and no nature reserves associated with the watercourses
Mean	**2.05**	
EIS class	**High**	

The National Web based Environmental Screening Tool has characterised the aquatic theme sensitivity as "Very High" and "Low" for the Project Footprint. Table 3-10 provides a comparison between the Environmental Screening Tool and the specialist determined Site Ecological Importance (SEI) of the project. The specialist-assigned sensitivity ratings are based largely on the SEI process. Refer to the wetland report (TBC, 2026) for the wetland sensitivities and screening tool comparisons.

Table 3-10 Summary of the Screening Tool Sensitivity versus the Specialist assigned Site Ecological Importance (SEI) for the Field Survey Area of the Project Area

Screening Tool Theme	Screening Tool	System	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Aquatic Biodiversity Theme	Very High	Rivers Sand River, Doring River, and Boschluispruit	High	Disputed – The Middle Vaal WMA supports aquatic fauna distributed widely throughout the region, with moderate local species richness including more than one taxon that is rare or endangered at a local scale. Source zone conditions limit flowing water occurrence, resulting in flow-intolerant taxa comprising only a small portion of the fauna. The watercourses are located in the mid to upper reaches of river systems with few impoundments, moderate sensitivity to flow modifications, and limited refuge areas. The system has experienced impacts, predominantly permanent erosion-related degradation, and is not listed under NFEPA designations nor associated with formal nature reserves.
	Low	-	Low	Validated – No natural riverine features were identified within the rest of the project area of influence.

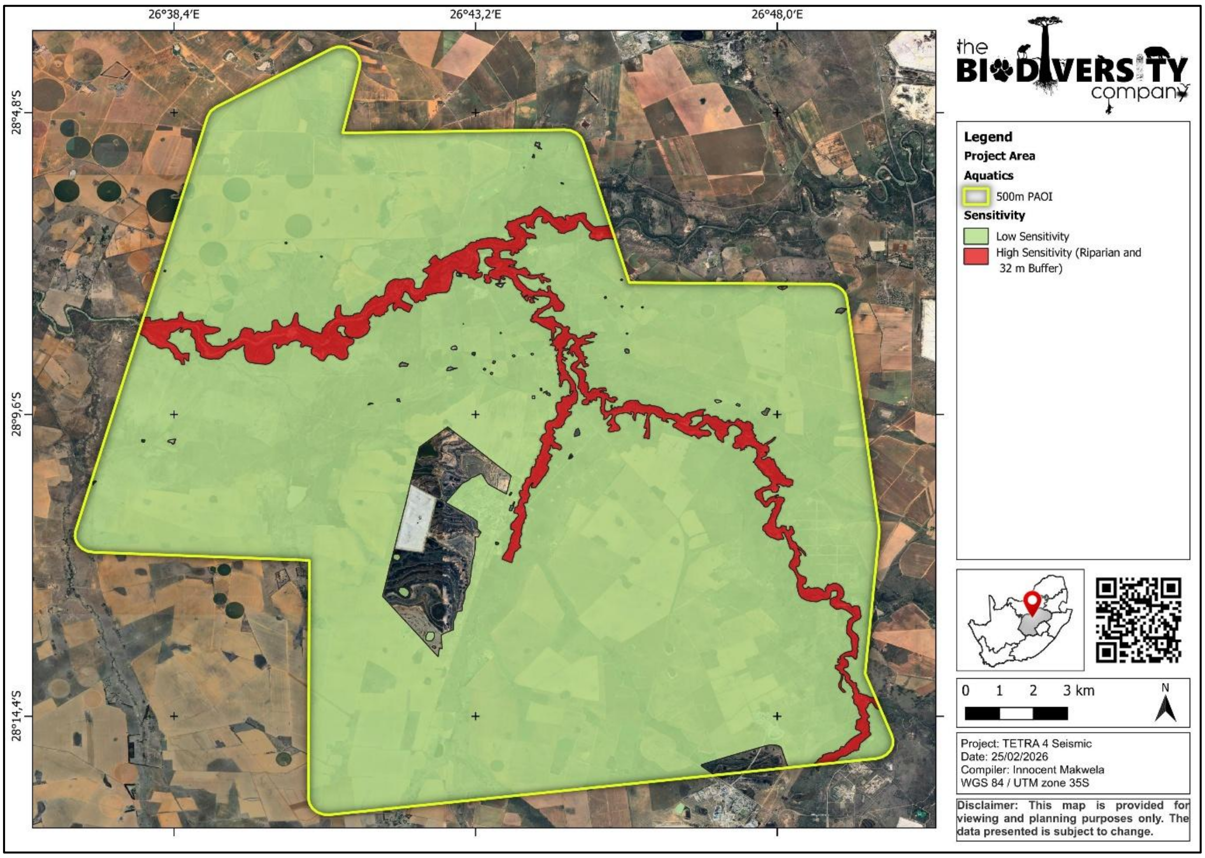


Figure 3-9 Freshwater Sensitivity for the project area of influence

4 Riverine Impact Assessment

4.1 Riverine Impact Assessment (EIMS)

The proposed 3D seismic survey is anticipated to result in localised, predominantly temporary disturbance within the project footprint, primarily associated with vehicle movement along the planned transect lines and related field activities. Although direct impacts to the riverine areas (Riparian and active channels) are not anticipated based on an avoidance approach, inappropriate crossings, wet-weather access or uncontrolled driving could result in incidental encroachment into sensitive riparian areas. The potential impacts associated with the proposed activities were assessed using the EIMS impact assessment methodology, and the results are summarised in Table 4-1 .The assessment focuses on the operational phase of the seismic survey. For each impact, significance was determined for the pre- and post-mitigation scenarios in accordance with the prescribed EIMS procedure.

It should be noted that as the proposed activity intends to avoid sensitive environments (such as riparian zones with their delineated buffers and active channel), very low impacts is anticipated to the riverine features including aquatic biota. Therefore, not assessed in this report. The impact assessment indicated that the risks/impacts from the proposed project are generally of "Medium to Low" significance prior to mitigation. With the application of mitigation measures, all impacts are reduced to "Low" significance, indicating effective management. The results confirm that, with proper controls, the long-term impacts on aquatic ecosystem health and function are minimal.

Should the layout and/or project description change, the impact assessment should be reviewed by a qualified Aquatic Ecologist.

Table 4-1 Summative results of the EIMS Impact Assessment conducted for the proposed project

Impact	Phase	Pre-Mitigation Significance	Post-Mitigation Significance	Final Significance
1. Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems	**Operation**	**Medium to Low**	**Low**	**Low**
Mitigation Measures				
• Micro-site transect lines to avoid delineated riparian areas and demarcate no-go areas before operations. • Keep vehicles to existing tracks and approved routes; no ad hoc detours or route widening near wet areas. • Prefer dry-season operations and stop/reroute if soils are wet/saturated to prevent rutting and compaction. • Use single, pre-approved crossing points only where unavoidable, applying low-impact measures (no blading/excavation of riparian or river bed soils).				
2. Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation	**Operation**	**Medium to Low**	**Low**	**Low**
Mitigation Measures				
• Avoid the creation of new access roads; use existing roads where possible. • Minimise disturbance by keeping the operational footprint as small as practicable and prohibiting unnecessary vegetation disturbance/clearing. • Inspect and clean vehicles/equipment (wheels, undercarriages) before entering the site and when moving between properties to reduce weed seed transfer. • Monitor disturbed areas and access routes for alien/invasive plant establishment during and after operations and remove/eradicate infestations as they arise (mechanical/hand removal or appropriate treatment). • Rehabilitate any disturbed areas promptly (re-profile, stabilise and re-vegetate as required using locally appropriate indigenous species or an agreed pasture mix, in consultation with the landowner).				
3. Impaired water quality due to accidental hydrocarbon spill	**Operation**	**Medium to Low**	**Low**	**Low**
Mitigation Measures				
• Prohibit refuelling, servicing/maintenance and hazardous substance handling within riparian areas; undertake these activities only at designated areas located away from freshwater features. • Ensure fuels, oils and hazardous substances are stored and handled with secondary containment (e.g., bunding/drip trays) and that vehicles are regularly inspected for leaks (repair leaks before re-entry to the field). • Maintain good housekeeping: no dumping/burying/burning of waste; store waste securely and remove regularly to licensed facilities; prevent litter accumulation and collect windblown litter promptly. • Keep spill kits available on all relevant vehicles/teams, and ensure staff are trained to respond to leaks/spills. • Implement spill response procedures: stop source, contain, clean up and dispose of contaminated material appropriately, and record/report incidents in accordance with site requirements; any spill near a freshwater feature triggers immediate escalation and remediation. • Prevent discharge of contaminated water to the environment; manage any contaminated runoff/wash water via appropriate containment and disposal.				

4.2 Proposed Impact Management

The following table sets out the proposed mitigation and impact management measures for the riparian features associated with the 3D seismic survey project, including responsibilities, monitoring requirements and performance indicators. In light of the expected impacts from proposed activities the following mitigation measures have been proposed to lower the intensity of the impacts on the ecological integrity of the watercourse catchment and its downslope watercourses features. The mitigation approach prioritises avoiding traversing all delineated riparian areas where feasible and, where crossings cannot be avoided, using designated, pre-approved existing crossing points only to traverse riparian areas.

Table 4-2 Proposed impact management measures for riverine features associated with the seismic survey

No.	Mitigation / Management Measure	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target (Outcome)	Performance Indicators (Monitoring Tool)
Wetlands and Drainage Features							
1	Demarcate all delineated riparian zones as no-go areas before site establishment.	Planning, Operation	Pre-operations route planning and demarcation; throughout operations and maintained for life of project.	Project Manager; Environmental Officer; Contractor	ECO / Environmental Officer (weekly during operation)	No unauthorised disturbance in the delineated riparian zone; (Intact riverine areas)	Approved layout plan; physical demarcation such as danger tape / signage on site; (ECO inspection reports show zero encroachment incidents.)
2	Minimise vegetation disturbance by restricting driving to approved transect lines/routes and existing tracks where practicable, with no unnecessary clearing. Avoid riparian areas. Apply basic vehicle hygiene to limit seed transfer, monitor disturbed areas for alien/invasive plants, and rehabilitate any disturbance promptly to encourage re-vegetation.	Planning, Operation	Pre-operations route planning and demarcation; throughout operations; rehabilitation progressively as disturbance occurs (and at demobilisation).	Environmental Officer; Contractor	ECO / Environmental Officer (weekly during operations; and at demobilisation; follow-up inspection post-operations if required)	No unauthorised vegetation disturbance riparian areas; disturbance footprint restricted to approved routes with effective natural recovery/rehabilitation; no establishment/spread of alien/invasive plants attributable to the survey.	Approved layout/routes and demarcation records; ECO inspection checklists and photo records; evidence of route compliance (no off-route driving); vehicle hygiene records (where applied); rehabilitation/close-out notes; alien/invasive monitoring observations and removal records (if applicable).
3	Implement pollution-prevention measures for hydrocarbons, chemicals and concrete, including bunded storage, designated refuelling areas and spill-response procedures away from riverine features.	Planning, Operation	Pre-operations route planning and demarcation; throughout operations; rehabilitation progressively as disturbance occurs (and at demobilisation).	Environmental Officer; Contractor	ECO / Environmental Officer (weekly; after any spill incident)	Zero uncontrolled hydrocarbon/chemical/concrete spills reaching wetlands or riparian zones.	Presence of bunded storage and designated refuelling areas; spill register; (incident reports confirm no contamination of wetlands/riparian zones).

5 Conclusions

The baseline assessment established three main watercourses within the project area, namely the Sand River, Doring River, and Boschluisspruit, and a single system outside the project boundary, the Palmietkuilspruit. Additionally, numerous ephemeral systems and wetlands occur throughout the project area. The ecological assessment of the watercourses indicated moderate to large modifications attributed to varying land use, namely agriculture, mining, and urban activities upstream of the project area on the Sand River (Virginia). The land use activities have cumulatively resulted in a moderate deterioration in water quality, flow, and instream habitat, and subsequently to the biotic communities within the systems. Given the findings of this assessment, no pristine or natural (class B) watercourse were observed, with the Doring River being classed as largely modified (class D), the Boschluisspruit as largely modified (class D), and the Sand River as moderately modified (class C).

The water resources within the PAOI are poorly protected, and the ecosystems are critically endangered. Additionally, the *Labeobarbus kimberleyensis* (Largemouth Yellowfish) was expected within the Sand River and is the only species of conservational concern within the catchment and red listed as Near Threatened due to habitat fragmentation and water quality deterioration. The species was not collected during the survey, however, despite the absence of the species during the survey, the precautionary approach would assume the species to be within the project area and would likely be collected with increased sampling effort. The poorly protected nature of the systems indicates that strict mitigation measures should be adhered to ensure no further deterioration of the watercourses should the project proceed.

The Sand, Doring and lower reaches of the Boschluisspruit presented well defined riparian zones consisting of woody vegetation. The soils along the watercourses are highly susceptible to erosion and considered sensitive to any potential anthropogenic activities along these systems which could potentially compromise the ecological integrity of the watercourses. Therefore, a conservation buffer was calculated at 32 m.

5.1 Impact Statement

Given the nature of the proposed project (a temporary, vehicle-based seismic survey) and the application of the recommended avoidance and impact management measures, no direct impacts to riverine areas are anticipated, provided that riparian areas are avoided during final routing and field operations. The impact assessment indicated that the risks/impacts from the proposed project are generally of "Medium to Low" significance prior to mitigation. With the application of mitigation measures, all impacts are reduced to "Low" significance, indicating effective management. The results confirm that, with proper controls, the long-term impacts on aquatic ecosystem health and function are minimal. Should the layout and/or project description change, the impact assessment should be reviewed by a qualified Aquatic Ecologist.

5.2 Specialist Opinion

Considering the assessment findings, it is the opinion of the specialist that the project may be considered for authorisation, on condition that all prescribed mitigation measures are strictly implemented. This includes the avoidance of sensitive riverine features and their buffer zones (as far as is feasible).

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7 Appendix Items

7.1 Appendix A –Impact Assessment (EIMS)

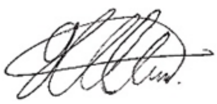
Table 20 EIMS Impact Assessment for the proposed project

Identifier	Discipline	Impact	Alternative	Phase	Event	Pre-Nature	Pre-Extent	Pre-Duration	Pre-Magnitude	Pre-Reversibility	Consequence	Pre-Probability	Pre-Mitigation Significance Score	Pre-Mitigation Significance	Post-Nature	Post-Extent	Post-Duration	Post-Magnitude	Post-Reversibility	Consequence2	Post-Probability	Post-mitigation Significance	Post-Mitigation Significance	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score	Final Significance
1	Biodiversity & Habitat Loss	Indirect loss, disturbance and increase in erosion and sedimentation to the receiving systems	Proposed Project	Operation	Normal operations or events	-1	2	2	2	2	-2	3	-6	Medium to low -	-1	1	1	1	1	-1	2	-2	Low -	High	2	1	1.13	-2.25	Low -
2	Biodiversity & Habitat Loss	Degradation of riparian vegetation and the introduction and spread of alien and invasive vegetation	Proposed Project	Operation	Normal operations or events	-1	2	2	2	2	-2	3	-6	Medium to low -	-1	2	1	2	2	-1.75	2	-3.5	Low -	High	2	1	1.13	-3.94	Low -
3	Water Resources & Drainage	Impaired water quality due to accidental hydrocarbon spill	Proposed Project	Operation	Normal operations or events	-1	2	2	2	2	-2	3	-6	Medium to low -	-1	2	1	2	2	-1.75	2	-3.5	Low -	High	2	1	1.13	-3.94	Low -

7.2 Appendix B – Specialist Declaration of Independence

I, Innocent Makwela, declare that:

- I act as the independent specialist in this application;
- 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 in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Innocent Makwela

Aquatic Ecologist

The Biodiversity Company

February 2026

I, Khethokuhle Hlatshwayo, declare that:

- I act as the independent specialist in this application;
- 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 in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Khethokuhle Hlatshwayo

Aquatic Ecologist

The Biodiversity Company

February 2026

I, Prasheen Singh, declare that:

- I act as the independent specialist in this application;
- 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 in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Prasheen Singh

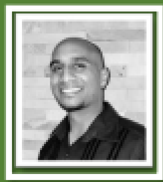
Aquatic Ecologist

The Biodiversity Company

February 2026

7.3 Appendix B – Specialist CVs

Prasheen SINGH



Pr. Sci. Nat. 116822 +27 69 206 9440 prasheen@thebiodiversitycompany.com

PROFILE SUMMARY

Prasheen Singh is a SACNASP registered Pr. Sci. Nat in the field of Aquatic Science. He is an Aquatic Ecologist and Water Quality Specialist whose 14 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 has working experience in South Africa, Angola, Zambia and Lesotho, specialising in water quality studies, aquatic biomonitoring, compliance audits, rehabilitation and monitoring plans and risk assessments.

PERSONAL INFO

Nationality: South African

Date of birth: 25 April 1989

EXPERIENCE

- Environmental Consulting and Specialist Studies
- Freshwater Aquatic Ecological and Functional Assessments (NEMA, DWS, IFC)
- Aquatic Biomonitoring Assessments
- River EcoStatus (IHI, MIRAI, VEGRAI, FRAI)
- Water and Sediment Quality

SKILLS

- ✓ Freshwater Ecology Assessments
- ✓ Critical Habitat Assessments
- ✓ Rehabilitation, Monitoring & Management Plans
- ✓ GIS and Remote Sensing
- ✓ Compliance and Auditing

LANGUAGES

English – Proficient

Afrikaans – Basic

ACADEMIC QUALIFICATIONS

University of Johannesburg (2014): MAGISTER SCIENTIAE (MSc) - Aquatic Health:
Title: *The assessment of sediment contamination in an acid mine drainage impacted river in Gauteng (South Africa) using three sediment bioassays.*

University of Johannesburg (2011): BACCALAUREUS SCIENTIAE CUM HONORIBUS (Hons) – Biodiversity and Conservation.

University of Johannesburg (2010): BACCALAUREUS SCIENTIAE – Botany and Zoology.

PROFESSIONAL EXPERIENCE

Nov 2022 – Present	**The Biodiversity Company** Aquatic Ecologist / Unit Manager
Feb 2016 – Oct 2022	**Prism EMS** Aquatic Ecologist
May 2012 – Jan 2016	**WSP Golder** Laboratory Scientist

INTERNATIONAL EXPERIENCE

Angola, Lesotho, Zambia, South Africa

PUBLICATIONS

Singh, P., Nel, A. and Durand, J.F. 2017. The use of bioassays to assess the toxicity of sediment in an acid mine drainage impacted river in Gauteng (South Africa). Water SA 43:4.

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Signed: Prasheen Singh

CURRICULUM VITAE: Prasheen Singh