

ICHTHYOFAUNA IMPACT ASSESSMENT REPORT

Proposed Blikana Dam Bulk Water Supply Scheme within the Joe Gqabi District Municipality, Eastern Cape.



Report Prepared For

Abantu Environmental Services



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Executive Summary

This report presents the findings of an Ichthyofauna Impact Assessment undertaken for the proposed Blikana Dam Bulk Water Supply Scheme within the Joe Gqabi District Municipality, Eastern Cape. The proposed scheme is intended to improve bulk water supply to communities within Wards 2, 3, 4, 5 and 6 of the Senqu Local Municipality through the development of a dam, abstraction infrastructure, pick-up weir, water treatment works, reservoirs and associated rising and gravity mains. From an ichthyofauna perspective, the most relevant project components are the proposed dam, abstraction point C-B1, pick-up weir at C-B2, pipeline river crossings, infrastructure located close to the Blikana River and construction or operational areas that may create sediment, erosion or pollution pathways into fish-supporting habitat.

The purpose of this assessment is to provide a fish-focused evaluation of the potential effects of the proposed development on freshwater fish species, fish habitat, fish movement, river connectivity and fish-related ecological functioning. The assessment was undertaken as a standalone specialist report and is limited to ichthyofauna only. It does not replace the broader aquatic biodiversity assessment and does not assess wetlands, macroinvertebrates, riparian vegetation or terrestrial biodiversity except where these features directly influence fish habitat, flow, water quality or connectivity.

The ichthyofauna assessment was undertaken using desktop review, field-based fish habitat assessment, visual observation, basic non-destructive fish sampling where conditions allowed, interpretation of available fish information and professional judgement. No electroshocking, gill netting, fish poisoning or destructive fish sampling methods were used. The assessment was therefore a fish-focused ecological risk assessment rather than a quantitative fish population survey. The methodology considered fish habitat features such as pools, riffles, runs, marginal vegetation, substrate, cover, refuge habitat, flow diversity and channel connectivity.

The Blikana River occurs within the Upper Orange / Orange–Senqu catchment context and is associated with the D18K and D18L quaternary catchments. Desktop information indicates that the Blikana River is a perennial system with ecological importance and sensitivity linked to flow, connectivity, instream habitat condition and fish assemblages. The Blikana BWSS project area is also located within the Eastern Cape Drakensberg Strategic Water Source Area, which provides important broader catchment context for water resource protection and management.

The desktop-estimated fish assemblage for the Blikana River includes rock-catfish (*Austroglanis sclateri*), smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Barbus anoplus* / *Enteromius anoplus*), all listed as Least Concern. During the ichthyofauna assessment, smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*) were observed and recorded in the Blikana River. The presence of these species confirms that the river supports indigenous fish and provides functional fish-supporting habitat.

Fish habitat in the Blikana River is associated with pools, runs, riffles, marginal vegetation, substrate diversity, refuge areas and longitudinal connectivity. These features are important for fish movement, feeding, shelter, refuge during low-flow periods and maintenance of indigenous fish assemblages. Although the system is subject to localised disturbance pressures such as erosion, grazing, road crossings and rural land-use impacts, it remains a functional fish-supporting river system.

The Fish Response Assessment Index was used as a guiding framework to interpret the ecological integrity of the fish assemblage. Based on the recorded presence of *Labeobarbus aeneus* and *Enteromius anoplus*, the absence of a fuller expected assemblage and the presence of localised disturbance pressures, the fish community of the Blikana River is interpreted as broadly consistent with Ecological Category C: Moderately Modified. This indicates that the system remains ecologically functional and continues to support indigenous fish, but that the fish assemblage has been modified from natural reference condition.

The overall ichthyofaunal sensitivity of the Blikana River is considered Moderate. This rating reflects the confirmed presence of indigenous fish species and functional fish habitat, while also recognising that no threatened fish species were confirmed, the desktop-estimated fish assemblage consists of Least Concern species, and the fish community is already moderately modified. However, localised areas associated with the active river channel, deeper pools, riffle-run habitats, the proposed dam, pick-up weir, abstraction infrastructure and river crossings should be treated as higher-risk fish habitat interaction zones.

The main construction-phase impacts identified are sedimentation and increased turbidity affecting fish habitat, construction-related water quality deterioration affecting fish, and temporary disturbance of fish habitat and fish movement. With implementation of the recommended mitigation measures, including erosion and sediment controls, pollution prevention, footprint control, no-go area demarcation, rehabilitation and flow continuity during in-channel works, these impacts are expected to reduce to Very Low negative significance.

The main operational-phase impacts are altered flow regime affecting downstream fish habitat, and barrier effects combined with conversion of riverine habitat to impounded or modified habitat. These impacts are linked to the proposed dam, pick-up weir and abstraction infrastructure. With implementation of ecological flow requirements, controlled abstraction, fish-sensitive design considerations, maintenance of wetted downstream connectivity, prevention of alien or extralimital fish stocking and operational monitoring, these impacts are expected to reduce to Low negative significance.

The preferred WTW site is considered more favourable from an ichthyofauna risk perspective where it has lower potential for direct hydrological connectivity to drainage features and the Blikana River. The WTW alternatives are relevant mainly through indirect impact pathways such as sediment-laden runoff, chemical spills, contaminated stormwater, sludge or process water mismanagement and erosion reaching fish-supporting habitat.

Overall, no fatal flaw was identified from an ichthyofauna perspective. The proposed Blikana BWSS may be acceptable from a fish ecology perspective, provided that the recommended mitigation, ecological flow management, buffer controls, sediment and erosion controls, water quality management measures, fish-sensitive design considerations and monitoring requirements are implemented. Particular attention must be given to infrastructure located in or near the Blikana River, including the proposed dam, abstraction infrastructure, pick-up weir and river crossings.

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Disclaimer

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Opinions presented in this report apply to the site conditions and features as they existed at the time of investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which Earthguard had no prior knowledge nor had the opportunity to evaluate. Therefore, the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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Definition of Terms

Abstraction: The removal of water from a watercourse, dam, weir or other water resource for use. **Alien fish species:** Fish species that do not occur naturally within a particular river system and have been introduced either intentionally or accidentally. Alien fish may affect indigenous fish through predation, competition, disease transfer, habitat alteration or disruption of natural food webs.

Aquatic biodiversity: The variety of living organisms associated with aquatic ecosystems, including fish, aquatic macroinvertebrates, aquatic plants, amphibians, algae and microorganisms, as well as the habitats and ecological processes that support them.

Aquatic buffer: A setback area around a river, stream, wetland or other aquatic feature within which development activities should be avoided or strictly controlled to reduce impacts such as sedimentation, erosion, pollution and habitat disturbance.

Barrier effect: The obstruction or restriction of fish movement along a river system, usually caused by structures such as dams, weirs, culverts, causeways or poorly designed crossings. Barrier effects may prevent fish from accessing feeding, breeding, refuge or recolonisation habitats.

Biodiversity: The variety of living organisms, including diversity within species, between species and of ecosystems. In this report, biodiversity is considered only where it relates directly to fish species and fish habitat.

Connectivity: The degree to which different parts of a river system are physically and ecologically linked. For fish, connectivity is important because it allows movement between habitats used for feeding, breeding, refuge and recolonisation after disturbance.

Cumulative impact: The combined effect of the proposed development together with existing and reasonably foreseeable future activities in the catchment.

Ecological Category: A classification used to describe the present ecological condition of a river or biological component relative to natural or reference conditions.

Ecological flow: The quantity, timing and quality of water flows required to sustain aquatic ecosystems and the species that depend on them. For fish, ecological flows are important for maintaining habitat depth, water velocity, connectivity, spawning cues, refuge pools and downstream ecological functioning.

Ecological Importance and Sensitivity: A measure of the importance of an ecosystem for maintaining ecological processes, biodiversity and species of conservation importance, as well as its sensitivity to disturbance. In an ichthyofauna context, this includes the importance and sensitivity of fish habitat, movement corridors and flow-dependent habitats.

Entrainment: The unintentional drawing of fish, fish eggs or larvae into abstraction infrastructure, pumps, intakes or pipelines. Entrainment risk is relevant where abstraction infrastructure is placed in rivers, weirs or dams without suitable screening or fish-sensitive design.

Fish assemblage: The group of fish species occurring within a particular river reach or habitat. The composition of the assemblage provides an indication of habitat condition, water quality, connectivity and ecological integrity.

Fish habitat: The physical and chemical environment required by fish for survival, feeding, shelter, spawning and movement. Fish habitat may include pools, riffles, runs, marginal vegetation, undercut banks, bedrock, cobbles, gravel, woody material, flow diversity and suitable water quality.

Fish passage: The ability of fish to move past natural or artificial barriers in a river system.

Fish Response Assessment Index: A biomonitoring and assessment tool used to interpret the ecological condition of a river based on the response of fish assemblages to changes in habitat, flow, water quality and connectivity.

Flow alteration: A change in the natural flow pattern of a river caused by abstraction, impoundment, flow regulation, diversion or catchment modification. Flow alteration can affect fish habitat availability, spawning cues, migration, water temperature, sediment transport and downstream habitat condition.

Fragmentation: The division of a previously connected river system into isolated sections, often caused by dams, weirs, culverts or other barriers. Fragmentation can reduce genetic exchange, limit recolonisation and restrict access to important habitats.

Habitat integrity:

The degree to which the physical structure, ecological processes and biological functioning of a habitat remain intact. For fish, habitat integrity is influenced by channel condition, flow diversity, substrate quality, cover, water quality, riparian condition and connectivity.

Ichthyofauna: Freshwater fish species occurring or expected to occur within a watercourse or aquatic system.

Indigenous fish species: Fish species that occur naturally within a particular river system or region.

Instream habitat: Habitat located within the active river channel, including flowing water, pools, riffles, runs, bed substrates, aquatic vegetation, marginal cover and channel features used by fish and other aquatic organisms.

Instream works: Construction or operational activities that take place within the active river channel or directly affect the channel bed, banks or flow.

Lotic habitat: Flowing-water habitat such as rivers and streams. Many indigenous river fish depend on lotic habitat for feeding, movement, spawning and maintaining healthy populations.

Lentic habitat: Still or slow-moving water habitat such as dams, reservoirs and impoundments. The proposed dam may convert a section of riverine lotic habitat into lentic habitat, which may favour different fish species and alter the natural fish assemblage.

Migration: The movement of fish between different habitats or river reaches. Migration may be seasonal or local and can be linked to feeding, spawning, refuge-seeking or recolonisation after disturbance.

Mitigation: Measures designed to avoid, reduce, rehabilitate or manage negative environmental impacts.

Perennial river: A river or stream that flows throughout most or all of the year under natural conditions.

Pool: A deeper, slower-flowing section of a river that often provides important refuge habitat for fish, particularly during low-flow periods or drought.

Reach: A defined section of a river with relatively similar physical, hydrological or ecological characteristics. Impact assessment is often undertaken at reach scale because fish habitat and connectivity extend beyond individual infrastructure footprints.

Refuge habitat: Habitat that allows fish to survive during stressful conditions such as drought, low flow, high turbidity, floods or temporary disturbance. Pools, undercut banks, marginal vegetation and deeper flowing sections may function as refuge habitats.

Riffle: A shallow, fast-flowing section of a river with coarse substrate such as gravel, cobble or stones. Riffles are often important for oxygenation, feeding and spawning habitat, depending on the fish species present.

Riparian habitat: The habitat along the banks of a river or stream that links terrestrial and aquatic environments.

Run: A flowing section of river with moderate depth and relatively uniform current. Runs can provide movement and feeding habitat for fish and often connect pools and riffles.

Sedimentation: The deposition of soil, sand, silt or other fine material into a watercourse. Sedimentation can smother fish eggs, reduce habitat quality, fill pools, cover gravel and cobble substrates and reduce feeding efficiency.

Sensitivity: The degree to which fish species or fish habitat may be affected by disturbance.

Spawning habitat: Habitat used by fish for breeding and egg deposition. Depending on the species, spawning habitat may include gravel beds, cobble riffles, marginal vegetation, shallow runs or protected pool margins.

Turbidity: The cloudiness of water caused by suspended particles such as silt, clay, organic matter or disturbed sediment.

Watercourse: A river, stream, wetland, natural channel or other water resource in which water flows either permanently or intermittently.

Water quality: The physical, chemical and biological condition of water.

Weir: A low barrier constructed across a river to raise water level or facilitate abstraction. Weirs can affect fish by altering flow, changing habitat conditions and creating barriers to movement.

List of Abbreviations

| Abbreviation | Meaning |
|---------------------|---|
| BAR | Basic Assessment Report |
| BWSS | Bulk Water Supply Scheme |
| CBA | Critical Biodiversity Area |
| CR | Command Reservoir |
| DFFE | Department of Forestry, Fisheries and the Environment |
| DEDEAT | Department of Economic Development, Environmental Affairs and Tourism |
| DWS | Department of Water and Sanitation |
| EA | Environmental Authorisation |
| EAP | Environmental Assessment Practitioner |
| ECBCP | Eastern Cape Biodiversity Conservation Plan |
| ECO | Environmental Control Officer |
| EIA | Environmental Impact Assessment |
| EIS | Ecological Importance and Sensitivity |
| EMPr | Environmental Management Programme |
| ESA | Ecological Support Area |
| EWR | Ecological Water Requirement |
| FBIS | Freshwater Biodiversity Information System |
| FEPA | Freshwater Ecosystem Priority Area |
| FRAI | Fish Response Assessment Index |
| GA | General Authorisation |
| GIS | Geographic Information System |
| GN | Government Notice |
| GPS | Global Positioning System |
| IHI | Index of Habitat Integrity |
| IUA | Integrated Unit of Analysis |
| IUCN | International Union for Conservation of Nature |
| JGDM | Joe Gqabi District Municipality |
| NEMA | National Environmental Management Act, 1998 |
| NEMBA | National Environmental Management: Biodiversity Act, 2004 |
| NFEPA | National Freshwater Ecosystem Priority Areas |
| NWA | National Water Act, 1998 |
| PAOI | Project Area of Influence |
| PES | Present Ecological State / Present Ecological Status |
| REC | Recommended Ecological Category |
| RQO | Resource Quality Objective |
| SACNASP | South African Council for Natural Scientific Professions |
| SANBI | South African National Biodiversity Institute |
| SASS5 | South African Scoring System Version 5 |
| SCC | Species of Conservation Concern |
| SLM | Senqu Local Municipality |
| SQ | Sub-quadernary |
| SQR | Sub-quadernary Reach |
| SR | Service Reservoir / Storage Reservoir |
| SSV | Site Sensitivity Verification |
| SWSA | Strategic Water Source Area |
| WMA | Water Management Area |
| WQMP | Water Quality Management Plan |
| WTW | Water Treatment Works |
| WUL | Water Use Licence |
| WULA | Water Use Licence Application |

Declaration of Independence

I, **Zona Quvile**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being a member of the general public;
- This document and all information contained herein is and will remain the intellectual property of Earthguard Consulting and the specialist investigator responsible for conducting the study. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- As a registered member of the Environmental Assessment Practitioners Association of South Africa, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on the information provided to me by the project proponent, and in addition to information obtained during this study, have presented the results and conclusion within the associated document to the best of my professional judgement.



2026.04.30

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The details of Specialist are as follows – Mrs Zona Quvile

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- River and fish habitat assessment;
- Ichthyofauna field assessment and fish assemblage interpretation;
- PES, EIS, IHI and FRAI interpretation;
- Watercourse delineation and classification;
- Assessment of impacts associated with dams, weirs, abstraction and river crossings;
- Sedimentation, erosion and water quality risk assessment;
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1 Introduction

Earthguard Consulting (Pty) Ltd was appointed by Abantu Environmental Services to undertake an Ichthyofauna Impact Assessment for the proposed Blikana Dam Bulk Water Supply Scheme (BWSS), located within the Senqu Local Municipality, Joe Gqabi District Municipality, Eastern Cape.

This report has been prepared as a standalone specialist assessment focused specifically on ichthyofauna, namely freshwater fish species, fish habitat, fish movement, ecological connectivity, and fish-related impact pathways associated with the proposed development. Although the report is informed by the broader Aquatic Biodiversity Impact Assessment undertaken for the project, it does not duplicate the full aquatic assessment and does not assess wetlands, aquatic macroinvertebrates, riparian vegetation or general aquatic biodiversity except where these features directly influence fish habitat and fish ecological functioning.

1.1 Project Background

The Joe Gqabi District Municipality (JGDM) is proposing the development of a bulk water supply using the eastern and western tributaries of the Blikana river. The proposed development entails construction of a dam, reservoirs, abstraction points, water treatment works and pipelines to supply water within wards 2, 3, 4, 5 and 6 within Senqu Local Municipality (SLM). The proposed development entails:

- The Blikana river's eastern and western tributaries will supply water for this development
- A dam will be constructed upstream of abstraction point C-B1.
- The required water will be released from the dam and then abstracted from a pick-up weir located at C-B2.
- A water treatment works (WTW) (7.5Mℓ/d) will be constructed downstream of the abstraction point CB2, where water will be treated, stored and pumped to the various reservoirs

The reservoir supply areas and sizes are indicated below:

- Command Reservoir 1 (CR1) (9Mℓ) – Supplies water to Ward 2 and Ward 3 (Northern Portion)
- CR2 (2Mℓ) – Supplies water to Ward 4 (Western Side) & 5
- CR3 (2.5Mℓ) – Supplies water to Ward 4 (Eastern Side)

Pipelines for this option include the following:

- Rising main from WTW to CR1 & SR 1
- Rising main from WTW to Era village, 5164.42m (5.16km) long, 200mm-400mm steel pipe
- Rising main middle portion from Era village through Tlakaneng to Musong village, 2015.97m (2.02km) long, 150mm-400mm steel pipe
- Rising main at Musong tying to SR1, 2048.33m (2.05km) long, 150mm-400mm steel pipe
- Rising main from WTW to CR2, 200mm-400mm steel pipe
- Rising main from WTW to CR3, 200mm-400mm steel pipe
- Rising main from CR3 to Emqheyen village, 6731.99m (6.73km) long, 150mm-400mm steel pipe
- Rising main from WTW to SR2, 7179m long (7.18km), 150mm-400, steel pipe
- Rising main from WTW to SR2, 4064.89m (4.06km) long, 150mm-400mm steel pipe
- Gravity main from Henge village to Magalagaleneni village, 2005.86m (2.01km) long,
- Gravity main from Abstraction point 2, 1101.48m (1.10km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)
- Gravity main from CR2 to Blikana village, 1665.73m (1.67km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)
- Gravity main from CR3 to Ntubeni village, 2837.39m (2.84km) long, 50mm to 400mm pipes (Steel/PVC/HDPE)

1.2 Project Location

The proposed bulk water supply is located in the area of Blikana, within wards 2, 3, 4, 5 and 6 within Senqu Local Municipality (SLM) (Figure 1-1).

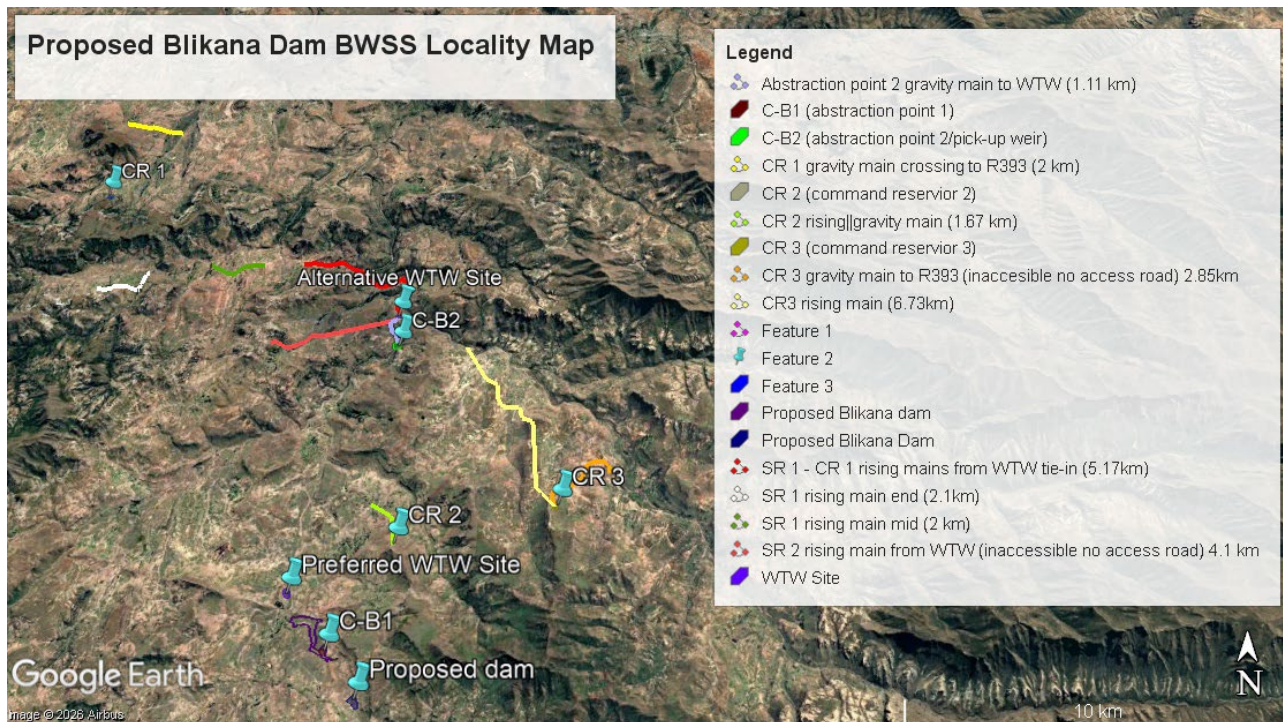


Figure 1-1: Blikana BWSS locality

1.3 Project Description Relevant to Ichthyofauna

The proposed Blikana Dam Bulk Water Supply Scheme involves the development of bulk water supply infrastructure within the Blikana area, Senqu Local Municipality, Eastern Cape. The scheme will utilise water from the eastern and western tributaries of the Blikana River and includes the construction of a dam, abstraction infrastructure, a pick-up weir, water treatment works, reservoirs and associated pipeline infrastructure.

The proposed dam is to be constructed upstream of abstraction point C-B1. Water released from the dam will be abstracted from a pick-up weir located at C-B2. A water treatment works with a design capacity of approximately 7.5 ML/day is proposed downstream of C-B2, from where treated water will be stored and pumped to various command reservoirs serving communities within Wards 2, 3, 4, 5 and 6 of Senqu Local Municipality. From an ichthyofauna perspective, the project components of greatest relevance are those that may directly or indirectly affect fish habitat, river connectivity, flow conditions and water quality. These include:

Table 1-1: Project components relevant to this study

| Project component | Relevance to ichthyofauna |
|--|--|
| Proposed dam | May inundate riverine habitat, alter natural flow patterns, change downstream habitat availability and create a barrier to fish movement. |
| Pick-up weir at C-B2 | May alter local flow, affect fish movement and modify habitat conditions immediately upstream and downstream of the structure. |
| Abstraction infrastructure | May reduce local flow availability, particularly during low-flow periods, and may pose entrainment risk if intake structures are not fish-sensitive. |
| River crossings by pipelines | May disturb the channel bed, riverbanks, pools, riffles, runs and fish movement corridors during construction. |
| Pipelines within or near the aquatic buffer | May increase the risk of sedimentation, erosion and construction disturbance near fish-supporting habitats. |
| Water treatment works | May indirectly affect fish through contaminated runoff, chemical spills, sludge/process water mismanagement or operational stormwater impacts. |
| Access roads, laydown areas and construction camps | May increase sediment and pollution risks if placed too close to the Blikana River or drainage pathways. |

For the purposes of this assessment, the key ichthyofauna impact areas are the proposed dam and associated inundation area, abstraction point C-B1, the pick-up weir at C-B2, river crossings, infrastructure located close to the Blikana River, and any construction areas that may create sediment, erosion or pollution pathways into fish-supporting habitat.

The project therefore has both direct and indirect relevance to ichthyofauna. Direct impacts may occur where infrastructure is located in or immediately adjacent to the river channel, while indirect impacts may occur through altered flow, reduced water quality, increased sedimentation, drainage alteration and cumulative disturbance within the catchment.

1.4 Alternatives Considered

Alternatives for the proposed Blikana Dam Bulk Water Supply Scheme were considered mainly in relation to the location of the Water Treatment Works. The remaining core project components, including the dam, abstraction points, reservoirs and pipeline alignments, are largely influenced by water availability, hydraulic requirements, topography, settlement distribution and constructability.

From an ichthyofauna perspective, the dam, pick-up weir, abstraction infrastructure and river crossings are the most important project components because they may directly affect fish habitat, flow conditions, river connectivity and fish movement. No separate fish-specific alternatives were provided for these components at the time of assessment.

The WTW alternatives are relevant to ichthyofauna mainly through indirect impact pathways. These include the potential for sediment-laden runoff, chemical spills, contaminated stormwater, sludge/process water mismanagement or erosion to reach the Blikana River and affect fish-supporting habitat.

The preferred WTW site is considered more favourable from an aquatic and ichthyofauna risk perspective where it has lower potential for direct hydrological connectivity to drainage features and the Blikana River (Figure 1-2). In contrast, a WTW site associated with drainage lines, dongas or steeper erosion-prone areas

would present a higher indirect risk to fish habitat due to faster movement of sediment or pollutants toward the river.

Accordingly, from an ichthyofauna perspective, the preferred alternative is the option that:

- avoids direct disturbance of the Blikana River channel;
- avoids drainage lines, dongas and erosion-prone areas as far as possible;
- maintains the greatest practical distance from fish-supporting habitat;
- allows effective stormwater, sediment and pollution control;
- minimises river crossing disturbance; and
- reduces the risk of contaminated runoff reaching the river.

The final design should continue to apply the mitigation hierarchy by avoiding fish-supporting habitats where possible, minimising unavoidable disturbance, rehabilitating disturbed areas, and maintaining ecological flow and connectivity requirements.

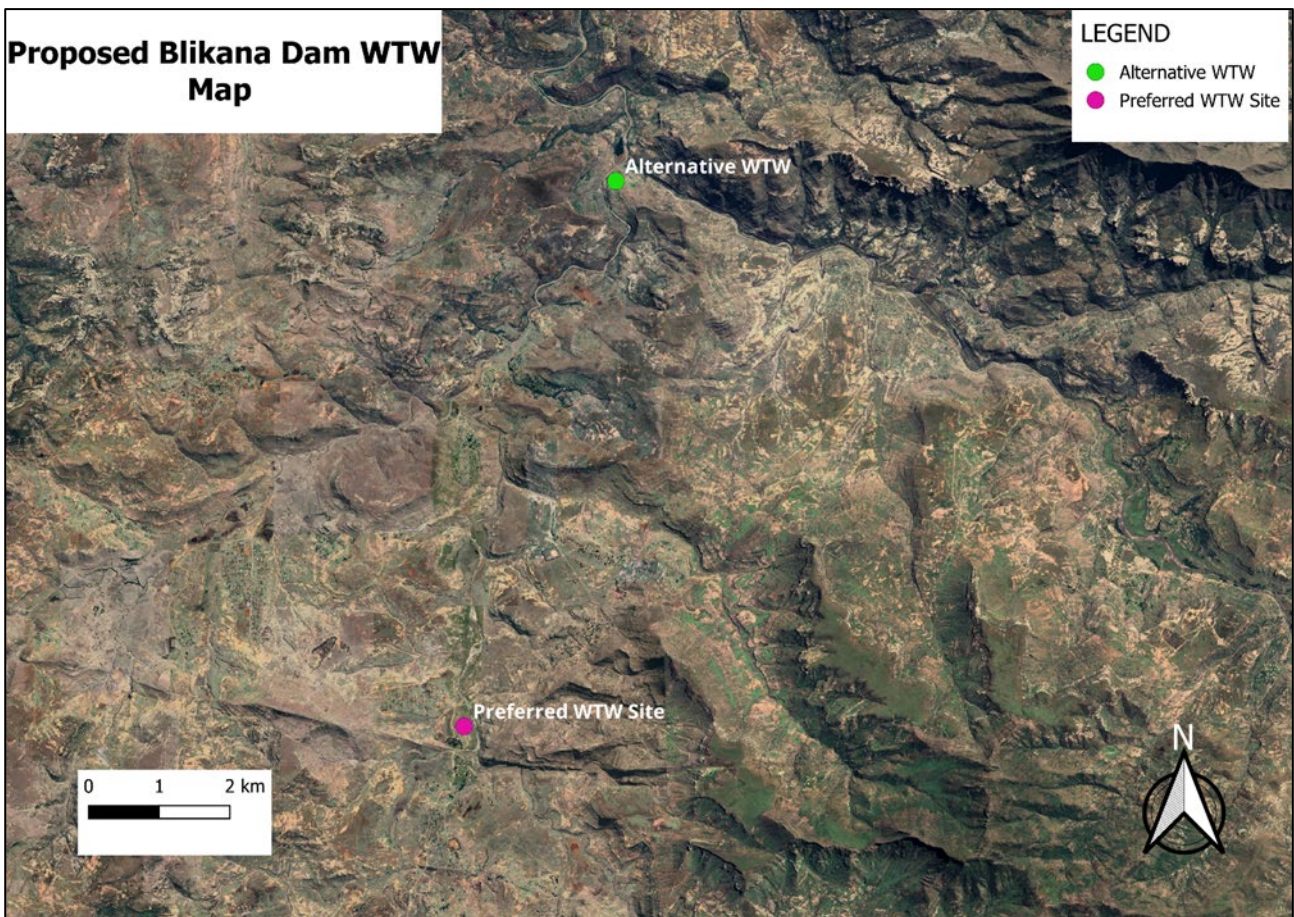


Figure 1-2: Project alternatives

1.5 Purpose and Objectives of the Assessment

The purpose of this Ichthyofauna Impact Assessment is to assess the potential impacts of the proposed Blikana Dam Bulk Water Supply Scheme on freshwater fish species, fish habitat, fish movement and river connectivity within the Blikana River system. The assessment provides a fish-focused evaluation of the proposed development and identifies measures required to avoid, minimise and manage impacts on ichthyofauna during the construction and operational phases of the project.

The specific objectives of the assessment are to:

- describe the ichthyofaunal context of the Blikana River system;
- identify fish habitat features that may be affected by the proposed development;
- consider fish species recorded or likely to occur within the affected river system;
- assess the sensitivity of fish habitat associated with the proposed dam, abstraction point, pick-up weir, river crossings and pipeline sections near watercourses;
- identify potential impacts on fish species, fish habitat, fish movement and ecological connectivity;
- assess construction-phase and operational-phase impacts from an ichthyofauna perspective;
- recommend mitigation measures to reduce impacts on fish and fish habitat;
- recommend monitoring and management actions for inclusion in the EMPr and water-use authorisation conditions, where relevant; and
- provide a specialist opinion on the acceptability of the proposed development from an ichthyofauna perspective.

The assessment is intended to support environmental decision-making by identifying fish-related risks early and ensuring that the proposed development is planned, constructed and operated in a manner that maintains aquatic ecological functioning as far as reasonably practicable.

1.6 Scope of Assessment

This report is a standalone ichthyofauna assessment and is limited to fish species, fish habitat and fish-related ecological processes associated with the Blikana River system. The assessment focuses on project components that may affect fish directly or indirectly, particularly the proposed dam, abstraction infrastructure, pick-up weir, river crossings, pipelines located near watercourses, and operational areas that may influence water quality or flow conditions. The scope of the assessment includes:

- freshwater fish species recorded or likely to occur within the Blikana River system;
- fish habitat features, including pools, riffles, runs, marginal vegetation, substrate, cover and refuge areas;
- river connectivity and potential fish movement pathways;
- flow-related habitat requirements for fish;
- potential barrier effects associated with the proposed dam, pick-up weir and other instream structures;
- potential construction-phase impacts on fish habitat, including sedimentation, turbidity, erosion, instream disturbance and water quality deterioration;
- potential operational-phase impacts associated with altered flow, abstraction, impoundment, barrier effects, water quality risks and alien fish establishment;
- sensitivity of fish-supporting habitats within and downstream of the project footprint;
- mitigation measures required to reduce impacts on fish species and fish habitat; and
- monitoring requirements for construction and operational phases.

This assessment does not include a full aquatic biodiversity assessment, wetland delineation, macroinvertebrate assessment, riparian vegetation assessment, terrestrial biodiversity assessment or detailed hydrological modelling. These components are addressed separately where relevant. However, where features such as riparian vegetation, flow regime, water quality, sedimentation and channel condition directly influence fish habitat, they are considered in this report from an ichthyofauna perspective.

The report is therefore intended to provide a focused assessment of the potential effects of the proposed BWSS on fish and fish habitat, rather than a broader assessment of all aquatic ecological receptors.

1.7 Terms of Reference

The Terms of Reference for this standalone Ichthyofauna Impact Assessment are to:

- review available project information relevant to the proposed Blikana Dam Bulk Water Supply Scheme;
- review available aquatic biodiversity information relating to ichthyofauna and fish habitat within the Blikana River system;
- describe the fish-related receiving environment associated with the proposed project area;
- identify fish species recorded or likely to occur within the affected river reaches;
- describe fish habitat features, including pools, riffles, runs, substrate, marginal vegetation, cover, refuge habitat and connectivity;
- assess the sensitivity of fish habitat associated with the proposed dam, abstraction point, pick-up weir, river crossings and nearby pipeline infrastructure;
- identify potential construction-phase impacts on fish species and fish habitat;
- identify potential operational-phase impacts associated with flow alteration, impoundment, abstraction, barrier effects, water quality deterioration and alien fish risk;
- assess the significance of identified impacts before and after mitigation;
- identify cumulative impacts on ichthyofauna within the Blikana River system;
- recommend mitigation measures to avoid, minimise and manage impacts on fish and fish habitat;
- recommend monitoring measures for construction and operational phases; and
- provide a specialist opinion on the acceptability of the proposed development from an ichthyofauna perspective.

The assessment is based on available information, field-based habitat observations, fish habitat suitability interpretation and professional judgement. It is intended to support the Environmental Authorisation, Water Use Licence Application and Environmental Management Programme processes for the proposed BWSS.

2 Legislative and Policy Context

The proposed Blikana Dam Bulk Water Supply Scheme must be considered within the South African environmental and water resource management framework. From an ichthyofauna perspective, the most relevant legislation and policy instruments are those that regulate the protection of aquatic ecosystems, watercourses, water quality, ecological functioning, biodiversity, and water-use activities.

Table 2-1: Legislative and Policy Context

| Legislation / policy / guideline | Relevance to the ichthyofauna assessment |
|--|--|
| National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended | Provides the overarching framework for environmental management and sustainable development. Relevant to this assessment because the proposed BWSS may affect fish-supporting aquatic habitat through instream works, abstraction, flow alteration, sedimentation, water quality deterioration and disturbance of riverine habitat. |
| Environmental Impact Assessment Regulations, 2014, as amended | Regulate listed activities requiring Environmental Authorisation and require assessment of potential impacts on sensitive environmental features. Relevant because the project includes infrastructure located near or within watercourses, including the proposed dam, pick-up weir, abstraction infrastructure and river crossings. |
| GN 320 of 2020: Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity | Provides minimum report content requirements for aquatic biodiversity assessments. Although this report is focused specifically on ichthyofauna, fish form part of aquatic biodiversity and the protocol is relevant to impact identification, mitigation, monitoring and specialist opinion. |
| National Water Act, 1998 (Act No. 36 of 1998) | Provides for the protection, use, development, conservation and management of water resources. Relevant because fish habitat depends on suitable flow, water quality, channel condition and ecological connectivity. The project may involve water uses associated with abstraction, instream structures, river crossings and works within or near watercourses. |
| Section 21 of the National Water Act | Regulates water uses, including taking water from a water resource, impeding or diverting flow, and altering the bed, banks, course or characteristics of a watercourse. Relevant to the proposed dam, abstraction infrastructure, pick-up weir, pipeline crossings and any works affecting the Blikana River system. |
| Section 19 of the National Water Act | Places a duty on landowners and persons in control of land to prevent and remedy pollution of water resources. Relevant to construction and operational risks such as sediment-laden runoff, hydrocarbon spills, chemical spills, cement contamination, sludge/process water mismanagement and contaminated stormwater. |
| National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) | Provides for biodiversity conservation and management of threatened, protected and alien invasive species. Relevant where indigenous fish species, species of conservation concern or alien invasive fish may occur within the Blikana River system. |
| Alien and Invasive Species Regulations | Relevant to preventing the introduction, spread or stocking of alien fish species in the proposed dam, weir pool or modified aquatic habitats. Alien fish can affect indigenous fish through predation, competition, habitat alteration and disease transfer. |
| National Freshwater Ecosystem Priority Areas | Provides freshwater biodiversity planning information, including priority rivers, fish support areas and freshwater conservation context. Relevant to understanding the ecological importance of the Blikana River system and the need to protect fish-supporting habitats. |
| River EcoClassification approach | Provides a framework for assessing the ecological condition of river systems and biological components. Relevant to interpreting river condition and fish-related ecological responses to habitat, flow and water quality changes. |

| Legislation / policy / guideline | Relevance to the ichthyofauna assessment |
|--|---|
| Fish Response Assessment Index | A fish-based assessment approach used to interpret the ecological condition of river fish assemblages in response to changes in flow, habitat, water quality and connectivity. Relevant to interpreting fish ecological condition and likely fish responses to project impacts. |
| Eastern Cape Biodiversity Conservation Plan | Provides provincial biodiversity planning context, including Critical Biodiversity Areas and Ecological Support Areas. Relevant where these planning layers overlap with watercourses and fish-supporting habitats associated with the proposed BWSS. |
| Water Use Licence / General Authorisation requirements | Relevant where project activities trigger water uses under the National Water Act. Conditions of authorisation should include measures to protect fish habitat, maintain flow continuity, prevent pollution and rehabilitate disturbed watercourse areas. |

3 Approach and Methodology

The Ichthyofauna Impact Assessment was undertaken using a desktop review, site-based fish habitat assessment, visual observation, basic non-destructive fish sampling where conditions allowed, interpretation of available fish information, and professional judgement. The assessment focused on the Blikana River system and project-related interaction points where the proposed BWSS may affect fish species, fish habitat, flow conditions, water quality and river connectivity.

No electroshocking, gill netting, fish poisoning or destructive fish sampling methods were used for this assessment. The assessment was therefore based on non-destructive and habitat-based methods.

Table 3-1: Summary of methodology applied for the ichthyofauna assessment

| Assessment component | Methodology applied |
|-------------------------------------|--|
| Desktop review | Available project information, aquatic biodiversity information, freshwater conservation planning datasets and available fish-related information were reviewed to understand the ichthyofaunal context of the Blikana River system. |
| Review of project components | The proposed dam, abstraction infrastructure, pick-up weir, WTW, reservoirs, rising mains, gravity mains, pipeline crossings and infrastructure near watercourses were reviewed to identify fish-related impact pathways. |
| Fish habitat assessment | Fish habitat features were assessed based on the presence and condition of pools, riffles, runs, marginal vegetation, undercut banks, substrate, flow diversity, cover, refuge habitat and channel connectivity. |
| Visual observation | Visual observation was undertaken where access, water clarity and habitat conditions allowed. This included checking shallow margins, pools, runs and visible refuge areas for fish activity. |
| Basic non-destructive fish sampling | Where safe and practical, hand-held dip nets or scoop nets may be used in shallow marginal habitats, small pools and slow-flowing areas to capture fish briefly for identification. Captured fish should be kept in water as far as possible, handled with wet hands or soft nets, identified quickly, photographed where necessary, and released immediately at the point of capture. |
| Habitat suitability interpretation | The suitability of available habitat for indigenous fish was interpreted using observed habitat features, flow conditions, substrate, cover, refuge availability and connectivity. |
| River connectivity assessment | The assessment considered whether project components could affect fish movement along the river, including potential barrier effects associated with the proposed dam, pick-up weir, crossings and low-flow conditions. |
| Flow-related assessment | The potential influence of abstraction, impoundment and flow regulation on fish habitat availability, movement, refuge pools and downstream habitat condition was considered. |
| Water quality risk assessment | Potential risks to fish from sedimentation, turbidity, hydrocarbons, chemicals, cement wash water, sludge/process water and contaminated stormwater were assessed. |
| Impact assessment | Potential construction and operational impacts were identified and assessed before and after mitigation, with emphasis on fish habitat, movement, connectivity, flow and water quality. |
| Mitigation and monitoring | Practical mitigation and monitoring measures were developed to avoid, minimise and manage impacts on fish species and fish habitat. |

The assessment was not a quantitative fish population survey. It was a fish-focused ecological risk assessment based on available information, field-based habitat observations, visual observation, basic non-destructive fish sampling where suitable, fish habitat suitability, and the likely response of fish to project-related disturbance.

A precautionary approach was applied where uncertainty existed, particularly in relation to species detectability, seasonal flow variability, final engineering design, ecological flow requirements and the long-term operation of the dam and abstraction infrastructure.

3.1 Assumptions, Limitations and Gaps in Knowledge

This Ichthyofauna Impact Assessment was prepared using available project information, desktop data, field-based habitat observations, visual observations, basic non-destructive fish assessment methods where

practical, and professional judgement. The findings and recommendations are therefore subject to the assumptions, limitations and gaps in knowledge outlined below.

- The assessment is based on the project information available at the time of reporting. Any material changes to the final layout, dam design, abstraction infrastructure, pipeline crossings, construction methodology or operational regime may require this assessment to be reviewed and updated.
- The assessment focused specifically on ichthyofauna and fish-related ecological processes. Wetlands, macroinvertebrates, riparian vegetation, terrestrial biodiversity and broader aquatic biodiversity aspects were not assessed in detail except where they directly influence fish habitat, water quality, flow or river connectivity.
- No electroshocking, gill netting, fish poisoning or destructive fish sampling methods were used. The assessment was based on desktop information, visual observation, fish habitat assessment, habitat suitability interpretation and basic non-destructive fish sampling where conditions allowed.
- Basic fish sampling using hand-held dip nets or scoop nets is limited by water depth, flow velocity, turbidity, access, fish behaviour and habitat complexity.
- The absence of a fish species during field observation or basic sampling must not be interpreted as confirmed absence from the river system. Fish detectability varies according to season, flow conditions, time of day, habitat type, water clarity and sampling effort.
- The assessment was not a quantitative fish population survey and did not estimate fish abundance, population structure, recruitment success or long-term population trends.
- Fish habitat condition was assessed using observable habitat indicators such as pools, riffles, runs, substrate, marginal vegetation, cover, refuge areas, flow diversity, erosion, sedimentation and channel connectivity.
- The assessment assumes that fish habitat in the Blikana River is influenced by natural seasonal flow variability, and that habitat availability may differ between low-flow and higher-flow periods.
- The final ecological flow requirements for the proposed dam and abstraction infrastructure were not available at the time of assessment. This limits the certainty with which long-term operational impacts on fish habitat, movement and downstream connectivity can be predicted.
- Desktop fish records and freshwater planning datasets are useful for understanding regional context but may be incomplete or mapped at a broad scale. Site-specific interpretation was therefore applied where relevant.
- Impact significance ratings assume that the mitigation measures recommended in this report will be implemented effectively. Residual impacts may increase if mitigation measures are not implemented, if construction deviates from approved methods, or if operational management is poor.
- The assessment was undertaken as a specialist environmental impact assessment and does not replace detailed ecological flow modelling, hydraulic modelling, fish passage engineering design, or long-term biomonitoring

3.2 Impact Assessment Framework and Methodology

The impacts that may result from the planning and design phase, construction phase, operation phase of the proposed development were assessed according to several criteria to arrive at an overall significance rating. The criteria used were as follows (based on DEAT 2002 - Impact Significance, IEM Information Series 5; and DEAT 2006 - Assessment of Alternatives and Impacts in support of the EIA Regulations, IEM Guideline Series 5) (Table 3-3):

Table 3-3: Criteria used in determining significance ratings to potential impacts

| ASPECT | IMPACT RATING | | | | | | | | | | | | |
|-----------------------------|---|-------------|---|------------|-----------------------|--|---|-----------------------|--|------------------------|--------------|---|---|
| Status of the Impact | A statement of whether the impact is positive (a benefit), negative (a cost), or neutral | | | | | | | | | | | | |
| Direct impact | Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable. | | | | | | | | | | | | |
| Indirect Impacts | Indirect impacts are not a direct result of the project but are often produced away from or because of a complex impact pathway related to the project. | | | | | | | | | | | | |
| Cumulative Impacts | Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of the past, present, or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts. | | | | | | | | | | | | |
| Nature of the Impact | The evaluation of the nature is impact specific. Most negative impacts will remain negative, however, after mitigation, significance should reduce to: <ul style="list-style-type: none"> • Positive • Negative | | | | | | | | | | | | |
| Extent | A description of whether the impact would occur on a scale limited to within the study area (local), limited to within 5 km of the study area (area) on a regional scale. i.e. the Chris Hani District Municipality & Eastern Cape (Region); or would occur on a national or international scale. <table border="1" data-bbox="432 853 1094 1016"> <tr> <td>Local</td> <td>1</td> </tr> <tr> <td>Area</td> <td>2</td> </tr> <tr> <td>Regional</td> <td>3</td> </tr> <tr> <td>National</td> <td>4</td> </tr> <tr> <td>International</td> <td>5</td> </tr> </table> | Local | 1 | Area | 2 | Regional | 3 | National | 4 | International | 5 | | |
| Local | 1 | | | | | | | | | | | | |
| Area | 2 | | | | | | | | | | | | |
| Regional | 3 | | | | | | | | | | | | |
| National | 4 | | | | | | | | | | | | |
| International | 5 | | | | | | | | | | | | |
| Duration | A prediction of whether the duration of the impact would be immediate and once-off (less than one month), more than once, but short term (less than one year), regular, medium term (1 to 5 years), long term (6 to 15 years), project life/permanent (> 15 years, with the impact ceasing after the operational life of the development or should be considered as permanent). <table border="1" data-bbox="432 1178 1094 1344"> <tr> <td>Immediately</td> <td>1</td> </tr> <tr> <td>Short term</td> <td>2</td> </tr> <tr> <td>Medium term</td> <td>3</td> </tr> <tr> <td>Long term</td> <td>4</td> </tr> <tr> <td>Project life/permanent</td> <td>5</td> </tr> </table> | Immediately | 1 | Short term | 2 | Medium term | 3 | Long term | 4 | Project life/permanent | 5 | | |
| Immediately | 1 | | | | | | | | | | | | |
| Short term | 2 | | | | | | | | | | | | |
| Medium term | 3 | | | | | | | | | | | | |
| Long term | 4 | | | | | | | | | | | | |
| Project life/permanent | 5 | | | | | | | | | | | | |
| Intensity | This provides an order of magnitude of whether or not the intensity (magnitude/size/frequency) of the impact would be negligible, low, medium, high or very high. This is based on the following aspects: <ul style="list-style-type: none"> • An assessment of the reversibility of the impact (permanent loss of resources, or impact is reversible after project life) • Whether or not the aspect is controversial • An assessment of the • The level of alteration to the natural system, process or systems. <table border="1" data-bbox="432 1630 1382 1984"> <tr> <td>Negligible</td> <td>The impact does not affect physical, biophysical or socio-economic functions and processes.</td> <td>1</td> </tr> <tr> <td>Low/potential harmful</td> <td>The impact has limited impacts on physical, biophysical or socio-economic functions and processes.</td> <td>2</td> </tr> <tr> <td>Medium/slight harmful</td> <td>The impact has an effect on physical, biophysical or socio-economic functions and processes, but in such a way that these processes can still continue to function albeit in a modified fashion.</td> <td>3</td> </tr> <tr> <td>High/harmful</td> <td>Where the physical, biophysical or socio-economic functions and processes are impacted on in such a way as to cause them to temporarily or permanently cease.</td> <td>4</td> </tr> </table> | Negligible | The impact does not affect physical, biophysical or socio-economic functions and processes. | 1 | Low/potential harmful | The impact has limited impacts on physical, biophysical or socio-economic functions and processes. | 2 | Medium/slight harmful | The impact has an effect on physical, biophysical or socio-economic functions and processes, but in such a way that these processes can still continue to function albeit in a modified fashion. | 3 | High/harmful | Where the physical, biophysical or socio-economic functions and processes are impacted on in such a way as to cause them to temporarily or permanently cease. | 4 |
| Negligible | The impact does not affect physical, biophysical or socio-economic functions and processes. | 1 | | | | | | | | | | | |
| Low/potential harmful | The impact has limited impacts on physical, biophysical or socio-economic functions and processes. | 2 | | | | | | | | | | | |
| Medium/slight harmful | The impact has an effect on physical, biophysical or socio-economic functions and processes, but in such a way that these processes can still continue to function albeit in a modified fashion. | 3 | | | | | | | | | | | |
| High/harmful | Where the physical, biophysical or socio-economic functions and processes are impacted on in such a way as to cause them to temporarily or permanently cease. | 4 | | | | | | | | | | | |

| ASPECT | IMPACT RATING | | | | | | | | | | | | | | | | | |
|--|--|---|---|-----------------|--|---|------------|--|---|----------|--|---|----------------|--|---|------------|--|---|
| | Very high/disastrous | Where the physical, biophysical or socio-economic functions and processes are highly impacted on in such a way as to cause them to permanently cease. | 5 | | | | | | | | | | | | | | | |
| Frequency | <p>This provides a description of any repetitive, continuous or time-linked characteristics of the impact: Once-off (occurring any time during construction or operation); intermittent (occurring from time to time, without specific periodicity); periodic (occurring at more or less regular intervals); continuous (without interruption).</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Once-off</td> <td style="width: 33%;">Once</td> <td style="width: 33%;">1</td> </tr> <tr> <td>Rare</td> <td>1/5 to 1/10 years</td> <td>2</td> </tr> <tr> <td>Frequent</td> <td>Once a year</td> <td>3</td> </tr> <tr> <td>Very frequent</td> <td>Once a month</td> <td>4</td> </tr> <tr> <td>Continuous</td> <td>≥Once a day/per shift</td> <td>5</td> </tr> </table> | | | Once-off | Once | 1 | Rare | 1/5 to 1/10 years | 2 | Frequent | Once a year | 3 | Very frequent | Once a month | 4 | Continuous | ≥Once a day/per shift | 5 |
| Once-off | Once | 1 | | | | | | | | | | | | | | | | |
| Rare | 1/5 to 1/10 years | 2 | | | | | | | | | | | | | | | | |
| Frequent | Once a year | 3 | | | | | | | | | | | | | | | | |
| Very frequent | Once a month | 4 | | | | | | | | | | | | | | | | |
| Continuous | ≥Once a day/per shift | 5 | | | | | | | | | | | | | | | | |
| Probability of occurrence | <p>A description of the chance that consequences of that selected level of severity could occur during the exposure.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">Highly unlikely</td> <td style="width: 60%;">The probability of the impact occurring is highly unlikely due to its design or historic experience.</td> <td style="width: 25%;">1</td> </tr> <tr> <td>Improbable</td> <td>The probability of the impact occurring is low due to its design or historic experience.</td> <td>2</td> </tr> <tr> <td>Probable</td> <td>There is a distinct probability of the impact occurring.</td> <td>3</td> </tr> <tr> <td>Almost certain</td> <td>It is most likely that the impact will occur</td> <td>4</td> </tr> <tr> <td>Definite</td> <td>The impact will occur regardless of any prevention measures.</td> <td>5</td> </tr> </table> | | | Highly unlikely | The probability of the impact occurring is highly unlikely due to its design or historic experience. | 1 | Improbable | The probability of the impact occurring is low due to its design or historic experience. | 2 | Probable | There is a distinct probability of the impact occurring. | 3 | Almost certain | It is most likely that the impact will occur | 4 | Definite | The impact will occur regardless of any prevention measures. | 5 |
| Highly unlikely | The probability of the impact occurring is highly unlikely due to its design or historic experience. | 1 | | | | | | | | | | | | | | | | |
| Improbable | The probability of the impact occurring is low due to its design or historic experience. | 2 | | | | | | | | | | | | | | | | |
| Probable | There is a distinct probability of the impact occurring. | 3 | | | | | | | | | | | | | | | | |
| Almost certain | It is most likely that the impact will occur | 4 | | | | | | | | | | | | | | | | |
| Definite | The impact will occur regardless of any prevention measures. | 5 | | | | | | | | | | | | | | | | |
| Incidence (frequency + probability) | | | | | | | | | | | | | | | | | | |
| Risk rating | <p>The risk rating is calculated based on input from the above assessments. The incidence of occurrence is calculated by adding the extent of the impact to the duration of the impact. The severity of the impact is calculated based on input from the extent of the impact, the duration and the intensity.</p> <p>Risk = Severity (extent + duration + intensity) x Incidence (frequency + probability)</p> <p>Significance: The significance of the risk based in the identified impacts has been expressed qualitatively as follows:</p> <ul style="list-style-type: none"> Low – the impact is of little importance/insignificant but may/may not require minimal management. Medium – the impact is importance; management is required to reduce negative impacts to acceptable levels. High – the impact is of great importance, negative impacts could render development options or the entire project unacceptable if they cannot reduce to acceptable levels | | | | | | | | | | | | | | | | | |

| ASPECT | IMPACT RATING |
|--------|---|
| | and/or if they are not balanced by significant positive impact, management of impacts is essential. |

Based on a synthesis or combination of the information contained in the above-described criteria; and drawing on legal policies and guidelines as well as the status of the impacts and potential risks, the overall significance was determined as follows (Table 3-4):

Table 3-4: Definition of significance ratings (positive and negative)

| Significance | Description |
|----------------------------------|--|
| Very high (VH) (150+) | An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options. |
| High (H) (101-149) | An impact of high significance which could influence a decision about whether to proceed with the proposed project, regardless of available mitigation options. |
| Medium (M) (51-100) | If left unmanaged, an impact of medium significance could influence a decision about whether to proceed with a proposed project. |
| Low (L) (25-50) | An impact of low significance would have little effect on decision making and only a small influence on project design or alternative motivation. |
| Very low (VL) (1-24) | An impact of very low significance is likely to contribute to positive decisions about whether to proceed with the project. It will have little effect and is unlikely to have an influence on project design or alternative motivation. |
| Negligible / zero impact | There will be no impact, or any impact identified can be viewed as negligible. This rating will be unlikely to have an influence on project design or alternative motivation. |
| Positive impact (+) | A positive impact is likely to result in a positive consequence/effect and is likely to contribute to positive decisions about whether to proceed with the project. |

4 Description of the Receiving Environment

Understanding the context of the study area and surrounding landscape is important as it informs decision making regarding the significance of the area to be affected. This chapter provides baseline information at the regional scale.

4.1 Topography

The topography of Blikana is characterised by a rugged and undulating landscape typical of the eastern interior highlands (Figure 4-1). The topography consists of rolling hills, dissected valleys, and elevated plateaus, with steep slopes occurring along river corridors and tributaries. Rocky outcrops and shallow soils are common, particularly on hilltops and upper slopes, while deeper alluvial soils occur along drainage lines. The landscape is largely open and expansive, shaped by erosion processes, seasonal water flow, and long-term grazing activities, resulting in a mosaic of grass-dominated areas, scattered shrubs, and exposed rock surfaces.

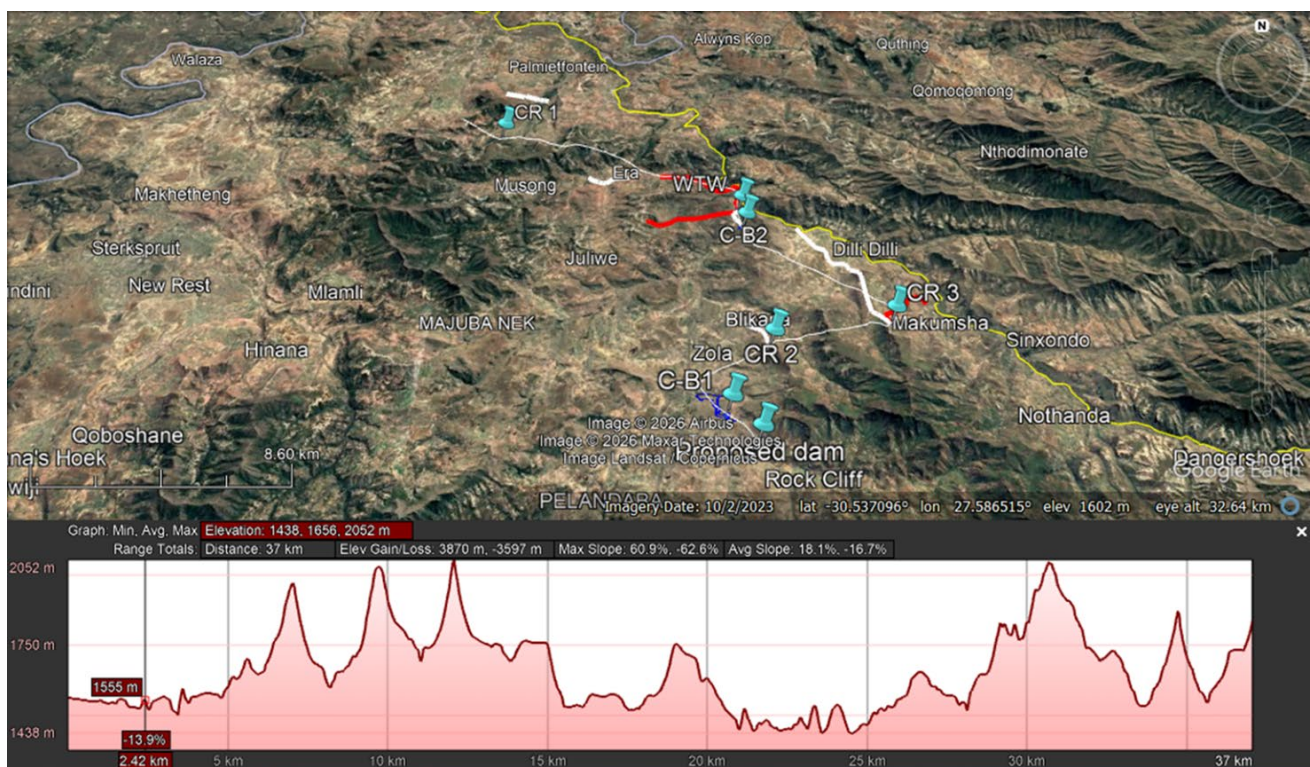


Figure 4-1: Topographic profile of study site

4.2 Climate

The Blikana River area, located near Sterkspruit in the Eastern Cape, experiences a semi-arid to temperate interior climate. Summers (October–March) are warm to hot, with average daytime temperatures ranging between 25–32°C and occasional thunderstorms contributing most of the annual rainfall. Winters (May–August) are cold and dry, with temperatures frequently dropping below 5°C at night and frost common in low-lying areas. Annual rainfall generally ranges between 400–600 mm, occurring mainly in summer, while winters are typically dry with clear skies and strong winds. The climate is characterised by high evaporation rates, seasonal rainfall variability, and periodic droughts, all of which influence river flow patterns and water resource availability in the Blikana catchment.

4.3 Geology and Soils

Blikana geology is underlain predominantly by sedimentary rocks of the Karoo Supergroup, mainly sandstones and mudstones, with occasional dolerite intrusions that form resistant ridges and rocky outcrops (Figure 4-2). These geological formations contribute to the undulating to rugged terrain and influence drainage patterns

within the catchment. Soils are generally shallow, stony, and moderately to poorly developed on upper slopes and hilltops, while deeper, more fertile alluvial soils occur along valley bottoms and drainage lines. Due to the semi-arid climate and grazing pressure, soils in many areas show signs of compaction and erosion, particularly where vegetation cover is sparse.

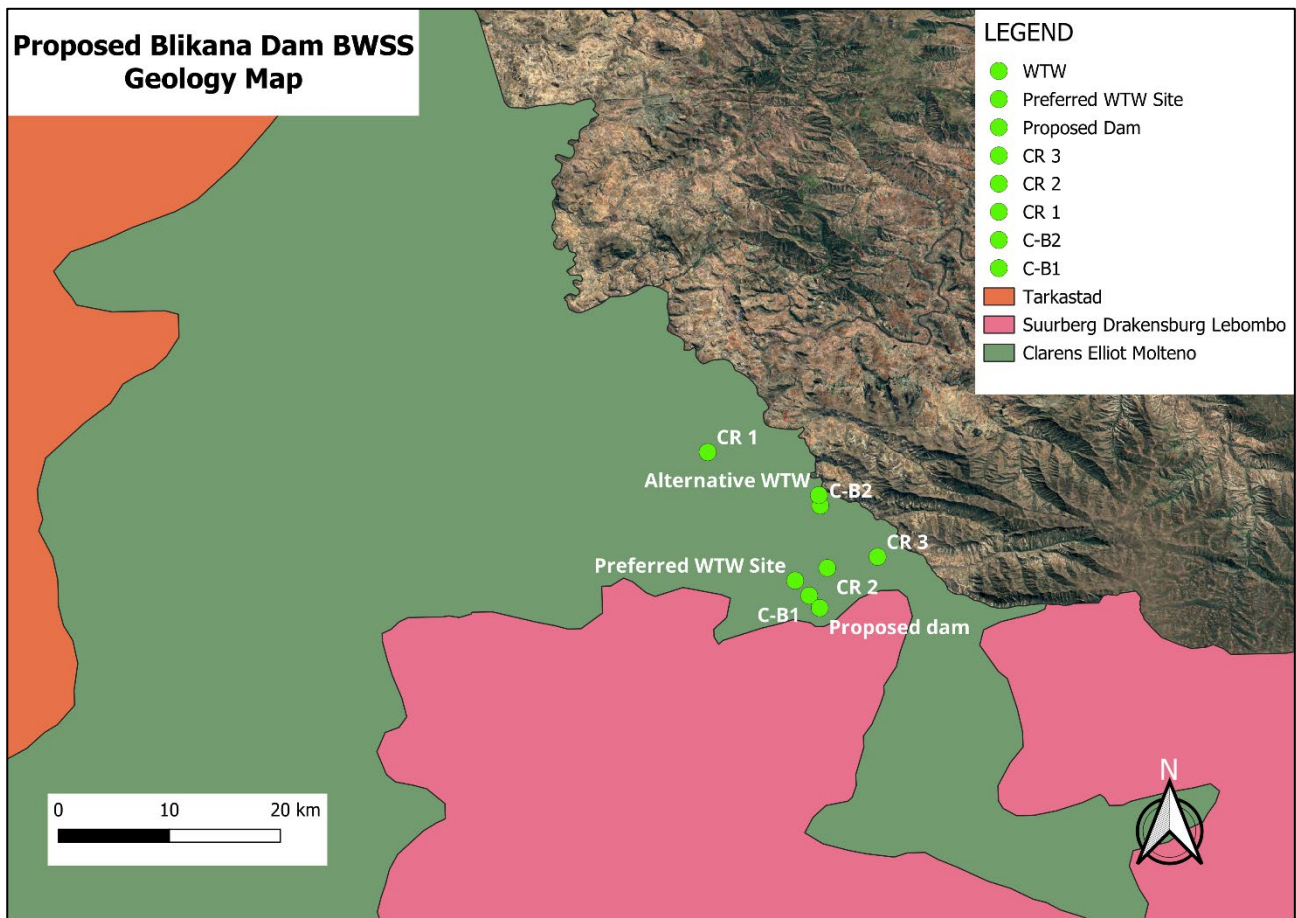


Figure 4-2: Geology map of study site

4.4 Land Use

The dominant land use in the general area is best described as:

- Rural communal land / rangeland used mainly for subsistence livestock grazing (typically sheep/goats/cattle) on montane grassland; with
- Dispersed rural settlements/villages and associated access tracks; and
- Localised small-scale cultivation/home gardens (on valley floors and near drainage lines/riparian areas, where soils and moisture are better).

4.5 Vegetation

According to SANBI VEGMAP 2018 (Vegetation Map of South Africa, Lesotho and Swaziland 2018), the BWSS footprint occurs in the Grassland Biome, within Zastron Moist Grassland and Senqu Montane Shrubland.

Zastron Moist Grassland

General character: A mesic (moist) Highveld grassland type dominated by a tussock grass layer, with a diverse suite of forbs that are typically most evident in the growing season. It generally occurs in a summer-rainfall climate and supports relatively continuous grass cover where not transformed.

Landscape position: Typically associated with rolling plains and gentle slopes rather than steep mountainous scarps, although it can interface with drainage features and local rocky patches depending on terrain.

Conservation context: In the national ecosystem threat status assessment (Terrestrial Red List of Ecosystems), it is treated as Least Concern (LC) (i.e., not a listed threatened ecosystem type at national scale), although local condition can vary widely with grazing pressure, erosion and fragmentation.

Senqu Montane Shrubland

General character: A montane grassland–shrubland mosaic occurring in cooler, higher-lying and more rugged terrain, where rocky substrates, shallow soils and slope exposure favour a more patchy vegetation pattern. It typically includes a grass layer with a stronger presence of low shrubs on rocky slopes and protected niches and can transition into cliff/rock microhabitats.

Landscape position: Commonly associated with mountain slopes, rocky ridges and escarpment-associated terrain, where ecological processes (erosion control, slope stability, runoff regulation) and habitat heterogeneity are important.

Conservation context: Also treated as Least Concern (LC) in the national ecosystem threat status assessment, but this does not imply low ecological importance—montane grassland–shrubland systems often play a key role in catchment function and connectivity, especially in strategic headwater landscapes.

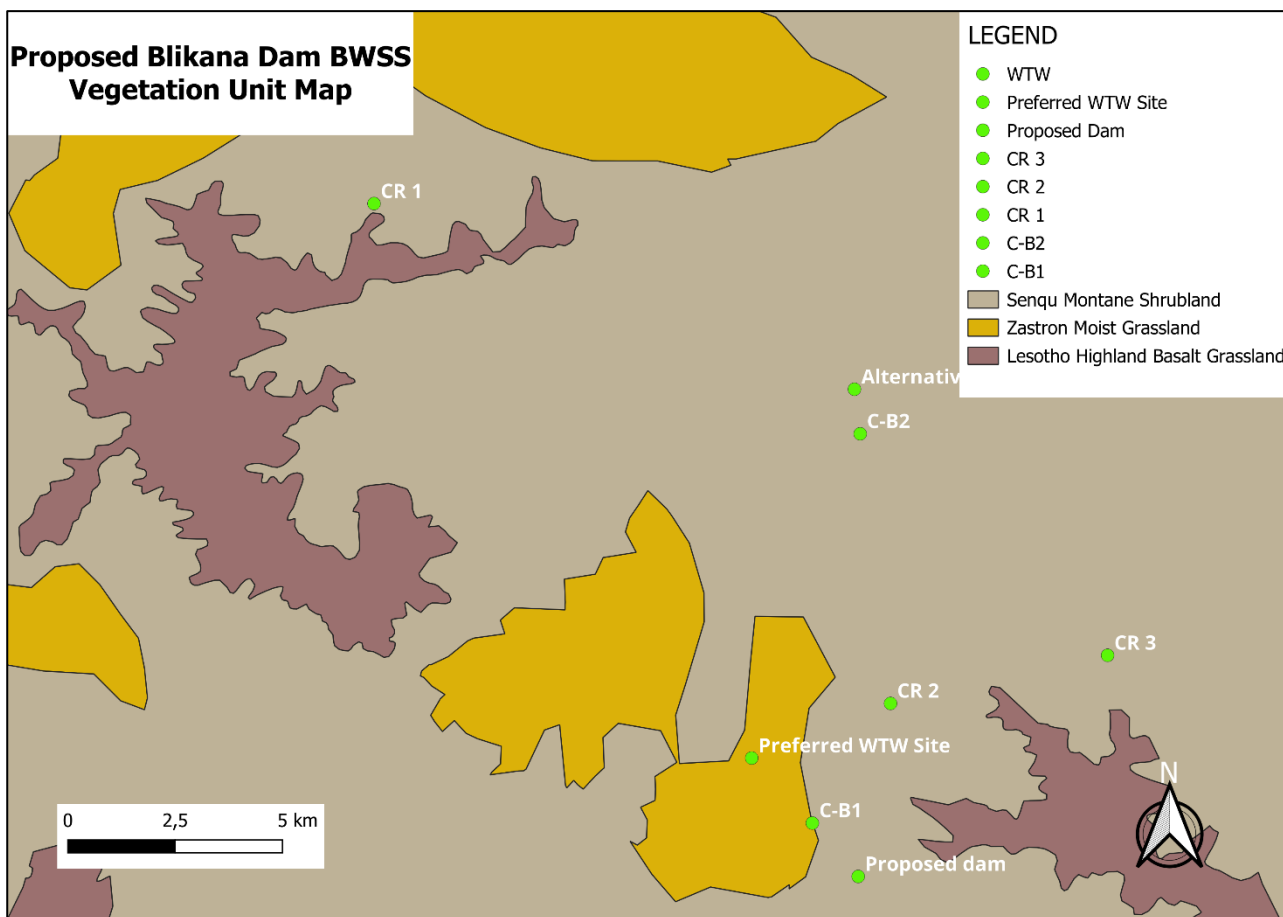


Figure 4-3: Vegetation of the study area

4.6 Biodiversity Conservation Plans- Eastern Cape Biodiversity Conservation Plan, 2019

The Eastern Cape Biodiversity Conservation Plan (ECBCP) (2019) replaces the ECBCP (2007) in its entirety and provides a map of important biodiversity areas, outside of the Protected Areas network, which must be

used to inform land use and resource-use planning and decision making. The objectives of the ECBCP (2019) are to:

- 1) Identify the minimum spatial requirements needed to maintain a living landscape that continues to support all aspects of biodiversity and retain/maintain essential ecological infrastructure. This is achieved through the selection of areas, based on achieving targets, which represent important biodiversity pattern AND ecological processes;
- 2) Serve as the primary source of biodiversity information for land use planning and decision making; and
- 3) Inform conservation and restoration action in important biodiversity areas.

The aim of the ECBCP (2019) was to map biodiversity priority areas through a systematic conservation planning process. The main outputs of the ECBCP include Protected Areas (PA), Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA), Other Natural Areas (ONA) and No Natural Habitat Remaining (NNR) for both terrestrial and aquatic ecosystems. The ECBCP (2019) has been adopted by DEDEAT as a systematic biodiversity plan for the Eastern Cape Province.

According to the ECBCP (2019), the proposed Blikana bulk water supply works are located within ESA 1 Figure 4-4).

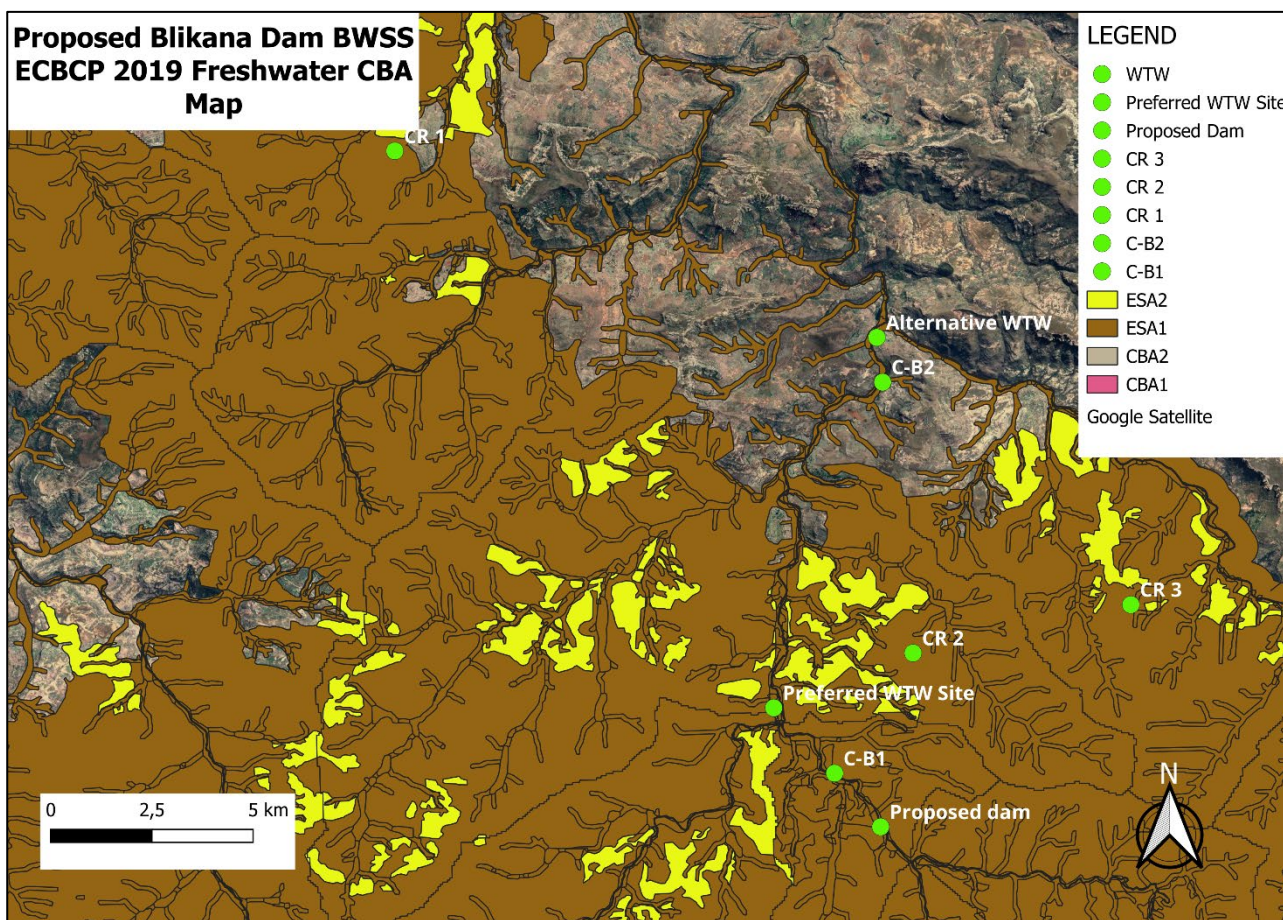


Figure 4-4: ECBCP (2019) Map

4.7 Quaternary Catchment

The proposed Blikana Water Supply Scheme (BWSS) and associated infrastructure occur within the Upper Orange (Orange–Senqu) catchment, specifically within the D18K and D18L quaternary catchments (Figure 4-5). In terms of the current national Water Management Area (WMA) framework (new nine WMAs), the project area falls within the Orange Water Management Area (which includes the South African portions of tertiary drainage region D18). The BWSS is associated with tributaries of the Orange–Senqu system, with the principal

watercourses relevant to the project including the Blikana River and the Tele River, together with smaller tributaries and drainage features (including the Kwa Bangindlala stream and an unnamed Orange–Senqu tributary crossing). Table 4-1 summarises the water resources in the catchment (Nel *et al.*, 2011).

Table 4-1: Summary of water resources

| DESCRIPTION | QUATERNARY CATCHMENT | MAIN RIVERS |
|--------------|----------------------|---|
| Blikana BWSS | D18K D18L | Tele River, Blikana River, Tele River (Lesotho border area) |

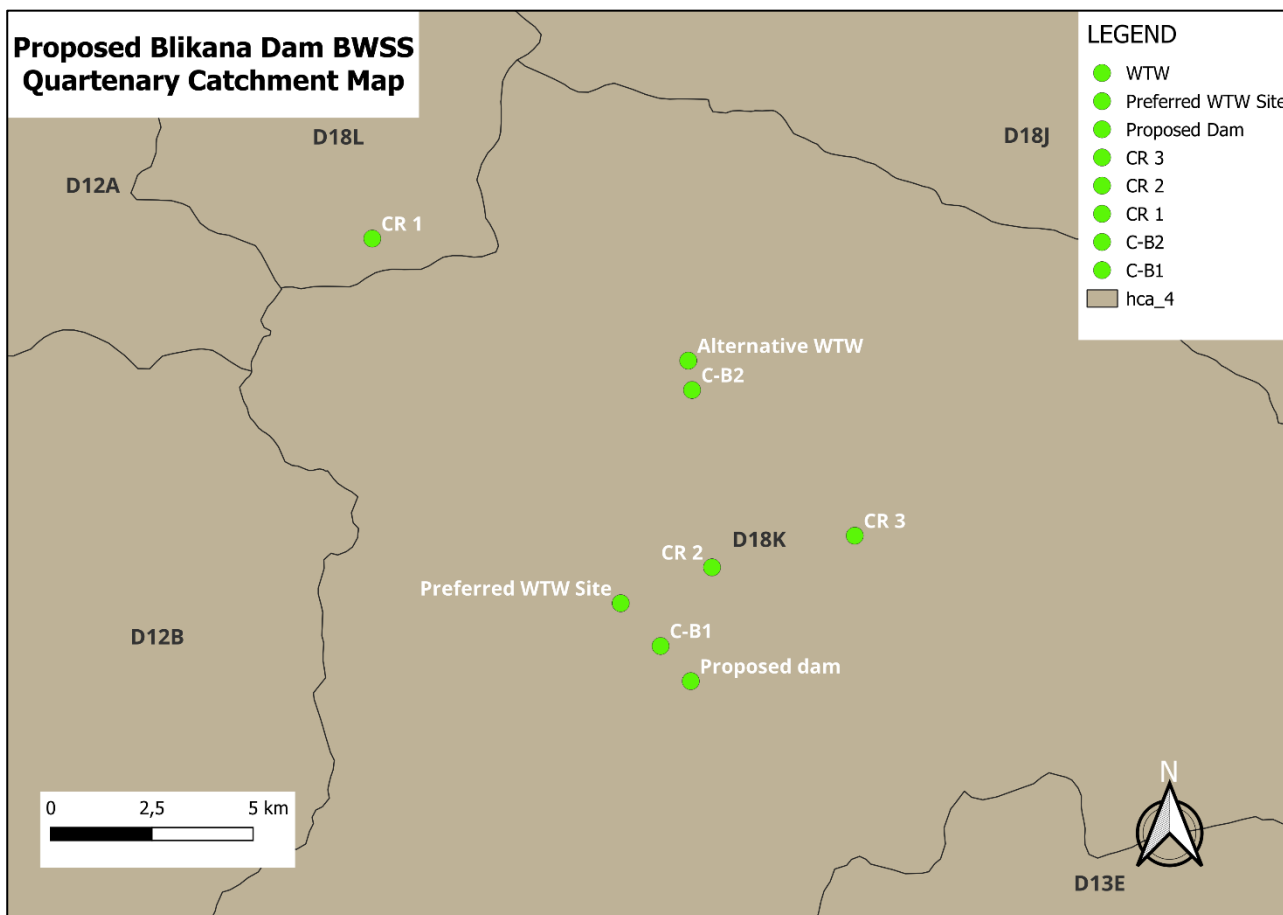


Figure 4-5: Quaternary Catchments associated with the proposed Project

4.8 National Freshwater Ecosystem Priority Areas (NFEPAs)

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al.*, 2011a) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPAs), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa’s freshwater ecosystems and supporting sustainable use of water resources.

Freshwater Ecosystem Priority Areas (FEPA’s) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (NWI Wetlands) (SANBI, 2011) to provide information on the distribution and extent of wetland areas. River, wetland and estuarine FEPAs should be regarded as significant water resources and should be regarded as ecologically important and as generally

sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources.

4.8.1 River FEPAs

River FEPAs are often tributaries that support hard-working mainstem rivers, and are an essential part of an equitable and sustainable water resource strategy. This does not mean that FEPAs need to be fenced off from human use, but rather that they should be supported by good planning, decision-making and management to ensure that human use does not impact on the condition of the ecosystem.

River FEPAs achieve biodiversity targets for river ecosystems and threatened/near threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. For river FEPAs the whole sub-quaternary catchment is shown in dark green (Figure 3-6), although FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach. It is important to note that river FEPAs currently in an A or B ecological category may still require some rehabilitation effort, e.g. clearing of invasive alien plants and/or rehabilitation of riverbanks. From a biodiversity point of view, rehabilitation programmes should therefore focus on securing the ecological structure and functioning of FEPAs before embarking on rehabilitation programmes in Phase 2 FEPAs or other areas.

Figure 4-6 below shows that SR 1 rising main end and the SR 1 rising main mid are within a River FEPA and associated sub-quaternary catchment.

NFEPA Rivers (National Freshwater Ecosystem Priority Areas) refers to a South African spatial dataset and strategic framework used to identify and protect the country's most critical river ecosystems. The project provides guidance on which rivers should remain in a natural or near-natural condition to support water resource protection goals under the National Water Act. Figure 4-7 shows rivers identified by NFEPA within the study area with the Blikana River being the river that would be impacted by the development.

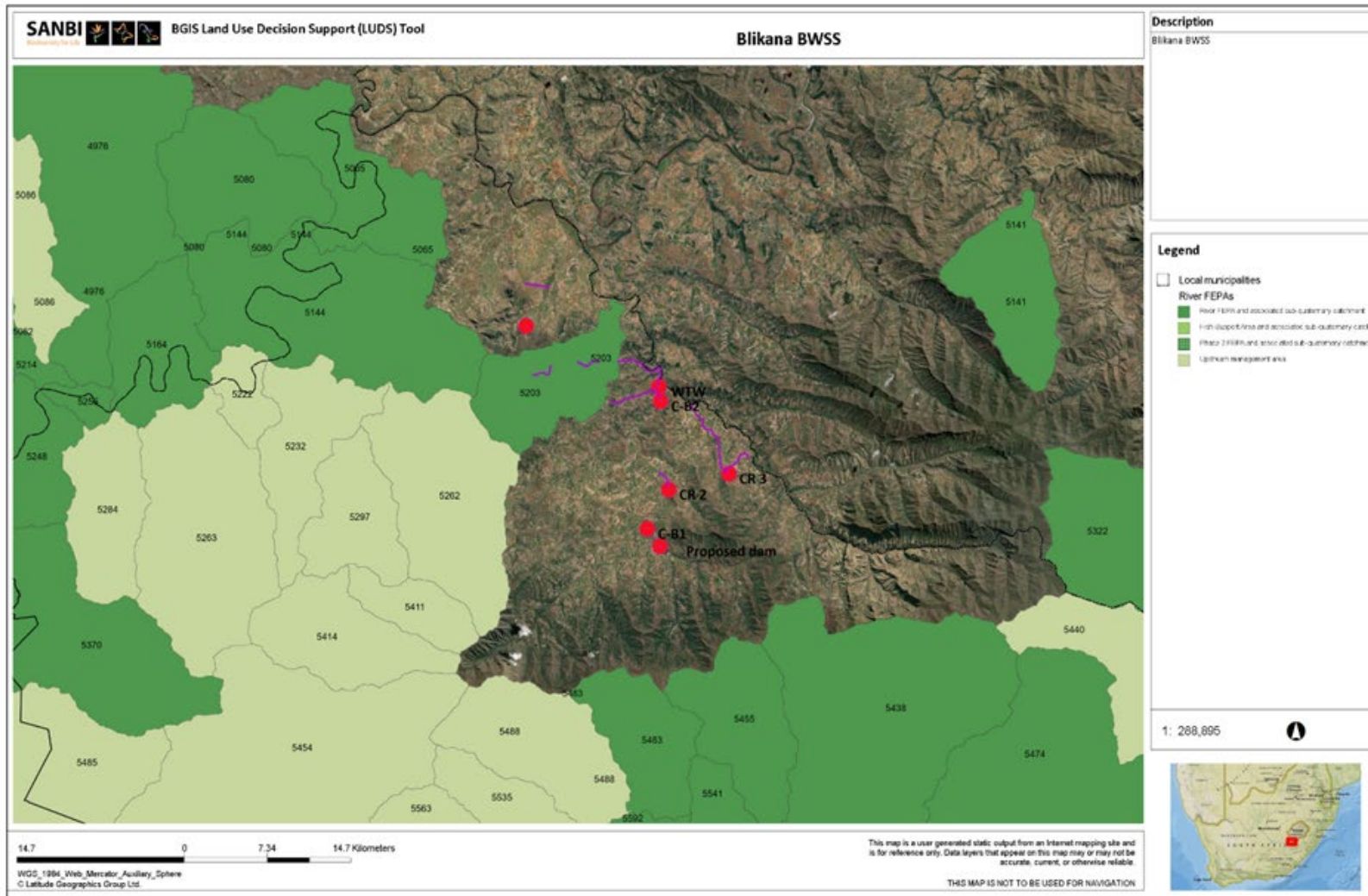


Figure 4-6: Riverine Freshwater Ecosystem Priority Area map

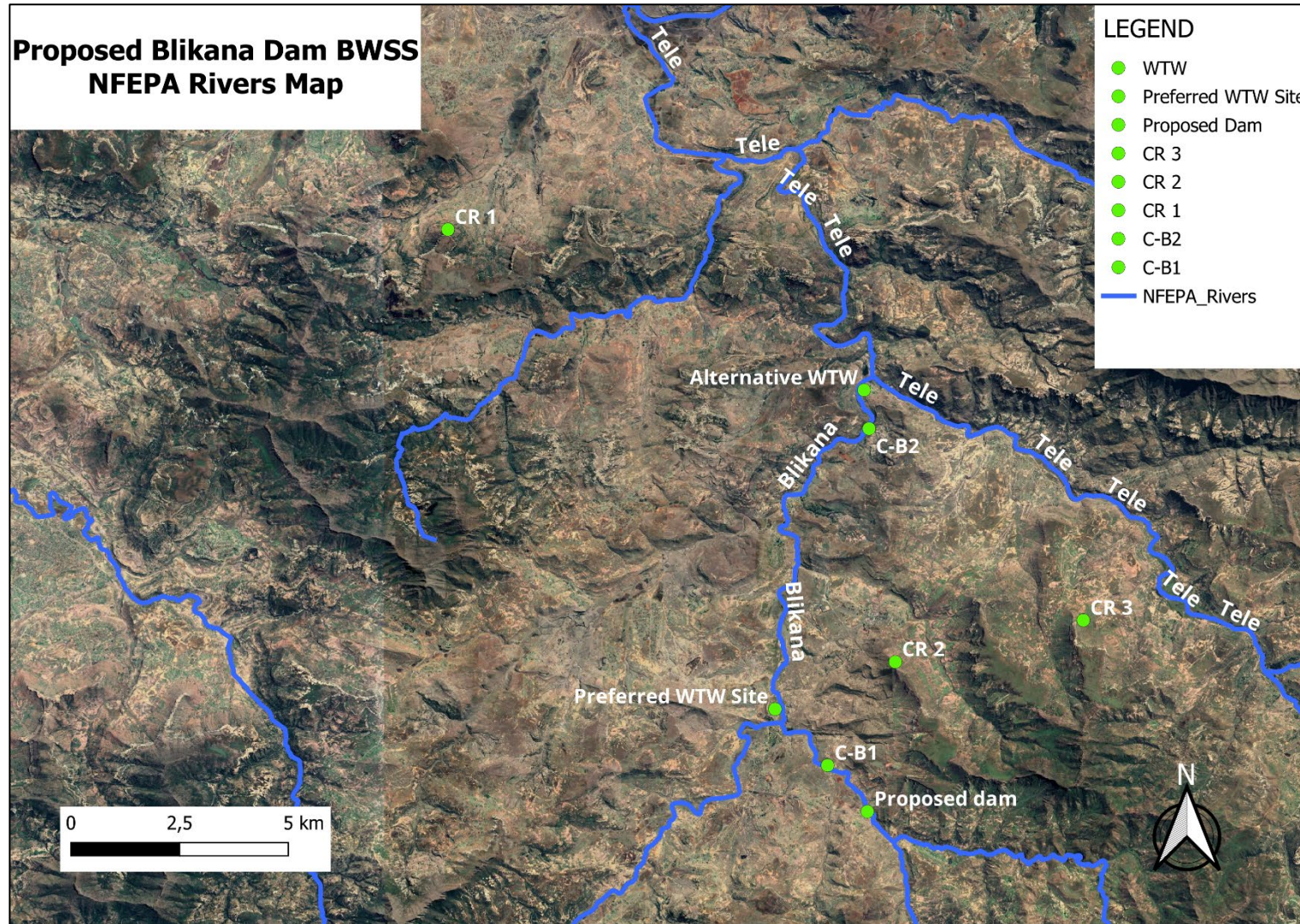


Figure 4-7: Rivers within the study area

4.9 Fish Sanctuary and Associated Sub-Quaternary Catchment

Fish sanctuaries are rivers that are essential for protecting threatened and near threatened freshwater fish that are indigenous to South Africa. The associated sub-quaternary catchment is marked with a red or black fish symbol on the map. A red fish indicates that there is at least one population of a critically endangered or endangered fish species within that sub-quaternary catchment. A black fish indicates the presence of vulnerable and near threatened fish populations. Some fish sanctuaries are FEPAs, with their associated sub-quaternary catchments shown in dark green; others are Fish Support Areas, with their associated sub-quaternary catchments shown in medium green (see explanation of Fish Support Areas below). A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened or near threatened from going extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment. Fish management plans need to be developed for all fish sanctuaries to protect the fish they contain, with priority given to those fish sanctuaries containing critically endangered or endangered fish species. These plans should address issues such as management of a particular stretch of river habitat within the sub-quaternary catchment, the construction of weirs to keep invasive alien fish species to a minimum (following an environmental impact assessment) and managing aquaculture and angling to ensure no further introduction of invasive alien fish species.

- Fish Support Area and associated sub-quaternary catchment: Fish sanctuaries in a good condition (A or B ecological category) were identified as FEPAs, and the whole associated sub-quaternary catchment is shown in dark green. The remaining fish sanctuaries in lower than an A or B ecological condition were identified as Fish Support Areas, and the associated sub-quaternary catchment is shown in medium green. Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened or near threatened fish species – these are not marked with a fish symbol.

Fish sanctuaries are sub-quaternary catchments that are essential for protecting threatened and near-threatened freshwater fish populations that are indigenous to South Africa. Fish sanctuaries were identified at the scale of sub-quaternary catchments. The SAIAB/Albany fish data were used to guide the choices. This shapefile provides a summary of what the sub-quaternary catchment status is in terms of being selected as a FEPA, Fish Support Area, Fish Relocation & Translocation Area, Fish Rehabilitation Area and Migration Corridors for threatened and near-threatened fish indigenous to South Africa. The Blikana BWSS does not fall within any of the fish sanctuary categories (Figure 4-8).

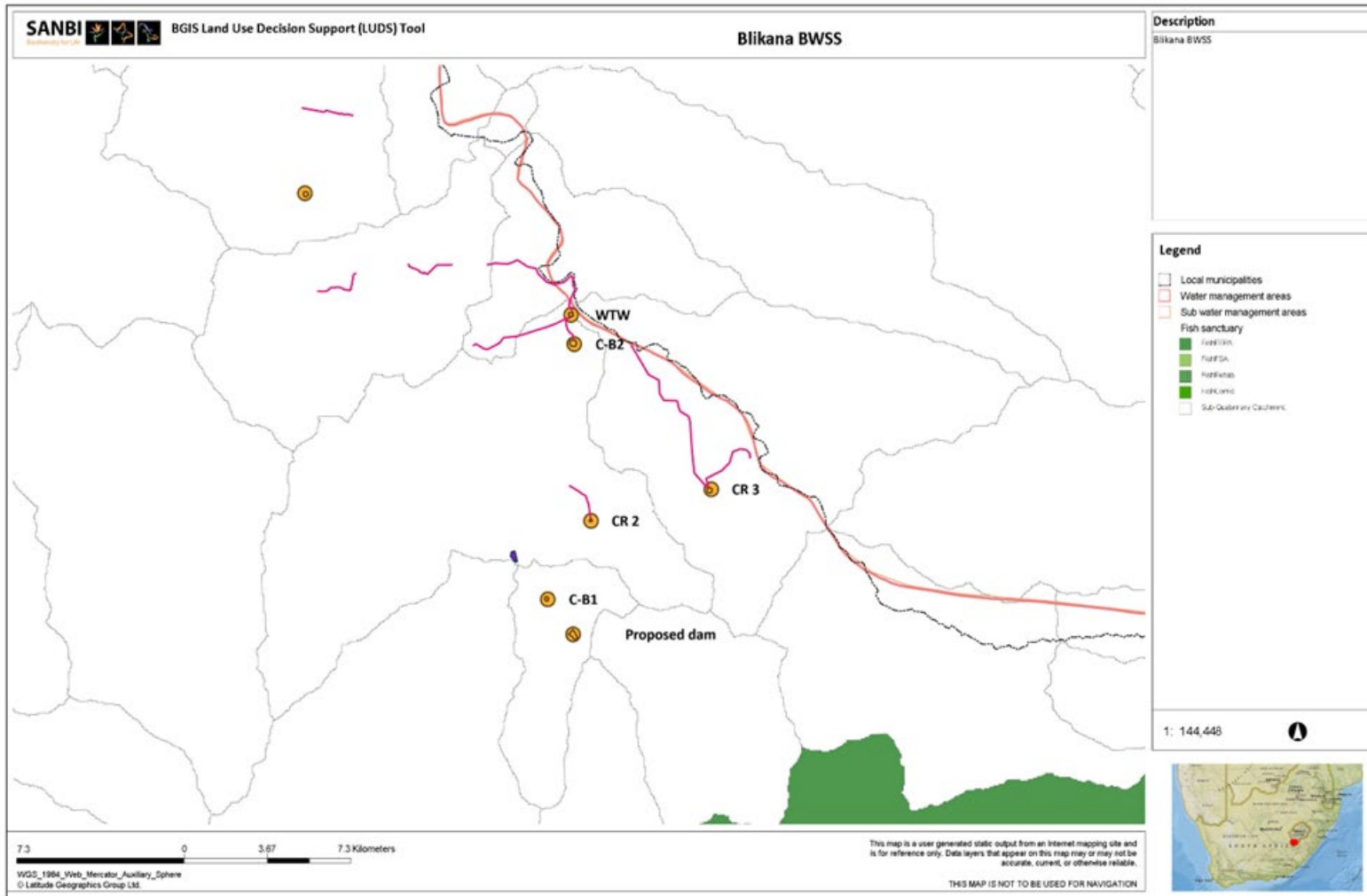


Figure 4-8: Fish Sub-quaternary catchment

4.10 Strategic Water Source Area (SWSAS, 2017)

Strategic Water Source Areas (SWSAs) are now defined as areas of land that either: (a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or (b) have high groundwater recharge and where the groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). They include transboundary Water Source Areas that extend into Lesotho and Swaziland. All surface water SWSAs are located in high rainfall areas where baseflow is at least 11 25 mm/a, which is evidence of a strong link between groundwater and surface water in the SWSAs. The aquifers sustain baseflow, contribute to runoff and, especially, contribute to dry season flows. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, especially during the dry season and droughts.

The Blikana BWSS project lies within the Eastern Cape Drakensberg SWSA (2017) (Figure 4-9).

The Eastern Cape Drakensberg SWSA

The Eastern Cape Drakensberg Strategic Water Source Area is a nationally important high-altitude catchment identified by the South African National Biodiversity Institute as a priority water-producing landscape. Located along the Drakensberg–Maloti escarpment near the Lesotho border, it comprises montane grasslands, wetlands, and headwater streams that generate a disproportionate share of surface water feeding major river systems such as the Orange River (Senqu system) and the Mzimvubu River. Although covering a relatively small land area, it plays a critical role in national water security, biodiversity conservation, and climate resilience, and is highly sensitive to land degradation, overgrazing, invasive species, and inappropriate development.

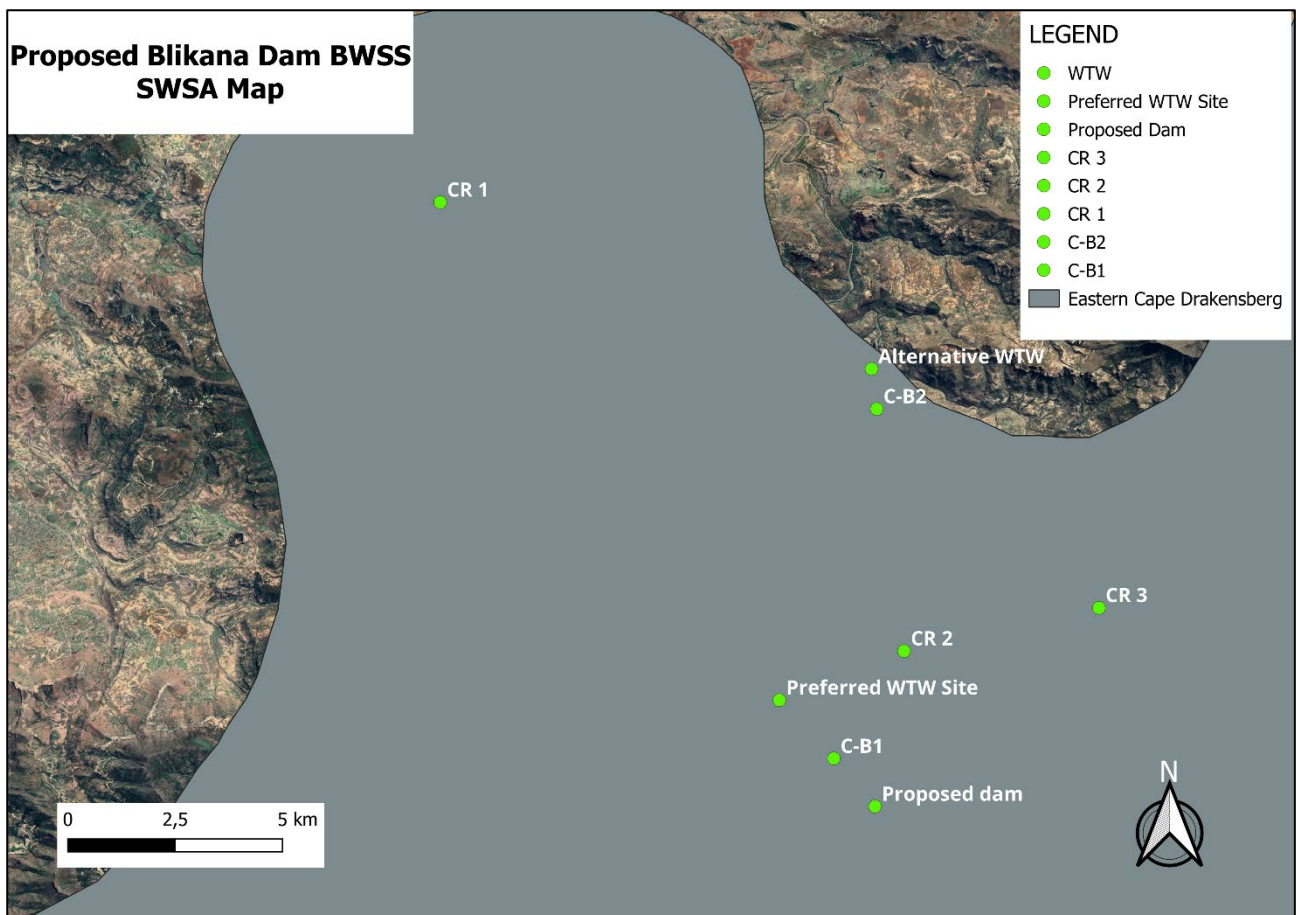


Figure 4-9: SWSA associated with the proposed Blikana BWSS project area

4.11 Desktop Present Ecological State, Importance and Sensitivity

The BWSS infrastructure and components are within the Blikana SQ Reach. The Blikana river is a perennial river that remains relatively natural at catchment and corridor scale, despite some localised disturbance pressures. Below is a description of the desktop Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES).

Table 4-2: Summary of desktop PES, EI and ES for the Blikana River SQ Reach

| Aspect | Summary result | Key findings / interpretation |
|--------------------------------|--|--|
| Reach description | Blikana SQ Reach | The BWSS infrastructure and components fall within the Blikana SQ Reach. The Blikana River is a perennial system that remains relatively natural at catchment and corridor scale, despite localised disturbance. |
| Present Ecological State (PES) | Category B – Largely Natural | The reach is considered largely natural, with small to moderate modification. Main pressures include subsistence agriculture, settlements, grazing, erosion, and roads/access crossings. |
| PES confidence | Average confidence = 3 | Desktop confidence is moderate. |
| Ecological Importance (EI) | Mean EI = Moderate; Maximum EI = Very High | The reach has a mixed importance profile, with some indicators rating high to very high. |
| Fish EI | Representivity = Moderate; Rarity = Very High | Fish assemblages contribute strongly to the ecological importance of the reach, especially due to rarity. |
| Macroinvertebrate EI | Representivity = Low; Rarity = High | Macroinvertebrate importance is lower in terms of representivity, but rarity remains significant. |
| Other ecological features | 13 species in SQ; 0 special species | Main habitats include incised channel, surface water, grassy edges, riparian trees, alluvial sand banks, shallow areas, and mountainous terrain. Main adverse conditions include agriculture, erosion, and rural effluent. |
| Habitat and connectivity | Habitat diversity = Low; Habitat size = Very Low; Instream migration link = Very High; Instream habitat integrity = High | Although habitat diversity and size are limited, the reach appears to function as an important connected river corridor. |
| Ecological Sensitivity (ES) | Mean ES = High; Maximum ES = High | The reach is highly sensitive overall. |
| Fish ES | Physico-chemical sensitivity = Moderate; No-flow sensitivity = High | Fish are particularly sensitive to reduced or altered flow conditions. |

| Aspect | Summary result | Key findings / interpretation |
|-----------------------------------|---|--|
| Macroinvertebrate ES | Physico-chemical sensitivity = Moderate; Velocity dependence = High | Macroinvertebrates are sensitive to hydraulic changes and water quality impacts. |
| Flow/water level sensitivity | High | The reach is sensitive to water level and flow changes. |
| Stream size sensitivity | High | The system is sensitive to modified flow and water level changes. |
| Integrated EIS | High | Overall, the reach is both ecologically important and sensitive. |
| Default Ecological Category (DEC) | B | The default ecological category for the reach is Category B. |

Desktop Present Ecological State, Ecological Importance and Ecological Sensitivity

The desktop assessment indicates that the Blikana River SQ Reach is a largely natural perennial system with a PES Category B and a High integrated EIS. Although the average Ecological Importance is Moderate, several indicators, particularly fish rarity, connectivity, and habitat integrity, are rated High to Very High, indicating that the reach performs an important ecological function. The Ecological Sensitivity of the reach is High, particularly in relation to flow modification, water level change, velocity alteration, and water quality deterioration. These findings indicate that the Blikana River is a sensitive aquatic receptor and that the proposed BWSS infrastructure should be carefully managed to avoid or minimise impacts associated with abstraction, impoundment, pipeline crossings, sedimentation, and effluent-related disturbances.

This SQR is expected to host a total of 15 aquatic macroinvertebrates taxa (Table 4-3) and only three fish species (Table 4-4). It should be noted that the DWS (2016) PESEIS database lists expected biota at catchment level and with the species richness in headwater streams known to be lower compared to downstream reaches (Richardson, 2019), not all the biota was expected at the sampled sites. This was taken into consideration in the determination of biotic integrity in the latter sections of the report.

Table 4-3: Expected aquatic biota for the Blikana River SQR (DWS, 2016)

| Family names | | |
|-----------------------------|--------------------------------|------------------------|
| <i>Hirudinea</i> | <i>Gerridae</i> | <i>Gyrinidae</i> |
| <i>Potamonautidae</i> | <i>Oligochaeta</i> | <i>Ceratopogonidae</i> |
| <i>Hydracarina</i> | <i>Notonectidae</i> | <i>Chironomidae</i> |
| <i>Baetidae (2 species)</i> | <i>Veliidae / Mesoveliidae</i> | <i>Culicidae</i> |
| <i>Corixidae</i> | <i>Naucoridae</i> | <i>Muscidae</i> |

Table 4-4: Desktop-estimated fish assemblage for Blikana River

| Scientific name | Common name | IUCN Status |
|------------------------------|-----------------------|--------------------|
| <i>Austroglanis sclateri</i> | Rock-catfish | Least Concern |
| <i>Labeobarbus aeneus</i> | Smallmouth yellowfish | Least Concern |
| <i>Barbus anoplus</i> | Chubbyhead barb | Least Concern |

5 Aquatic Ecology - Site Specific Findings

5.1 Selection of Sampling Sites

The selection of monitoring sites was based on the proposed location of infrastructure relative to the aquatic ecosystems likely to be impacted. The sites were strategically selected based on ease of accessibility and availability of suitable habitat. A total of six sites were selected. Site names, GPS coordinates and brief descriptions are provided in Table 5-1.

Table 5-1: Location of the sampling points and brief descriptions

| River | Site | GPS | Site Description |
|---------------|------|------------------------------|--|
| Blikana River | BK1 | 30°36'58.04"S, 27°37'17.52"E | Located within the Upper Orange catchment. Site is located upstream of the proposed dam site. Site serves as sampling point to determine any impacts resulting from the dam and associated infrastructure located within the proposed project area. |
| | BK2 | 30°36'48.40"S, 27°37'12.78"E | Located within the Upper Orange catchment. Site located downstream of the proposed dam site. Site serves as sampling point to determine any impacts resulting from the dam and associated infrastructure located within the proposed project area. |
| | BK3 | 30°30'29.38"S, 27°37'4.42"E | Located within the Upper Orange catchment. Site is located upstream of the proposed alternative WTW site (including SR 2 rising main from WTW and Abstraction point 2 gravity main to alternative WTW). Site serves as sampling point to determine any impacts resulting from the alternative WTW and associated infrastructure as well as impacts resulting from SR 2 rising main from WTW and Abstraction point 2 gravity main to WTW that are proposed to cross the river located within the proposed project area. |
| | BK4 | 30°30'20.06"S, 27°37'12.01"E | Located within the Upper Orange catchment. Site is located downstream of the proposed Alternative WTW site (including proposed crossing for SR 1 rising mains from Alternative WTW tie in). Site serves as sampling point to determine any impacts resulting from the WTW and associated infrastructure located within the proposed project area. |
| | BK5 | 30°35'27.70"S, 27°35'57.23"E | Located within the Upper Orange catchment. Site is located upstream of the preferred WTW site. Site serves as sampling point to determine any impacts resulting from the WTW. |
| | BK6 | 30°35'2.11"S, 27°35'50.11"E | Located within the Upper Orange catchment. Site is located downstream of the preferred WTW site. Site serves as sampling point to determine any impacts resulting from the WTW. |

5.2 Ichthyofauna – Baseline

The ichthyofaunal baseline for this assessment is based on fish observed during the field assessment of the Blikana River, supported by site-based fish habitat observations and interpretation of habitat suitability within the affected river reaches. The assessment focused on fish-supporting habitats associated with the proposed Blikana Dam Bulk Water Supply Scheme, including the proposed dam area, abstraction point C-B1, the pick-up weir at C-B2, river crossing points and river reaches located upstream and downstream of key project components.

During the ichthyofauna assessment, two indigenous fish species were observed and recorded in the Blikana River, namely smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*). The presence of these species confirms that the Blikana River supports an indigenous fish assemblage and provides functional instream habitat suitable for freshwater fish.

Smallmouth yellowfish (*Labeobarbus aeneus*) is associated with riverine environments and is dependent on suitable flow conditions, water quality, instream habitat diversity and river connectivity. Its presence within the Blikana River indicates that the system retains flowing-water habitat capable of supporting larger-bodied indigenous fish species.

Chubbyhead barb (*Enteromius anoplus*) is a smaller-bodied indigenous cyprinid species commonly associated with streams and rivers. Its presence indicates that the river provides suitable habitat for smaller fish species, including marginal habitats, shallow runs, pools, refuge areas and areas with suitable cover.

Table 5-2: Fish species recorded in the Blikana River

| Species | Common name | Ecological interpretation |
|---------------------------|-----------------------|--|
| <i>Labeobarbus aeneus</i> | Smallmouth yellowfish | Indicates perennial flowing habitat with reasonable connectivity and fair ecological condition |
| <i>Enteromius anoplus</i> | Chubbyhead barb | Common indigenous species tolerant of some disturbance, but still indicative of functional river habitat |

The observed fish assemblage is considered representative of a functional but modified perennial river system. Although only two species were recorded during the assessment, their presence confirms that the Blikana River should be treated as a fish-supporting aquatic ecosystem.

5.3 Fish Habitat Assessment

The fish habitat assessment focused on the Blikana River and project-related areas where the proposed Blikana Dam Bulk Water Supply Scheme may affect fish-supporting habitat. Particular attention was given to the proposed dam area, abstraction point C-B1, the pick-up weir at C-B2, river crossing points, and pipeline sections located close to the Blikana River or within the recommended aquatic buffer.

Fish habitat within the Blikana River is associated with the presence of flowing water, pools, runs, riffles, channel substrates, marginal vegetation, instream cover and river connectivity. These habitat features provide feeding areas, refuge habitat, movement pathways and potential breeding or juvenile habitat for indigenous fish species.

The aquatic biodiversity assessment confirmed that the Blikana River is a perennial river system within a relatively natural landscape context, although it is affected by localised pressures such as erosion, grazing, rural access, roads and diffuse rural land-use impacts. These pressures may influence fish habitat quality through bank disturbance, sediment input, riparian disturbance and localised changes in channel condition.

Table 5-3: Fish habitat features and ichthyofaunal relevance

| Fish habitat feature | Description | Relevance to ichthyofauna |
|----------------------|---|---|
| Pools | Deeper, slower-flowing sections of the river channel. | Provide refuge during low-flow periods, shelter for larger-bodied fish, juvenile habitat and local feeding areas. |
| Runs | Moderately flowing sections of river with relatively uniform depth and current. | Provide movement corridors, feeding habitat and connectivity between pools and riffles. |
| Riffles | Shallow, faster-flowing sections with stones, cobbles or gravel. | Important for oxygenation, feeding, habitat diversity and potential spawning or juvenile habitat for some fish species. |
| Marginal vegetation | Vegetation along the river margins and banks. | Provides cover, shading, bank stability, organic inputs and protection for juvenile or small-bodied fish. |
| Substrate diversity | Bedrock, cobbles, stones, gravel, sand or finer sediments within the channel. | Provides habitat complexity, shelter, feeding areas and potential spawning substrate. |
| Refuge habitat | Pools, undercut banks, marginal vegetation, deeper runs and shaded areas. | Allows fish to survive during low flow, high flow, disturbance or poor water quality events. |
| Flow diversity | Variation in water depth, velocity and hydraulic conditions. | Supports different life stages and habitat preferences of fish species. |
| River connectivity | Longitudinal connection between upstream and downstream river reaches. | Allows fish movement for feeding, breeding, refuge-seeking and recolonisation after disturbance. |
| Water quality | Physical and chemical condition of water. | Essential for fish survival, respiration, feeding, reproduction and ecological functioning. |

The confirmed presence of smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*) indicates that the Blikana River provides suitable habitat for both larger-bodied and smaller-bodied indigenous cyprinid fish species.

The proposed dam and pick-up weir are the most important long-term fish habitat considerations because they may alter flow conditions, inundate riverine habitat, modify downstream habitat availability and create barriers to fish movement. Pipeline crossings and construction areas near the river are mainly construction-phase risks, particularly where they may cause sedimentation, turbidity, bank disturbance or temporary obstruction of fish movement.

5.4 Ichthyofauna Ecological Condition

The Fish Response Assessment Index (FRAI) was used as a guiding framework to interpret the ecological integrity of the fish assemblage. FRAI assesses the deviation of the observed fish community from the expected reference assemblage for a site or river reach, with consideration of key ecological drivers such as flow, habitat availability, water quality, cover and connectivity.

For the Blikana River, the ichthyofaunal interpretation was based on the recorded presence of smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*), together with the absence of a fuller expected assemblage and the presence of localised disturbance pressures such as erosion, grazing, road crossings and rural land-use impacts. On this basis, the fish community of the Blikana River is interpreted as being broadly consistent with Ecological Category C: Moderately Modified.

This category indicates that the system remains ecologically functional and continues to support indigenous fish species, but that the fish assemblage has been modified from natural or reference condition. The likely drivers of this modification include localised sedimentation, disturbance of channel and riparian habitat, and water quality or flow-related pressures.

Overall, the ichthyofaunal condition of the Blikana River is therefore considered to be moderately modified, but still of ecological significance because indigenous fish species are present and fish-supporting habitat remains functional.

Table 5-4: FRAI-based interpretation of fish ecological condition for the Blikana River

| Aspect | Interpretation |
|--------------------------------|---|
| Fish assemblage | Indigenous fish assemblage confirmed, based on recorded <i>Labeobarbus aeneus</i> and <i>Enteromius anoplus</i> . |
| Ecological condition | Moderately modified, broadly consistent with FRAI Category C. |
| Habitat functionality | Fish-supporting habitat remains present, including pools, runs, riffles, marginal vegetation and refuge areas. |
| Main disturbance pressures | Erosion, grazing, rural access, road crossings, sediment inputs and diffuse rural land-use impacts. |
| Flow dependency | The fish assemblage depends on continued perennial flow, seasonal flow variability and maintenance of suitable downstream habitat. |
| Connectivity | Longitudinal connectivity remains important for fish movement, refuge-seeking, feeding and recolonisation. |
| Sensitivity to project impacts | Moderate to high, particularly in relation to flow alteration, habitat fragmentation, sedimentation, turbidity and water quality deterioration. |

The presence of smallmouth yellowfish is particularly important because this species is associated with riverine habitat and is more dependent on suitable flow and connectivity than highly tolerant, opportunistic species. The presence of chubbyhead barb further indicates that the river supports smaller-bodied indigenous fish that may use marginal vegetation, shallow runs, pools and refuge habitats.

Although the fish assemblage is not considered pristine, it remains ecologically meaningful because it confirms that the Blikana River is still capable of supporting indigenous fish. The river should therefore be managed to avoid further degradation of fish habitat and to prevent a decline from a moderately modified condition to a more seriously modified condition.

From an ichthyofauna perspective, the current condition of the Blikana River supports development only where mitigation is applied. Particular attention must be given to the proposed dam, pick-up weir, abstraction infrastructure and river crossings, as these components have the greatest potential to alter fish ecological condition over the long term.

5.5 Species of Conservation Importance

Species of conservation concern are those that are important for South Africa's conservation decision-making processes. For the purposes of this document, species of conservation concern are taken to include those listed as Threatened (Critically Endangered, Endangered or Vulnerable), Extinct in the Wild, Data Deficient, Near Threatened, Critically Rare, Rare and Declining (Raimondo et al., 2009). Aquatic taxa regarded as being of conservation concern were identified based on confirmed observations and/or on distribution records (known extant and probably extant), while their likelihood of occurrence within the study area was based on the representivity of habitat within the watercourse under study.

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5.6 Non-native Species

Non-native fish species are important to consider in ichthyofauna assessments because they may affect indigenous fish assemblages through predation, competition, hybridisation, disease transmission, habitat alteration and disruption of natural aquatic food webs. Their impacts can be particularly significant in rivers where indigenous fish populations are already affected by flow modification, habitat fragmentation, sedimentation or water quality deterioration.

No non-native fish species were recorded during the ichthyofauna assessment of the Blikana River. The fish species recorded and expected for the river system are indigenous species associated with riverine habitat. However, the proposed dam and associated impounded habitat may increase the risk of future introduction or establishment of non-native fish species, particularly if informal stocking, recreational angling or accidental introductions occur.

From an ichthyofauna management perspective, no alien or extralimital fish species should be stocked into the proposed dam, pick-up weir pool or any associated watercourse.

5.7 Aquatic Ecosystem Buffers

Buffer zones associated with water resources have been shown to perform a wide range of functions and have been proposed as a standard measure to protect water resources and associated biodiversity on this basis. These functions can include (Macfarlane & Bredin, 2016):

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

However, despite the range of functions potentially provided by buffer zones, buffer zones are unable to address all water resource-related problems. For example, buffers can do little to address impacts such as hydrological changes caused by stream flow reduction activities or changes in flow brought about by abstractions or upstream impoundments. Buffer zones are also not the appropriate tool for mitigating against point-source discharges (e.g. sewage outflows), which can be more effectively managed by targeting these areas through specific source-directed controls (Macfarlane & Bredin, 2016).

In determining the functional buffer zones necessary for the Blikana River, use was made of the buffer zone guideline; 'Buffer Zone Guidelines for Wetlands, Rivers and Estuaries', as described and developed by Macfarlane & Bredin (2016). While the tool requires the input of specific data pertaining to each resource, buffer determinations also rely heavily on the professional expertise of a qualified specialist and each buffer may be regarded as site specific.

A 50 m aquatic buffer for the Blikana River is recommended. This buffer is relevant to the ichthyofauna assessment because it provides a protective setback between construction activities and fish-supporting river habitat. The buffer is particularly important where project infrastructure occurs near the Blikana River, at river crossings, and near the proposed dam, abstraction infrastructure and pick-up weir. Although some infrastructure may need to occur within the buffer due to engineering and water-supply requirements, these areas should be treated as high-risk fish habitat interaction zones.

Where works are unavoidable within the 50 m buffer, the following controls should be applied:

- limit disturbance to the approved footprint only;
- demarcate no-go areas along the river margin;
- prohibit stockpiling, refuelling, servicing and chemical storage within the buffer;
- install erosion and sediment control before earthworks begin;

- maintain clean and dirty water separation;
- rehabilitate disturbed banks and margins immediately after construction;
- prevent direct discharge of contaminated runoff into the river; and
- monitor the river for turbidity, sediment plumes, erosion and pollution during construction.

The buffer is therefore not only a spatial setback, but a practical management tool to protect fish habitat, maintain water quality and reduce construction-related impacts on the indigenous fish assemblage of the Blikana River.

5.8 Ichthyofaunal Sensitivity Assessment

The ichthyofaunal sensitivity of the Blikana River system was assessed based on the fish species recorded during the assessment, the desktop-estimated fish assemblage for the relevant river reach, the availability of fish-supporting habitat, the interpreted ecological condition of the fish assemblage, and the potential for project-related impacts to affect fish habitat, flow, water quality and river connectivity.

The desktop-estimated fish assemblage for the Blikana River includes rock-catfish (*Austroglanis sclateri*), smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Barbus anoplus / Enteromius anoplus*), all of which are listed as Least Concern. During the assessment, smallmouth yellowfish and chubbyhead barb were observed, confirming that the river supports indigenous fish species and functional fish habitat.

The fish assemblage is interpreted as being broadly consistent with Ecological Category C: Moderately Modified, indicating that the system remains ecologically functional but has been modified from reference condition. The likely drivers of modification include localised sedimentation, channel and riparian disturbance, grazing, road crossings and rural land-use impacts.

Based on these factors, the overall ichthyofaunal sensitivity of the Blikana River system is considered to be Moderate. This rating reflects the confirmed presence of indigenous fish species and functional fish habitat, but also recognises that no threatened fish species were confirmed, the expected assemblage is composed of Least Concern species, and the fish community is already moderately modified.

Table 4-5: Site sensitivity verification results

| Sensitivity factor | Site-specific interpretation | Sensitivity rating |
|--|--|--------------------|
| Conservation status of expected fish species | Desktop-estimated assemblage includes Least Concern species only. | Low to Moderate |
| Confirmed indigenous fish presence | Smallmouth yellowfish and chubbyhead barb were observed, confirming fish-supporting habitat. | Moderate |
| Fish habitat availability | Pools, runs, riffles, marginal habitat and refuge areas are present and support indigenous fish. | Moderate |
| Current ecological condition | Fish assemblage interpreted as Category C: Moderately Modified. | Moderate |
| Existing disturbance pressures | Erosion, grazing, road crossings and rural land-use impacts have modified habitat condition. | Moderate |
| Flow dependence | Fish habitat depends on perennial flow and suitable low-flow conditions. | Moderate to High |
| Sensitivity to water quality deterioration | Fish may be affected by sediment, turbidity, spills, cement contamination, chemicals and poor stormwater management. | Moderate to High |
| Sensitivity to barriers and fragmentation | The proposed dam and pick-up weir may restrict fish movement and alter connectivity. | Moderate to High |
| Sensitivity at river crossings | Localised construction disturbance may affect fish habitat and movement. | Moderate |

6 Impact Significance & Risk Assessments

The ichthyofauna impact assessment focuses on the most important and most likely impacts associated with the proposed Blikana Dam Bulk Water Supply Scheme. The assessment considers impacts to fish species, fish habitat, fish movement, flow-dependent habitat and water quality.

For this report, five key ichthyofauna impacts were assessed:

- Sedimentation and increased turbidity affecting fish habitat;
- Construction-related water quality deterioration affecting fish;
- Temporary disturbance of fish habitat and fish movement;
- Altered flow regime affecting downstream fish habitat; and
- Barrier effects and conversion of riverine habitat to impounded habitat.

6.1 Sedimentation and increased turbidity affecting fish habitat

Table 6-1: Sedimentation and increased turbidity affecting fish habitat

| | | | |
|--|---|--|--|
| Issue 1 | Sediment mobilisation and increased turbidity during construction | | |
| Consequence of issue | Earthworks, trenching, vegetation clearing, exposed soils, access road use and stockpiling may result in sediment-laden runoff entering the Blikana River. Increased turbidity and sediment deposition may affect fish by reducing water clarity, covering substrates, filling pools, degrading refuge habitat and reducing feeding efficiency. This is especially relevant where works occur near the proposed dam, abstraction point, pick-up weir, river crossings and infrastructure located within or close to the aquatic buffer. | | |
| Number of impacts identified associated with this issue | 1 | | |
| Impact | Sedimentation and increased turbidity affecting fish habitat. | | |
| Phase | Construction phase | | |
| Nature of impact | Sediment from disturbed soils may enter fish-supporting habitat, increasing turbidity and causing deposition of fine material within pools, runs, riffles and marginal habitats. | | |
| Cumulative impact | Repeated sediment inputs may contribute to long-term habitat degradation, especially when combined with existing erosion, grazing and rural land-use pressures. | | |
| Indirect impacts | Reduced water clarity, reduced feeding efficiency, smothering of substrate, reduced refuge quality and deterioration of juvenile fish habitat. | | |
| Residual impacts | Minor short-term sedimentation risk may remain, particularly after rainfall, but should be manageable with erosion and sediment controls. | | |
| Classification of impact | Before mitigating | After mitigating | Consequence of impact |
| Duration of impact | 2 | 2 | Mainly construction-period impact, but deposited sediment may persist if not managed. |
| Extent of impact | 2 | 1 | May affect local downstream areas; reduced to localised effects with sediment controls. |
| Intensity of impact | 3 | 2 | Moderate effect on fish habitat before mitigation; reduced to low with controls. |
| Severity | 7 | 5 | Duration + extent + intensity. |
| Probability of impact occurring | 3 | 2 | Probable during earthworks; reduced with sediment control. |
| Frequency | 4 | 2 | Frequent during active construction and rainfall events; reduced with controls. |
| Incidence | 7 | 4 | Frequency + probability. |
| Degree of reversibility | Moderate | High | Sediment impacts can be reduced if erosion is controlled and disturbed areas are stabilised. |
| Irreplaceability | Low to Moderate | Low | Habitat functions can recover if sedimentation is not prolonged. |
| Mitigations | Mitigatory potential | Recommended mitigations | |
| | High | <ul style="list-style-type: none"> - Install erosion and sediment controls before earthworks begin. - Avoid major earthworks during heavy rainfall where possible. - Keep soil stockpiles outside drainage pathways and away from the river. - Stabilise exposed soils as soon as possible. - Maintain clean and dirty water separation. - Inspect erosion controls after rainfall events. - Rehabilitate disturbed areas immediately after construction. | |
| Significance of impact (Severity x Incidence) | Pre-mitigation significance | Post-mitigation significance | |
| | Low negative (49) | Very low negative (20) | |

6.2 Construction-related Water Quality Deterioration Affecting Fish

Table 6-2: Construction-related water quality deterioration affecting fish

| | | | |
|---|--|-------------------------|--|
| Issue 2 | Pollution and contaminated runoff during construction | | |
| Consequence of Issue | Accidental spills, cement wash water, hydrocarbons, chemicals, sewage, litter and contaminated runoff may enter the Blikana River during construction. Fish are sensitive to changes in water quality, particularly elevated turbidity, hydrocarbons, toxic substances, pH changes and reduced dissolved oxygen. | | |
| Number of impacts identified associated with this issue | 1 | | |
| Field | Detail | | |
| Phase of project | Construction Phase | | |
| Nature of impact | Pollutants may enter fish-supporting habitat and affect fish survival, respiration, feeding, movement and habitat suitability. | | |
| Cumulative impact | Repeated small pollution events may reduce habitat quality and affect fish condition over time. | | |
| Indirect impacts | Reduced habitat suitability, fish stress, reduced feeding activity and possible localised fish mortality under severe spill conditions. | | |
| Residual impacts | Very low residual risk if hazardous substances, cement wash water, waste and stormwater are properly managed. | | |
| Classification of impact | Before mitigating | After mitigating | Consequence of Impact |
| Duration of impact | 2 | 1 | Short-term to medium-term depending on pollutant type; reduced to immediate/short-term with response controls. |
| Extent of impact | 2 | 1 | May affect local downstream habitat; reduced to site-specific risk with controls. |
| Intensity of impact | 4 | 2 | Potentially harmful to fish before mitigation; reduced to low with pollution prevention. |
| Severity | 8 | 4 | Duration + Extent + Intensity |
| Probability of impact occurring | 3 | 2 | Possible to probable without controls; reduced with spill prevention and management. |
| Frequency | 3 | 1 | Could occur during construction; reduced to rare/once-off with controls. |
| Incidence | 6 | 3 | Frequency + Probability |
| Degree of reversibility | Moderate | High | Most impacts are reversible if spills are prevented or cleaned up immediately. |
| Irreplaceability | Moderate | Low | Severe pollution could affect fish, but risk is low with controls. |
| Mitigations | Mitigatory potential | | Recommended Mitigations |
| | High | | <ul style="list-style-type: none"> - No refuelling, servicing or chemical storage within the aquatic buffer. - Store hazardous substances in bunded areas. - Provide spill kits at all active work fronts. - Prohibit cement wash water from entering watercourses. - Provide sanitation facilities away from the river. - Implement a spill response procedure. - Remove construction waste from site regularly. |
| Significance of impact (Severity x Incidence) | Pre-mitigation significance | | Post-mitigation significance |
| | Low negative (48) | | Very low negative (12) |

6.3 Temporary disturbance of fish habitat and fish movement

Table 6-3: Temporary disturbance of fish habitat and fish movement

| | | | |
|---|---|-------------------------|--|
| Issue 3: | Temporary disturbance of fish-supporting habitat and movement pathways | | |
| Consequence of Issue | Construction activities at the proposed dam, abstraction infrastructure, pick-up weir, river crossings and pipeline sections near the river may temporarily disturb fish habitat and restrict movement. This may include disturbances of shallow margins, pools, runs, riffles, banks, channel substrates and local connectivity. | | |
| Number of impacts identified associated with this issue | 1 | | |
| Impact | Temporary disturbance of fish habitat and fish movement. | | |
| Phase | Operational Phase | | |
| Nature of impact | Changes in flow quantity, timing and variability may reduce fish habitat availability and affect movement, feeding, refuge use and recruitment. | | |
| Cumulative impact | Long-term flow alteration may combine with drought, climate variability, erosion and catchment disturbance to reduce fish habitat resilience. | | |
| Indirect impacts | Reduced downstream habitat quality, reduced pool connectivity, altered substrate condition and reduced ecological functioning. | | |
| Residual impacts | Residual impact may remain medium because flow alteration is inherent to dam and abstraction operation. | | |
| Classification of impact | Before mitigating | After mitigating | Consequence of Impact |
| Duration of impact | 5 | 5 | Long-term to project-life impact. |
| Extent of impact | 2 | 2 | May affect downstream reaches beyond the immediate infrastructure footprint. |
| Intensity of impact | 4 | 3 | High before mitigation; reduced to medium with ecological flow management. |
| Severity | 11 | 10 | Duration + extent + intensity |
| Probability of impact occurring | 4 | 3 | Almost certain without flow management; reduced if ecological flows are maintained. |
| Frequency | 5 | 4 | Continuous operational risk; reduced with managed releases. |
| Incidence | 9 | 7 | Frequency + Probability |
| Degree of reversibility | Low to Moderate | Moderate | Partly reversible through flow releases and adaptive management. |
| Irreplaceability | Moderate | Moderate | Fish habitat function may be reduced if ecological flows are not maintained. |
| Mitigations | Mitigatory potential | | Recommended mitigations |
| | Medium | | <ul style="list-style-type: none"> - Determine and implement ecological flow requirements. - Maintain downstream flow releases. - Avoid sudden flow cessation downstream of the dam or weir. - Manage abstraction to avoid excessive low-flow reduction. - Monitor downstream fish habitat condition. - Apply adaptive management if downstream habitat deterioration is observed. |
| Significance of impact (Severity x Incidence) | Pre-mitigation significance | | Post-mitigation significance |
| | Low negative (36) | | Very Low negative (12) |

6.4 Altered flow regime affecting downstream fish habitat

Table 6-4: Altered flow regime affecting downstream fish habitat

| | | | |
|--|--|-------------------------|--|
| Issue 4: | Flow alteration due to dam, pick-up weir and abstraction operation. | | |
| Consequence of Issue | Operation of the dam, pick-up weir and abstraction infrastructure may alter the natural flow regime of the Blikana River. This may affect downstream fish habitat through reduced flow depth, reduced connectivity between pools and runs, altered movement cues, changed sediment transport and reduced refuge habitat during low-flow periods. | | |
| Number of impacts identified associated with this issue | 1 | | |
| Impact | Altered flow regime affecting downstream fish habitat. | | |
| Phase | Operational Phase | | |
| Nature of impact | Changes in flow quantity, timing and variability may reduce fish habitat availability and affect movement, feeding, refuge use and recruitment. | | |
| Cumulative impact | Long-term flow alteration may combine with drought, climate variability, erosion and catchment disturbance to reduce fish habitat resilience. | | |
| Indirect impacts | Reduced downstream habitat quality, reduced pool connectivity, altered substrate condition and reduced ecological functioning. | | |
| Residual impacts | With implementation of ecological flow requirements, controlled abstraction, downstream releases and adaptive monitoring, residual impacts are expected to be reduced to low significance. | | |
| Classification of impact | Before mitigating | After mitigating | Consequence of Impact |
| Duration of impact | 5 | 4 | Long-term operational risk, reduced where ecological flow releases are maintained and monitored. |
| Extent of impact | 2 | 1 | Potentially affects downstream reaches; reduced to localised effects with managed releases. |
| Intensity of impact | 4 | 2 | High before mitigation; reduced to low where ecological flows and abstraction controls are implemented. |
| Severity | 11 | 7 | Duration + extent + intensity |
| Probability of impact occurring | 4 | 2 | Almost certain without controls; reduced to improbable/possible where ecological flow requirements are implemented. |
| Frequency | 5 | 3 | Continuous operational risk; reduced to periodic or manageable with controlled releases and monitoring. |
| Incidence | 9 | 5 | Frequency + Probability |
| Degree of reversibility | Low to Moderate | Moderate to High | Partly reversible through flow releases and adaptive management. |
| Irreplaceability | Moderate | Low | Fish habitat function can be maintained if ecological flows are implemented. |
| Mitigations | Mitigatory potential | | Recommended mitigations |
| | Medium | | <ul style="list-style-type: none"> - Determine and implement ecological flow requirements. - Maintain downstream flow releases. - Avoid sudden flow cessation downstream of the dam or weir. - Manage abstraction to avoid excessive low-flow reduction. - Monitor downstream fish habitat condition. - Apply adaptive management if downstream habitat deterioration is observed. - Include flow-release requirements in the operational management plan and water-use authorisation conditions. |
| Significance of impact (Severity x Incidence) | Pre-mitigation significance | | Post-mitigation significance |
| | Medium negative (99) | | Medium negative (52) |

6.5 Barrier effects and conversion of riverine habitat

Table 6-5: Barrier effects and conversion of riverine habitat

| | | | |
|--|--|-------------------------|--|
| Issue 5: | Long-term modification of riverine habitat and connectivity | | |
| Consequence of Issue | The proposed dam and pick-up weir may create permanent or semi-permanent barriers to fish movement and will modify flowing river habitat. The dam will convert a section of riverine habitat into impounded or slower-flowing habitat, while the weir may alter local hydraulics and restrict movement. This may affect fish access to refuge, feeding and breeding habitats and may reduce riverine habitat availability. | | |
| Number of impacts identified associated with this issue | 1 | | |
| Impact | Barrier effects and conversion of riverine habitat to impounded habitat. | | |
| Phase | Operational Phase | | |
| Nature of impact | Permanent structures may fragment fish habitat, restrict movement and convert flowing-water habitat into impounded or modified habitat. | | |
| Cumulative impact | This impact may combine with flow alteration, existing road crossings, low-flow periods and catchment disturbance to reduce habitat connectivity and fish assemblage resilience. | | |
| Indirect impacts | Reduced recolonisation potential, altered fish assemblage structure, reduced access to refuge habitat, increased alien/non-native fish risk and reduced flowing-water habitat availability. | | |
| Residual impacts | With design controls, maintenance of wetted connectivity, ecological flow releases, reduced vertical drops where feasible, and monitoring of upstream and downstream fish habitat, the residual impact is expected to reduce to low significance. | | |
| Classification of impact | Before mitigating | After mitigating | Consequence of Impact |
| Duration of impact | 5 | 4 | Long-term to permanent structures, but ecological effect can be reduced through design and operational controls. |
| Extent of impact | 2 | 1 | Local to downstream/upstream affected reaches; reduced to localised managed effects. |
| Intensity of impact | 4 | 2 | High barrier and habitat transformation effect before mitigation; reduced to low with fish-sensitive design and flow management. |
| Severity | 11 | 7 | Duration + extent + intensity |
| Probability of impact occurring | 4 | 3 | Almost certain before mitigation; reduced where design and operational measures maintain habitat continuity. |
| Frequency | 5 | 4 | Continuous while structures remain; reduced ecological effect with managed flow and design measures. |
| Incidence | 9 | 7 | Frequency + Probability |
| Degree of reversibility | Low | Moderate | Structural change remains, but ecological effects can be reduced by design and operational measures. |
| Irreplaceability | Moderate | Low to Moderate | Riverine habitat alteration remains localised, and downstream habitat function can be maintained with mitigation. |
| Mitigations | Mitigatory potential | | Recommended mitigations |
| | Medium | | <ul style="list-style-type: none"> - Consider fish movement requirements during final dam and weir design. - Avoid unnecessary vertical drops and high-velocity outlet structures. - Maintain wetted downstream connectivity. - Maintain downstream ecological flows. - Minimise impoundment footprint where feasible. - Prevent stocking of alien or extralimital fish species. - Maintain vegetated margins around the impoundment. - Monitor upstream and downstream fish habitat condition during operation. - Apply corrective action if habitat fragmentation or deterioration is observed. |
| Significance of impact (Severity x Incidence) | Pre-mitigation significance | | Post-mitigation significance |
| | Medium negative (99) | | Medium negative (49) |

6.6 Assessment of WTW Site Alternatives

Although both the preferred WTW site and Alternative 1 are located outside the recommended 50 m buffer of the Blikana River, the preferred site is considered more suitable from an aquatic perspective. This is because the preferred site is not associated with drainage lines or dongas, whereas Alternative 1 is associated with such features, which may facilitate the rapid conveyance of spills, contaminated runoff or sediment toward the Blikana River during rainfall events. The preferred site therefore presents a lower risk of indirect aquatic impact and is recommended as the preferred alternative.

6.7 Water Quality Management Plan

The following measures are recommended to protect fish and fish-supporting habitat in the Blikana River during construction and operation of the proposed BWSS. These measures are intended to prevent sedimentation, turbidity, hydrocarbon contamination, cement pollution, chemical spills, sewage contamination and contaminated stormwater from entering fish habitat:

- Construction materials, rubble, spoil and waste must be stored outside the recommended aquatic buffer and away from drainage pathways leading to the Blikana River.
- No soil, spoil, cement, rubble, concrete residue or general construction waste may be placed where it can be washed into the river, tributaries or drainage lines.
- Construction vehicles, plant and machinery must not be parked, serviced or refuelled within the aquatic buffer or close to drainage pathways, except where this is unavoidable for approved works and subject to strict controls.
- Drip trays must be used under stationary machinery where there is a risk of oil or fuel leakage.
- Fuels, oils, lubricants, chemicals and hazardous substances must be stored in bunded areas located away from the river and drainage pathways.
- Spill kits must be available at active work fronts, particularly near river crossings, abstraction works, the dam site, the pick-up weir and WTW-related construction areas.
- A spill response procedure must be implemented. Any spill must be contained immediately, contaminated material must be removed and disposed of appropriately, and the incident must be recorded and reported to the ECO or site manager.
- Concrete mixing, cement handling and washout must take place only in controlled areas. Cement wash water must not be discharged onto bare ground, into drainage lines or into the Blikana River.
- Adequate ablution facilities and waste bins must be provided for construction workers and serviced regularly to prevent sewage, greywater and litter from entering fish habitat.
- Erosion and sediment control measures, including silt fences, berms, sediment traps and stormwater diversion controls, must be installed before major earthworks begin.
- Exposed soils must be stabilised as soon as possible, and disturbed riverbanks or margins must be rehabilitated immediately after construction.
- Clean and dirty water must be separated during construction and operation. Runoff from potentially contaminated areas must not be discharged untreated into the Blikana River.
- During operation, the WTW must be operated and maintained to prevent leaks, untreated discharges, chemical spills, sludge/process water runoff or contaminated stormwater from entering the river.
- Basic downstream water quality monitoring should include, where practical, temperature, pH, electrical conductivity, dissolved oxygen and visible turbidity, particularly upstream and downstream of key infrastructure.

- Any visible pollution, fish distress, fish mortality, unusual turbidity, oil sheen, foam, cement residue or discolouration in the river must trigger immediate investigation and corrective action.

7 Conclusion

This Ichthyofauna Impact Assessment assessed the potential effects of the proposed Blikana Dam Bulk Water Supply Scheme on freshwater fish species, fish habitat, fish movement and river connectivity within the Blikana River system. The assessment focused on the project components most relevant to fish ecology, including the proposed dam, abstraction infrastructure, pick-up weir, river crossings, pipeline sections near the river, and operational areas that may affect flow or water quality.

The Blikana River was confirmed to support indigenous fish species, namely smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*). The presence of these species confirms that the river provides functional fish-supporting habitat and should not be treated as an ecologically insignificant drainage feature. Desktop information also identifies rock-catfish (*Austroglanis sclateri*) as part of the expected fish assemblage for the reach, although this species was not confirmed during the assessment.

The fish assemblage is interpreted as broadly consistent with Ecological Category C: Moderately Modified. This indicates that the Blikana River remains ecologically functional and supports indigenous fish, but has been modified from natural reference condition. The likely drivers of modification include localised erosion, grazing, road crossings, sedimentation, riparian or channel disturbance and rural land-use pressures.

The overall ichthyofaunal sensitivity of the Blikana River is considered Moderate. This rating is considered appropriate because the river supports indigenous fish and functional habitat, but no threatened fish species were confirmed and the expected fish assemblage consists of Least Concern species. Nevertheless, the active river channel, deeper pools, riffle-run areas, proposed dam, pick-up weir, abstraction points and river crossings should be treated as sensitive fish habitat interaction zones because these areas may directly influence fish habitat, movement, flow and water quality.

The impact assessment identified three main construction-phase impacts: sedimentation and increased turbidity, construction-related water quality deterioration, and temporary disturbance of fish habitat and movement. These impacts are considered manageable and are expected to reduce to Very Low negative significance after mitigation. The most important management measures include strict footprint control, erosion and sediment control, pollution prevention, protection of river margins, maintenance of flow continuity during in-channel works and rehabilitation of disturbed areas.

The main operational-phase impacts are altered flow regime and barrier effects associated with conversion of riverine habitat to impounded or modified habitat. These impacts are linked to the proposed dam, pick-up weir and abstraction infrastructure. With effective mitigation, including ecological flow releases, controlled abstraction, fish-sensitive design considerations, monitoring and prevention of alien or extralimital fish introductions, these impacts are expected to reduce to Low negative significance.

From an ichthyofauna perspective, the proposed development is not considered fatally flawed, provided that the recommended mitigation measures and monitoring requirements are implemented. The proposed BWSS should proceed only with strict management of construction activities near the river, protection of water quality, maintenance of downstream flow, prevention of sedimentation, rehabilitation of disturbed fish habitat margins and operational monitoring of fish-supporting habitat.

7.1 Specialist Opinion

Based on the findings of this Ichthyofauna Impact Assessment, it is the specialist's opinion that the proposed Blikana Dam Bulk Water Supply Scheme is acceptable from an ichthyofauna perspective, subject to the implementation of the recommended mitigation, management and monitoring measures contained in this report.

The Blikana River supports indigenous fish species and functional fish habitat. The fish assemblage is interpreted as moderately modified but still ecologically significant, with confirmed occurrence of smallmouth yellowfish (*Labeobarbus aeneus*) and chubbyhead barb (*Enteromius anoplus*). The system therefore retains fish habitat value and must be managed to avoid further degradation of flow, habitat quality, water quality and connectivity.

No confirmed threatened fish species were recorded during the assessment, and the desktop-estimated fish assemblage for the Blikana River consists of Least Concern species. However, the absence of threatened species does not remove the need to protect indigenous fish habitat. The ecological importance of the river in this assessment is linked to its role as a perennial fish-supporting system, its habitat features, its connectivity and its contribution to indigenous fish assemblage persistence.

The most important ichthyofauna risks are associated with the proposed dam, pick-up weir, abstraction infrastructure and river crossings. These components may affect fish through altered flow, reduced connectivity, conversion of flowing river habitat, sedimentation, turbidity and water quality deterioration. These risks are not considered unacceptable, provided that the recommended mitigation measures are implemented and incorporated into the EMP, WULA conditions and operational management requirements.

The proposed preferred WTW site is supported from an ichthyofauna perspective where it presents a lower indirect risk pathway to the Blikana River compared with alternatives associated with drainage lines, dongas or stronger hydrological connectivity to fish-supporting habitat. The final layout should continue to avoid drainage features and areas where contaminated runoff or sediment could be rapidly conveyed to the river. The following conditions are recommended from an ichthyofauna perspective:

- ecological flow requirements must be determined and implemented for downstream reaches;
- abstraction must be managed to avoid excessive reduction of low flows;
- the dam, pick-up weir and abstraction infrastructure must be designed and operated to maintain downstream wetted habitat as far as reasonably practicable;
- river crossings and in-channel works must be undertaken under strict method statements and environmental supervision;
- sediment and erosion controls must be installed before construction begins and maintained throughout construction;
- no cement wash water, hydrocarbons, chemicals, sewage or contaminated runoff may enter the Blikana River;
- disturbed banks, river margins and crossing areas must be rehabilitated immediately after construction;
- alien or extralimital fish species must not be stocked into the dam, weir pool or associated watercourses;
- fish habitat and basic water quality monitoring must be undertaken during construction and operation; and
- corrective action must be implemented immediately if sedimentation, pollution, fish distress, flow interruption or habitat deterioration is observed.

Subject to these conditions, the residual ichthyofauna impacts are expected to be manageable. The construction-phase impacts are expected to reduce to Very Low negative significance after mitigation, while the operational impacts associated with flow alteration and habitat modification are expected to reduce to Low

negative significance if ecological flow management, fish-sensitive design considerations and monitoring are implemented.

It is therefore the specialist's opinion that the proposed Blikana BWSS may be authorised from an ichthyofauna perspective, provided that all recommended mitigation and monitoring measures are implemented and that the competent authority includes appropriate fish habitat, water quality, erosion control and ecological flow requirements in the relevant authorisation conditions.

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