Maintenance of the Road TR03105 from Ladismith to Calitzdorp (km 0.9 to km 47.63), Western Cape

Freshwater Assessment

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EXECUTIVE SUMMARY

The Western Cape Government: Department of Public Works – Roads Branch (the applicant) is planning to undertake maintenance of the road TR03105 from Ladismith to Calitzdorp (km 0.9 to km 47.63), Western Cape (Figure 1). Maintenance activities will include the pre-treatment and application of a new surfacing and appurtenant works that include, *inter alia,* the following:

- Pre-treatment of road repairs (surfacing / base repairs);
- Drainage structures (minor culverts and side drains);
- Minor repairs to structures (major culverts and bridges);
- Cleaning and clearing of minor and major culverts;
- Fencing repairs;
- Guardrail repairs; and
- Replacement of road signs (where applicable) etc.

The road crosses numerous watercourses and the nature of the proposed rehabilitation activities trigger activities listed under the National Environmental Management Act (NEMA) and the National Water Act (NWA).

Travelling in the direction of Ladismith to Calitzdorp (in an easterly direction) the road generally passes through valleys and plains with higher hills and mountains to the north and south. Numerous non-perennial watercourses originate from these areas of higher elevation and cross the road and converge with the larger perennial rivers further downstream. Without exception, all of these watercourses can be classified as non-perennial rivers, with clearly discernible bed and banks, that are characterised by a highly intermittent hydroperiod (i.e. flowing for a short period – hours to a few days - only after heavy rainfall events in the catchment area). The size of these watercourses varied from minor, first order drainage lines (approximately one meter in width) to broader second and third order streams (up to 5 m in width). The Present Ecological State (PES) of these streams ranges from natural (A) to largely modified (D) and their Ecological Importance and Sensitivity (EIS) is low. In addition, the road crosses the perennial Huis, Gamka and Nels rivers, which offer a wide diversity of instream and riparian habitat and are important for supporting aquatic biodiversity (particularly fish species). The PES of these rivers ranges from moderately (C) to largely modified (D) and their EIS is high.

Proposed maintenance activities are considered routine and maintenance of culverts in particular is viewed as essential for ensuring their intended purpose, which is to maintain unimpeded flows through these structures and avoid unnecessary erosion and scouring of the bed and banks of watercourses. It can be concluded, with a high degree of certainty, that the proposed maintenance activities can be mitigated to an acceptable level and that the risk of these activities to affected watercourses is Low. It is therefore recommended that environmental authorisation for the activities associated with the road maintenance should be granted. In terms of the NWA, considering the Low risk associated with all construction and operational phase activities the rehabilitation plan qualifies for a General Authorisation.

Declaration of Specialist Independence

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- 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 members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. 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 investigators.
- All the particulars furnished by me in this document are true and correct.

Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources; SACNASP Reg. No: 114084)

November 2025

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Project Background

The Western Cape Government: Department of Public Works – Roads Branch (the applicant) is planning to undertake maintenance of the road TR03105 from Ladismith to Calitzdorp (km 0.9 to km 47.63), Western Cape (Figure 1). Maintenance activities will include the pre-treatment and application of a new surfacing and appurtenant works that include, *inter alia,* the following:

- Pre-treatment of road repairs (surfacing / base repairs);
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- Fencing repairs;
- Guardrail repairs; and
- Replacement of road signs (where applicable) etc.

The road crosses numerous watercourses and the nature of the proposed maintenance activities trigger activities listed under the National Environmental Management Act (NEMA) and the National Water Act (NWA). The scope of work for this report is therefore defined by the legislative requirements of these respective acts.

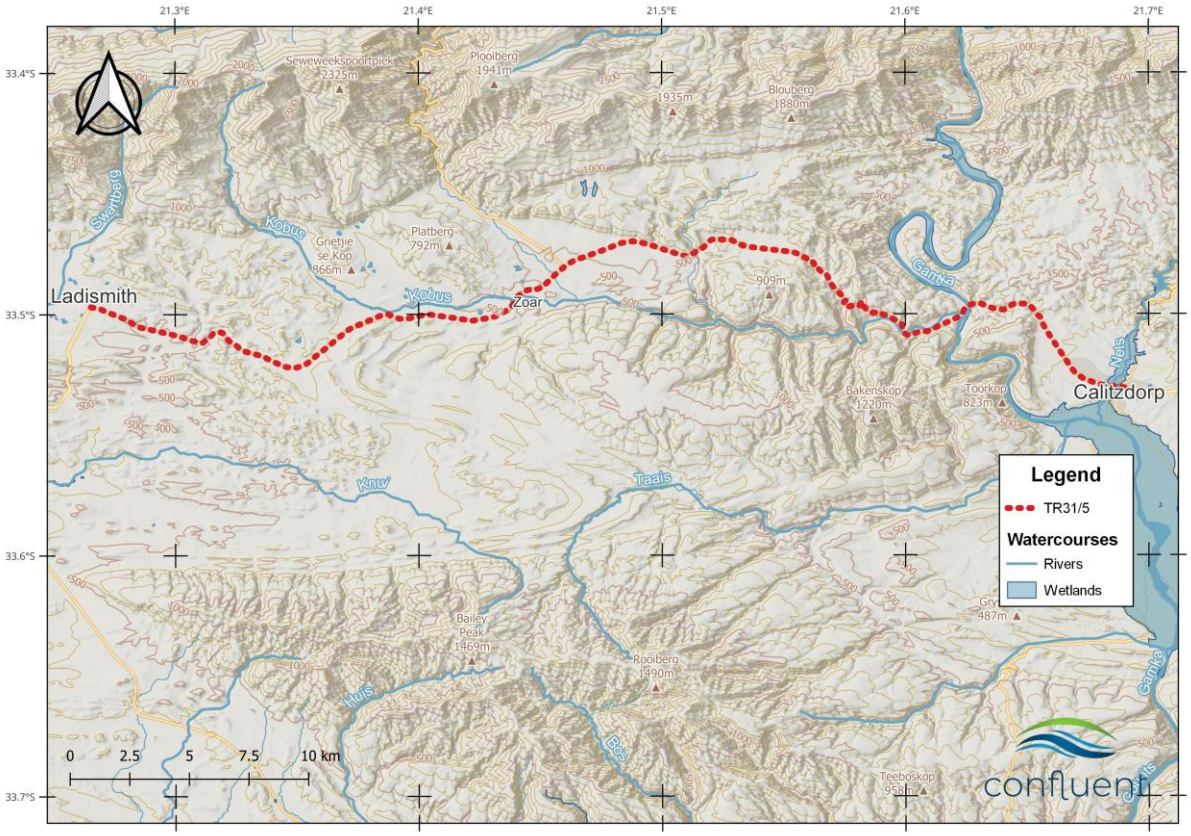


Figure 1: Map indicating the section of the TR31/5 that will undergo maintenance.

1.2 Key Legislative Requirements

1.2.1 National Environmental Management Act (NEMA, 1998)

A Management and Maintenance Plan (MMP) is a document that describes maintenance activities that need to take place within a watercourse. The MMP specifically relates to Activities 19 and 27, as listed in the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA) Environmental Impact Assessment (EIA) Regulations Listing Notice 1 of 2014 (GN R. 327), as amended. In line with the MMP, infilling or removal of more than 10 m^3 material within a watercourse, and/or the clearance of 1 ha or more of indigenous vegetation, are allowed only if the works are undertaken for maintenance purposes AND form part of the EMMP when approved by the Department of Environmental Affairs and Development Planning (DEA&DP).

1.2.2 National Water Act (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) aims to protect water resources, through:

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

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, a Water Use License (WUL) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

Rehabilitation activities along the road will require work to be undertaken at numerous river crossings all of which fall within the regulated area of a watercourse. Any water use activities that do occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix (GN4167) to determine whether activities may be generally authorised (Low Risk according to the Risk Assessment Matrix) or require a WUL (Medium or High Risk according to the Risk Assessment Matrix).

1.3 Scope of Work

Based on the key legislative requirements listed above, the scope of work for this report includes the following:

- A desktop review of freshwater features and provincial and national freshwater conservation plans relevant to the site;
- Undertake a site visit to the study area to verify the sensitivity of aquatic biodiversity affected by maintenance activities; and
- Compile an aquatic biodiversity assessment report that meets the requirements of the both the NEMA and the NWA.

2 METHODS

2.1 Watercourse Assessment

A desktop assessment was conducted to contextualize the affected watercourses in terms of their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel at al., 2011);
- National Wetland Map 5 and Confidence Map (CSIR, 2018);
- Western Cape Biodiversity Spatial Plan (CapeNature, 2023); and
- DWS hydrological spatial layers.

A site visit was conducted on the 17th of September 2025, with the objective of identifying and classifying watercourses affected by maintenance activities, determining their Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), and assessing the impacts of the maintenance activities on these watercourses.

2.1.1 Watercourse Classification

Watercourses were classified based on their hydrological and geomorphological characteristics which provides a fundamental understanding of the drivers that characterize each watercourse and therefore assists in the interpretation of impacts to the watercourse. The classification of the watercourse also determines which PES and EIS assessment methodologies can be applied. Each watercourse was categorised into discrete hydrogeomorphic units (HGMs) based on its geomorphic characteristics, source of water and

pattern of water flow through the watercourse. These HGMs were then classified according to Ollis et al. (2013).

2.1.2 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of affected watercourses was assessed using the Index of Habitat Integrity (IHI) (see Appendix 1).

2.1.3 Ecological Importance and Sensitivity

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. The EIS of affected watercourses was assessed using methods described in Appendix 2.

3 DESKTOP ASSESSMENT

The TR31/5 road connects Ladismith to Calitzdorp and passes through several quaternary catchments: J11K, J25B, J25A and J25D (Figure 2). The entire road alignment falls within the Southern Folded Mountains ecoregion which is characterized by parallel hills and low mountains (altitude ranging from 100 to 1300 m.a.m.s.l). Numerous non-perennial streams drain these mountains down towards the lowland areas (Figure 3 to Figure 5). The majority of the road alignment runs along the lower elevation of these hills, while a short stretch does traverse the scenic Huisrivier Pass. Rainfall for the ecoregion is low, ranging from 365 mm in the east to 220 mm per annum in the west. The road crosses several perennial river systems, including the Huis River (J25B), the Gamka River (J25A) and the Nels River, which passes through the town of Calitzdorp (J25D). Vegetation is predominantly a mixture of karoo renosterveld, fynbos and thicket, all of which is Least Concern. The Nels River (flowing through Calitzdorp) is associated with the Muscadel Riviere vegetation type, which is classified as Critically Endangered.

Long sections of the road are associated with highly erodible soils (predominantly the western half of the road alignment; Figure 6) which are minimally developed, usually shallow on hard or weathering rock. Moderately erodible soils are associated with rocky areas with very limited soil development and occur more along the eastern half of the road alignment.

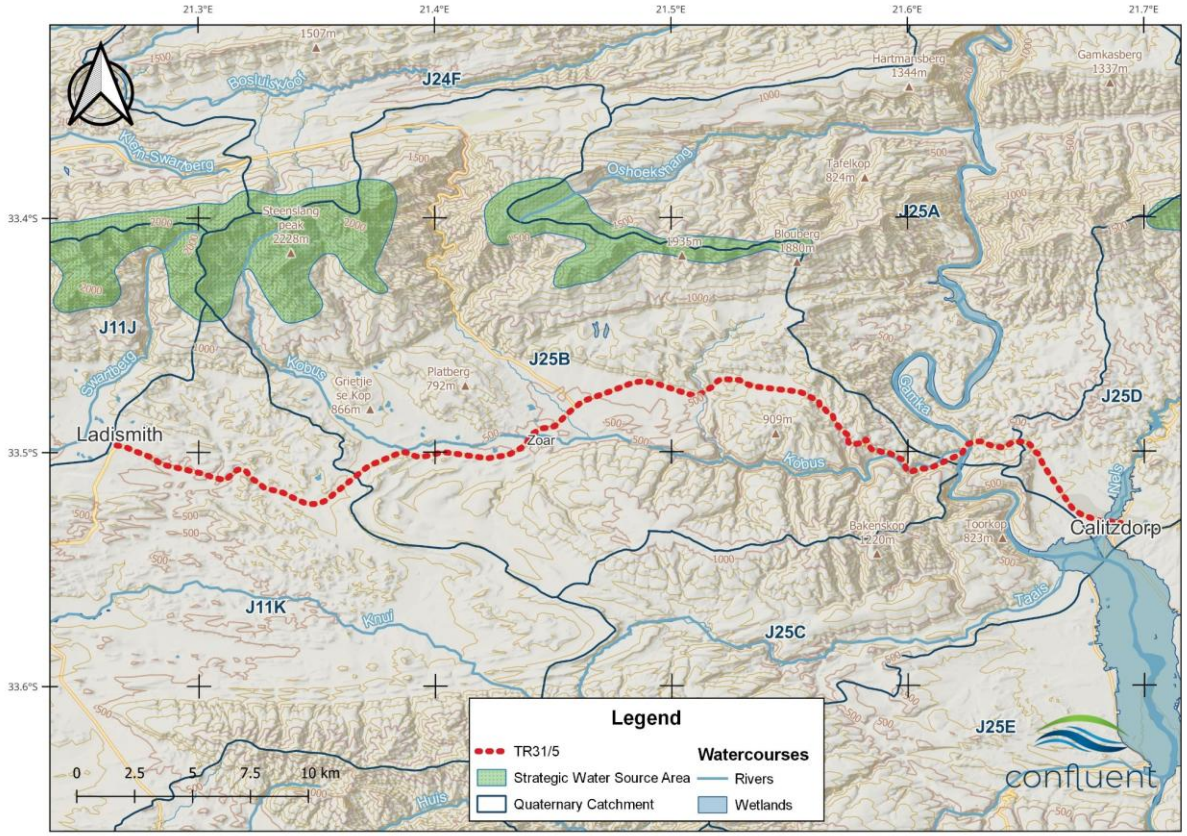


Figure 2: Location of the TR31/5 relative to main rivers and quaternary catchments.

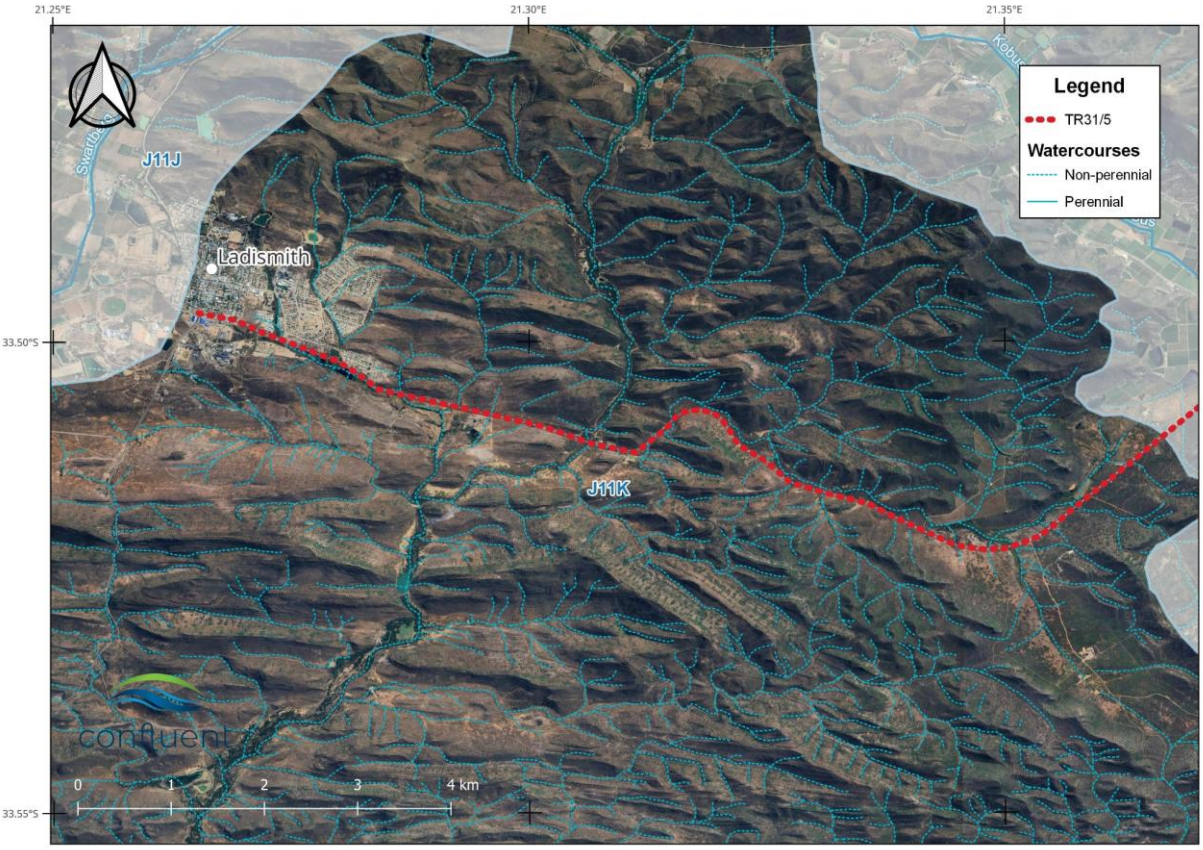


Figure 3: Mapped watercourses in quaternary catchment J11K.

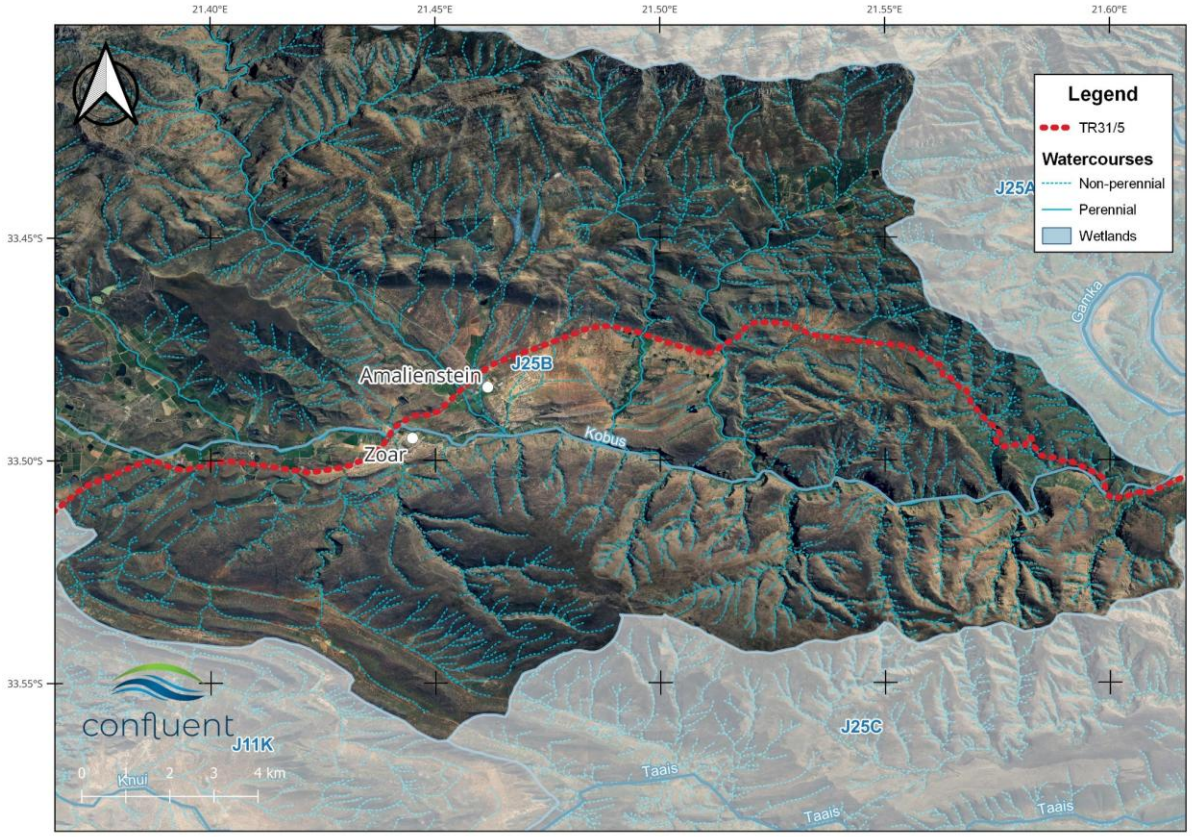


Figure 4: Mapped watercourses in quaternary catchment J25B

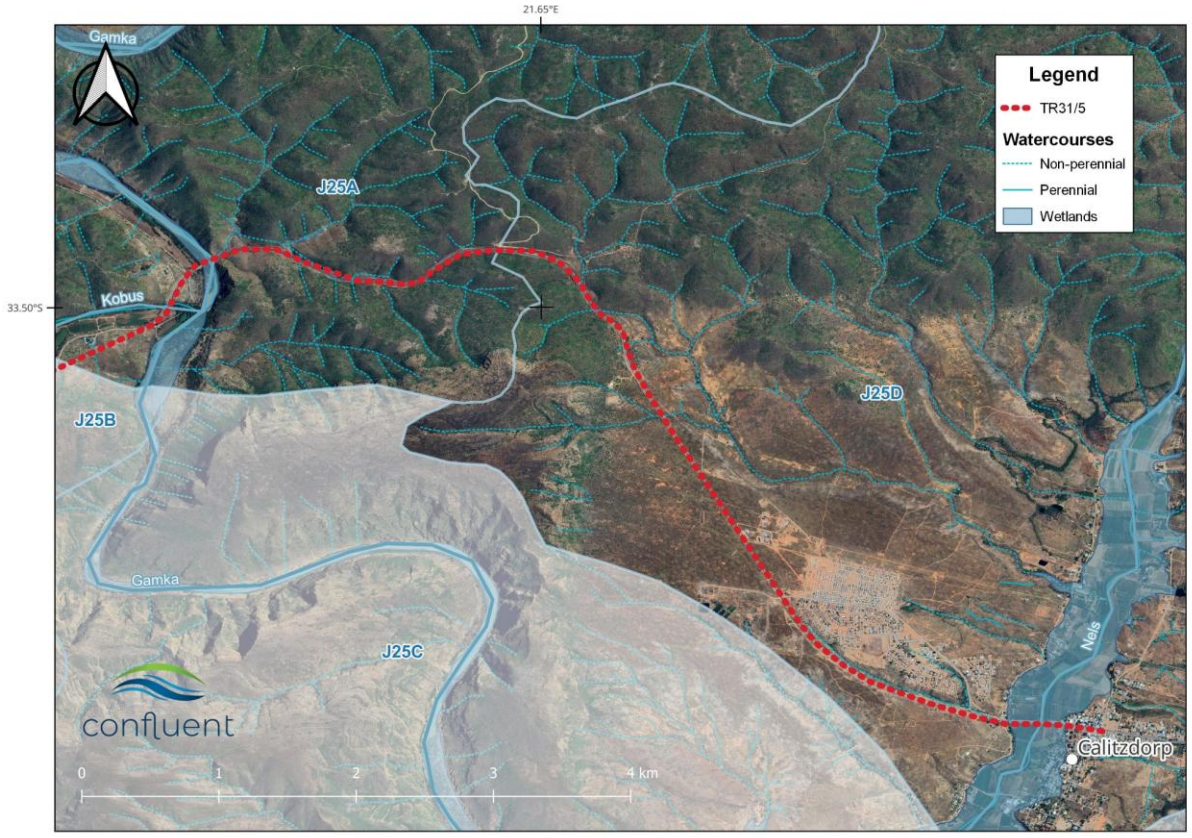


Figure 5: Mapped watercourses in quaternary catchments J25A and J25D.

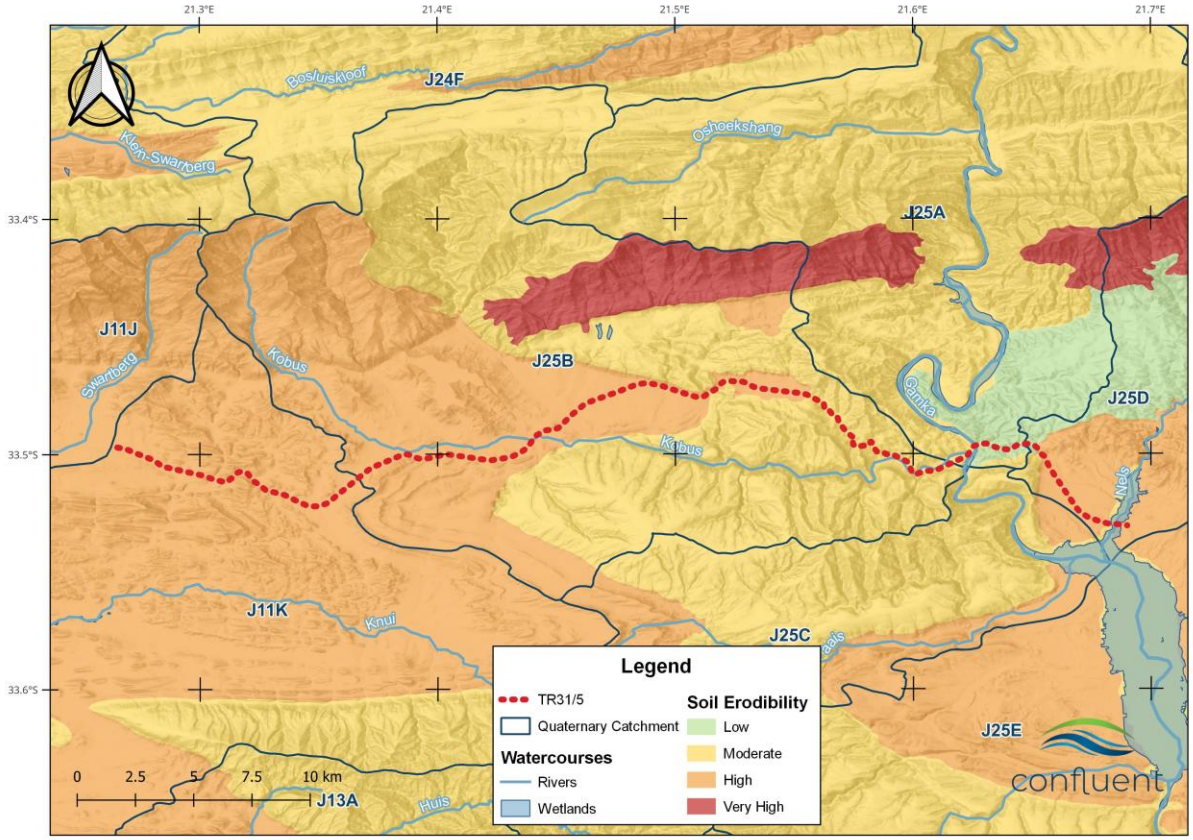


Figure 6: Map show soil erodibility classes along the alignment of the TR31/5.

3.1 Freshwater Conservation & Management

3.1.1 National Freshwater Ecosystem Priority Atlas (NFEPA)

The majority of the road alignment is located within sub-quaternary catchments (SQCs), that, according to the National Freshwater Ecosystem Priority Atlas (NFEPA, Nel et al., 2011), have been classified as Fish Support Areas (FSAs). FSAs are SQCs that are not necessarily in a good ecological condition but are still essential for protecting threatened or near-threatened freshwater fish species that are indigenous to South Africa. The management goal of FSAs is to prevent additional fish species from becoming threatened or to prevent threatened or near-threatened species from becoming extinct. In order to achieve these objectives, there should be no further deterioration in river condition. Important fish species that are known to occur in the SQCs include:

Table 1: Fish species expected to occur in perennial rivers

Scientific Name	Common Name	Threat Status	Description
Pseudobarbus asper	Smallscale redfin	Vulnerbale	Endemic to South Africa, restricted to the Gouritz and Gamtoos River systems
Pseudobarbus tenuis	Slender redfin	Near-threatened	Endimic to Western Cape, restricted to Gouritz River system
Galaxias zebratus	Cape galaxias	Data Deficient	Largely restricted to Western Cape, several distinct genetic lineages recently discovered, many of which are likely to be novel species

Scientific Name	Common Name	Threat Status	Description
Labeobarbus aeneus	Smallmouth yellowfish	Least Concern	Occurs naturally in the Vall-Orange system, extra-limital in the Western Cape
Enteromius anopolus	Chubbyhead Barb	Least Concern	Widespread throughout South Africa

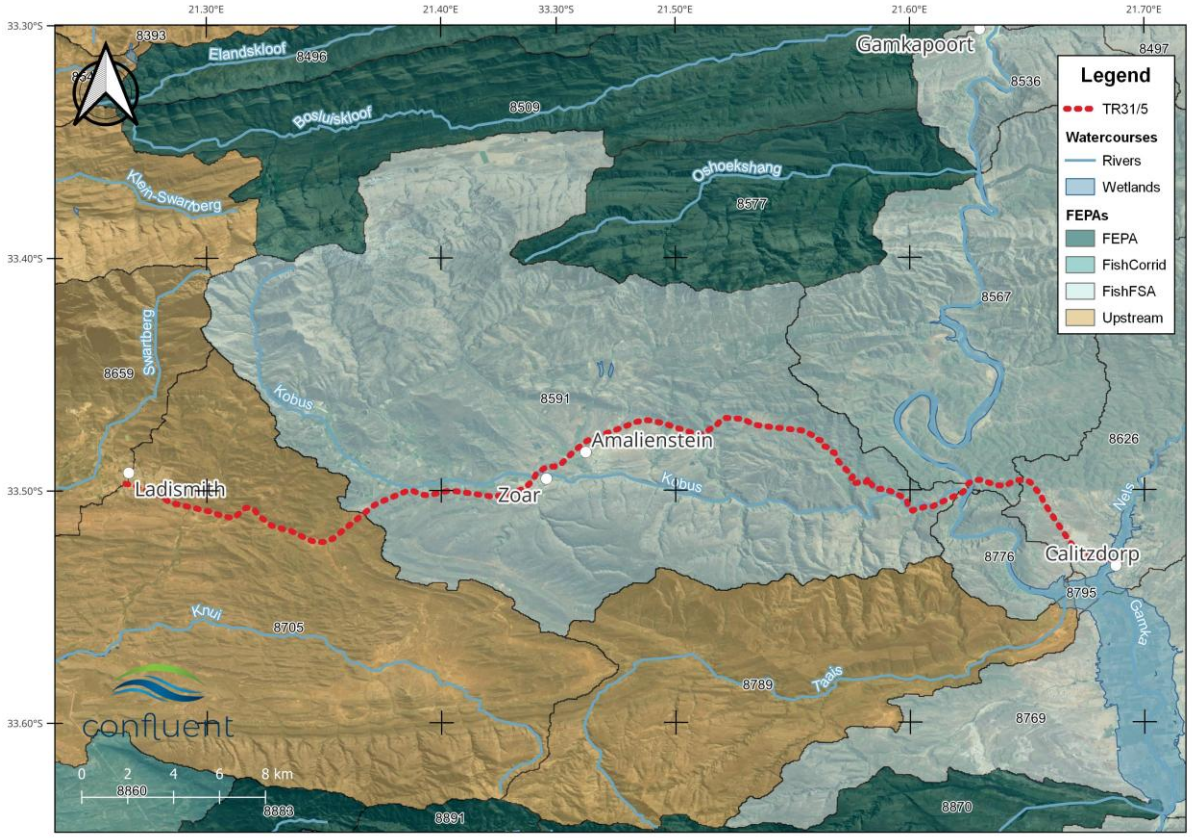


Figure 7: Map indicating the location the TR31/5 road in relation to mapped FEPAs and watercourses.

3.2 Western Cape Biodiversity Spatial Plan

The main purpose of a biodiversity spatial plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land use and development planning, environmental assessments and authorisations, natural resource management and other multi-sectoral planning processes. The WCBSP plan achieves this by providing a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

According to the WCBSP the major perennial rivers (Nels, Huis, Gamka and Nels (at Calitzdorp) crossed by the TR31/5 have been categorized as natural aquatic CBAs (Figure 8 to Figure 10). The Seweweekspoort River and all minor non-perennial rivers crossing the TR31/5 have been categorized as natural ESAs. The definitions and associated management objectives of these biodiversity features are described in Table 2. The management objectives for ESAs allow for some habitat loss provided that the ecological function of these watercourses is not compromised. Low impact activities within CBAs are considered acceptable. Maintenance of existing road infrastructure (including maintenance or extension of culverts) can therefore be considered as an acceptable activity within the context of these objectives.

Table 2: Descriptions and management objectives of mapped biodiversity planning units.

Biodiversity Unit	Description	Management Objective
Aquatic ESA1	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.
Aquatic CBA1	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

Figure 8: Map of the section of the Western Cape Biodiversity Spatial Plan (WCBSP) in quaternary catchment J11K.

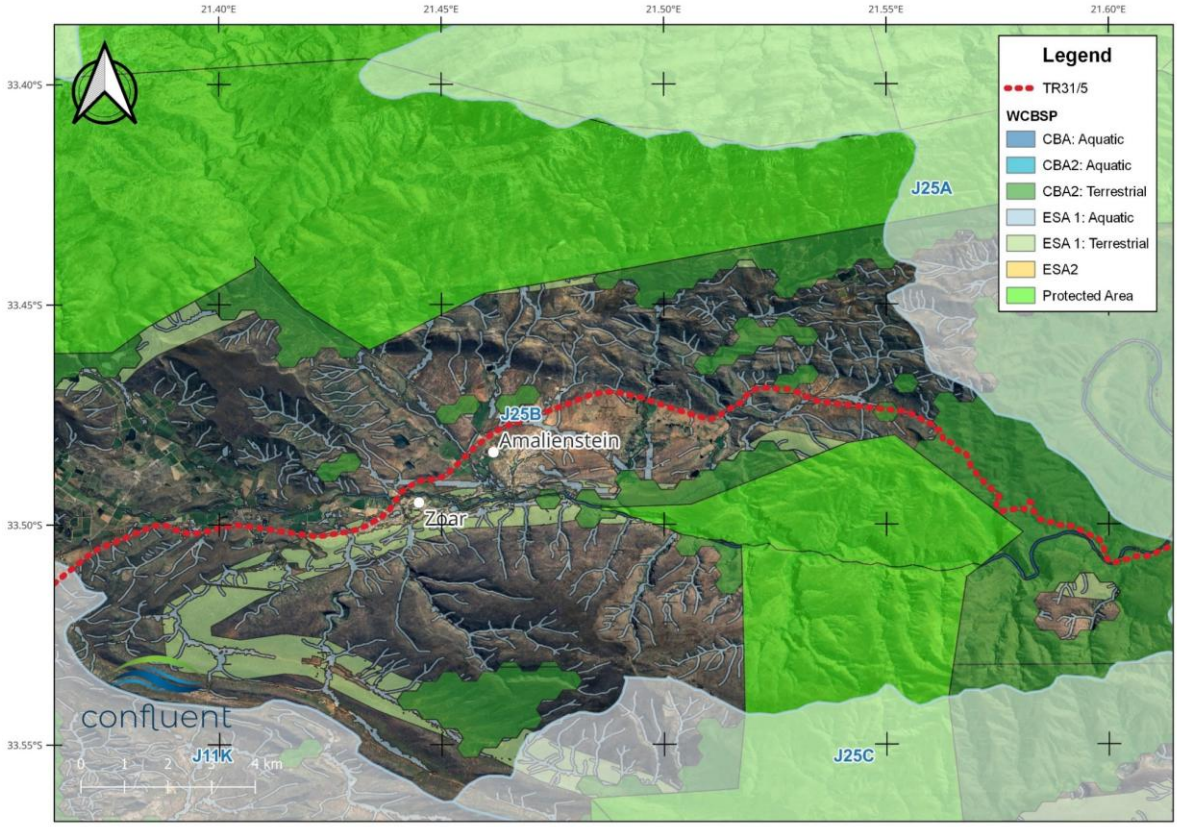


Figure 9: Map of the section of the Western Cape Biodiversity Spatial Plan (WCBSP) in quaternary catchment J25B.

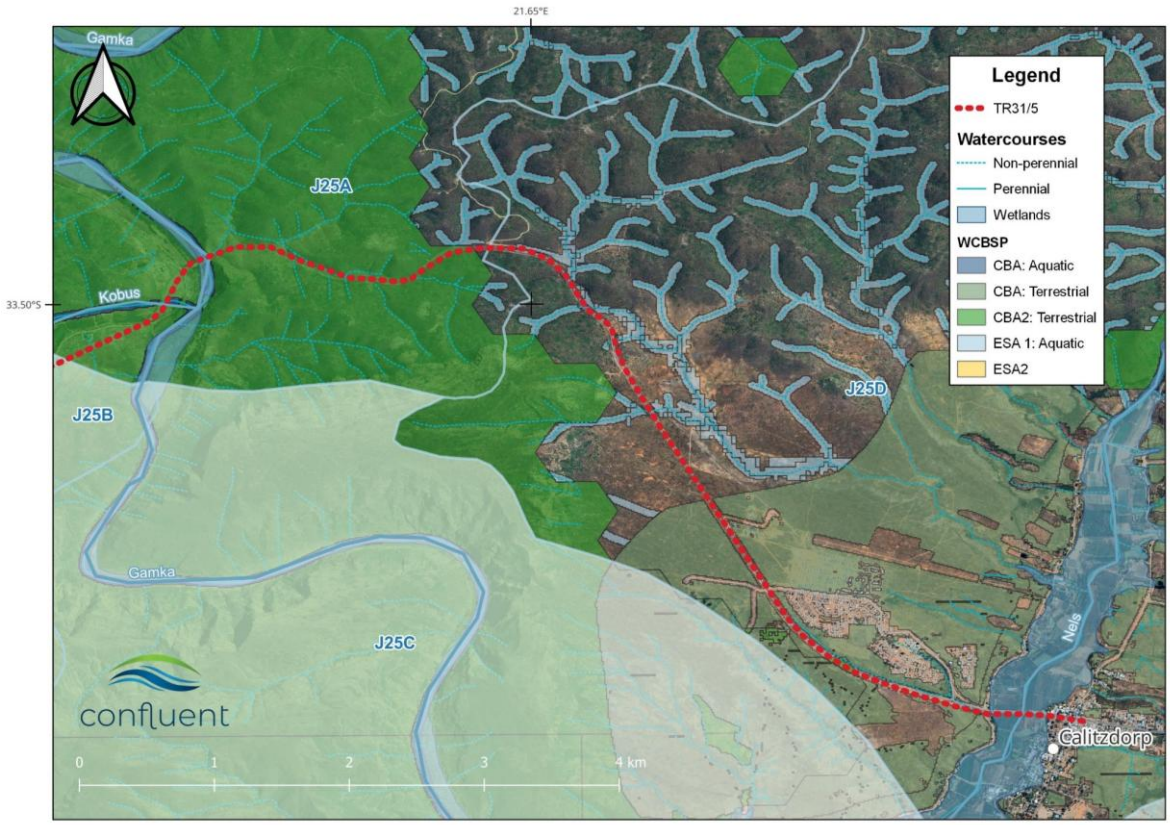


Figure 10: Map of the section of the Western Cape Biodiversity Spatial Plan (WCBSP) in quaternary catchment J25A and J25D.

4 WATERCOURSE ASSESSMENT

4.1 Minor Rivers & Streams

4.1.1 Watercourse Classification

Travelling in the direction of Ladismith to Calitzdorp (in an easterly direction) the road generally passes through valleys and plains with higher hills and mountains to the north and south. Numerous non-perennial watercourses originate from these areas of higher elevation and cross the road and converge with the larger perennial rivers further downstream. Without exception, all of these watercourses can be classified as non-perennial rivers, with clearly discernible bed and banks, that are characterised by a highly intermittent hydroperiod (i.e. flowing for a short period – hours to a few days - only after heavy rainfall events in the catchment area). The size of these watercourses varied from minor, first order drainage lines (approximately one meter in width) to broader second and third order streams (up to 5 m in width). A brief classification of each watercourse is provided in Table 4.

All watercourses identified in the field cross the TR31/5 road via formalised culverts and ultimately flow into the larger perennial systems draining each of the catchments. Some mapped first order watercourses had been filled in completely during the historical construction of the road and there was no culvert associated with the watercourse. These watercourses were not marked in Figure 11 to Figure 13 as no culvert maintenance would be required on these. Numerous culverts constructed for stormwater drainage were observed along the road. These function purely as conduits to drain stormwater beneath the road surface and are not associated with a watercourse – these have also not been marked in Figure 11 to Figure 13 as they are not considered as natural watercourses

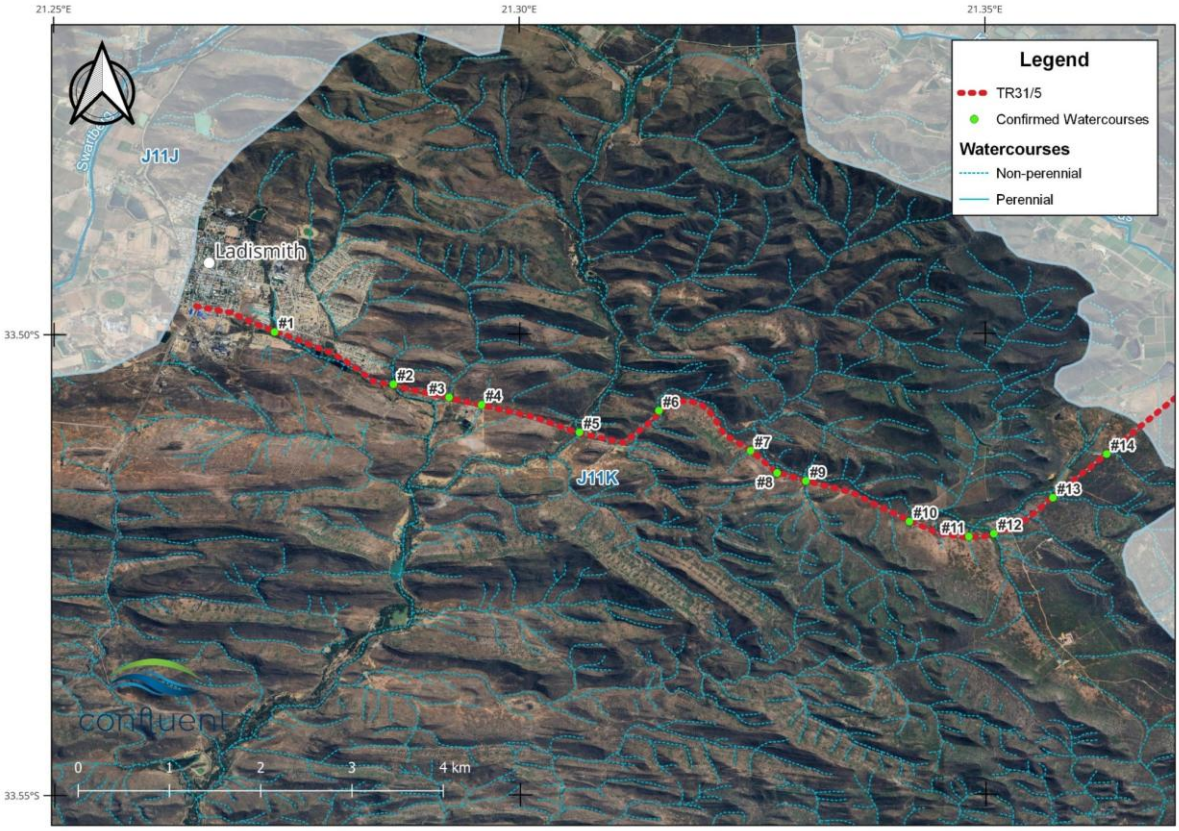


Figure 11: Confirmed watercourses in quaternary J11K where maintenance of culverts or bridges could be required.

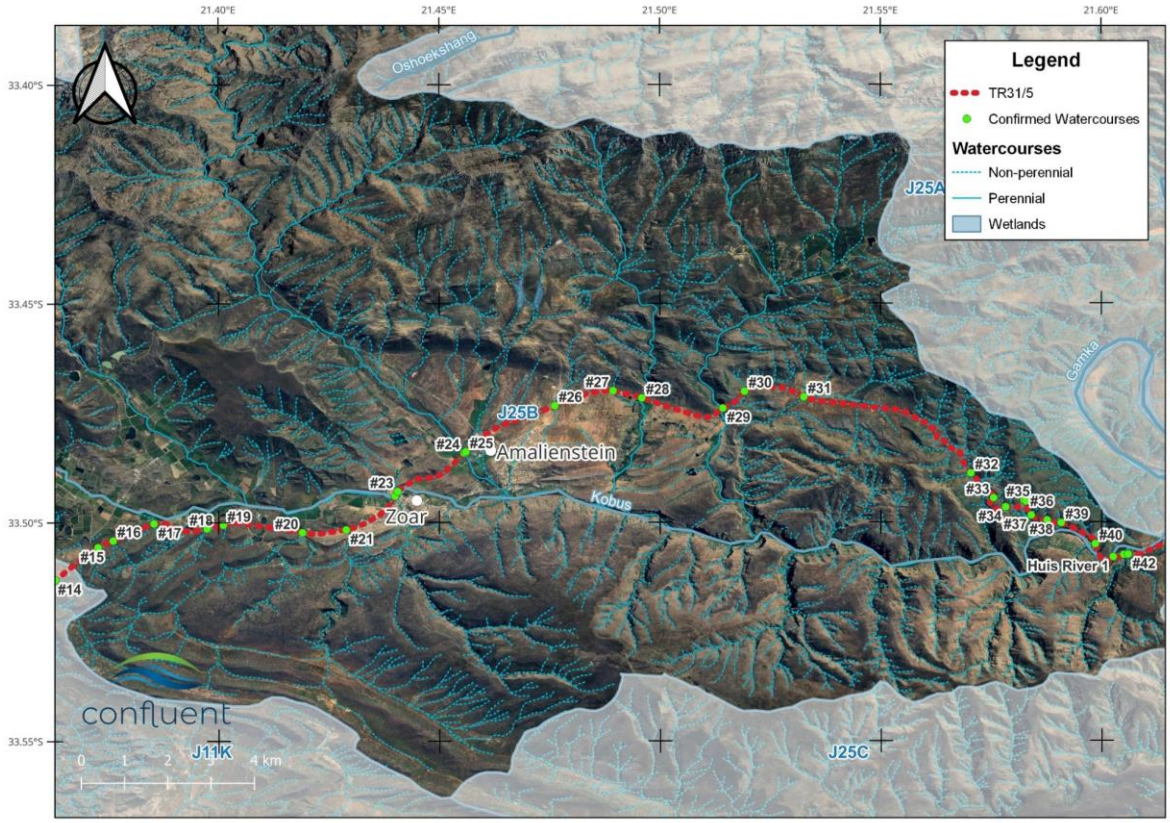


Figure 12: Confirmed watercourses in quaternary J25B where maintenance of culverts or bridges could be required.

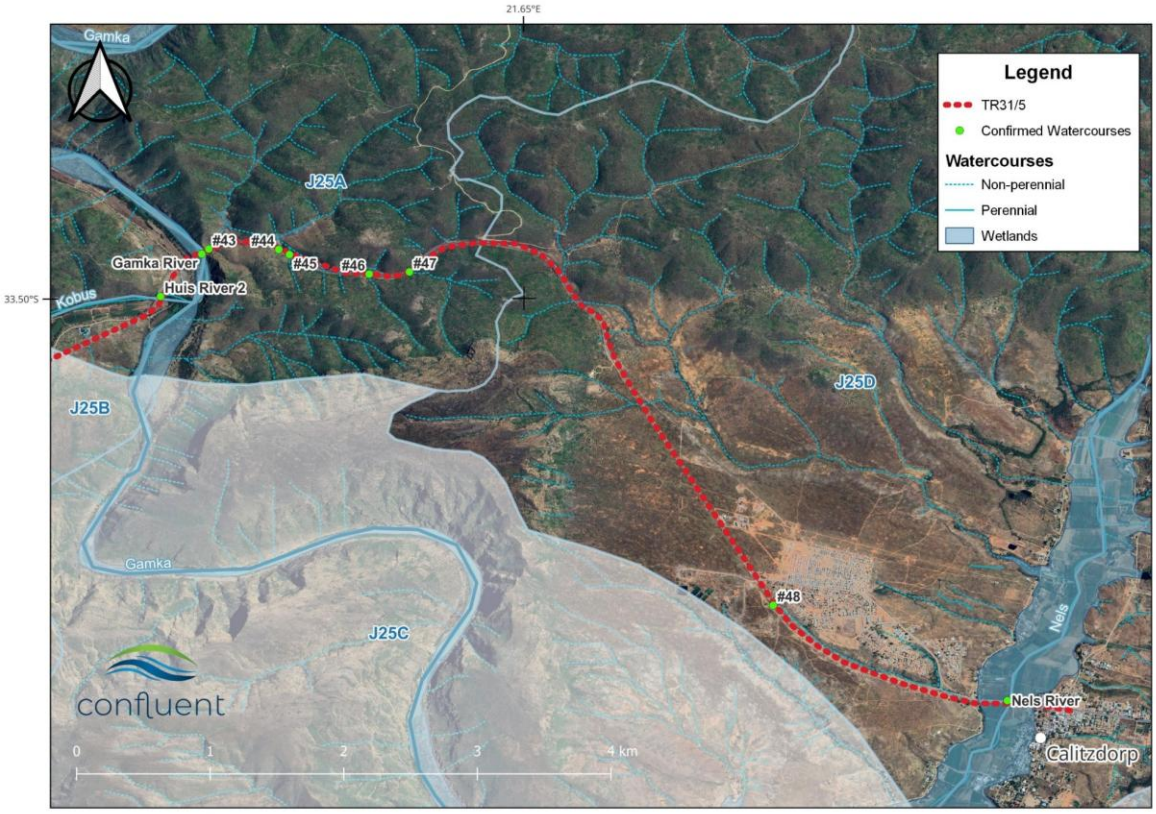
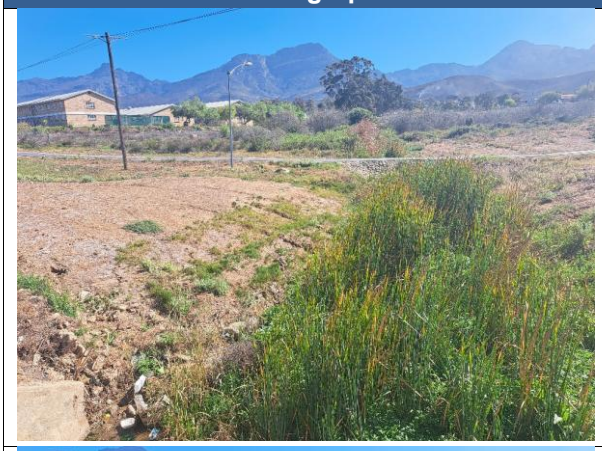


Figure 13: Confirmed watercourses in quaternaries J25A and J25D where maintenance of culverts or bridges could be required.

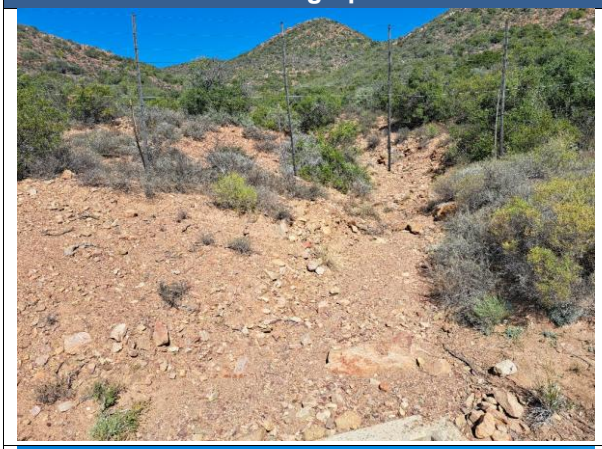
4.1.2 Present Ecological State (PES)

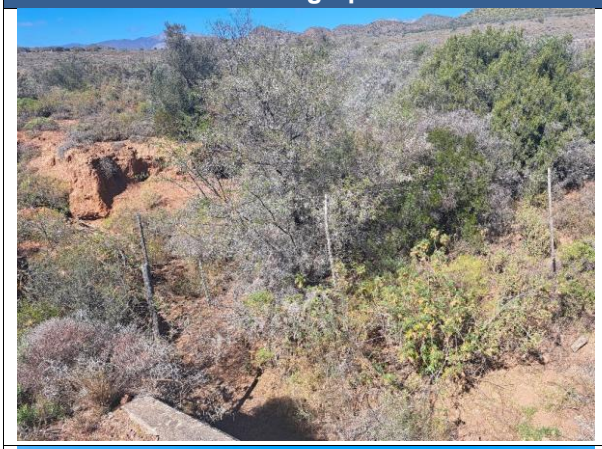
The PES of watercourses varied from pristine and largely natural (PES: A) to largely modified (PES:D). Natural and largely natural watercourses originate mainly from undisturbed mountains and hills, where natural vegetation is largely intact and agricultural activities are not present or are very limited in scale (relative to the larger catchment area). Modifications in these watercourses are mainly related to evidence of minor erosion in the catchment area (presumably due to grazing). Moderately and largely modified streams were mainly impacted either by intensive agricultural activities (e.g. instream dams, diversion of streams into furrows, removal of riparian vegetation etc.) or more serious signs of erosion in the catchment (mainly in quaternary J25B where soils are highly erodible - see Figure 6). A brief description of impacts and the PES per watercourse is provided in Table 4.

Table 3: Classification, brief description of impacts and PES and EIS for each watercourse verified in the field (only for watercourse where maintenance of infrastructure may be required).

Photograph	Description
	**Code: #1** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Urban stormwater runoff, riparian zone invaded by alien tree species, removal of riparian vegetation, crossings impede flow leading to establishment of *Typha capensis.* **PES:** C **EIS:** Low
	**Code: #2** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Clearing of riparian vegetation, over grazing within catchment area, small weirs constructed within watercourse channel. **PES:** C **EIS:** Low
	**Code: #3** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Evidence of erosion in the catchment, leading to high sediment loads (presumably due to over grazing. **PES: B** **EIS:** Low

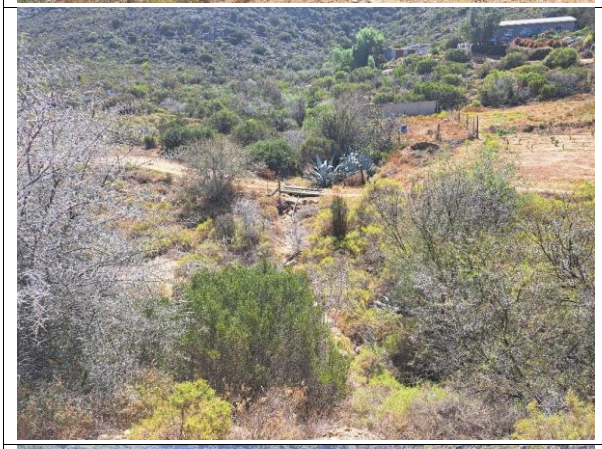
Photograph	Description
	**Code: #4** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Evidence of erosion in the catchment, leading to high sediment loads (presumably due to over grazing. **PES: B** **EIS:** Low
	**Code: #5** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Agriculture in upper reaches, including several instream dams, leading to water abstraction and flow regulation along the river. **PES: C** **EIS:** Low
	**Code: #6** **Classification:** Stream (fifth order) **Hydroperiod:** Non-perennial **Impacts:** Agriculture in upper reaches, including instream dams, leading to water abstraction and flow regulation along the river. Evidence of erosion in the catchment, leading to high sediment loads (presumably due to over grazing. **PES: C** **EIS:** Low
	**Code: #7** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Minimal impacts apart from minor erosion in catchment area and road crossing. **PES: B** **EIS:** Low

Photograph	Description
	**Code: #8** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Minimal impacts apart from minor erosion in catchment area and road crossing. **PES: B** **EIS:** Low
	**Code: #9** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Erosion of watercourse is prevalent throughout catchment area, presumably due to over-grazing. **PES: C** **EIS:** Low
No Photo Available	**Code: #10** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel, diverted into agricultural fields. **PES: C** **EIS:** Low
	**Code: #11** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel, evidence of erosion in catchment area. **PES: B** **EIS:** Low

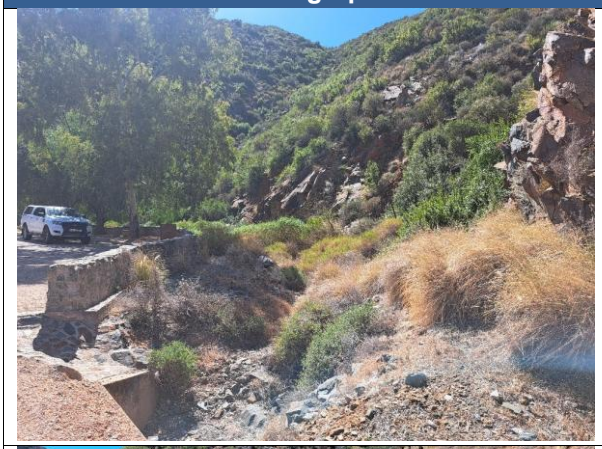
Photograph	Description
	**Code: #12** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Widespread **e**rosion in catchment area. **PES: C** **EIS:** Low
	**Code: #13** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Heavily eroded channel **PES: C** **EIS:** Low
	**Code: #14** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Instream dam and eroded channel **PES: C** **EIS:** Low
	**Code: #15** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Instream dam and flow diverted into agricultural furrow **PES: C** **EIS:** Low

Photograph	Description
	**Code: #16** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Flow diverted into agricultural furrow **PES: B** **EIS:** Low
	**Code: #17** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Flow diverted into agricultural furrow **PES: B** **EIS:** Low
	**Code: #18** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Eroded catchment area, some invasion by invasive plant species. Flow diverted into agricultural furrow. Lower channel straightened, riparian vegetation cleared. **PES: C** **EIS:** Low
	**Code: #19** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Flow terminates into an instream dam – no connectivity to downstream watercourses. **PES: C** **EIS:** Low

Photograph	Description
	**Code: #20** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Heavily impacted by agricultural activities – straightened channel, loss of riparian zone, abstraction of water. **PES: D** **EIS:** Low
	**Code: #21** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Large parts of catchment in natural state. Small dams in uppermost catchments area and a large instream dam in lower most reach. **PES: B** **EIS:** Low
	**Code: #23** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Large parts of catchment in natural state. Some erosion visible **PES:** B **EIS:** Low
	**Code: #24 (Seweweekspoort River)** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Side channel of river. Large parts of catchment in natural state. More intensive agriculture in lower most reaches, including instream dams and water abstraction **PES:** B **EIS:** Low

Photograph	Description
	**Code: #25 (Seweweekspoort River)** **Classification:** Stream (fifth order) **Hydroperiod:** Non-perennial **Impacts:** Main channel of river. Large parts of catchment in natural state. More intensive agriculture in lower most reaches, including instream dams and water abstraction **PES:** B **EIS:** Moderate
	**Code: #26** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Downstream of landfill – relatively high levels of litter. Erosion evident – particularly in lower reaches **PES:** C **EIS:** Low
	**Code: #27** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Channel infilled along lower most reaches **PES:** C **EIS:** Low
	**Code: #28** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from Swartberg mountains - upper to lower-mid reaches relatively unimpacted, catchment dominated by natural vegetation. Lower reaches impacted by intensive agriculture and alien invaded riparian zone **PES:** B **EIS:** Low

Photograph	Description
	**Code: #29** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from Swartberg mountains – agriculture and abstraction in upper and lower most reaches – large areas unimpacted. **PES:** B **EIS:** Low
	**Code: #30** **Classification:** Stream (third order) **Hydroperiod:** Non-perennial **Impacts:** Originates from foothills of Swartberg mountains – largely unimpacted. Dam and abstraction in lower most reach. **PES:** B **EIS:** Low
	**Code: #31** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from foothills of Swartberg mountains - overgrazing and clearing of fields in mi-reaches, erosion of land and stream channel. Instream dams for water abstraction. **PES:** C **EIS:** Low
	**Code: #32** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from foothills of Swartberg mountains – largely natural – some first order tributaries infilled by R62, minor erosion of channel. **PES: B** **EIS:** Low

Photograph	Description
	**Code: #33-39** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** All streams originate from hills to the north. All streams diverted into channels and/or culverts through R62. Below R62, channels have been infilled during construction of R62. **PES: C** **EIS:** Low
	**Code: #40** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from foothills of Swartberg mountains – largely natural – some first order tributaries infilled by R62, minor erosion of channel. **PES: B** **EIS:** Low
	**Code: #41** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from Paardenberg Mountains to the south – near pristine. **PES:** A **EIS:** Low
	**Code: #42** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Originates from Paardenberg Mountains to the south – near pristine. **PES:** A **EIS:** Low

Photograph	Description
	**Code: #43** **Classification:** Stream (fourth order) **Hydroperiod:** Non-perennial **Impacts:** Largely natural. Borrow pit within lower reach of channel.. **PES: B** **EIS:** Low
	**Code: #44-45** **Classification:** Stream (second order) **Hydroperiod:** Non-perennial **Impacts:** Runs adjacent to R62, crossing vi channelled culverts twice. Stream canalised in parts **PES: C** **EIS:** Low
	**Code: #46** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Unimpacted, near pristine. **PES:** A **EIS:** Low
	**Code: #47** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Unimpacted, near pristine. **PES:** A **EIS:** Low

Photograph	Description
	**Code: #48** **Classification:** Stream (first order) **Hydroperiod:** Non-perennial **Impacts:** Poorly defined channel. Unimpacted, near pristine. **PES:** A **EIS:** Low

4.1.3 Ecological Importance & Sensitivity

Given the non-perennial and highly intermittent flow characteristics of all watercourses, they are not important with respect to hosting a diverse aquatic assemblage that is dependent on permanently flowing water. The main function of these watercourses is to supply intermittent surface flows to downstream perennial rivers as opposed to hosting instream aquatic fauna and flora. Similarly, the intermittent flows and geomorphological characteristics limits the diversity of aquatic habitat features and refuge and migration options for aquatic biota. They are however relatively important in terms of maintaining corridors for migration of riparian biota (mainly terrestrial fauna) through quaternary catchments and connecting terrestrial CBAs to larger perennial river systems. Overall, the EIS of these watercourses is considered to be **Low** (Table 4).

Table 4: Ecological Importance and Sensitivity (EIS) of the non-perennial watercourses crossing the TR31/5 road.

Determinant	Drainage Line
Presence of Rare & Endangered Species	**0 –** No rare or endangered taxa.
Populations of Unique Species	**0 –** No unique species.
Intolerant Biota	**1 -** Very low proportion of biota is expected to be dependent on flowing water for the completion of their life cycle.
Species/Taxon Richness	**1 -** Low diversity of fauna and flora expected on a local scale.
Diversity of Habitat Types or Features	**1 –** Non-perennial, with little geomorphological variation
Refuge value of habitat types	**2** – Important at a local scale particularly considering that they run through terrestrial CBAs
Sensitivity of habitat to flow changes	**1 –** Non-perennial watercourses- low sensitivity to changes in flow.
Sensitivity to flow related water quality changes	**1 –** Non-perennial watercourse - low sensitivity to modifications in water quality.
Migration route for instream and riparian biota	**2** – Important at a local scale – connects terrestrial CBA areas to the larger Klip River system.
Protection Status	**1** – ESAs
EIS Score	**1 (Low)**

4.2 Major Rivers

4.2.1 Nels River (Quaternary J25B).

Classification: Fourth order perennial river system that originates from the Swartberg Mountains. Upper, mid and lower reaches are named as the Kobus, Nels and Huis river, respectively. At the bridge crossing, the river is a moderately steep gradient system, consistent with an Upper Foothills (or D) geomorphological zonation, characterised by cobble-bed substrate with a variety of instream biotopes including plane bed, pool-riffle or pool-rapid. A narrow floodplain of sand, gravel or cobble is present.

PES: Upper-most reaches are pristine while mid to upper and lower most reaches are adjacent to intensive agriculture, with high rates of abstraction for irrigation. Several, relatively large instream dams in tributaries also regulate flows through the river system and flow had been reduced to a trickle at the time of the site visit. Low flows have encouraged growth of instream vegetation (e.g. *Typha capensis* and *Phragmites australis*) in lower gradient reaches. Alien invasive tree species in the riparian zone are synonymous with agricultural activity. Physical habitat along the middle reaches (as the river passes through the narrow, steep gorges of the Paardeberg Mountains) is relatively unimpacted, although regulation of flows in the upper agricultural areas does influence the diversity and quality available of instream aquatic habitat. Here riparian habitat is prominent and is characterised by well vegetated kloofs. Riparian zone is dominated by *Vachelia karroo* and *Salix mucronate*, however, regulated flows in the catchment area have favoured the establishment of reedy species within the channel of the river. The PES is D (Largely Modified).

Figure 14: Photograph of the Nels River from Bridge 2664.

4.2.2 Huis River 1 & 2

Classification: Sixth order, perennial river. Site located at lower most reach of Huis River (forms part of the same system as the Nels River). The geomorphological zonation is Upper Foothills (or D), and the river channel is dominated by cobbles, boulders and bedrock outcrops. Pool-riffle or pool-rapid habitat is common along these lower reaches.

PES: This site is situated downstream of an agricultural area and the riparian zone is densely vegetated with alien invasive species (predominantly *Eucalytpus sp*.) – reed beds of invasive *Arundo donnax* are also prevalent along the channel. High rates of water abstraction occur to sustain irrigated agriculture. Irrigated agricultural fields are located immediately adjacent to the river, which is poorly buffered against agricultural impacts. The riparian zone is densely vegetated with alien invasive species (predominantly *Eucalytpus sp*.) and the channel and banks are heavily invaded by the invasive *Arundo donnax*. The PES is D (Largely Modified)

Figure 15: Photograph of the Huis River from Bridge 4940.

Figure 16: Photograph of the Huis River from Bridge 4941.

4.2.3 Gamka River

Classification: Large 6th order, perennial river, consistent with a Lower Foothill (E) geomorphological zonation, characterised by a low gradient, mixed-bed alluvial channel 9 (bed dominated by sand and gravel. Reach biotopes are dominated large pools, interspersed with riffles and rapids. River forms part of a channelled valley bottom wetland system – the margins of the river are dominated by a mixture of riparian and wetland vegetation which becomes seasonally inundated during flood peaks and include *Vachelia karoo, Salix mucronate, Cliffortia strobilifera, Melianthus comosus, Eligia capensis, Cyperus textilis*.

PES: Flow through the entire SQC is regulated by the Gamkapoort Dam which was constructed primarily for flood control. Large areas of the SQC run through mountainous areas, that are largely in a natural state. Floodplain areas in the lower reaches of the SQC are cultivated. Overall, impacts are moderate and the PES is C (Moderately Modified).

Figure 17: Photograph of the Gamka River from Bridge 4342.

4.2.4 Nels River (Quaternary J25D).

Classification: Large 6th order, perennial river. At the bridge, the river is a moderately steep gradient system, consistent with an Upper Foothills (or D) geomorphological zonation, characterised by cobble-bed substrate with a variety of instream biotopes including plane bed, pool-riffle or pool-rapid. A narrow floodplain of sand, gravel or cobble often present. The river is associated with a large floodplain wetland area.

PES: Almost the entire extent of the floodplain has been cultivated, and wetland habitat is restricted to the margins of the main channel of the river that flows through this cultivated area. Infilling to expand agricultural fields restricts the river to a narrow channel that has been heavily invaded by *Arundo donnax* and interspersed with *S. mucronate.* Any signs of the natural Muscadel Riviere vegetation type are largely absent. High rates of abstraction in combination

with the Calitzdorp Dam located further upstream, regulate flows through the river and no flow was visible along the river at the time of the site visit. The PES is D (Largely Modified).

Figure 18: Photograph of the Nels River from Bridge 4942.

4.2.5 Ecological Importance & Sensitivity

These are large perennial river systems that run through a relatively arid environment and are considered important for the conservation of endemic and endangered fish species. The rivers transition from transitional mountain streams to lower foothill rivers and provide a diversity of instream habitat. The main channels, associated tributaries and riparian zones provide key refuge, corridors and general habitat for a wide variety of mammals, reptiles and birds. These systems require at least some water to persist and are therefore sensitive to changes in flow and water quality. The EIS is High (Table 5).

Table 5: Ecological Importance and Sensitivity (EIS) of the major perennial rivers crossing the TR31/5 road.

Determinant	Drainage Line
Presence of Rare & Endangered Species	**3 –** Red-listed fish species occur (not endangered)
Populations of Unique Species	**3 –** Presence of fish species endemic to the Western Cape.
Intolerant Biota	**4 -** A very high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle.
Species/Taxon Richness	**2 –** Good diversity of fauna and flora expected on a local scale.
Diversity of Habitat Types or Features	**2 –** Important at a local scale
Refuge value of habitat types	**3** – Important at a regional scale particularly considering that they run through terrestrial CBAs
Sensitivity of habitat to flow changes	**3 –** Perennial watercourses- sensitive to changes in flow.

Determinant	Drainage Line
Sensitivity to flow related water quality changes	**3 –** Perennial watercourses - sensitive to modifications in water quality.
Migration route for instream and riparian biota	**2** – The stream delineations are an important link in terms of connectivity for the survival of biota upstream and downstream and are sensitive to modification.
Protection Status	**2**– CBAs
EIS Score	**3 (High)**

5 PROPOSED MAINTENANCE ACTIVITIES

Proposes maintenance activities are described below. This is a general description of activities that will be undertaken and may not be applicable to each and every single piece of infrastructure.

5.1 Road Works

- It is proposed to reseal the entire section with a 14mm pre-coated aggregate, using a bitumen rubber modified binder followed by a fog spray.
- It is proposed that the intersections with heavy turning movements receive a 40mm asphalt surface.

5.2 Bridge Structures

- Clear vegetation and reeds in waterway.
- Repair of gabion baskets.
- Seal cracks on infrastructure using an appropriate sealant.
- Repair bridge guard rails.
- Clear blocked drainage scuppers.
- Repair localised concrete spalling on structures.
- Reinstate bridge number by retrofitting the structure numbers to the inside elevation of the end blocks as per current standard plans
- Replacement of expansion joints.

5.3 Major Culverts

- Clear vegetation, litter and sediment
- Clean and prepare the eroded surfaces and apply protective sealants/concrete repair mortar to restore surfaces and reduce future erosion caused by water flow or chemical exposure.
- Seal cracks with epoxy resin to prevent water ingress.
- Replace missing reflector plates
- Realignment of guardrail

5.4 Minor culverts

- Siltation and vegetation in the culverts, inlet and outlet must be removed
- The damaged concrete inlet/outlet structures are to be repaired
- Non-functional stone pitched inlet and outlet structures must be replaced with WCG standard concrete inlet and outlet structures
- Scour protection works are to be constructed where evidence of damage due to scour.

6 IDENTIFIED IMPACTS

6.1 Disturbance of aquatic habitat

Operation of personnel, vehicles and machinery and execution of maintenance activities (e.g. vegetation clearing) in and in close proximity to watercourses can lead to physical disturbance of aquatic habitat (riparian vegetation and the bed and banks of the watercourse). Maintenance activities will however be restricted to the road reserve and areas where existing infrastructure is in place. Impacts will therefore be restricted to very limited areas and the nature of maintenance activities is not likely to lead to deterioration in the ecological health or function of watercourses.

6.1.1 Mitigation

- Where at all possible, existing access routes should be used. In cases where none exist, a route should be created through the most degraded area avoiding sensitive/indigenous vegetation areas.
- Vehicle access roads to maintenance areas must not cross watercourses. Vehicles must be diverted back to the existing road at these points (i.e. watercourses must not become traffic thoroughfares).
- Access to the watercourse is only for work specifically being conducted to maintain existing structures. In these areas, access must be limited to essential equipment only.
- Clearance of sediment from culverts must be restricted to the culvert only and the channel of the watercourse must not be widened or deepened.
- Clearing of riparian/instream vegetation at bridges must be restricted to the bridge span only. Clearing of vegetation at culverts must be limited to culvert openings only and must not extend upstream or downstream of the culvert. When practicable, prune or top the vegetation instead of grubbing/uprooting
- All rubble and waste (including excavated sediment and cleared vegetation) must be removed from the watercourse and be disposed at an appropriate waste facility.
- Sediment removed from culverts may:
    - be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion, which form part of this MMP;
    - not be deposited anywhere within the watercourse or anywhere along the banks of a watercourse. Material that cannot be used for maintenance purposes must be removed out of the riparian area to a suitable stockpile location or disposal site.

- On completion of the maintenance action, the condition of the site in terms of relative topography should be similar to the pre-damaged state (i.e. the shape of the river bank should be similar or in a state which is improved to manage future damage). This ultimately dictates that the channel, banks and bed cannot be made narrower, higher or deepened respectively.

6.2 Erosion & Sedimentation

Maintenance and rehabilitation activities could lead to localised disturbance of soil which can lead to increased erosion and sedimentation of watercourses and/or modifications to the bed and banks of watercourses (through bank erosion and destabilisation). In addition, excessive clearing of sediment from stream channels can lead to localised scouring of the bed and banks caused long-term erosion of the watercourse. These impacts can result in the deterioration of permanent and temporary instream aquatic habitat. Many of the non-perennial streams exhibit the impacts of erosion in their respective catchment areas and have river-beds dominated by coarse and fine sediment. Clearance of sediment and vegetation in and around culverts will be very limited in spatial scale and it is unlikely that these activities will alter sediment dynamics and instream habitat. Measures must however consider the likelihood of high rainfall periods that may wash the mobile soils and maintenance materials downslope during maintenance activities.

6.2.1 Mitigation

- Clearance of sediment from culverts must be restricted to the culvert only and the channel of the watercourse must not be widened or deepened.
- Following the completion of maintenance, disturbed areas must be cleared of rubble, excavated sediment material and any cut/cleared vegetation.
- Any disturbed banks or channels must be reshaped to free-draining and non-erosive contours where possible.
- Disturbed banks must be re-vegetated with indigenous vegetation suitable to the area.
- Excavated material (e.g. sediment) or rubble must not be stockpiled within the river channel or within riparian vegetation adjacent to the channel.
- Stockpiling of materials must be restricted to level areas safe from flood prone areas.

6.3 Flow Modification

Flow modification, such as impeding and diverting flows, refers to any direct alterations in the quantity, timing and distribution of water inputs and flows within a river. Culverts and bridges are designed to be free-flowing structures and blockage of culverts caused by vegetation and build up sediment and can impede or divert flows around structures which can cause unanticipated erosion and scouring in and around structures. This in turn can lead to erosion of the bed and banks of watercourses and associated degradation of instream and riparian habitat. In this respect, clearance and maintenance of culvert structures is viewed as essential not only for protecting infrastructure, but also for maintaining the ecological function and health of watercourses. Some repair of concrete structures at bridges may require flowing water to be temporarily diverted in order to establish dry working conditions.

6.3.1 Mitigation

- Where construction is to take place within a river channel, if flowing, temporary diversions may need to be put in place to temporarily divert water away from activities and ensure a dry work area.
- •Any diversions must be temporary in nature and no permanent walls, berms or dams may be installed within the rivers. Upon completion of the construction at the site, the diversions shall be removed to restore natural flow patterns.

6.4 Water pollution

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). Additionally, litter indirectly decreases the aesthetic value of the rivers. Maintenance activities could potentially pollute watercourses through a variety of sources, including:

- Surface runoff of bitumen into watercourses caused by rainfall shortly after application.
- Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with spillages, leaks or refueling of vehicles/machinery may potentially pollute watercourses.
- Raw cement entering the systems through incorrect batching procedure and/or direct disposal.
- The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the systems.
- Spills caused by poor storage and handling of pollutants (e.g. fuel, oil, bitumen, paint, cement etc.).

6.4.1 Mitigation

- Application of bitumen to road surface must be strictly planned according to reliable weather forecasts. No bitumen may be applied within 24 hours of a predicted rainfall event.
- Provide bins or rubbish bags for rubbish and place them in an area designated for break-time. Ensure bins are cleaned out on a regular basis.
- Provide portable chemical toilets on-site (1 toilet per 10 workers). Waste from toilets is to be disposed of regularly, at least weekly, in a responsible manner by a registered waste contractor. Toilets must be located more than 30 m away from watercourses.
- All maintenance personnel must be briefed that no waste is to be disposed of in the environment.
- Fuel storage and vehicle refuelling areas must be located at least 50 m from any watercourse.
- Discontinue maintenance activities during periods of high rainfall.
- Vehicles and machinery must be inspected for leaking fuel before accessing the site, and leaking vehicles must not be permitted to work at the site.

- Construction camps, equipment and material lay down areas must be located at least 30 m from any watercourse.
- Concrete or cement mixing is not permitted at or in the vicinity of the watercourse. Any cement mixing cannot take place on bare ground. An impermeable or bunded area must be established in a way that cement slurry will not run off into the surrounding environment.
- Any soil or material stockpiles must be covered with a geotextile or plastic to prevent erosion of the material down slopes into the watercourse.
- Excess cement or other materials must be left to dry out before being removed and disposed of at an appropriate facility.

7 DWS RISK ASSESMENT

Risks of activities associated with the activities described in Section 6 were determined according to the risk assessment matrix developed as part of GN 4167 of 2023 (Section 21 (c) and (i) water use Risk Assessment Protocol). The first stage of the risk assessment is the identification of environmental activities, aspects and impacts. The intensity of impact to receptors and resources (i.e. hydrology, water quality, geomorphology, biota and vegetation) is rated (from 0 to 5, representing negligible and very high impact, respectively), which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Risks were then quantified based on the anticipated spatial scale, duration and likelihood of occurrence for the minor non-perennial rivers (Table 6) and the larger perennial rivers systems (i.e. the Nels and Huis river system and the Gamka and Nels rivers - Table 7).

Given the low impact associated with all activities highlighted in this report, and according to GN 4167 of 2023, the proposed rehabilitation and maintenance activities are Generally Authorised and do not require a Water Use License. While the rehabilitation is generally authorised, it is important to note that the water use activity should still be registered with the DWS. In this respect the following steps, as highlighted in the General Authorisation for Section 21 (c) and (i) water uses, are relevant:

1. Subject to the provisions of the General Authorisation, the applicant must submit the relevant registration forms to the responsible authority;
2. Upon completion of registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission;
3. On written receipt of a registration certificate from the Department, the applicant will be regarded as a registered water user and can only then commence with the water use as contemplated in the General Authorisation; and
4. The registration forms can be obtained from DWS Regional Offices or Catchment Management Agency office of the Department or from the Departmental website: http://www.dwa.gov.za/Projects/WARMS/Licensing/licensing1.aspx

Table 6: DWS Risk Assessment matrix for maintenance activities conducted on minor non-perennial watercourses crossing TR31/5 road.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating (without mitigation)	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
MAINTENANCE	Clearing of vegetation and sediment from culverts	Disturbance of instream and riparian habitat	Non-perennial watercourses	A-D	Low	0	1	1	1	1	**2**	1	2	**5**	**2**	**10**	40%	**4**	L	High
		Mobilisation of fine sediments and smothering of aquatic habitat	Non-perennial watercourses	A-D	Low	0	0	0	1	1	**2**	1	1	**4**	**2**	**8**	20%	**1.6**	L	High
	Repair/sealing of concrete structures using sealants and/or cement mortar.	Pollution of watercourses	Non-perennial watercourses	A-D	Low	0	1	0	0	0	**2**	1	2	**5**	**2**	**10**	20%	**2**	L	High
	Operation of vehicles and machinery within watercourse	Disturbance of instream and riparian habitat	Non-perennial watercourses	A-D	Low	1	0	1	2	1	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	L	High
		Pollution caused by leaks and/or spillages (i.e. during refueling)	Non-perennial watercourses	A-D	Low	0	2	0	1	1	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	L	High
	Stockpiling of excavated materials	Runoff and erosion of stockpiled materials into watercourse	Non-perennial watercourses	A-D	Low	0	1	0	1	1	**2**	1	1	**4**	**2**	**8**	20%	**1.6**	L	High
	Mixing cement (e.g. for repair to infrastructure)	Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.	Non-perennial watercourses	A-D	Low	0	0	0	0	0	**0**	1	1	**2**	**2**	**4**	20%	**0.8**	L	High
	Resurfacing of road	Runoff of biutmen into watercourses	Non-perennial watercourses	A-D	Low	0	2	2	2	2	**4**	1	3	**8**	**2**	**16**	40%	**6.4**	L	High
	Chemical toilets	Pollution caused by leaks and/or inadequate maintenance	Non-perennial watercourses	A-D	Low	0	2	0	2	2	**4**	1	1	**6**	**2**	**12**	20%	**2.4**	L	High
	Temporary diversion of flows to create dry working conditions	Temporary disturbance to instream habitat	Non-perennial watercourses	A-D	Low	2	2	0	2	2	**4**	1	1	**6**	**2**	**12**	20%	**2.4**	L	High

Table 7: DWS Risk Assessment matrix for maintenance activities conducted on major perennial rivers crossing TR31/5 road.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating (without mitigation)	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
MAINTENANCE	Clearing of vegetation and sediment from culverts	Disturbance of instream and riparian habitat	Non-perennial watercourses	C/D	High	0	1	1	1	1	**2**	1	2	**5**	**4**	**20**	40%	**8**	**L**	High
		Mobilisation of fine sediments and smothering of aquatic habitat	Non-perennial watercourses	C/D	High	0	2	0	2	2	**4**	1	1	**6**	**4**	**24**	80%	**19.2**	**L**	High
	Repair/sealing of concrete structures using sealants and/or cement mortar.	Pollution of watercourses	Non-perennial watercourses	C/D	High	0	1	0	0	0	**2**	1	2	**5**	**4**	**20**	60%	**12**	**L**	High
	Operation of vehicles and machinery within watercourse	Disturbance of instream and riparian habitat	Non-perennial watercourses	C/D	High	0	0	1	2	1	**4**	1	2	**7**	**4**	**28**	60%	**16.8**	**L**	High
		Pollution caused by leaks and/or spillages (i.e. during refueling)	Non-perennial watercourses	C/D	High	0	2	0	1	1	**4**	1	2	**7**	**4**	**28**	60%	**16.8**	**L**	High
	Stockpiling of excavated materials	Runoff and erosion of stockpiled materials into watercourse	Non-perennial watercourses	C/D	High	0	1	0	1	1	**2**	1	1	**4**	**4**	**16**	20%	**3.2**	**L**	High
	Mixing cement (e.g. for repair to infrastructure)	Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.	Non-perennial watercourses	C/D	High	0	0	0	0	0	**0**	1	1	**2**	**4**	**8**	20%	**1.6**	**L**	High
	Resurfacing of road	Runoff of biutmen into watercourses	Non-perennial watercourses	C/D	High	0	2	2	3	3	**6**	1	3	**10**	**4**	**40**	40%	**16**	**L**	High
	Chemical toilets	Pollution caused by leaks and/or inadequate maintenance	Non-perennial watercourses	C/D	High	2	2	0	2	2	**4**	1	1	**6**	**4**	**24**	20%	**4.8**	**L**	High
	Temporary diversion of flows to create dry working conditions	Temporary distrubance to instream habitat (i.e. temporary drying out of habitat)	Non-perennial watercourses	C/D	High	2	2	0	2	3	**6**	1	1	**8**	**4**	**32**	80%	**25.6**	**L**	High

8 CONCLUSION

The TR31/5 crossed numerous minor non-perennial and major perennial watercourses and maintenance of infrastructure (bridges and culverts) will require work to be carried out adjacent to and within these watercourses. Maintenance activities are considered routine for such roads and will include, *inter alia*, repair/sealing of concrete works, clearing of vegetation and sediment from culverts etc. Maintenance of culverts in particular is viewed as essential for ensuring their intended purpose which is to maintain unimpeded flows through these structures and avoid unnecessary erosion and scouring of the bed and banks of watercourses. It can be concluded, with a high degree of certainty, that the proposed maintenance activities can be mitigated to an acceptable level and that the risk of these activities to affected watercourses is Low. It is therefore recommended that environmental authorisation for the activities associated with the road maintenance should be granted. In terms of the NWA, considering the Low risk associated with all construction and operational phase activities the rehabilitation plan qualifies for a General Authorisation.

9 REFERENCES

CapeNature (2017). *2017 WCBSP Oudsthoorn [Vector] 2017*. Available from the Biodiversity GIS website, downloaded on 26 March 2019.

CSIR (2018). National Wetland Map 5 and Confidence Map [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 15 February 202.

Department of Water and Sanitation (DWS). (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: [J3]. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx accessed on [2 April 2023].

DWAF (2005). *Final Draft: A Practical Field Procedure for Identification and Delineation of Wetlands and Riparian Areas*.

Milner, A.M. (1994). System recovery. In: Calow P and Petts GE (eds.): The rivers handbook. Vol. 2. Blackwell Scientific Publications. London.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). *Technical Report for the National Freshwater Ecosystem Priority Areas project.* WRC Report No. 1801/2/11. Water Research Commission, Pretoria, South Africa.

Ollis, D.J., Snaddon, C.D., Job, N.M. and Mbona, N. (2013). *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems.* SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria

Resh, V.H., Brown, A.P., Covich, M.E., Gurtz, H.W., Li, G.W., Minshall, S.R., Reice, A.L., Sheldon, J.B., Wallace and Wissmar, R.C. (1988). The role of disturbance theory in stream ecology. Journal of the North American Benthological Society. 7: 433-455.

10 APPENDICES

Appendix 1 – Index of Habitat Integrity

Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI was regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 8) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (x):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

- IHI = rating score for the criteria (Table 8);
- 25 = maximum possible score for a criterion; and
- Weight = Weighting score for the criteria (Table 9).

Table 8: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

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

Table 9: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – Table 10).

Table 10: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

Reference:

Kleynhans, C.J. (1996). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo system, South Africa) Journal of Aquatic Ecosystem Health 5:41-54 1996.

Appendix 2 – Ecological Importance & Sensitivity (River)

The ecological importance and sensitivity (EIS) of the watercourse was assessed using a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;
  - Size and rarity of the wetland types present;
  - Diversity of habitat types within the wetland.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 11.

Table 11: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and <=4	A
High: Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and <=3	B
Moderate: Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and <=2	C
Low/marginal: Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and <=1	D

Reference:

Duthie, A. (1999). IER (Floodplain Wetlands) Determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). Resource Directed Measures for Protection of Water Resources: Wetland Ecosystems. Department of Water Affairs and Forestry.