water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP
NATIONAL DEVELOPMENT PLAN
Our Future - make it work

CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS (WP11387)

RQO Workshop, Durban, 22 August 2023

RESOURCE QUALITY OBJECTIVES: WATER QUALITY



Resource Quality Objectives: Water Quality

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BACKGROUND PREPARATION FOR RQO DEVELOPMENT

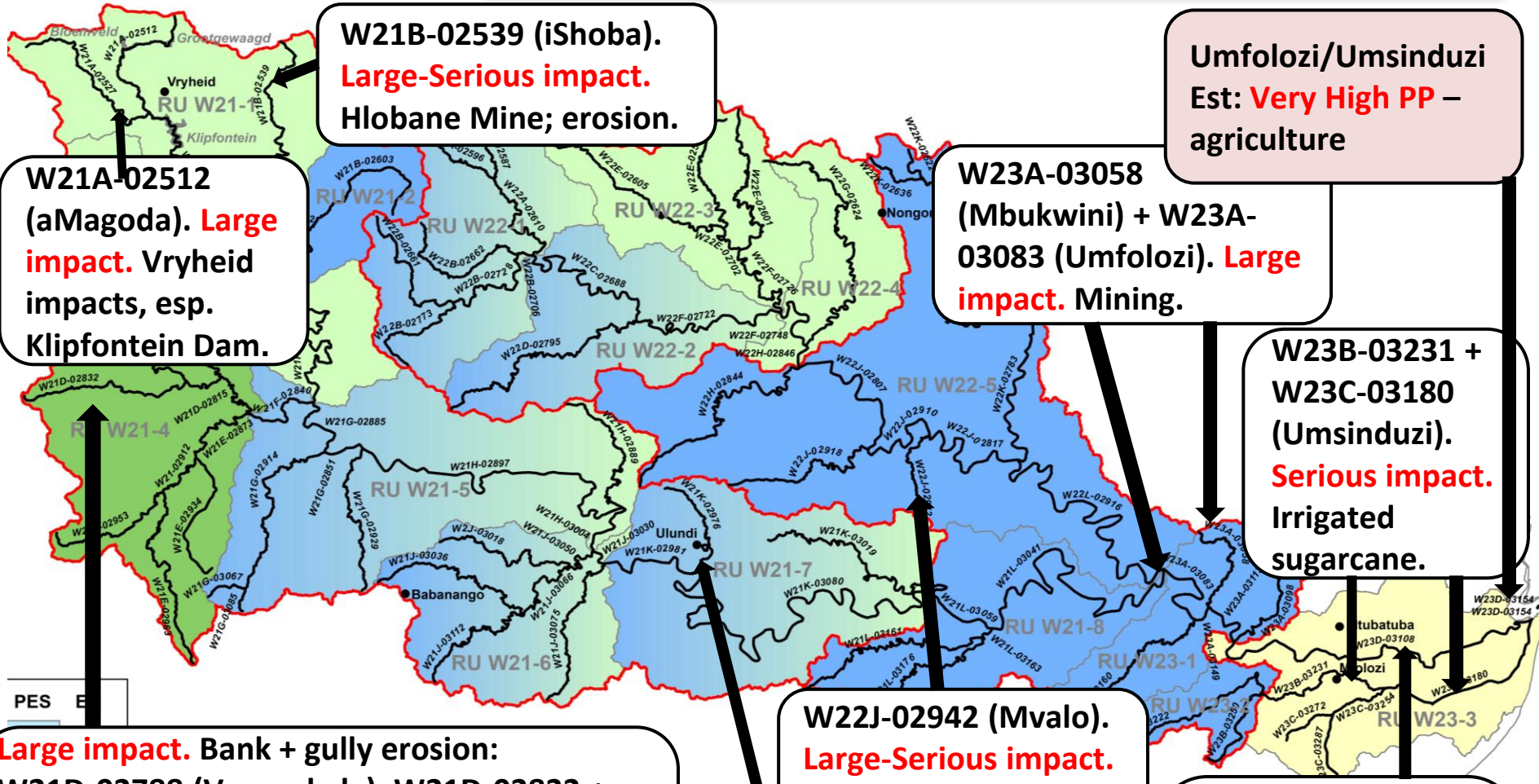
- **Water quality Status Quo**
- **Identify preliminary water quality hot spots**
- **Prepare for November 2022 TTG meeting**

- **<u>At TTG and follow up meetings:</u>**
  - **ID wq role players, including non-ecological e.g. irrigation, settlements**
  - **Identify indicators linked to driving variables associated with indicator wq role players, e.g. elevated *phosphate* associated with nutrients linked to stock-watering**
  - **Identify pollution priority areas and / or priority protection areas**

STATUS QUO: WATER QUALITY

- **Aim: Identify preliminary water quality priority areas per secondary catchment. NB: First step toward identifying driving water quality variables for which RQOs will be set.**
- **Rivers: Based on a water quality impact rating (0: no impact to 5: serious impact) on PES EIS spreadsheets.**
- **Based on desktop information and liaison with water quality managers.**
- **Following data sources used:**
  - **ISP 2004, Reserve 2014, PES/EIS review of Jan 2022, 2020 DWS Planning Review, DWS's IRIS, 2020 IUCMA Usuthu EcoStatus report, 2022 Green Drop report**

W2 (Umfolozi): Water quality status quo



W21B-02539 (iShoba). Large-Serious impact. Hlobane Mine; erosion.

Umfolozi/Umsinduzi Est: Very High PP – agriculture

W21A-02512 (aMagoda). Large impact. Vryheid impacts, esp. Klipfontein Dam.

W23A-03058 (Mbukwini) + W23A-03083 (Umfolozi). Large impact. Mining.

W23B-03231 + W23C-03180 (Umsinduzi). Serious impact. Irrigated sugarcane.

Large impact. Bank + gully erosion: W21D-02788 (Vumankala), W21D-02832 + W21D-02848 (Joiosi), W21E-02963 (Large-Serious), W21E-02912 + W21E-02873 (Nondweni), W21D-02676 (Mvunyane): Also settlements, WWTW.

W22J-02942 (Mvalo). Large-Serious impact. Zululand Anthracite Collieries impact.

W21K-02976 (Mbilane). Serious impact. WWTW + urban impacts; coal mining; erosion.

W23D-03108 (Umfolozi). Serious impact. Extensive urban impacts; irrigated sugarcane; extensive cultivation.

WATER QUALITY HOTSPOTS: W2

WQ ratings 3-5, so Large (3) to Critical (5)

SQR	River name	Water quality impact (rating) or category (estuaries)	Water quality issues
To be identified and confirmed	*Mbucwane River*	*Priority protection area*	*Perennial spring linked to the Mbucwane River and historically used as a water source (Wilson, 2020).*
W21A-02512	aMagoda	Large (3)	Urban impacts from Vryheid, particularly from Vryheid WWTW on Klipfontein Dam.
W21B-02539	iShoba	Large-Serious (3.5)	Intermittent impacts from Hlobane Mine dumps; extension settlements; grazing and erosion.
W21D-02676	Mvunyane	Large (3)	Dense settlements; erosion; sand-mining; WWTW.
W21D-02788	Vumankala	Large (3)	Extensive bank and gully erosion; overgrazing.
W21D-02832	Jojosi	Large (3)	Extensive bank and gully erosion; overgrazing.
W21D-02848	Jojosi	Large (3)	Extensive bank and gully erosion; overgrazing.
W21E-02963	Nondweni	Large-Serious (3.5)	Extensive bank and gully erosion; overgrazing.
W21E-02912	Nondweni	Large (3)	Extensive erosion; sand-mining.
W21E-02873	Nondweni	Large (3)	Extensive erosion.
W21K-02976	Mbilane	Serious (4)	Urban impacts from Ulundi, including a non-compliant WWTW; pollution from coal mining; erosion.
W22J-02942	Mvalo	Large-Serious (3.5)	Impacts from Zululand Anthracite Collieries.
W23A-03058	Mbukwini	Large (3)	Mining operations.
W23A-03083	Umfolozi	Large (3)	Mining operations.
W23B-03231	Umsinduzi	Serious (4)	Irrigated sugar cane.
W23C-03180	Umsinduzi	Serious (4)	Irrigated sugar cane.
W23D-03108	Umfolozi	Serious (4)	Urban impacts from KwaMsane, including WWTW; irrigated sugar cane; Umfolosi Sugar Mill; Mtubatuba and Mtubatuba Hospital WWTW; extensive cultivation within wetlands and riparian zone.
Umfolozi/Umsinduzi Estuary		E Category	Very High pollution pressure; primarily from agriculture.

PRINCIPLES: WATER QUALITY RQOs (1)

- **If EcoSpecs not available from an EWR study, wq guidelines are used (linked to a level of protection, e.g. TWQR, rather than a TEC).**
- **WQ RQOs IMMEDIATELY APPLICABLE = ONLY where monitoring data are available.**
- **Monitoring recommendations and PROVISIONAL RQOs are set for identified driving variables for which RQOs are *not immediately* applicable, but for which a database needs to be developed.**
- **Once an adequate dataset has been produced, evaluate the provisional RQOs provided and update the RQOs for the driving variables.**
- **Numerical and narrative RQOs are prepared using all existing data sources for identified monitoring points, and for *driving variables ONLY* for High Priority WQ sites, and for *ALL variables* for High Priority EWR sites.**

PRINCIPLES: WATER QUALITY RQOs (2)

- **Note that Reserve data available as A–F categories were converted to Ideal to Tolerable categories (required for water quality gazetting purposes), as follows:**

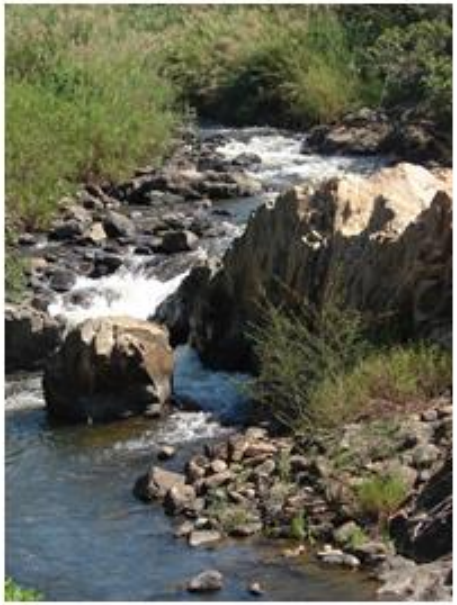
Categories A and A/B: Ideal
Categories B, B/C and C: Acceptable
Categories C/D and D: Tolerable

- **RQOs are not set for dams.**
- **Values used for setting RQOs were linked to standard DWS methods and procedures, data format from WMS and DWAF (2008). Note data confidence.**
- **Monitoring data to be collected for measurement against RQOs that are immediately applicable and to be gazetted, should be collected from the monitoring sites as identified in the water quality Reserve documentation, if possible.**

METHODS FOR DETERMINING THE WATER QUALITY COMPONENT OF THE ECOLOGICAL RESERVE FOR RIVERS

SECOND DRAFT

March 2008



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PRINCIPLES: WATER QUALITY RQOs (3)

- **Microbial compliance targets: as in NMMP (risk guidelines) where full or partial recreation guidelines are not met), and set below each WWTW, town and large settlement.**

Narrative RQO	Numerical RQO		
Meet faecal coliform and *E. coli* targets for recreational / other (full or partial contact) use*.	Potential health risks in terms of counts / 100 ml (SA NMMP guidelines).		
	Low	Medium	High
	< 600	600 – 2 000	> 2 000

* Guidelines are provided in the absence of data or knowledge of recreational activities in the area.

It is assumed that run-of-river water is not used for domestic use UNLESS primary treatment has been undertaken. Objectives for domestic use, such as drinking untreated water from the river, are therefore not covered in the water quality RQOs.

- **Toxics: Broad numerical guidelines for *toxics* are not suitable for areas where specific information on toxics are not available, or where the identity of contaminants are not known. Where no data, biotic response and biological monitoring are used to indicate toxicity.**

DATA SELECTION

The general rule for data selection is the following:
*Select the RC (or Reference Condition/natural state) data as the **first** 3–5 yrs (**minimum of 60 data points for high confidence, 25 samples for moderate confidence and 12 samples for low confidence**) of the data record, and the PES as the **last** 3–5 years of data (again a minimum of 60, 25 or 12 data points for difference confidence levels). The monitoring point suitable for Reference Condition must therefore either be in an unimpacted tributary (this can be in an adjacent catchment, but in the same Level II EcoRegion) or a very early data record (e.g. from the 1960s – early 1980s). It is possible to use the same monitoring point for Reference Condition and PES data, if the appropriate data record is available.*

Note that although a low confidence desktop assessment can be run using 12 data points, these points should preferably be spread across the hydrological cycle. Alternatively, weekly monitoring over a 60 day period can be undertaken.

Note: If inadequate data exists for an assessment in a *High / Very High* EIS area **(i.e. n < 25)**, recommend that monitoring is initiated (preferably over one hydrological cycle) before a Reserve can be determined, including at the Desktop level. This constraint may be waived if sufficient biological monitoring and site-specific information is available.

This note also applies to EWR sites

HIGH PRIORITY EWR SITE: Black Mfolozi River, BM1

EWR site: Black Mfolozi, BM1

River	Black Mfolozi	Water Quality Monitoring Points	
		RC	Benchmark tables (DWAF, 2008)
EWR Site	BM1	PES	W2H028 (WMS W22_102857, n=29, 2014-2018.
	Parameter / units	PES value	Rating for PAI / Comment
Inorganic salt ions (mg/L)	Sulphate as SO_4	234.8: 95th percentile 70.4: median	Intermittent elevated sulphates
	Sodium as Na	35.13	
	Magnesium as Mg	22.7	
	Calcium as Ca	65.34	
	Chloride as Cl	26.25	
	Potassium as K	5.48	
Electrical conductivity	mS/m	58.18	Due to elevated sulphate levels
Nutrients (mg/L)	SRP-P	0.01	1
	TIN-N	0.1	0
Physical variables	pH (5 th and 95th % tiles)	7.5 + 8.3	1
	Temperature (º C)	-	1. Largely natural temperature range expected.
	Dissolved oxygen (mg/L)	-	0.5. Largely natural oxygen range expected.
	Turbidity (NTU)	-	1. Some localized erosion at the site due to land–use.
Response variable	Chl-*a*: phytoplankton (ug/L)	-	
	Macroinvertebrate score (MIRAI) SASS score ASPT score	81.2% 185 6.3	B/C
	Diatoms	SPI=17 (n=1)	Indicates Very Good water quality
	Fish score (FRAI)	75.9%	C
Toxics (mg/L)	Ammonia (as N)	0.005	A
	Fluoride (F)	0.58	A
Overall site classification (from PAI table)			B/C (81.8%)

-: no data

The assessment is of moderate confidence as recent data could not be sourced. Diatom results indicate Good water quality (category A/B for diatoms). Despite the good water quality state, intermittent high sulphate levels moved the assessment from a B to B/C category. It is assumed upstream mining is responsible for intermittent increases.

METRIC	RATING	THRESHOLD EXCEEDED?	CONF	DEFAULT WEIGHTS	ADJUSTED RANKS	ADJUSTED WEIGHTS
pH	1.00	N	4.00	50.00		40.00
Salts	2.00	NONE SPECIFIED	4.00	50.00		40.00
Nutrients	1.00	NONE SPECIFIED	4.00	65.00		90.00
Water Temperature	1.00	N	2.50	55.00		60.00
Water clarity	1.00	NONE SPECIFIED	2.50	55.00		50.00
Oxygen	0.00	N	2.50	75.00		60.00
Toxics	1.50	N	3.00	100.00		80.00
PC MODIFICATION RATING WITH THRESHOLD APPLIED (MAX)	1.06	MEAN CONF →	3.21			
CALCULATED PC MODIFICATION RATING WITHOUT THRESHOLD AND WITH DEFAULT WEIGHTS	1.06					
CALCULATED P-C RATING WITHOUT THRESHOLD AND BASED ON ADJUSTED WEIGHTS	1.05					
FINAL PC MODIFICATION RATING	1.20					
P-C CATEGORY %	P-C CATEGORY					
81.8	B/C	REVISED % & CATEGORY (2014)				

EWR BM1: Black Mfolozi River

Coordinates	S27.93890 E31.21030
SQ code	W22A-02610
RU	RU W22-1
IUA	IUA W22
Level 2 EcoRegion	3.1
Geomorphic Zone[4]	Upper foothills

PRESENT ECOLOGICAL STATE: PES

I IHI	R IHI	PC	Geom	Rip Veg	Fish	Inverts	Instream	EcoStatus
B/C (77.7%)	C (74.4%)	B/C (81.8%)	A (93%)	C (74.9%)	C (75.9%)	B/C (81.2%)	B/C (78.9%)	C (76.9%)

ECOLOGICAL IMPORTANCE AND SENSITIVITY

MODERATE

RECOMMENDED ECOLOGICAL CATEGORY (REC) = PES

REC = C for ECOSTATUS

PROCESS: HIGH PRIORITY EWR SITES

- **RQOs and TPCs (Thresholds of Probable Concern, or 'red flags') must be set for all variables.**

- **Use PAI, WQ table summary table, and DWAF (2008) and WQ ecosystem guidelines to set RQOs and TPCs, e.g. for electrical conductivity.**
  - **Electrical conductivity summary statistic (95th %ile) is 58.8 mS/m.**
  - **Check assigned category in PAI, and boundary values in DWAF (2008).**
  - **Is electrical conductivity a driving variable?**
  - **Set associated EcoSpec, so 95th %ile of data must be ≤ xx mS/m.**
  - **Set associated TPC, so the 95th percentile of the data is xx – xx mS/m. A range between 80% and boundary of category generally used, e.g. so 8-10 mg/L: TPC if category is up to 10mg/L, for example.**
  - **Assign confidence and IMMEDIATELY APPLICABLE vs PROVISIONAL RQOs**

HIGH PRIORITY WQ SITES

Extract of points from W2

RU	SQ reach	River name	Impact rating	WQ role players	WQ driving variables	WQ notes
W21-1	W21A-02527	White Mfolozi	3.0	WWTW	Nutrients, salts, *E. coli* / coliforms	Stilwater Hotel wit package plant that non-compliant; discharges into th Reach is long; ins point downstream discharge at botto reach
W21-1	W21B-02539	iShoba	4.0	Hlobane Mine; erosion	Toxics, salts, nutrients, turbidity, sulphate	Highest salts and sulphates in W2
W21-1	W21B-02546	White Mfolozi	3.0	WWTW	Nutrients, salts, *E. coli* / coliforms	WWTW discharge White Mfolozi ups (u/s) dam. High nu into Klipfontein Da
W21-4	W21D-02676	Mvunyane	3.0	Urban impacts, incl. WWTW; erosion	Toxics, salts, nutrients, turbidity, *E. coli* / coliforms	Mondlo WWTW discharges into sr tributary (Ugoqo) a into dam. 1.5 km f dam.
W21-4	W21D-02788	Vumankala	3.0	Erosion	Turbidity	
W21-4	W21D-02832	Jojosi	3.0	Erosion; over-grazing	Turbidity	
W21-4	W21D-02848	Jojosi	3.0	Erosion; over-grazing	Turbidity	
W21-4	W21E-02963	Nondweni	3.5	Erosion; over-grazing	Turbidity	
W21-4	W21E-02912	Nondweni	3.0	Erosion; over-grazing	Turbidity	
W21-4	W21E-02873	Nondweni	3.0	Erosion; over-grazing	Turbidity	Recommendations data collection, e.g turbidity/Total Suspended Solids
W21-7	W21K-02976	Mbilane	3.0	Ulundi WWTW; urban impacts	Nutrients, salts, toxics	WWTW discharge into W21K-02981

PROCESS: HIGH PRIORITY WQ SITES

- **Check if data are available for use**
- **If DATA, determine PES, check drivers and set RQOs + TPCs**
- **If NO DATA, check following steps:**
  - **Check position of site on GE**
  - **Is extrapolation from another EWR or EcoRegion level II site possible?**
  - **If so, determine PES, check drivers and set RQOs and TPCs**
  - **Set confidence and 'ímmediatly applicable' vs 'provisional'**
  - **If no, check drivers and set PROVISIONAL RQOs and TPCs**
  - **Prepare text: Flag for monitoring or notes for implementation**

GENERAL NOTES

- **Ecology is the main "user" at stretches containing EWR sites. Remember Chapter 3, NWA:**

SUSTAINABLE UTILISATION = LONG-TERM BALANCE BETWEEN USE AND PROTECTION OF WATER RESOURCES

- **Information on other users was "checked" at these river stretches.**
- **Driving user at sites = often ecological protection. Suitable if wq data is linked to the maintenance or reaching of a particular water quality category, which is part of a specific EC, catchment configuration and Water Resource Class.**
- **RQOs for driving variables set accordingly.**

RESULTS

EWR BM1: ECOSPECS AND TPCs

Water quality metrics	EcoSpecs	TPC
Inorganic salts (*)		
$MgSO_4$	The 95th percentile of the data must be ≤ 23 mg/L.	The 95th percentile of the data is 19–23 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤ 33 mg/L.	The 95th percentile of the data is 27–33 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤ 30 mg/L.	The 95th percentile of the data is 24–30 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤ 57 mg/L.	The 95th percentile of the data is 46–57 mg/L.
NaCl	The 95th percentile of the data must be ≤ 191 mg/L.	The 95th percentile of the data is 153–191 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤ 773 mg/L.	The 95th percentile of the data is 618–773 mg/L.
Inorganic salts ions (**)		
Sulphate as SO_4	The 95th percentile of the data must be ≤ 30 mg/L[1]	The 95th percentile of the data is 24-30 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤ 55 mS/m.	The 95th percentile of the data is 44–55 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is < 6.7 and > 7.8, and the 95th percentile is < 6.7 and > 8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be > 8.0 mg/L.	The 5th percentile of the data is ≤ 8.2 mg/L.
Turbidity	Small changes expected.	Some localized erosion at the site due to land use.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be < 0.25 mg/L.	The 50th percentile of the data is 0.2–0.25 mg/L
PO_4-P	The 50th percentile of the data must be ≤ 0.015 mg/L.	The 50th percentile of the data is 0.012–0.015 mg/L.
Response variables (#)		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤ 15 mg/L.	The 50th percentile of the data is 12–15 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be ≤ 12 mg/m^2	The 50th percentile of the data is 10–12 mg/m^2
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤ 0.02 mg/L	The 95th percentile of the data is 0.016–0.02 mg/L
Other variables (#)	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008), or within the Acute Effects Value (AEV) as stated in DWAF (1996a) for those variables not in DWAF (2008).	An impact is expected if the 95th percentile of the data exceeds the A category range in DWAF (2008), or the Target Water Quality Range (TWQR) as stated in DWAF (1996a).

[1] A guideline of 309 mg/L SO_4 for aquatic ecosystem protection for moderately hard to hard water (average hardness at

Example of High Priority WQ site

Source: No detailed water quality assessment conducted. PESEIS data (DWS, 2014c) and literature sources (e.g. DWS, 2014a; DWAF, 1996a–e) were used.
Model: N/A
Users: Run-off from rural settlements.
Water quality issue: Nutrients, turbidity.

Narrative and numerical details are provided in **Table 4.6**.

Table 4.6 RU T31-4: Narrative and numerical water quality RQOs

Narrative RQO	Numerical RQO
Ensure that turbidity or clarity levels stay within Acceptable limits.	A moderate change from natural with temporary high sediment loads and turbidity during runoff events (Aquatic ecosystems: driver).
Ensure that nutrient levels are within Acceptable limits.	50th percentile of the data must be less than 0.025 mg/L PO_4-P (Aquatic ecosystems: driver).