HAWKE'S BAY
REGIONAL COUNCIL

Ngaruroro, Tutaekuri, Karamu River and Ahuriri Estuary Catchments

State and Trends of River Water Quality and Ecology

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159 Dalton Street . Napier 4110
Private Bag 6006 Napier 4142
Telephone (06) 835 9200
Fax (06) 835 3601
Regional Freephone (06) 0800 108 838

Environmental Science - Water Quality and Ecology

Ngaruroro, Tutaekuri, Karamu River and Ahuriri Estuary Catchments

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HBRC Report No. RM 16-08. Plan Number 4787.

Prepared By:
Dr Sandy Haidekker
Dr Adam Uytendaal
Dr Andy Hicks
Oliver Wade
Heli Wade
Vicki Lyon
Anna Madarasz-Smith

Reviewed By:

Stephen Swabey – Manager – Environmental Science

Approved By:

Iain Maxwell – Group Manager – Resource Management

Signed:

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Executive summary

This report summarises state and trends in river water quality and ecology across the Ngaruroro River, Tutaekuri River, Ahuriri and Karamu catchments. The report is one of six State of Environment (SOE) reports for the Hawke's Bay region summarising river water quality and ecology data collected up to December 2013.

The six SOE reports cover the river catchments and water management zones listed below and outlined in Figure 1-1. The catchments examined in this report are emphasised in **bold** typeface below:

(A) Porangahau River/Southern Coastal
(B) Tukituki River
(C) TANK (**Tutaekuri River**, **Ahuriri Estuary**, **Ngaruroro River**, **Karamu Stream** - bordered in black)
(D) Mohaka River
(E) Waikari River/Esk River/Aropoanui River
(F) Wairoa River/Northern Coastal

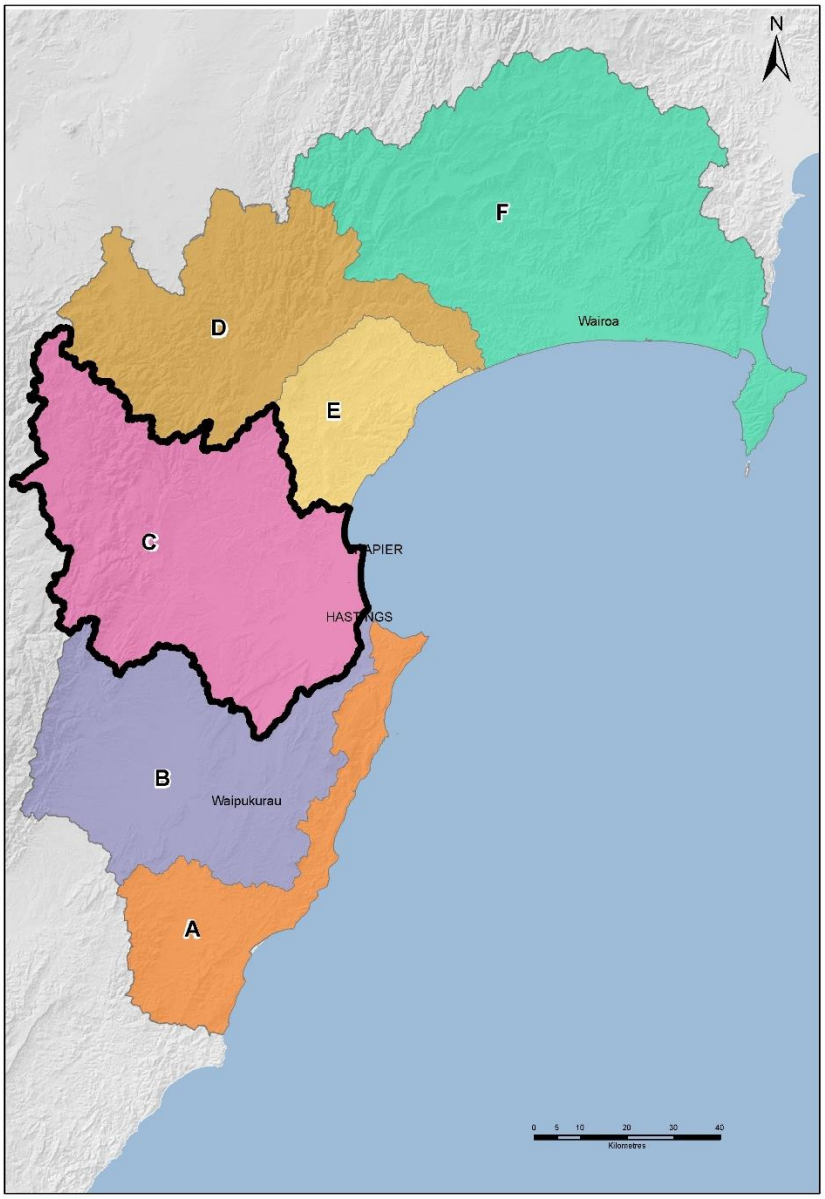


Figure 1-1: Map of the catchments for which water quality and ecology are reported.

The 6 SOE reports form the detailed regional 5 yearly review of surface water quality and ecology and are an update from the previous round of reports completed in 2009.

For the TANK region, Hawke's Bay Regional Council is working through a proposed plan change. This report informs the plan change process - and the requirement under the NPS to set water quality limits to protect in-stream community values. This report therefore includes more detailed information than other SOE reports, including results from additional sites intended to fill 'gaps' in knowledge and specific studies for these catchments.

The headwaters of the Ngaruroro and the Tuatekuri rivers begin in the forested areas of the Kaweka Range (north) and the Ruahine Range (south). The upper catchments are mostly in native vegetation, and land use in the middle catchments is mainly dry stock farming and a few dairy operations. In the lower reaches where the valley gradient is less steep, land use becomes more varied, including vineyards and orchards. Dry stock farming is found in the surrounding hills, and peri-urban and commercial development is also present.

The Karamu catchment extends south from Awatoto to Havelock North and west to the Raukawa Range. The Karamu catchment is the main region in Hawke's Bay for orchards, cropping, and viticulture, while the southwestern half of the catchment mostly supports dryland sheep and beef. The exception to this pattern is the Poukawa Basin, which is a significant cropping area. Waterways in the Karamu catchment have been extensively modified for flood protection purposes.

The Ahuriri is Hawke's Bay's most urbanised catchment, and includes the settlement of Napier and surrounding suburbs, north to Bay View and south to Awatoto.

The Tutaekuri, Ngarururo and Karamu rivers meet the sea at the Waitangi estuary. The estuary includes a variety of habitats, including open water, intertidal flats, salt marsh, and two associated freshwater wetlands at Muddy Creek and The Horseshoe.

Due to significant differences in the stream 'types' of the Ngaruroro and Tutaekuri catchments in comparison to the Karamu and Ahuriri catchments the following SOE Technical report presents and discusses data on the Ngaruroro and Tutaekuri Rivers independent of the Karamu and Ahuriri.

The following conclusions can be drawn from the data, analysis and information presented in this report:

1. Ngaruroro and Tutaekuri catchments

    - The Ngaruroro main stem was in excellent condition in the upper to middle catchment. The lower reaches showed some minor enrichment in nutrients and a decrease in water clarity. Water quality parameters showed a minor upstream to downstream decline, which was reflected in the biological indicators of periphyton biomass and macroinvertebrate community. Overall water quality and ecology of the Ngaruroro River main stem was healthy. The Taruarau tributary also showed excellent water quality and ecological health.

    - The Ngaruroro tributaries (other than the Taruarau River) were enriched in nutrients, especially phosphorus, which was always above guideline levels. The influence of nutrient loads coming from the tributaries into the main stem had only a minor effect on the water quality in the main stem Ngaruroro, because large volumes of water with high water quality from the pristine upper catchment dilutes the influence of the tributaries.

    - The Tutaekuri main stem showed some enrichment in nutrients from upstream to downstream, particularly in phosphorus. Ecological parameters also showed a gradient from upstream to

downstream, with increasing periphyton biomass, and MCI values declined from excellent to fair towards the lower reaches.

- Tutaekuri tributaries had water quality issues similar to the Ngaruroro tributaries, with elevated nutrient concentrations. The high phosphorus concentrations were mostly above guidelines. MCI was good across all tributary sites and periphyton biomass was high in the Mangatutu Stream, and low in the upper Mangaone. The effect of tributary nutrient loads on main stem water quality was greater in the Tutaekuri than in the Ngaruroro, because the volume of water coming from the pristine upper catchment is lower and the dilution effect less than in the Ngaruroro.

Toxicity effects on aquatic organisms from nitrate and ammonia were not an issue anywhere in the Ngaruroro and Tutaekuri catchments, as concentrations were always low. In the case of ammonia levels were mostly below detection limit. *Escherichia coli* (*E. coli*) levels were very low in both catchments and were below the lowest guideline ('alert'-) level.

2. Karamu and Ahuriri catchments

- Nitrogen concentrations are variable across sites, with very high concentrations in the Karewarewa, Awanui, Mangarau at Te Aute Road and Clive River. Phosphorus concentrations are very high and always above guidelines at all sites.
- Water clarity was low and generally did not comply with the contact recreation guideline at most of the sites.
- Median *E. coli* concentrations were at or below the MfE recreation guideline 'Alert/Amber mode' at most of the sites except the Karewarewa, Herehere and Taipo streams. The Herehere Stream had the highest median *E. coli* concentration, which was close to the MfE 'Action/Red mode'.
- Toxicity risk for aquatic organisms was generally low, with the exception of the Karewarewa, Awanui and Taipo streams. These had elevated ammoniacal-nitrogen at times, and nitrate-nitrogen concentrations that maintain 90% species protection but exceeded the 99% species protection threshold.
- Biological indicators showed high macrophyte growth and poor MCI values that indicated the streams were severely impacted.
- The poor MCI values triggered a targeted study to identify major stressors in the Karamu and Ahuriri catchments. High water temperature, low dissolved oxygen minima and poor habitat were identified to be major stressors in the streams where MCI was particularly low. Excessive macrophyte growth was a contributing factor to the severely low oxygen levels.
- Overall, nutrient concentrations were high (particularly phosphorus), at all SOE sites in the Karamu and Ahuriri catchments, and MCI values indicated poor ecosystem health. Excessive macrophyte growth was observed at most sites, but the Karewarewa, Awanui and Taipo streams were the most affected sites.

1 Introduction

1.1 TANK Catchment Descriptions and Land Use Overview

This State of Environment technical report covers four specific catchment areas of the Hawke's Bay, the Tutaekuri River, Ahuriri Estuary, Ngaruroro River and the Karamu Stream catchments (TANK) (Figure 1-1).

Hawke's Bay Regional Council is working through a proposed plan change for the TANK catchments to meet the requirements of the National Policy Statement for Freshwater Management (MfE 2014). This report informs the plan change process - and the requirement under the NPS to set water quality limits to protect in-stream community values.

The Tutaekuri and Ngaruroro rivers have very different catchment characteristics compared to the Karamu and Ahuriri catchments. The Tutaekuri and Ngaruroro are large 6th order rivers (Strahler ordering system 1952) and the catchments cover an area of approximately 836 km^2 and 2,000 km^2 respectively. The headwaters are in forested hills of the Kaweka and Ruahine ranges. The main stems of both rivers are characterised by gravel beds that form wide, braided channels in the lower catchment.

The Karamu and Ahuriri catchments are smaller, approximately 500 km^2 and 86 km^2 respectively. The Karamu catchment covers most of the surface area of the Heretaunga Plains. The Ahuriri catchment, north of Napier, has small tributaries flowing into the Ahuriri Estuary. Most of the tributaries of both catchments drain lowland country, and have very low gradients with slow flowing water, and the streambed is often made up of fine gravel or sandy/silty substrate. This provides ideal growing conditions for aquatic plants (macrophytes). By contrast, algae are more commonly found in streams with faster flowing, stony substrates, like the Tutaekuri and Ngaruroro rivers.

Due to significant differences in the stream 'types' of the Ngaruroro and Tutaekuri catchments in comparison to the Karamu and Ahuriri catchments the following SOE technical report presents and discusses data on the Ngaruroro and Tutaekuri rivers independent of the Karamu and Ahuriri.

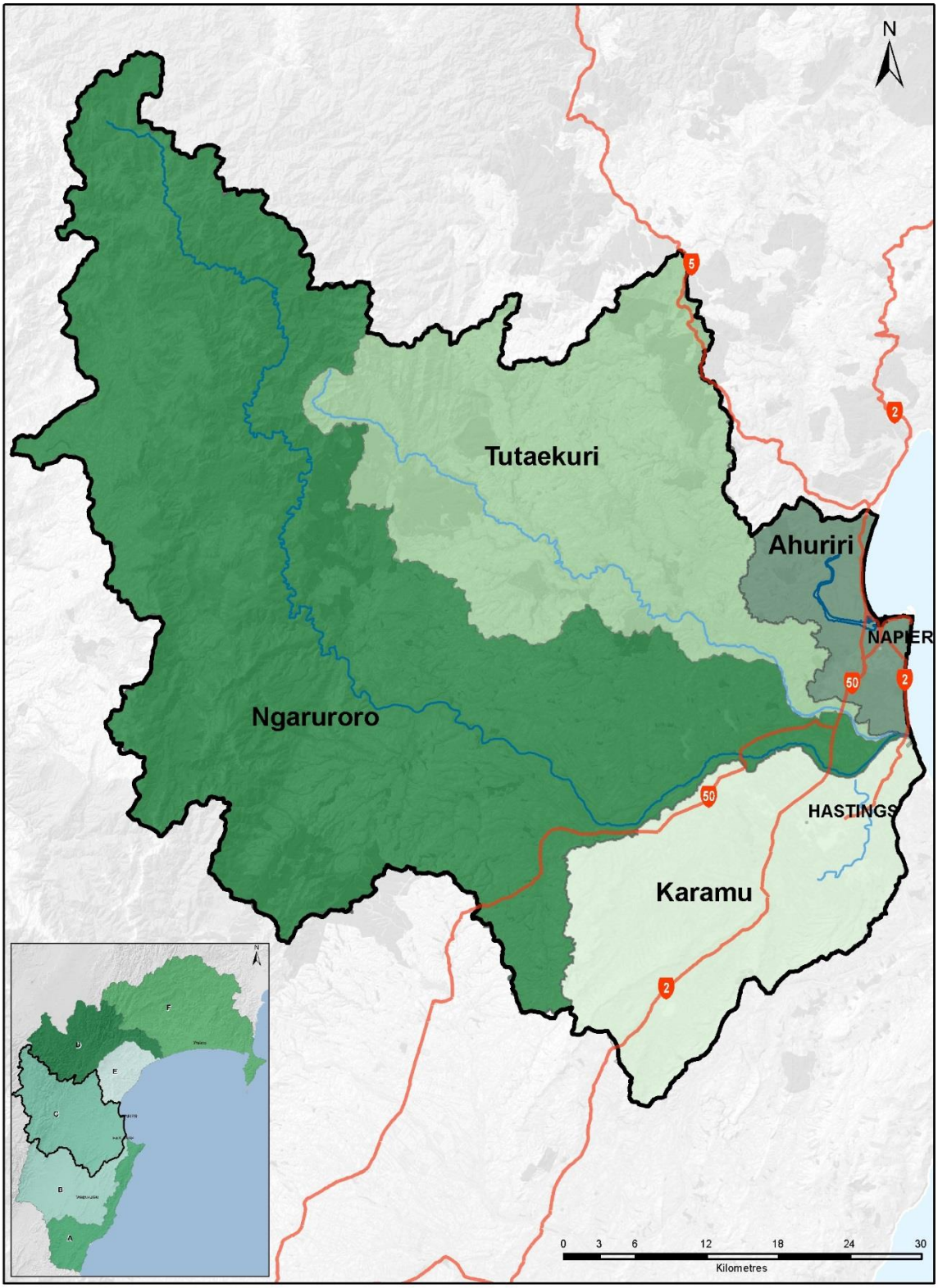


Figure 1-1: Location of the TANK catchments according to the wider Hawke's Bay region.

1.2 Description of the Ngaruroro River Catchment

The headwaters of the Ngaruroro River are in the forested areas of the Kaweka Range (north) and the Ruahine Range (south). In its upper catchment the Ngaruroro River is a fast flowing river in a bed of rocks, boulders and coarse gravel. This area is predominantly in native vegetation with some pasture down to Whanawhana. Between Whanawhana and Maraekakaho, the river is braided, flowing in a relatively wide and flat channel bordered by steep hill country and high river terraces. The land use in this part of the catchment is predominantly dry stock farming with land use changes occurring in the last 15 years. There are two large intensive dairy operations, one on either side of the Ngaruroro River downstream of Whanawhana.

Downstream of Maraekakaho the river runs through plains and low rolling hill country and land use becomes more varied, including viticulture and cropping. The river channel is wide and flat, with a low gradient and a semi-braided morphology, constrained on each side by stopbanks. The area is a zone of groundwater recharge, losing approximately 5 m^3/s, or 20% of its median flow, to groundwater between Ohiti and Fernhill. The aquifer is important to the region, providing water for multiple uses including irrigation, processing and industrial use, as well as an untreated water source for Hastings and Napier. The Ngaruroro River then flows eastwards to an estuary shared with the Tutaekuri River. It flows into the Pacific Ocean at Hawke's Bay, south of Napier.

The Ngaruroro catchment supports a significant brown trout and rainbow trout fishery. Angling activity is spread throughout the catchment, with the Ngaruroro main stem above the Taruarau confluence and the Taruarau itself the most sought after fishery. Trout populations in the catchment are self-sustaining, with trout spawning occurring in the main stem and a number of tributaries.

Recreational activities occur in many parts the catchment. The Ngaruroro River upstream of Whanawhana is highly prized for white water kayaking particularly around Kuripapango, and flat-water kayaking occurs from here to the coast. Jet-boating is popular from Maraekakaho to Whanawhana. Popular swimming locations are found at Kuripapango and at Chesterhope and Fernhill bridges.

The catchment also has significant ecological values, associated with aquatic and riparian ecosystems and with indigenous fauna and flora. Significant wetlands include lakes Runanga, Oingo, Hurimoana, Kautuku and Potaka, along with Pig Sty Swamp and Waitangi wetland. These support a large range of fish and bird species, some of which are threatened. Nineteen native fish species (8 with declining populations at a national level) can be found in the catchment and it is a stronghold for longfin eel, banded kokupu, lamprey, koaro, dwarf galaxiid and inanga in the Waitangi Estuary. The upper reaches are a stronghold for whio (blue duck) and the lower braided reaches support a very high population of banded dotterels.

HBRC monitors ecological health, water quality and flow across the Ngaruroro catchment (Figure 1-2). Seven of the long-term state of the environment (SOE) sites for water quality and ecology are on the Ngaruroro River main stem, and two on the Waitio and Tutaekuri-Waimate tributaries. Four additional sites in tributaries (Taruarau, Poporangi, Ohiwa and Maraekakaho streams) were added recently to fill knowledge gaps in the catchment, to inform Plan Change processes. NIWA also monitors water quality and flow at 2 sites (Figure 1-2).

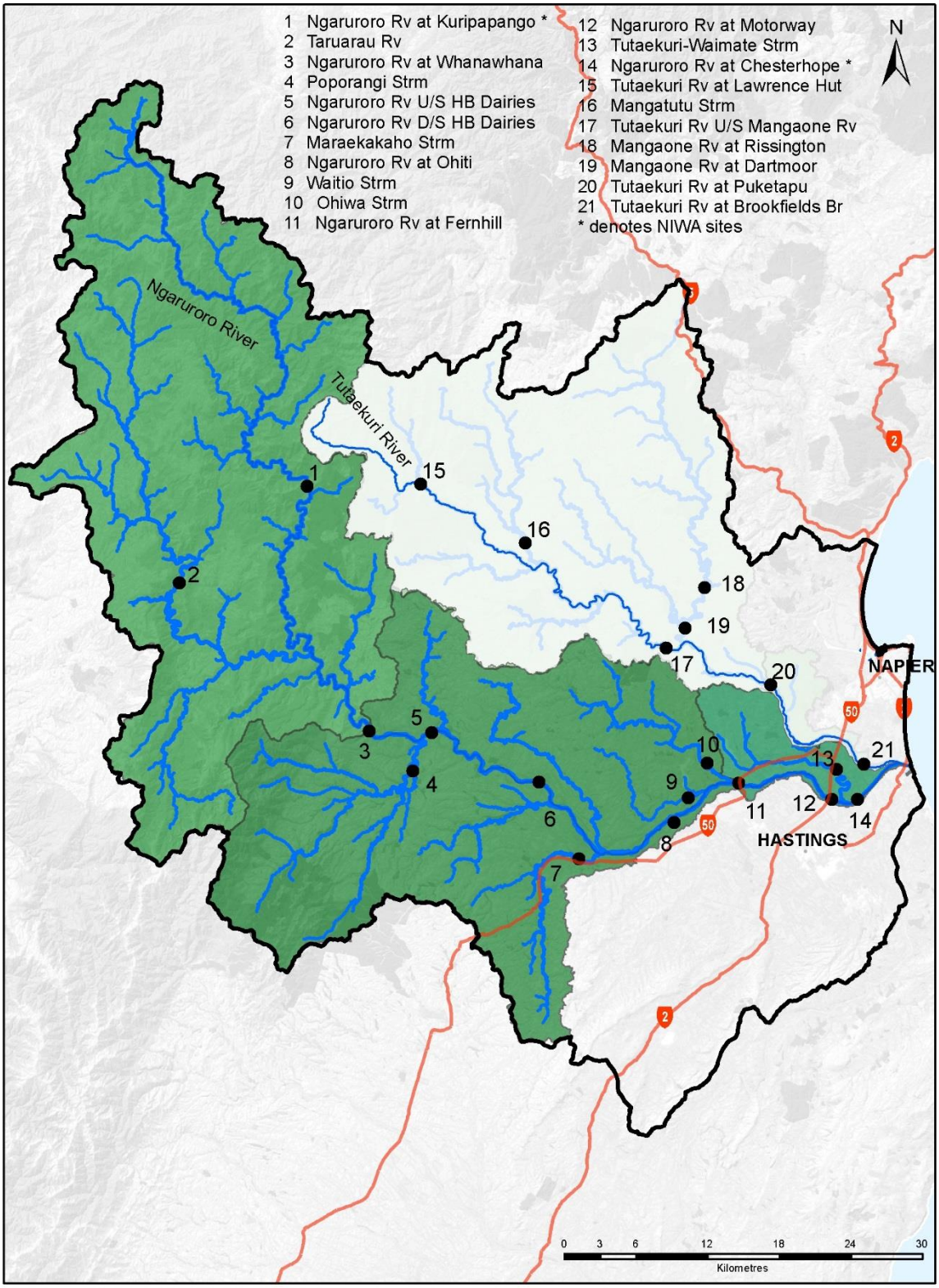


Figure 1-2: Ngaruroro River catchment and its State of the Environment (SOE) monitoring sites for water quality and ecology.

Zone	Climate and Source-of-Flow categories (REC)	Geology (REC)		Land cover (LCDB4)		Land Use Capability (LUC)	
Upper Zone Source to Whanawhana Total catchment area 110880 ha	Cool wet (55%) climate with flow originating in mountain country, and Cool wet (44%) climate with flow originating in hill country, and Cool wet (1%) climate with flow originating in lowland country.	Volcanic acidic Hard sedimentary Miscellaneous	62% 34% 3%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards Cropping Urban areas	84% 4% 10% 1% 0% 0% 0%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	0% 0% 0% 5% 0% 18% 23% 55% 0% 0% 0%
Middle Zone Whanawhana to Fernhill Total catchment area 83226 ha	Cool wet (26%) climate with flow originating in hill country, and Warm dry (48%) / warm wet (3%) / cool dry (12%) / cool wet (5%) climate with flow originating in lowland country, and Cool wet (4%) climate with flow originating in mountain country, and Warm dry (1%) climate with flow originating in lakes.	Miscellaneous Alluvium Hard sedimentary Volcanic acidic Soft sedimentary	34% 28% 21% 17% 1%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards Cropping Urban areas	17% 9% 68% 1% 2% 1% 0%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	1% 0% 21% 18% 5% 31% 10% 11% 0% 3% 0%

Lower Zone Fernhill to Coast Total catchment area 8094 ha	Warm dry (94%) climate with flow originating in lowland country, and Warm dry (6%) climate with flow originating in lakes	Alluvium Miscellaneous	51% 49%	Native Cover Plantation forestry High producing Low producing Orchards/Vineyards Cropping Urban areas	1% 4% 	 43% 0% 27% 19% 1%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	16% 35% 5% 6% 2% 26% 0% 0% 1% 9% 0%

Table 1-1: Catchment characteristics of the major Ngaruroro River catchment zones. Information has been taken from the River Environment Classification (REC) and the Land Cover Data Base (New Zealand) version 4 (LCDB4). Note: the LDCB4 categories have been summarised to 7 principal land cover categories, see table Table 1-5: for further details. For explanation of LUC Classes see Table 1-6.

1.3 Description of the Tutaekuri River Catchment

The Tutaekuri catchment is approximately 836 km^2 in size. Its headwaters are in native vegetation in the Kaweka Range. Around the SOE site at Lawrence Hut the Tutaekuri River passes through commercial pine forest. The river has good quality habitat for most of its length, with regular occurrence of riffles, pools and bends and a predominantly cobble streambed.

Dry stock farming dominates the middle catchment although approximately 7000 ha of dairy farming has been established over the last 10 to 15 years, mostly around Patoka. Downstream of the Mangaone River confluence, the Tutaekuri valley widens and flattens, and the river takes a braided morphology. Land use here is predominantly vineyards and orchards, with dry stock farming in the surrounding hills as well as peri-urban/commercial development.

The catchment holds significant ecological value associated with the aquatic and riparian ecosystems and indigenous fauna and flora. Seven native fish species with populations which are classified as 'declining at a national level' are found in the Tutaekuri and it is an important catchment for lamprey and koaro.

There are a number of freshwater wetlands in the catchment which support a wide range of bird and fish species, the largest being the ecologically significant Lake Te Rotokare. The lower braided reach of the Tutaekuri supports a high population of banded dotterels.

The catchment supports a significant brown and rainbow trout fishery with good angling opportunities in the Mangatutu and the Tutaekuri main stem. Trout populations are self-sustaining with spawning occurring in a number of tributaries.

Other recreational activities in the catchment include tramping, swimming and kayaking. In the upper reaches, the Donald River is highly valued for whitewater kayaking while flatwater kayaking occurs in the lower catchment near Puketapu. Popular swimming locations are found near Puketapu and at Guppy Rd near Taradale where the recreational grade is recorded as fair due to occasional bacterial contamination. The lower section of the Tutaekuri is fenced to keep cattle out and to support the high recreational value of the river.

HBRC monitors ecological health and water quality at seven SOE sites in the Tutaekuri catchment, of which three are long-term data records covering 20 years of quarterly samples, and four additional sites since 2012. The four sites on the Tutaekuri main stem are Lawrence Hut, upstream of the Mangaone River confluence at Rissington, Puketapu and Brookfields Bridge. The three remaining sites are in the two biggest tributaries, the Mangatutu (one) and the Mangaone (two) (Figure 1-3).

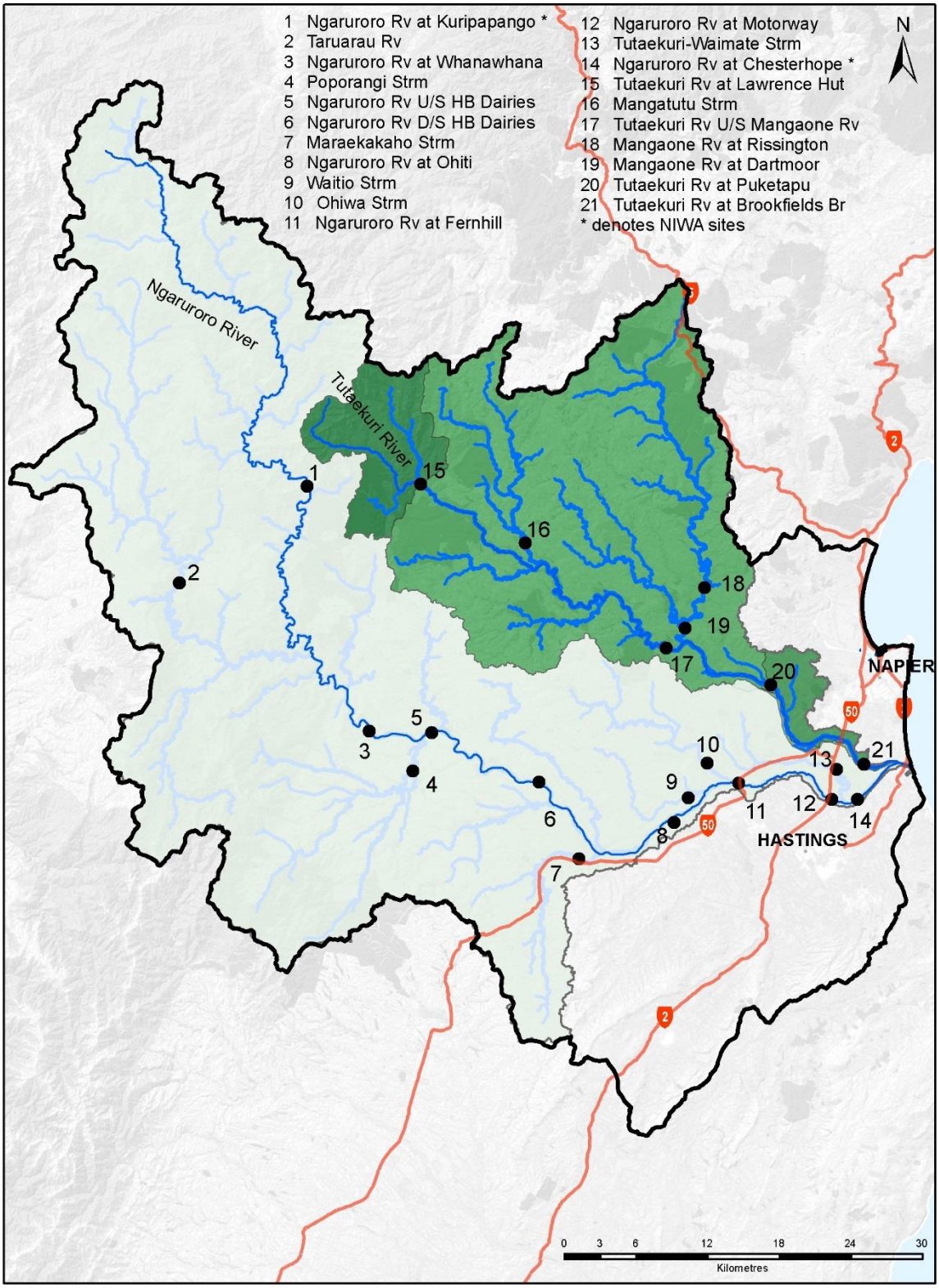


Figure 1-3: Location of the Tutaekuri River catchment and its State of the Environment (SOE) monitoring sites for water quality and ecology.

Table 1-2: Catchment characteristics of the major Tutaekuri River catchment zones. Information has been taken from the River Environment Classification (REC) and the Land Cover Data Base (New Zealand) version 4 (LCDB4). Note: the LDCB4 categories have been summarised to 7 principal land cover categories, see table Table 1-5: for further details. For explanation of LUC Classes see Table 1-6.

Zone	Climate and Source-of-Flow categories (REC)	Geology (REC)		Land cover (LCDB4)		Land Use Capability Class (LUC)	
Upper Zone Source to Lawrence Hut Total catchment area 10060 ha	Cool wet (59%)/ cool extremely wet (4%) climate with flow originating in hill country, and Cool extremely wet (29%)/ cool wet (8%) climate with flow originating in mountain country.	Volcanic acidic Hard sedimentary Miscellaneous	64% 27% 9%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards Cropping Urban areas	77% 21% 0% 0% 0% 0% 0%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	0% 0% 0% 0% 0% 25% 15% 60% 0% 0% 0%
Middle Zone Lawrence Hut to Puketapu Total catchment area 68553 ha	Cool Wet (38%) climate with flow originating in hill country, and Warm wet (39%)/ warm dry (20%) climate with flow originating in lowland country, and Cool wet (3%) climate with flow originating in mountain country.	Miscellaneous Alluvium Volcanic acidic Soft sedimentary	48% 2% 45% 5%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards Cropping Urban areas	17% 19% 62% 1% 1% 0% 0%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	0% 0% 9% 19% 0% 52% 14% 5% 0% 0% 0%
Lower Zone Puketapu to coast Total catchment area	Warm dry (82%) /Cool wet (18%) climate with flow originating in lowland country.	Miscellaneous Alluvium	69% 31%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards	0% 8% 63% 1% 10%	Class 1 Class 2 Class 3 Class 4 Class 5	8% 10% 17% 0% 9%

3214 ha			Cropping	9%	Class 6	42%
			Urban areas	4%	Class 7	0%
					Class 8	0%
					Lake	0%
					River	12%
					Town	2%

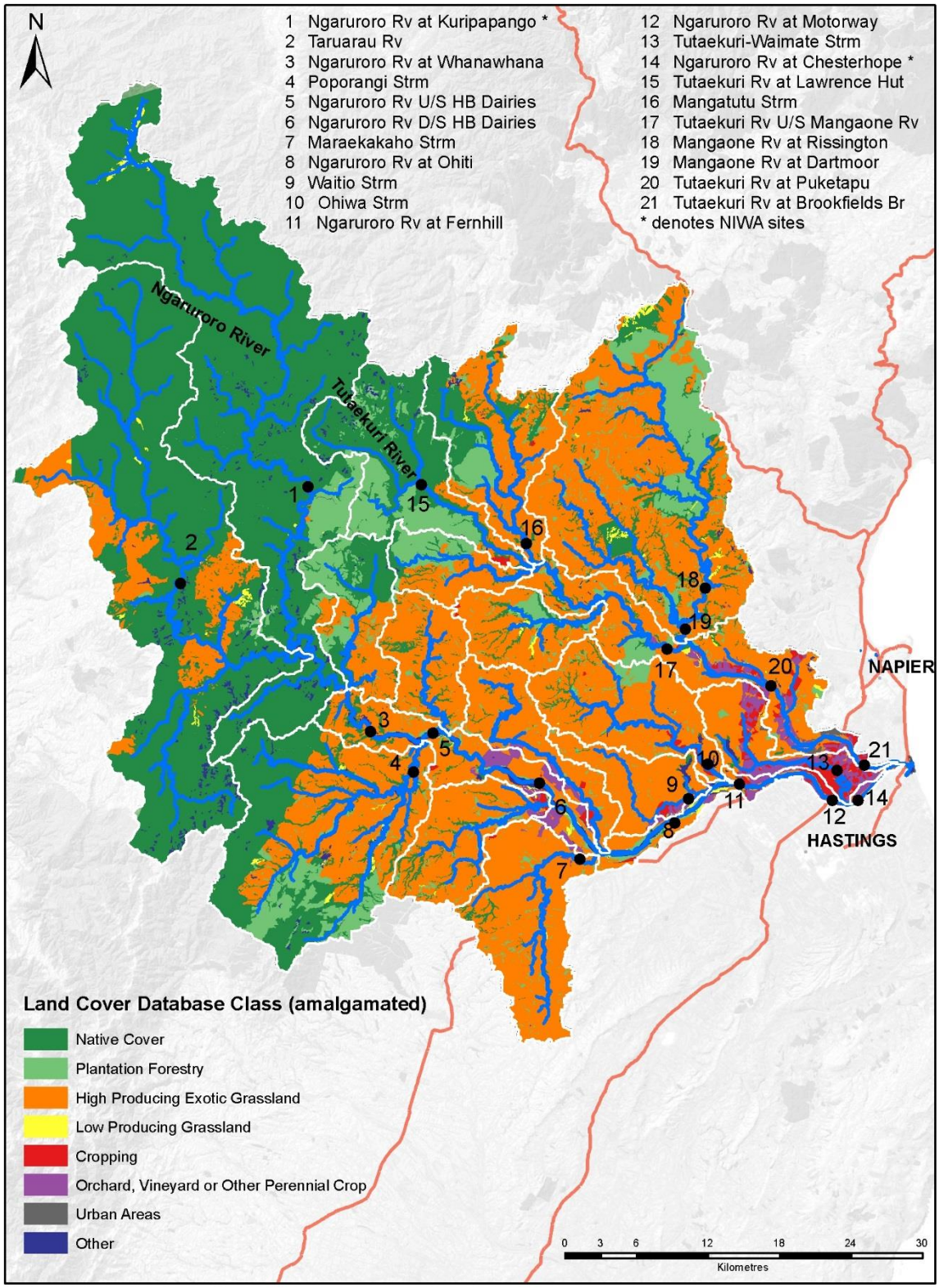


Figure 1-4: LDCB4 classification of the Ngaruroro and Tutaekuri River catchments.

1.4 Description of the Karamu Stream Catchment

The Karamu catchment is approximately 490 km^2, extending south from Awatoto to Havelock North and west to the Raukawa Range. The Karamu Stream and its tributaries drain the Poukawa Basin, the Kohinurakau, Kaokaoroa and Raukawa Ranges and a large part of the Heretaunga Plains.

The catchment covers the majority of the Heretaunga Plains which has been developed extensively for agriculture and comprises some of the most productive cropping areas in New Zealand. The Karamu catchment is the predominant region in Hawke's Bay for orcharding, cropping, and viticulture, while the southwestern half of the catchment primarily supports dryland sheep and beef with the exception of the Poukawa Basin, which is a significant cropping area.

Waterways in the Karamu catchment have been extensively modified for flood protection purposes. The current Karamu Stream occupies a former course of the Ngaruroro River. Flooding of the productive, southern area of the Heretaunga Plains has been an issue since the 1850s. In 1969, as part of the Heretaunga Plains Flood Protection scheme, the Ngaruroro River was diverted to the north, leaving the Karamu and Raupare streams to feed the lower Karamu Stream or, as it is also known, the Clive River and Ngaruroro Tawhito (the 'old' Ngaruroro).

There are several freshwater wetlands in the catchment which are ecologically significant, the largest being Lake Poukawa and Pekapeka Swamp. They support a significant number of bird species, some of which are threatened.

HBRC monitors water quality at 8 long-term SOE sites across the Karamu catchment in the Poukawa, Karewarea, Mangarau (2 sites), Herehere, Ruahapia, Awanui streams and the Clive River. An additional short-term concurrent gauging programme with water quality samples was carried out at 14 sites in 2010.

Figure 1-5: Location of the Karamu and Ahuriri catchments and its State of the Environment (SOE) monitoring sites for water quality and ecology.

Table 1-3: Catchment characteristics of the Karamu Stream Information has been taken from the River Environment Classification (REC) and the Land Cover Data Base (New Zealand) version 4 (LCDB4). Note: the LDCB4 categories have been summarised to seven principal land cover categories, see table Table 1-5: for further details. For explanation of LUC Classes see Table 1-6.

Zone	Climate and Source-of-flow categories (REC)	Geology (REC)		Land cover (LCDB4)		Land Use Capability Class (LUC)	
Karamu Stream Total catchment area 51462 ha	Warm dry (97%)/ cool dry (3%) climate with flow originating in lowland country	Hard sedimentary	34%	Native Cover	0%	Class 1	12%
		Soft Sedimentary	28%	Plantation forestry	2%	Class 2	10%
		Alluvium	26%	High producing grassland	56%	Class 3	23%
		Miscellaneous	10%	Low producing grassland	0%	Class 4	7%
		Volcanic acidic	2%	Orchards/Vineyards	15%	Class 5	16%
				Cropping	11%	Class 6	24%
				Urban areas	6%	Class 7	4%
						Class 8	0%
						Lake	0%
						River	1%
						Town	3%

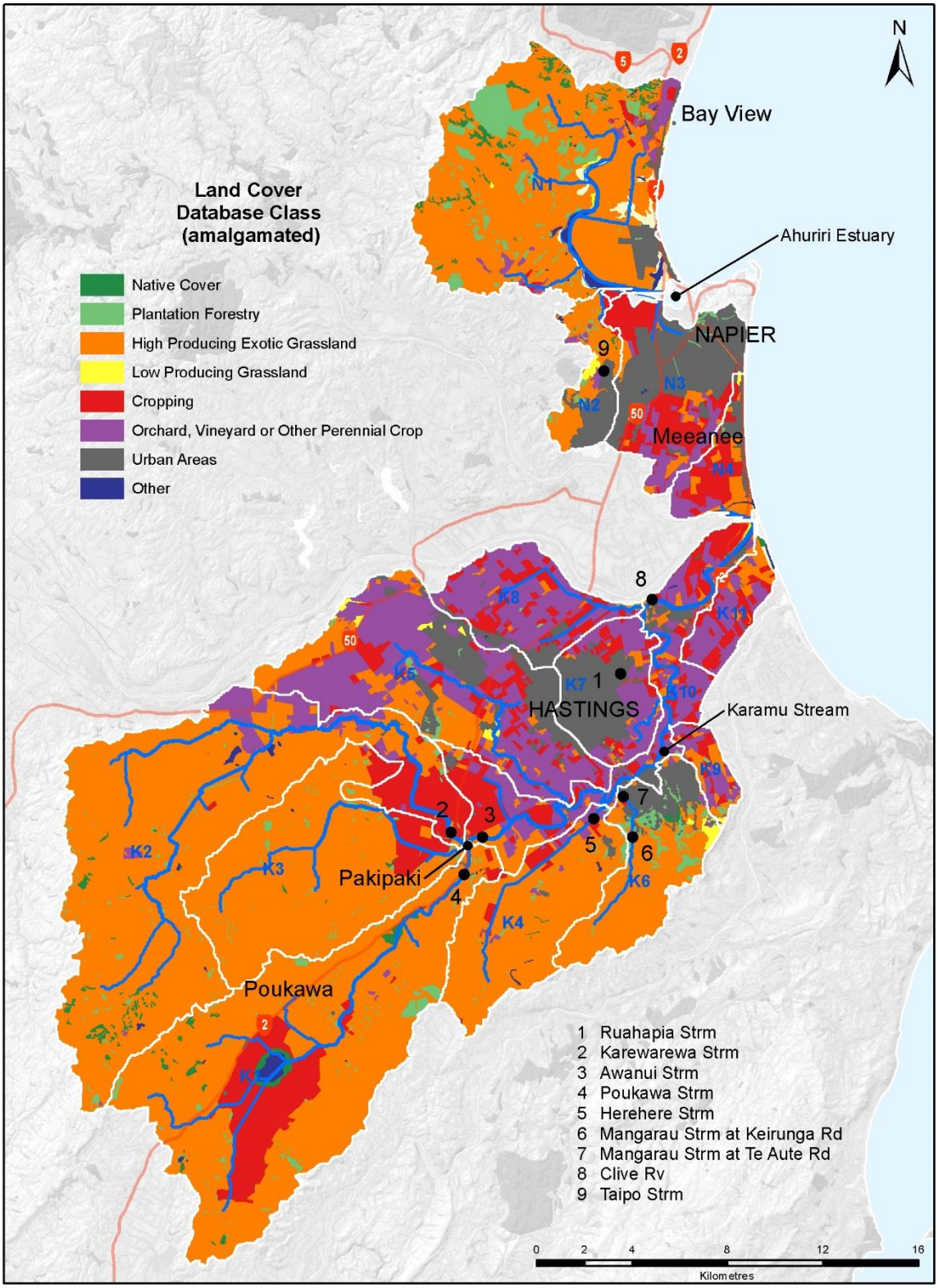


Figure 1-6: LDCB4 classification of the Karamu Stream and Ahuriri Estuary catchments.

1.4.1 Waitangi Estuary: Receiving environment of the Ngaruroro, Tutaekuri and Karamu catchments

The Waitangi estuary (Figure 1-7) is where the Tutaekuri, Ngaruroro and Karamu rivers meet the sea. The estuary includes a variety of important habitats including subtidal seagrass beds, intertidal flats, salt marsh and two associated freshwater wetlands at Muddy Creek and the Horseshoe. These habitats host a broad diversity of flora and fauna. There is a large number of bird and fish species (some threatened) that use this area during some or all of their lifecycle. In the Regional Coastal Environment Plan (2012), the Waitangi Estuary is classified a Significant Conservation Area which affords the estuary particular protection.

The presence of rich natural resources has meant that this area has always been important to Maori. *Te Awapuni*, which is the Māori name for the mouth of the Ngaruroro River, was once an important pā site. Hawke's Bays first mission was established adjacent to the pā by William and Elizabeth Colenso in 1844. This was washed away in 1897. At this time the Waitangi estuary was linked with the mouth of the Tukituki River. This area has been greatly modified both by natural processes such as storm events, floods and wave action as well as the construction of flood defences, land drainage and pump stations. The wetlands that exist now are a fragment of their past extent.

Despite this extensive modification, the Waitangi estuary is still highly valued as a recreational area. Dependent on the weather conditions, the estuary is extensively used by kayakers, kite surfers, jet boaters, fishermen and surfers.

The water quality, especially sediment loads, coming from the Ngaruroro, Tutaekuri and Karamu catchments influences the state of the estuary as it is the receiving environment of all three catchments. The state and trends of water quality within the Waitangi estuary is reported on in the TANK Coastal report (Wade et al. 2016).

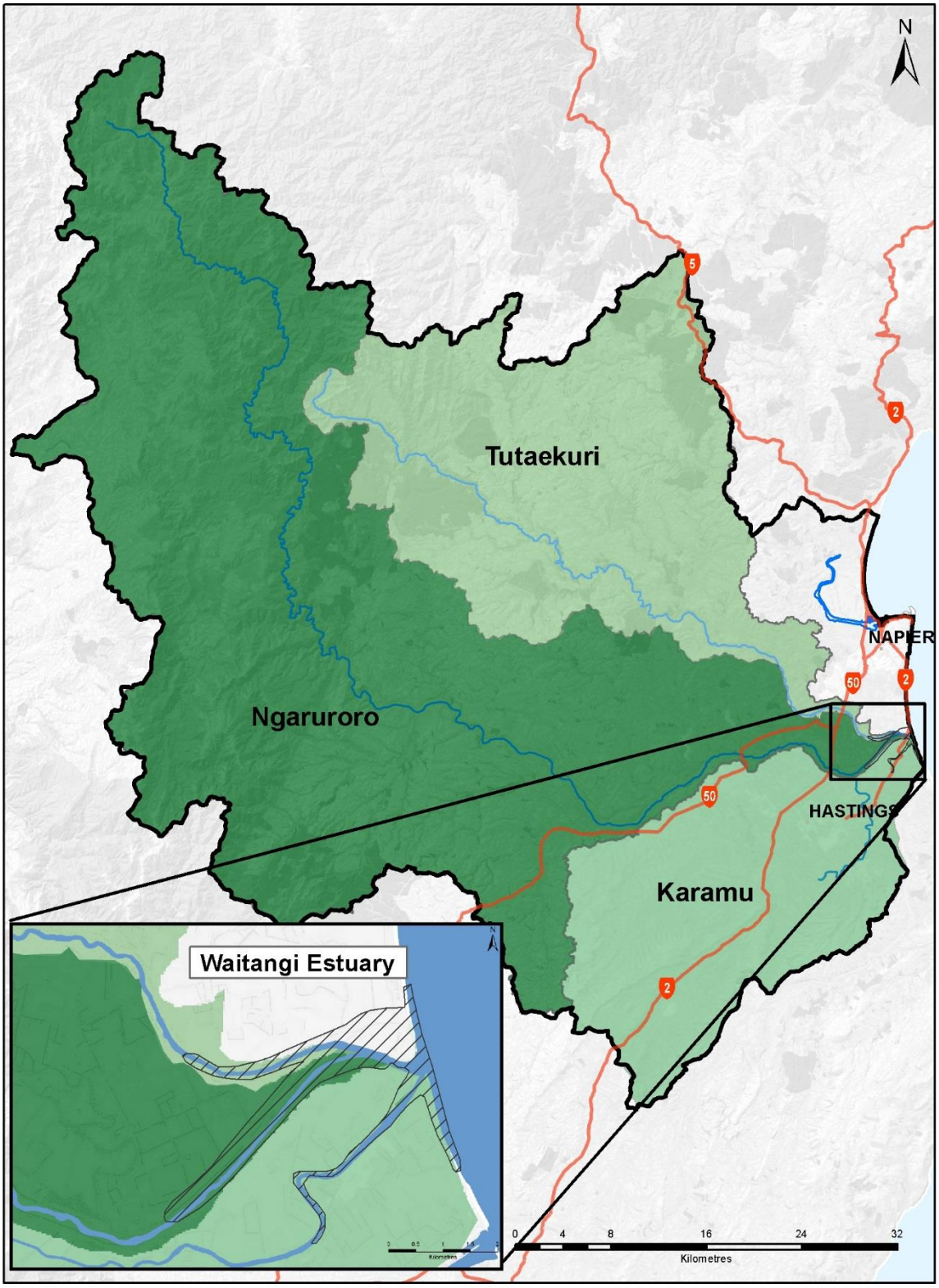


Figure 1-7: Location of the Waitangi Estuary.

1.5 Description of the Ahuriri Catchment

The Ahuriri estuary has a catchment of 14,564 hectares. The Ahuriri is Hawke's Bay's most urbanised catchment and includes Napier and surrounding suburbs north to Bay View and south to Awatoto. Whararangi and Te Maara marae are in the catchment. Therefore, the most significant water management issues are urban-based. The Napier City stormwater network which protects the urban and industrial areas from flooding generally flows into the Ahuriri Estuary.

The Ahuriri estuary itself is a shallow microtidal estuary with an area of approximately 270 hectares. Due to its shallow nature the estuary is well mixed. (Hume et al. 1990) calculated the tidal prism as 196,330 m^2. Freshwater inflows into the estuary are minimal compared to other estuaries in the region.

Despite extensive modification, reclamation, drainage, and discharges from the stormwater network, the estuary is recognised as a regionally and nationally significant area, with high wildlife and fisheries values. Over 70 species of resident and migratory waterbirds use the estuary as a feeding and roosting area. Almost 30 species of fish have been recorded in the estuary. In the Regional Coastal Environment Plan (2012), the Ahuriri Estuary is classified as a Significant Conservation Area, which affords the estuary particular protection mechanisms.

As one of the few sheltered, tidal lagoon estuaries within Hawke's Bay, Pandora Pond provides for a number of recreational opportunities including swimming, kayaking, sailing, and waka ama. On an exposed coastline such as Hawke's Bay, and with the proximity of the region's urban centres, this is one of the most important recreation sites in Hawke's Bay.

The Ahuriri catchment has one freshwater SOE monitoring site, which is located in Taipo Stream (Figure 1-5). In this report the site is included in the results and discussion of the Karamu SOE sites due to its similarity in stream type (lowland, slow-flowing stream). A wider monitoring programme of the Ahuriri catchment and estuarine water quality was established in 2014. The results of this monitoring are reported on in the TANK coastal environment report (Wade et al. 2016).

Table 1-4: Catchment characteristics of the Ahuriri Estuary Information has been taken from the River Environment Classification (REC), Land Use Capability classification (LUC) and the Land Cover Data Base (New Zealand) version 4 (LCDB4). Note: the LDCB4 categories have been summarised to seven principal land cover categories, see table Table 1-5 for further details. For explanation of LUC Classes see Table 1-6.

Zone	Climate and Source-of-Flow categories (REC)	Geology (REC)		Land cover (LCDB4)		Land Use Capability Class (LUC)	
Ahuriri Estuary Total catchment area 14564 ha	Warm dry (99%) climate with flow originating in lowland country, and Cool dry (1%) with flow originating in hill country	Alluvium Miscellaneous Volcanic acidic	30% 69% 1%	Native Cover Plantation forestry High producing grassland Low producing grassland Orchards/Vineyards Cropping Urban areas	4% 7% 53% 1% 6% 10% 18%	Class 1 Class 2 Class 3 Class 4 Class 5 Class 6 Class 7 Class 8 Lake River Town	5% 12% 25% 0% 2% 40% 2% 0% 0% 2% 13%

1.6 Recreational usage and water quality in the TANK catchments

The rivers and estuaries found within the TANK catchments are frequently used for recreational activities because they're near to Hawke's Bays population centres and ease of access. During a survey of recreational use of Hawke's Bay rivers (Madarasz-Smith 2010), the Clive (Karamu), Tutaekuri and Ngarururo were rated the third, fourth and fifth most popular respectively. These 3 rivers are used for a variety of activities including kayaking, swimming, fishing, dog walking, picnicking, bird watching and kite-surfing. The same survey also highlighted that good water quality is one of the most important attributes that make a river appealing to the public and poor water quality is the most important attribute which makes sites unappealing. HBRC monitors recreational water quality at one site in the lower reaches of each of these rivers (see map).

HBRC has a sampling site at Pandora pond which is situated close to the mouth of the Ahuriri estuary. The safe sheltered water, proximity to Napier and amenities make the Ahuriri the most well used estuary in Hawke's Bay. Pandora pond and the lower Ahuriri estuary are popular for swimming, kayaking, waka ama, picnicking and dinghy sailing. The Waitangi estuary is probably the next most used estuary in Hawke's Bay and is a popular spot for kayaking, waka ama, jet boating, surfing, kite-surfing and fishing. There is no specific sampling site in the Waitangi estuary. However, the sampling sites on the 3 rivers are at the upper limit of the estuary.

Alongside the river and estuarine sites, HBRC monitors recreational water quality at 4 beach sites (map), which can at times come under the influence of these catchments. Tests for faecal bacterial contamination as an indicator for pathogens associated with human health risks is performed weekly during the summer months and.

Hawke's Bay's main urban and agricultural centres are found within the TANK catchments. Urban and agricultural areas have elevated risks for poor recreational water quality due to increased levels of stormwater and agricultural runoff. Despite these risks, recreational water quality within the TANK catchments is typically of an acceptable standard (see chapter 6). Elevated concentrations of bacteria generally only occur after periods of heavy rain.

1.7 SOE Water Quality Data and Analysis

Water quality monitoring across the TANK catchments has been carried out by HBRC since 1980 as part of the State of the Environment (SOE) programme. The SOE monitoring programme was undertaken on a quarterly basis until June 2012, when monthly sampling began across the whole region.

Over this time a total of 21 sites have been sampled in the Tutaekuri and Ngaruroro. Of these, 14 sites are long-term SOE monitoring sites as outlined above, two sites are monitored long-term by NIWA and 7 sites were sampled additionally since 2012 to fill in knowledge gaps in some of the tributaries without long-term SOE data. These will be referred to as 'gap sites' and are marked by an asterisk (*) in figures. Eight sites have been sampled in the Karamu catchment, and one in the Ahuriri catchment.

Water quality parameters routinely measured across SOE monitoring sites include the following field-based measurements:

- Turbidity (NTUs)
- Visual clarity (as black disc sighting distance in metres)
- Dissolved oxygen (mg/L)

- Conductivity (μS/cm)
- pH
- Water temperature (°C)

Visual periphyton assessments were introduced to the programme in 2011 and are undertaken at most sites, subject to flow conditions and substrate type. Water samples are collected at each site and submitted to R.J. Hills Laboratory (Hamilton) for analysis of total and dissolved nutrients (nitrogen and phosphorus), suspended solids, and faecal bacteria (as *E. coli*).

At the Ngaruroro River at Whanawhana, upstream of Hawke's Bay Dairies and Fernhill, rock scrapes are collected and submitted to R.J. Hills for periphyton biomass estimates (as chlorophyll *a*). Additional sites in the Tutaekuri River were added in 2013 as part of a 'Gap' study and sampled for periphyton on a monthly basis

On several occasions, particular effort has been made to investigate the effects of dairy conversion in the Patoka/Puketitiri area on water quality. This is a separate report (Lyon in prep). Similarly, a targeted study was undertaken on the Karamu Stream to better understand pressures on life supporting capacity (Haidekker 2016). Coastal water quality has been monitored twice quarterly since 2006 offshore of the Waitangi and Ahuriri estuaries and is reported on in the report (Wade et al. 2016).

1.7.1 Trend analyses: Introduction and method

Trend analysis of environmental monitoring data is important because environmental characteristics may exhibit trends which indicate the significance of particular issues is changing. For example, if nitrate concentrations are increasing or decreasing at a particular site, the cause and significance of these changes may need to be identified.

Trend analyses in this report use non-parametric statistical approaches similar to those used in recent nationwide water quality analyses undertaken for the LAWA project (Ballantine 2012), which involved seasonal Kendall trend tests. Some sites had a long term monthly record, whereas others only had monthly sampling for the latter part of the record. For these latter sites, a quarterly sampling interval was applied to the entire time period using median quarterly values, to avoid biasing the trend analyses to the latter part of the period. January was used as the 'start' month, i.e. the seasons were: Jan-Mar; Apr-Jun, Jul-Sep; Oct-Dec, to be consistent with the LAWA project.

It is inappropriate to compare trends when datasets cover a different time period. For this reporting, we decided to adopt an 8 out of 10-year stipulation, whereby any dataset that had samples from at least 8 years of time period between January 2004 and December 2013 were considered comparable.

In some reporting of trend analyses, adjustment of the results is made to accommodate variation in river flow. This is known as flow adjustment, and changes the trend analyses to a parametric approach which complicates the statistical approach required. Flow adjustment was not completed on data hosted by LAWA when undertaking trend analyses, and there currently is no industry standard for flow adjustment for trend analyses of water quality in New Zealand. For these reasons, no flow adjustment was undertaken for the trend analyses presented here.

The seasonal Kendall tests help identify whether variability in the data is randomly distributed, or whether a significant trend exists over time. For example, did most of the higher ranked values occur in the last few

years, or did higher values occur randomly over time? It was decided that a 'significant' trend existed, since there was a less than 5% probability that the observed data was obtained by chance.

To estimate the strength of trends over time, a Theil-Sen slope estimator was used. The non-parametric Theil-Sen slope estimator estimates the median slope amongst lines through all pairs of points in the dataset. This approach is effective at estimating the true slope in water quality data series because it is less sensitive to outliers.

The values derived from the Theil-Sen slope estimator are given as "Percent Annual Change" (PAC), which is the magnitude of the trend given as a percent of the median of observed values. A trend in PAC was considered meaningful if the PAC was greater than 1% per year. For some variables, such as black disc distance, an increase in observed values is improvement (i.e., we can see further in the water). For other variables such as phosphorus concentration, an increase in observed values represents a deterioration (i.e. there is more phosphorus in the water).

In all tables that present trend results, the changes are represented in bold when they are significant (i.e., p value is less than 0.05). Given a significant trend for a particular variable, the PAC is highlighted in blue if there was a significant improvement in the water quality variable, and highlighted in red if there was a significant deterioration in the water quality variable.

The discussion around improvement and deterioration does not relate to natural enrichment of streams and rivers that occurs from the headwaters of the catchment to the coast, but instead to short-term site-specific increases or decreases in a water quality variable. The cause of water quality trends can be difficult to conclude from SOE reporting alone, but possible explanations of observed patterns are provided where appropriate.

The full details of trend analyses are presented in Appendix C, and a summary of trend results is presented in the sections on water quality variables that follow.

Only trend results for sites with 8 or more years of data are presented in the body of the report. Results of trend analyses for sites that contain less than 8 years of data are presented in Appendix C, and the different time period noted.

1.7.2 Water quality guidelines relevant to the TANK catchments

Environmental guidelines are often used to describe the general state of a natural resource, even though they may not be directly applicable in a regulatory context.

Table 1-2 outlines several relevant 'trigger values' and suggested water quality limits that are included in graphical summaries throughout Section 1.7. The various trigger values, guidelines and limits are discussed in the following paragraphs.

(ANZECC 2000) guidelines are used to indicate environmental conditions in "baseline" (essentially unaffected) or "pseudo-baseline" (lightly impacted) catchments (Davies-Colley 2000). The 'trigger' values are based on water quality conditions taken from sites from the NIWA National River Water Quality Monitoring Network (NRWQMN) (Davies-Colley 2000). The trigger values relate to 80th percentile or 20th percentile values for the data range taken from the NRWQMN.

In the development of (ANZECC 2000) trigger values, Davies-Colley (2000) states: '[r]unning medians of water quality data measured in monitoring programmes may be compared with these trigger values. If the median value of a water quality variable for a particular site exceeds the trigger value, then it is intended to "trigger" a response on the part of water managers, which might be to initiate special sampling or carry out an investigation of reasons for the degraded water quality.'

The (Biggs 2000) NZ periphyton guidelines are used nationally to set limits around periphyton biomass as well as identifying possible values for setting nutrient limits or targets to manage nuisance periphyton growth.

The (Hickey 2013a) Nitrate Toxicity Guidelines represent the most up-to-date assessment of nitrate toxicity and provide guidance around nitrate concentration thresholds, both as annual median and annual concentration peaks (95th percentile) for managing nitrate toxicity risk.

Hay et al. (2006) identified several appropriate limits for the protection of trout fisheries in their report 'Water quality guidelines to maintain trout fishery values'. The report was produced on behalf of Horizons Regional Council in the development of the One Plan.

The MfE/MoH (2003) '[m]icrobiological water quality guidelines for marine and freshwater areas' are used extensively to assess 'risk' according to contact recreation and exposure to bacteria present in aquatic environments.

The HBRC (2006) Regional Resource Management Plan (RRMP) identifies several water quality targets for nutrients and other water quality variables, including the limit for dissolved oxygen saturation (Table 1-3). This limit also aligns with the limit identified in the RMA (1991) for the protection of trout fisheries.

Table 1-2: Summary of relevant water quality guidelines for the TANK catchments. .

Variable[1]	Trigger / Limit	Source
TN – ANZECC Lowland	0.614 mg/L	ANZECC (2000)
TN – ANZECC Upland	0.295 mg/L	ANZECC (2000)
TP – ANZECC Lowland	0.033 mg/L	ANZECC (2000)
TP – ANZECC Upland	0.026 mg/L	ANZECC (2000)
DIN/NO_x-N – ANZECC Lowland	0.444 mg/L	ANZECC (2000)
DIN/NO_x-N – Periphyton growth 20 day accrual	< 0.295 mg/L	Biggs (2000)
DIN/NO_x-N – ANZECC Upland	0.167 mg/L	ANZECC (2000)
DRP – Periphyton growth 20 day accrual	< 0.010 mg/L	Biggs (2000)
DRP – ANZECC Lowland	0.010 mg/L	ANZECC (2000)
DRP – ANZECC Upland	0.009 mg/L	ANZECC (2000)
NO_3-N Toxicity 90% species protection	< 3.8 mg/L	Hickey (2013a)
NO_3-N Toxicity 95% species protection	< 2.4 mg/L	Hickey (2013a)
NO_3-N Toxicity 99% species protection	< 1.0 mg/L	Hickey (2013a)
Clarity – contact recreation	> 1.6 m	ANZECC (2000); HBRC RRMP 2006
Clarity – 'Significant' trout fishery	> 3.5 m	Hay et al. (2006)
Clarity – 'Outstanding' trout fishery	> 5.0 m	Hay et al. (2006)
E. coli – Contact recreation (health) Red alert	> 550 (CFU/100ml)	MfE/MoH (2003)
E. coli – Contact recreation (health) Amber alert	> 260 (CFU/100ml)	MfE/MoH (2003)
Enterococci – Contact recreation (health) Red alert	> 280 (CFU/100ml)	MfE/MoH (2003)

[1] TN = Total Nitrogen; TP = Total Phosphorus; DIN = Dissolved Inorganic Nitrogen; NOx-N = Oxides of Nitrogen or Nitrate/Nitrite- Nitrogen; DRP= Dissolved Reactive Phosphorus; NO_3-N = Nitrate – Nitrogen; Clarity = Black disc sighting distance; *E. coli* = faecal bacteria levels measured as *E. coli* in colony forming units / 100ml; MCI = Macroinvertebrate Community Index; DO% Saturation = % Dissolved Oxygen Saturation.

Variable[1]	Trigger / Limit	Source
Enterococci – Contact recreation (health) Amber alert	> 140 (CFU/100ml)	MfE/MoH (2003)
Periphyton biomass - biodiversity	< 50 mg/m^2	Biggs (2000)
Periphyton biomass – aesthetic/recreation	< 120 mg/m^2	Biggs (2000)
MCI – 'Outstanding' trout fishery	> 120	Hay et al. (2006)
MCI –'Significant' trout fishery	> 100	Hay et al. (2006)
DO % Saturation – protection of trout fisheries	> 80%	RMA (1991); HBRC RRMP 2006
DO concentration – ecological health	> 4.0 mg/L bottom line 1-day minimum	Proposed for NOF Davies-Colley et al. (2013)

Table 1-3: HBRC Regional Resource Management Plan (2006) water quality limits - "Environmental Guidelines – Surface Water Quality". The table has been taken from Table 7, page 99, Section 5.4 of the RRMP.

Variable	Guideline[2]
Temperature	The temperature of the water should be suitable for sustaining the aquatic habitat
Dissolved oxygen	The concentration of dissolved oxygen should exceed 80% of saturation concentration
Ammoniacal-nitrogen	The concentration of ammoniacal (NH_4-N) should not exceed 0.1 mg/L
Soluble Reactive Phosphorus	The concentration of soluble reactive phosphorus should not exceed 0.015 mg/L
Clarity	In areas used for recreation, the horizontal sighting range of a 200mm black disc should exceed 1.6m

Box plots have been used throughout Chapter 2 to summarise water quality data. The sites are ordered from left to right in an upstream to downstream order along the river channel. Sites are grouped by their position in the same major sub-catchment. For example, the Poporangi stream is a tributary to the Ngaruroro and is located further upstream than the Maraekakaho Stream, so the Poporangi SOE site appears to the left of the Maraekakaho SOE site in the graph.

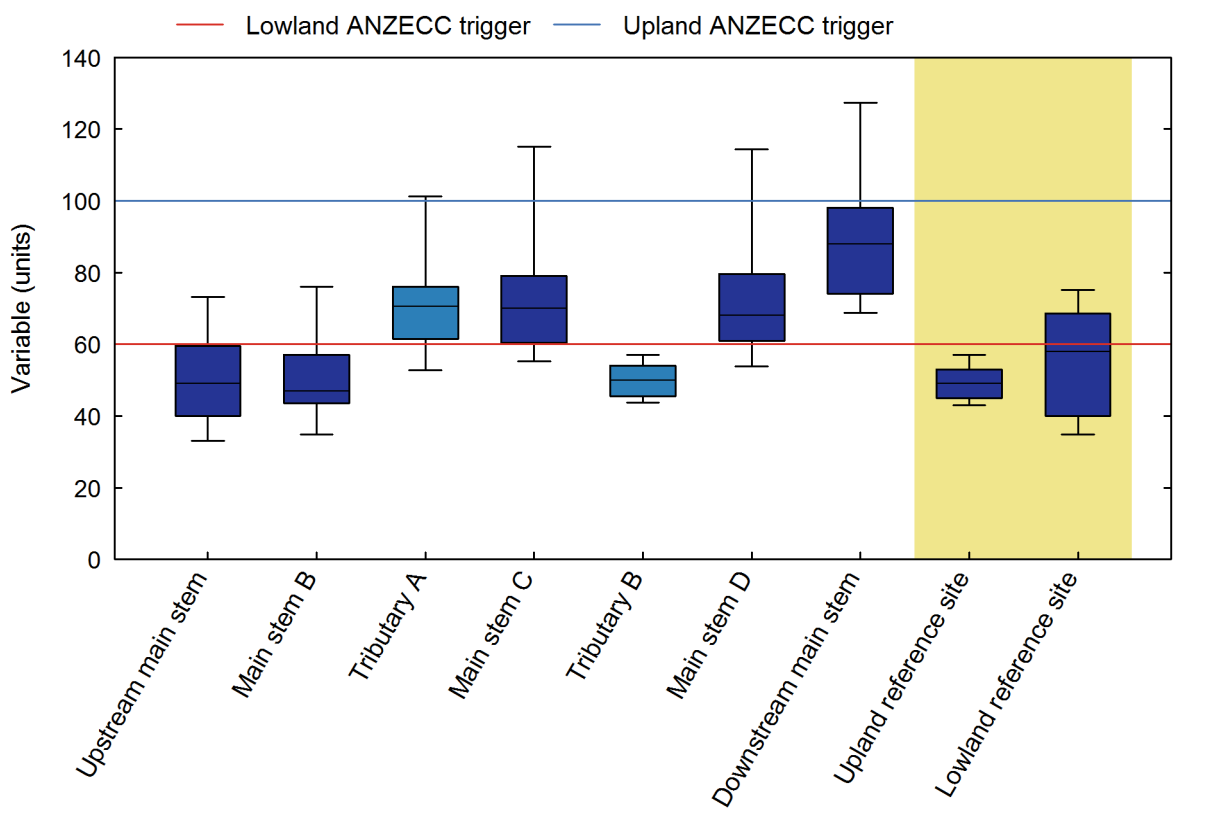
Catchment maps have been used to spatially represent changes in water quality data based on the median value of observations taken over the last 5 years for the water quality variable in question. The catchment maps include arrows indicating the direction of statistically significant trends, with green arrows for improvement and red arrows for deterioration of the variable in question. Sites without an arrow did not exhibit a statistically significant trend.

Tables of summary statistics are presented in Appendix A for the Ngaruroro and Tutaekuri catchments and in Appendix B for the Karamu and Ahuriri catchments to provide additional context to the changes in water quality variables under differing flow conditions. For example, the levels of faecal bacteria in rivers during high flows may not be relevant for bathing, because people will not be swimming during high flows. The conditions most likely to be experienced by bathers can be found in the < Lower Quartile Flow table (i.e. low flows).

[2] These guidelines apply after reasonable mixing and disregarding the effect of any natural perturbations that may affect the water body, as set out in Policy 72 of the HBRC RRMP 2006 that states that the guidelines for the variables included in Table 1-3 apply "at or below median flows".

Box plots, catchment water quality summary maps and statistical summaries of water quality variables all use the last 5 years of data to best represent current conditions throughout the catchment. Data obtained from sites during all flow conditions was used for these comparisons.

KEY POINT: Box plots graph data as a box representing statistical values. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers (error bars) above and below the box indicate the 90th and 10th percentiles.



2 Water Quality in the Ngaruroro and Tutaekuri River Catchments: Long-term SOE data

2.1 Nutrients

Nitrogen (N) and phosphorus (P) are key 'growth limiting' nutrients that influence the growth rate and extent of algae (or periphyton) and aquatic plants. A deficit in the supply of one or both of these two nutrients often limits plant biomass development (Matheson et al. 2012).

Eutrophication is the term used to describe the enrichment of water bodies by inorganic plant nutrients such as nitrate or phosphate. Eutrophication may occur naturally over geological timescales, particularly in lakes, and in rivers eutrophication increases on an upstream to downstream gradient, but higher levels of

enrichment are commonly the result of human activity. Land-use change and intensification often give rise to elevated levels of nitrogen and phosphorus, particularly in areas where appropriate farming practices are not followed. Nuisance periphyton growth can be managed by reducing or eliminating inputs of N and P from point-source discharges and/or diffuse sources such as discharges from land-use (Biggs 2000).

KEY POINT: Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) are dissolved inorganic forms of the nutrients nitrogen (N) and phosphorus (P) respectively. N and P are the two key macronutrients required for growth of plants and algae, occurring in all living cells – for example being key elements in proteins and DNA. DIN includes nitrate, nitrite and ammonia. DRP includes phosphate. Although numerous other forms of nitrogen and phosphorus exist and are commonly referred to in the field of water quality (e.g. organic and particulate forms), it is the dissolved forms DIN and DRP that are most readily available for uptake by plants and are thus most relevant for assessing effects on nuisance plant growth in rivers. The terms total nitrogen (TN) and total phosphorus (TP) refer to the sum total of all forms of N and P respectively in a sample. TN and TP are most relevant for assessments in lakes and coastal waters. At sufficiently elevated concentrations, nitrate and ammonia forms of nitrogen have toxic effects on aquatic biota (and on humans in the case of nitrate). This effect is independent of their significance as plant nutrients (Norton 2012).

2.1.1 Total nitrogen (TN) and total phosphorus (TP)

Figure 2-1 and Figure 2-2 are box-plots of total nitrogen (TN) and total phosphorus (TP) concentration for SOE monitoring sites across the Ngaruroro and Tutaekuri catchments. ANZECC trigger levels have been included on the plots for upland (> 150m altitude) and lowland sites (< 150m altitude). Upland sites in the Ngaruroro catchment are Ngaruroro River at Kuripapango and the Taruarau River, and in the Tutaekuri catchment Tutaekuri River at Lawrence Hut. All other sites are lowland sites according to ANZECC guidelines.

TN concentrations in the main stem of the Ngaruroro River stayed well below lowland ANZECC trigger values (Figure 2-1). There was a gradual increase in TN concentrations from upstream to downstream, but the TN concentration levels remained generally very low, even below the more stringent ANZECC upland trigger value over the entire length of the main stem. The tributaries had high TN concentrations, the median TN concentration in the Poporangi, Maraekakaho and Ohiwa streams exceeded ANZECC lowland trigger value.

TN concentrations in the Tutaekuri main stem increased between the sites at Lawrence Hut and upstream of the Mangaone confluence in the middle catchment, but TN was below the lowland ANZECC trigger value at all sites in the main stem. TN concentrations in the tributaries stayed below the lowland trigger value. The Mangatutu Stream and the Mangaone River had the highest TN concentrations, but also were mostly below ANZECC lowland trigger levels.

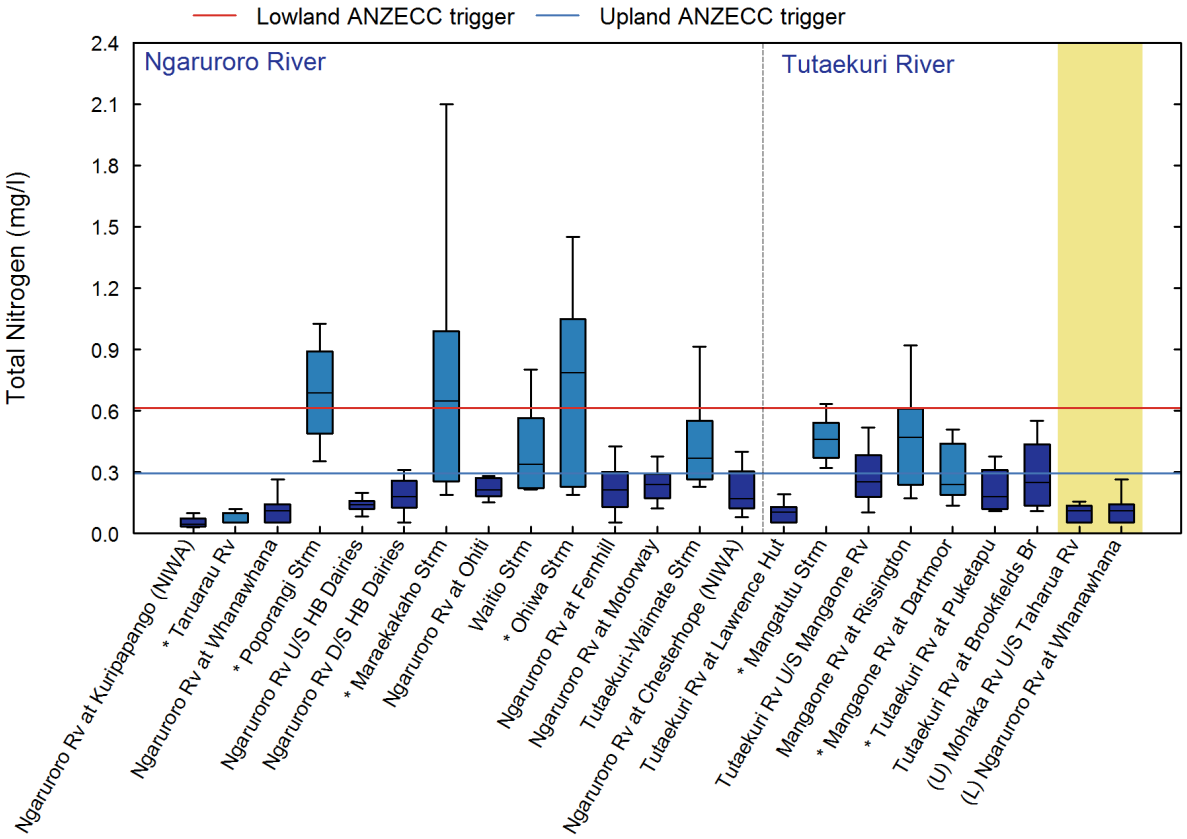


Figure 2-1: Total nitrogen (TN) levels at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TN trigger value; the red line to ANZECC (2000) 'Lowland' TN trigger value. Ngaruroro at Kuripapango, Taurarau River and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

TP concentration in the Ngaruroro main stem increased towards the sea in a similar way as TN, and was also below ANZECC trigger levels along the river. All tributaries except for the Taruarau River showed elevated levels of TP, but were particularly high in the Ohiwa and Tuatekuri-Waimate streams, where concentrations always exceeded the lowland ANZECC trigger level.

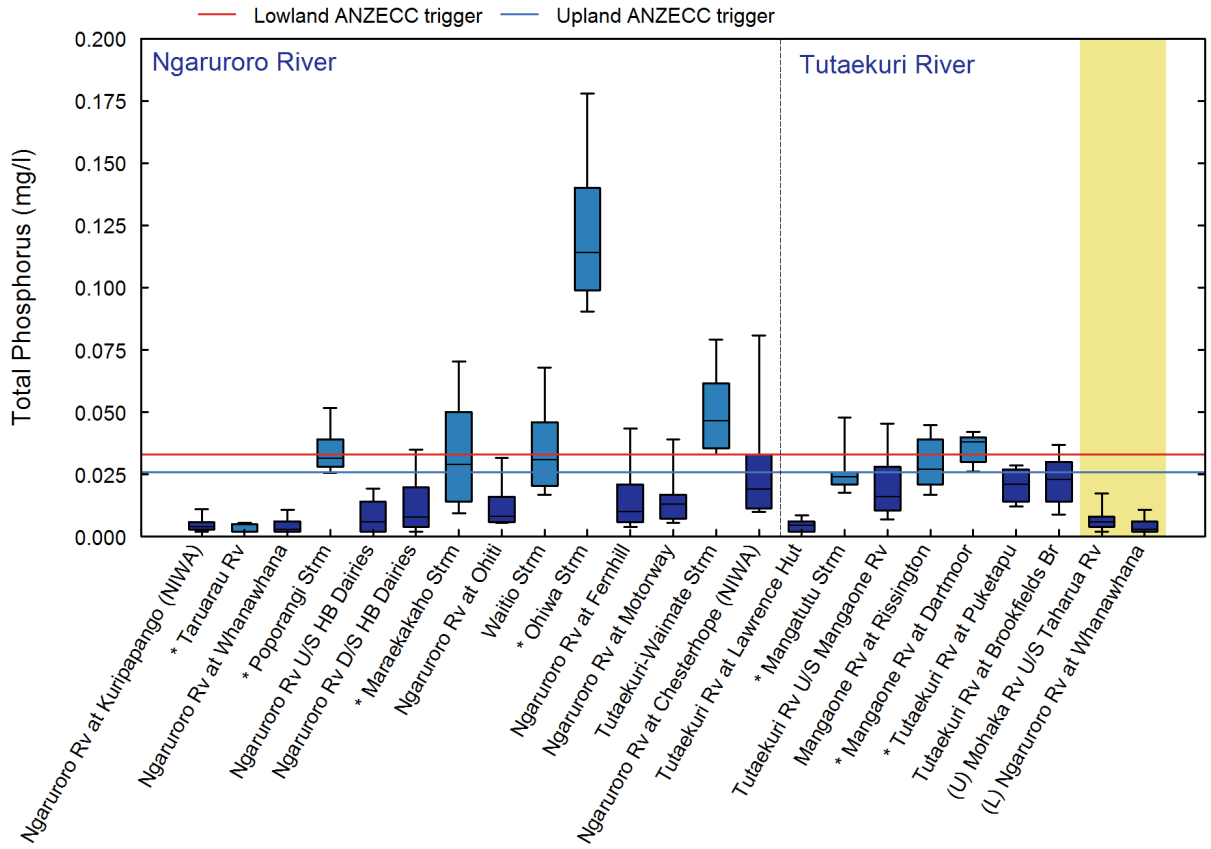


Figure 2-2: Total phosphorus (TP) levels at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TP trigger value; the red line to ANZECC (2000) 'Lowland' TP trigger value. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Several sites in the Ngaruroro and Tutaekuri catchments showed significant decreasing trends in TN and TP concentration between 2003 and 2013. This includes the reference (near-pristine) site Tutaekuri at Lawrence Hut, and the sites in the Ngaruroro main stem at Whanawhana and upstream of Hawke's Bay Dairies. TP decreased significantly at 2 sites further downstream in the Ngaruroro and Tutaekuri main stems, and in a large tributary of the Tutaekuri - the Mangaone River at Rissington.

Trend analysis was carried out on TN and TP across the SOE monitoring sites of the Ngaruroro and Tutaekuri catchments (Table 2-1 contains a summary, and Appendix C a full results of trend analysis). Several significant trends are apparent in the dataset. TN and TP concentrations decreased at all studied sites over time. TN decreased significantly (bold P values in Table 2-1) in the Ngaruroro main stem at Whanawhana and upstream of Hawke's Bay Dairies, and in the Tutaekuri River at Lawrence Hut.

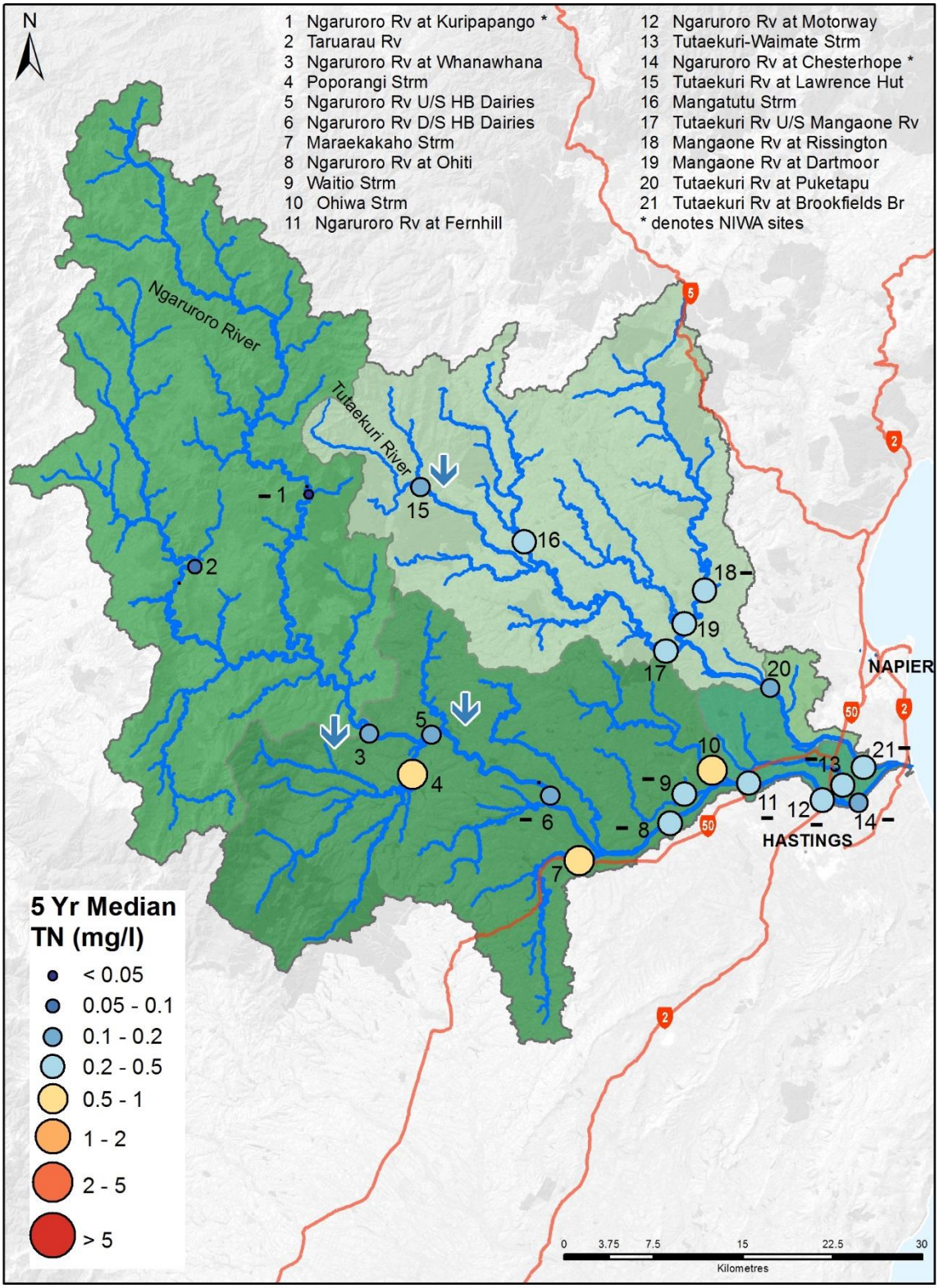


Figure 2-3: 5 year median total nitrogen (TN) levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

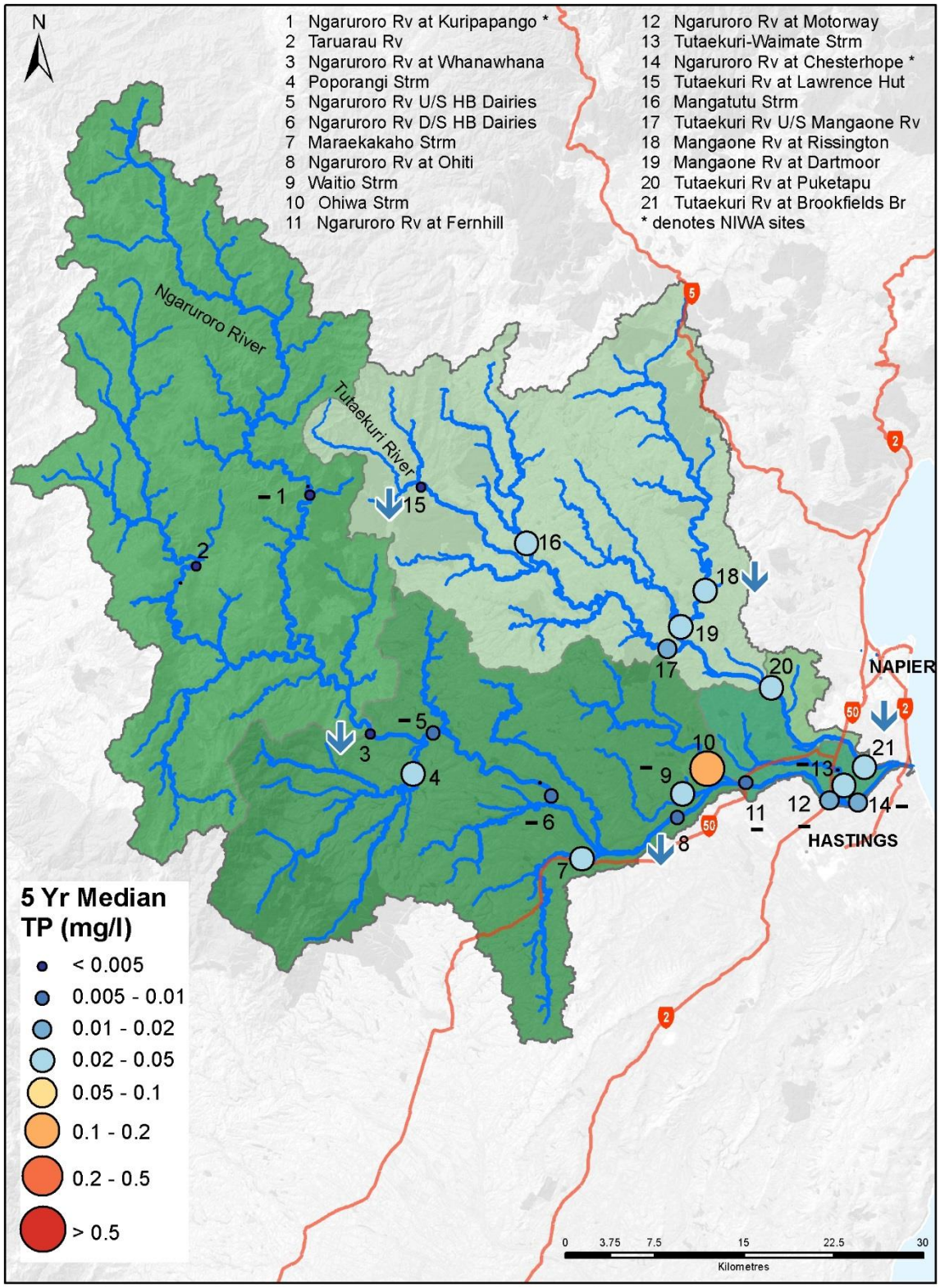


Figure 2-4: 5 year median total phosphorus (TP) levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record required between 2003 and 2013 for trend analysis.

TP decreased significantly in the Ngaruroro River at Whanawhana and at Ohiti. In the Tutaekuri catchment TP decreased at Lawrence Hut and in the Mangaone River. Interannual variation may be caused by natural variation in weather patterns and climate, such as the El-Niño Southern Oscillation and Pacific Decadal Oscillation. This also affects flow conditions. These patterns can be seen in water quality data trends and can confound efforts to analyse land use effects. The significant trends observed at near pristine sites like Tutaekuri at Lawrence Hut or Ngaruroro at Whanawhana are more likely to be caused by climate variability than by land use changes.

Table 2-1: Trend analysis results for DIN and DRP for Ngaruroro and Tutaekuri catchment SOE monitoring sites
Includes only sites with sufficient data and monitoring length for trend analysis. In bold: significant trend when $p < 0.05$. Cells shaded blue for improving trend, red for deteriorating trend.

Site	Total Nitrogen			Total Phosphorus		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Ngaruroro Rv at Kuripapango	0.05	0.59	-0.88	0.004	0.65	0
Ngaruroro Rv at Whanawhana	0.121	**0.002**	**-5.45**	0.004	**0.003**	**-9.17**
Ngaruroro Rv U/S HB Dairies	0.145	**0.039**	**-3.31**	0.008	0.083	-8.92
Ngaruroro Rv D/S HB Dairies	0.199	0.201	-3.51	0.009	0.101	-5.92
Ngaruroro Rv at Ohiti	0.23	0.212	-1.83	0.01	**0.036**	**-7**
Waitio Strm	0.35	0.105	-2.83	0.029	0.367	-1.73
Ngaruroro Rv at Fernhill	0.25	0.355	-2.43	0.012	0.066	-7.94
Ngaruroro Rv at Motorway	0.24	0.465	-2.19	0.013	0.19	-5.65
Tutaekuri-Waimate Strm	0.368	0.69	-0.46	0.048	0.252	-1.41
Ngaruroro Rv at Chesterhope NIWA	0.169	0.325	1.48	0.016	1	0
Tutaekuri Rv at Lawrence Hut	0.117	**0.008**	**-3.55**	0.006	**0.007**	**-7.86**
Mangaone Rv at Rissington	0.55	0.139	-3.83	0.034	**0.017**	**-5.39**
Tutaekuri Rv at Brookfields Br	0.3	0.128	-6.01	0.028	**0.005**	**-5.67**

2.1.2 Dissolved nutrients

Figure 2-5 and Figure 2-6 are box-plots of Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) concentrations for SOE monitoring sites across the Ngaruroro and Tutaekuri catchments. Upland sites in the Ngaruroro catchment are Ngaruroro River at Kuripapango and the Taruarau River. In the Tutaekuri catchment they are Tutaekuri River at Lawrence Hut. All other sites are considered lowland sites according to ANZECC guidelines.

As discussed in the 'Key Note' above, DIN and DRP are important because they represent the 2 most significant nutrients that stimulate or limit periphyton growth, since they are immediately 'bioavailable' to algae and plants for growth. By comparison, some forms of nitrogen and phosphorus, such as organic nitrogen and particulate phosphorus, are not immediately available to algae and plants and need to go through decomposition processes such as re-mineralisation to be turned into bio-available forms.

Increases in DIN and DRP can lead to increased periphyton growth and eutrophication of a waterway. Nuisance algal growth is more likely during long periods of low flow and in river reaches with high light availability. As a result, guidelines for nutrient concentrations are used as a proxy for keeping periphyton growth at acceptable levels.

DIN concentrations in the Ngaruroro main stem increased from upstream to downstream but at very low concentrations, always well below lowland ANZECC trigger values and the periphyton 20-day accrual guideline. DIN concentrations in the tributaries were higher than in the main stem, and the median concentration in Poporangi, Maraekakaho and Ohiwa streams was at or above lowland ANZECC trigger values and exceeded the periphyton accrual guideline.

DIN concentrations in the upper Tutaekuri at Lawrence Hut were very low, comparable to levels at reference conditions in the upper Mohaka and Ngaruroro. DIN increased in the middle to lower Tutaekuri reaches but remained generally below the lowland ANZECC trigger value and periphyton 20-day accrual guideline. DIN concentrations in the Tutaekuri tributaries were generally higher than in the main stem but remained below lowland ANZECC trigger values.

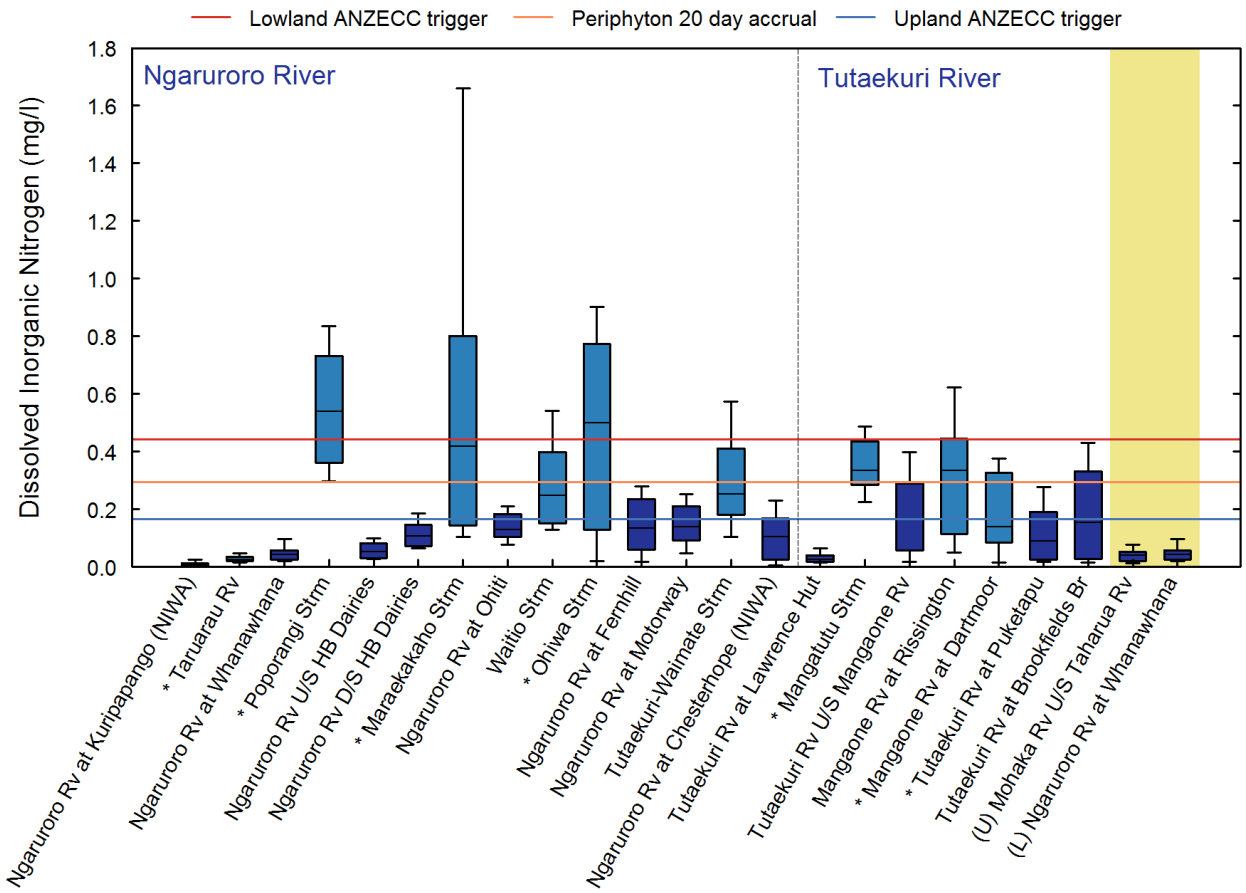


Figure 2-5: Dissolved inorganic nitrogen (DIN) concentrations at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TN trigger value; the red line to ANZECC (2000) 'Lowland' TN trigger value, the orange line is the periphyton 20 day accrual guideline (Biggs 2000). The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All others are lowland sites according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

DRP concentrations followed a similar pattern to the TP concentrations in the Ngaruroro catchment: DRP in the Ngaruroro main stem increased towards the sea but remained at low concentrations, generally below

ANZECC trigger levels. All tributaries except the Taruarau River had high DRP concentrations, which always exceeded the lowland trigger levels. The Ohiwa Stream, a short term study site, showed particularly high levels of DRP concentration with a median concentration of 0.111 mg/L which was 10 times higher than ANZECC trigger value. In the Tutaekuri catchment the DRP concentration was very low at the near pristine site at Lawrence Hut and increased to median concentrations that were above ANZECC lowland trigger value from the mid catchment (upstream of the Mangaone River confluence) to the sea. DRP concentrations in the Tutaekuri tributaries always exceeded ANZECC trigger values.

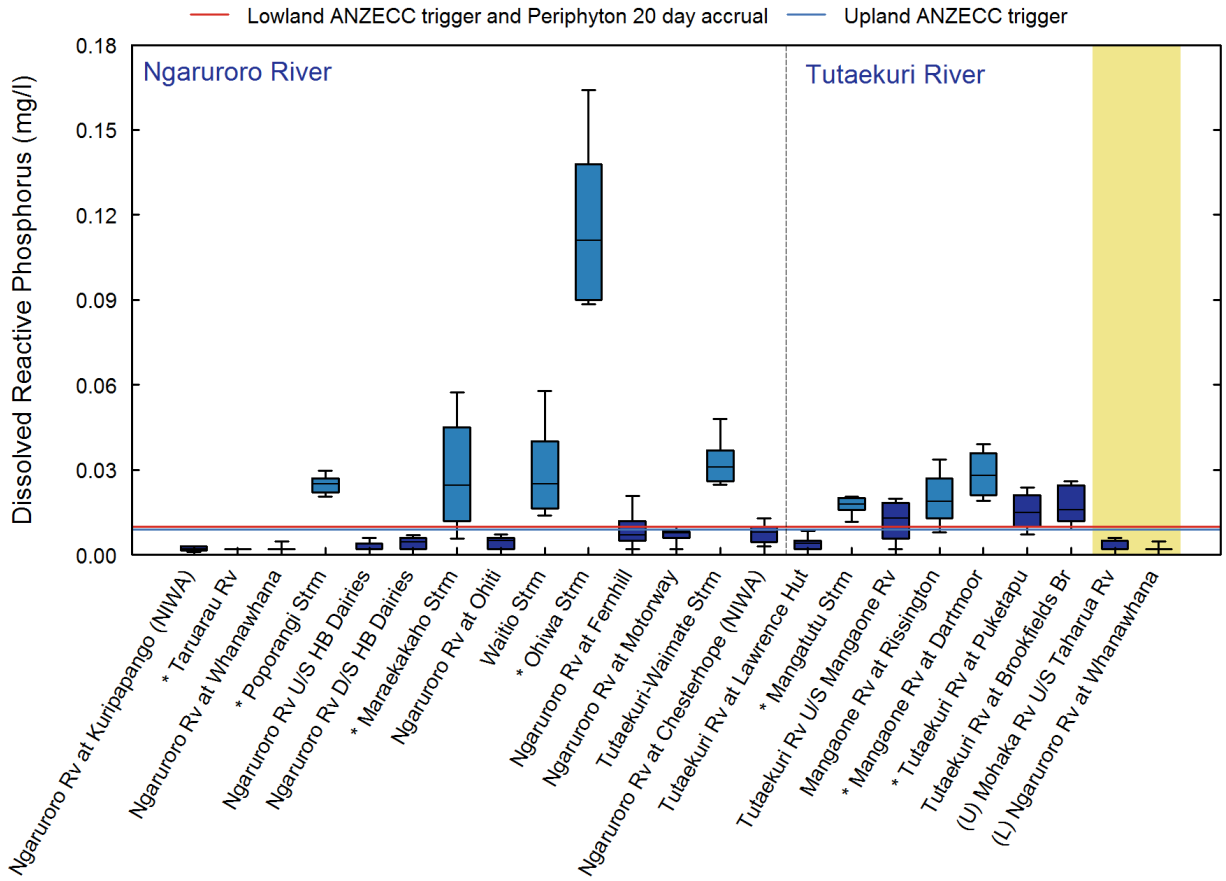
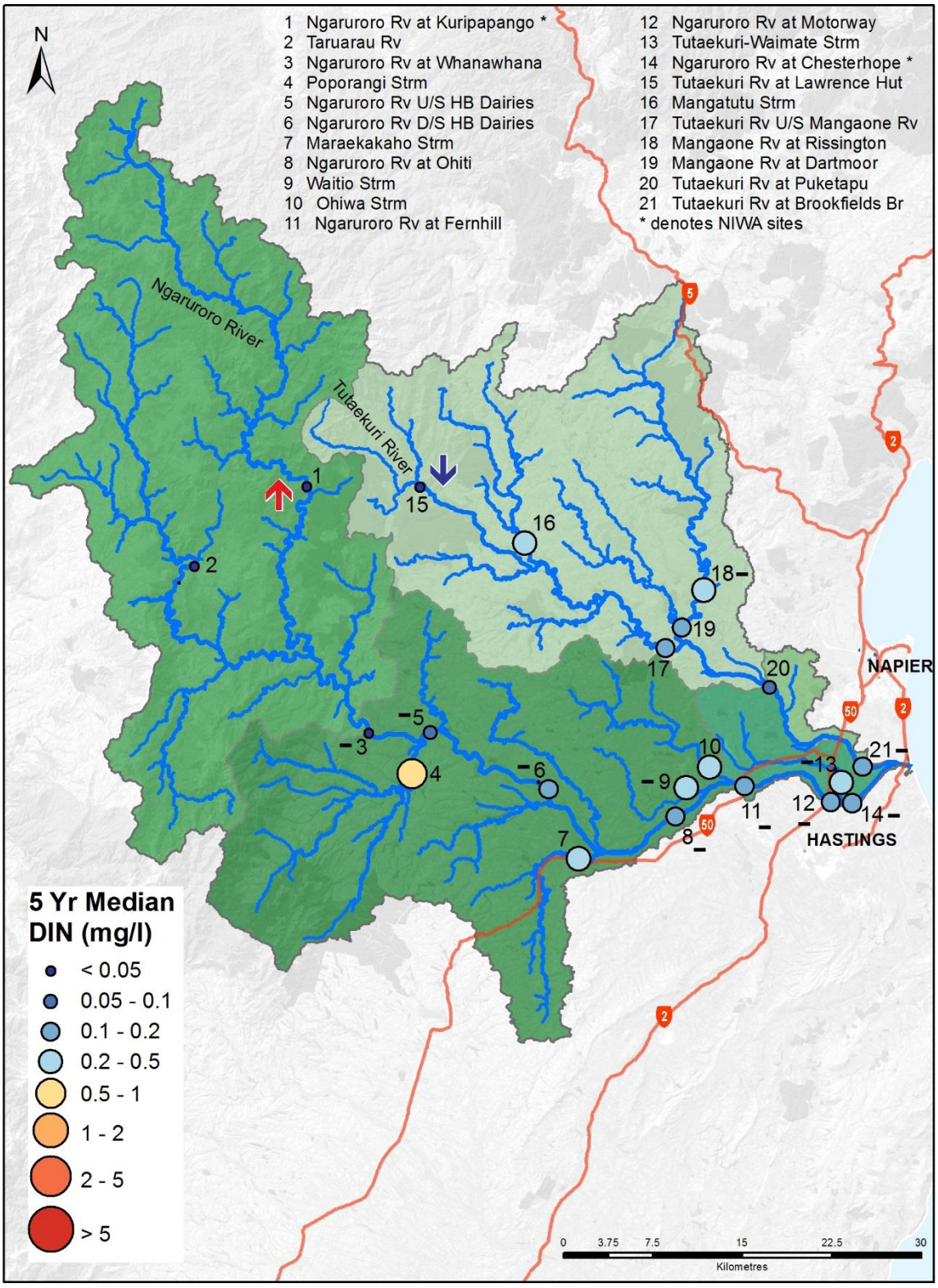


Figure 2-6: Dissolved reactive phosphorus (DRP) levels at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' DRP trigger value, the red line to ANZECC (2000) 'Lowland' DRP trigger value and the Biggs (2000) suggested limit for DRP for periphyton growth management for a 20 day accrual period. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Table 2-2 summarises the results of trend analysis carried out on DIN and DRP concentration across long-term SOE monitoring sites in the Ngaruroro and Tutaekuri river catchments. For a full summary of trend analysis results refer to Appendix C.

The only significant trends in DIN concentrations were found at the near pristine sites Tutaekuri at Lawrence Hut and Ngaruroro at Kuripapango in the upper catchments, which are located below a catchment area draining predominantly native bush protected by DOC land. As explained earlier natural weather patterns could appear as trends in water quality data which potentially explains trends at pristine sites were water quality is not likely to change due to land use.

DIN concentrations (



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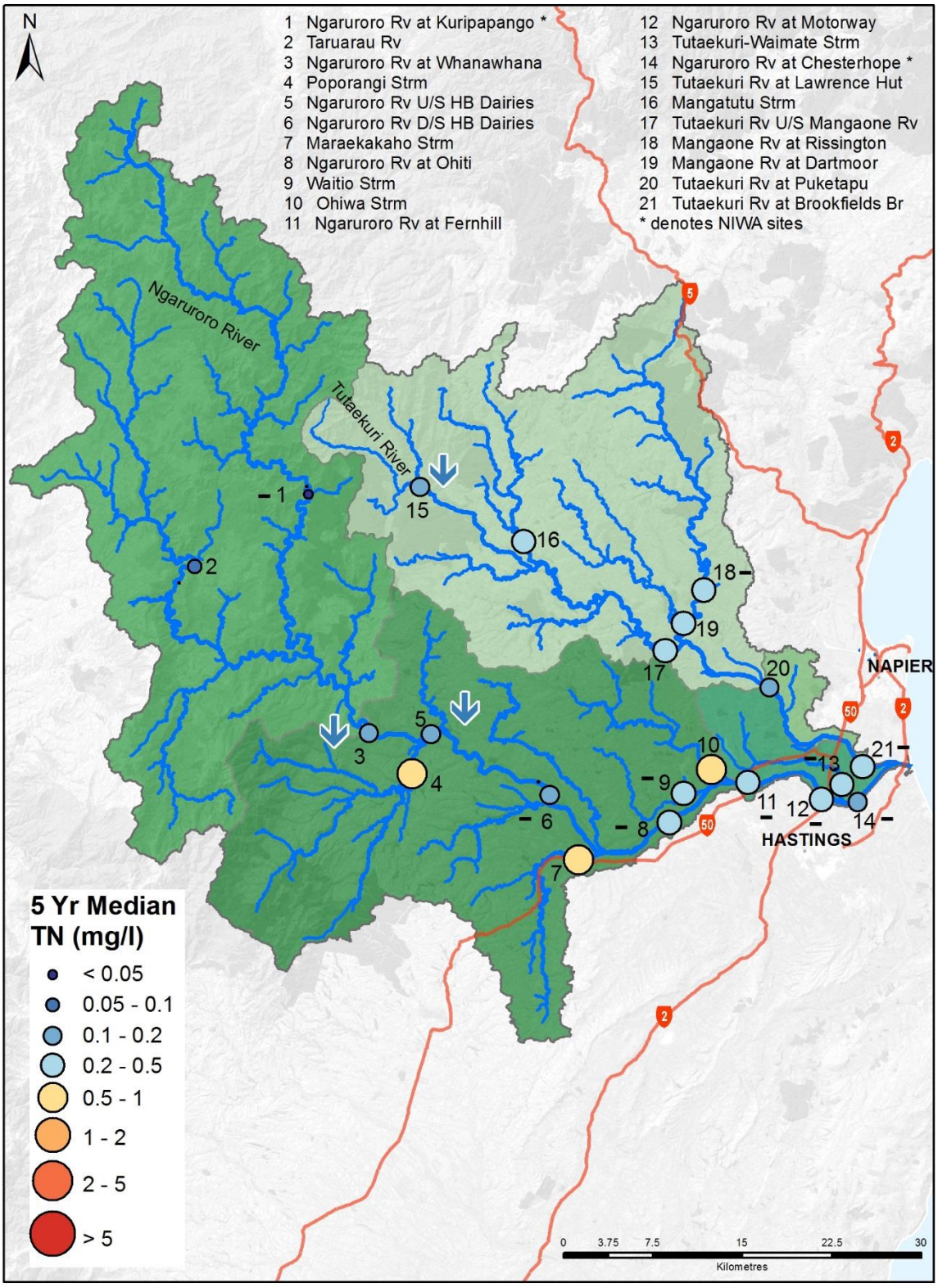


Figure 2-3 for TN). There was an increasing trend in DIN at Ngaruroro at Kuripapango. No trend was observed for TN concentration at the same site. This could be because the proportion of DIN was only about 20% of TN at this site. If the other, greater proportion of TN (e.g. organic N) did not have a significant

trend then TN overall would not show a significant trend.

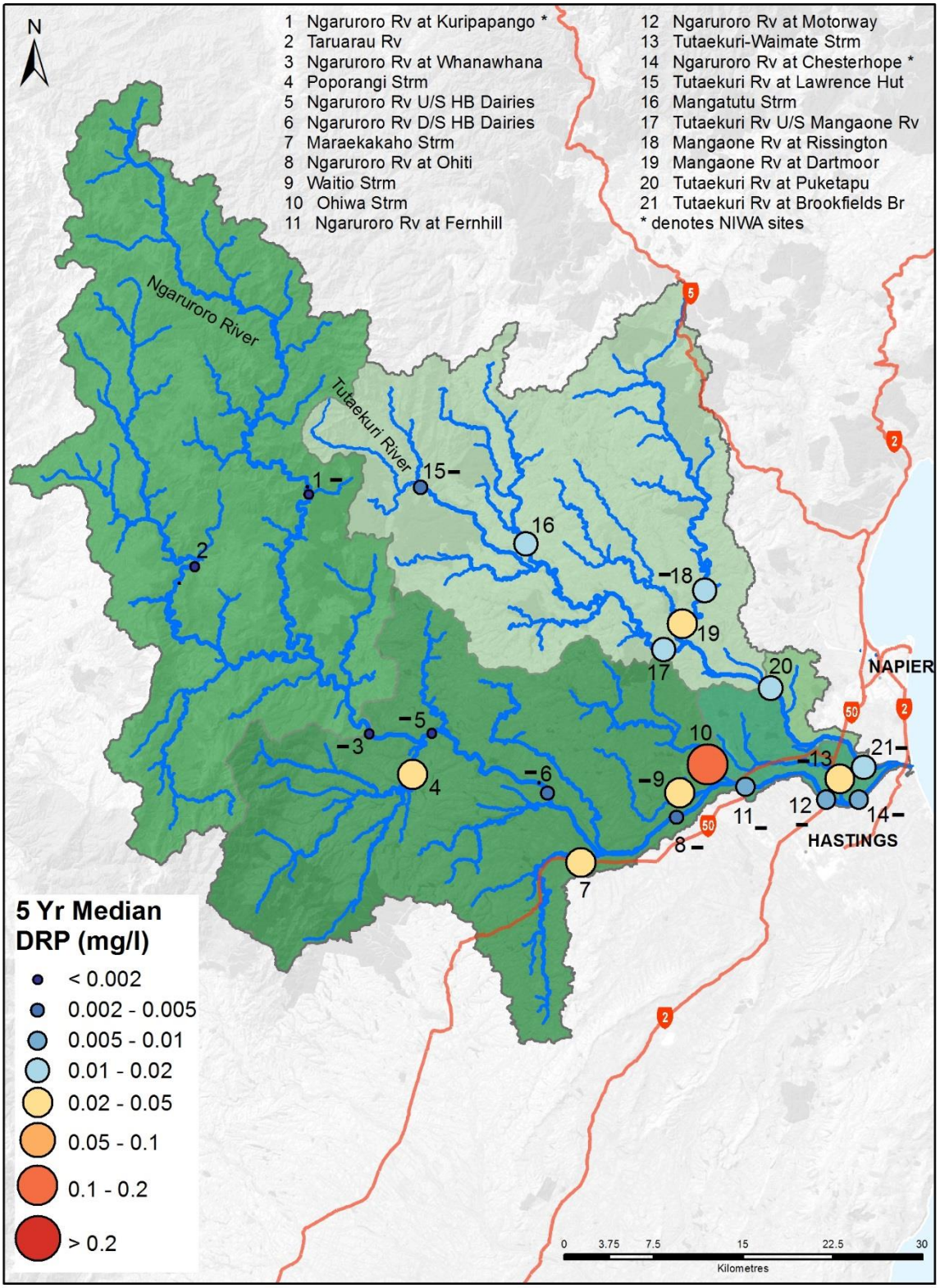


Figure 2-8 showed no significant trends in DRP at any of the sites in the Ngaruroro or Tutaekuri catchments, while TP decreased significantly at 5 sites (Ngaruroro at Whanawhana and Ohiti, Tutaekuri at Lawrence Hut and Brookfields Bridge and Mangaone at Rissington) (for TP refer to Figure 2-4). As for TN, different

components of TP (e.g. particulate P) could have dissimilar trends leading to different trends results for DRP and TP.

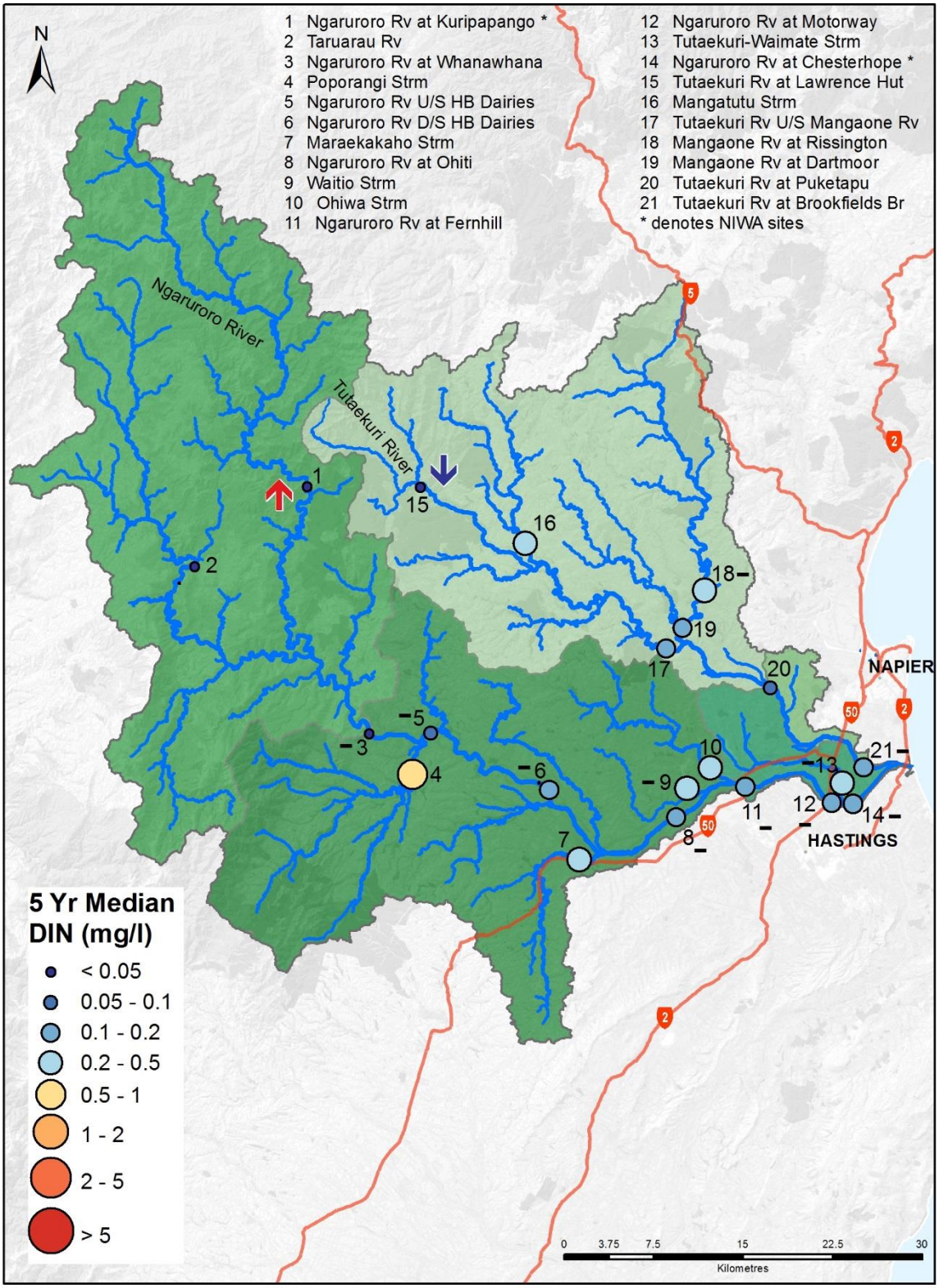


Figure 2-7: 5 year median dissolved inorganic nitrogen (DIN) levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

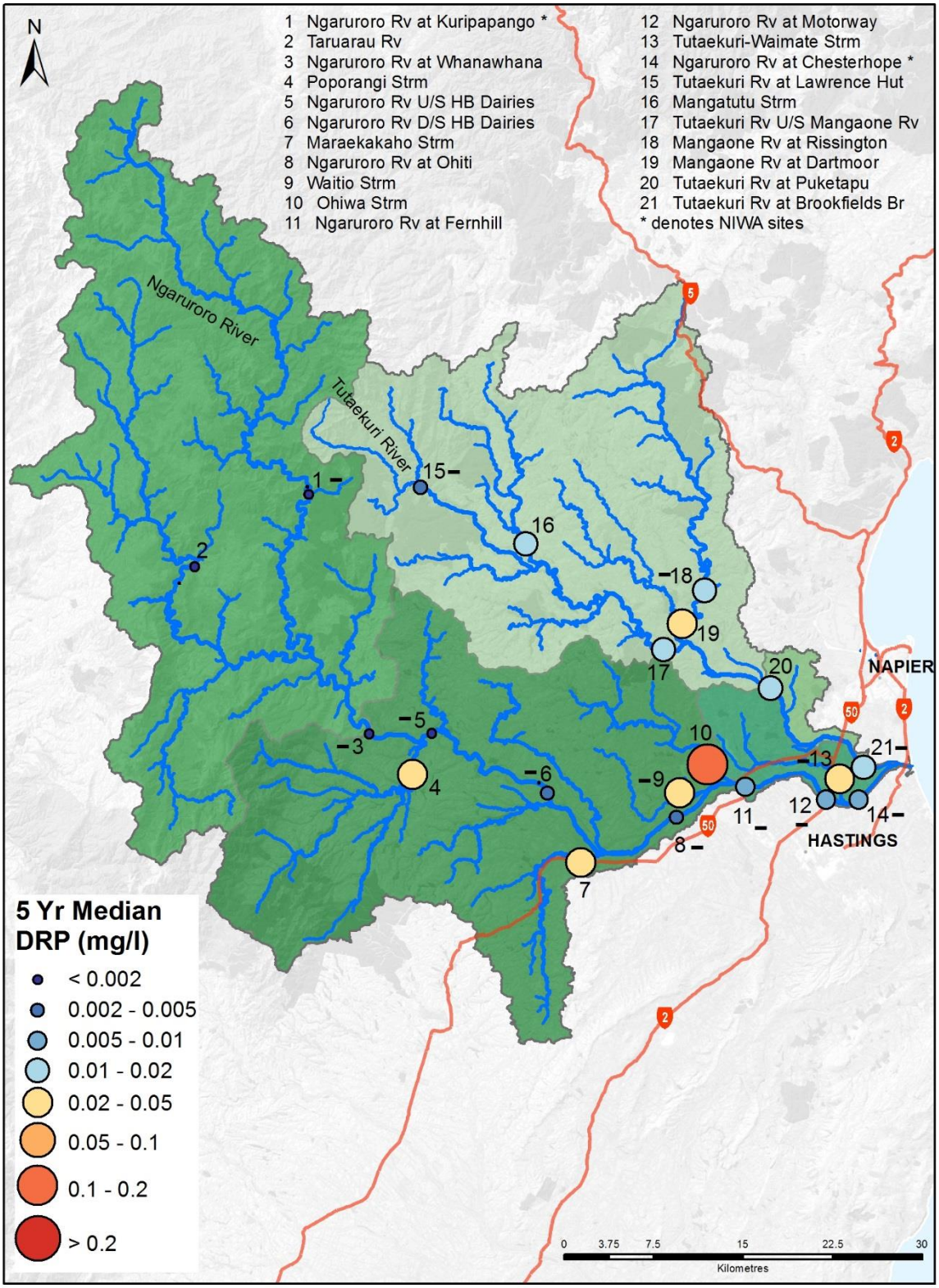


Figure 2-8: 5 year median dissolved reactive phosphorus (DRP) levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

Table 2-2: Trend analysis results for DIN and DRP for SOE monitoring sites of the Ngaruroro and Tutaekuri catchments. Includes only sites with sufficient data for trend analysis. In bold: significant trend when p < 0.05. Cells shaded blue for improving trend, red for deteriorating trend.

Site	DIN			DRP		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Ngaruroro Rv at Kuripapango	0.008	**0.004**	**4.17**	0.002	0.879	0
Ngaruroro Rv at Whanawhana	0.047	0.416	-3.84	0.002	0.282	0
Ngaruroro Rv U/S HB Dairies	0.055	0.786	-0.77	0.002	0.217	0
Ngaruroro Rv D/S HB Dairies	0.11	0.413	-2.71	0.005	0.256	0
Ngaruroro Rv at Ohiti	0.14	0.835	0.64	0.005	0.258	-2.27
Waitio Strm	0.247	0.42	-2.02	0.023	0.928	0
Ngaruroro Rv at Fernhill	0.157	0.893	0.63	0.007	0.927	0
Ngaruroro Rv at Motorway	0.15	0.958	-0.44	0.007	0.588	0
Tutaekuri-Waimate Strm	0.254	0.484	-1.17	0.033	0.393	-0.68
Ngaruroro Rv at Chesterhope NIWA	0.107	0.531	1.03	0.007	0.68	0
Tutaekuri Rv at Lawrence Hut	0.031	**0.022**	**-5.37**	0.004	0.103	0
Mangaone Rv at Rissington	0.347	0.139	-2.91	0.024	0.127	-5.02
Tutaekuri Rv at Brookfields Br	0.195	0.195	-3.99	0.02	0.177	-3.14

Some tributaries in the Ngaruroro catchment discharge water with relatively high concentrations of dissolved nutrients into the Ngaruroro main stem, in which nutrient concentrations increase from upstream to downstream towards the coast. Although nutrient concentrations increase in the Ngaruroro main stem, they remain well below (ANZECC 2000) guidelines for lowland streams and periphyton 20-day accrual guidelines (Biggs and Kilroy 2000) because they are diluted by a high volume of water from upper catchments in native forest, with low nutrient levels.

The tributaries of the Tutaekuri also contribute water with higher levels of dissolved nutrients to the main stem of the river. There is less afforestation in the upper catchment of the Tutaekuri than in the Ngaruroro, so nutrients from tributaries are not diluted as much by water from the upper catchments. This means that nutrient concentrations in the main stem of the Tutaekuri increase from the mountains to the sea. In some cases nutrient levels in the lower Tutaekuri catchment exceed (ANZECC 2000) guidelines and periphyton accrual guidelines.

2.2 Nitrate-nitrogen toxicity

At high concentrations, nitrate can be toxic to aquatic animals (Hickey and Martin 2009). ANZECC (2000) nitrate toxicity guidelines were reviewed by NIWA for Environment Canterbury in 2009 (Hickey and Martin 2009). Chronic toxicity thresholds derived in the 2009 review were based largely on aquatic species from overseas, although some of the species are now resident in New Zealand. No native New Zealand species were included in the 2009 review (Hickey 2013a).

To assist with the development of robust nitrate toxicity concentration guidelines, NIWA was engaged by HBRC in 2012/2013 to undertake the following:

- Nitrate toxicity trials using several New Zealand specific species, including inanga, *Deleatidium* mayfly and early life stages (including eggs) of New Zealand strains of introduced rainbow trout;

- Update the (Hickey and Martin 2009) guidelines by including recent international data as well as data derived from New Zealand trials;
- Help develop nitrate-nitrogen toxicity guidelines applicable to Hawke's Bay

DIN (discussed in Chapter 2.1 Nutrients) includes nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N) and ammoniacal-nitrogen (NH_4-N). Nitrate-nitrogen is the dominant component of DIN in areas not directly affected by point-source discharges and in catchments without large areas of wetland with anoxic soils.

Nitrate-nitrogen concentration patterns across the Ngaruroro and Tutaekuri catchments (Figure 2-9 and

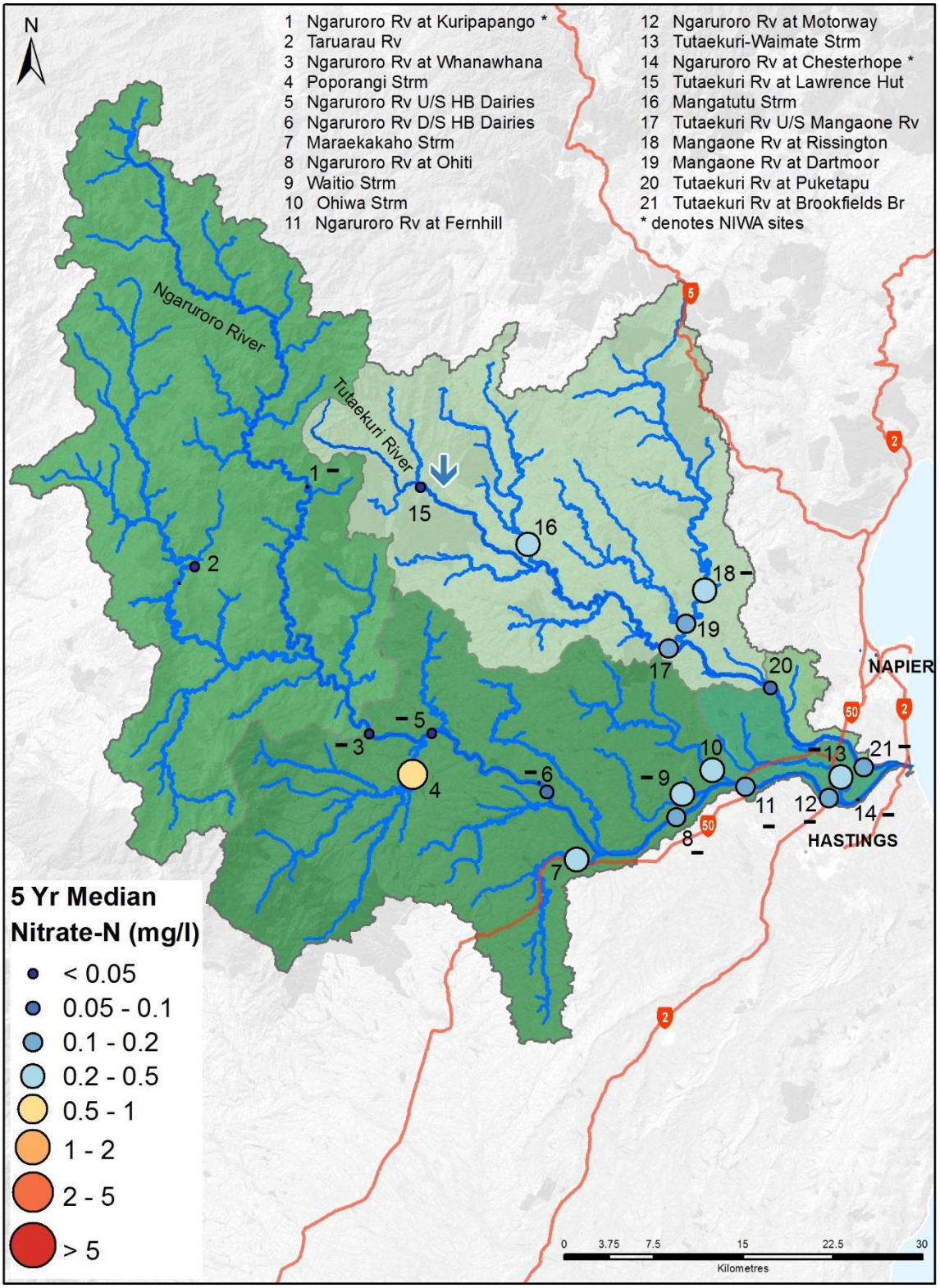


Figure 2-10) are similar to DIN concentration patterns (Figure 2-5 and

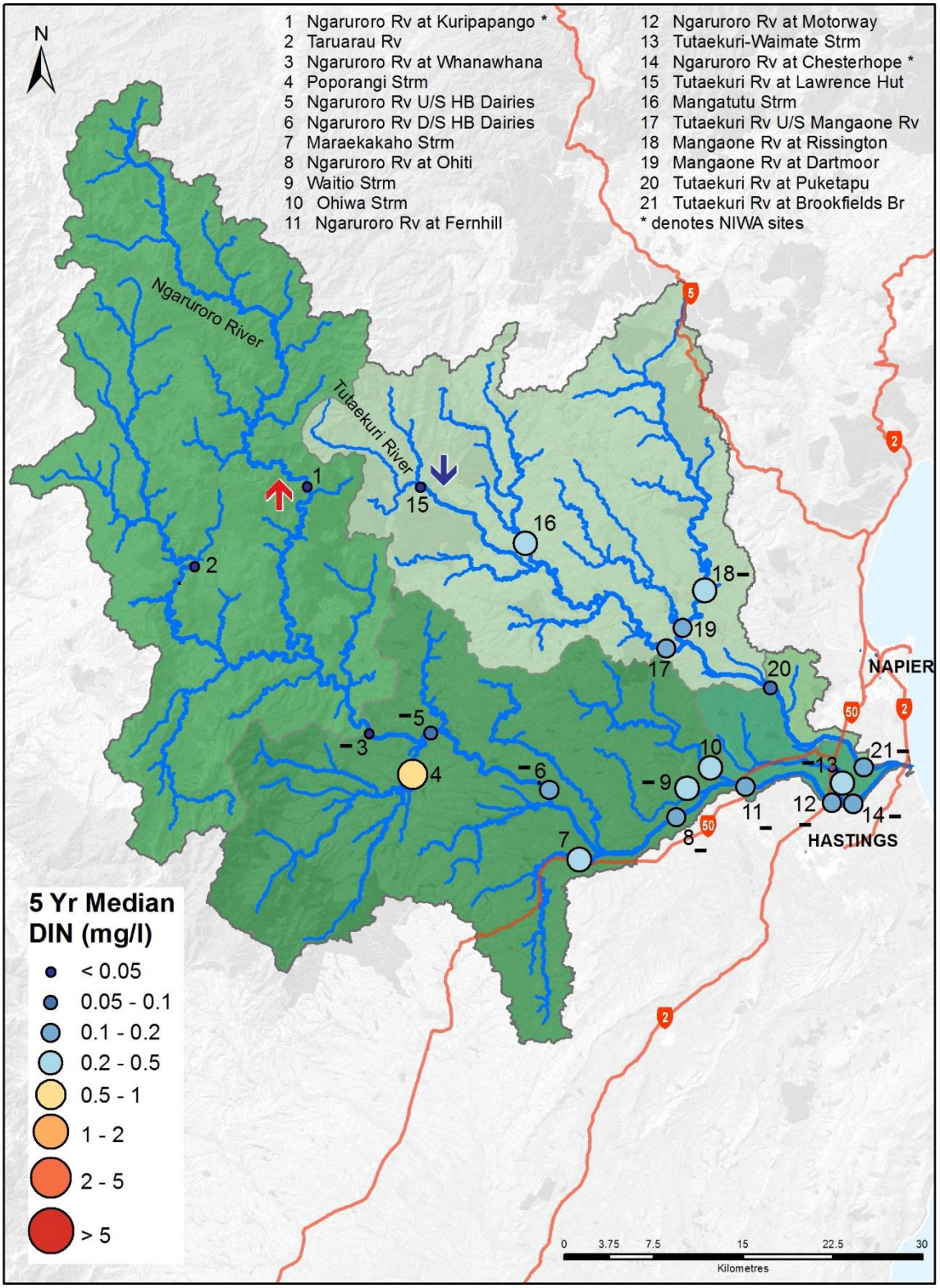


Figure 2-7).

Figure 2-9 shows that nitrate-nitrogen concentrations at all sites in the Ngaruroro main stem and Tutaekuri catchment are low - well below the most stringent toxicity threshold, ensuring a 99% species protection level. There are higher and more variable nitrate concentrations in the Ngaruroro tributaries, especially the

Poporangi, Maraekakaho and Ohiwa streams, with a few samples exceeding the 99% species protection guideline in the Maraekakaho Stream.

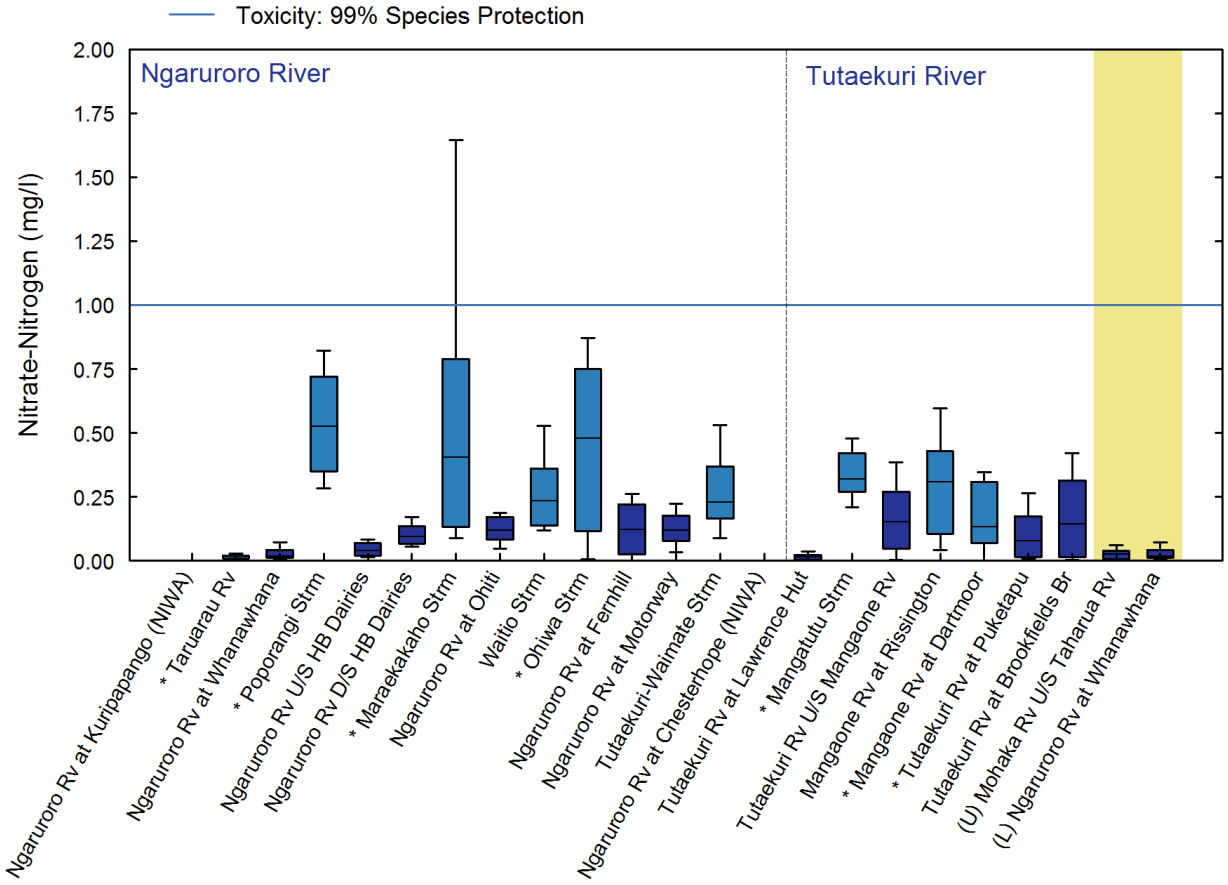


Figure 2-9: Nitrate - nitrogen (NO_3-N) levels at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the Hickey (2013a) nitrate toxicity limits for '99% species protection' or 'Excellent' management classification. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

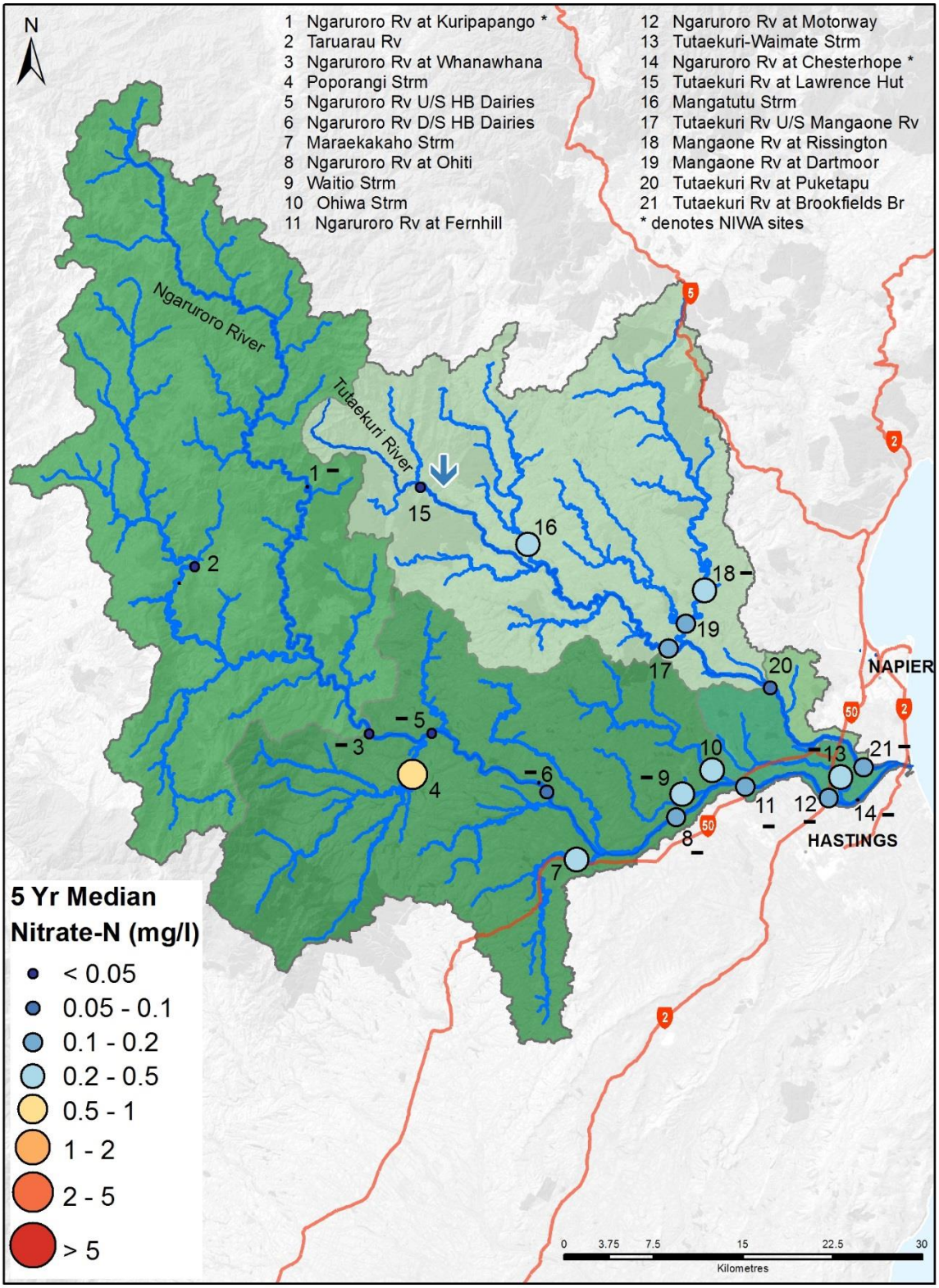


Figure 2-10: 5 year median nitrate-nitrogen (NO_3-N) levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not include the 8 years of record required between 2003 and 2013 for trend analysis.

Nitrate-nitrogen concentrations decreased in the Tutaekuri at Lawrence Hut (

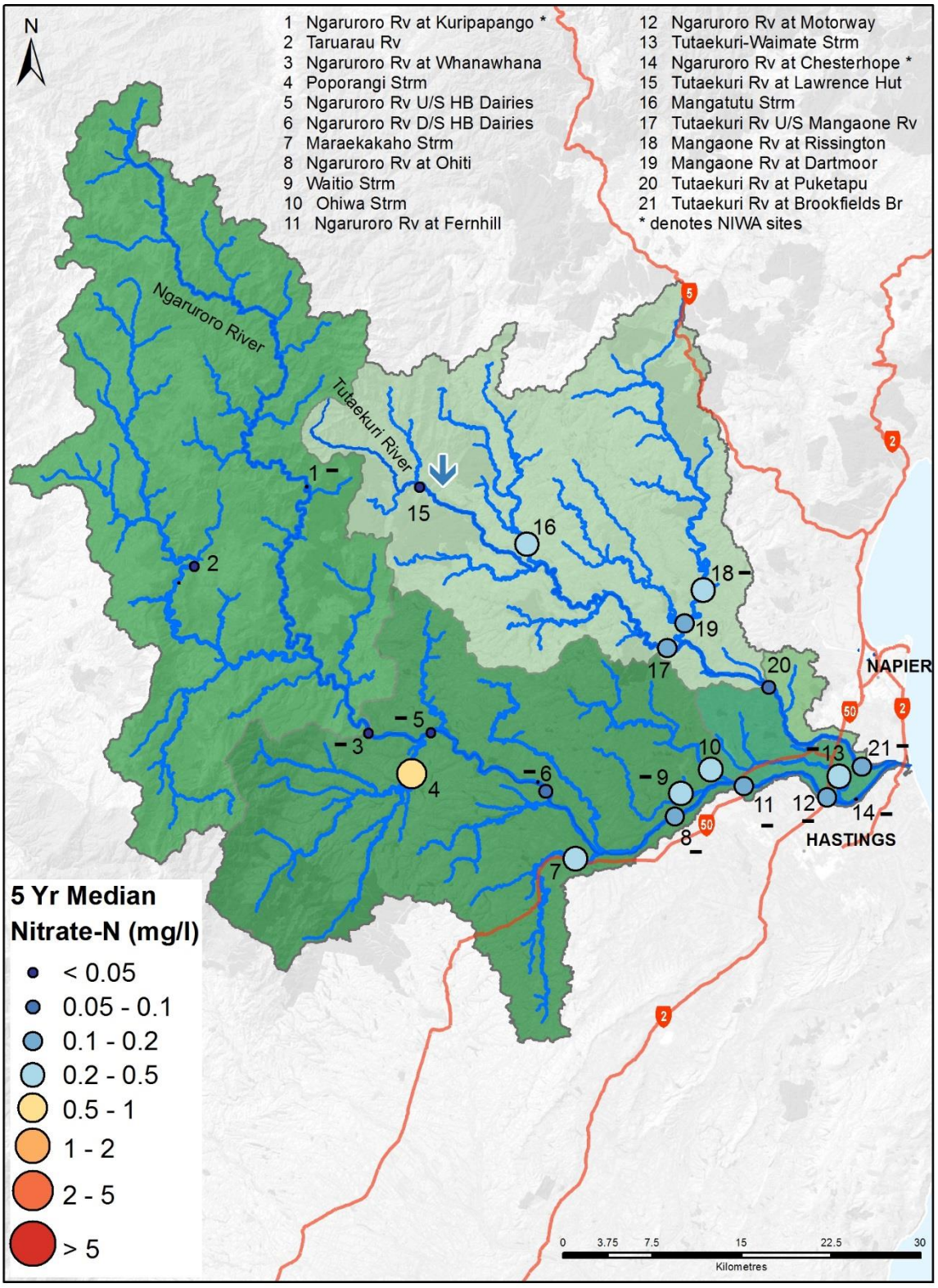


Figure 2-10), the near-pristine reference site, and the trend is consistent with the significant decreasing trends in TN and DIN concentration at the same site.

Table 2-3: Trend analysis results for Nitrate-nitrogen (NO_3-N) for SOE monitoring sites of the Ngaruroro and Tutaekuri catchments. Includes only sites with sufficient data for trend analysis. In bold: significant trend when p < 0.05. Cells shaded blue for improving trend, red for deteriorating trend.

Site	Nitrate		
	Median	P value	Per cent Annual Change
Ngaruroro Rv at Whanawhana	0.024	0.094	-6.31
Ngaruroro Rv U/S HB Dairies	0.045	0.744	-0.93
Ngaruroro Rv D/S HB Dairies	0.1	0.47	-2.05
Ngaruroro Rv at Ohiti	0.13	1	-0.06
Waitio Strm	0.235	0.72	-0.9
Ngaruroro Rv at Fernhill	0.143	1	0.26
Ngaruroro Rv at Motorway	0.134	1	-0.14
Tutaekuri-Waimate Strm	0.239	0.515	-1.2
Tutaekuri Rv at Lawrence Hut	0.018	**0.003**	**-8.09**
Mangaone Rv at Rissington	0.321	0.331	-2.49
Tutaekuri Rv at Brookfields Br	0.182	0.37	-2.67

2.3 Water Clarity – Black disc and turbidity

Water clarity refers to light transmission through water, and has 2 important aspects: visual clarity (sighting range for humans and aquatic animals), and light penetration for growth of aquatic plants (Davies-Colley and Smith 2001, Davies-Colley et al. 2003).

Water clarity is important for the protection of contact recreation values, because it directly affects the water's aesthetic quality for recreational users. In addition, adequate visual clarity allows swimmers to estimate depth and identify subsurface hazards (ANZECC 2000). Changes (generally reductions) in water clarity can also affect the foraging ability of fish, such as trout, by reducing their ability to see food drifting in the water column (Shearer and Hays 2010).

Water clarity is determined by measuring the horizontal distance that a black disc of standard size can be viewed under water. Where streams are big enough, black disc measurements are carried out monthly at all HBRC SOE monitoring sites.

Trout hunt visually and drift feeding is their main foraging behaviour in most rivers (Hay et al. 2006). Reduced visual clarity (or equivalent increases in water turbidity), reduces foraging efficiency (i.e. more energy is spent consuming the same amount of prey, or fewer prey are consumed).

ANZECC (2000) and the HBRC (2006) Regional Resource Management Plan (RRMP) defines a minimum water clarity of 1.6 m for contact recreation waters. However, to maintain the foraging efficiency of drift feeding trout Hay et al. (2006) recommend a minimum water clarity of 5 m for outstanding or regionally significant trout fisheries and 3.5m for trout fisheries of lesser importance.

The upper sites in the Ngaruroro and Tutaekuri catchments had excellent water clarity with median black disc viewing distances greater than 5 m, and at times more than 10 m viewing distance was recorded (Figure 2-11). This means that water clarity at these sites was generally above the guideline for outstanding trout fisheries. Water clarity decreased from upstream to downstream, and sites in the middle to lower catchments had a median clarity of less than 1.5 m black disc viewing distance, which was below the

guideline for contact recreation. The tributaries had greater water clarity than the main stem, except for the Poporangi and Tutaekuri-Waimate streams, which had lower water clarity, at or below 1.6 m black disc viewing distance.

Water clarity is reduced at times of elevated flow even in pristine catchments. The data reported here include all flows (Figure 2-11). Water clarity under low flow conditions, when contact recreation is most likely, is shown in Appendix A. At less than median flow, sites in the Ngaruroro main stem had a median black disc viewing distance at or greater than 2 m, and were better than ANZECC guideline for contact recreation.

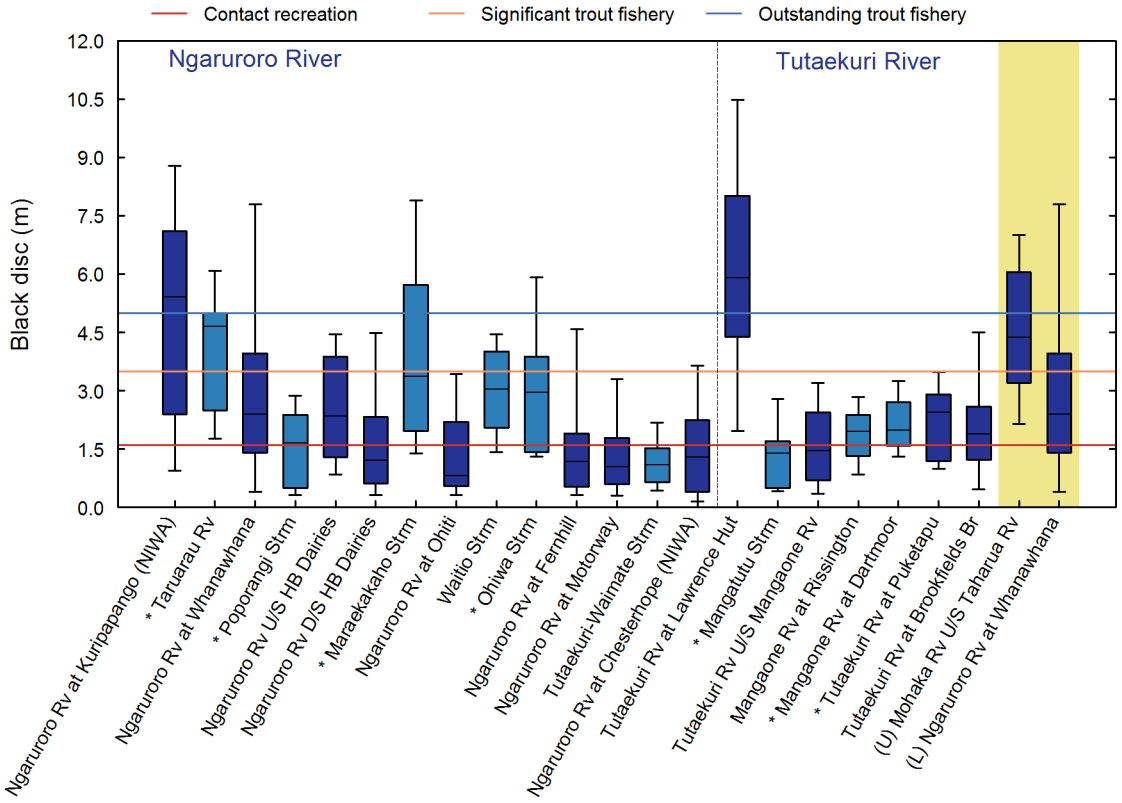


Figure 2-11: Water clarity measured as black disc horizontal sighting distance for Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the Hay and Hayes (2006) 'Outstanding trout fishery' limit; the green line the 'Significant trout fishery' limit. The amber line is ANZECC (2000)/ HBRC RRMP 2006 recreational amenity limit. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Water clarity in the Tutaekuri main stem decreased substantially between Lawrence Hut and the site upstream of the Mangaone confluence (i.e., in the middle catchment). Further downstream, between the Mangaone confluence and the site at Brookfields Bridge, median water clarity remained at or above the contact recreation guideline of 1.6 m and below the guideline for significant trout fishery (3.5 m). Water clarity in the tributaries was similar to the Tutaekuri main stem.

Water clarity in the Ngaruroro in the mid to lower main stem (downstream of Hawke's Bay Dairies) was lower than in the middle to lower reaches of the Tutaekuri.

Figure 2-12 shows turbidity measurements across SOE monitoring sites throughout the Ngaruroro and Tutaekuri catchments. Turbidity is a measurement of the degree of light scattering of the water and is caused by suspended particles present in the water column. The greater the concentration or number of suspended particles, the higher the turbidity.

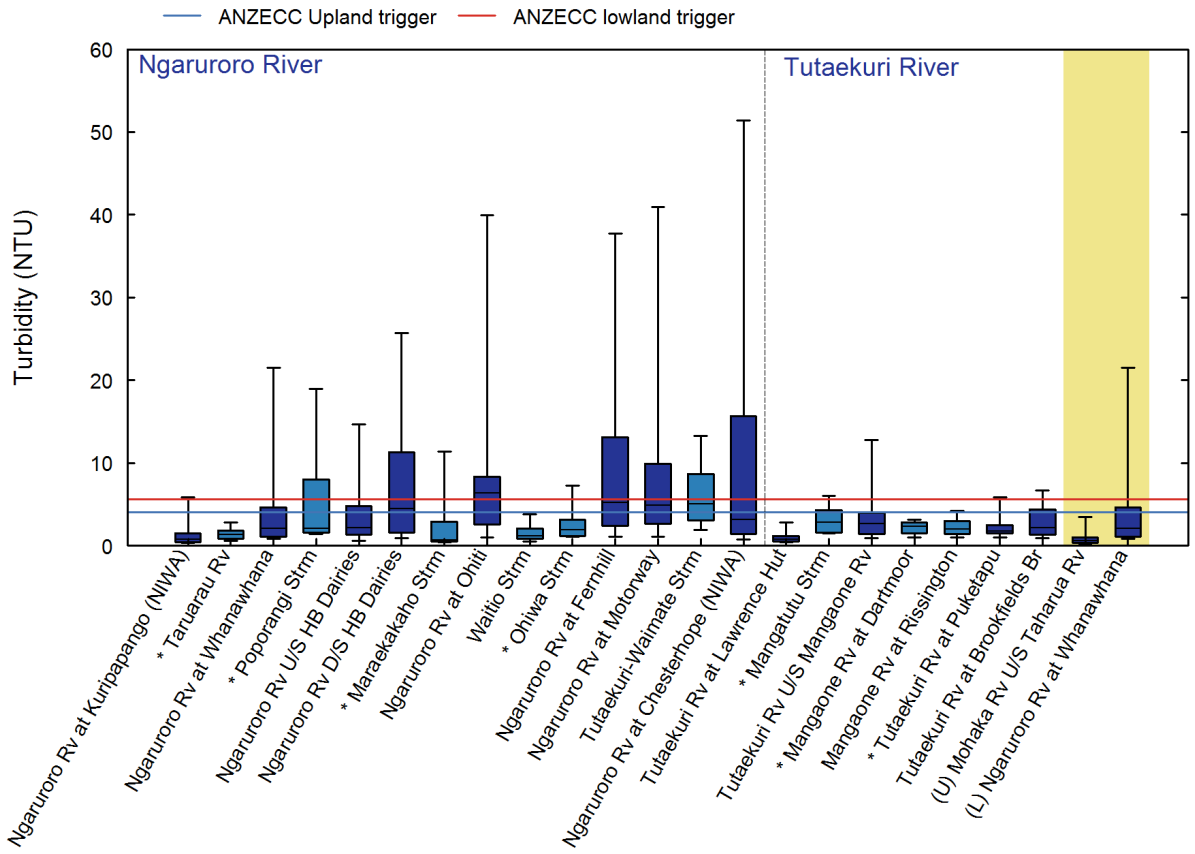


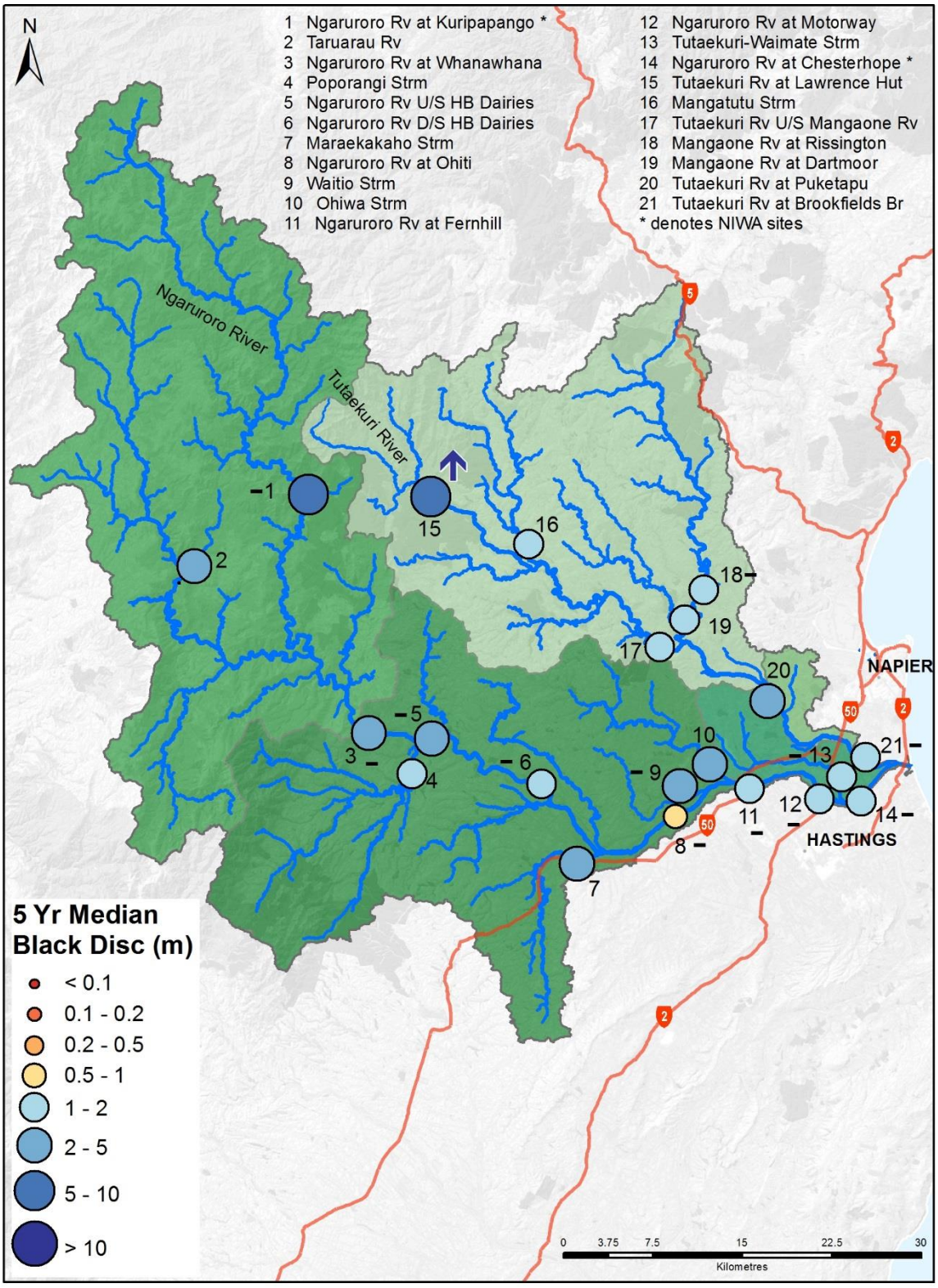
Figure 2-12: Water clarity measured as turbidity (NTU) for Ngaruroro and Tutaekuri River SOE monitoring sites. NTU stands for Nephelometric Turbidity Units. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TN trigger value; the red line to ANZECC (2000) 'Lowland' TN trigger value. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

There is a direct relationship between water clarity, as measured using a black disc, and turbidity: The higher the turbidity the lower the water clarity. At very low turbidity levels a small increase in turbidity results in a large decrease in black disc. Turbidity readings less than 1 Nepholometric Turbidity Unit (NTU) typically produce black disc distances greater than 3.5 m, which are distances optimal for drift feeding trout (Hay et al. (2006). Such turbidity readings reflect very low numbers of suspended particles in the water column. Very minor increases - whether caused by the presence of soft-sedimentary geology like mudstone or papa rock, or by minor catchment disturbance causing increased sediment transport, will cause minor

increases in turbidity and rapid reductions in water clarity. Heavy rain and associated floods mobilise catchment sediment and cause substantial turbidity increases, of 500 NTU or more.

There is a strong relationship between black disc viewing distance (Figure 2-11) and turbidity (Figure 2-12) in the Ngaruroro catchment: Turbidity increased from upstream to downstream in a similar way as the water clarity decreased. The tributaries had lower turbidity than the main stem, except for the Poporangi and Tutaekuri-Waimate streams, which had low clarity and high turbidity, comparable to the Ngaruroro main stem. Turbidity in the Tutaekuri increased between Lawrence Hut and upstream of the Mangaone confluence, but generally stayed below ANZECC turbidity trigger values at all sites.

There are different trends for water clarity and turbidity in the Ngaruroro and Tutaekuri catchments (



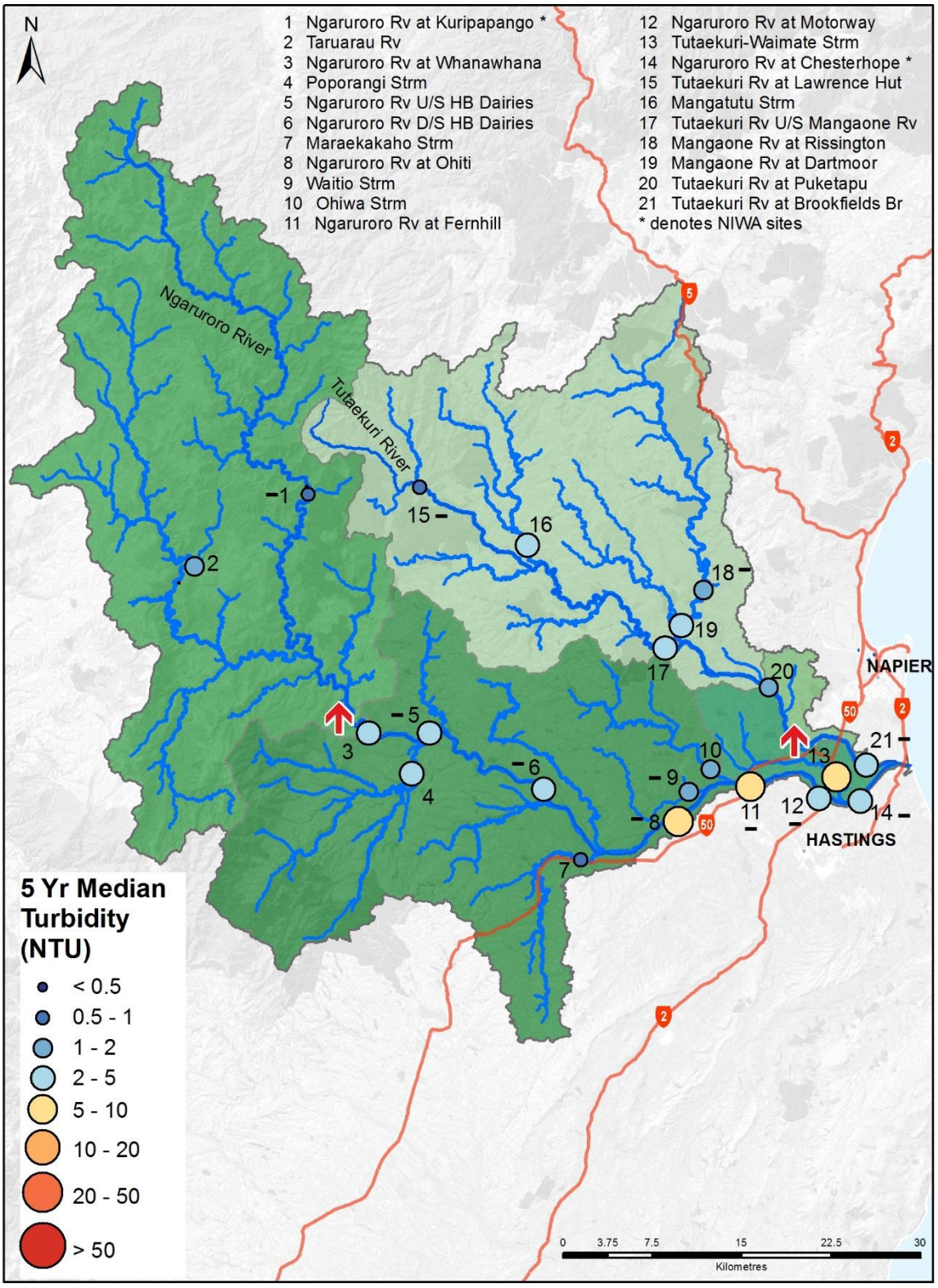


Figure 2-14 and Table 2-4). Water clarity increased significantly at the reference site in the Tutaekuri at Lawrence Hut. Turbidity increased significantly in the Ngaruroro catchment at the reference site Ngaruroro at Kuripapango, at Whanawhana and in 2 tributaries – Waitio and Tutaekuri-Waimate streams.

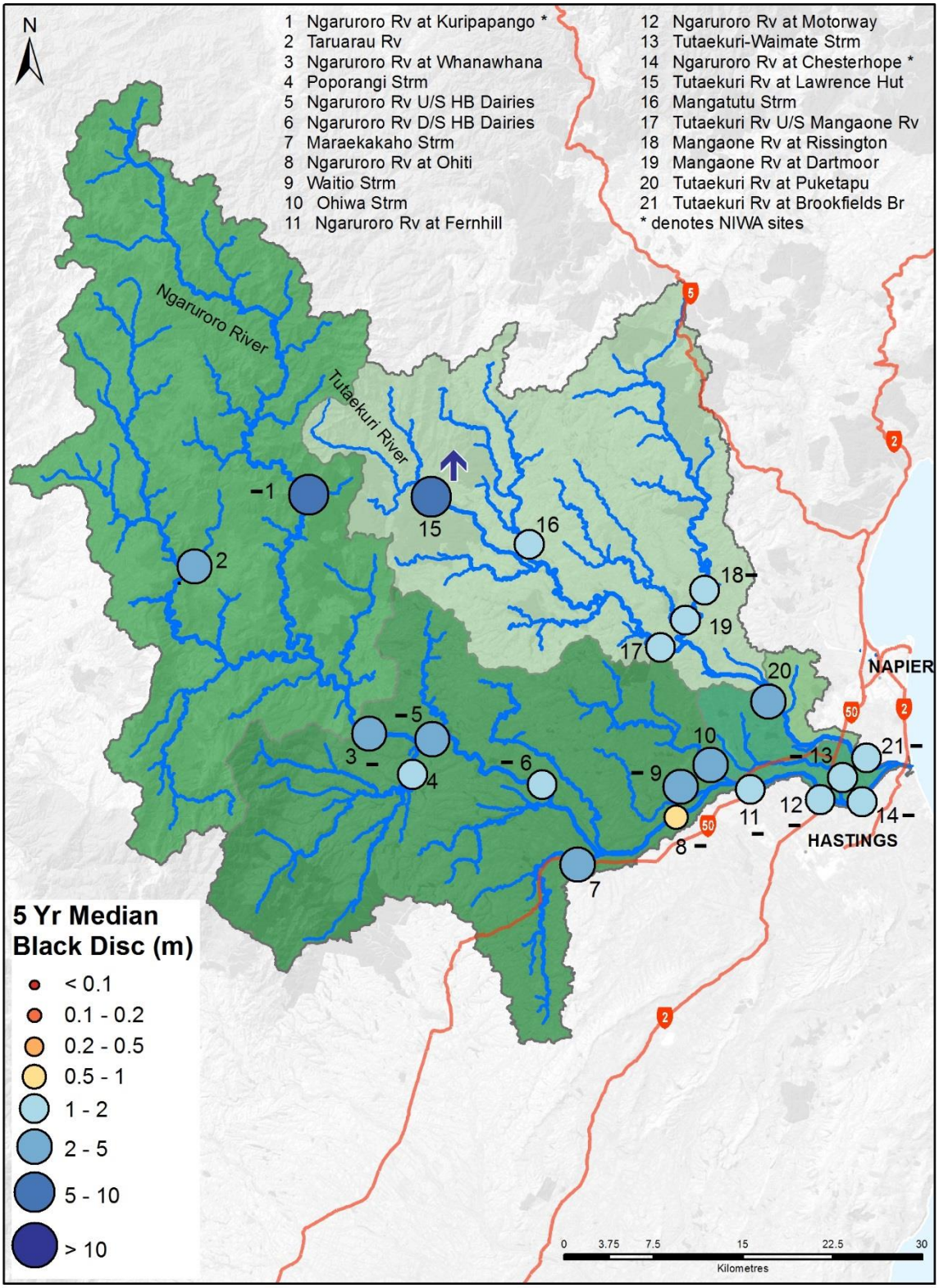


Figure 2-13: 5 year median black disc (BD) water clarity levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not have 8 years of record between 2003 and 2013 required for trend analysis.

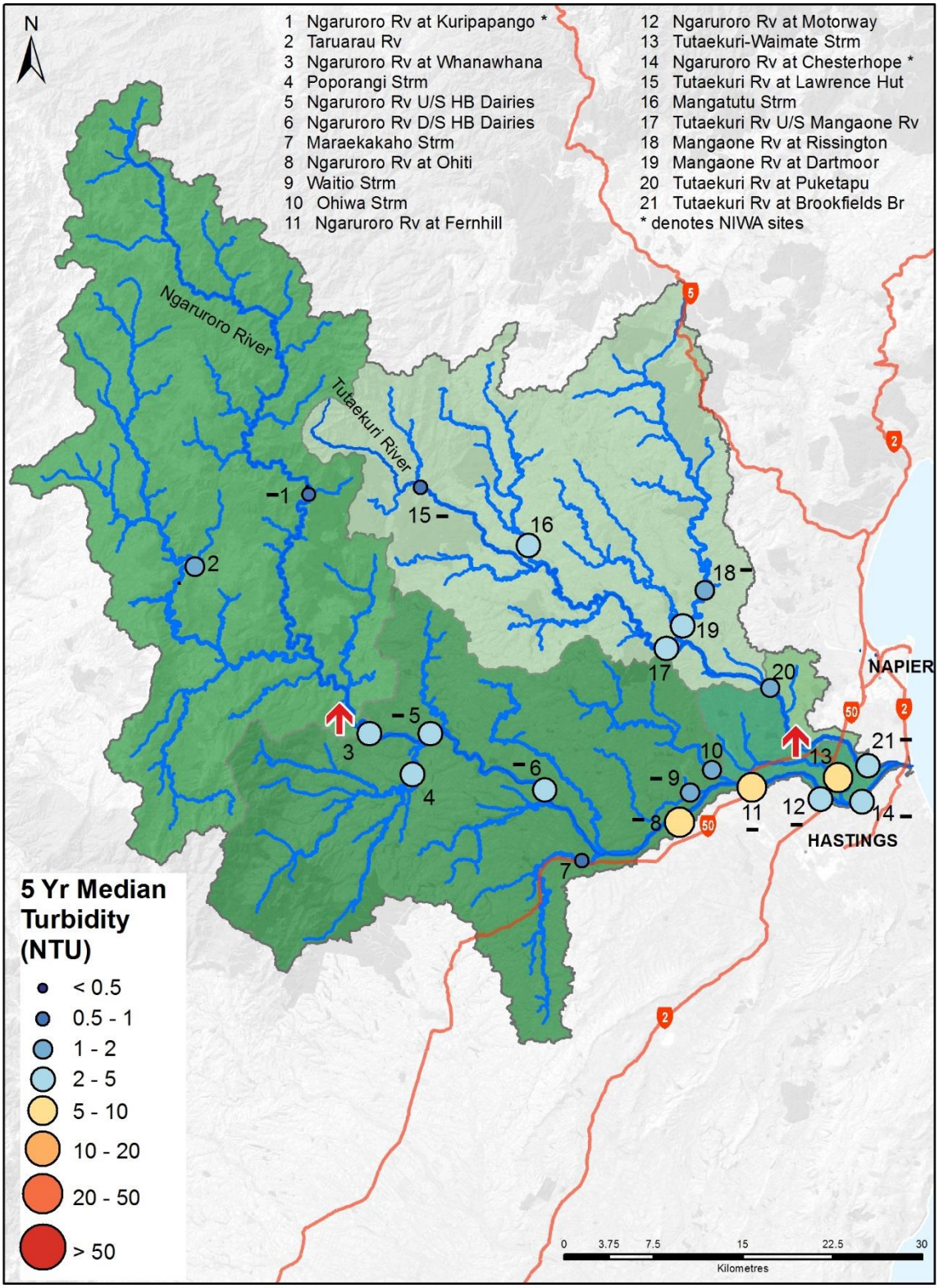


Figure 2-14: 5 year median turbidity levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not have 8 years of record between 2003 and 2013 required for trend analysis.

Table 2-4: Trend analysis results for black disc clarity and turbidity for SOE monitoring sites of the Ngaruroro and Tutaekuri River. Includes only sites with sufficient data and monitoring length for trend analysis. In bold: significant trend when p < 0.05. Cells shaded blue for improving trend, red for deteriorating trend.

Site	Black disc			Turbidity		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Ngaruroro Rv at Kuripapango	5.6	0.117	-4.21	0.7	0.016	8.08
Ngaruroro Rv at Whanawhana	3.4	0.376	2.69	1.2	0.044	8.8
Ngaruroro Rv U/S HB Dairies	3.4	0.663	0.76	1.6	0.231	7.54
Ngaruroro Rv D/S HB Dairies	1.4	0.765	-1.09	2.2	0.084	8.32
Ngaruroro Rv at Ohiti	1	0.692	2.16	3.9	0.715	4.79
Waitio Strm	3.4	1	0	1	0.041	7.02
Ngaruroro Rv at Fernhill	1.3	0.259	1.8	3.8	0.823	1.17
Ngaruroro Rv at Motorway	1.2	0.735	0.83	3.4	0.794	1.7
Tutaekuri-Waimate Strm	1	0.599	1.3	4.9	0.024	4.11
Ngaruroro Rv at Chesterhope NIWA	1.4	0.754	-0.92	2.7	0.446	3.05
Tutaekuri Rv at Lawrence Hut	5.1	0.001	9.34	0.9	0.404	-5.19
Mangaone Rv at Rissington	1.9	0.205	2.37	1.8	0.244	4
Tutaekuri Rv at Brookfields Br	1.7	0.298	3.52	2.5	0.781	-1.08

2.4 Bacteriological water quality – *E. coli*

Escherichia coli (*E. coli*) levels have been routinely monitored throughout the Ngaruroro and Tutaekuri catchments as an indicator of microbiological water quality. *E. coli* is a bacterium commonly found in the lower intestine of warm-blooded animals and indicates the presence of pathogens of faecal origin in the water. *E. coli* is used to assess the level of health risk to water users having direct contact with water.

The 2002 microbiological water quality guidelines (MfE/MoH 2003) define a 3-mode management system for recreational freshwaters: Acceptable/Green (*E. coli* < 260 counts/100 mL); Alert/Amber (*E. coli* < counts 550/100 mL) and Action/Red (*E. coli* > counts 550/100 mL). The red mode indicates an unacceptable level of health risk to contact recreation users (e.g. swimmers). These are single-value criteria, designed to trigger further investigation and additional sampling (amber mode) and positive action to identify the source(s) of contamination and warn recreational users (red mode). The < 550 counts/100 mL amber level has been used in this report to assess suitability for swimming at all river flows.

Figure 2-15 and

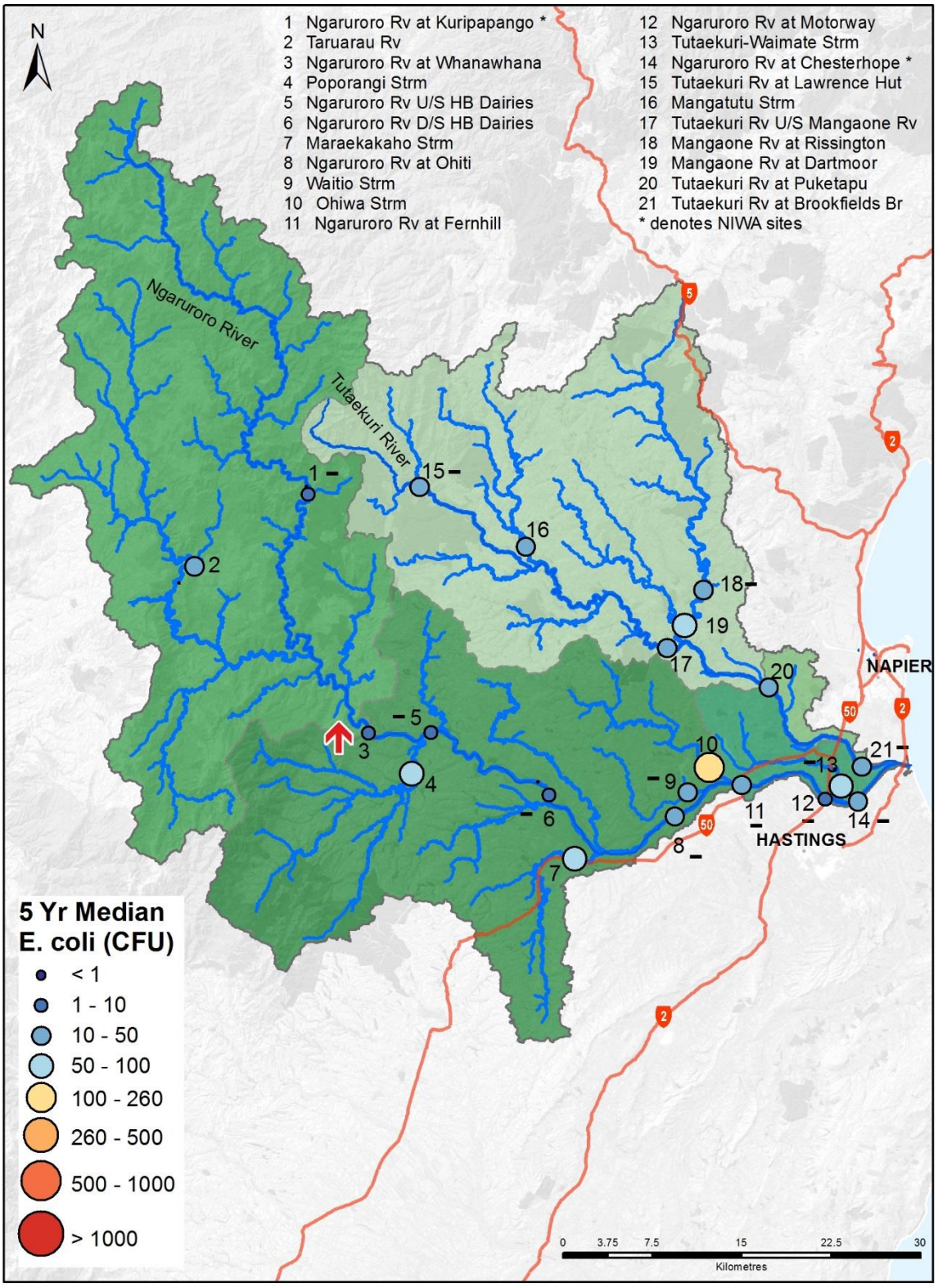


Figure 2-16 show *E. coli* levels at monitoring sites across the Ngaruroro and Tutaekuri catchments. There were typically very low levels of bacteria at all monitoring sites across both catchments, and levels stayed generally within the MfE acceptable/green mode for recreational freshwaters at all flows. The Ohiwa Stream, which had the highest recorded *E. coli* levels of all monitored sites, frequently were in the MfE alert/amber mode.

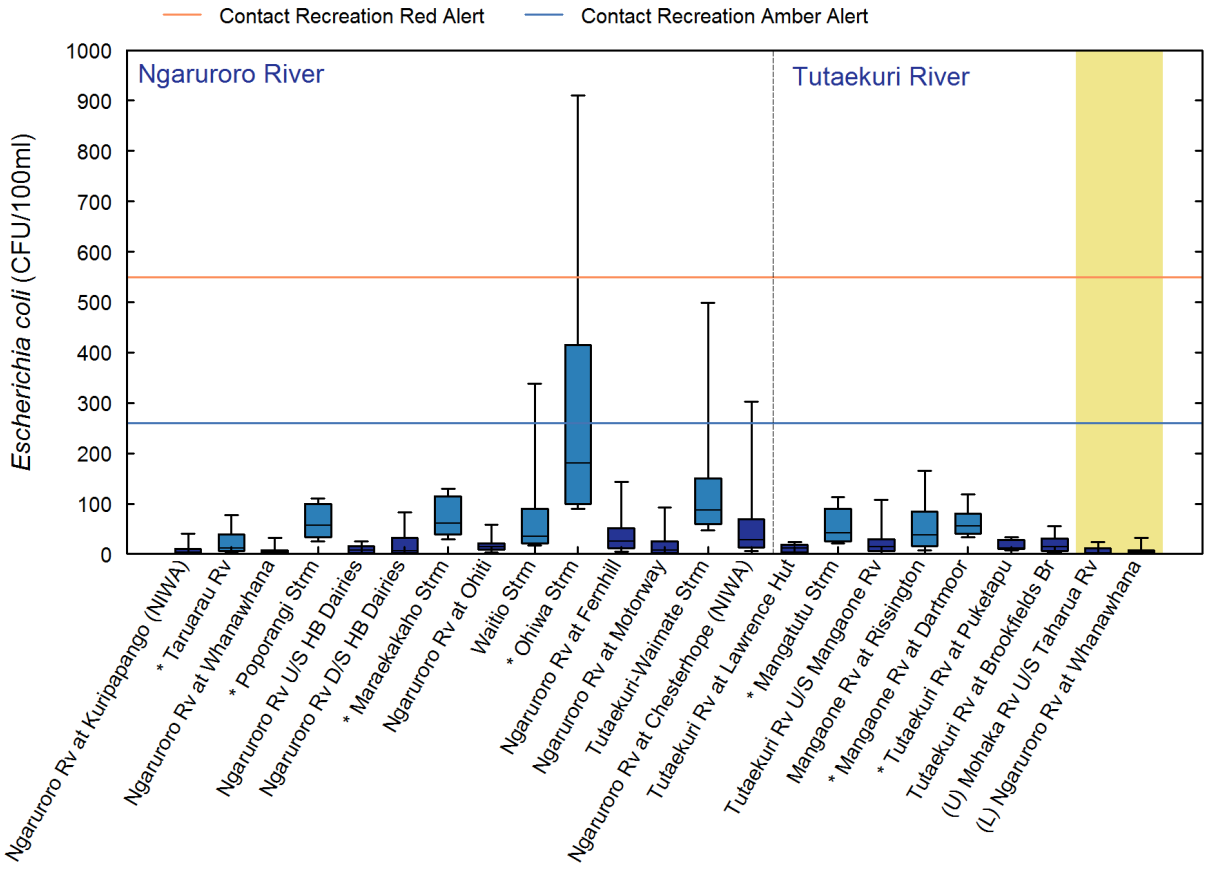


Figure 2-15: Bacteriological water quality levels measured as *E. coli* counts (Colony Forming Units / 100ml) at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the MfE and MoH (2003) amber alert level; the red line the MfE and MoH (2003) red alert level. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Table 2-5 summarises trend analysis results of *E. coli* or bacteria levels across SOE monitoring sites of the Ngaruroro and Tutaekuri catchments. Only Ngaruroro at Whanawhana, the site with the lowest *E. coli* levels in both catchments, showed a significant increase in *E. coli* numbers. No other site had a significant trend, which means that levels remained very low at all sites.

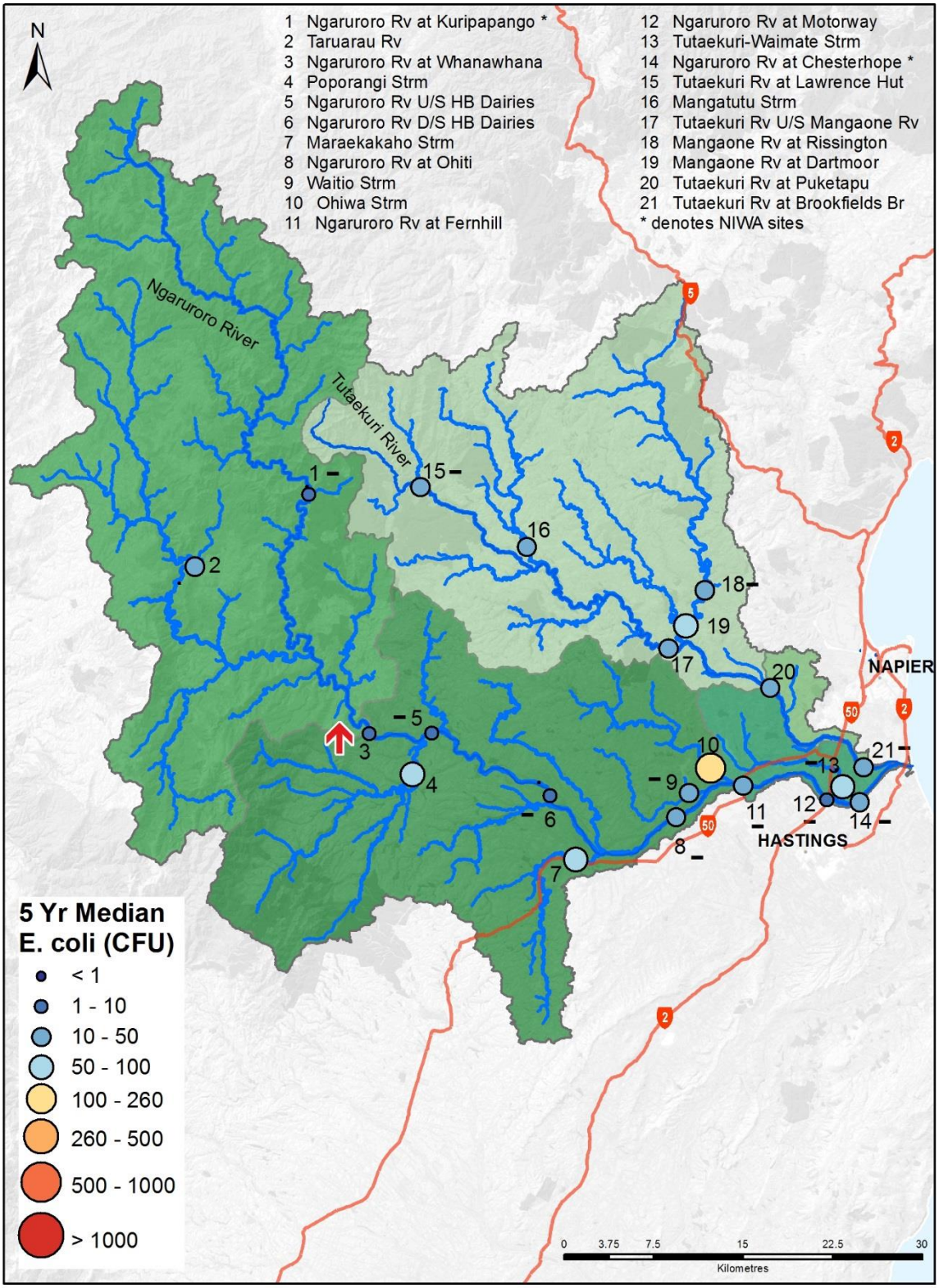


Figure 2-16: 5 year median *E. coli* levels at Ngaruroro and Tutaekuri River SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not include the 8 years of record between 2003 and 2013 required for trend analysis.

Table 2-5: Trend analysis results for *E. coli* for SOE monitoring sites of the Ngaruroro and Tutaekuri catchments. Includes only sites with sufficient data and monitoring length for trend analysis. In bold: significant trend when p < 0.05. Cells shaded blue for improving trend, red for deteriorating trend.

Site	*E. coli*		
	Median (counts /100 mL)	P value	Per cent Annual Change
Ngaruroro Rv at Kuripapango	4	0.109	3.66
Ngaruroro Rv at Whanawhana	3	**0.038**	**7.76**
Ngaruroro Rv U/S HB Dairies	4	0.131	14.09
Ngaruroro Rv D/S HB Dairies	4	0.455	0
Ngaruroro Rv at Ohiti	13	0.208	7.63
Waitio Strm	31	0.361	6.46
Ngaruroro Rv at Fernhill	18	0.122	5.64
Ngaruroro Rv at Motorway	14	0.306	-6.61
Tutaekuri-Waimate Strm	84	0.128	4.77
Ngaruroro Rv at Chesterhope NIWA	26	0.715	3.34
Tutaekuri Rv at Lawrence Hut	10	0.283	4.93
Mangaone Rv at Rissington	27	0.249	8.47
Tutaekuri Rv at Brookfields Br	13	0.358	4.4

2.5 Dissolved oxygen

Dissolved oxygen (DO) is an important component in the life supporting capacity of freshwater ecosystems. Humans absorb oxygen from air through their lungs, while aquatic organisms absorb oxygen from water through their gills. Fish, invertebrates and other organisms are stressed when insufficient oxygen is dissolved in water.

Various elements of aquatic systems either consume and/or produce oxygen. Plants and algae growing in the water produce oxygen as a by-product of photosynthesis. This supplements oxygen passively diffusing into the water from the atmosphere or being infused by turbulence or aeration in steeper or fast flowing streams, a process known as re-aeration (Figure 2-17). However, plants and algae also use oxygen when they respire, as do animals, fungus and bacteria living in the water. The breakdown of organic matter by aerobic micro-organisms also consumes oxygen and is termed the 'biochemical oxygen demand' (BOD). This process also occurs in the sediments and is termed the 'sediment oxygen demand' (SOD) as shown in Figure 2-17.

In un-shaded streams with high nutrient inputs, excessive growth of plants and algae results in extremely high dissolved oxygen levels during the day, then extremely low dissolved oxygen levels during the night or early morning, when these plants and algae consume more oxygen than the waterway is capable of supplying. The low dissolved oxygen conditions mean there is little oxygen for fish and other organisms to use (Figure 2-17).

Three main processes are likely to cause low dissolved oxygen conditions:

1) Aquatic plant and algal respiration during the night

2) Oxygen consumption by microbes that break down organic matter

3) Low reaeration of oxygen from the atmosphere, which may occur in low gradient streams with reduced flow and/or without flow turbulence typically provided by logs, roots, plants or variable stream banks in lowland streams

DO may also be low in river reaches where substantial upwelling of potentially low-oxygen or anoxic groundwater occurs. Likewise, in wetland systems where bacterial respiration levels are high, oxygen levels can be very low. These are consequences of natural background conditions and are independent of anthropogenic (human) influences.

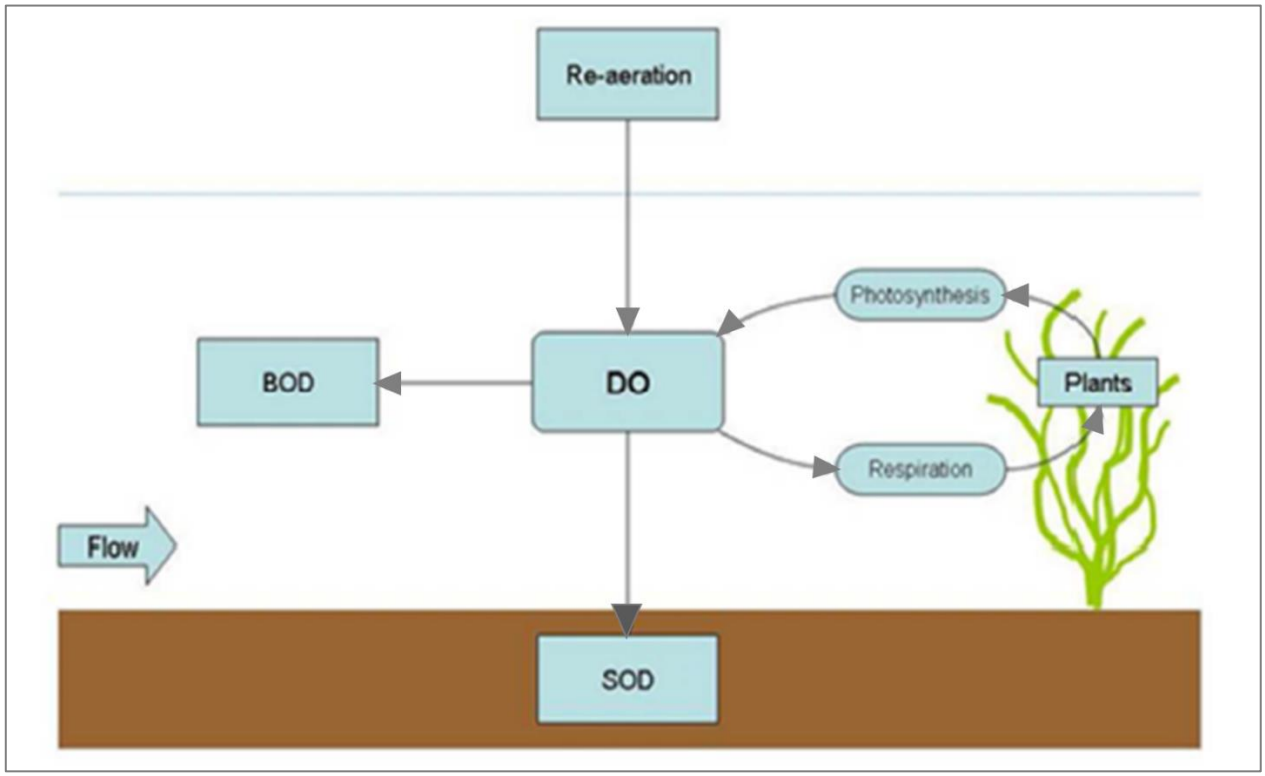


Figure 2-17: Schematic of the major processes influencing dissolved oxygen concentration in rivers. DO = dissolved oxygen; BOD = biochemical oxygen demand; SOD = sediment oxygen demand (Davies-Colley et al. 2013).

A waterway with DO consistently below 5.0 mg/L is unable to support sensitive species and the ecological integrity of these systems will be compromised. DO greater than 8.0 mg/L is typically capable of supporting the full range of aquatic organisms (MfE 2013).

Colder water can hold more oxygen than warmer water. When water temperature is greater than 27^{o}C it cannot hold more than 8.0 mg/L of oxygen. Un-shaded systems that overheat during the day can also be depleted of oxygen.

Water temperature increases detrimentally affect trout in 2 ways. As water temperature increases, trout oxygen requirements also increase as they become more active (Elliott 1994). At the same time, increasing water temperatures decrease the oxygen-carrying capacity of water.

Rainbow trout are more sensitive to low DO concentrations than most New Zealand native fish species (Dean and Richardson 1999). Free swimming trout can tolerate DO concentrations of 5 to 5.5 mg/L, but the saturation should be at least 80% (Hay et al. 2006). RMA Schedule 3 states that "*The concentration of*

dissolved oxygen shall exceed 80% saturation concentration" in Class AE (Aquatic Ecosystems), F (Fishery) and FS (Fish Spawning) waters".

ANZECC (1992) guidelines recommend minimum DO concentrations of 6 mg/L and 80% saturation. Hay et al. (2006) suggest these limits should be seen as short-term exposure levels (i.e. occurring only for a few days), as data suggest that long-term exposure to DO levels of 6 mg/L can impair the growth of salmoniids, including trout (CCME 1997).

In New Zealand, the Resource Management Act 1991 (RMA) proposes a default standard of 80% DO saturation, which has been adopted widely across the country. DO criteria for effects on aquatic organisms are primarily expressed as concentration (DO mg/L) rather than saturation (% DO), based on the strong observed relationship between DO concentrations and ecological response (Franklin 2013). This provides greater protection at higher temperatures without the need for a temperature dependent threshold scale: The proportion of dissolved oxygen (%DO) in water changes with temperature while the concentration (DO mg/L) does not. Additionally, the oxygen demand of aquatic organisms like fish and macroinvertebrates increases with higher temperatures while the DO saturation decreases, which seems counterintuitive to use as standard for ecosystem protection purposes. Based on the SOE spot measurements, DO concentrations were typically good throughout the Ngaruroro and Tutaekuri river catchments, with all sites recording oxygen saturation levels greater than 80% (Figure 2-18 and Figure 2-21) and 8 mg/L (Figure 2-19) on nearly all occasions.

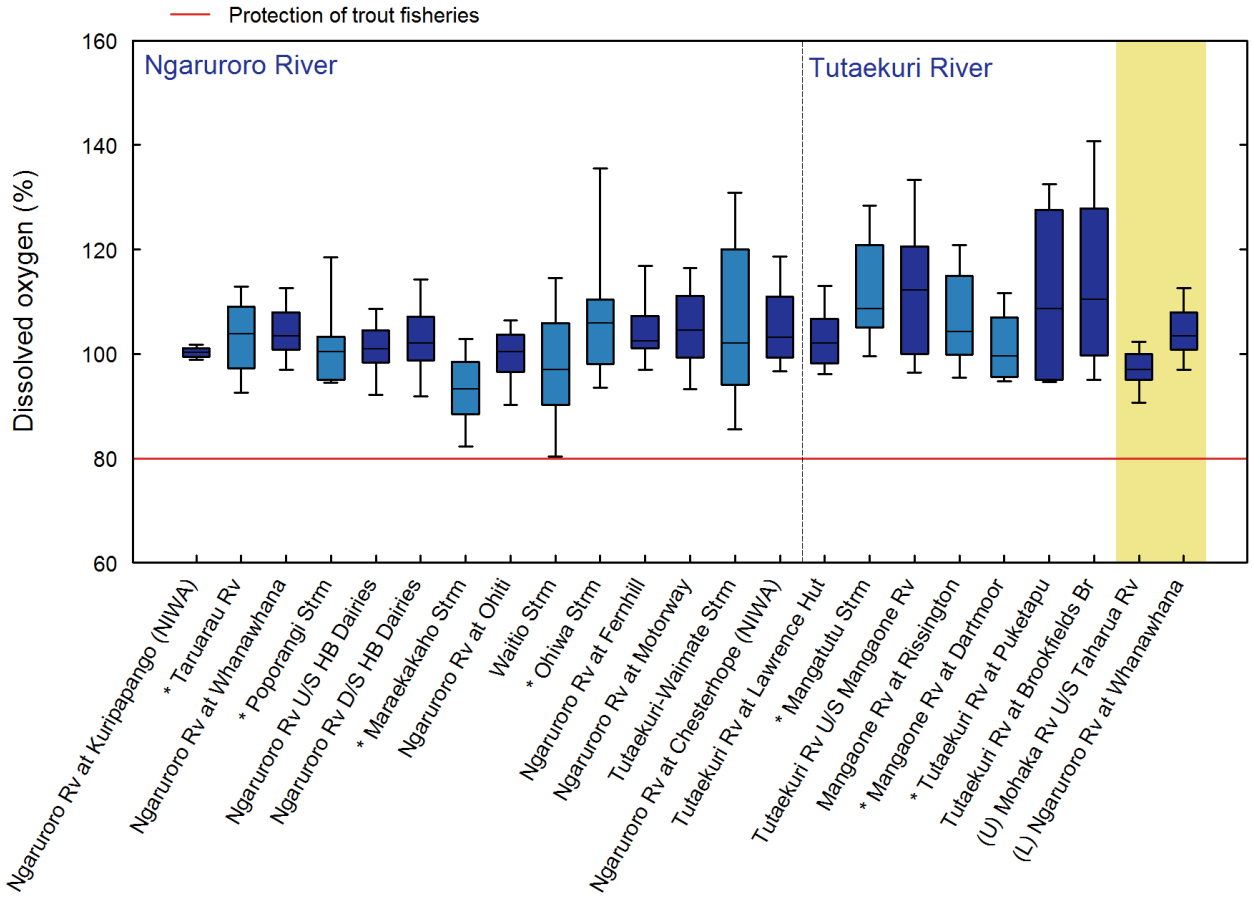


Figure 2-18: Dissolved oxygen saturation at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The red line is the RMA (1991) Schedule 3 lower limit of 80% for supporting salmoniid (trout) fisheries. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

The results are not surprising for the main stem sites, given the high-energy, turbulent nature of flow, with mostly gravel substrate producing well aerated water. This is coupled with low levels of in-stream productivity and relatively low levels of oxygen uptake through metabolic processes. This means large fluctuations in DO concentrations would not be expected.

The Maraekakaho and Waitio streams are an exception, with occasional low DO concentrations. The Waitio Stream – and to a lesser extent the Maraekakaho – have high aquatic plant (macrophyte) biomass, which can reduce in-stream DO levels through overnight respiration. These 2 sites may also be influenced by upwelling of groundwater with low DO concentrations, which may cause localised lower in-stream DO concentrations.

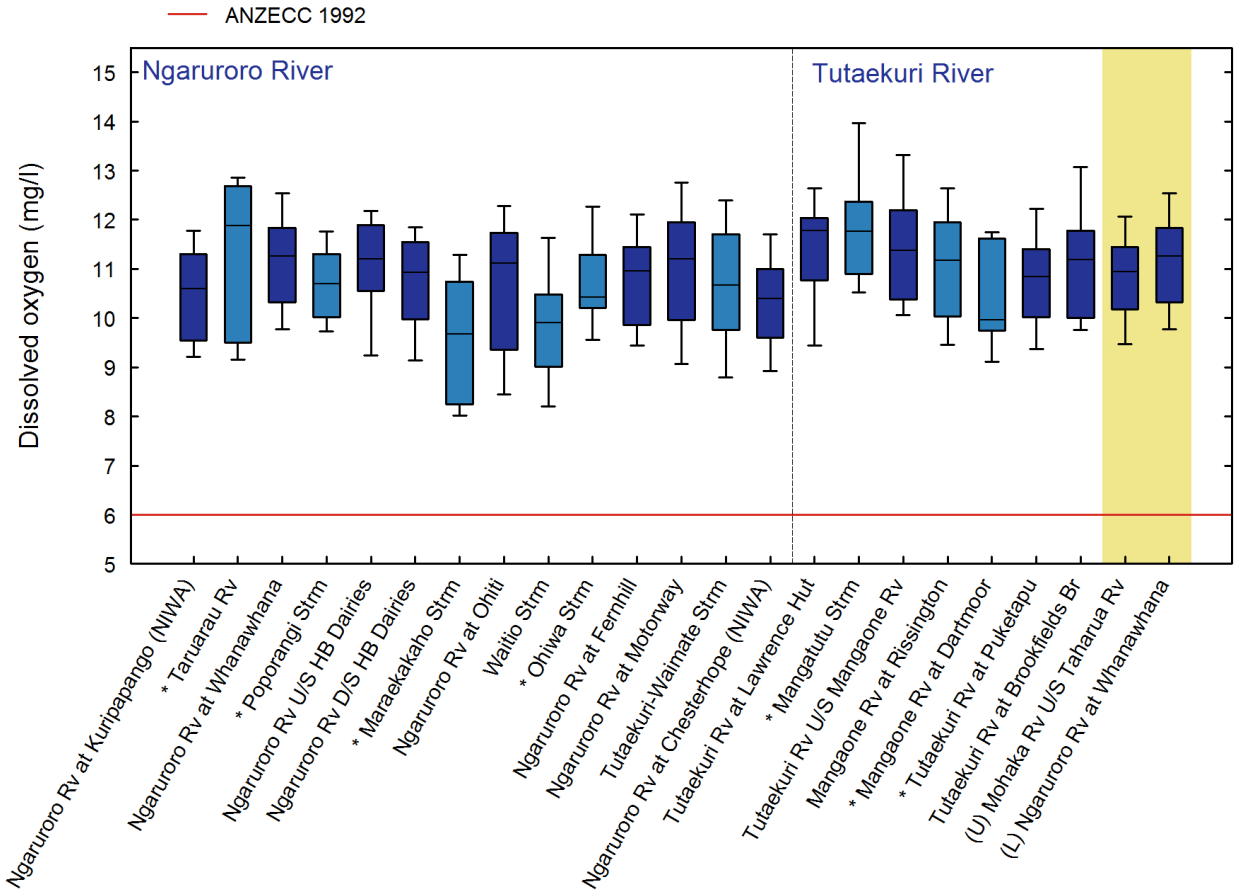


Figure 2-19: Dissolved oxygen concentration at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The red line is the ANZECC (1992) guideline minimum DO concentration of 6 mg/L. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Spot measurements of dissolved oxygen have limited value, particularly if samples have consistently been taken at a sampling site later in the day, when in-stream photosynthesis increases oxygen content in the water. Oxygen levels fluctuate diurnally because plant oxygen production peaks during daylight hours as a

result of photosynthesis and bottoms out at night time because of plant consumption. To account for this, continuous DO measurements are required.

DO was measured continually for 24 hours in the Waitio and Tutaekuri-Waimate streams during a warm, dry period in February 2014 (Haidekker 2016). Both streams had minima of 50% DO saturation (Figure 2-20) and 5 mg/L DO concentration, which shows that minimum oxygen levels measured continuously during a 24-hour period can be considerably different to what is detected using spot measurements: The temperature minima occur usually during early morning hours, but spot measurements are rarely taken at that time of the day. The minimum DO saturation measured by spot measurements over the 5 year SOE monitoring period was 71% in the Tuatekuri-Waimate, and 72% in the Waitio (Appendix A).

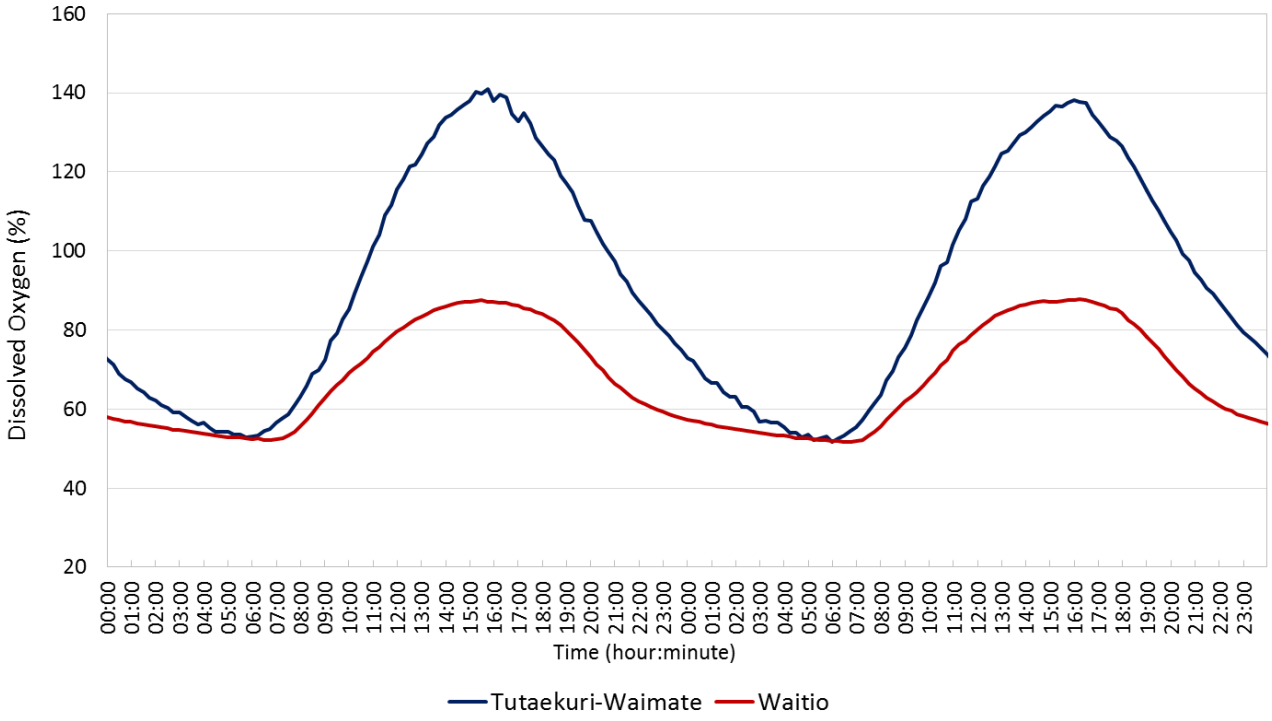


Figure 2-20: Dissolved oxygen saturation in the Waitio and Tutaekuri-Waimate streams. 24-hour measurements shown for the 18th and 19th Feb 2014.

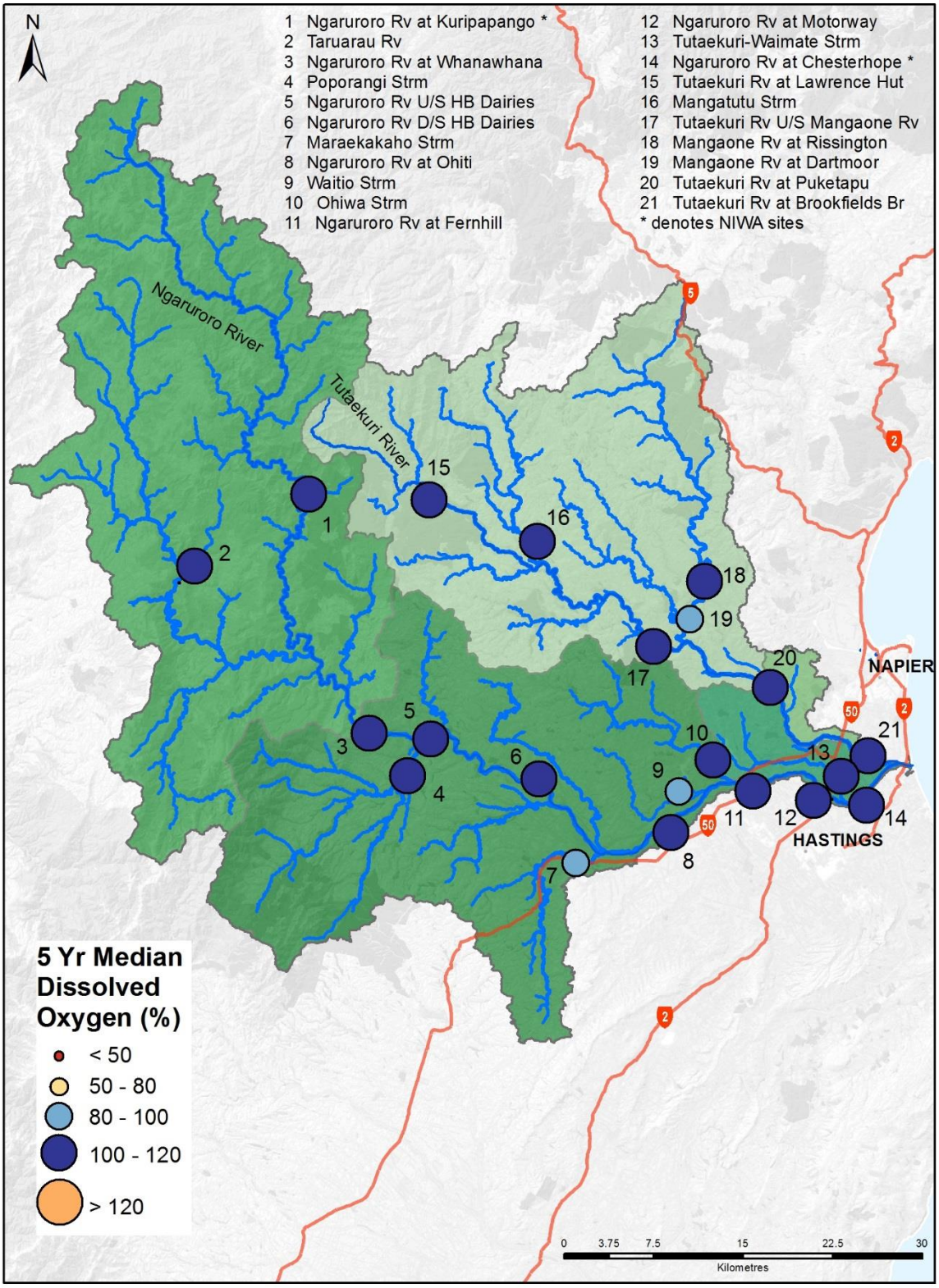


Figure 2-21: 5 year median dissolved oxygen saturation levels at Ngaruroro and Tutaekuri River SOE monitoring sites.

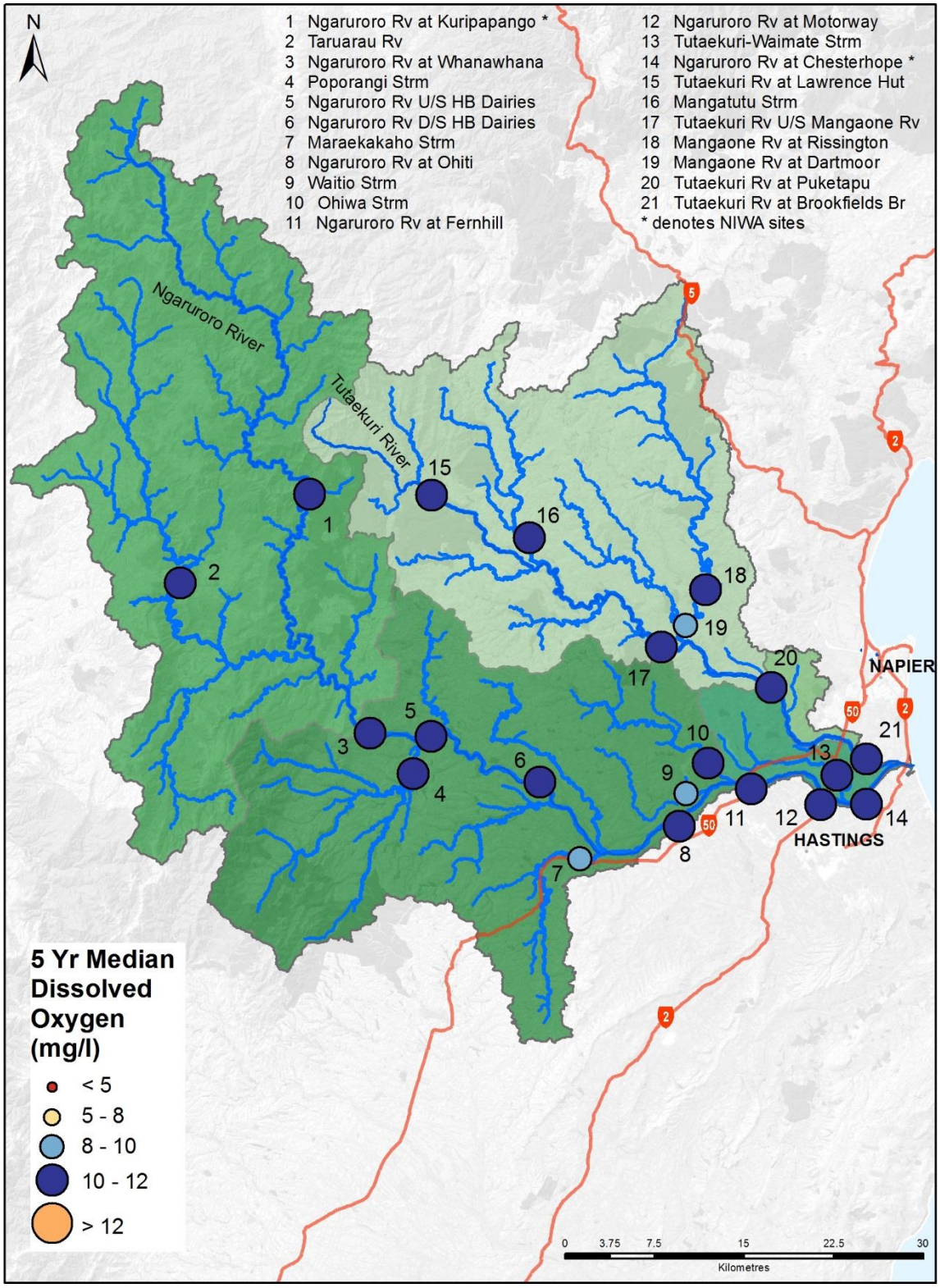


Figure 2-22: 5 year median dissolved oxygen saturation levels at Ngaruroro and Tutaekuri River SOE monitoring sites.

2.6 Temperature

NOTE: Temperature is important for stream ecology, because it affects instream processes such as metabolism, organic matter decomposition, and the solubility of gases. Temperature also directly affects stream biota by influencing cellular processes such as development, survival, reproductive success and behaviour.

Unlike mammals, which thermoregulate, aquatic organisms cannot keep their bodies at a constant temperature. Instead, their temperature varies with the environment (thermoconforming). Consequently, temperature exerts a key role on physiological processes in aquatic organisms.

Different species can tolerate different temperature ranges. 'Lethal limits' seriously stress species and they may die, but 'sub-lethal limits', affect feeding and species growth (Olsen et al. 2011).

The most significant instream temperature effect on aquatic organisms is summer high water temperatures.

Water temperature varies between day and night in a similar way to DO. Water temperature responds to changes in air temperature and exposure to solar radiation, leading to afternoon maxima and night minima. Spot measurements may not capture the full temperature regime of a stream or river.

Loggers were deployed 9–23 January 2013 at 3 sites in the Ngaruroro catchment (Ngaruroro main stem at Kuripapango and Fernhill, and the Taruarau tributary) and at 3 sites in the Tutaekuri catchment (Tutaekuri main stem at Lawrence Hut and upstream of the confluence with the Mangaone River, and at the Mangaone River at Rissington).

Measurements were obtained during warm, dry, sunny summer weather when water temperature was likely to be at or near maximum annual temperatures. At the Tutaekuri at Lawrence Hut, Ngaruroro at Kuripapango and the Taruarau tributary of the Ngaruroro water temperatures varied daily between 16^{o}C and 23°C on the hottest days.

The middle to lower catchment sites (Ngaruroro at Fernhill, and Tutaekuri upsteam of the Mangaone confluence) maximum water temperatures were 4^{o}C-5^{o}C higher than at the upper sites, ranging from 18°C-28°C daily.

Ngaruroro at Kuripapango and Tutaekuri at Lawrence Hut are considered pristine reference sites, because the catchment upstream of the site is almost completely in native forest cover. The Taruarau River has a high natural character with tussock/grassland, manuka/kanuka and indigenous forest, with only a small proportion in extensive pastoral farming. The sites at Ngaruroro at Fernhill, Tutaekuri upstream Mangaone and Mangaone River show the influence of land use and unshaded channels.

The pristine reference sites occasionally exceeded temperatures considered to be stressful for sensitive aquatic organisms (>20°C in upland streams (Olsen et al. 2011)). A maximum temperature of 23°C was reached briefly on several days within the monitoring period in the Ngaruroro at Kuripapango. Sites further downstream consistently exceeded critically high temperatures.

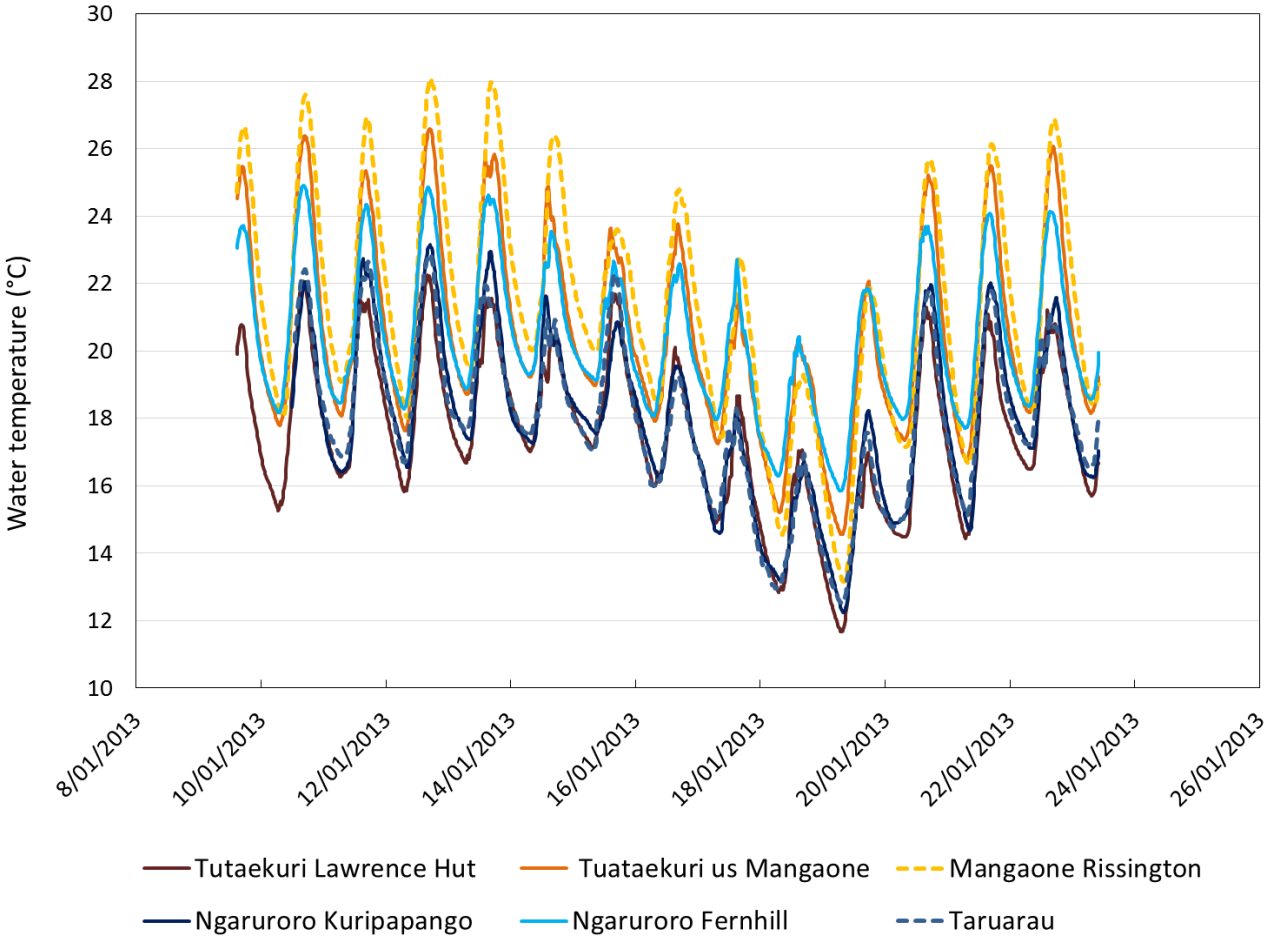


Figure 2-23: Water temperature at six sites in the Ngaruroro and Tutaekuri catchments. Continuous logger measurements taken in January 2013 at SOE sites in the main stem Ngaruroro (Kuripapango, Fernhill) and a tributary (Taruarau), and in the main stem Tutaekuri (Lawrence Hut, upstream Mangaone confluence) and a tributary (Mangaone River).

The effect of water temperature on species has generally been tested under constant temperatures in laboratory experiments. However, stream temperatures fluctuate daily, with afternoon maxima and night minima. To account for the temperature varying over a daily cycle in rivers, Cox and Rutherford (2000) showed that the critical temperatures affecting species were best expressed as the value mid-way between the daily maximum and mean temperatures. This Cox-Rutherford Index (CRI) permits the application of (constant) temperature criteria to temperature regimes varying over a diel cycle in rivers. Temperature thresholds proposed for the National Objectives Framework (Davies-Colley et al. 2013) are based on the Cox-Rutherford Index (CRI), which are shown in Table 2-6.

Table 2-6: Proposed temperature thresholds for discussion for the National Objectives Framework . Applicable in rivers and streams in 'Eastern Dry' regions of New Zealand. Temperature thresholds in °C, calculated as summer measurements of the Cox-Rutherford Index, averaged over 5 hottest days from a continuous temperature record.

Attribute State	Numeric Attribute State Temperature (°C)	Narrative Attribute State
A	≤ 19	No thermal stress on any aquatic organisms that are present on matched (near-pristine) reference sites.
B	>19 to ≤ 21	Minor thermal stress on occasion (clear days in summer) on particularly sensitive organisms such as certain insects and fish.
C	>21 to ≤25	Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish.
D	>25	Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.

CRI was calculated for the 5 consecutive hottest days in the monitoring period for the 6 sites in the Ngaruroro and Tutaekuri catchments (Table 2-7). The 3 pristine or near pristine sites (Ngaruroro at Kuripapango, Tutaekuri at Lawrence Hut and Taruarau River) were in the proposed NOF 'B band' for temperature. However, the catchments above these sites are in native vegetation and the temperature regimes measured here should represent natural reference conditions. If they naturally reach these temperatures on hot summer days characteristic of Hawke's Bay, it suggests the NOF bands do not adequately deal with warm climates such as this region's.

Table 2-7: Cox-Rutherford Index (CRI) at 6 sites in the Ngaruroro and Tutaekuri catchments. as temperature, calculated for the 5 hottest consecutive days over the monitoring period in January/February 2013. Classification into attribute bands as proposed for the NOF in (Davies-Colley et al. 2013).

Site	Max (°C)	Average (°C)	Min (°C)	CRI (°C)	Proposed NOF band
Ngaruroro Rv at Kuripapango	22.3	19.2	17.0	20.7	B
Taruarau Rv	22.1	19.2	17.1	20.7	B
Ngaruroro Rv at Fernhill	24.0	21.0	18.8	22.5	C
Tutaekuri Rv at Lawrence Hut	21.5	18.7	16.6	20.1	B
Tutaekuri Rv u/s Mangaone	25.3	21.4	18.5	23.3	C
Mangaone Rv at Rissington	26.6	22.6	19.3	24.6	C

2.7 Biological indicators

2.7.1 Periphyton biomass and cover

Algae are found in many locations in rivers. They may drift in the water column in both rivers and lakes, but they are called periphyton when they are attached to objects underwater such as the streambed gravel, rocks, logs, branches or any other stable material.

Low levels of algal growth occur naturally in healthy riverine ecosystems. Algae are the main primary producers in streams and rivers, and are fundamental to the functioning of aquatic ecosystems (Biggs 2000). They support invertebrate and fish productivity and diversity. But when periphyton cover grows too thickly, it can detrimentally affect ecosystem health and recreational values. Algal growth is controlled by several biotic and abiotic factors. Biotic factors include grazing by invertebrates and abiotic factors are nutrient availability, available light, and the time available for algae to grow between flood flows that scour algae off the river bed (known as the 'accrual' period).

Regional climate determines the frequency of floods capable of resetting algae to low levels, thereby starting a new accrual period. Catchments in dryer climates generally accumulate more algae between infrequent floods than those in regions with wetter climate and higher flood frequencies (Snelder et al. 2014).

Excessive periphyton growth can have detrimental effects on benthic habitat quality and macroinvertebrates, which can in turn affect native fish and trout growth, since macroinvertebrates are a food source for native fish and trout. Excessive growth can also cause wide daily variation in pH and dissolved oxygen concentrations, which can also detrimentally affect aquatic life (Biggs 2000). By contrast, the benthic cyanobacteria Phormidium can be hazardous because it produces toxins.

Excessively long filamentous algae and thick mats are unsightly and can directly affect amenity/aesthetic values of a river, and the quality of fishing for anglers by fouling fishing lures and lines (Biggs 2000, Wilcock et al. 2007).

Biomass is used to assess the effects of increased in-stream nutrient concentrations because periphyton and algae respond to changes in nutrient availability. Biggs (2000) developed the 'New Zealand Periphyton Guidelines', which identifies suitable limits for in-stream periphyton biomass and cover to support biodiversity and recreational amenity. The guidelines are:

- A maximum biomass of 120 mg chlorophyll *a*/m^2 of filamentous algae for the protection of aesthetic/recreation values, trout habitat and angling; and
- A maximum periphyton biomass of 50 mg chlorophyll *a*/m^2 for the protection of aquatic biodiversity values.

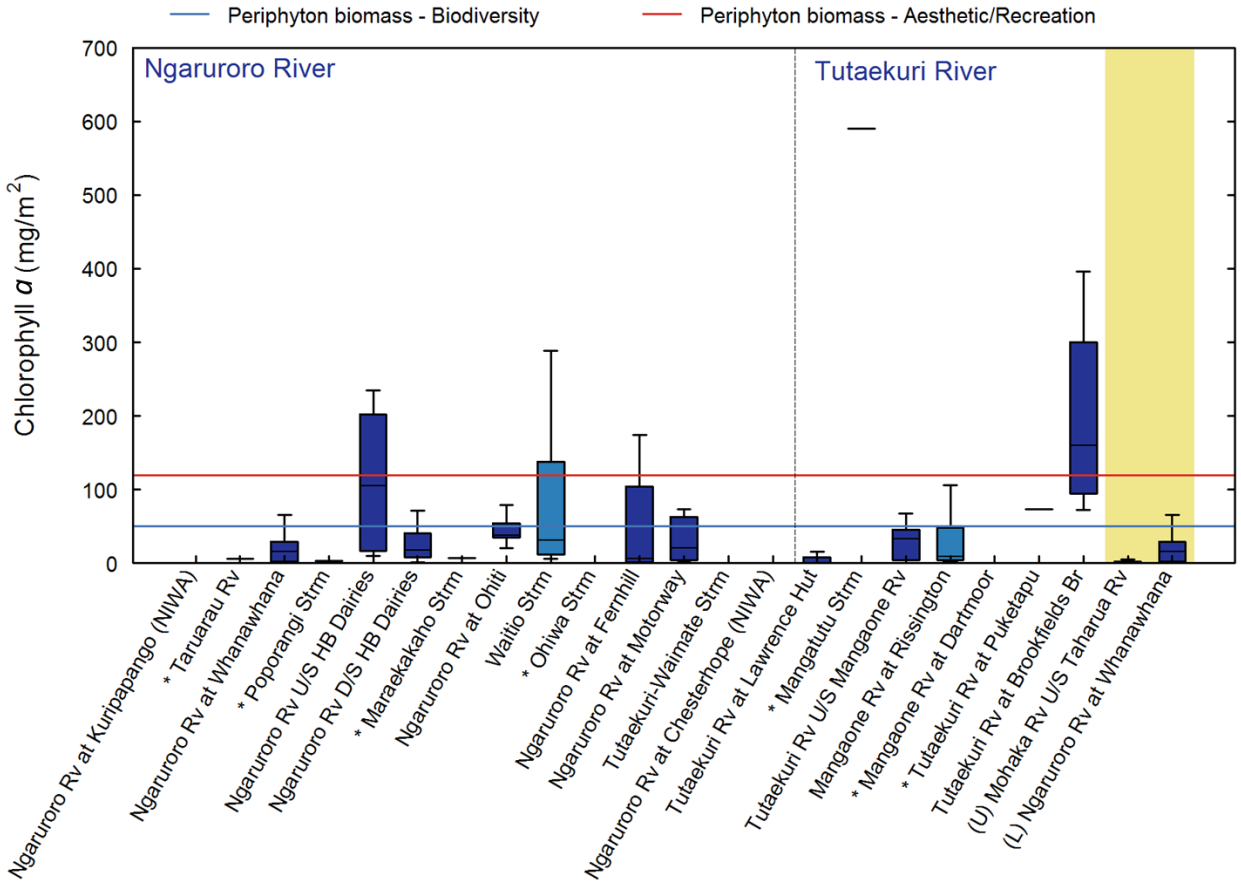


Figure 2-24: Periphyton biomass levels measured at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the Biggs (2000) 'Biodiversity' protection limit; the green line the 'Recreational amenity' limit for filamentous algae. The sites Ngaruroro at Kuripapango, Taurarau River, and Tutaekuri at Lawrence Hut are upland sites. All other sites are lowland according to ANZECC guidelines. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites.

Periphyton biomass results for the Ngaruroro catchment were excellent being at very low levels suitable for protection of biodiversity values at most sites in the upper and middle catchment (Figure 2-24). However, Ngaruroro upstream of Hawke's Bay Dairies had the highest periphyton biomass of all sites in the catchment. With 113 mg/m^2, median chlorophyll *a* here was above the biodiversity guideline of 50 mg/m^2, but below the aesthetic/recreation guidelines of 120 mg/m^2. In two summer samples (2009 and 2011) periphyton biomass exceeded the 120 mg/m^2 recreation guideline.

Periphyton biomass in the Ngaruroro at Whanawhana was slightly higher than at Kuripapango or the Tutaekuri at Lawrence Hut, although nutrient concentrations were at a similarly very low level at all sites (see Chapter 2.1.2). Under strongly N- and P-limited conditions nutrients can be taken up rapidly by periphyton. Under those conditions rapid nutrient uptake by plants reduces nutrients observed in the water column, while also facilitating higher periphyton growth rates. This effect may occur in the Ngaruroro because 10% of the catchment is in dry stock farming upstream of Whanawhana in the Taruarau tributary. This land-use may contribute nutrients that are not provided from the naturally-vegetated catchment at Lawrence Hut and Ngaruroro at Kuripapango. This pattern of periphyton growth may be exacerbated by

long periods of low flow that do not 'reset' growth, coupled with sunny, warm weather. Nutrients may also be supplied via a groundwater pathway, which could be difficult to pick up during regular SOE monitoring.

Most tributaries were sampled as short-term gap study sites, with only 1 periphyton biomass sample taken in summer 2013. The Taruarau, Poporangi and Maraekakaho streams had very low levels of periphyton biomass. For the Poporangi and the Maraekakaho streams this is surprising, given elevated nutrient levels at these sites. This may occur because 1 sample does not capture long-term variability seen in multiple years of SOE sampling at other sites such as Waitio Stream and the main stem Ngaruroro. Other conditions may also limit periphyton growth.

No data are available for Ohiwa and Tutaekuri-Waimate tributaries in the lower Ngaruroro catchment, which are macrophyte-dominated streams that cannot be sampled for periphyton biomass because sampling requires hard substrate to scrape an algal sample.

Periphyton growth in the Tutaekuri catchment was very low and at excellent levels for protection of biodiversity values in the upper and middle catchment (Tutaekuri at Lawrence Hut and upstream of the Mangaone confluence). There was a significant increase in periphyton biomass in the lower Tutaekuri catchment: The highest levels of periphyton biomass were found at Brookfields Bridge, where most samples taken exceeded the 120 mg/m^2 guideline for recreation.

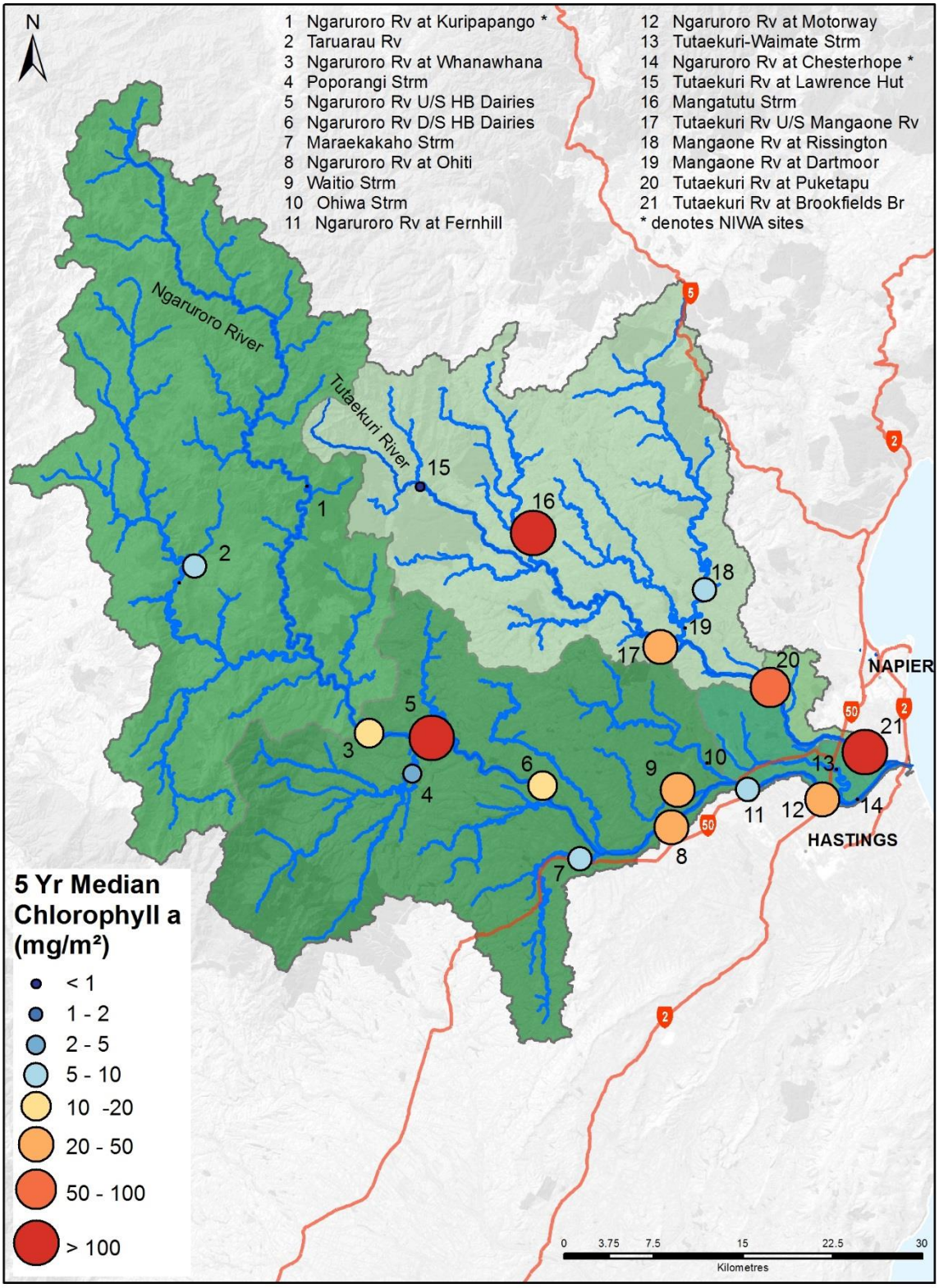


Figure 2-25: 5 year median periphyton biomass levels at Ngaruroro and Tutaekuri River SOE monitoring sites.

2.7.2 Nutrient limitation of algal growth – case study

Setting concentration limits is assisted by knowing which nutrient restricts algal growth and by identifying appropriate nutrient management strategies to limit excessive periphyton growth (Death et al. 2007). Algae require a wide range of chemical elements for growth (Larned 2010). River water normally has adequate supplies of most elements, so their relative abundance is not limiting. However, periphyton growth is often limited by how much of the nutrient elements nitrogen (N) and phosphorus (P) are available. Because land use changes can alter the supply of N and P to streams, these nutrients are most often the focus for management strategies.

A 2013 and 2014 study of nutrient limitation of algal growth in the Ngaruroro and Tutaekuri catchments (Haidekker and Wade 2016) is briefly summarised here.

A range of nutrient enrichment levels in the Ngarururo and Tutaekuri rivers was chosen to help understand nutrient dynamics and nutrient limitation of algal growth. Nutrient Diffusing Substrate (NDS) studies in the Ngaruroro River, the Tutaekuri River, and in the Mangaone River were completed in January 2013 and January, February, and March 2014. For both the Ngaruroro and Tutaekuri rivers, an upper- and a lower catchment site were chosen. Two sites were also selected in the Waitangi estuary downstream of the confluence of the Ngaruroro and Tutaekuri rivers. The Waitangi estuary is the downstream receiving environment for both the Tutaekuri and Ngaruroro Rivers before they discharge to the ocean.

Long dry spells typical of Hawke's Bay increase the likelihood that high algal biomass will occur in our rivers, even at relatively pristine sites. Although nutrient concentrations increase from source to sea in the Ngaruroro River, they remain low along its length and remain below ANZECC guideline levels. Observations using a periphyton cover index in 2014 showed that, despite nutrient concentrations remaining relatively low, algal growth rates double between Whanawhana and Fernhill. Nutrients and algal growth rates in the Tutaekuri River were higher than in the Ngaruroro River.

NDS studies show that algal blooms in both catchments are limited largely by both nitrogen and phosphorus. The Tutaekuri River showed co- and N-limitation over several trials, with a tendency towards secondary P-limitation in the lower Tutaekuri River. The upper Ngaruroro River was entirely co-limited. The lower Ngaruroro River at Fernhill potentially switches between different nutrient-limitation conditions. An increase in either N or P will result in increased algal growth rates and therefore a higher periphyton cover and frequency in algal blooms.

The NDS studies have also shown that the Waitangi estuary is predominantly co-limited. This suggests more algae will grow in the estuary if there is any increase in N or P in the rivers. Phytoplankton blooms would probably be more frequent, more extensive and/or last longer. Benthic micro- and macro-algae growth may also increase.

2.7.3 Macroinvertebrate Community Index

Macroinvertebrate communities are commonly used as an indicator of water quality and ecosystem health. The macroinvertebrate community of a stream adjusts to conditions in the aquatic environment, including naturally induced changes and stressors affecting ecosystem health. The macroinvertebrates collected at a site are exposed to changes in conditions at that site for periods of months, to a year or even several years, depending on their life cycle. Macroinvertebrate community composition changes as sensitive species experiencing stress are lost, which leads to a community dominated by more tolerant species. Both human activities and natural changes such as drought and floods, or natural variations in stream bed substrate

type and water temperature may affect macroinvertebrate communities. Assessing the composition of macroinvertebrate communities provides a long-term and integrated view of "water quality".

The Macroinvertebrate Community Index (MCI) was developed by Stark (1985) as a biomonitoring tool to assess stream health based on the presence or absence of certain invertebrate species. A higher MCI score indicates more pollution 'intolerant' or sensitive species are present. The MCI of a site can be used to assess the likely level of ecosystem degradation. *Ephemeroptera* (mayfly), *Plecoptera* (stonefly) and *Trichoptera* (caddisfly) larvae (called EPT taxa) are sensitive to pollution, so MCI scores are high when they are present. Community composition metrics like the proportion of EPT taxa present at a site can also be used as an indicator of stream health complementary to the MCI.

The MCI also has the potential to provide an indication of the relative availability of trout food species since many taxa that score highly in the MCI are also important prey for drift feeding trout (Hay et al. (2006).

The MCI summarises the complexity of stream health in a single numeric value that can be related to a wide range of factors. The MCI is the most commonly used indicator of macroinvertebrate community health in large-scale monitoring and reporting in New Zealand, such as State of the Environment monitoring and reporting undertaken by Regional Councils and TLAs[3].

The quality classes indicated by the MCI score are included in Table 2-8.

Table 2-8: MCI quality classes as defined by Stark and Maxted (2007).

≥120	Excellent quality, clean water
100-119	Good quality, possible mild pollution
80 – 99	Fair quality, probable moderate pollution
< 80	Poor quality, probable severe pollution

[3] Territorial Local Authorities

Figure 2-26 and

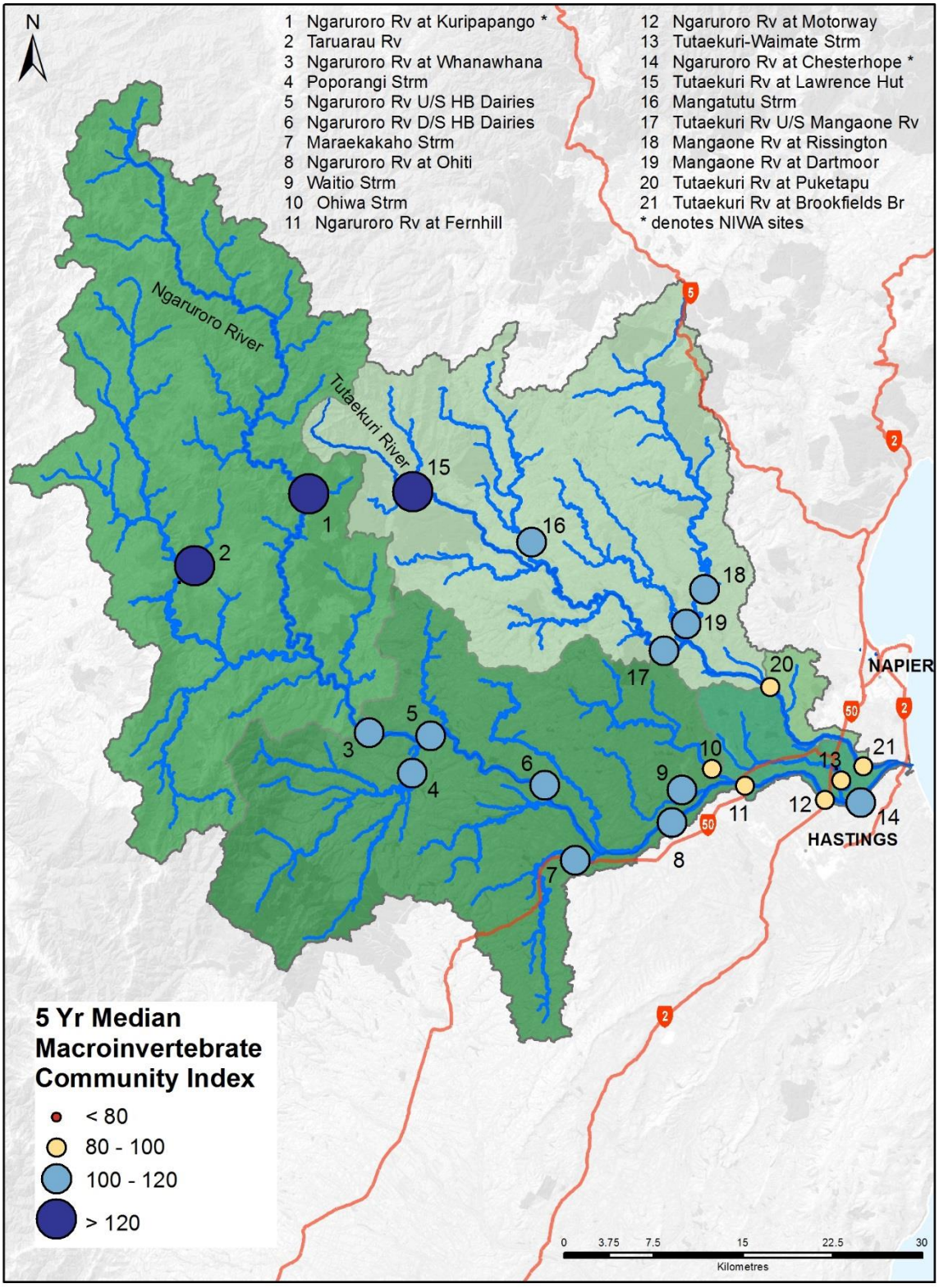


Figure 2-27 summarises MCI scores for the Ngaruroro and Tutaekuri catchment SOE monitoring sites. Boxes with whiskers show long term SOE monitoring data, whereas the lines are only one sample taken at the short-term gap sites.

As with the previous water quality parameters also the MCI indicates a gradient from upstream to downstream in both, the Ngaruroro and Tutaekuri catchments.

The sites in the upper catchments (Tutaekuri at Lawrence Hut, Ngaruroro at Kuripapango and Taruarau River) show MCI scores that indicated excellent water quality, with scores above 120 and at times over 130. The middle catchment of the Ngaruroro and its tributaries in the reach between Whanawhana to Ohiti had good MCI values between 100 and 120. Also the middle catchment of the Tutaekuri (upstream of the confluence with the Mangaone and the tributaries Mangatutu and Mangaone) indicated good water quality with MCI values greater than 100. In the lower Ngaruroro main stem MCI ranged around 100, therefore scores of samples during the monitoring period were falling into both, good and fair quality categories. The tributaries in the Lower Ngaruroro catchment indicated fair water quality of MCI < 100. In the lower Tutaekuri catchment MCI values indicated fair water quality, with MCI scores between 80 and 100 (Tutaekuri at Ohiti and at Brookfields Bridge).

EPT taxa (***E****phemeroptera* - mayflies, ***P****lecoptera* - stoneflies, and ***T****richoptera* - caddisflies) are mostly pollution sensitive taxa that indicate good water quality when present in higher proportions in a macroinvertebrate community. The proportion of EPT taxa in the macroinvertebrate community at SOE sites are in Appendix A in the column '%EPT taxa'. Close to 60% of the macroinvertebrate community consisted of the sensitive EPT taxa at the upper reference sites Ngaruroro at Kuripapango and Tutaekuri at Lawrence Hut. In the middle reach of the Ngaruroro main stem more than half of the macroinvertebrate community were EPT taxa. Ohiwa and Tutaekuri-Waimate tributaries had the lowest proportion of EPT taxa, at less than one third of the macroinvertebrate community. The middle reach of the Tutaekuri River and the Mangaone River had between 40 and 50% EPT taxa, while the lower Tutaekuri main stem (at Puketapu and Brookfields Bridge) had only 30% EPT taxa.

The change in community composition and in MCI scores from upper to lower catchment is accompanied by changes in other water quality parameters, such as increases in suspended sediment concentrations, indicated by turbidity and water clarity), temperature (Chapter 2.6), periphyton biomass (Chapter 2.7.1), and substrate type. These factors are known to influence macroinvertebrate communities.

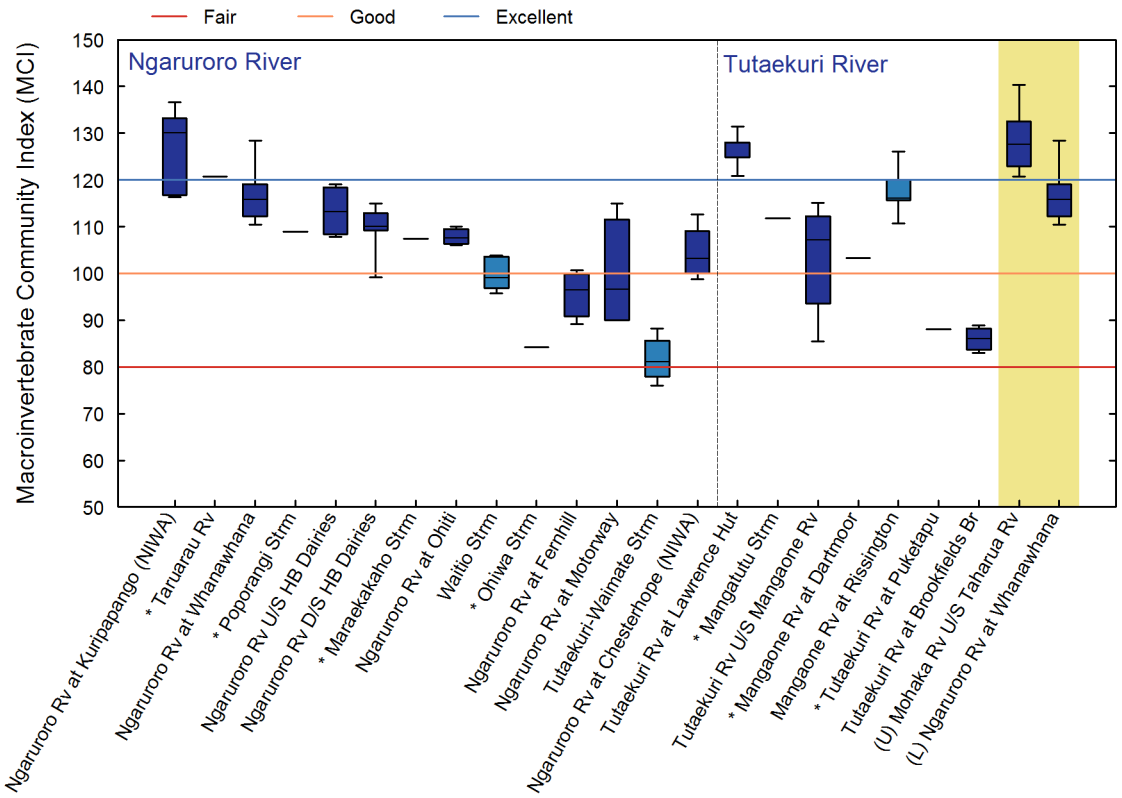


Figure 2-26: MCI levels measured at Ngaruroro and Tutaekuri River SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The lines are boundaries between MCI quality classes as defined by Stark and Maxted (2007): Blue line is the boundary between excellent and good classes, orange line: boundary between good and fair classes, red line: boundary between fair and poor classes.

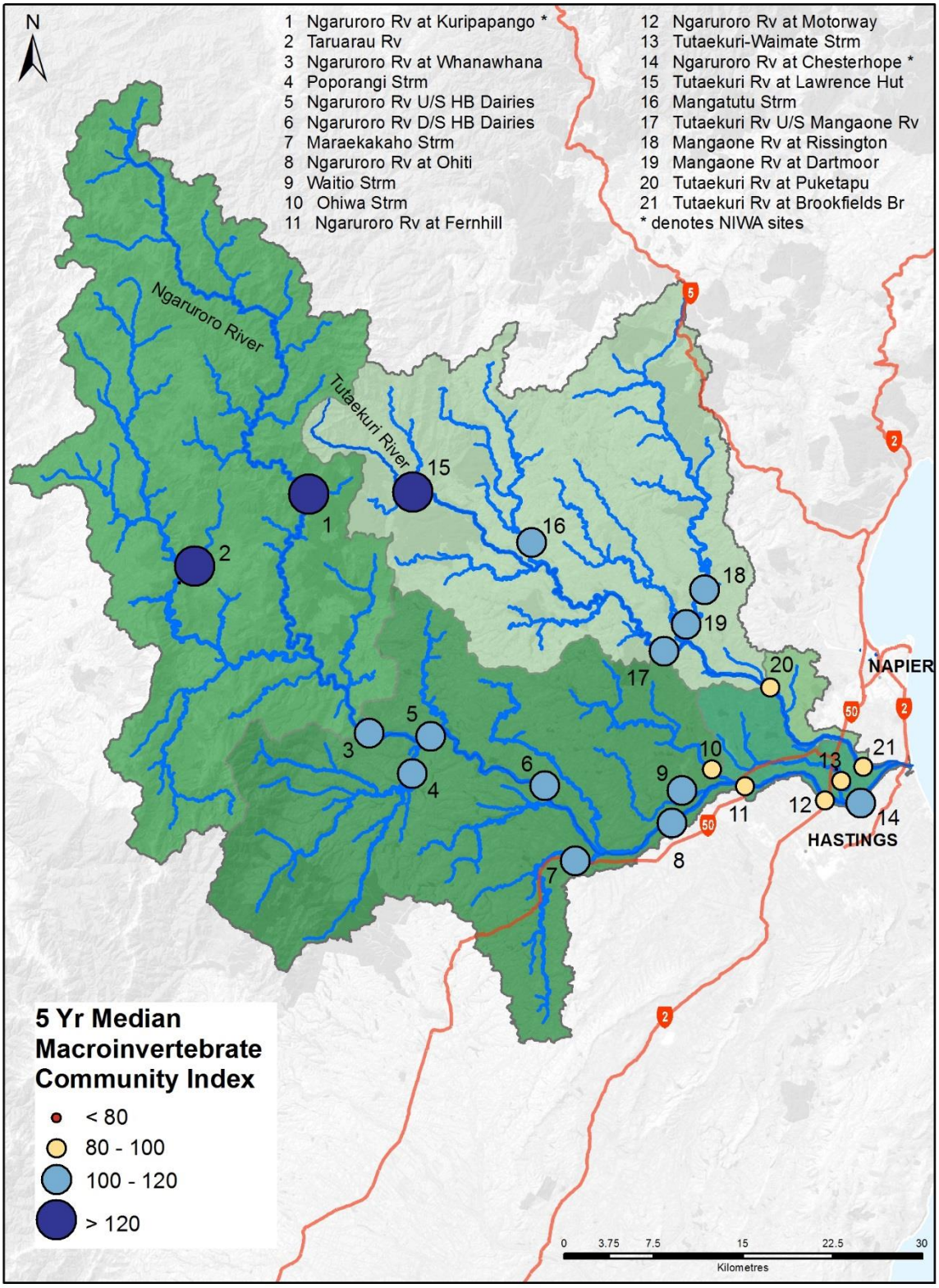


Figure 2-27: 5 year median macroinvertebrate community index (MCI) levels at Ngaruroro and Tutaekuri River SOE monitoring sites.

2.8 Assessment against the NOF NPS-FM (2014) attribute bands

The National Policy Statement for Freshwater Management (NPS-FM) 2014 (MfE 2014) sets out the objectives and policies for freshwater management under the Resource Management Act 1991. The NPS-FM came into effect on 1 August 2014 and is one of the initiatives developed as part of the Government's *Fresh Start for Fresh Water* programme of water reform.

The NPS-FM includes a National Objectives Framework (NOF) aimed at providing 'an approach to establish freshwater objectives and national values, and any other values that: a) is nationally consistent; and b) recognises regional and local circumstances.' (Objective CA1).

Appendix 2 of the NOF outlines a number of attribute tables. An attribute 'is a measureable characteristic of freshwater, including physical, chemical and biological properties, which supports particular values'. The NOF includes river-related attributes for periphyton (as number of chlorophyll-*a*/m^2), nitrate-nitrogen (mg/L), ammoniacal-nitrogen (mg/L), dissolved oxygen (mg/L – applicable downstream of point-source discharges only), and *E. coli* (number of *E. coli*/100ml - for secondary contact recreation only). Targets have been proposed within the NOF attributes that include 'national bottom lines' (D band) – thresholds of water quality attributes that good management should prevent waterways from crossing. A 'bottom line' is the minimum water quality level that all water bodies must achieve.

Each attribute table sets out the attribute and the unit in which it is to be measured (Appendix E). It then sets out A, B, C and D states and defines these in narrative and numeric terms, with A being the highest/best quality and D being below the national bottom line.

The data for DO and periphyton biomass could not be assessed against the attribute standards because there were insufficient monitoring data. Where adequate monitoring data existed for *E. coli*, nitrate and ammoniacal-nitrogen concentrations, NOF attribute states were calculated at each monitoring site and summarised in Table 2-9 Numerical results for each year are listed in Appendix F.

2.8.1 Escherichia coli (E.coli)

Secondary contact is defined under the NPS-FM 2014 as 'people's contact with fresh water that involves only occasional immersion and includes wading or boating (except boating where there is a high likelihood of immersion)'. In areas where the community values activities that result in more frequent immersion in water such as swimming, white-water rafting or water skiing (primary contact recreation), the NPS-FW (2014) states that 'the risk of infection will be no more than moderate'. In these areas a more stringent 95th percentile value is used to assess the risk of infection (MfE 2014).

All sites in the Ngaruroro and Tutaekuri catchments were in the A band considering both median *E. coli* concentrations over 5 years monitoring as well as for individual years between 2009 and 2013 (medians for years are in Appendix F). The narrative attribute state for the A band classification using the median *E. coli* concentration means that 'people are exposed to a very low risk of infection from contact with water activities with occasional immersion and some ingestion of water'.

Nineteen out of 21 sites in the Ngaruroro and Tutaekuri catchments were within the A band of the 95th percentile *E. coli* concentrations. At these sites graded A for primary contact recreation, people will be exposed to a low (<1%) risk of infection. Only the Ohiwa and Tutaekuri-Waimate streams were classified in the D band. The 95th percentiles calculated at these sites were above 540 counts/100mL, which is above the minimum acceptable state for full immersion activities. These sites are therefore considered unsuitable for primary contact recreation.

2.8.2 Nitrate-Nitrogen

The nitrate (toxicity) attribute helps assess chronic toxicity risk for aquatic animals. Chronic exposure typically includes a biological response of relatively slow progress and long continuance, often affecting a life stage (Hickey 2013a). Such a response may be reduced growth rate or reduced gonad development, compared to optimum growth conditions (a control). It does not relate to acute toxicity effects that result in the death of an animal. The attribute bands for a site are based on annual median and the annual 95th percentile of nitrate concentrations. The annual median concentration reflects the exposure of aquatic species under average conditions, while the 95th percentile manages the exposure during seasonal peaks in nitrate concentration. The narratives for each nitrate attribute band are included in Appendix E. Further reading on nitrate toxicity and guidelines for New Zealand can be found in Hickey (2013a) and (Hickey 2013b).

Median and 95th percentile nitrate-nitrogen concentrations for all Ngaruroro and Tutaekuri catchment sites (where data are available) were in the A band overall, when considering individual calendar years from 2009 to 2013 (Appendix F). The A band reflects a low level of risk from nitrate toxicity to any aquatic species. The narrative attribute state for the A band states there is 'unlikely to be effects even on sensitive species'. One exception in the Ngaruroro catchment was the Maraekakaho Stream, which fell into the B band for the 95th percentile. The B band means that some growth effect on up to 5% of species may occur (Appendix E).

2.8.3 Ammonia

The ammonia (toxicity) attribute helps assess chronic ammonia toxicity risk to aquatic animals. The attribute bands for a site are based on annual median and maximum concentrations (Appendix E). The annual median concentration reflects the exposure of aquatic species under average conditions while the maximum concentration manages the exposure during critical events and daily or seasonal peaks in ammonia concentration.

Median ammonia concentrations for all monitoring sites in the Ngaruroro and Tutaekuri catchments are in the A band for years 2009 to 2013 (Appendix F).

When considering annual maxima most sites had an A grading in the Ngaruroro and Tutaekuri catchments. All other sites were in the B band and located in the mid Ngaruroro main stem at Ohiti and at Fernhill, in the tributaries Waitio and Tutaekuri-Waimate, and 1 site in the Tutaekuri catchment at the monitoring sites at Lawrence Hut and upstream of the confluence of the Mangaone River. These sites are graded B due to 1 or 2 annual exceedances, and most occurred in the same year (2010). At the B graded sites ammoniacal-nitrogen concentrations were always below 0.1 mg/L which means concentrations were just exceeding into the B band, which lies between the thresholds of 0.05 mg/L and 0.4 mg/L annual maximum ammoniacal-nitrogen. The Waitio Stream was the only site that graded B in 3 consecutive years of the monitoring period.

The A band reflects an extremely low level of risk from ammonia toxicity for any aquatic species with a narrative that states 'no observed effect on any species tested'. The B band narrative states that ammonia 'starts impacting occasionally on the 5% most sensitive species' (MfE (2014); Appendix E).

Table 2-9: NPS-FW (2014) NOF band summary for freshwater river attributes for Tutaekuri and Ngaruroro catchment monitoring sites for the period 2009 to 2013. Sites marked with * are short-term monitoring sites (data records of 1 year) for additional information to long-term SOE sites. ** NIWA monitoring sites.

Site	*E. coli*		Nitrate (toxicity)		Ammonia (toxicity)	
	5 year median	95th percentile	5 year median	95th percentile	5 year median	Maximum
Ngaruroro Rv at Kuripapango*	A	A	NA	NA	A	A
Taruarau Rv	A	A	A	A	A	A
Ngaruroro Rv at Whanawhana	A	A	A	A	A	A
Poporangi Strm	A	A	A	A	A	A
Ngaruroro Rv U/S HB Dairies	A	A	A	A	A	A
Ngaruroro Rv D/S HB Dairies	A	A	A	A	A	A
Maraekakaho Strm	A	A	A	B	A	A
Ngaruroro Rv at Ohiti	A	A	A	A	A	B
Waitio Strm	A	A	A	A	A	B
Ohiwa Strm	A	D	A	A	A	A
Ngaruroro Rv at Fernhill	A	A	A	A	A	B
Ngaruroro Rv at Motorway	A	A	A	A	A	A
Tutaekuri-Waimate Strm	A	D	A	A	A	B
Ngaruroro Rv at Chesterhope*	A	A	NA	NA	A	A
Tutaekuri Rv at Lawrence Hut	A	A	A	A	A	B
Mangatutu Strm	A	A	A	A	A	A
Tutaekuri Rv U/S Mangaone Rv	A	A	A	A	A	B
Mangaone Rv at Rissington	A	A	A	A	A	A
Mangaone Rv at Dartmoor	A	A	A	A	A	A
Tutaekuri Rv at Puketapu	A	A	A	A	A	A
Tutaekuri Rv at Brookfields Br	A	A	A	A	A	A

2.9 Compliance with HBRC Regional Resource Management Plan 2006 surface water quality Environmental Guidelines

The RRMP 2006 defines Environmental Guidelines for dissolved oxygen saturation, black disc clarity, DRP and ammoniacal-nitrogen concentrations. These guidelines apply at river flows less than median flows. The water quality data collected between 2009 and 2013 at flows less than median flow at each monitoring site were compared with the RRMP water quality guidelines in the following ways:

(1) The overall mean DO saturation, mean black disc clarity, mean DRP, and mean/max ammoniacal-nitrogen (a toxicant) were compared with RRMP 2006 guideline values (Table 2-10),

(2) The total number of samples taken, the number of samples not meeting the guideline and the proportion of samples meeting the RRMP 2006 Environmental Guideline were calculated to provide a more detailed analysis of how often each guideline is met/exceeded at each site (Table 2-11).

Surface water quality compliance in the Ngaruroro and Tutaekuri catchments was generally very good when mean values (Table 2-10) were compared to Environmental Guideline values listed in the HBRC RRMP 2006.

Mean DO levels were fully compliant with Environmental Guideline values at all sites throughout the Ngaruroro and Tutaekuri catchments (Table 2-10). At most sites all observations for DO levels were greater (better) than the RRMP 2006 guideline value of 80% DO saturation. Only the Maraekakaho and Waitio streams had 1 single observation each of less than 80% saturation, but were still compliant with the RRMP.

Black disc water clarity was fully compliant at all sites in the Ngaruroro and Tutaekuri catchments when comparing average clarity (Table 2-10) to the RRMP guideline levels. In the Ngaruroro main stem at Kuripapango, Whanawhana, upstream Hawke's Bay Dairies, at Chesterhope, and in the Taruarau tributary water clarity was compliant in more than 80% of the observations (Table 2-11). At all other sites, particularly in the tributaries, water clarity was generally lower, and less than 80% of the observations were compliant. Clarity in the Tutaekuri-Waimate was the lowest in the Ngaruroro catchment, with only 40% of the observations greater than 1.6 m black disc clarity. In the Tuatekuri catchment all sites complied in more than 80% of the observations except for the Mangatutu Stream (50% compliance) and in the Tutaekuri at Puketapu (75% compliance).

Mean DRP levels were compliant (lower that the 0.015 mg/L guideline) in the main stem of the Ngaruroro and Tutaekuri rivers, and non-compliant in all tributaries (Table 2-10). All DRP observations in the main stem Ngaruroro complied with the 0.015 mg/L guideline, while only half of the observations were lower than the guideline in the Maraekakaho Stream (Table 2-11).

In the Waitio, Poporangi, and Tutaekuri-Waimate streams more than half the DRP concentrations were higher than 0.015 mg/L, and only 42%, 13%, and 8% of the observations complied, respectively. Ohiwa Stream had the highest DRP concentrations, and never complied with the guideline.

In the Tutaekuri main stem the proportion of samples exceeding the 0.015 mg/L DRP guideline increased gradually from upstream to downstream, while compliance declined. At Lawrence Hut 100% of the observations complied, and compliance decreased to 62% at the lowest site at Brookfields Bridge. Fewer than half of the observations in the Mangatutu and Mangaone tributaries were lower than the DRP guideline, and the Mangaone at Dartmoor site had only 10% of the observations below the guideline level.

All sites fully complied with the ammoniacal-nitrogen (NH_4-N) RRMP 2006 guideline of 0.1 mg/L (Table 2-10).

Table 2-10: Comparison of average measured dissolved oxygen, black disc, dissolved reactive phosphorus and ammoniacal-nitrogen levels with HBRC RRMP 2006 Environmental Guideline levels. The data summarised in the table are for samples taken between January 2008 and December 2013 when river flows were below median, as stipulated in Policy 72 of the HBRC RRMP 2006.

Site name	Mean of DO (%)	Mean of Black disc Clarity (m)	Mean of DRP (mg/L)	Mean of NH_4-N (mg/L)	Max of NH_4-N (mg/L)
Ngaruroro Rv at Kuripapango	101	7.6	0.002	0.002	0.005
Taruarau Rv	104	5.0	0.003	0.010	0.041
Ngaruroro Rv at Whanawhana	104	5.1	0.002	0.006	0.020
Poporangi Strm	101	2.2	0.026	0.008	0.018
Ngaruroro Rv U/S HB Dairies	102	3.7	0.003	0.006	0.012
Ngaruroro Rv D/S HB Dairies	105	3.0	0.003	0.005	0.010
Maraekakaho Strm	89	5.6	0.016	0.006	0.012
Ngaruroro Rv at Ohiti	101	2.7	0.004	0.016	0.091
Waitio Strm	98	3.5	0.020	0.010	0.053
Ohiwa Strm	108	3.2	0.098	0.006	0.014
Ngaruroro Rv at Fernhill	107	3.1	0.006	0.011	0.096
Ngaruroro Rv at Motorway	105	2.8	0.006	0.005	0.005
Tutaekuri-Waimate Strm	122	1.6	0.029	0.009	0.029
Ngaruroro Rv at Chesterhope	112	3.1	0.006	0.004	0.011
Tutaekuri Rv at Lawrence Hut	101	6.7	0.004	0.006	0.015
Mangatutu Strm	114	2.3	0.016	0.007	0.017
Tutaekuri Rv U/S Mangaone Rv	119	2.5	0.008	0.005	0.005
Mangaone Rv at Rissington	112	2.5	0.019	0.007	0.022
Mangaone Rv at Dartmoor	105	2.6	0.025	0.009	0.028
Tutaekuri Rv at Puketapu	118	2.7	0.013	0.006	0.014
Tutaekuri Rv at Brookfields Br	121	3.2	0.013	0.010	0.048
HBRC RRMP 2006 guideline level	**80%**	**1.6 m**	**0.015 mg/L**	**0.100 mg/L**	**0.100 mg/L**
Number of sites compliant	21 / 21	21 / 21	16 / 21	21 / 21	21 / 21
% site compliance	100%	100%	76%	100%	100%

Table 2-11: Comparison of measured DO, BD clarity and DRP values with HBRC RRMP 2006 Environmental Guideline levels. The data summarised in the table is for samples taken between January 2009 and December 2013 when river flows were below median, as stipulated in Policy 72 of the HBRC RRMP 2006. Sites with more than 80% of observations compliant with guidelines are shaded GREEN; between 50% and 80% compliant are shaded ORANGE; and less than 50% compliant are shaded RED.

Site name	Dissolved Oxygen Saturation			Black disc Clarity			Dissolved Reactive Phosphorus		
	Samples at < median flows	Samples > 80% satn.	Samples > limit	Samples at < median flows	Samples > 1.6m	Samples > limit	Samples at < median flows	Samples > 0.015 mg/L	Samples < limit
Ngaruroro Rv at Kuripapango	16	16	100%	16	16	100%	16	0	100%
Taruarau Rv	8	8	100%	7	7	100%	8	0	100%
Ngaruroro Rv at Whanawhana	13	13	100%	14	13	93%	16	0	100%
Poporangi Strm	7	7	100%	7	5	71%	8	7	13%
Ngaruroro Rv U/S HB Dairies	6	6	100%	8	7	88%	8	0	100%
Ngaruroro Rv D/S HB Dairies	13	13	100%	14	9	64%	16	0	100%
Maraekakaho Strm	8	7	88%	6	5	83%	8	4	50%
Ngaruroro Rv at Ohiti	6	6	100%	7	5	71%	8	0	100%
Waitio Strm	12	11	92%	12	11	92%	12	7	42%
Ohiwa Strm	7	7	100%	6	4	67%	7	7	0%
Ngaruroro Rv at Fernhill	13	13	100%	13	10	77%	15	1	93%
Ngaruroro Rv at Motorway	3	3	100%	6	3	50%	6	0	100%
Tutaekuri-Waimate Strm	10	10	100%	10	4	40%	13	12	8%
Ngaruroro Rv at Chesterhope	29	29	100%	29	27	93%	29	0	100%
Tutaekuri Rv at Lawrence Hut	15	15	100%	13	12	92%	14	0	100%
Mangatutu Strm	9	9	100%	8	4	50%	9	5	44%
Tutaekuri Rv U/S Mangaone Rv	12	12	100%	10	8	80%	12	1	92%
Mangaone Rv at Rissington	18	18	100%	15	13	875	18	11	39%
Mangaone Rv at Dartmoor	10	10	100%	8	7	88%	10	9	10%
Tutaekuri Rv at Puketapu	8	8	100%	8	6	75%	8	2	75%
Tutaekuri Rv at Brookfields Br	13	13	100%	13	12	92%	13	5	62%

2.10 Land use intensification in the upper Tutaekuri catchment – potential impacts on the Mangatutu Stream and the Mangaone River

This chapter is a brief summary of a study on the potential impacts of land use intensification on the Mangatutu Stream and Mangaone River completed in 2011, which is yet to be reported (Lyon in prep).

The Mangatutu Stream and Mangaone River catchments together are more than 55% of the Tutaekuri catchment area. The Tutaekuri River has excellent water quality and provides substantial ecological and recreational value to the Hawke's Bay region. However, nuisance levels of periphyton develop during extended low flows, probably associated with high DIN and DRP contributed from the Mangatutu and Mangaone catchments. Nuisance periphyton growth has an impact on both, ecological and recreational values in rivers.

The Mangatutu catchment is west of Patoka, with an area of 11,945 hectares. The Mangaone catchment is 33,782 hectares. Before 2000, most land in Patoka was used for sheep and beef grazing. Since then, conversion of grazing land to dairy farms has increased substantially, doubling dairying in Patoka since the late-1990s (Sevicke-Jones 1998).

Water quality was monitored weekly at 21 sites from 14 September to 14 October 2011 at sites selected to represent a variety of land intensification to identify land-use influences on water quality, and to identify priority sub-catchments contributing elevated nutrient loadings.

In-stream nitrogen and phosphorus concentrations were generally highest in dairy-farming catchments, followed by (in descending order) sheep and beef, pine plantation and native forest catchments. In-stream nutrients increased substantially in catchments with increased stocking rates from 1998/99 to 2011: NNN (Nitrate- and Nitrite-N) and DRP increased significantly at a Mangatutu Stream tributary and in the Mangatutu Stream (only DRP).

2.11 Summary and conclusion for the Ngaruroro and Tutaekuri River catchments

Both the Ngaruroro and Tuatekuri catchments have very low levels of nitrate, that indicate no risk of toxicity affecting fish or other aquatic animals. *E. coli* levels are also very low in both catchments, indicating a very low risk for primary contact recreation.

Water clarity decreases from upstream to downstream in the Ngaruroro catchment, while turbidity increases. Even pristine sites in the upper catchment experience reduced water clarity during high flows. Soft rocks in the catchment increase the likelihood of hillslope erosion. Vegetation clearances may allow more sediment to enter waterways. A modelling study is underway to identify how much the reduction in water clarity and increase in turbidity is due to land-uses or natural processes. The Tutaekuri main stem has better water clarity and turbidity than the Ngaruroro main stem, generally better than contact recreation guidelines, even in the lower catchment.

The Ngaruroro River has excellent water quality in terms of nutrients over its entire length, although nutrient concentrations increase from upstream to downstream. Low levels of nitrogen and low to moderate levels of phosphorus are found, compared to natural background levels. In the Tutaekuri River nutrient levels also increase from upstream to downstream, but nitrogen stays at moderate levels, while dissolved phosphorus increases significantly.

Increasing nutrient enrichment in both the Tutaekuri and the Ngaruroro rivers from upstream to downstream is largely derived from tributaries that successively contribute water with high in-stream nutrient concentrations. Nevertheless, over the entire length of the main stem of the Ngaruroro, nutrient concentrations remain generally very low, and below recommended periphyton accrual thresholds. By contrast nutrient concentrations in the main stem of the Tutaekuri increase until dissolved phosphorus is above recommended periphyton accrual thresholds in the middle and lower main stem. The situation in the Ngaruroro main stem is the result of a large volume of low-nutrient water from the upper Ngaruroro diluting nutrient-enriched tributary inflows lower in the catchment. This dilution effect is not as substantial in the Tutaekuri. Periphyton growth was higher in the Tutaekuri compared to the Ngaruroro, which parallels the increasing level of nutrients.

MCI indicates excellent conditions in the upper catchment and good conditions at most other sites in the middle Ngaruroro and Tutaekuri. MCI values were good to fair in the lower Ngaruroro and fair in the lower Tutaekuri main stem. In the lower catchments loss of sensitive species is probably caused by several natural and human-induced changes in the aquatic environment. These could include increasing temperature in the lower reaches, and increased sediment and periphyton cover, which both affect macroinvertebrate habitat.

3 Water Quality of the Karamu Stream and Ahuriri Estuary Catchments: Long-term SOE data

3.1 Nutrients

Nitrogen (N) and phosphorus (P) are key 'growth limiting' nutrients that influence the growth rate and extent of algae (or periphyton) and aquatic plants. A deficit in the supply of one or both of these two nutrients often limits plant biomass development (Matheson et al. 2012).

Eutrophication is the term used to describe the enrichment of water bodies by inorganic plant nutrients such as nitrate or phosphate. Eutrophication may occur naturally over geological timescales, particularly in lakes, and in rivers eutrophication increases on an upstream to downstream gradient, but higher levels of enrichment are commonly the result of human activity. Land-use change and intensification often give rise to elevated levels of nitrogen and phosphorus, particularly in areas where appropriate farming practices are not followed. Nuisance periphyton growth can be managed by reducing or eliminating inputs of N and P from point-source discharges and/or diffuse sources such as discharges from land-use (Biggs 2000).

KEY POINT: Dissolved Inorganic Nitrogen (DIN) and Dissolved Reactive Phosphorus (DRP) are dissolved inorganic forms of the nutrients nitrogen (N) and phosphorus (P) respectively. N and P are the two key macronutrients required for growth of plants and algae, occurring in all living cells – for example being key elements in proteins and DNA. DIN includes nitrate, nitrite and ammonia. DRP includes phosphate. Although numerous other forms of nitrogen and phosphorus exist and are commonly referred to in the field of water quality (e.g. organic and particulate forms), it is the dissolved forms DIN and DRP that are most readily available for uptake by plants and are thus most relevant for assessing effects on nuisance plant growth in rivers. The terms total nitrogen (TN) and total phosphorus (TP) refer to the sum total of all forms of N and P respectively in a sample. TN and TP are most relevant for assessments in lakes and coastal waters. At sufficiently elevated concentrations, nitrate and ammonia forms of nitrogen have toxic effects on aquatic biota (and on humans in the case of nitrate). This effect is independent of their significance as plant nutrients (Norton 2012).

3.1.1 Total nitrogen (TN) and total phosphorus (TP)

Total nitrogen concentrations were high in the Karamu catchment. Samples were always above the ANZECC lowland trigger value of 0.614 mg/L in the Karewarewa, Awanui, Poukawa, Mangarau streams and generally exceeding the trigger value in the Taipo Stream. In the Ruahapia, Herehere and Clive River TN median concentrations were lower than at the other sites, but also mostly above the ANZECC trigger value (Figure 3-1).

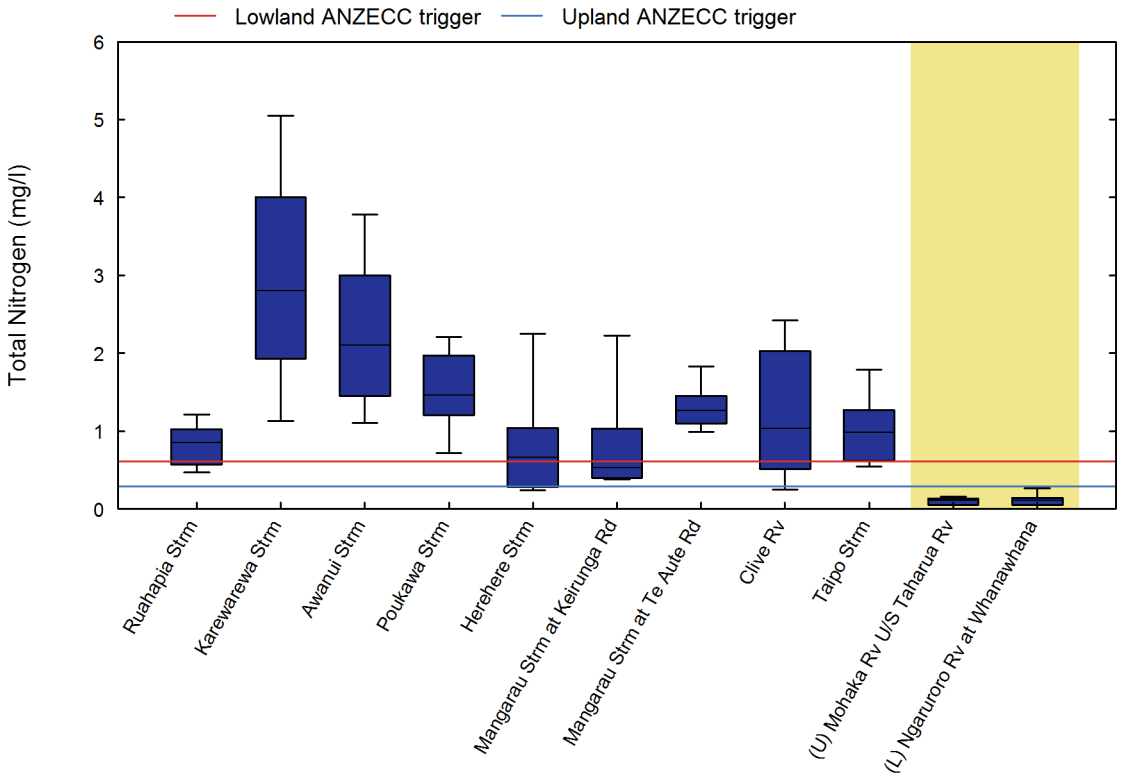


Figure 3-1: Total Nitrogen (TN) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TN trigger value; the red line ANZECC (2000) 'Lowland' TN trigger value.

Total phosphorus concentrations in the Karamu and Ahuriri catchments were very high and always above the lowland ANZECC trigger value of 0.033 mg/L at all sites (Figure 3-2). Median TP concentrations ranged from twice the ANZECC trigger value (Mangarau Stream at Keirunga Gardens TP 0.06 mg/L), to median concentrations that are 12 times the trigger value (Taipo Stream TP 0.41 mg/L).

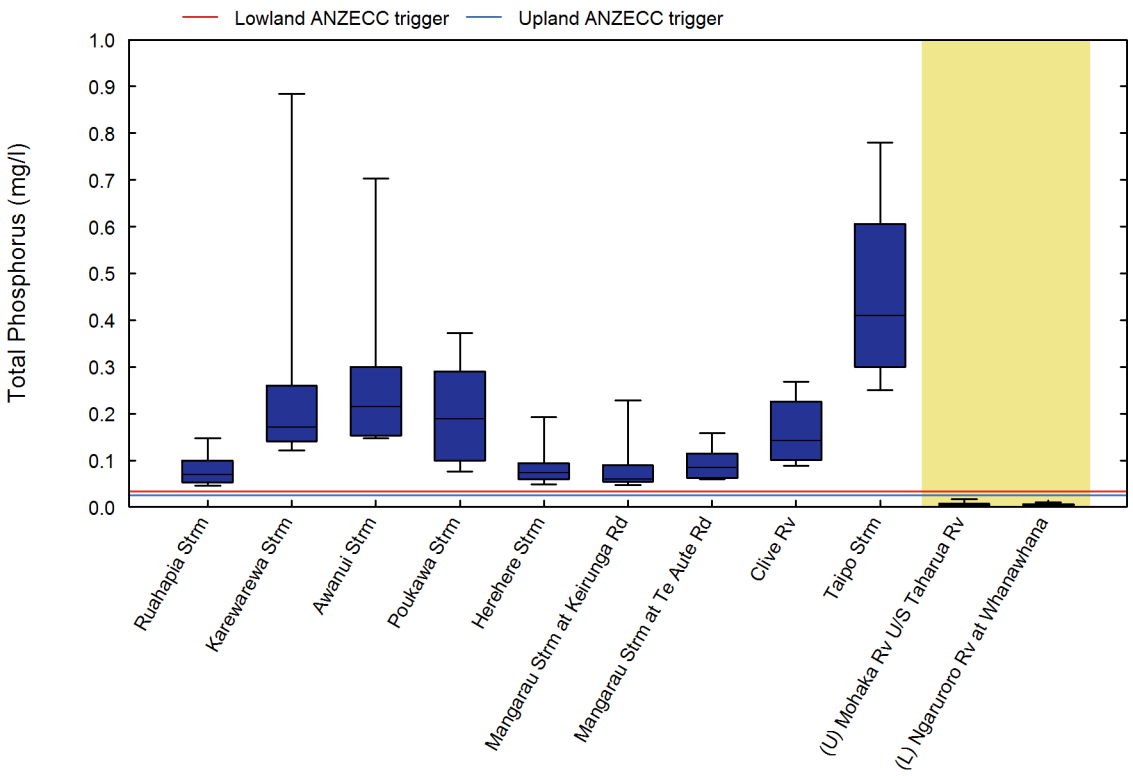


Figure 3-2: Total phosphorus (TP) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TP trigger value; the red line ANZECC (2000) 'Lowland' TP trigger value.

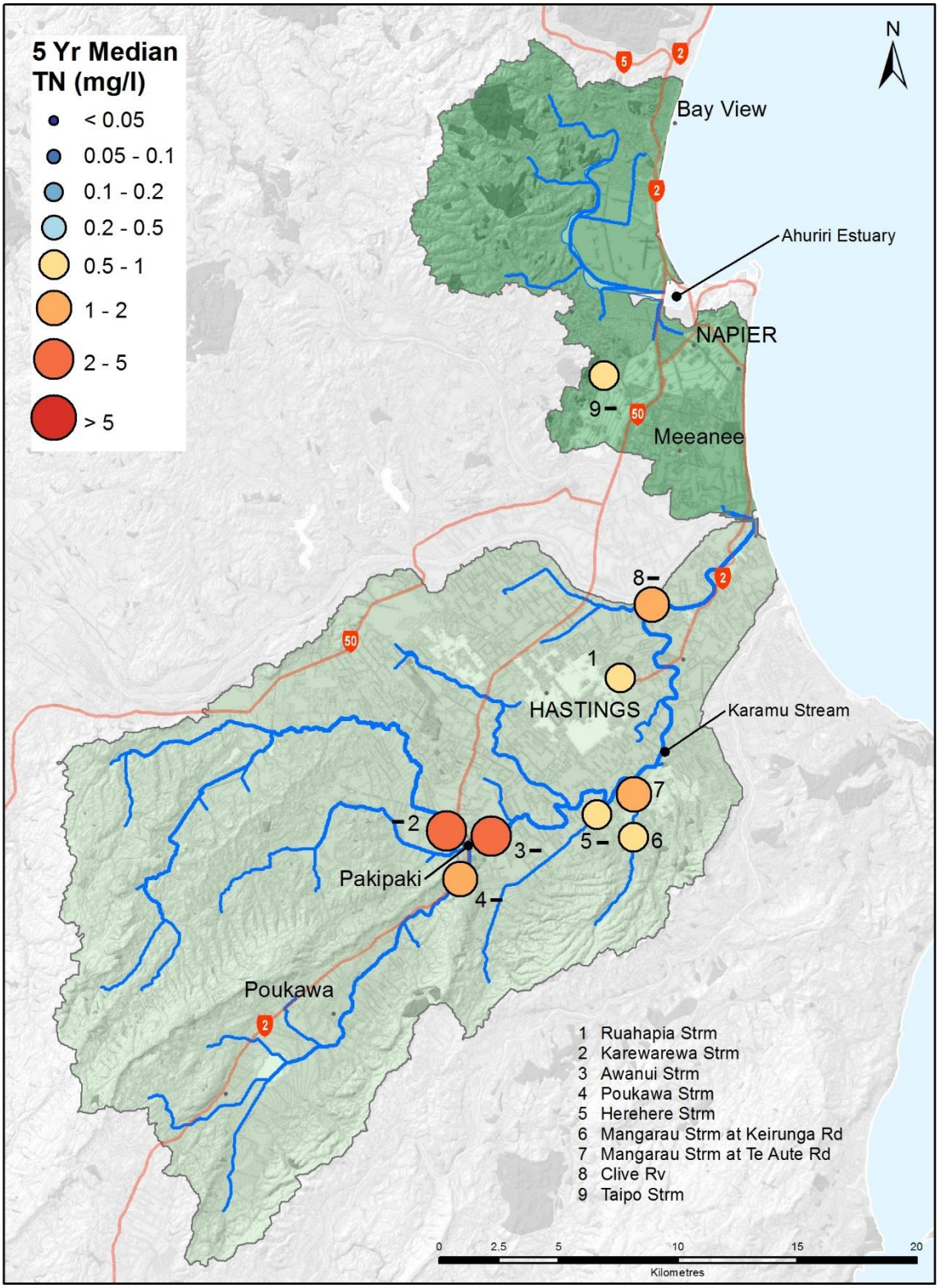


Figure 3-3: 5 year median total nitrogen (TN) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Dashes indicate no significant trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

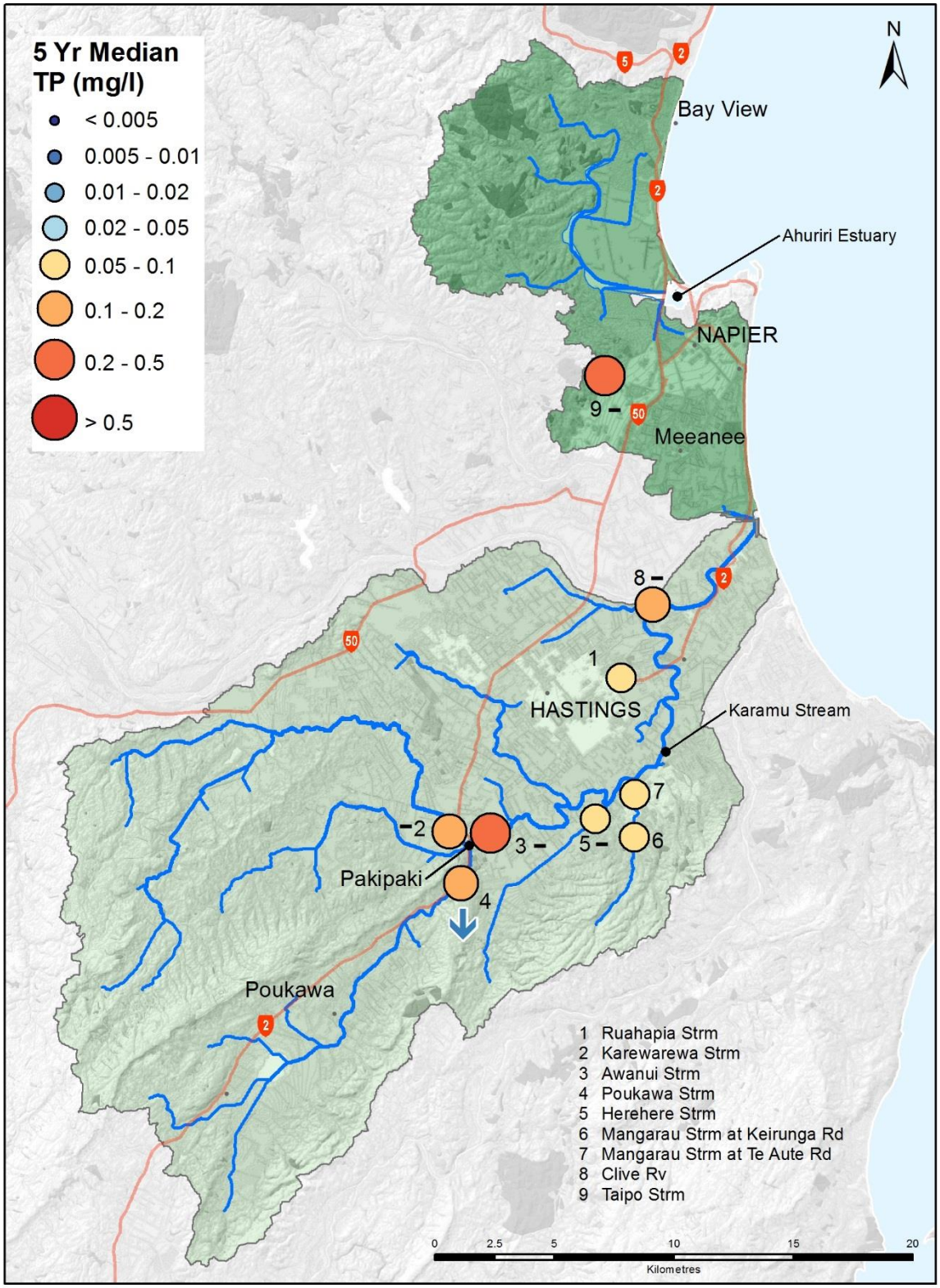


Figure 3-4: 5 year median total phosphorus (TP) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

Table 2-1 summarises the results of trend analysis carried out on TN and TP across all SOE monitoring sites of the Karamu and Ahuriri catchments. For a full summary of trend analysis results refer to Appendix C: Trend analysis results for water quality variables. There were no significant trends apparent in the dataset for TN, but TP decreased significantly in the Poukawa Stream at Pakipaki.

Table 3-1: Trend analysis results for DIN and DRP for SOE monitoring sites of the Karamu Stream and Ahuriri Estuary catchment. Some sites have been discarded from the table due to short time periods of data available for analysis. The remaining sites are included in Trend analysis results for water quality variables.

Site	Total Nitrogen			Total Phosphorus		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Karewarewa Strm	2.8	0.842	-0.95	0.178	0.268	-1.75
Awanui Strm	2.055	1	-0.81	0.22	0.549	-1.67
Poukawa Strm	1.475	0.81	0.28	0.205	**0.016**	**-5.45**
Herehere Strm	0.494	0.882	0.54	0.076	0.766	-0.99
Clive Rv	1	0.144	2.54	0.135	0.549	1.36
Taipo Strm	0.915	0.139	8.09	0.425	0.374	-4.65

3.1.2 Dissolved nutrients

Nutrient concentration patterns across study sites in the Karamu catchment and the Taipo in the Ahuriri catchment were similar for both total and dissolved nutrients (Figure 2-5 and Figure 2-6). All samples from the Karewarewa, Awanui, and Mangarau streams were above DIN trigger values. In the Ruahapia, Clive and Taipo streams the median DIN concentration was above the ANZECC lowland trigger value. There was a strong increasing DIN concentration from upstream to downstream sites in the Mangarau Stream.

DRP concentrations in the Karamu and Ahuriri catchments were high, and always above ANZECC trigger value levels at all SOE sites, in a similar pattern to TP concentrations. The Taipo Stream had the highest DRP concentrations - the median value of 0.270 mg/L is 18 times higher than the 0.015 mg/L trigger ANZECC lowland trigger value.

Dissolved nutrients DIN and DRP did not show any significant trends at long-term SOE monitoring sites in the Karamu and Ahuriri catchments (Table 2-2, Appendix C), with one exception: DRP in the Poukawa Stream decreased significantly. This is consistent with a significant decrease in TP concentration at the same site.

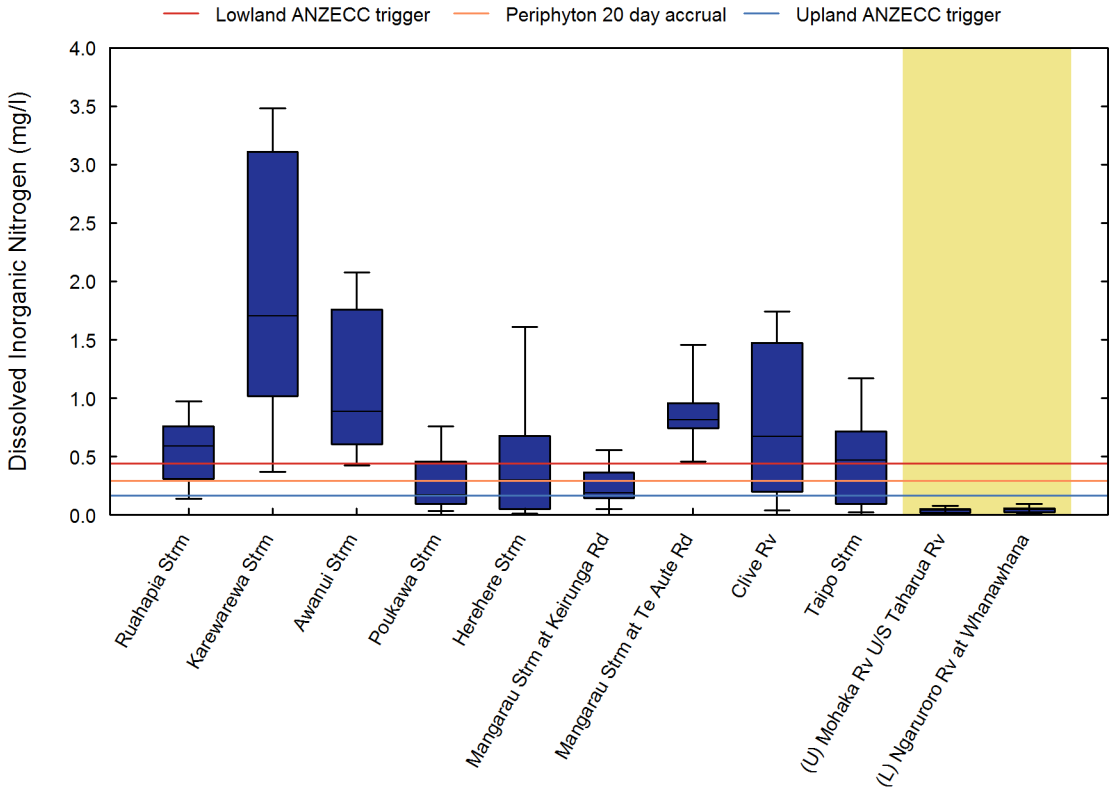


Figure 3-5: Dissolved inorganic nitrogen (DIN) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. Several lines relating to trigger values and limits have been included on the figure. The blue line is the ANZECC (2000) 'Upland' DIN trigger value; the orange line is the Biggs (2000) suggested limit for DIN for periphyton growth management for a 20-day accrual period; the red line is the ANZECC (2000) 'Lowland' DIN trigger value.

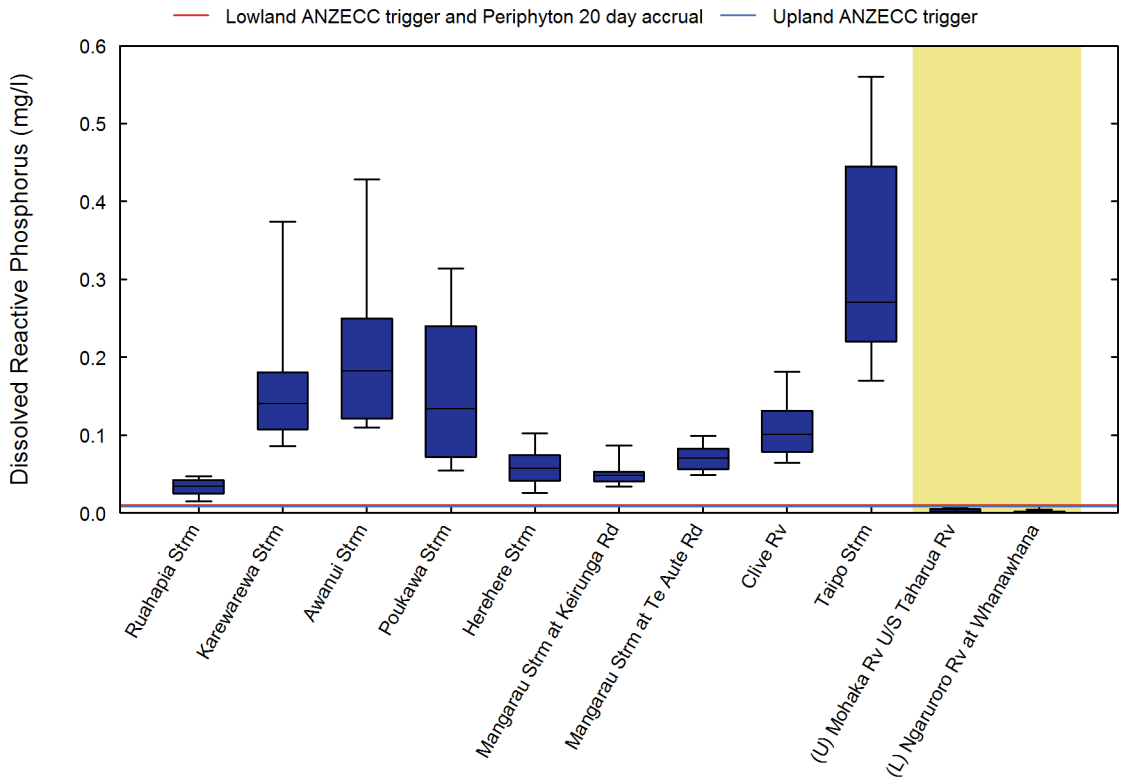


Figure 3-6: Dissolved reactive phosphorus (DRP) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the ANZECC (2000) 'Upland' DRP trigger value; the red line is the ANZECC (2000) 'Lowland' DRP trigger value and the Biggs (2000) suggested limit for DRP for periphyton growth management for a 20-day accrual period.

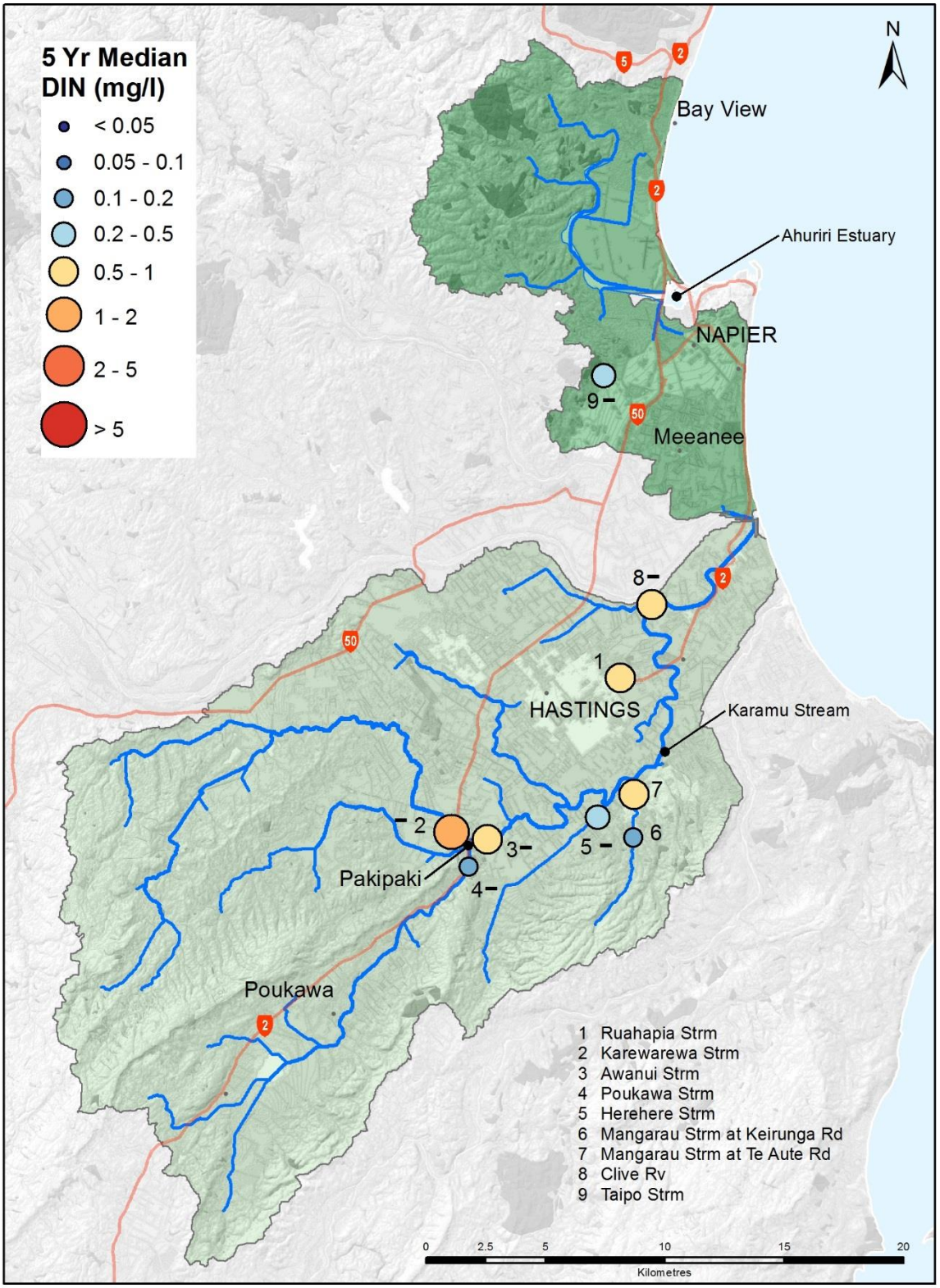


Figure 3-7: 5 year median dissolved inorganic nitrogen (DIN) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Dashes indicate no significant trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

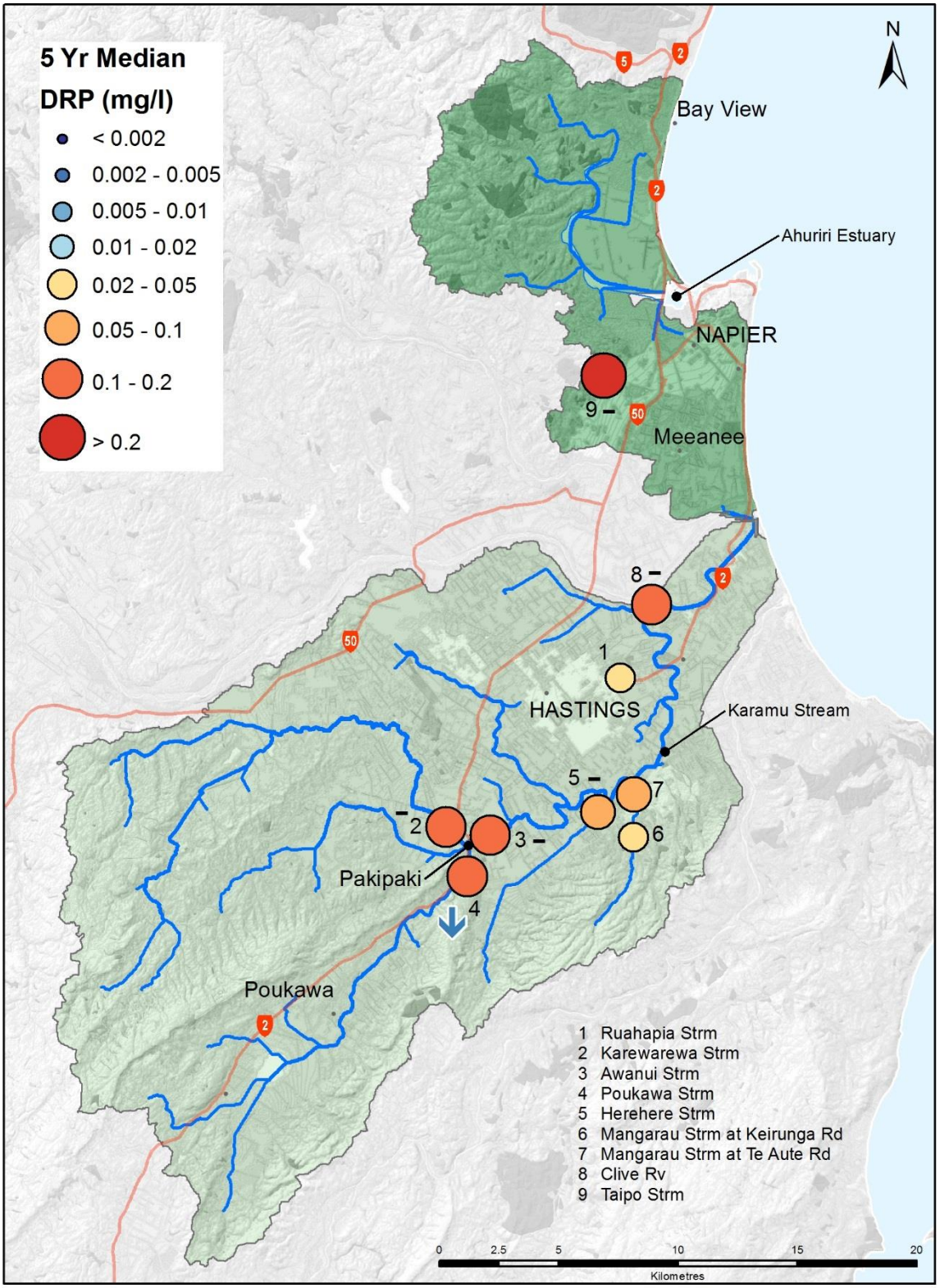


Figure 3-8: 5 year median dissolved reactive phosphorus (DRP) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with blue arrows for improvement, dashes indicate no significant trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

Table 3-2: Trend analysis results for DIN and DRP for SOE monitoring sites of the Karamu Stream and Ahuriri Estuary catchment. Refer to Appendix C for a full breakdown of trend analysis results.

Site	DIN			DRP		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Karewarewa Strm	1.857	0.69	-1.87	0.132	0.29	-1.42
Awanui Strm	0.979	0.618	1.15	0.162	0.453	1.16
Poukawa Strm	0.242	0.666	1.09	0.153	**0.016**	**-6.02**
Herehere Strm	0.229	0.824	0.19	0.059	0.334	1.71
Clive Rv	0.629	0.484	1.63	0.097	0.53	0.99
Taipo Strm	0.362	0.207	5.62	0.3	0.882	-1.66

3.2 Toxicity: nitrate-nitrogen and ammoniacal-nitrogen

DIN (discussed in chapter 2.1 Nutrients) is made up of nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N) and ammoniacal-nitrogen (NH_4-N). Nitrate-nitrogen is the dominant form of DIN in areas not directly affected by point-source discharges, and in catchments without large areas of wetland with anoxic soils.

The Ruahapia, Poukawa, Mangarau (at Keirunga Gardens) and Taipo streams were below any nitrate-nitrogen toxicity thresholds (Figure 3-9). Some sites exceeded the 99% species protection threshold, but were below the 95% species protection limit (Awanui Stream, Clive River). Karewarewa had the highest nitrate- nitrogen concentration of these SOE sites - the median was below the 95% protection limit, and more than a quarter of all samples were between the 90% and 95% species protection limits. No sites exceeded the 90% species protection limit.

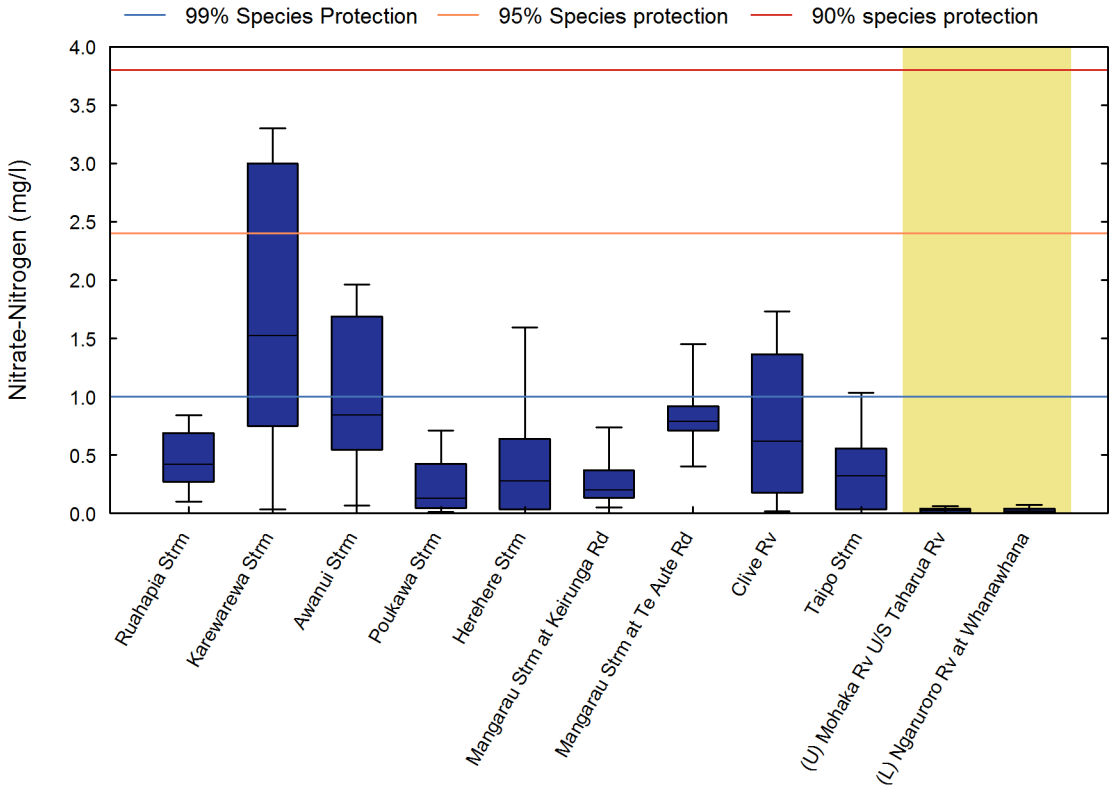


Figure 3-9: Nitrate - nitrogen (NO_3-N) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The lines relate to the Hickey (2013a) nitrate toxicity limits: the blue line for '99% species protection' or 'Excellent' management classification, the orange line is the 95% species protection and the red line to 90% species protection.

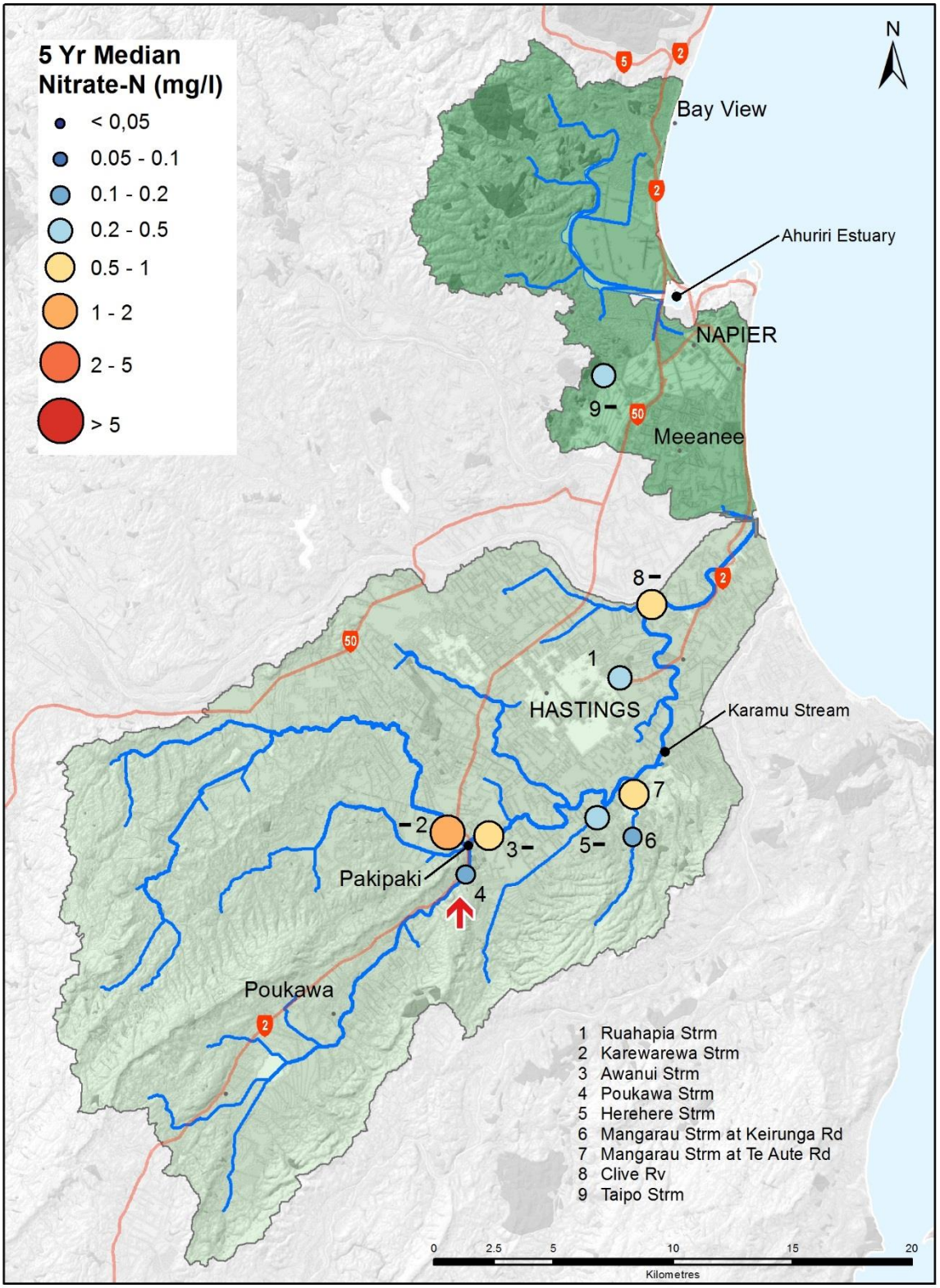


Figure 3-10: 5 year median nitrate-nitrogen (NO_3-N) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

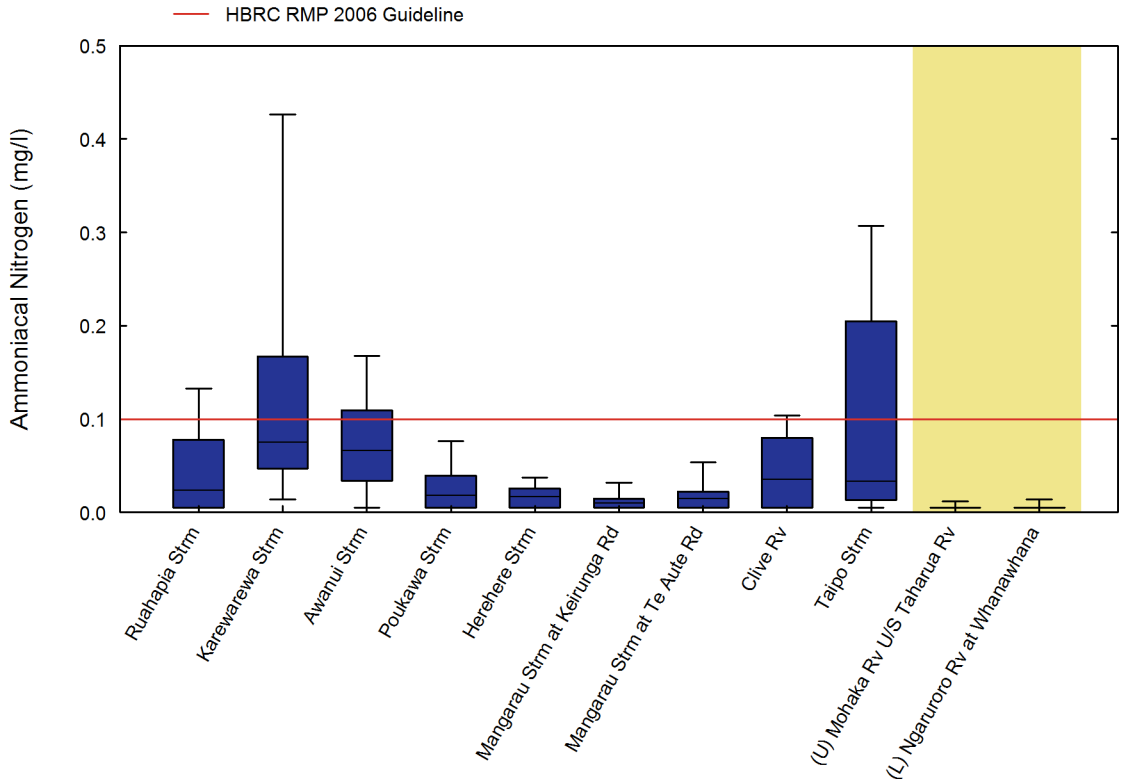


Figure 3-11: Ammoniacal - nitrogen (NH_4-N) levels at Karamu and Ahuriri catchment SOE monitoring sites. . SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The red line is the RMP (2006) guideline.

Median ammoniacal-nitrogen concentration stayed below the RMP guideline at all sites in the Karamu and Ahuriri catchments (Figure 3-11). The concentrations sometimes exceeded the guideline in the Karewarewa, Taipo and Awanui Streams.

Trend analysis of the Karamu and Ahuriri showed that the Poukawa Stream had a significant increase in nitrate-nitrogen, and a significant decrease in ammoniacal-nitrogen (Table 3-3). A decreasing trend in ammoniacal-nitrogen was also observed in the Awanui Stream.

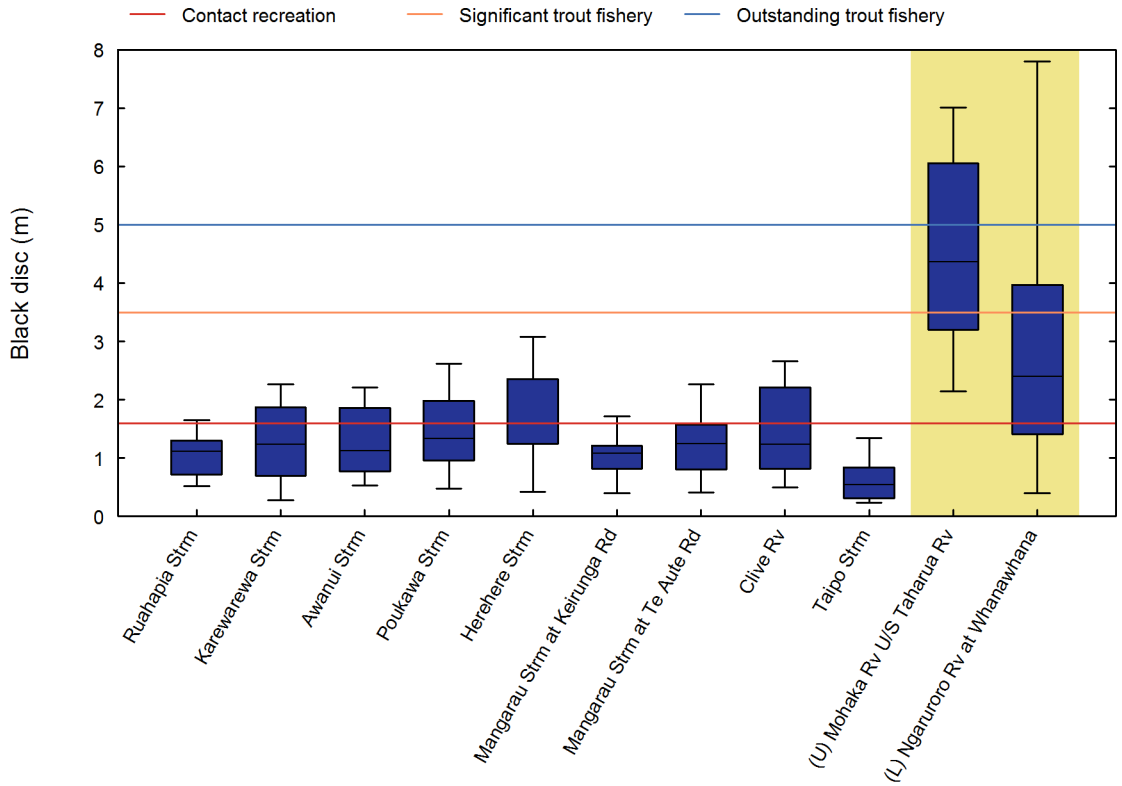
The Poukawa Stream had several changing trends in water quality variables – an increase in nitrate, but a decrease in ammoniacal-nitrogen, DRP and TP. There is a large wetland complex in Pekapeka upstream of the Poukawa SOE monitoring site. Willow and raupo clearance may have increased flow through these wetlands, which can cause greater oxidation within the wetland complex, which would increase the conversion of ammoniacal-nitrogen to nitrate-nitrogen. This would also explain why nitrate levels have increased. Higher oxygen levels in the wetland system would also increase the capacity of sediments in the system to adsorb phosphorus, and explain why the dissolved fraction of P has decreased, along with TP.

Table 3-3: Trend analysis results for nitrate-nitrogen (NO_3-N) for SOE monitoring sites of the Karamu Stream and Ahuriri Estuary. Refer to Appendix C for a full breakdown of trend analysis results.

Site	Nitrate			Ammoniacal-N		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Karewarewa Strm	1.54	1	0	0.078	0.412	-2.34
Awanui Strm	0.845	0.842	0.78	0.07	**0.026**	**-6.1**
Poukawa Strm	0.175	**0.049**	**5.13**	0.023	**0.04**	**-14.53**
Herehere Strm	0.212	0.657	1.14	0.019	0.333	0
Clive Rv	0.59	0.484	1.61	0.038	0.286	0
Taipo Strm	0.201	0.183	5.75	0.028	0.71	7.38

3.3 Water Clarity – Black disc and turbidity

For a background summary of water clarity and turbidity refer to section 2.3.



Even in pristine catchments water clarity is reduced at times of elevated flow throughout the Karamu and Ahuriri catchments (Figure 3-12). Note, Figure 2-11 includes data collected at all flows so it cannot be used to assess what water clarity for a site would nominally be under low flow conditions. Water clarity under low flow conditions can best be understood from less than median flows and less than lower quartile flows in Appendix E.

Figure 3-12: Water clarity measured as black disc horizontal sighting distance for Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the

Hay and Hayes (2006) 'Outstanding trout fishery' limit; the orange line the 'Significant trout fishery' limit. The red line is the ANZECC (2000)/ HBRC RRMP 2006 recreational amenity limit.

Visual clarity was similar across the SOE sites, with median black disc viewing distance from 0.5 m to 1.6 m, which is below the contact recreation guideline.

Black disc water clarity is inversely related to turbidity. Turbidity is a measurement of the degree of light scattering caused by suspended particles in the water column. The greater the concentration of suspended particles, the higher the turbidity. Turbidity at the SOE sites in the Karamu and Ahuriri catchments is shown in Figure 3-13. Median turbidity was below ANZECC guidelines, with the exception of the Taipo Stream where median turbidity was 5.8 NTU and therefore just exceeded the lowland ANZECC guideline of 5.6 NTU. Clarity and turbidity had similar patterns, where higher clarity was associated with lower turbidity. The Taipo Stream had the lowest clarity and highest turbidity of all sites.

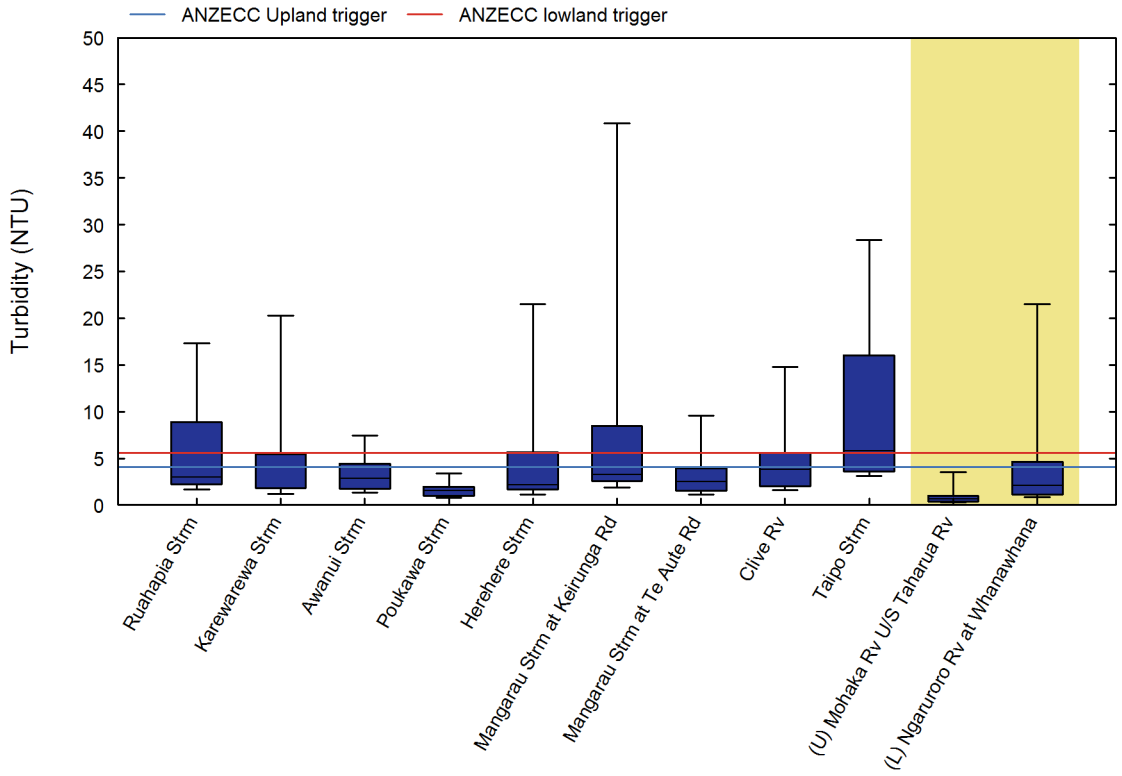


Figure 3-13: Water clarity measured as turbidity (NTU) for Karamu Stream and Ahuriri Estuary SOE monitoring sites. NTU stands for Nephelometric Turbidity Units. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is ANZECC (2000) 'Upland' TN trigger value; the red line to ANZECC (2000) 'Lowland' TN trigger value.

Water clarity decreased with a statistically significant trend in the Poukawa Stream, whereas turbidity increased with a statistically significant trend in the Karewarewa and Herehere Streams (Figure 3-14, Figure 3-15 and Table 3-4).

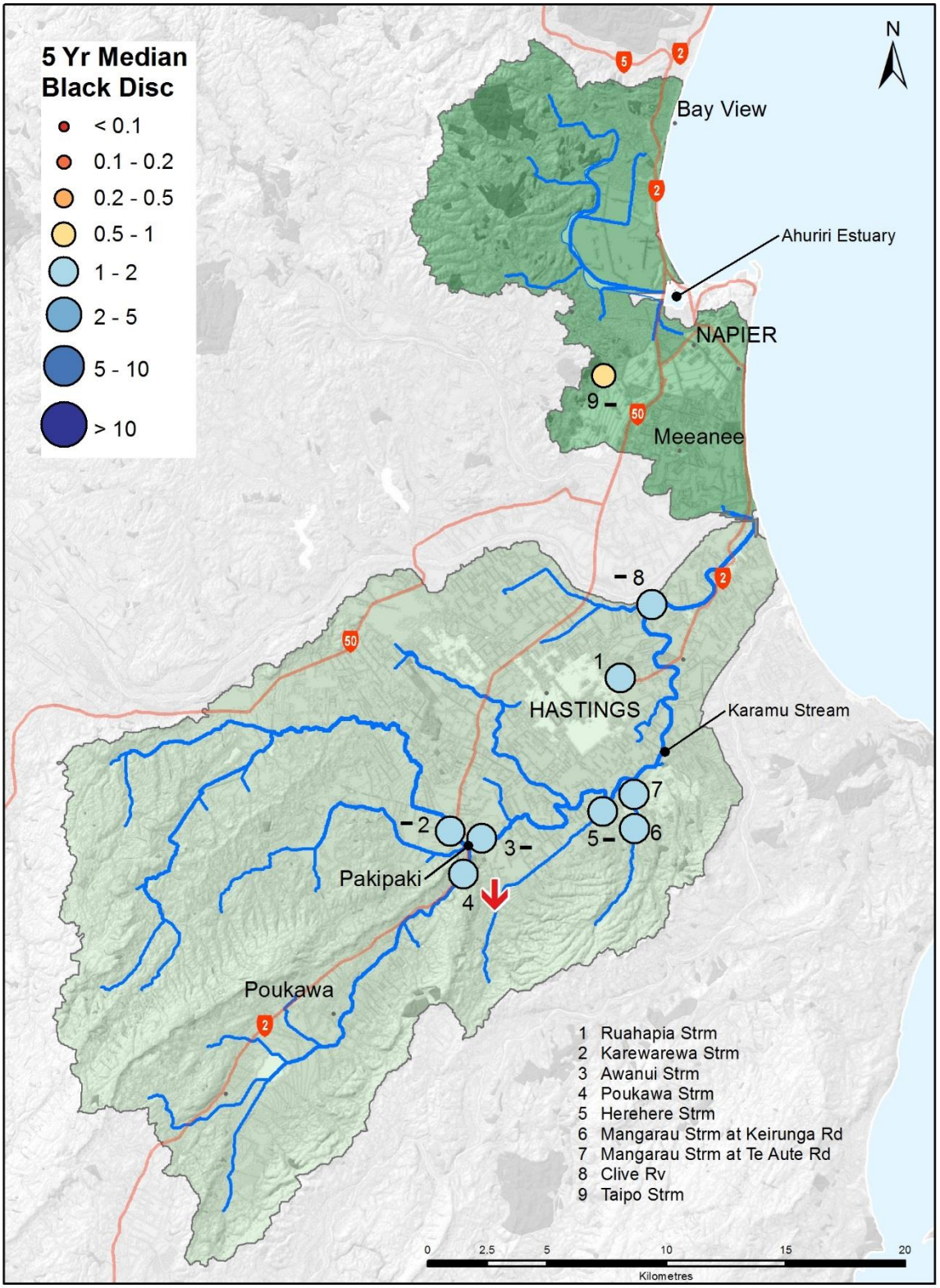


Figure 3-14: 5 year median black disc (BD) water clarity levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

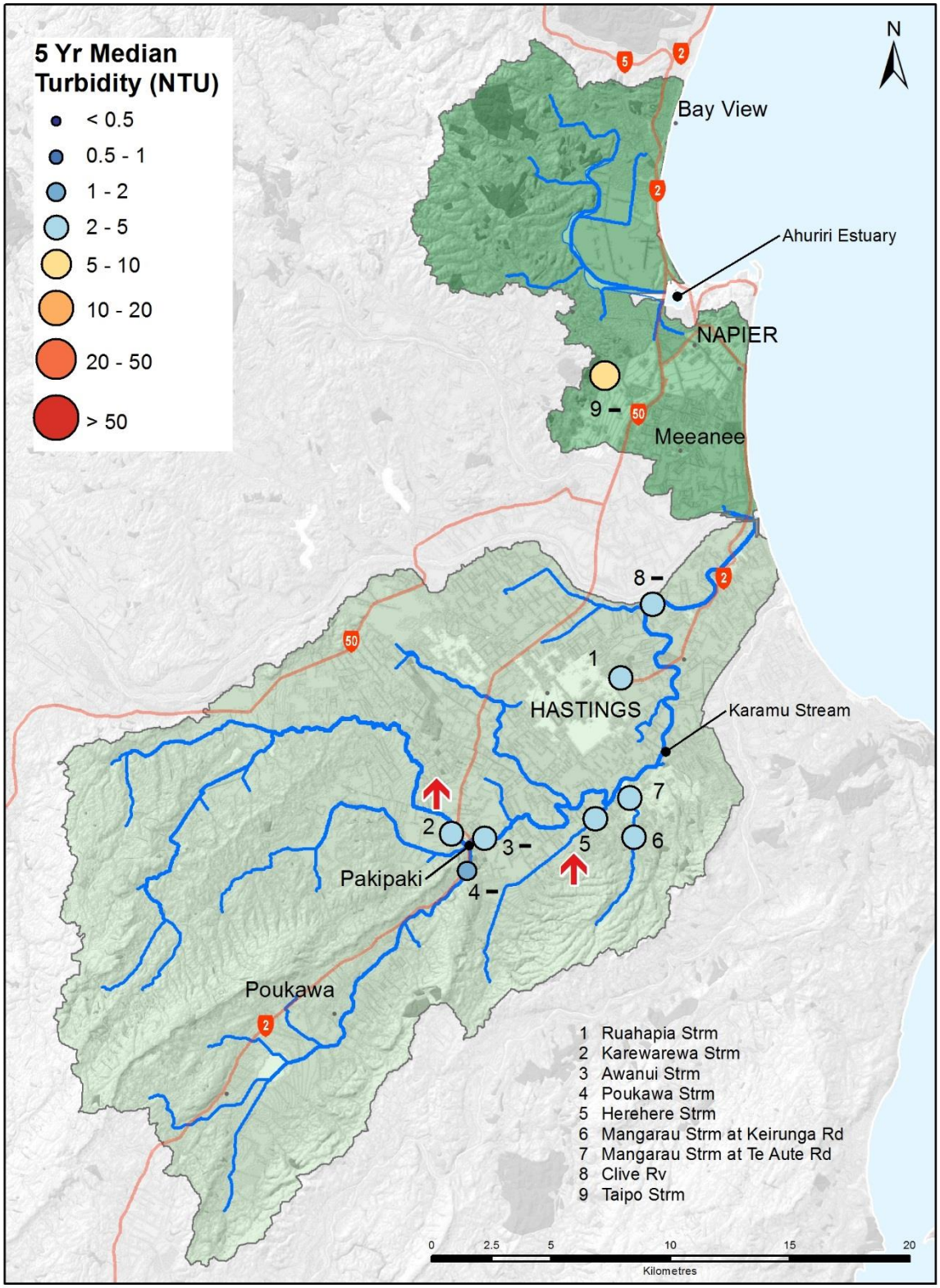


Figure 3-15: 5 year median turbidity levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

Table 3-4: Trend analysis for black disc clarity and turbidity in the Karamu Stream and Ahuriri Estuary (see Appendix E for full results)**.**

Site	Black disc			Turbidity		
	Median	P value	Per cent Annual Change	Median	P value	Per cent Annual Change
Karewarewa Strm	1	0.563	-2.56	3.4	**0.039**	**8.64**
Awanui Strm	1.3	0.896	-4.21	2.8	0.92	0.24
Poukawa Strm	1.9	**0.027**	**-8.87**	1.6	0.372	2.79
Herehere Strm	1.6	0.499	16.6	2	**0.018**	**14.55**
Clive Rv	1.5	0.099	-5.11	2.8	0.309	4.16
Taipo Strm	0.6	1	-2.74	5	0.374	7.38

3.4 Bacteriological water quality – *E. coli*

Escherichia coli (commonly abbreviated *E. coli*) levels have been routinely monitored in the Karamu and Ahuriri catchments as an indicator of microbiological water quality. *E. coli* is a bacterium commonly found in the lower intestine of warm-blooded animals and is an important indicator of the presence of pathogens of faecal origin in the water. *E. coli* is used to assess the level of health risk to water users having direct contact with water.

Median *E. coli* concentrations are generally below the MfE amber alert mode in the Poukawa Stream and the Clive River (Figure 3-16 and

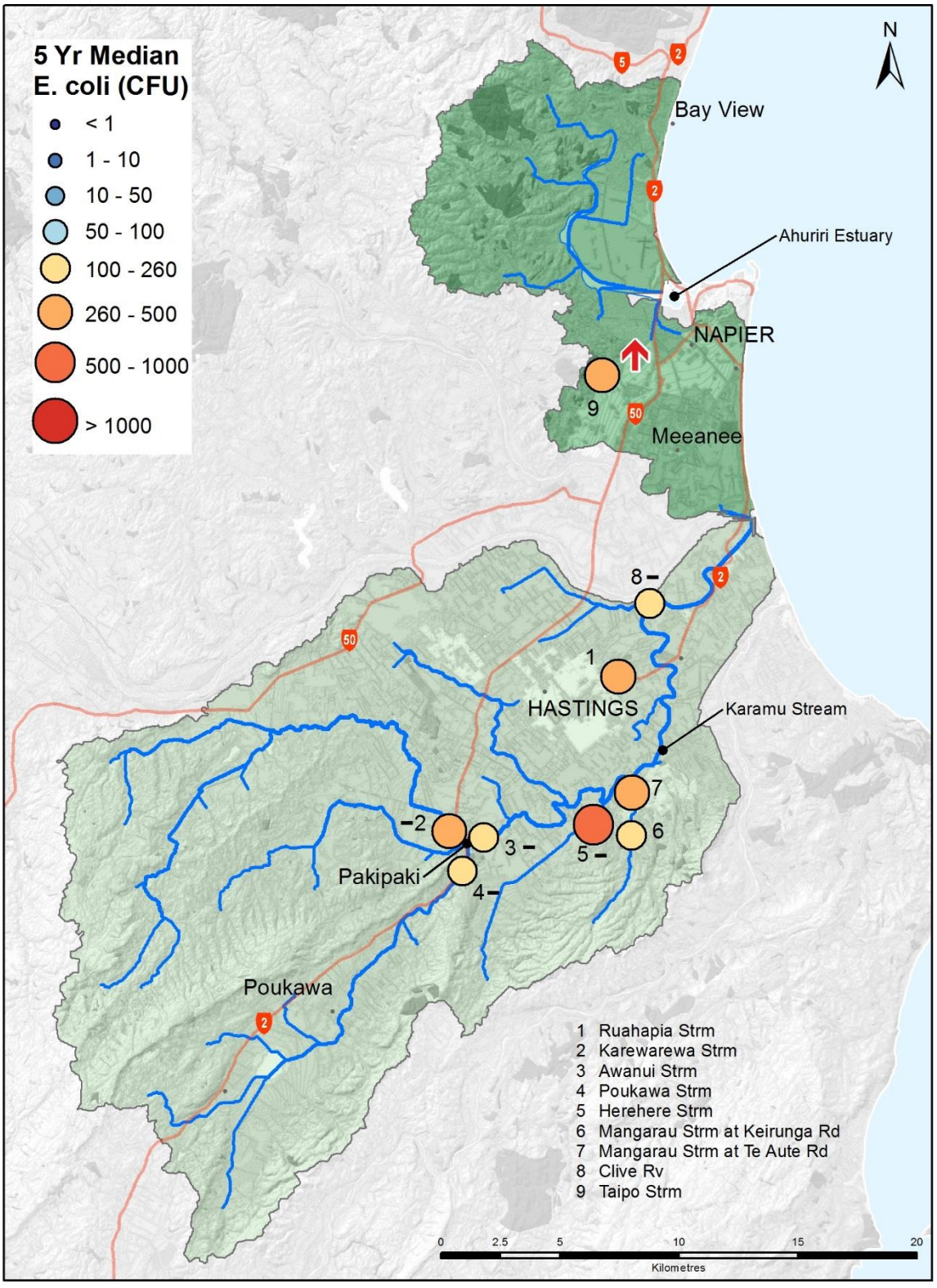


Figure 3-17). At all other sites the median concentration is at or above the alert threshold. In the Ruahapia, Karewrewa, Herehere and Taipo streams more than a quarter of samples are also in the MfE Action/Red

mode. This means these sites would have frequently been unsafe for contact recreation according to national guidelines.

Generally most sites in the Karamu and Ahuriri catchments show no significant increase in *E. coli* numbers, but there is a significant strongly increasing trend in *E. coli* concentrations in the Taipo Stream (Table 3-5).

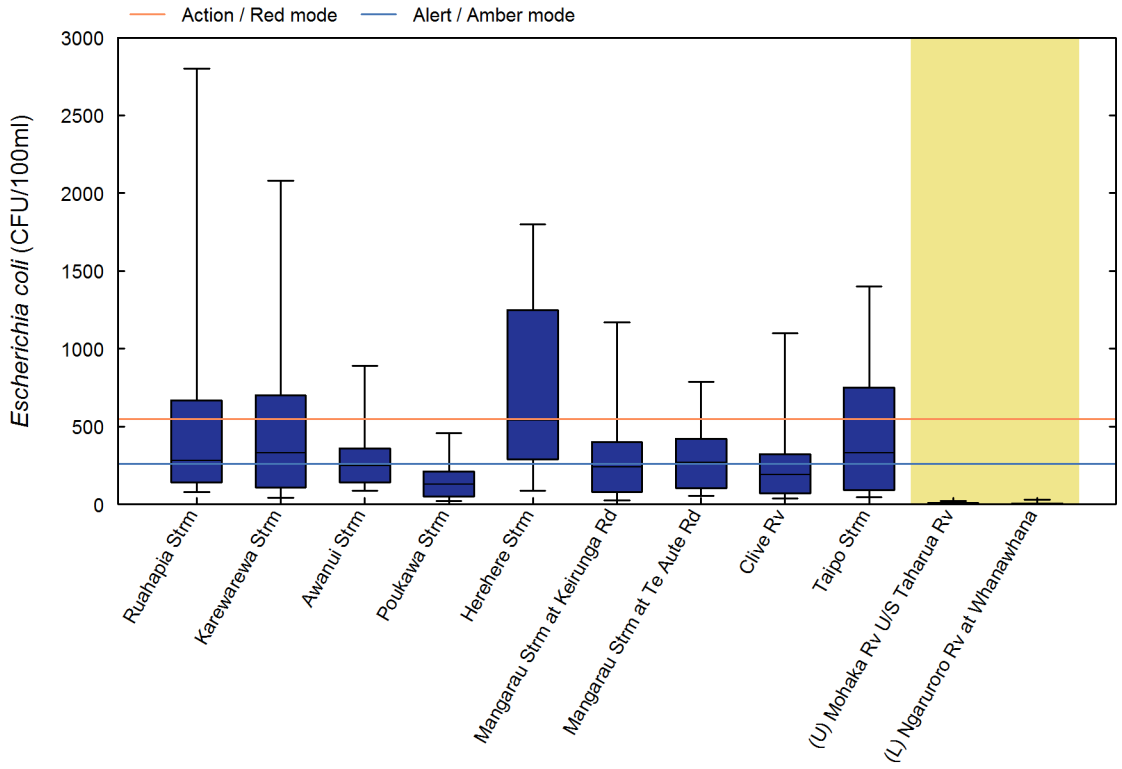


Figure 3-16: Bacteriological water quality levels measured as *E. coli* counts (Colony Forming Units / 100ml) at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line is the MfE and MoH (2003) amber alert level; the red line the MfE and MoH (2003) red alert level.

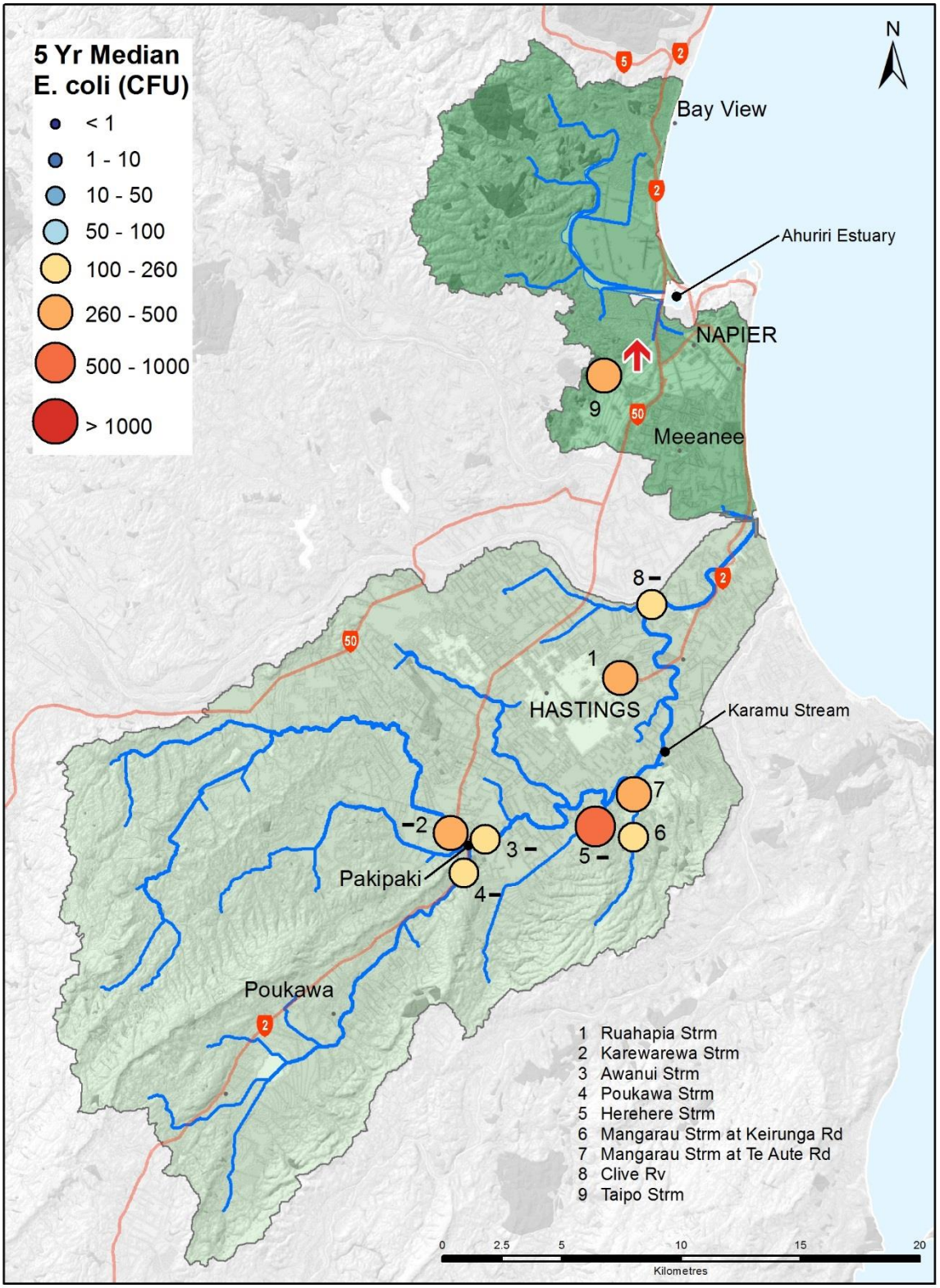


Figure 3-17: 5 year median *E. coli* levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites including trend direction. Arrows indicate direction of significant trends, with red arrows for deterioration of the variable in question, dashes indicate no trend. Sites without a sign did not cover the required 8 years of record between 2003 and 2013 for trend analysis.

Table 3-5: Trend analysis results for *E. coli* for SOE monitoring sites in the Karamu Stream and Ahuriri Estuary (full results in Appendix E)**.**

Site	*E. coli*		
	Median	P value	Per cent Annual Change
Karewarewa Strm	210	0.341	5.06
Awanui Strm	172	0.119	8.21
Poukawa Strm	90	0.516	4.45
Herehere Strm	450	0.207	15.68
Clive Rv	140	0.072	7.33
Taipo Strm	106	**0.007**	**45.19**

3.5 Dissolved oxygen

Oxygen dissolved in water is important for respiration of almost all aquatic organisms. Dissolved oxygen (DO) concentrations in water are controlled by several processes: The most important ones are listed below (Davies-Colley et al. 2013):

DO increases through:

(1) Re-aeration: transfer of atmospheric oxygen to water.
(2) Photosynthesis: plant and algae release oxygen during photosynthesis during daytime.

Dissolved oxygen decreases through:

(1) Respiration when plants and algae consume oxygen from the water.
(2) Biochemical oxygen demand (BOD) when microgranisms require oxygen as they consume organic matter in the water.
(3) Sediment oxygen demand (SOD) when microgranisms require oxygen as they consume organic matter in the sediments.

A more detailed introduction on the role of DO in the aquatic environment is presented in Chapter 2.5.

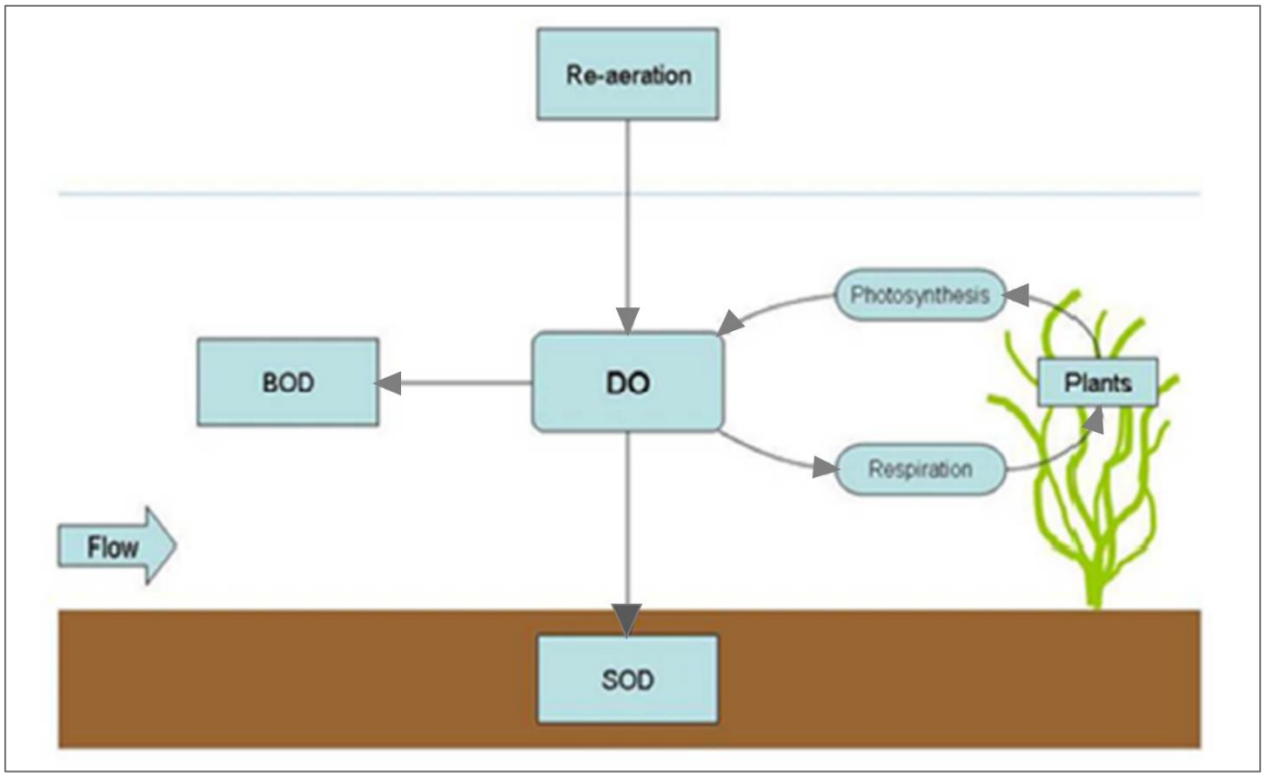


Figure 3-18: Schematic of the major processes influencing dissolved oxygen concentration in rivers. DO = dissolved oxygen; BOD = biochemical oxygen demand; SOD = sediment oxygen demand (Davies-Colley *et al.* 2013).

In unshaded streams with high nutrient inputs, excessive growth of plants and algae results in extremely high DO levels during the day, then extremely low DO levels during the night or early morning, when these plants and algae consume more oxygen than the waterway is capable of supplying. The low DO conditions mean there is little oxygen for fish and other organisms.

In the SOE programme DO was typically only been assessed as spot measurements on the sampling day (Figure 3-19 and Figure 3-20).

There are limitations in the value of spot measurements of DO, particularly if samples have consistently been taken at a sampling site later in the day when in-stream photosynthesis increases oxygen content in the water. Diurnal fluctuations in oxygen levels are caused by plant oxygen production during daylight hours through photosynthesis and respiration at night time: Oxygen concentration peaks in the afternoon with photosynthesis and minima occur in the early morning hours due to the oxygen consumption. Therefore, compliance with guidelines need to be assessed against continuous DO measurements to be able to detect critical oxygen minima.

Based on SOE spot measurements, DO saturation (Figure 3-20) is good and complies with the RMA guideline for protecting trout fisheries in the Mangarau and Herehere streams. Approximately half of the DO data measured in the Clive River are also above the guideline. All other streams in the Karamu and Ahuriri catchments fail to meet the 80% DO threshold.

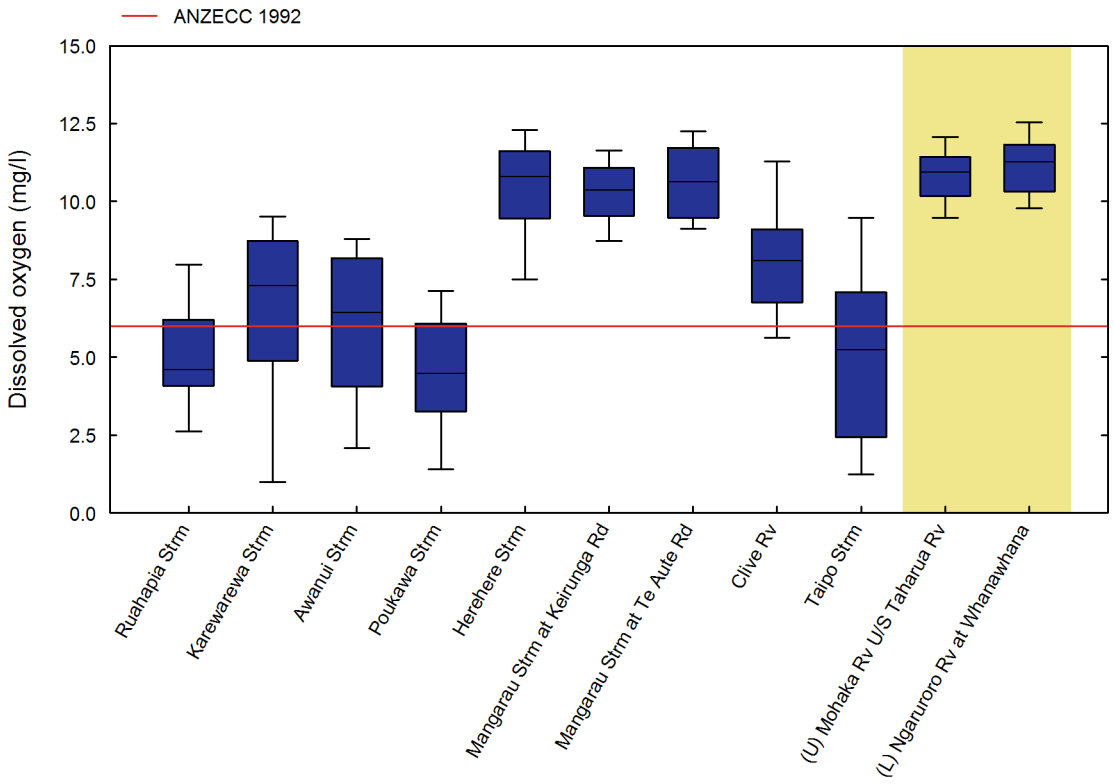


Figure 3-19: Dissolved oxygen concentration at Karamu and Ahuriri catchments SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The red line is the ANZECC (1992) guideline minimum DO concentration of 6 mg/L.

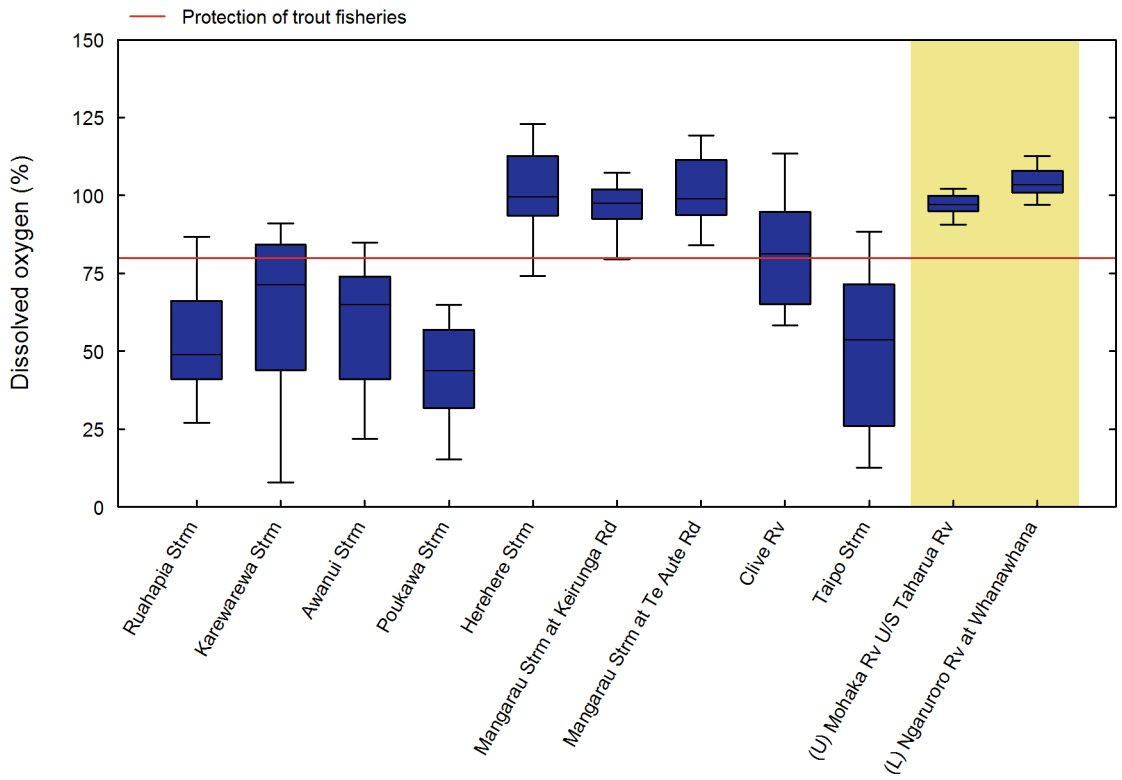


Figure 3-20: Dissolved oxygen saturation at Karamu and Ahuriri catchment monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The red line is the RMA (1991) Schedule 3 lower limit of 80% for supporting salmoniid (trout) fisheries

The spot measurements indicate the risk that potential low oxygen could have for impact on aquatic organisms. The Ruahapia, Karewarewa, Awanui, Poukawa, Herehere and Taipo streams were part of a study of 16 sites with continuous 24-hour oxygen measurements during a warm, dry summer period in February 2014 (Haidekker 2016). Minimum oxygen levels measured continuously during a 24-hour period can be considerably different to what is detected using spot measurements (Table 3-6): The Ruahapia and Awanui streams experienced complete oxygen depletion, and the Karewarewa, Poukawa and Taipo streams ranged between 8% and 14% DO. At night these streams reach critically low DO conditions that put aquatic organisms at risk. Only the Herehere Stream had always oxygen concentrations above 50%.

Table 3-6: Results from 24-hour continuous DO measurements during a warm summer period. at the Karamu and Ahuriri catchments SOE sites conducted as part of a special investigation in summer 2014 (Haidekker 2016): Maximum, minimum and average DO saturation (%).

Site	DO max (%)	DO min (%)	DO average (%)
Ruahapia Strm	0.2	-0.2	0.1
Karewarewa Strm	167	14	60
Awanui Strm	187	0	63
Poukawa Strm	105	11	48
Herehere Strm	112	51	74
Taipo Strm	191	8	86

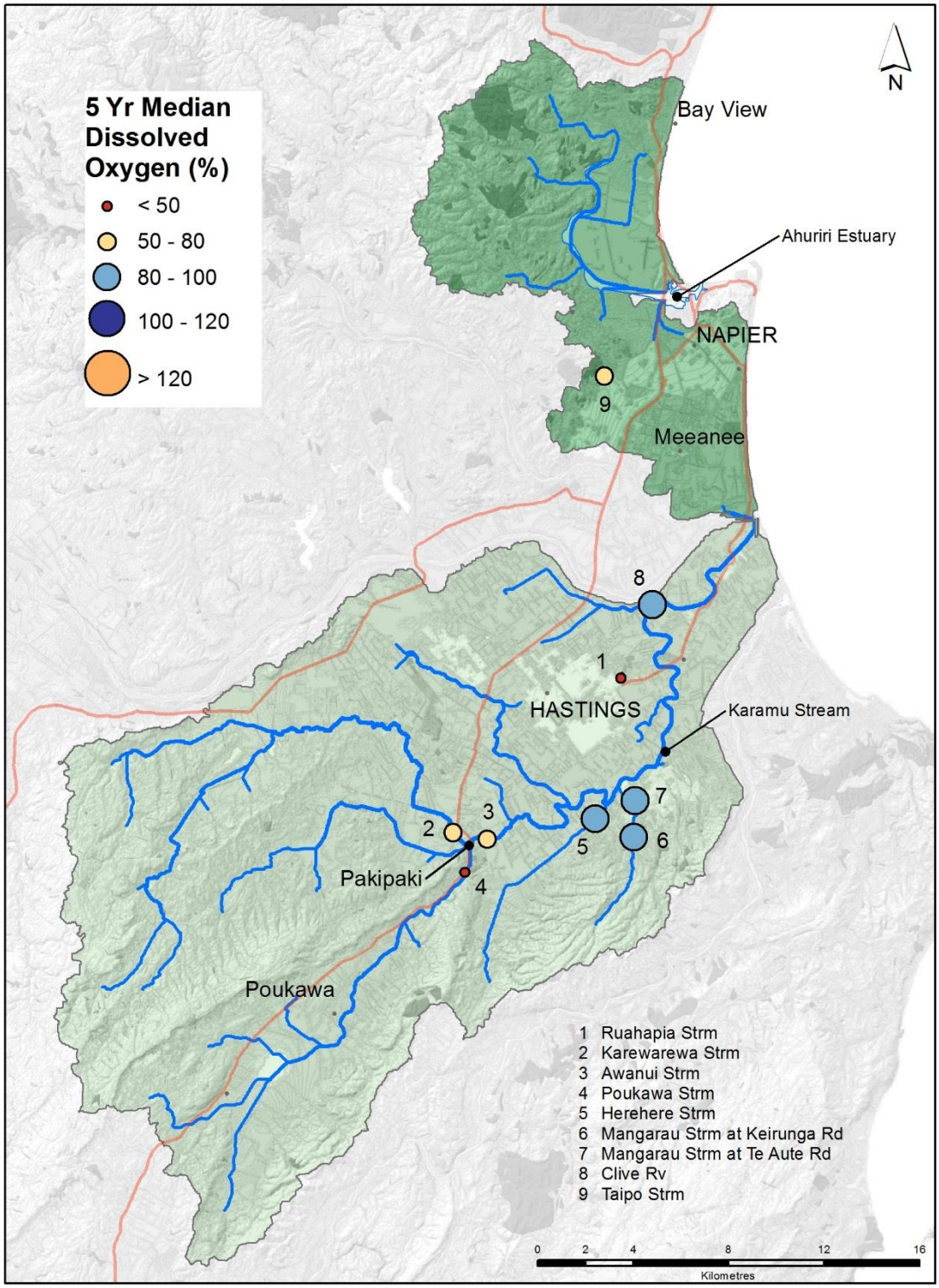


Figure 3-21: 5 year median dissolved oxygen saturation levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites.

3.6 Temperature

In January and February 2013 4 temperature loggers were deployed in the Karamu catchment for 2 months. Two were placed at long-term SOE sites at Mangarau at Te Aute Road and Poukawa Stream at Stock Road, and 2 at additional sites at Irongate Stream at Riverslea Road and Te Waikaha Stream at Mutiny Road (Figure 3-22).

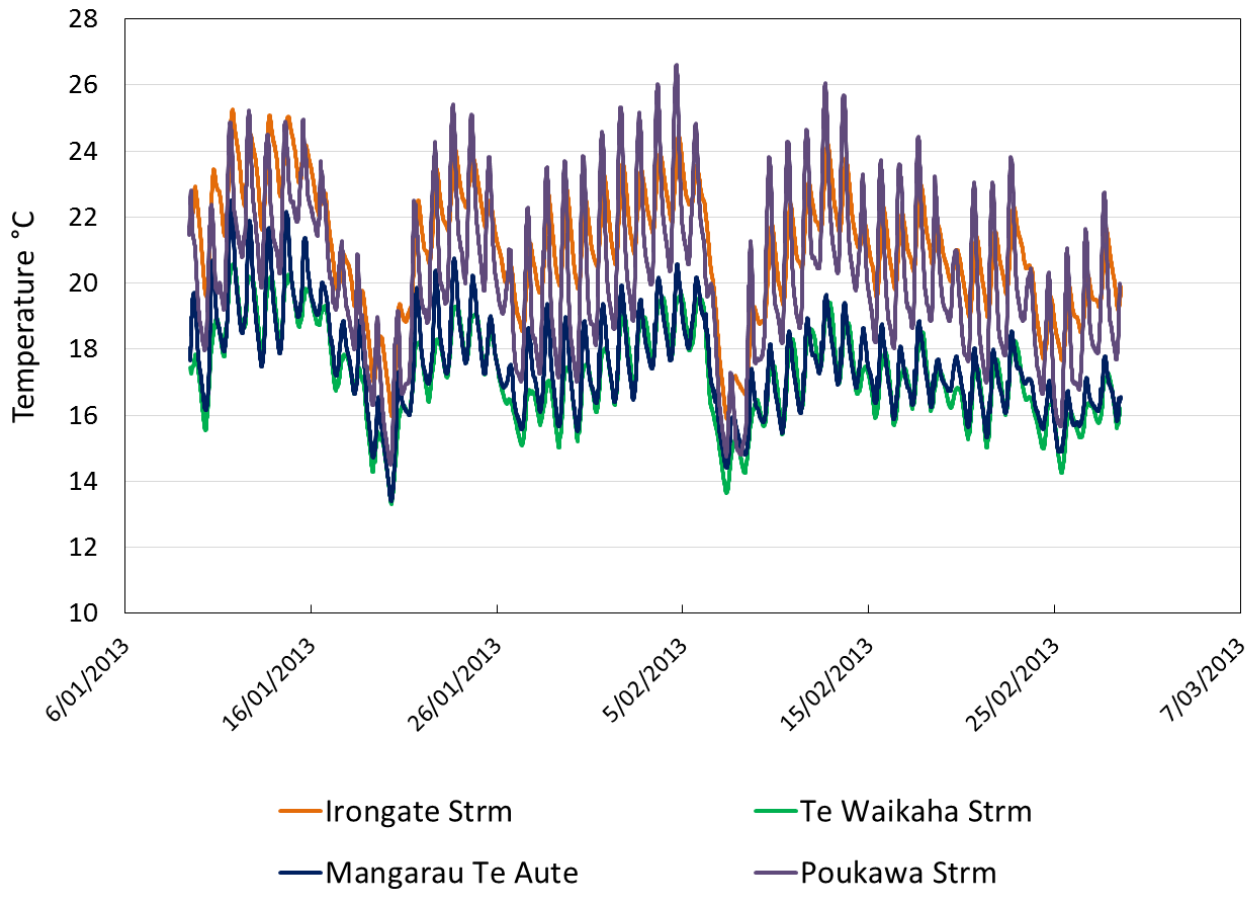


Figure 3-22: Water temperature at 4 sites in the Karamu catchment. Continuous measurements at SOE sites Mangarau Stream at Te Aute Road and Poukawa Stream at Stock Road with 2 additional sites Irongate River and Te Waikaha Stream at Mutiny Road.

On warm, sunny days during January and February water temperatures reached 25°C and 26°C in the Irongate Stream and Poukawa Stream, respectively. This is a critical temperature for aquatic organisms, producing substantial thermal stress on some aquatic organisms, and would probably cause loss of sensitive species. The maximum water temperature measured in the Mangarau Stream at Te Aute Road was 22°C, and 20°C in the Te Waikaha Stream. In both streams riparian vegetation provides shade for the stream channels, in contrast to the Irongate and the Poukawa streams, which are largely unshaded.

Temperature thresholds proposed for discussion for the National Objectives Framework on Temperature and Dissolved Oxygen (Davies-Colley et al. 2013) are based on the Cox-Rutherford Index (CRI, see Section 2.6), and suggest attributes and boundaries for temperature as shown in Table 3-7.

CRI calculated for the 5 consecutive hottest days in the monitoring period for the 4 sites in the Karamu catchment (Table 3-8) shows Te Waikaha and Mangarau streams have no thermal stress that could cause harm to aquatic organisms (proposed Band A).

Table 3-7: Proposed temperature thresholds for discussion for the National Objectives Framework. Applicable in rivers and streams in 'Eastern Dry' regions of New Zealand. Temperature thresholds in °C, calculated as summer measurements of the Cox-Rutherford Index, averaged over 5 hottest days from a continuous temperature record.

Attribute State	Numeric Attribute State Temperature (°C)	Narrative Attribute State
A	≤ 19	No thermal stress on any aquatic organisms present at matched (near-pristine) reference sites
B	>19 to ≤ 21	Minor thermal stress on occasion (clear days in summer) on particularly sensitive organisms such as certain insects and fish
C	>21 to ≤25	Some thermal stress on occasion, with elimination of certain sensitive insects and absence of certain sensitive fish
D	>25	[National Bottom Line] Significant thermal stress on a range of aquatic organisms. Risk of local elimination of keystone species with loss of ecological integrity.

The CRI of the Poukawa Stream at Stock indicates Band B (occasional minor stress on sensitive organisms), but the temperature is only just below the 21°C threshold to Band C, where the risk of elimination of sensitive species increases. The CRI of the Irongate Stream falls into the proposed Band C, indicating that water temperature is likely to pose occasional thermal stress on aquatic organisms, with the elimination of certain sensitive insects and absence of certain fish (Table 3-7).

The reasonable shade over Te Waikaha and Mangarau streams is likely to cause the lower maximum water temperatures and the lower CRI, compared to the Poukawa and Irongate streams.

Table 3-8: Cox-Rutherford Index (CRI) at 4 sites in the Karamu catchment. as temperature in °C, calculated for the 5 hottest consecutive days over the monitoring period in January/February 2013. Classification into attribute Bands as proposed for the NOF in (Davies-Colley et al. 2013).

Site	Max (°C)	Average (°C)	Min (°C)	CRI (°C)	Proposed band
Irongate Strm at Riverslea Rd	24.5	23.4	24.0	22.2	C
Te Waikaha Strm at Mutiny Rd	20.0	19.3	19.7	18.3	A
Mangarau Strm at Te Aute Rd	21.4	19.7	20.5	18.3	A
Poukawa Strm at Stock Rd	24.6	22.3	23.5	20.6	B

3.7 Biological indicators

3.7.1 Periphyton and Macrophyte biomass and cover

Algae are an important natural component of the aquatic environment, but can become problematic for ecosystem health and recreational values when excessive growth occurs. Periphyton are algae that attach to objects underwater such as streambed gravel, rocks, logs, branches or any other stable material. The role of algae in streams and rivers and the definition of periphyton is explained in greater detail in Chapter 2.7.1.

Apart from algae, aquatic plants (also called macrophytes) are another group of primary producers that grow in streams and rivers. These are true 'vascular' plants and are comparable to their terrestrial relatives, in contrast to algae, which lack true roots, stems and leaves. Macrophytes typically grow in low gradient, slow flowing, fine bed substrate streams and rivers. Under natural conditions they are important habitat for macroinvertebrates and fish in soft sediment streams, where stable habitat is scarce.

As with algae, macrophytes can grow to nuisance levels in summer, when growth rates peak. Macrophytes in high abundance can detrimentally affect ecological health by (a) affecting in-stream DO levels through photosynthetic processes, (b) by reducing flow conveyance, and (c) by detrimentally affecting aesthetic and recreational values. In addition, consumption of inorganic carbon during photosynthesis results in changes to the equilibrium balance of carbonate/bicarbonate/carbonic ions and can lead to marked diurnal fluctuations in pH.

Streams in the Karamu catchment originate from lowland country in a warm dry climate, according to the New Zealand River Environment Classification REC (Snelder et al. 2010). Most streams in the catchment have very low gradients and flow slowly, on fine gravel or sandy/silty streambed. This provides ideal growing conditions for aquatic plants. By contrast, algae - more commonly found in streams with faster flowing water and stable, stony substrates - are mostly found in the Tutaekuri and Ngaruroro catchments.

Periphyton was only sampled at sites in the Karamu catchment that have a significant proportion of hard streambed substrate - the Herehere Stream and 2 sites in the Mangarau Stream. The proportional cover of periphyton and macrophytes at these sites varies greatly from year to year and so only a few periphyton samples were taken over the monitoring period of this report. The Herehere was sampled for periphyton biomass once, Mangarau at Keirunga Road 3 times, and Mangarau at Te Aute Road twice (Figure 3-23). Very low levels of periphyton growth were found in the Herehere Stream in 2011. At least 3 values are needed to produce a boxplot, which is why the Herehere Stream and Mangarau Stream at Te Aute Rd plots look unusual in Figure 3-23.

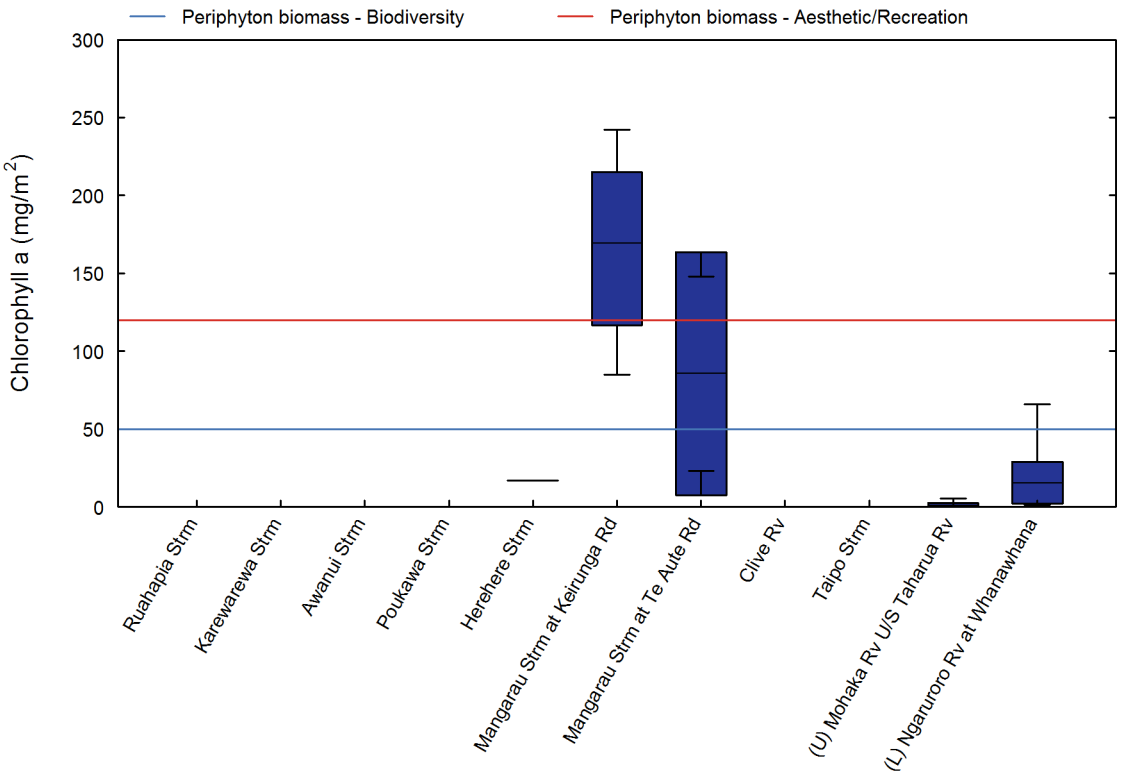
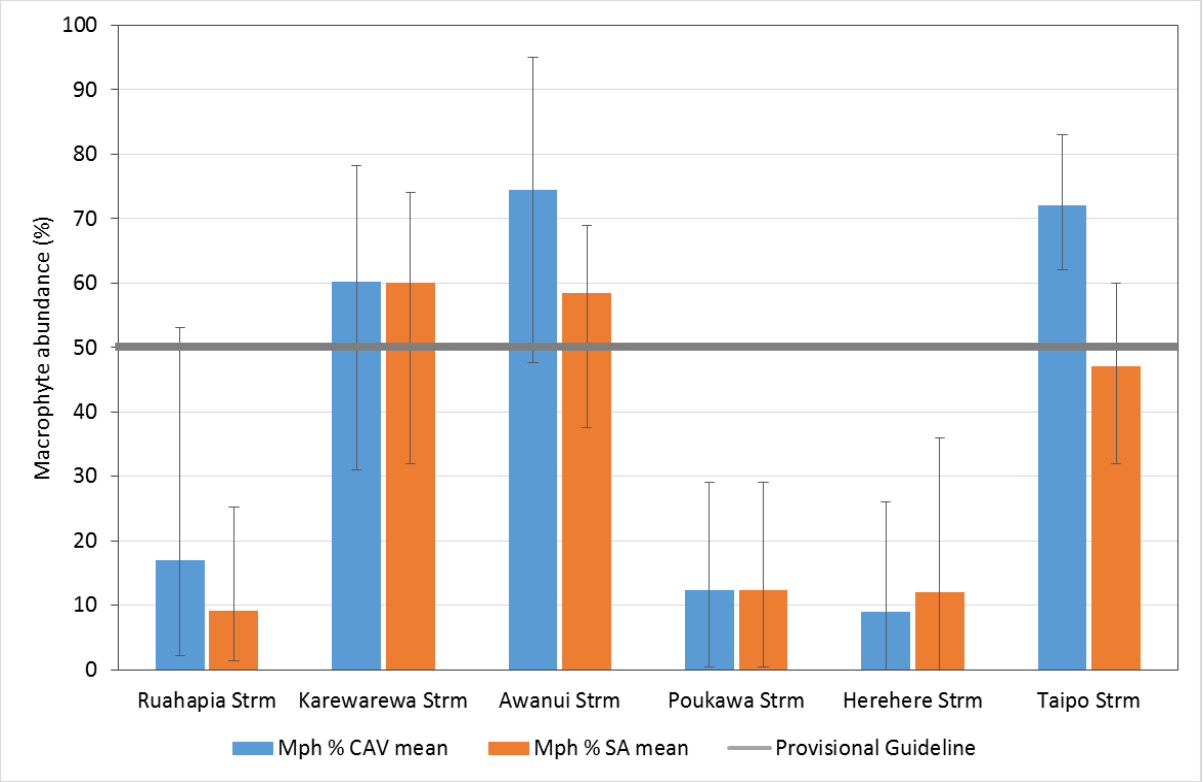


Figure 3-23: Periphyton biomass levels measured at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The blue line (at 50 mg/L) is the Biggs (2000) 'Biodiversity' protection limit; the red line (at 120 mg/L) the 'Recreational amenity' limit for filamentous algae.

Periphyton biomass in the Mangarau Stream was higher at the upstream site (at Keirunga Road) than at the downstream site (at Te Aute Road). Two of the 3 samples at Mangarau at Keirunga Road exceeded the chlorophyll-*a* aesthetic/recreation guideline of 120 mg/m^2. One sample exceeded the guideline further downstream in the Mangarau at Te Aute Road.

Macrophyte abundance in steams was not monitored routinely for SOE reporting during this period, in part because no suitable monitoring protocol was available. Monitoring started in 2013 and was also used for a targeted study 2014 (Chapter 3.8). Figure 3-24 shows macrophyte abundance measured as cross-sectional area/volume (CAV) and surface area (SA) at 6 SOE sampling sites in the Karamu and Ahuriri catchments in February 2014.



Provisional guidelines are suggested as ≤ 50% cover for the cross-sectional area/volume (CAV) with the purpose of protecting ecological conditions, flow conveyance and recreation, and ≤ 50% surface area (SA) for aesthetics and recreation (Matheson et al. 2012). Matheson et al. (2012) stress that only sparse information exists on the relationship between in-stream macrophyte abundance and detrimental impacts on key in-stream values, and further research is needed.

Figure 3-24: Macrophyte abundance assessed at SOE sites in the Karamu and Ahuriri catchments in January 2014. Mph % CAV mean is the proportional volume occupied by macrophytes in a stream cross section, averaged over 5 transects. Mph % SA mean is the proportional stream surface area covered by macrophytes, averaged over 5 transects. Grey line is the provisional guideline as proposed in Matheson et al. (2012).

Macrophyte abundance was highest in the Karewarewa, Awanui and Taipo streams, and these sites exceeded the proposed guideline for CAV of 50% to protect ecological conditions, flow conveyance and recreation. The guideline of 50% SA for recreation and aesthetical values was exceeded in the Karewarewa and Awanui streams.

3.7.2 Macroinvertebrate Community Index

Macroinvertebrate communities are commonly used as an indicator of water quality and ecosystem health. The macroinvertebrate community of a stream adjusts to conditions in the aquatic environment, including natural conditions and natural and artificial stressors affecting ecosystem health. The Macroinvertebrate Community Index (MCI) was developed by Stark (1985) as a biomonitoring tool to assess stream health in New Zealand, based on the presence or absence of sensitive and tolerant invertebrate taxa. The MCI is derived by scoring individual taxa observed at a site based on their 'tolerance value' which is a taxon's sensitivity or tolerance to pollution, with higher scores for more sensitive taxa and lower scores for taxa tolerant to pollution.

The macroinvertebrate community found in naturally soft-bottomed streams dominated by fine sediments, woody debris and macrophytes (due to a low stream or catchment gradient) is different to that found in hard bottomed streams, even under pristine conditions. As a result, MCI data collected from soft bottomed streams may overstate the degree of degradation compared with hard bottomed streams (Stark and Maxted 2007). Stark and Maxted (2007) calculated specific taxa scores for a separate index for soft-bottomed streams (MCI-sb), accounting for the natural conditions in these streams. The final scores indicate the same water quality classes as the MCI, but tolerance scores for taxa from which it was derived are different. A more detailed introduction to the MCI is available in Section 2.7.2.

The quality classes indicated by the MCI score are included in Table 3-9.

Table 3-9: MCI and MCI-sb quality classes as defined by Stark and Maxted (2007).

≥120	Excellent quality, clean water
100-119	Good quality, possible mild pollution
80 – 99	Fair quality, probable moderate pollution
< 80	Poor quality, probable severe pollution

MCI scores for the Karamu and Ahuriri catchments SOE monitoring sites show in-stream macroinvertebrate communities were in poor condition throughout the SOE sites (Figure 3-25 and

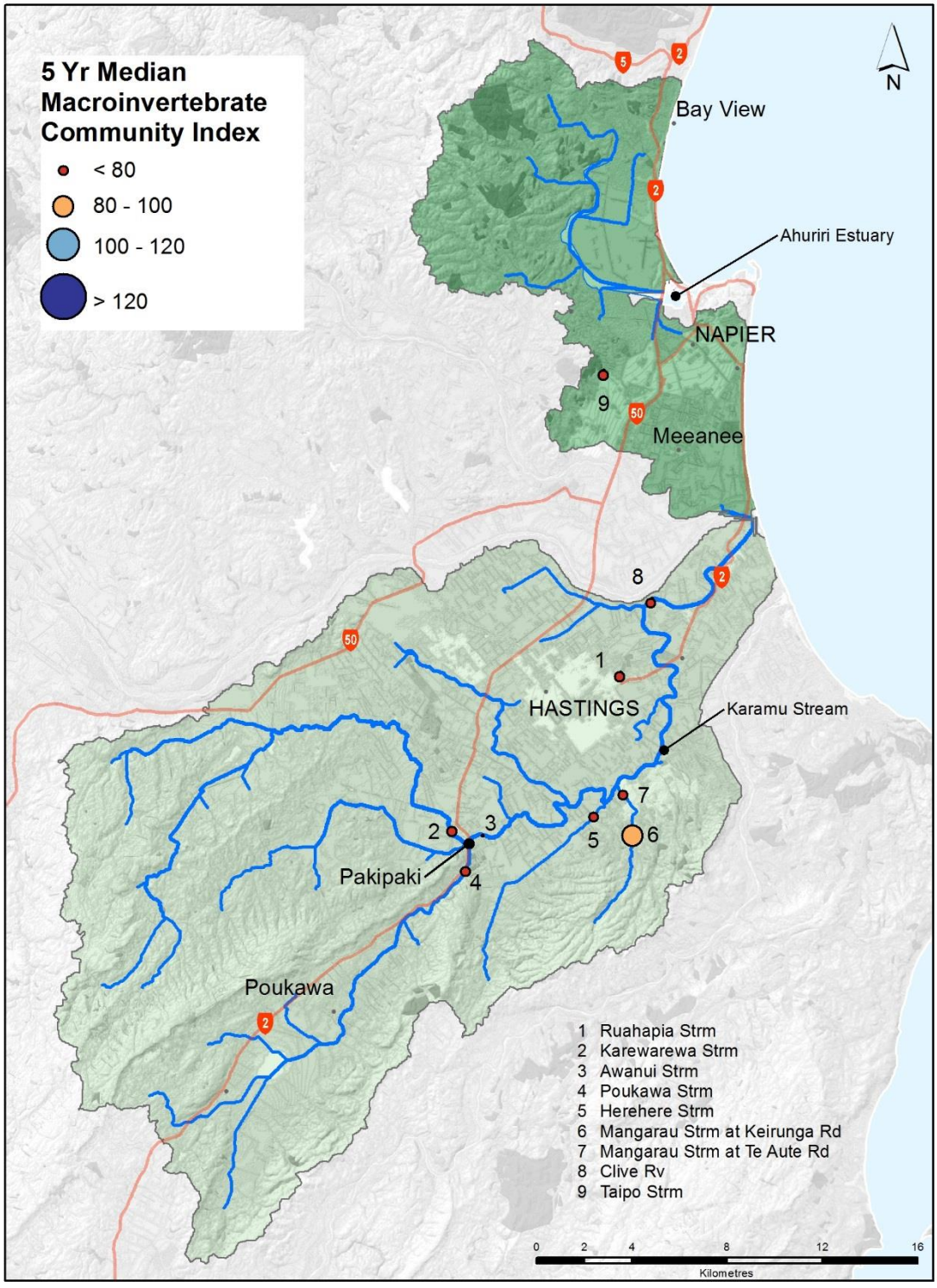


Figure 3-26). All sites except 1 had poor water quality, with probable severe pollution. Only the Mangarau Stream at Keirunga Road had a median MCI of greater than 80, and was therefore in the fair quality class.

SOE monitoring sites across Hawke's Bay had MCI scores in all 4 environmental quality classes. The regional average MCI score was 104, with a regional maximum of 150. In the Karamu catchment most data collected had MCI scores lower than 80 – which means they were very low compared to regional sites, and would be described as being of 'poor quality with probable severe pollution' (Stark and Maxted 2007).

While usually 20 to 30 different taxa of varying pollution sensitivities are found at SOE monitoring sites, some Karamu catchment sites had less than 10 very pollution-tolerant taxa. This indicates that stream health was severely compromised, with low life-supporting capacity, because all pollution sensitive taxa had been lost from these sites.

EPT taxa (***E**phemeroptera* - mayflies, ***P**lecoptera* - stoneflies, and ***T**richoptera* - caddisflies) are mostly pollution sensitive taxa that indicate good water quality when present in higher proportions in a macroinvertebrate community. The proportion of EPT taxa in the macroinvertebrate community at SOE sites are in Appendix B in the column '%EPT taxa'. For example, the macroinvertebrate community in the Ngaruroro River at Whanawhana (lowland reference site) consisted 54% EPT taxa. The Mangarau Stream at Keirunga Road had 29%, and further downstream at Te Aute Road there were 21% EPT taxa in the community. In the Karewarewa, Awanui, Poukawa and Taipo streams the EPT comprised less than 10% of the taxa present, and there were no EPT taxa in the Ruahapia Stream.

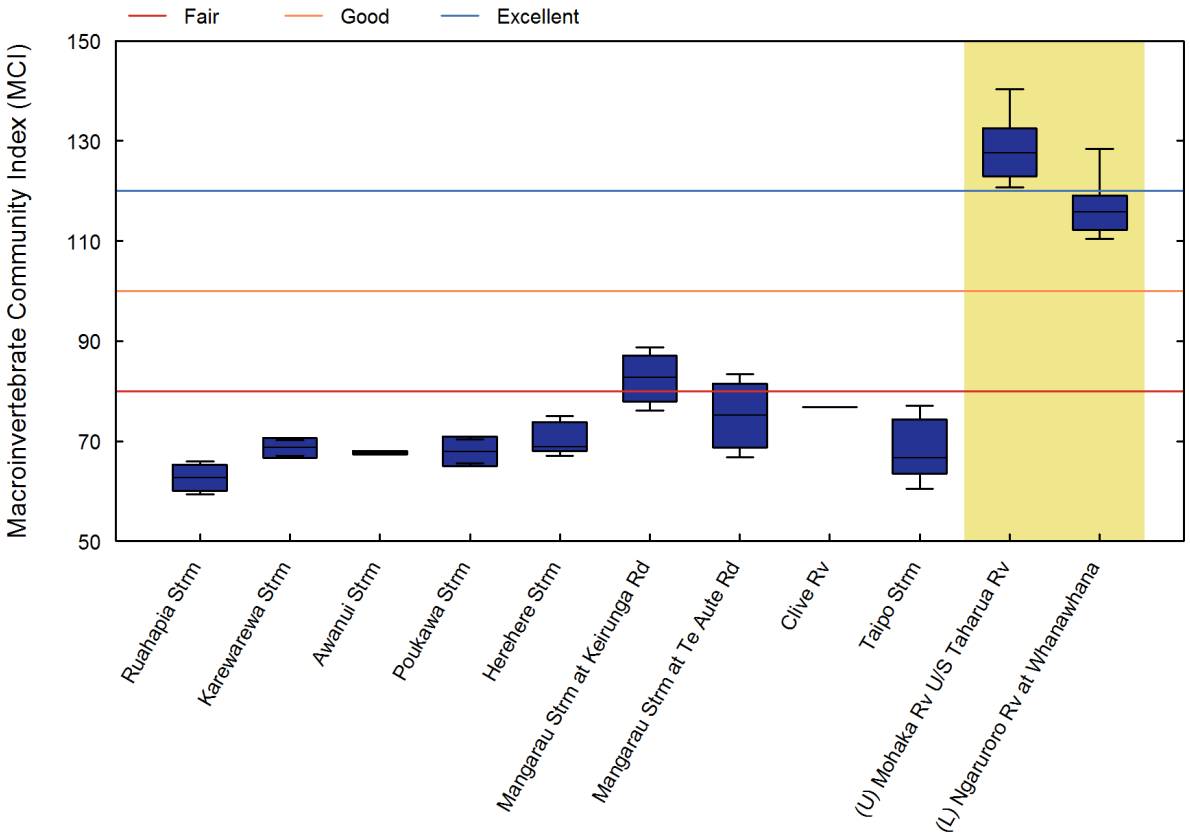


Figure 3-25: MCI levels measured at Karamu Stream and Ahuriri Estuary SOE monitoring sites. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison. The lines are boundaries between MCI quality classes as defined by Stark and Maxted (2007): Blue line: boundary between classes excellent and good, orange line: boundary between classes good and fair, red line: boundary between classes fair and poor.

A targeted investigation in the summer of 2013/14 provided detailed information on the multiple stressors that influence MCI in this system. The study (Haidekker 2016) aims included being able to identify 1 or several key factors that limited life supporting capacity, as the first step in identifying ways to improve stream ecological health (Chapter 3.8).

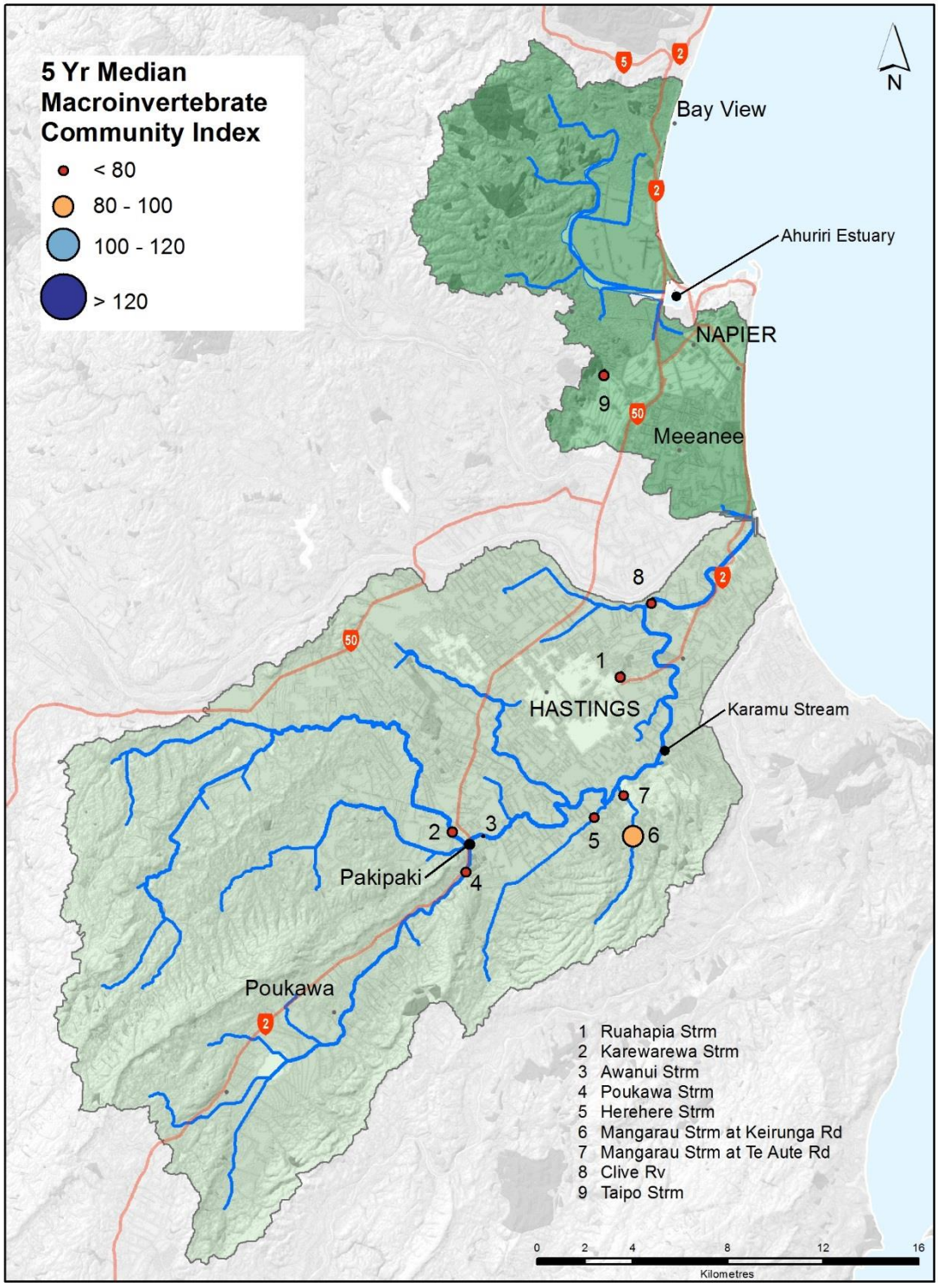


Figure 3-26: 5 year median Macroinvertebrate Community Index (MCI) levels at Karamu Stream and Ahuriri Estuary SOE monitoring sites.

3.8 Karamu targeted study – life-supporting capacity

MCI scores in the Karamu and Ahuriri catchments were amongst the lowest in Hawke's Bay, indicating the life-supporting capacity in these streams is compromised. In the summer of 2013/14, an investigation was carried out to identify what particular factors are most detrimental to the ecological health of these streams.

Sixteen lowland stream sites with a range of environmental conditions were chosen for this study. Most were situated in the Karamu and Ahuriri catchments, and additional sites were chosen for comparison in the Tukituki and Ngaruroro catchments. Macroinvertebrates were sampled, along with water quality parameters, and stream habitat and macrophytes were assessed. DO and water temperature were recorded continuously at the sites for several days.

At many sites macrophytes blocked more than half of the stream channel volume, and habitat quality was degraded. Temperature in some streams increased above 27°C and DO was extremely low for several hours each day. In these situations, ecosystem respiration (by plants, animals and microorganisms) consumes more oxygen in the stream than is produced by photosynthesis or derived from the atmosphere, leading to very low DO during the day.

Maximum water temperature, minimum DO concentration and habitat quality were most strongly correlated to changes in macroinvertebrate community composition. The abundance of mayflies and caddisflies - and MCI scores - were lowest at sites with high maximum temperature and low daily oxygen minima. These appeared to be the major factors compromising life-supporting capacity in the study streams (Haidekker 2016).

3.9 Stormwater

The ability of the Karamu Stream and the Ahuriri Estuary to buffer stormwater discharges from the wider catchment and prevent flooding and associated social and economic costs, is one of the values associated with these important TANK catchments.

Stormwater consists of excess rainwater that does not infiltrate the ground. During the transition from pervious forested catchments to more impervious urbanised areas, stormwater has less opportunity for infiltration, and consequently higher overland flows result due to increased runoff (Figure 3-27).

Unless treated, stormwater runoff carries associated contaminants into the ultimate receiving environments. Such contaminants can include trace metals, hydrocarbons, bacteria, sediments, organics, nutrients and gross litter which are entrained as the stormwater is diverted from roads, footpaths and property into roadside drains and underground networks. As urbanisation increases, the speed with which stormwater reaches the receiving environment increases, and subsequently the quality of stormwater decreases due to the lack of ability for contaminants to settle out.

High suspended sediment loading from erosion can occur during the early stages of urbanisation, followed by contaminants associated with developed urban catchments that can include high levels of zinc (roofing), copper (plumbing fixtures, garden sprays), lead and Polycyclic Aromatic Hydrocarbons (PAHs – combustion from vehicles and industry). These contaminants are typically the priority contaminants in urbans areas (USEPA 1999, Kelly 2010). Industrial areas can also contribute metals and hydrocarbons from specific industry practise (e.g. chromium from tanneries, zinc from galvanisers, manganese from electro-plating).

Of the 4 TANK catchments, only Ahuriri and Karamu catchments have relatively high proportions of urban/industrial land-use that contribute to increased stormwater loading. In Ahuriri approximately 17% of the catchment is urbanised, with a large portion of the Napier City area diverting stormwater into the Ahuriri Estuary at the Westshore tide gates. In the Karamu catchment, the city of Hastings discharges most of its stormwater into tributaries of the Karamu Stream such as the Ruahapia, Irongate, and Raupare Streams.

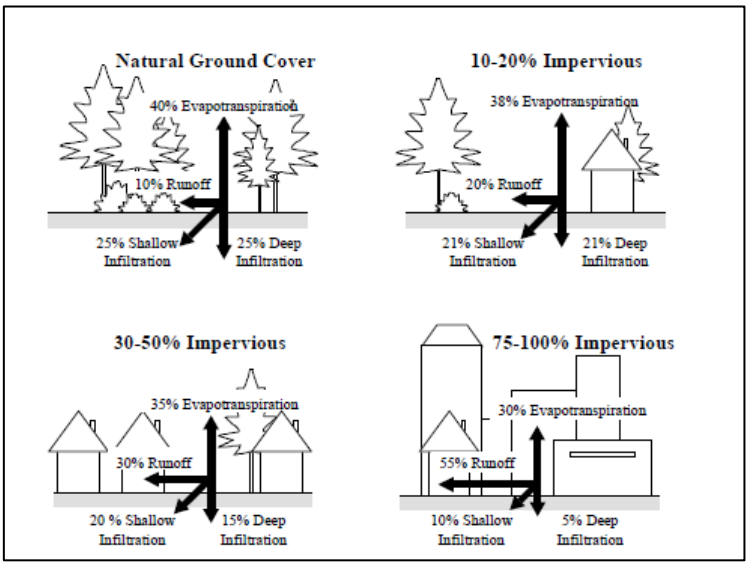


Figure 3-27: Effects of imperviousness on runoff and infiltration. From USEPA, 1999.

While the conveyance of stormwater away from properties is vital in built-up areas, the discharge of stormwater runoff into waterways can compromise other values associated with these water bodies. The type of contaminants present in stormwater depends largely on land-use activities in the surrounding catchment, while the scale of contamination will depend on factors including imperviousness and stormwater infrastructure management (e.g. sump cleaning, on-site treatments and yard maintenance). The capacity of the receiving environment to assimilate contaminants, and therefore limit any adverse effects on other values, will be closely associated with the physical characteristics of the receiving environment. A well-flushed, receiving environment that moves water and sediments quickly through to the coast, with limited additional discharges of similar quality will facilitate the dilution and dispersion of contaminants (Green 2008). By contrast, low-energy, depositional receiving environments with multiple stresses tend to have limited assimilative capacity.

The urban streams of the Karamu catchment - and the estuarine environment associated with stormwater in the Ahuriri catchment - tend to be highly sensitive to the effects of stormwater-derived contaminants. They are often the immediate receiving environments for stormwater, with limited attenuation potential prior to the discharge point. They can also have multiple discharge points into the streams and so are sensitive to the cumulative effects of the catchment load.

Common sources of stormwater derived contaminants are described below (Table 3-10).

Table 3-10: Sources of stormwater derived contaminants that may affect values associated with the Karamu and Ahuriri receiving environments.

Contaminant	Value affected	Source
Trace Metals	Ecological integrity, food gathering	Roofing, plumbing, industry, garden sprays, vehicles, atmospheric deposition.
Bacteria	Contact recreation, food gathering	Wastewater infiltration, animal wastes.
Polycyclic Aromatic Hydrocarbons	Ecological integrity, recreation, amenity	Organic compounds produced by incomplete combustion or pressure (e.g. industrial, vehicles, fuels etc.).
Nutrients	Ecological integrity, recreation, amenity	E.g. Nitrogen, phosphorus from fertilisers, detergents, plant debris.
Suspended Sediments	Ecological integrity, recreation, amenity	Erosion
Gross pollutants (litter)	Ecological integrity, recreation, amenity	Litter

3.9.1 The Ahuriri Catchment

Although it is one of the smallest catchment areas in Hawke's Bay, the Ahuriri catchment has a history and significance to the region that belies its size. Although the Ahuriri Estuary is a key feature of the catchment, the land-uses in its hinterland are dominated by high producing exotic grassland, which accounts for over half of the catchment. Combined with the urban centre of Napier City, this grassland, the short-rotational cropland, and exotic forest account for over 80% of the land-use (Table 3-11).

Table 3-11: Top four land-uses in the Ahuriri catchment (Source: LCDB4.)

Land-use	% Catchment	Cumulative % Catchment
High Producing Exotic Grassland	50.3	
Built-up Area	16.6	67.0
Short-rotation Cropland	9.5	76.5
Exotic Forest	6.4	82. 9

The receiving environment

The Ahuriri Estuary (Te Whanganui-a-Orotu) represents one of the few marine dominated estuaries in Hawke's Bay. Formed in the wake of the 1931 earthquake, the Ahuriri Estuary is the remains of the former Ahuriri Lagoon. The earthquake uplifted the area by between 1 m and 2 m, exposing approximately 1300 hectares (Chague-Goff et al. 2000). Subsequent drainage and reclamation has reduced the area to its

current size of approximately 470 hectares of true estuary, and around 175 hectares of associated wetlands (Cromarty et al. 1995).

Figure 3-28: Ahuriri Lagoon prior to the 1931 earthquake. Source: Hawke's Bay Museum.

Despite extensive modification, reclamation, drainage and receipt of discharges, the estuary continues to be recognised as an area of regional and national significance, with high wildlife and fisheries values. The estuary is an important feeding area for 20 species of trans-equatorial migrants (waders and terns), 6 Australian species (herons, ibises and duck), and a number of native species including white heron and royal spoonbill (Knox 1979). The estuary also makes a significant contribution to Hawke's Bay marine fisheries with approximately 29 species of fish using the estuary at some stage of their life cycle. Some species (e.g. kahawai, grey mullet, yellow-bellied flounder, stargazer and parore) use the area for feeding, and around 11 species also use the area as a nursery or spawning ground. These include commercially important species such as yellow-bellied flounder, grey mullet, sand flounder, common sole, and yellow-eyed mullet.

Ahuriri Estuary is listed as a Significant Conservation Area under the Regional Coastal Environment Plan (HBRC 2012), and a Wildlife Refuge affords protection to the areas between the Southern Marsh, Westshore Lagoon and the estuary from the low level bridge to Pandora Pond.

Shellfish beds containing cockle (*Austrovenus stutchburyi*) within the estuary are commonly used by the community.

In addition to ecological and food gathering values, the Pandora Pond (or Humber Street Pond) within the Ahuriri Estuary provides recreational opportunities, including swimming, kayaking, sailing, and waka ama. This is perhaps one of the highest profile uses of the estuary, along with birdwatching, and its accessibility makes recreation a dominant use and value for the estuary.

Stormwater from the Ahuriri catchment is also discharged into the Pacific Ocean via the Cross County Drain, Napier Sailing Club and Port of Napier stormwater discharges. Napier City Council also operate a discharge into the Iron Pot in the Inner Harbour. As these are discharges to the coastal marine area, they will not be discussed further in this report.

Current consented stormwater discharges

Much of the stormwater derived from the Ahuriri catchment, both rural and urban, is diverted into the Ahuriri Estuary via large managed waterways (e.g. Purimu, Pump Rd, Georges Drive and County pump stations), which carry stormwater under flood protection schemes and stormwater from the Napier city reticulated network. The estuary historically received approximately 90% of the runoff generated by Napier city. However since the development of the Cross Country Drain in 2010, this has reduced the amount of stormwater being directed to the estuary to approximately 75% (Smith 2014). Additional discharges enter at various points within the estuary, including stormwater from residential, industrial land-uses, and orchard and airport activities (Figure 3-29).

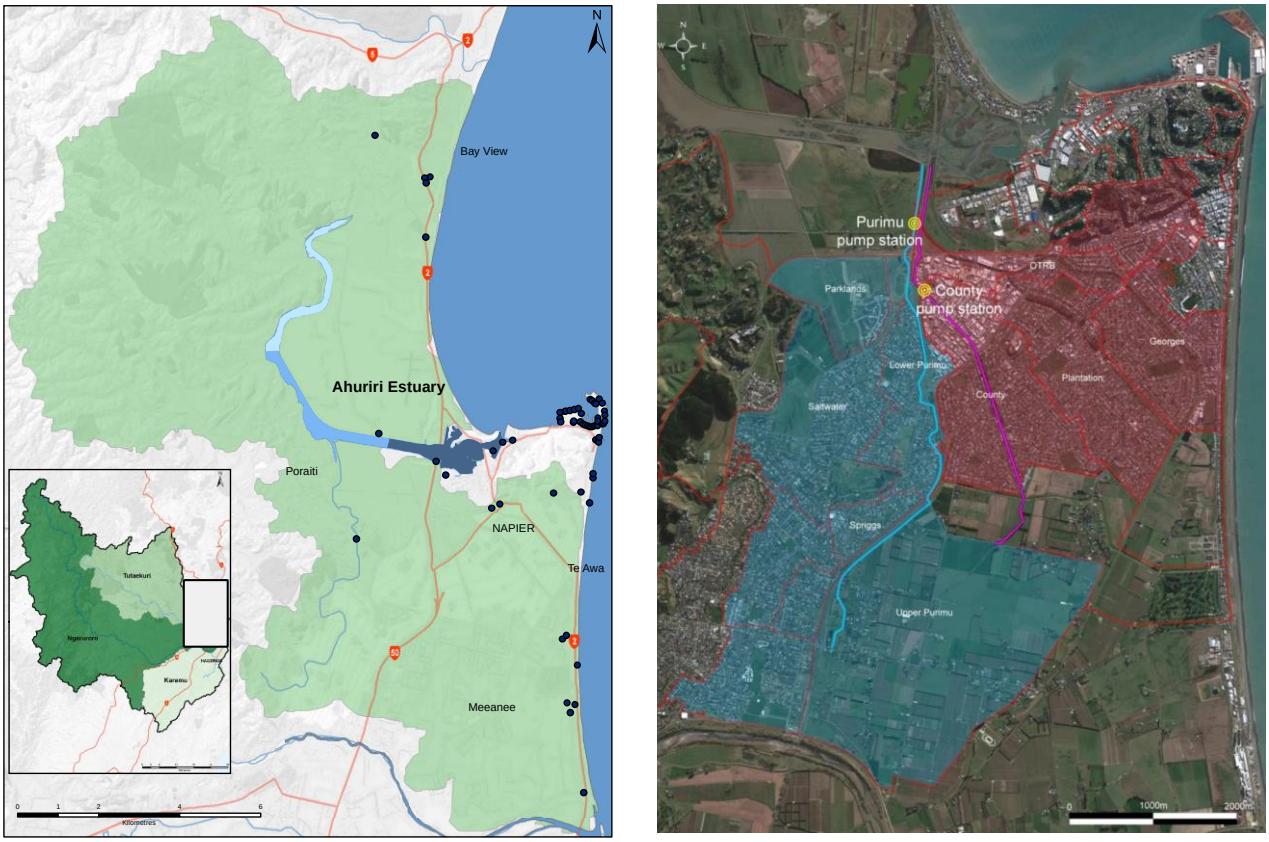


Figure 3-29: A) Consented stormwater discharge points in the Ahuriri catchment at August 2015 (black dots). B) Napier City urban stormwater catchments that discharge to the Ahuriri Estuary (Smith 2014).

Effects of consented stormwater discharges on the receiving environment

The contaminants most commonly observed in the Ahuriri Estuary are typical of urban stormwater discharges, and reflect the large quantity of urban stormwater directed here.

Trace metals

Sediment trace metal concentrations exceed background concentrations throughout the waterways that convey stormwater into the estuary. The high concentrations of cadmium, zinc, lead, copper, mercury, arsenic, chromium, nickel indicate metal has arrived in these sediments from land-based activities. Of these, chromium, copper, mercury, arsenic and nickel exceed interim sediment quality guidelines (ISQG) –

low (ANZECC, 2000) indicating adverse biological effects may occur occasionally. Zinc, lead and chromium exceed interim sediment quality guidelines (ISQG) – 'High', suggesting that at these sites adverse biological effects may occur frequently (Strong 2004, Smith 2014, Strong 2014). Additional studies have observed lead and zinc at levels that exceed environmental guidelines in the estuary proper near to stormwater discharges (Madarasz-Smith 2007, Ataria et al. 2008, Smith 2010, Aussiel 2011, HBRC 2014, Strong 2014).

Elevated zinc and copper concentrations from the County Drain discharge to the estuary, highlighting the role of industrial stormwater in the enrichment of receiving environments with regard to trace metals (Stansfield 2013).

Table 3-12: Maximum and highest median levels of acid soluble copper and zinc from NCC/HBRC CD990516W. Source: Unpublished data on file.

Trace metal (µg/L)	Max	Median	ANZECC*
Copper (acid soluble)	9.1 (Plantation)	4.0 (Plantation)	1.4 (FW)/1.3 (Mar)
Zinc (acid soluble)	890.0 (County)	250.0 (County)	8.0 (FW) /15.0 (Mar)

*(ANZECC 2000) – Trigger values for 95% species protection for freshwater (FW) and Marine water (Mar)

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs have been observed in the sediment of the Ahuriri Estuary at sites adjacent to stormwater discharges such as the Tyne Street outlet (Ataria et al. 2008) and South East Wetland (Aussiel 2011) at levels exceeding ISQG – Low and exceeding ISQG – High. This suggests that adverse biological effects are likely to be occurring occasionally to frequently within the estuary due to these stormwater contaminants. Analysis of the compounds suggests the source is likely to be of petrogenic rather than pyrogenic sources indicating that they are likely to have come from unburnt fuel sources such as fuel leaks or spills rather than from burnt petroleum compounds such as motor vehicle emissions (Ataria et al. 2008).

Figure 3-30: A white faced heron feeding in the Mersey Street waterway. NB: scums on water edges.

Nutrients and sediments

Nitrogen and phosphorus nutrient levels are elevated within the Ahuriri Estuary waters and sediments. While it is likely that much of the nutrient is derived from surrounding land use, catchment geology and the breakdown of organic products, stormwater can also be a major contributor of nutrients to the receiving environment. Section 3.1 of the current report indicates the contribution that the Taipo Stream makes to the phosphorus levels within the Ahuriri Estuary. While the Taipo does not appreciatively increase the *concentrations* downstream of the confluence, its contribution to the overall *load* is likely to be substantial.

Nutrients from stormwater sampled at the Westshore tide gates show that large masses of nutrients and sediments can enter the estuary during peak flows (Table 3-13).

Table 3-13: Maximum and median levels of nutrients (g/m^3) monitored as part of the NCC/HBRC joint stormwater consent (CD990516W) NB Samples taken 50 m downstream of pump station). Source: Unpublished data on file.

Nutrient	Max	Median	Williamson (1993)# 90th %ile
Ammoniacal-Nitrogen	0.43 (Purimu)	0.109 (Plantation)	0.25
Nitrate + Nitrite Nitrogen	3.60 (County)	0.195 (Plantation)	1.5*
Dissolved Reactive Phosphorus	**5.70 (County)**	**0.370 (Purimu)**	**0.07**
Total Phosphorus	5.60 (County)	0.450 (Purimu)	1.12
Total Suspended Solids	138.00 (County)	2.0 (Purimu)	470

 # from (Kingett-Mitchell-Ltd 2005)
*Nitrate only

Ecotoxicological data for the stormwater discharged from the Pandora Industrial area into the Ahuriri Estuary at the Thames/Tyne interface indicates a high likelihood of adverse biological effects on organisms within the immediate receiving environment. Additionally, concentrations of nutrients and many trace metal species in the stormwater entering the estuary at the Thames/Tyne confluence are an order of magnitude higher than available national data (Strong 2014).

3.9.2 The Karamu Catchment

The Karamu catchment is the main primary producing catchment of the Heretaunga Plains. Draining the Poukawa basin, the Kohinurakau, Kaokaoroa and Ruakawa ranges (HBRC 2004), a large number of tributaries contribute to the Karamu Stream. The upper catchment is dominated by beef and sheep, while the lower catchment contains the urban centres of Hastings and Havelock North, and a large number of orchards and vineyards (Table 3-14).

Table 3-14: Top four land-uses in the Karamu catchment. Source LCDB 4.

Land-use	% Catchment	Cumulative % Catchment
High Producing Exotic Grassland	56	
Orchard, Vineyard or Other Perennial Crop	15	71
Short-rotation Cropland	11	82
Built-up Area	6	88

The receiving environment

The ultimate receiving environment of the ranges and plains of the Heretaunga is the Karamu Stream. Once the main channel of the Ngaruroro River, a flood in the 1860s realigned the main stem of the Ngaruroro River to its current location to the north, with the Karamu Stream occupying the original channel (HDC 2015). The Karamu Stream continues east where it merges with the Raupare Stream to become the Clive River. The Clive shares a common mouth with the Ngaruroro and Tutaekuri Rivers which enter from the north to form the Waitangi Estuary, before discharging to the sea.

Both the Karamu – Clive Rivers and the Waitangi Estuary have high ecological, recreational and amenity values including fish passage, bird feeding, roosting and nesting, inanga spawning habitats, and a high-use area by both fishers and watercraft (*see also* sections 1.4.1 and 1.5). Muddy Creek, a small tributary to the estuary, is a designated Wildlife Refuge.

The Waitangi Estuary, which forms the downstream receiving environment of the Tutaekuri, Ngaruroro and Karamu catchments, also receives stormwater from the Awatoto subcatchment of the Ahuriri. The Waitangi Estuary is recognised as an area of regional and national significance, with high wildlife and fisheries values, and has high recreational use, both by fishers and water craft users. Muddy Creek, a small tributary to the estuary, is a designated Wildlife Refuge.

An additional value associated with the Karamu Stream is its ability to direct flood flows away from the Heretaunga Plains. Clearance programmes in the Karamu Stream began in the late 1940s to increase the flood capacity of the stream, and active management of willow, land purchase, stopbanking and maintenance continue to the present day (HBRC 2004).

Current consented stormwater discharges

The Karamu Stream and associated tributaries collect stormwater from the urban centres of Hastings and Havelock North, and from industry associated with Whakatu industrial estate which borders the stream between Hastings and Clive. A total of 201 individual discharge points in 15 subcatchments are identified in the stormwater consent held by Hastings District Council (Figure 3-31). Of the further 53 stormwater

discharge consents in this area, many are held by industries associated with orchard operations such as packaging.

Consented stormwater entering the Waitangi Estuary via the Awatoto waterway is generated from industrial premises including the production of fertiliser and concrete, and wool scourers.

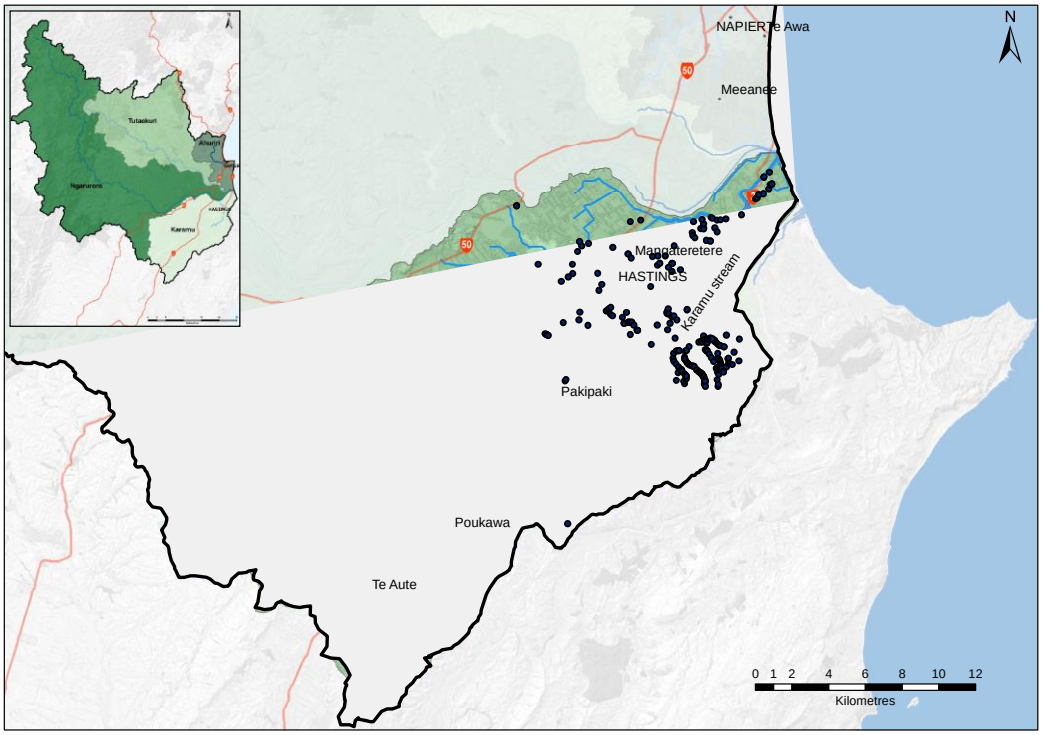


Figure 3-31: Consented stormwater discharge points in the Karamu catchment at August 2015. Consented takes are represented as black dots on the map.

Effects of consented stormwater discharges on the receiving environment

Several operations hold consent to discharge stormwater into various waterways within the Karamu catchment. Many of these are relatively low risk, controlled activities, however many operations have joint consents that approve the discharge of stormwater along with low contaminant process water. This can allow contaminants to be released into the receiving environment if strict monitoring and assessment conditions are not met.

Hastings District Council holds consent for the diversion and discharge of stormwater from 15 subcatchments into the Ruahapia, Tomoana, Riverlea, Irongate, Wellswood waterways, and to Muddy Creek. These waterways all ultimately meet the Karamu Stream (excepting Muddy Creek), and the Karamu is therefore susceptible to the cumulative effects from these discharges.

Sediment quality

Recent monitoring of the effects of the Hastings District Council stormwater discharges on the receiving environment indicate lead, zinc and PAHs in sediments within the Havelock North streams at levels where adverse effects could be expected occasionally. In the low gradient tributaries (e.g. Riverslea, Windsor, Tomoana, and Irongate) levels of copper, lead and PAHs are at levels where adverse effects could be expected occasionally, while zinc levels could be expected to cause frequent adverse effects. The Ruahapia

Streams appear the most contaminated, with copper, lead and zinc levels exceeding ISQG-High, while in the Karamu Stream, only zinc exceeds environmental guidelines (Forbes 2015).

Stormwater quality

Very little information exists on the quality of stormwater from the Hastings urban network. However, a one-off event indicated that nutrient and trace metal levels in the Ruahapia Stream exceeded environmental trigger and guidelines values (Table 3-15). This is consistent with previously reported data for urban streams in the Clive-Karamu area (Stansfield 2009).

Table 3-15: Nutrient and trace metal levels in a single composite sample from the Ruahapia August 2014. Source: Unpublished data on file.

Nutrient	g/m^3	ANZECC (2000)
Nitrate + Nitrite Nitrogen	0.370	0.444
Dissolved Reactive Phosphorus	**0.089**	**0.010**
Total Phosphorus	**0.130**	**0.033**
Dissolved Arsenic	**0.115**	**0.024**
Dissolved Copper	**0.037**	**0.0014**
Dissolved Lead	0.001	0.0034
Dissolved Manganese	0.028	1.9
Dissolved Zinc	**0.290**	**0.008**

Aquatic ecology

In addition to high trace metal sediment concentrations, aquatic communities (macroinvertabrates) present at sites receiving urban stormwater discharges are rated as being in 'Poor' condition (Forbes 2014). While additional factors such as bed sediments, morphology and shading are also likely to play a role in the structure of these communities, the presence of stormwater related contaminants at the levels observed are likely to influence the absence of sensitive species at these sites.

3.9.3 Cumulative impacts

Like many downstream receiving environments, the Ahuriri Estuary and the Karamu-Clive-Waitangi can be sensitive to the combined impacts of the surrounding catchment. A range of activities can contribute similar contaminants to the receiving waters, so these environments can be exposed to nutrients, organics, pesticides and trace metal pollution.

A number of sites that receive stormwater within the Ahuriri and Karamu systems are flagged as at risk of effects on the ecology due to stormwater contamination.

3.10 Assessment against the NOF NPS-FM (2014) attribute bands

The National Policy Statement for Freshwater Management 2014 (NPS-FM (2014)) sets out the objectives and policies for freshwater management under the Resource Management Act 1991. The NPS-FM (2014) came into effect on 1 August 2014 and is one of the initiatives developed as part of the Government's Fresh Start for Fresh Water programme of water reform.

The NPS-FW (2014) includes a National Objectives Framework (NOF) aimed at providing "an approach to establish freshwater objectives and national values, and any other values that: a) is nationally consistent; and b) recognises regional and local circumstances." (Objective CA1).

Appendix 2 of the NOF outlines a number of attribute tables. An attribute "is a measureable characteristic of freshwater, including physical, chemical and biological properties, which supports particular values". The NOF includes river-related attributes for periphyton (as number of chlorophyll-*a*/m^2), nitrate-nitrogen (mg/L), ammoniacal-nitrogen (mg/L), dissolved oxygen (mg/L – applicable downstream of point-source discharges only), and *E. coli* (number of *E. coli*/100ml - for secondary contact recreation only). Targets have been proposed within the NOF attributes that include 'national bottom lines' (D band) – thresholds of water quality attributes that good management should prevent waterways from crossing. A 'bottom line' is the minimum water quality level that all water bodies must achieve.

Each attribute table sets out the attribute and the unit in which it is to be measured (Appendix E). It then sets out A, B, C and D states and defines these in narrative and numeric terms, with A being the highest/best quality and D being below the national bottom line.

The data for DO and periphyton biomass could not be assessed against the attribute standards because there were insufficient monitoring data. Where adequate monitoring data existed for *E. coli*, nitrate and ammoniacal-nitrogen concentrations, NOF attribute states were calculated at each monitoring site and summarised in (Table 3-16). Numerical results for each year between 2009 and 2013 are listed in Appendix F.

3.10.1 Escherichia coli

Secondary contact is defined under the NPS-FM 2014 as 'people's contact with fresh water that involves only occasional immersion and includes wading or boating (except boating where there is a high likelihood of immersion)'. In areas where the community values activities that result in more frequent immersion in water such as swimming, white-water rafting or water skiing, the NPS-FW (2014) states that 'the risk of infection will be no more than moderate'. In these areas a more stringent 95th percentile value may be used to assess the risk of infection (NPS-FM 2014).

When considering overall median *E. coli* concentrations (i.e. calculated over the reporting period 2009 to 2013), only the Clive River and the Poukawa Stream were rated as A band with 'a very low risk of infection from contact with water during activities with occasional immersion such as wading and boating'. At all sites median *E. coli* concentrations were variable during the 5 year monitoring period and NOF bands changed from year to year at most sites. The Poukawa Stream and the Clive River were in the A band in 4 out of 5 years, the Clive River was in the B band in 2012 and the Poukawa Stream in the C band in 2010. This means that people are generally exposed to a very low risk of infection during activities with occasional immersion but years with higher median *E. coli* concentrations can occur as an exception.

The Herehere Stream was rated in the D band over the 5 year monitoring period and therefore did not meet the minimum acceptable state for secondary contact recreation. This site had a specifically high inter-

annual variability which ranged from A band in 2009 to D band in 2010 and B- and C bands in the other years, indicating that the risk of infection was highly variable in this stream.

The Karewarewa, Awanui, Mangarau and Taipo streams ranked overall in the B band with bands changing year to year between A and B bands in the Awaui and Mangarau streams and between A and C bands in the Karewarewa and Taipo streams. Here, the risk of infection from secondary contact recreation varied between very low (< 0.1% risk) and moderate (< 5% risk).

The 95th percentile concentrations were only calculated on the basis of the whole dataset available (up to five years). At 6 of the 7 monitoring sites the 95th percentiles were above 540 counts/100mL and therefore in the D band, which means they were unsuitable for primary contact recreation (full immersion activities and likely ingestion of water). Only the Mangarau Stream ranked in the B band, which indicates a moderate (<5%) risk of infection when undertaking primary contact recreation activities.

3.10.2 Nitrate-Nitrogen

The nitrate (toxicity) attribute helps assess chronic toxicity risk for aquatic animals. Chronic exposure typically includes a biological response of relatively slow progress and long continuance, often affecting a life stage (Hickey 2013a). Such a response may be reduced growth rate or reduced gonad development, compared to optimum growth conditions (a control). It does not relate to acute toxicity effects that result in the death of an animal. The attribute bands for a site are based on annual median and the annual 95th percentile of nitrate concentrations. The annual median concentration reflects the exposure of aquatic species under average conditions while the 95th percentile manages the exposure during seasonal peaks in nitrate concentration. The narratives for each nitrate attribute band are included in Appendix E. Further reading on nitrate toxicity and guidelines for New Zealand can be found in Hickey (2013a),and Hickey (2013b).

Median nitrate-nitrogen concentrations for Karamu catchment sites (where data are available) were in the A band overall, except for the Karewarewa Stream, which was in the B band. When considering individual calendar years from 2009 to 2013 (Appendix F), the Taipo and Poukawa streams were in the A band every year. The narrative attribute state for this band states there are ‘unlikely to be effects even on sensitive species’, which reflects a low level of risk from nitrate toxicity to any aquatic species. The Clive River, Herehere and Awanui streams were rated A band over the 5 year monitoring period and ranked in the B band in 1 (Clive, Herehere) or 2 (Awanui) years between 2009 and 2013. In these streams generally nitrate concentration was unlikely to have any effect even on sensitive species, but in some years some growth effect on up to 5% of species can occur.

When considering annual 95th percentiles over the 5 year monitoring period, 5 out of 7 sites in the Karamu catchment were in the B band, one site (Poukawa) was in the A band and one site (Karewarewa) was in the C band. Inter annual variability was high, with most sites changing between A, B and C bands over the 5 year monitoring period (Appendix F). The Poukawa Stream was generally in the A band and only ranked in the B band in 2013. The Clive River was in the A band 2009 and 2010, and in the B band all other years. Even sensitive species in these steams are unlikely to be affected by seasonal peaks in nitrate concentrations but at times some growth effects may occur on up to 5% of species. Awanui, Herehere, Mangarau and Taipo streams were variable between A, B and C bands considering individual years. This means that in these streams generally some growth effect may occur on up to 5% of species, while in some years there is unlikely to be any effect even on sensitive species, and in other years there may be some growth effects on up to 20% of species.

3.10.3 Ammonia

The ammonia (toxicity) attribute helps assess chronic ammonia toxicity risk to aquatic animals. The attribute bands for a site are based on annual median and maximum concentrations (Appendix E). The annual median concentration reflects the exposure of aquatic species under average conditions while the maximum concentration manages the exposure during critical events and daily or seasonal peaks in ammonia concentration.

Median ammonia concentrations were in the A band at 3 sites and in the B band at 4 sites in the Karamu catchment. Considering individual years of the 3 sites in the A band, the Mangarau Stream was graded A consistently across all years. The Poukawa and Herehere streams were in the A band in 4 out of 5 years, and rated B in 2010. Looking at the 4 sites that were overall in the B band, Karewarewa Stream was consistently in the B band for all individual years. Awanui Stream and Clive River were changing between A and B band over the 5 year monitoring period. The A band reflects a very low level of risk from ammonia toxicity for any aquatic species with a narrative that states 'no observed effect on any species tested'. The B band narrative states that ammonia 'starts impacting occasionally on the 5% most sensitive species' (NPS-FW 2014; Appendix E). The Taipo Stream had the most variable median ammonia concentrations, changing between A, B and C bands between the years 2009 to 2013 (Appendix F). The C band narrative states that 'growth effects on up to 20% of species (mainly sensitive species such as fish)' can occur, but no acute effects can be expected (Appendix E)

When considering annual maxima, 5 sites are in the B band, with maximum ammonia values changing between A and B bands on a year to year basis between 2009 and 2013. Both the Karewarewa and Awanui streams rated in the C band over the 5-year period, but maximum ammonia values fell into the B band consistently between 2009 and 2012, and were higher in 2013 where both sites were in the C band. The B band narrative states that ammonia concentrations start impacting occasionally on the 5% most sensitive species (i.e. 95% species protection level), and the C band reflects an 80% species protection level. These reflect the effect of daily are seasonal impacts in ammonia concentration.

Table 3-16: NPS-FW (2014) NOF band summary for freshwater river attributes for Karamu and Ahuriri catchment monitoring sites for the period 2009 to 2013.

Site	*E. coli*		Nitrate (toxicity)		Ammonia (toxicity)	
	5 year median	95th percentile	5 year median	95th percentile	5 year median	Maximum
Karewarewa Strm	B	D	B	C	B	C
Awanui Strm	B	D	A	B	B	C
Poukawa Strm	A	D	A	A	A	B
Herehere Strm	C	D	A	B	A	B
Mangarau Strm at Te Aute Rd	B	B	A	B	A	B
Clive Rv	A	D	A	B	B	B
Taipo Strm	B	D	A	B	B	B

3.11 Compliance with HBRC Regional Resource Management Plan (2006) surface water quality Environmental Guidelines

Two types of data summary have been prepared to compare existing water quality values to RRMP 2006 Environmental Guideline values:

(1) For samples collected between 2009 and 2013 at flows less than median flow, comparison of mean DO saturation, mean black disc clarity, mean DRP, and mean/max ammoniacal-nitrogen (a toxicant) with RRMP 2006 guideline values (Table 3-17),

(2) For samples collected between 2009 and 2013 at flows less than median flow, the total number of samples taken and the number of samples being non-compliant with RRMP 2006 Environmental Guideline levels (Table 3-18).

Only some sites in the Karamu and Ahuriri catchments complied with surface water quality Environmental Guideline values listed in the HBRC Regional Resource Management Plan 2006 (Table 3-17).

Mean DO levels were compliant at 3 out of 7 sites (Table 3-18). Karewarewa, Awanui, Poukawa and Taipo streams did not comply with the mean RRMP DO guideline, with only 6% to 15% of the observations higher than 80% DO saturation.

Mean black disc water clarity was compliant with the RRMP guideline levels at 5 out of 7 sites (Table 3-17). The 2 non-compliant sites were the Awanui and Taipo streams. However, no site was compliant in more than 80% of the observations (Table 3-18). In the Karewarewa and Herehere streams and the Clive River about two-thirds of the observations were compliant with the 1.6m clarity guideline. All other sites had between 17% and 47%of the observations compliant with the guideline.

All sites in the Karamu and Ahuriri catchments exceeded the 0.015mg/L mean DRP guideline (Table 3-17). All observations at every site were above the DRP guideline level (Table 3-18).

Only the Karewarewa Stream had non-compliant mean ammoniacal-nitrogen (NH_4-N), with more than twice the guideline level of 0.1 mg/L (Table 3-17). The Herehere and Mangarau streams and the Cliver River complied with both the RRMP maximum and mean NH_4-N concentration guideline. At most sites more than 80% of the observations were compliant with the mean NH_4-N guideline. Only the Karewarewa and Awanui streams had 50% and 78% of the observations respectively below the NH_4-N guideline (Table 3-18).

Compliance with RRMP DRP guidelines was particularly poor in the Karamu and Ahuriri catchments, and clarity was consistently a problem in the catchment. Often DO saturation was lower than the 80% DO guideline. True minima are likely to be lower, as these occur in early morning hours, while spot measurements used in this dataset were typically obtained from late morning to early afternoon, when DO is higher. NH_4-N concentrations appear to be a problem occasionally, particularly in the Karewarewa and Awanui streams.

Table 3-17: Comparison of measured DO, BD clarity, DRP and ammoniacal-nitrogen levels with HBRC RRMP 2006 Environmental Guideline levels at the Karamu and Ahuriri catchment SOE monitoring sites. The data summarised in the table are for samples taken between January 2008 and December 2013 during times that flows in the river were below median flow, as prescribed in Policy 72 of the HBRC RRMP 2006.

Site name	Mean of DO (%)	Mean of Black disc Clarity (m)	Mean of DRP (mg/L)	Mean of NH_4-N (mg/L)	Max of NH_4-N (mg/L)
Karewarewa Strm	39	1.8	0.252	0.222	0.980
Awanui Strm	60	1.5	0.197	0.091	0.570
Poukawa Strm	40	1.9	0.163	0.032	0.107
Herehere Strm	99	2.6	0.054	0.013	0.031
Mangarau Strm at Te Aute Rd	102	2.1	0.078	0.020	0.057
Clive Rv	88	2.6	0.109	0.018	0.050
Taipo Strm	31	0.9	0.386	0.054	0.370
HBRC RRMP 2006 guideline	**80%**	**1.6 m**	**0.015 mg/L**	**0.100 mg/L**	**0.100 mg/L**
Number of sites compliant	3 / 7	5 / 7	0/ 7	6 / 7	3 / 7
% site compliance	43%	71%	0%	86%	43%

Table 3-18: Comparison of measured DO, BD clarity and DRP values with HBRC RRMP 2006 Environmental Guideline levels for the Karamu Stream and Ahuriri Estuary SOE monitoring sites. The data summarised in the table are for samples taken between January 2009 and December 2013 at times that flows in the river were below median flow, as prescribed in Policy 72 of the HBRC RRMP 2006. Sites with more than 80% of observations compliant with guideline levels are shaded GREEN; between 50% and 80% compliant are shaded ORANGE; and less than 50% compliant are shaded RED.

Site name	Dissolved Oxygen Saturation			Black disc Clarity			Dissolved Reactive Phosphorus		
	Samples at < median flows	Samples > 80% satn.	Samples > limit	Samples at < median flows	Samples > 1.6m	Samples > limit	Samples at < median flows	Samples > 0.015 mg/L	Samples < limit
Karewarewa Strm	13	2	15%	10	6	60%	14	14	0%
Awanui Strm	31	4	13%	23	9	39%	31	31	0%
Poukawa Strm	16	1	6%	15	7	47%	16	16	0%
Herehere Strm	12	10	83%	8	5	63%	12	12	0%
Mangarau Strm at Te Aute Rd	11	10	91%	5	2	40%	10	10	0%
Clive Rv	13	7	54%	6	4	67%	13	13	0%
Taipo Strm	14	2	14%	6	1	17%	14	14	0%

Site name	Ammoniacal-nitrogen		
	Samples at < median flows	Samples > 0.100 mg/L	Samples < limit
Karewarewa Strm	14	7	50
Awanui Strm	32	7	78
Poukawa Strm	17	2	88
Herehere Strm	12	0	100
Mangarau Strm at Te Aute Rd	10	0	100
Clive Rv	13	0	100
Taipo Strm	14	2	86

4 Recreational Water Quality in the TANK catchments

The coastal waters and rivers of the TANK catchments are frequently used for a range of recreational activities. However, the suitability of these areas for contact recreation can be compromised through contamination by human or other animal faecal matter, which may carry harmful, illness-causing pathogens.

To monitor the risk associated with contact recreation, Hawke's Bay Regional Council (HBRC) undertake an annual Recreational Water Quality Monitoring Programme in collaboration with Territorial Local Authorities (TLAs) and the Public Health Unit of the Hawke's Bay District Health Board (PHU). Monitoring is carried out at seven sites throughout the TANK area (Figure 4-1) to assess the microbiological water quality of areas commonly used for contact recreation. The results are then compared to Ministry for the Environment (MfE) and Ministry of Health (MoH) guidelines (MfE/MoH 2003). Water quality is monitored at one site for faecal contamination to determine the relative risk to the public from consuming shellfish at this site (Section 4.5). This chapter outlines the results of this monitoring programme in the TANK catchments.

The concentration of indicator bacteria gives an indication of the health risk associated with contact recreation arising from pathogenic organisms. Two indicator bacteria are used, depending on the salinity of a site. Samples were analysed for the indicator bacteria enterococci at marine sites. Enterococci has been shown to be the indicator most closely correlated with health effects in New Zealand marine waters (MfE/MoH 2003). *E. coli* was used as the preferred indicator for freshwater sites (MfE/MoH 2003). At estuarine or freshwater sites subject to tidal influences, both indicator bacteria were tested for.

Figure 4-1: Recreational water quality monitoring sites within the TANK catchments. Colours denote SFRG gradings.

4.1 ANZECC guidelines

All sampling and evaluation of results was undertaken in accordance with the 'Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas 2003'(MfE/MoH 2003) (Table-4-1).

When water quality falls within the limits of the 'surveillance mode' (the 'Green' mode), the risk of contracting an illness from bathing is considered acceptable (MfE/MoH 2003). If the water quality falls into the 'Alert/Amber' category (the 'Amber' mode) there is an increased risk of illness, but this risk is also considered acceptable. This result signals to agencies a requirement to conduct follow up sampling of the site to determine whether contamination levels have increased to the 'Action/Red' level (the 'Red' mode).

Table-4-1: Water quality guideline values and indicator organisms used to assess marine and freshwater recreational areas (MfE and MoH, 2003).

Response Level	Marine Water Enterococci CFU/100 mL Single Sample	Freshwater *E. coli* CFU/100 mL Single sample	Shellfish gathering waters Faecal coliforms CFU/100 mL (over season)
Surveillance/Green Mode	<140	<260	
Alert/Amber Mode	140 - 280	260 - 550	
Action/Red Mode	>280*	>550	
Seasons results			Median concentration < 14/100 mL and 90% of samples < 43/100 mL

CFU = Colony forming units on an agar plate.

- Note: Two consecutive samples taken within 24 hrs exceeding 280 enterococci/100 mL are required before action mode is initiated.

4.2 Suitability for Recreation Grade

The Suitability for Recreation Grade (SFRG) describes the general water quality of a site by combining monitoring data (the Microbial Assessment Category - MAC) with a catchment risk assessment (the Sanitary Inspection Category - SIC) to produce a grade which indicates the *general* state of water quality at the site (Figure 4-1).

The SFRG grade descriptions can be used to indicate how suitable a site is for contact recreation, as follows (see also(MfE/MoH 2003):

Very Good – the site has generally excellent microbial water quality and very few potential sources of faecal pollution exist. Water is considered suitable for contact recreation almost all of the time.

Good – the site has water quality considered suitable for contact recreation most of the time. Swimming should be avoided during or following heavy rain.

Fair – the site has water quality generally suitable for contact recreation, but because significant sources of faecal contamination exist, extra care should be taken to avoid swimming during or following rainfall or if signs of pollution, such as discoloured water, odour, or debris in the water exist.

Poor – the site is susceptible to faecal pollution and microbial water quality is not always suitable for contact recreation. During dry weather conditions, ensure that the swimming location is free of signs of pollution, such as discoloured water, odour or debris in the water, and avoid swimming at all times during and for up to three days following rainfall.

Very Poor – the site is very susceptible to faecal pollution and the microbial water quality may often be unsuitable for contact recreation. Swimming at these sites is not recommended.

Follow-Up – a conflict exists between the bacterial levels observed in the MAC, and the *risk* outlined in the SIC which requires further work e.g. the catchment risk based on the SIC appears low, however the 95% percentile of the observed bacteria levels is high, or the catchment risk is assessed as high but the 95th% percentile of the observed bacterial levels is low.

4.3 Recreational Usage

The term 'contact recreation' refers to any activity involving the potential for the ingestion of, or immersion in, water. This can include swimming, surfing, kite-surfing, kayaking, diving and any other activity likely to result in immersion.

The TANK catchments include some of the most valued recreational sites in Hawke's Bay. The population concentration in these areas means that the waters of the TANK catchments are some of the most utilised for recreational purposes.

The Clive, Tutaekuri and Ngarururo rivers are the 3rd, 4th and 5th most popular rivers used for recreation in Hawke's Bay (Madarasz-Smith 2010). These rivers are popular for a range of activities including swimming, kayaking, fishing, picnicking, dog walking and walking.

Council also monitors recreational water quality in the Ahuriri and Waitangi estuaries. These are two of the most popular areas for recreation within Hawke's Bay, being used for swimming, kayaking, kite-surfing, dinghy sailing, fishing and surfing.

There are also several beaches adjacent to the mouths of the Waitangi and Ahuriri estuaries which are influenced by the TANK catchments.

4.4 Faecal bacterial contamination

Water quality at beach sites which are influenced by the TANK catchments generally have better water quality than estuarine and freshwater sites. This is reflected in the SFRGs (Figure 4-1) and the measured concentrations of faecal contaminants (Figure 4-2). The Westshore, Hardinge Road and Marine Parade sites all have an SFRG of 'Good', indicating the water quality is suitable for contact recreation most of the time.

The Pandora Pond, Tutaekuri and Ngarururo river sites all have an SFRG grading of 'Fair' (Figure 4-1). This indicates that extra care should be taken and that there is a higher chance of contamination at these sites.

The Clive River site is the only site in the TANK area with an SFRG of 'very poor' (Figure 4-1). This grading is due to high concentrations of faecal bacteria (Figure 4-2) and elevated risk associated with the catchment upstream. The Clive River site also has a deteriorating trend in *E. coli* concentrations, with an estimated increase of 12.85% per year (Table 4-2).

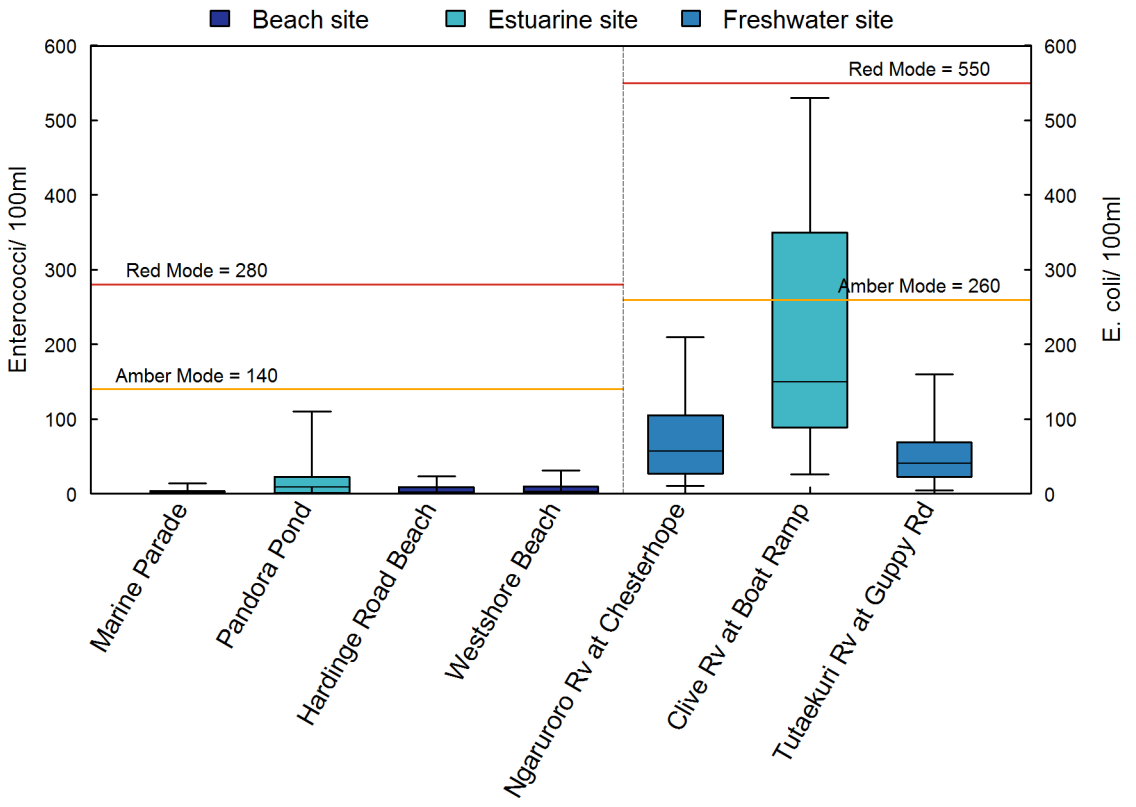


Figure 4-2: Enterococci and *E. coli* concentrations at recreational water quality monitoring sites in the TANK catchments. Boxes to the left of the vertical line depict enterococci concentrations, boxes to the right of the vertical line depict *E. coli* concentrations. Red lines are ANZECC action level and orange lines are the alert mode.

Table 4-2: Trend analysis and SFRG grades for recreational water quality monitoring sites within the TANK catchments.

Site	SFRG	P value	**Percent annual change**
Clive Rv at Boat Ramp	Very Poor	**0.00006**	**12.85**
Hardinge Rd Beach	Good	0.004	-6.296
Marine Parade	Interim Good	Dataset of 3 years	
Ngaruroro Rv at Chesterhope	Fair	0.332	2.69
Pandora Pond	Fair	0.034	-8.29
Tutaekuri Rv at Guppy Rd	Fair	0.063	4.72
Westshore Beach	Good	0.026	-4.93
Ahuriri Estuary (Shellfish site)		0.237	-2.545

4.5 Shellfish Gathering

Hawke's Bay Regional Council also undertakes water quality monitoring at locations favoured for shellfish gathering as part of the Recreational Water Quality Programme. Water at popular shellfish gathering sites is monitored for faecal contamination to determine the relative risk to the public from consuming shellfish gathered. There is a popular shellfish bed in the Ahuriri Estuary (Figure 4-1) where waters are monitored.

The MfE and MoH guidelines (MfE/MoH 2003) stipulate that for consumption of shellfish collected from a site to be considered safe two criteria must be met:

- The proportion of faecal coliform results above 43 cfu/100 mL for the season must not exceed 10%.
- The median faecal coliform value for the season must not exceed 14 cfu/100 mL.

It is important to note that monitoring for shellfish gathering is based on the quality of the surrounding waters, not on the shellfish themselves. Additionally, the Ministry for Primary Industries does not recommend collecting shellfish from areas where sewage or storm water is discharged and after heavy rain.

4.5.1 Ahuriri Estuary

The shellfish monitoring site is on the northern side of the estuary, approximately 50 metres upstream of the Pandora road bridge (Figure 4-1). The shellfish bed receives considerable harvesting pressure throughout the year for cockles (*Austrovenus stutchburyi*). Elevated bacteria levels are generally found after prolonged periods of rain, which cause increased surface water runoff to enter the Ahuriri catchment. This site passes both guideline criteria, however, MoH recommends not collecting shellfish from areas subject to urban influence. There has been no significant trend in water quality at this site (Table 4-2).

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Appendix A Summary statistics by flow in the Ngaruroro and Tutaekuri catchments

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Ngaruroro Rv at Kuripapango (NIWA)	Minimum	0.3	no data	1	0.1	0.001	0.001	0.023	0.002	1	no data	0.001	8.3	97	45	7.5	no data	no data	4.2	no data	116.0	50.0
	5%'ile	0.3	no data	1	0.7	0.002	0.001	0.026	0.004	2	no data	0.001	8.8	98	56	7.6	no data	no data	5.3	no data	no data	no data
	25%'ile	0.5	no data	1	2.4	0.003	0.002	0.036	0.005	3	no data	0.002	9.6	99	65	7.7	no data	no data	7.4	no data	116.6	53.4
	Median	0.8	no data	3	5.3	0.004	0.002	0.046	0.009	4	no data	0.002	10.7	100	73	7.8	no data	no data	11.0	no data	130.0	56.7
	75%'ile	1.5	no data	10	7.3	0.006	0.003	0.070	0.014	6	no data	0.003	11.4	101	89	7.9	no data	no data	14.9	no data	134.7	61.0
	95%'ile	6.5	no data	65	9.4	0.016	0.005	0.125	0.029	18	no data	0.005	12.3	102	112	8.2	no data	no data	18.3	no data	no data	no data
	Maximum	72.0	no data	91	10.9	0.097	0.006	0.171	0.047	47	no data	0.011	12.4	110	149	8.4	no data	no data	21.6	no data	139.0	64.0
	Mean	3.3	no data	12	5.1	0.008	0.002	0.057	0.012	6	no data	0.003	10.5	100	79	7.8	no data	no data	11.3	no data	127.0	57.0
	Std. Dev.	10.5	no data	21	2.9	0.015	0.001	0.031	0.009	7	no data	0.002	1.1	2	20	0.2	no data	no data	4.3	no data	10.2	5.3
	Count	60	no data	60	59	60	60	60	60	60	no data	60	60	60	60	60	no data	no data	60	no data	5	5
Taruarau Rv	Minimum	0.5	1.5	2	0.5	0.002	0.002	0.055	0.014	2	0.003	0.005	8.8	91	76	6.9	no data	no data	5.4	5.9	120.7	55.2
	5%'ile	0.5	1.5	2	0.7	0.002	0.002	0.055	0.014	3	0.003	0.005	8.8	91	76	7.0	no data	no data	5.5	no data	no data	no data
	25%'ile	0.9	1.5	6	2.4	0.002	0.002	0.055	0.021	11	0.009	0.005	9.5	97	82	7.8	no data	no data	7.7	no data	no data	no data
	Median	1.4	1.5	12	4.7	0.002	0.002	0.055	0.026	13	0.010	0.005	11.9	104	107	8.0	no data	no data	10.0	5.9	120.7	55.2
	75%'ile	1.8	1.5	39	5.2	0.005	0.002	0.100	0.035	18	0.020	0.005	12.7	109	141	8.0	no data	no data	14.1	no data	no data	no data
	95%'ile	7.4	12.4	233	6.5	0.006	0.007	0.176	0.053	27	0.040	0.034	13.1	116	202	8.6	no data	no data	19.6	no data	no data	no data
	Maximum	8.5	14.0	250	6.6	0.006	0.008	0.190	0.054	27	0.042	0.041	13.2	117	203	8.7	no data	no data	20.2	5.9	120.7	55.2
	Mean	1.9	2.9	39	3.9	0.003	0.002	0.077	0.029	14	0.015	0.008	11.4	103	120	7.9	no data	no data	11.0	5.9	120.7	55.2
	Std. Dev.	2.0	3.5	70	1.9	0.002	0.002	0.041	0.013	7	0.011	0.010	1.6	8	44	0.5	no data	no data	4.4	0.0	0.0	0.0
	Count	14	14	12	13	14	14	14	14	14	14	14	14	14	14	13	no data	no data	14	1	1	1
Ngaruroro Rv at Whanawhana	Minimum	0.3	1.5	1	0.0	0.002	0.002	0.055	0.014	5	0.001	0.005	9.5	83	72	7.3	0.3	24.0	5.7	0.2	109.2	44.4
	5%'ile	0.6	1.5	1	0.2	0.002	0.002	0.055	0.014	7	0.002	0.005	9.7	93	79	7.5	0.3	24.0	5.8	0.4	no data	no data
	25%'ile	1.1	1.5	1	1.4	0.002	0.002	0.055	0.026	11	0.012	0.005	10.3	101	95	7.7	0.7	28.0	8.6	2.2	111.5	48.6
	Median	2.1	1.5	3	2.4	0.003	0.002	0.110	0.044	15	0.018	0.005	11.3	103	102	7.9	1.8	33.0	11.5	15.5	115.8	54.2
	75%'ile	4.6	4.5	8	4.0	0.006	0.002	0.145	0.059	25	0.043	0.005	11.8	108	127	8.1	2.1	36.0	14.8	29.0	122.9	58.9
	95%'ile	110.3	139.4	120	9.1	0.083	0.005	0.466	0.158	77	0.143	0.018	12.9	119	176	8.9	2.4	46.4	18.5	109.6	no data	no data
	Maximum	247.0	400.0	1200	9.7	0.240	0.010	0.852	0.272	136	0.260	0.020	12.9	120	177	9.1	2.4	48.0	19.2	119.0	134.7	61.9
	Mean	15.5	21.5	52	3.1	0.014	0.003	0.143	0.055	22	0.037	0.007	11.2	104	113	8.0	1.5	33.0	11.8	26.6	118.2	53.7
	Std. Dev.	47.3	74.2	218	2.6	0.043	0.002	0.161	0.051	25	0.050	0.004	1.0	8	28	0.4	0.8	6.5	3.9	34.2	9.9	6.8
	Count	32	32	30	31	34	34	33	32	32	32	33	32	31	33	33	12	14	33	14	5	5
Poporangi Strm	Minimum	0.5	1.5	19	0.2	0.024	0.015	0.260	0.130	8	0.118	0.005	8.9	94	154	7.3	no data	no data	6.8	3.8	108.9	55.6
	5%'ile	0.7	1.5	20	0.2	0.024	0.016	0.276	0.160	8	0.148	0.005	9.0	94	159	7.3	no data	no data	7.0	no data	no data	no data
	25%'ile	1.6	1.5	33	0.5	0.028	0.022	0.490	0.362	14	0.350	0.005	10.0	95	191	7.7	no data	no data	9.3	no data	no data	no data
	Median	2.1	4.0	58	1.7	0.032	0.025	0.688	0.538	22	0.525	0.005	10.7	100	209	7.9	no data	no data	11.5	3.8	108.9	55.6
	75%'ile	8.0	24.0	100	2.5	0.039	0.027	0.892	0.732	33	0.720	0.012	11.3	104	245	8.3	no data	no data	15.1	no data	no data	no data
	95%'ile	29.7	47.2	245	3.2	0.066	0.038	1.136	0.998	39	0.986	0.017	14.1	122	264	8.5	no data	no data	22.8	no data	no data	no data
	Maximum	32.4	48.0	260	3.3	0.069	0.040	1.150	1.032	40	1.020	0.018	14.5	122	266	8.6	no data	no data	24.4	3.8	108.9	55.6
	Mean	7.3	14.1	76	1.5	0.036	0.025	0.674	0.554	23	0.541	0.008	10.9	102	215	7.9	no data	no data	12.6	3.8	108.9	55.6
	Std. Dev.	9.5	16.3	66	1.1	0.013	0.006	0.272	0.250	11	0.250	0.004	1.4	10	34	0.4	no data	no data	4.5	0.0	0.0	0.0
	Count	14	14	12	13	14	14	14	14	14	14	14	13	13	14	13	no data	no data	14	1	1	1

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ngaruroro Rv U/S HB Dairies	Minimum	0.4	1.5	1	0.2	0.002	0.002	0.055	0.021	4	0.009	0.005	9.0	89	88	6.8	0.3	28.0	7.1	6.1	107.0	44.0
	5%'ile	0.4	1.5	1	0.3	0.002	0.002	0.055	0.023	6	0.010	0.005	9.1	89	89	7.0	0.3	28.0	7.1	no data	no data	no data
	25%'ile	1.2	1.5	2	1.3	0.002	0.002	0.119	0.031	13	0.020	0.005	10.6	98	97	7.6	0.8	34.0	8.6	14.3	108.3	44.2
	Median	2.2	1.5	7	2.4	0.006	0.002	0.141	0.052	16	0.040	0.005	11.2	101	105	7.6	1.7	37.0	12.0	105.2	113.2	47.2
	75%'ile	5.2	5.3	17	3.9	0.015	0.004	0.161	0.082	31	0.071	0.005	11.9	105	118	7.8	1.8	40.0	13.9	215.6	118.4	55.0
	95%'ile	80.0	113.5	198	5.3	0.085	0.007	0.390	0.118	56	0.097	0.023	12.8	117	150	8.1	3.1	48.0	18.5	no data	no data	no data
	Maximum	110.0	160.0	290	5.6	0.120	0.007	0.463	0.120	60	0.100	0.029	13.1	120	159	8.1	3.1	49.0	19.1	257.2	120.0	60.0
	Mean	10.2	13.2	25	2.6	0.014	0.003	0.155	0.057	23	0.045	0.007	11.1	101	110	7.6	1.5	37.1	11.8	117.5	113.3	49.6
	Std. Dev.	26.3	38.3	69	1.6	0.028	0.002	0.092	0.032	16	0.030	0.006	1.2	8	18	0.3	0.9	5.9	3.6	111.0	6.1	7.5
	Count	17	17	17	16	17	17	16	16	16	16	17	16	15	17	17	12	14	17	5	4	4
Ngaruroro Rv D/S HB Dairies	Minimum	0.4	1.5	1	0.1	0.002	0.002	0.055	0.032	11	0.026	0.005	8.6	81	94	6.4	0.3	30.0	7.3	0.1	92.5	42.9
	5%'ile	0.6	1.5	1	0.2	0.002	0.002	0.055	0.063	15	0.051	0.005	9.1	90	97	7.5	0.3	30.6	7.4	0.1	no data	no data
	25%'ile	1.6	1.5	2	0.6	0.004	0.002	0.123	0.074	18	0.066	0.005	10.0	99	113	7.6	1.0	37.0	10.5	7.5	105.0	45.4
	Median	4.5	5.9	7	1.2	0.008	0.005	0.180	0.107	28	0.095	0.005	10.9	102	127	7.8	1.6	41.5	13.7	17.9	110.0	50.0
	75%'ile	11.4	12.5	32	2.3	0.020	0.006	0.263	0.152	37	0.137	0.005	11.5	107	147	8.2	2.4	47.0	17.6	43.1	113.8	51.6
	95%'ile	139.7	194.9	280	6.4	0.127	0.009	0.334	0.204	55	0.192	0.013	12.3	115	188	9.1	3.1	54.6	20.5	232.6	no data	no data
	Maximum	787.0	1240.0	2100	6.7	0.850	0.018	0.885	0.292	60	0.280	0.044	12.8	131	193	9.3	3.1	56.0	21.2	260.0	116.3	56.3
	Mean	36.6	54.7	95	1.9	0.040	0.005	0.200	0.116	30	0.104	0.007	10.7	103	132	7.9	1.7	41.7	13.8	42.2	108.2	49.1
	Std. Dev.	139.6	219.6	382	1.8	0.145	0.003	0.150	0.055	13	0.053	0.007	1.1	10	27	0.5	0.8	7.0	4.1	69.0	9.2	5.0
	Count	32	32	30	30	34	34	33	33	33	33	34	32	30	33	33	12	14	33	13	5	5
Maraekakaho Strm	Minimum	0.3	1.5	15	0.8	0.007	0.005	0.160	0.091	4	0.078	0.005	7.9	80	461	7.1	no data	no data	8.8	7.3	107.4	52.6
	5%'ile	0.4	1.5	16	0.9	0.007	0.005	0.162	0.092	5	0.078	0.005	7.9	80	470	7.2	no data	no data	8.9	no data	no data	no data
	25%'ile	0.5	1.5	39	2.0	0.014	0.012	0.255	0.145	13	0.133	0.005	8.3	88	535	7.8	no data	no data	12.4	no data	no data	no data
	Median	0.7	1.5	61	3.4	0.029	0.025	0.646	0.419	18	0.405	0.005	9.7	93	556	8.0	no data	no data	14.3	7.3	107.4	52.6
	75%'ile	3.1	1.5	115	5.7	0.050	0.045	0.990	0.802	32	0.790	0.005	10.7	99	573	8.2	no data	no data	16.0	no data	no data	no data
	95%'ile	23.3	51.2	823	9.1	0.097	0.069	3.160	2.517	44	2.498	0.012	11.4	116	597	8.6	no data	no data	20.4	no data	no data	no data
	Maximum	25.0	59.0	900	9.3	0.103	0.072	3.400	2.720	46	2.700	0.012	11.4	119	600	8.6	no data	no data	21.2	7.3	107.4	52.6
	Mean	4.0	6.9	136	4.1	0.036	0.029	0.931	0.683	21	0.670	0.006	9.7	94	549	8.0	no data	no data	14.2	7.3	107.4	52.6
	Std. Dev.	7.2	15.8	243	2.7	0.028	0.021	0.941	0.779	12	0.777	0.003	1.3	10	35	0.4	no data	no data	3.3	0.0	0.0	0.0
	Count	13	14	12	12	14	14	14	14	14	14	14	14	14	14	14	no data	no data	14	1	1	1
Ngaruroro Rv at Ohiti	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.113	0.052	11	0.012	0.005	8.1	82	106	7.3	0.6	35.0	8.0	11.0	105.6	36.0
	5%'ile	0.5	1.5	2	0.1	0.003	0.002	0.124	0.055	13	0.023	0.005	8.1	83	107	7.4	0.6	35.4	8.1	no data	no data	no data
	25%'ile	2.3	1.5	8	0.6	0.006	0.002	0.184	0.102	19	0.082	0.005	9.4	95	118	7.7	1.1	41.0	10.3	29.1	106.3	40.5
	Median	6.4	6.0	15	0.8	0.008	0.005	0.213	0.130	26	0.120	0.005	11.1	100	130	7.8	1.6	46.5	13.2	38.0	107.5	49.2
	75%'ile	9.1	11.8	22	2.5	0.019	0.006	0.271	0.185	48	0.173	0.005	11.7	104	145	8.0	2.3	52.0	16.1	64.9	109.4	53.6
	95%'ile	135.2	191.1	204	4.1	0.135	0.010	0.352	0.252	83	0.231	0.071	12.4	112	168	8.5	3.5	57.8	18.6	no data	no data	no data
	Maximum	180.0	260.0	260	4.2	0.190	0.011	0.380	0.262	98	0.250	0.091	12.5	114	174	8.7	3.5	59.0	19.3	96.5	110.8	53.8
	Mean	19.4	25.8	33	1.4	0.022	0.005	0.224	0.140	34	0.123	0.012	10.7	100	132	7.8	1.7	46.1	13.1	47.0	107.9	47.0
	Std. Dev.	43.4	62.5	63	1.3	0.044	0.002	0.065	0.058	21	0.062	0.022	1.5	8	18	0.3	0.9	6.8	3.5	31.7	2.2	8.4
	Count	17	17	17	15	17	17	16	17	17	17	17	16	15	17	17	12	14	17	5	4	4

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Waitio Strm	Minimum	0.4	1.5	1	0.1	0.015	0.013	0.170	0.123	2	0.111	0.005	7.5	72	3	7.3	1.1	72.0	10.7	0.2	95.0	37.5
	5%'ile	0.5	1.5	2	1.2	0.016	0.013	0.201	0.126	3	0.114	0.005	7.8	78	209	7.6	1.1	73.0	12.7	no data	no data	no data
	25%'ile	0.9	1.5	21	2.1	0.020	0.016	0.224	0.152	7	0.139	0.005	9.0	90	229	7.8	1.7	86.0	13.4	12.3	96.4	42.0
	Median	1.2	1.5	35	3.0	0.031	0.025	0.337	0.247	10	0.235	0.005	9.9	97	249	8.0	2.0	96.5	14.9	31.0	99.1	45.5
	75%'ile	2.1	1.5	90	4.0	0.048	0.041	0.565	0.398	12	0.360	0.013	10.5	106	294	8.3	3.0	108.0	15.9	138.0	103.7	53.2
	95%'ile	8.3	17.6	1500	4.7	0.242	0.203	1.085	0.574	27	0.549	0.058	12.6	128	316	8.7	4.9	123.2	16.7	no data	no data	no data
	Maximum	77.3	98.0	3200	4.9	0.390	0.220	1.701	0.728	28	0.660	0.075	13.0	130	341	8.8	5.0	126.0	17.2	438.5	104.0	55.0
	Mean	4.2	5.2	227	2.9	0.053	0.040	0.450	0.295	10	0.275	0.013	9.9	98	252	8.0	2.4	96.4	14.7	108.5	99.7	46.8
	Std. Dev.	13.9	17.2	630	1.2	0.076	0.049	0.324	0.166	6	0.159	0.018	1.3	14	58	0.3	1.2	14.7	1.5	169.1	4.0	7.1
	Count	30	32	30	30	31	31	32	32	31	32	32	31	30	32	32	12	14	32	6	5	5
Ohiwa Strm	Minimum	0.5	1.5	60	0.8	0.088	0.068	0.180	0.014	0	0.001	0.005	8.3	82	507	7.5	no data	no data	9.5	no data	84.2	29.2
	5%'ile	0.6	1.5	62	0.8	0.088	0.071	0.180	0.014	0	0.001	0.005	8.5	83	509	7.6	no data	no data	9.7	no data	no data	no data
	25%'ile	1.2	1.5	95	1.4	0.098	0.090	0.229	0.108	1	0.095	0.005	10.0	98	590	8.1	no data	no data	13.1	no data	no data	no data
	Median	1.9	1.5	180	3.0	0.114	0.111	0.785	0.499	4	0.480	0.005	10.4	106	607	8.2	no data	no data	15.0	no data	84.2	29.2
	75%'ile	3.2	1.5	478	3.9	0.149	0.143	1.090	0.804	6	0.772	0.015	11.3	116	627	8.5	no data	no data	18.5	no data	no data	no data
	95%'ile	7.9	6.6	1756	6.2	0.222	0.203	1.612	0.963	8	0.914	0.045	13.9	137	692	8.8	no data	no data	23.3	no data	no data	no data
	Maximum	7.9	7.0	1800	6.2	0.230	0.210	1.630	0.973	8	0.920	0.045	14.2	137	698	8.8	no data	no data	23.5	no data	84.2	29.2
	Mean	2.8	2.1	405	3.0	0.131	0.121	0.768	0.475	4	0.453	0.013	10.7	108	605	8.3	no data	no data	16.0	no data	84.2	29.2
	Std. Dev.	2.5	1.6	528	1.8	0.042	0.039	0.513	0.369	3	0.358	0.014	1.5	17	51	0.3	no data	no data	4.3	no data	0.0	0.0
	Count	12	12	11	12	13	13	13	13	13	13	13	13	13	13	13	no data	no data	13	no data	1	1
Ngaruroro Rv at Fernhill	Minimum	0.4	1.5	1	0.1	0.002	0.002	0.055	0.014	3	0.001	0.005	8.4	91	116	7.5	0.9	39.0	8.4	0.1	86.7	38.1
	5%'ile	0.6	1.5	1	0.2	0.002	0.002	0.055	0.014	4	0.001	0.005	8.6	96	124	7.6	0.9	39.6	8.7	0.1	no data	no data
	25%'ile	2.4	1.5	11	0.5	0.006	0.004	0.130	0.061	9	0.025	0.005	9.9	101	147	7.8	1.3	43.0	11.2	1.2	90.9	41.0
	Median	5.2	5.5	26	1.2	0.010	0.007	0.212	0.134	16	0.121	0.005	11.0	103	160	8.0	1.6	53.5	14.7	6.3	96.5	45.6
	75%'ile	13.1	16.5	52	1.9	0.021	0.012	0.300	0.236	23	0.220	0.005	11.4	107	172	8.3	2.1	61.0	18.0	120.8	99.9	48.7
	95%'ile	200.0	268.9	340	6.2	0.181	0.034	0.435	0.305	34	0.294	0.041	12.4	120	219	9.2	3.4	64.6	21.9	251.4	no data	no data
	Maximum	562.0	840.0	8000	6.4	0.690	0.090	0.590	0.362	155	0.350	0.096	12.6	128	222	9.3	3.4	65.0	23.1	274.8	101.9	50.0
	Mean	34.2	46.2	312	1.7	0.041	0.011	0.225	0.146	20	0.128	0.010	10.7	105	163	8.1	1.7	52.9	14.9	60.3	95.4	44.8
	Std. Dev.	106.2	153.8	1454	1.7	0.122	0.016	0.135	0.099	25	0.101	0.017	1.1	8	26	0.5	0.8	8.8	4.2	87.3	6.4	5.2
	Count	30	32	30	28	33	33	32	34	33	34	34	32	31	33	33	12	14	33	15	4	4
Ngaruroro Rv at Motorway	Minimum	0.5	1.5	1	0.1	0.004	0.002	0.087	0.027	6	0.015	0.005	7.7	83	115	7.6	0.3	36.0	8.7	2.9	90.0	30.8
	5%'ile	0.5	1.5	1	0.1	0.004	0.002	0.099	0.031	8	0.020	0.005	8.0	84	115	7.6	0.3	36.4	8.8	no data	no data	no data
	25%'ile	2.5	1.5	2	0.6	0.007	0.006	0.166	0.090	14	0.077	0.005	9.9	99	131	7.8	1.2	44.0	11.1	4.4	90.0	34.7
	Median	4.9	4.8	7	1.0	0.013	0.008	0.240	0.140	19	0.120	0.005	11.2	105	142	7.9	1.8	50.5	15.1	20.5	96.6	40.7
	75%'ile	10.0	11.3	28	1.9	0.017	0.008	0.300	0.212	27	0.182	0.005	12.1	111	156	8.1	2.4	55.0	18.3	62.5	111.6	42.9
	95%'ile	150.4	226.7	391	5.1	0.146	0.016	0.466	0.270	41	0.250	0.044	13.1	132	8254	8.8	5.5	63.2	22.9	no data	no data	no data
	Maximum	200.0	310.0	510	5.4	0.200	0.019	0.480	0.272	46	0.260	0.046	13.2	136	12600	8.9	5.7	64.0	23.7	90.0	120.0	42.9
	Mean	20.6	28.5	49	1.5	0.026	0.007	0.241	0.144	21	0.127	0.010	10.9	106	875	8.0	2.1	50.1	15.0	33.5	100.8	38.8
	Std. Dev.	48.4	74.6	125	1.5	0.046	0.004	0.108	0.077	9	0.073	0.013	1.5	13	3021	0.3	1.5	8.1	4.5	40.4	14.2	5.7
	Count	17	17	17	15	17	17	17	17	17	17	17	15	14	17	16	12	14	17	4	4	4

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri-Waimate Strm	Minimum	1.3	1.5	26	0.3	0.026	0.002	0.055	0.014	1	0.001	0.005	7.6	71	152	7.3	1.1	92.0	12.0	no data	74.7	21.1
	5%'ile	1.5	1.5	41	0.4	0.027	0.022	0.107	0.020	1	0.008	0.005	7.7	73	238	7.5	no data	92.4	12.1	no data	no data	no data
	25%'ile	3.1	5.0	60	0.6	0.036	0.026	0.265	0.180	6	0.166	0.005	9.7	94	258	7.7	2.2	100.0	13.3	no data	76.3	23.0
	Median	5.1	8.0	87	1.1	0.046	0.031	0.368	0.253	9	0.230	0.013	10.7	102	278	8.1	2.6	104.0	15.0	no data	81.1	28.6
	75%'ile	8.7	16.0	160	1.5	0.061	0.037	0.589	0.422	11	0.380	0.029	11.8	120	298	8.4	3.6	120.3	16.9	no data	87.8	32.1
	95%'ile	14.0	29.1	2615	2.6	0.122	0.068	1.224	0.771	24	0.681	0.080	13.9	144	385	8.8	no data	161.9	18.5	no data	no data	no data
	Maximum	14.1	31.0	4400	3.1	0.134	0.074	1.274	0.773	123	0.710	0.082	14.5	154	391	8.9	5.9	163.0	21.4	no data	90.0	33.3
	Mean	6.2	11.3	367	1.2	0.054	0.034	0.481	0.306	13	0.279	0.020	10.6	106	288	8.1	3.0	113.3	15.2	no data	81.9	27.7
	Std. Dev.	4.0	8.7	922	0.7	0.026	0.013	0.306	0.198	22	0.182	0.020	1.7	20	52	0.4	1.6	21.2	2.2	no data	7.7	6.2
	Count	28	29	27	24	28	29	29	29	29	29	29	27	26	29	29	9	11	29	no data	3	3
Ngaruroro Rv at Chesterhope (NIWA)	Minimum	0.4	no data	1	0.0	0.002	0.001	0.026	0.002	1	no data	0.001	8.4	96	61	7.7	no data	no data	7.5	no data	98.0	37.5
	5%'ile	0.6	no data	3	0.1	0.008	0.003	0.053	0.005	1	no data	0.001	8.8	97	114	7.8	no data	no data	9.0	no data	no data	no data
	25%'ile	1.4	no data	14	0.4	0.011	0.005	0.116	0.018	7	no data	0.003	9.6	99	131	7.9	no data	no data	11.8	no data	99.5	39.4
	Median	3.4	no data	28	1.3	0.018	0.008	0.173	0.106	14	no data	0.004	10.5	103	151	8.1	no data	no data	16.2	no data	103.2	45.5
	75%'ile	15.7	no data	70	2.3	0.033	0.010	0.305	0.170	20	no data	0.006	11.1	111	164	8.3	no data	no data	20.2	no data	110.6	48.0
	95%'ile	112.5	no data	625	6.0	0.182	0.019	0.492	0.301	31	no data	0.013	12.1	123	213	8.7	no data	no data	23.4	no data	no data	no data
	Maximum	150.0	no data	3448	9.1	0.199	0.033	0.588	0.325	38	no data	0.017	13.4	128	238	8.9	no data	no data	25.5	no data	115.0	50.0
	Mean	17.4	no data	140	1.8	0.035	0.008	0.211	0.113	14	no data	0.005	10.4	106	151	8.1	no data	no data	16.2	no data	105.1	44.1
	Std. Dev.	32.8	no data	461	1.9	0.047	0.005	0.132	0.091	10	no data	0.003	1.1	8	29	0.3	no data	no data	4.9	no data	7.0	5.2
	Count	60	no data	60	60	60	60	60	60	60	no data	60	60	60	60	60	no data	no data	60	no data	5	5
Tutaekuri Rv at Lawrence Hut	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.055	0.013	1	0.001	0.005	8.2	80	81	7.2	0.3	37.0	4.0	0.1	118.3	52.4
	5%'ile	0.4	1.5	1	1.0	0.002	0.002	0.055	0.014	3	0.001	0.005	8.8	93	87	7.5	0.4	37.6	4.7	0.1	no data	no data
	25%'ile	0.5	1.5	4	4.3	0.002	0.002	0.055	0.018	4	0.005	0.005	10.8	98	100	7.7	1.4	40.0	7.5	0.4	123.2	54.4
	Median	0.8	1.5	11	5.9	0.005	0.004	0.102	0.027	7	0.014	0.005	11.8	102	112	7.9	1.9	42.0	10.3	0.7	127.8	58.3
	75%'ile	1.2	1.5	18	8.3	0.006	0.005	0.131	0.040	14	0.024	0.005	12.0	107	123	8.1	2.3	45.0	13.4	8.2	129.4	62.8
	95%'ile	4.4	9.4	35	11.5	0.049	0.033	0.464	0.085	33	0.063	0.027	13.1	115	244	8.8	2.9	107.0	18.5	41.3	no data	no data
	Maximum	130.0	280.0	50	11.9	0.200	0.049	0.690	0.130	43	0.110	0.055	13.7	125	286	8.9	3.0	110.0	18.9	47.0	133.6	67.9
	Mean	5.1	10.5	13	6.2	0.013	0.007	0.126	0.035	10	0.019	0.008	11.4	103	121	7.9	1.8	49.9	10.6	6.7	126.5	58.9
	Std. Dev.	22.8	48.4	11	3.2	0.035	0.010	0.132	0.025	9	0.023	0.010	1.3	8	43	0.4	0.7	21.8	4.0	12.8	5.6	6.0
	Count	32	33	33	33	34	34	34	34	32	32	34	34	34	36	36	14	16	36	14	5	5
Mangatutu Strm	Minimum	1.1	1.5	1	0.3	0.010	0.002	0.300	0.155	13	0.141	0.005	10.2	99	223	8.1	no data	no data	7.2	590.0	111.8	52.9
	5%'ile	1.2	1.5	9	0.3	0.012	0.006	0.306	0.183	13	0.169	0.005	10.3	99	223	8.1	no data	no data	7.9	no data	no data	no data
	25%'ile	1.6	1.5	25	0.5	0.021	0.016	0.370	0.285	16	0.270	0.005	10.8	105	271	8.4	no data	no data	11.2	no data	no data	no data
	Median	2.8	4.5	42	1.4	0.024	0.018	0.460	0.334	20	0.320	0.005	11.8	109	302	8.6	no data	no data	12.4	590.0	111.8	52.9
	75%'ile	4.4	6.0	90	1.7	0.026	0.020	0.540	0.437	26	0.420	0.011	12.6	122	322	8.7	no data	no data	14.5	no data	no data	no data
	95%'ile	8.2	12.4	294	3.3	0.054	0.024	0.700	0.525	82	0.516	0.016	14.4	133	368	9.0	no data	no data	19.4	no data	no data	no data
	Maximum	8.6	16.0	410	3.4	0.055	0.025	0.740	0.545	112	0.540	0.017	14.4	136	383	9.0	no data	no data	20.3	590.0	111.8	52.9
	Mean	3.4	4.4	75	1.4	0.027	0.017	0.468	0.355	26	0.343	0.008	11.9	113	294	8.6	no data	no data	12.9	590.0	111.8	52.9
	Std. Dev.	2.1	3.6	91	0.9	0.012	0.005	0.121	0.103	22	0.105	0.004	1.3	11	44	0.2	no data	no data	3.2	0.0	0.0	0.0
	Count	17	18	18	18	18	18	18	18	18	18	18	19	19	19	19	no data	no data	19	1	1	1

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Tutaekuri Rv U/S Mangaone Rv	Minimum	0.8	1.5	1	0.1	0.002	0.002	0.055	0.014	3	0.001	0.005	9.1	92	151	6.9	0.6	97.0	8.4	0.1	80.0	27.3
	5%'ile	0.9	1.5	1	0.3	0.004	0.002	0.055	0.014	3	0.001	0.005	9.5	94	208	7.4	no data	97.0	8.6	0.2	no data	no data
	25%'ile	1.5	1.5	6	0.7	0.010	0.006	0.180	0.058	8	0.047	0.005	10.4	100	245	8.2	0.8	104.0	10.9	4.3	86.8	31.5
	Median	2.7	2.3	15	1.5	0.016	0.013	0.251	0.165	13	0.154	0.005	11.4	112	276	8.4	1.8	119.5	14.5	33.0	107.2	44.0
	75%'ile	4.2	5.0	30	2.6	0.028	0.018	0.382	0.289	25	0.270	0.005	12.2	121	302	8.8	3.0	133.0	16.8	46.0	114.6	48.5
	95%'ile	25.7	37.6	139	4.0	0.074	0.022	0.616	0.449	30	0.419	0.016	14.3	138	341	9.0	no data	152.0	21.3	81.6	no data	no data
	Maximum	45.8	66.0	1100	5.0	0.164	0.038	0.840	0.473	89	0.440	0.053	14.6	142	361	9.0	3.8	152.0	23.1	85.0	117.1	50.0
	Mean	5.7	6.8	61	1.7	0.025	0.012	0.291	0.191	18	0.177	0.007	11.5	113	273	8.4	1.9	121.4	14.2	31.0	101.4	40.4
	Std. Dev.	9.2	13.1	193	1.2	0.030	0.008	0.181	0.139	16	0.136	0.009	1.3	14	43	0.5	1.2	18.7	4.0	28.2	19.2	11.8
	Count	31	32	32	31	32	32	32	32	32	32	32	32	33	33	33	8	10	33	14	3	3
Mangaone Rv at Dartmoor	Minimum	0.8	1.5	31	1.2	0.019	0.006	0.110	0.014	1	0.001	0.005	8.3	93	344	8.1	no data	no data	6.9	no data	103.3	41.7
	5%'ile	0.8	1.5	31	1.2	0.020	0.008	0.114	0.014	1	0.001	0.005	8.5	93	345	8.1	no data	no data	7.3	no data	no data	no data
	25%'ile	1.5	1.5	40	1.6	0.029	0.021	0.178	0.068	3	0.053	0.005	9.7	96	372	8.3	no data	no data	12.0	no data	no data	no data
	Median	2.3	1.5	56	2.0	0.038	0.028	0.240	0.139	6	0.132	0.005	10.0	100	379	8.4	no data	no data	15.1	no data	103.3	41.7
	75%'ile	2.8	4.3	88	2.7	0.041	0.036	0.455	0.334	9	0.318	0.013	11.6	107	403	8.5	no data	no data	19.9	no data	no data	no data
	95%'ile	3.8	15.2	120	3.4	0.042	0.040	0.671	0.539	15	0.512	0.027	11.8	119	434	9.1	no data	no data	21.5	no data	no data	no data
	Maximum	3.8	17.0	120	3.4	0.042	0.040	0.700	0.567	16	0.540	0.028	11.8	121	435	9.2	no data	no data	21.6	no data	103.3	41.7
	Mean	2.2	3.4	67	2.1	0.034	0.027	0.316	0.202	6	0.187	0.010	10.3	102	385	8.5	no data	no data	15.1	no data	103.3	41.7
	Std. Dev.	0.9	4.3	32	0.7	0.007	0.010	0.180	0.170	4	0.166	0.008	1.1	8	27	0.2	no data	no data	4.7	no data	0.0	0.0
	Count	11	13	13	12	13	13	13	13	13	13	13	14	14	14	14	no data	no data	14	no data	1	1
Mangaone Rv at Rissington	Minimum	0.5	1.5	1	0.1	0.013	0.002	0.060	0.012	1	0.001	0.005	8.3	90	272	7.2	0.9	130.0	4.5	0.3	107.3	40.9
	5%'ile	0.7	1.5	2	0.3	0.014	0.007	0.143	0.022	2	0.010	0.005	8.8	93	290	7.4	0.9	130.4	6.4	0.9	no data	no data
	25%'ile	1.4	1.5	16	1.3	0.021	0.013	0.235	0.112	7	0.102	0.005	10.0	100	314	8.2	1.6	135.0	9.9	4.1	113.6	46.1
	Median	2.0	1.5	38	2.0	0.027	0.019	0.470	0.335	15	0.310	0.005	11.2	104	339	8.4	2.2	140.0	13.9	8.8	116.0	50.0
	75%'ile	3.0	4.8	85	2.4	0.039	0.027	0.613	0.455	24	0.440	0.011	12.0	115	354	8.6	3.0	145.0	17.0	49.0	122.5	53.7
	95%'ile	7.4	13.0	1426	3.0	0.095	0.039	1.007	0.746	42	0.722	0.022	13.5	135	392	8.9	3.4	167.6	22.5	143.2	no data	no data
	Maximum	19.0	116.0	2500	3.6	0.180	0.109	1.080	0.806	57	0.780	0.033	13.8	156	402	9.1	3.4	170.0	24.6	148.0	130.0	55.0
	Mean	2.9	6.5	175	1.8	0.035	0.022	0.473	0.318	17	0.302	0.009	11.1	108	335	8.3	2.2	142.6	13.4	36.3	117.8	49.4
	Std. Dev.	3.3	19.3	507	0.8	0.030	0.017	0.268	0.225	14	0.220	0.007	1.3	13	31	0.4	0.9	10.4	4.9	47.0	8.2	5.5
	Count	33	35	36	35	38	38	37	37	37	37	38	36	37	38	38	12	14	38	15	5	5
Tutaekuri Rv at Puketapu	Minimum	0.9	1.5	6	0.8	0.010	0.004	0.055	0.013	1	0.005	0.005	9.1	93	257	8.2	no data	no data	8.5	73.0	88.0	33.3
	5%'ile	0.9	1.5	6	0.8	0.010	0.004	0.063	0.014	1	0.005	0.005	9.1	94	260	8.2	no data	no data	8.7	no data	no data	no data
	25%'ile	1.4	1.5	10	1.2	0.014	0.010	0.119	0.026	3	0.014	0.005	9.9	95	300	8.3	no data	no data	12.2	no data	no data	no data
	Median	1.8	1.5	11	2.5	0.021	0.015	0.180	0.091	7	0.078	0.005	10.8	109	326	8.7	no data	no data	16.6	73.0	88.0	33.3
	75%'ile	2.6	3.5	29	2.9	0.027	0.022	0.315	0.197	9	0.184	0.005	11.5	128	335	9.0	no data	no data	20.7	no data	no data	no data
	95%'ile	7.0	9.7	48	3.6	0.200	0.024	0.399	0.318	13	0.305	0.014	12.4	137	357	9.2	no data	no data	24.0	no data	no data	no data
	Maximum	7.0	10.0	50	3.6	0.230	0.024	0.400	0.322	13	0.310	0.014	12.4	138	357	9.2	no data	no data	24.1	73.0	88.0	33.3
	Mean	2.6	3.0	18	2.2	0.036	0.015	0.218	0.121	7	0.110	0.006	10.8	112	318	8.7	no data	no data	16.9	73.0	88.0	33.3
	Std. Dev.	2.0	2.9	13	1.0	0.059	0.007	0.115	0.110	4	0.109	0.003	1.1	16	30	0.4	no data	no data	5.2	0.0	0.0	0.0
	Count	13	13	13	14	13	13	13	13	13	13	13	13	14	14	14	no data	no data	14	1	1	1

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri Rv at Brookfields Br	Minimum	0.3	1.5	1	0.3	0.002	0.002	0.055	0.015	1	0.003	0.005	8.6	92	151	7.3	0.6	120.0	9.0	58.0	81.9	27.3
	5%'ile	0.4	1.5	1	0.3	0.006	0.006	0.058	0.016	1	0.004	0.005	9.3	93	205	7.8	0.6	120.0	9.2	no data	no data	no data
	25%'ile	1.3	1.5	6	1.2	0.014	0.011	0.130	0.024	3	0.013	0.005	10.0	99	283	8.1	1.3	123.0	12.0	85.8	83.7	27.6
	Median	2.2	4.0	15	1.9	0.023	0.016	0.250	0.155	9	0.143	0.005	11.2	110	309	8.4	1.8	130.0	16.0	160.0	86.0	30.6
	75%'ile	4.4	6.8	31	2.6	0.031	0.025	0.438	0.337	15	0.318	0.013	11.8	128	325	8.7	2.7	135.0	19.9	340.0	88.2	36.7
	95%'ile	10.7	16.9	156	4.9	0.048	0.030	0.639	0.545	21	0.500	0.046	14.1	143	340	9.1	3.8	149.2	24.6	no data	no data	no data
	Maximum	23.2	40.0	250	6.0	0.061	0.035	0.804	0.550	22	0.530	0.048	14.3	144	349	9.1	3.9	150.0	25.4	460.0	90.0	40.0
	Mean	3.7	5.8	31	2.1	0.024	0.018	0.295	0.200	10	0.184	0.011	11.2	114	300	8.4	2.0	130.7	16.3	214.6	86.0	32.1
	Std. Dev.	4.4	7.5	51	1.4	0.013	0.008	0.189	0.175	7	0.172	0.011	1.4	18	41	0.4	1.0	9.2	5.0	165.3	3.3	5.9
	Count	29	31	31	32	31	31	31	31	31	31	31	31	31	31	32	12	14	32	5	4	4

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ngaruroro Rv at Kuripapango (NIWA)	Minimum	0.3	no data	1	0.8	0.002	0.001	0.023	0.002	2	no data	0.001	8.4	97	56	7.6	no data	no data	4.2	no data	116.8	no data
	5%'ile	0.3	no data	1	1.0	0.002	0.001	0.024	0.003	2	no data	0.001	8.6	98	62	7.7	no data	no data	5.3	no data	no data	no data
	25%'ile	0.5	no data	2	2.8	0.003	0.001	0.034	0.005	3	no data	0.001	9.6	100	66	7.8	no data	no data	7.6	no data	120.1	no data
	Median	0.8	no data	3	5.6	0.004	0.002	0.044	0.008	4	no data	0.002	10.6	100	72	7.9	no data	no data	11.0	no data	130.0	no data
	75%'ile	1.4	no data	7	7.6	0.005	0.003	0.056	0.012	6	no data	0.003	11.3	101	82	7.9	no data	no data	15.0	no data	132.4	no data
	95%'ile	5.9	no data	78	10.3	0.013	0.004	0.143	0.030	28	no data	0.005	12.2	102	108	8.2	no data	no data	19.1	no data	no data	no data
	Maximum	6.4	no data	91	10.9	0.018	0.004	0.171	0.047	47	no data	0.006	12.4	103	113	8.3	no data	no data	21.6	no data	133.2	no data
	Mean	1.4	no data	14	5.4	0.005	0.002	0.054	0.011	7	no data	0.002	10.5	100	76	7.9	no data	no data	11.4	no data	126.7	no data
	Std. Dev.	1.7	no data	24	2.8	0.004	0.001	0.034	0.009	9	no data	0.001	1.1	1	14	0.1	no data	no data	4.3	no data	8.7	no data
	Count	35	no data	35	35	35	35	35	35	35	no data	35	35	35	35	35	no data	no data	35	no data	3	no data
Taruarau Rv	Minimum	0.5	1.5	2	2.5	0.002	0.002	0.055	0.014	2	0.003	0.005	8.8	91	76	7.1	no data	no data	5.4	5.9	120.7	55.2
	5%'ile	0.5	1.5	no data	2.5	0.002	0.002	0.055	0.014	2	0.003	0.005	8.8	91	76	7.1	no data	no data	5.4	no data	no data	no data
	25%'ile	0.7	1.5	5	3.5	0.002	0.002	0.055	0.018	9	0.007	0.005	9.3	94	87	7.8	no data	no data	8.2	no data	no data	no data
	Median	1.1	1.5	11	4.8	0.002	0.002	0.055	0.022	11	0.010	0.005	11.6	103	112	8.0	no data	no data	10.3	5.9	120.7	55.2
	75%'ile	1.6	1.5	17	5.9	0.005	0.002	0.055	0.032	16	0.018	0.005	12.7	109	165	8.0	no data	no data	14.9	no data	no data	no data
	95%'ile	2.9	5.8	no data	6.6	0.006	0.008	0.120	0.054	27	0.041	0.039	13.2	116	202	8.7	no data	no data	20.1	no data	no data	no data
	Maximum	3.0	6.0	250	6.6	0.006	0.008	0.120	0.054	27	0.042	0.041	13.2	117	203	8.7	no data	no data	20.2	5.9	120.7	55.2
	Mean	1.3	1.9	37	4.7	0.003	0.003	0.067	0.028	13	0.014	0.008	11.1	102	127	8.0	no data	no data	11.7	5.9	120.7	55.2
	Std. Dev.	0.7	1.4	80	1.4	0.002	0.002	0.026	0.014	7	0.011	0.011	1.7	9	47	0.4	no data	no data	4.7	0.0	0.0	0.0
	Count	11	11	9	10	11	11	11	11	11	11	11	11	11	11	10	no data	no data	11	1	1	1
Ngaruroro Rv at Whanawhana	Minimum	0.3	1.5	1	0.2	0.002	0.002	0.055	0.014	5	0.001	0.005	9.5	83	78	7.3	0.3	24.0	5.7	0.2	109.2	44.4
	5%'ile	0.6	1.5	1	0.3	0.002	0.002	0.055	0.014	7	0.002	0.005	9.7	91	84	7.5	0.3	24.0	5.7	0.4	no data	no data
	25%'ile	1.1	1.5	1	1.6	0.002	0.002	0.055	0.024	11	0.011	0.005	10.3	101	96	7.7	0.7	29.5	8.6	2.7	111.5	48.6
	Median	1.6	1.5	3	2.5	0.002	0.002	0.055	0.042	15	0.017	0.005	11.2	103	102	7.9	1.7	34.0	11.5	23.0	115.8	54.2
	75%'ile	4.0	1.5	5	4.2	0.006	0.002	0.141	0.056	25	0.038	0.005	11.7	108	127	8.1	2.1	36.5	14.8	34.9	122.9	58.9
	95%'ile	22.3	23.3	39	9.2	0.011	0.005	0.387	0.175	87	0.161	0.018	12.9	118	176	8.9	2.4	46.8	18.6	112.0	no data	no data
	Maximum	23.4	44.0	90	9.7	0.013	0.005	0.852	0.272	136	0.260	0.020	12.9	119	177	9.1	2.4	48.0	19.2	119.0	134.7	61.9
	Mean	4.0	4.4	9	3.3	0.004	0.003	0.135	0.054	23	0.036	0.007	11.2	104	115	8.0	1.5	33.5	11.7	28.6	118.2	53.7
	Std. Dev.	5.8	8.7	18	2.6	0.003	0.001	0.158	0.053	26	0.053	0.004	1.0	7	28	0.4	0.8	6.6	4.0	34.7	9.9	6.8
	Count	28	28	26	28	30	30	29	28	28	28	29	28	27	29	29	11	13	29	13	5	5
Poporangi Strm	Minimum	0.5	1.5	19	0.2	0.024	0.015	0.260	0.130	8	0.118	0.005	8.9	94	154	7.3	no data	no data	6.8	3.8	108.9	55.6
	5%'ile	0.7	1.5	20	0.2	0.024	0.016	0.276	0.160	8	0.148	0.005	9.0	94	159	7.3	no data	no data	7.0	no data	no data	no data
	25%'ile	1.6	1.5	33	0.5	0.028	0.022	0.490	0.362	14	0.350	0.005	10.0	95	191	7.7	no data	no data	9.3	no data	no data	no data
	Median	2.1	4.0	58	1.7	0.032	0.025	0.688	0.538	22	0.525	0.005	10.7	100	209	7.9	no data	no data	11.5	3.8	108.9	55.6
	75%'ile	8.0	24.0	100	2.5	0.039	0.027	0.892	0.732	33	0.720	0.012	11.3	104	245	8.3	no data	no data	15.1	no data	no data	no data
	95%'ile	29.7	47.2	245	3.2	0.066	0.038	1.136	0.998	39	0.986	0.017	14.1	122	264	8.5	no data	no data	22.8	no data	no data	no data
	Maximum	32.4	48.0	260	3.3	0.069	0.040	1.150	1.032	40	1.020	0.018	14.5	122	266	8.6	no data	no data	24.4	3.8	108.9	55.6
	Mean	7.3	14.1	76	1.5	0.036	0.025	0.674	0.554	23	0.541	0.008	10.9	102	215	7.9	no data	no data	12.6	3.8	108.9	55.6
	Std. Dev.	9.5	16.3	66	1.1	0.013	0.006	0.272	0.250	11	0.250	0.004	1.4	10	34	0.4	no data	no data	4.5	0.0	0.0	0.0
	Count	14	14	12	13	14	14	14	14	14	14	14	13	13	14	13	no data	no data	14	1	1	1

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ngaruroro Rv U/S HB Dairies	Minimum	0.4	1.5	1	0.2	0.002	0.002	0.055	0.021	4	0.009	0.005	9.0	89	88	6.8	0.3	28.0	7.1	6.1	107.0	44.0
	5%'ile	0.4	1.5	1	0.3	0.002	0.002	0.055	0.022	6	0.010	0.005	9.1	89	89	7.0	0.3	28.0	7.1	no data	no data	no data
	25%'ile	1.1	1.5	2	1.3	0.002	0.002	0.119	0.031	13	0.019	0.005	10.5	97	99	7.6	0.7	34.0	8.3	14.3	108.3	44.2
	Median	2.0	1.5	7	2.4	0.005	0.002	0.139	0.052	16	0.040	0.005	11.2	101	107	7.6	1.6	37.0	11.8	105.2	113.2	47.2
	75%'ile	4.0	4.6	14	3.9	0.012	0.005	0.155	0.072	28	0.060	0.005	11.7	104	121	7.8	1.8	40.8	13.3	215.6	118.4	55.0
	95%'ile	19.5	20.7	26	5.3	0.020	0.007	0.392	0.118	56	0.097	0.024	12.9	109	151	8.1	3.0	48.3	18.6	no data	no data	no data
	Maximum	24.3	27.0	26	5.6	0.020	0.007	0.463	0.120	60	0.100	0.029	13.1	109	159	8.1	3.1	49.0	19.1	257.2	120.0	60.0
	Mean	4.0	4.0	9	2.6	0.008	0.003	0.150	0.055	21	0.042	0.007	11.0	100	111	7.6	1.4	37.5	11.6	117.5	113.3	49.6
	Std. Dev.	5.8	6.4	8	1.6	0.006	0.002	0.093	0.032	15	0.029	0.006	1.2	6	18	0.3	0.8	5.9	3.6	111.0	6.1	7.5
	Count	16	16	16	16	16	16	15	15	15	15	16	15	14	16	16	11	13	16	5	4	4
Ngaruroro Rv D/S HB Dairies	Minimum	0.4	1.5	1	0.1	0.002	0.002	0.055	0.032	14	0.026	0.005	8.6	81	97	6.4	0.3	30.0	7.3	0.1	92.5	42.9
	5%'ile	0.6	1.5	1	0.2	0.002	0.002	0.055	0.063	16	0.051	0.005	9.1	89	99	7.5	0.3	30.5	7.4	0.1	no data	no data
	25%'ile	1.6	1.5	1	0.6	0.004	0.002	0.110	0.073	18	0.062	0.005	10.1	98	115	7.6	0.9	39.3	10.6	10.3	105.0	45.4
	Median	4.5	5.7	6	1.2	0.007	0.005	0.177	0.104	27	0.095	0.005	10.8	102	129	7.8	1.5	42.0	13.6	23.5	110.0	50.0
	75%'ile	8.9	10.5	25	2.2	0.013	0.006	0.239	0.148	34	0.136	0.005	11.5	107	146	8.2	2.3	47.0	17.6	45.3	113.8	51.6
	95%'ile	27.1	48.6	85	6.4	0.036	0.008	0.310	0.207	55	0.195	0.010	12.4	117	190	9.1	3.1	55.0	20.6	241.7	no data	no data
	Maximum	47.0	59.0	110	6.7	0.036	0.009	0.335	0.292	60	0.280	0.044	12.8	131	193	9.3	3.1	56.0	21.2	260.0	116.3	56.3
	Mean	8.0	10.3	18	1.8	0.011	0.004	0.175	0.115	29	0.103	0.006	10.7	103	134	7.9	1.6	42.4	13.8	45.3	108.2	49.1
	Std. Dev.	10.2	13.9	26	1.8	0.010	0.002	0.086	0.056	12	0.054	0.007	1.1	10	26	0.6	0.8	6.8	4.1	71.1	9.2	5.0
	Count	29	29	27	29	31	31	30	30	30	30	31	29	28	30	30	11	13	30	12	5	5
Maraekakaho Strm	Minimum	0.3	1.5	15	1.4	0.007	0.005	0.160	0.091	4	0.078	0.005	7.9	80	503	7.1	no data	no data	8.8	7.3	107.4	52.6
	5%'ile	0.3	1.5	no data	no data	0.007	0.005	0.161	0.091	4	0.078	0.005	7.9	80	505	7.1	no data	no data	9.0	no data	no data	no data
	25%'ile	0.5	1.5	31	3.2	0.012	0.009	0.236	0.132	14	0.120	0.005	8.1	84	549	7.8	no data	no data	13.7	no data	no data	no data
	Median	0.6	1.5	60	5.1	0.026	0.023	0.402	0.282	18	0.270	0.005	9.2	93	561	8.0	no data	no data	15.6	7.3	107.4	52.6
	75%'ile	1.7	1.5	90	6.8	0.034	0.029	0.735	0.521	26	0.510	0.005	10.7	99	575	8.4	no data	no data	16.0	no data	no data	no data
	95%'ile	23.9	56.1	no data	no data	0.049	0.044	1.817	1.516	35	1.502	0.012	11.4	118	599	8.6	no data	no data	21.0	no data	no data	no data
	Maximum	25.0	59.0	130	9.3	0.050	0.045	1.860	1.554	35	1.540	0.012	11.4	119	600	8.6	no data	no data	21.2	7.3	107.4	52.6
	Mean	3.2	6.7	64	5.0	0.024	0.021	0.587	0.422	20	0.410	0.006	9.4	94	559	8.0	no data	no data	15.0	7.3	107.4	52.6
	Std. Dev.	7.3	17.3	42	2.5	0.014	0.013	0.500	0.438	9	0.438	0.002	1.4	11	26	0.4	no data	no data	3.1	0.0	0.0	0.0
	Count	11	11	9	9	11	11	11	11	11	11	11	11	11	11	11	no data	no data	11	1	1	1
Ngaruroro Rv at Ohiti	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.113	0.052	11	0.012	0.005	8.1	82	106	7.3	0.6	35.0	8.0	11.0	105.6	36.0
	5%'ile	0.5	1.5	2	0.1	0.003	0.002	0.122	0.055	13	0.021	0.005	8.1	84	109	7.4	0.6	35.5	8.1	no data	no data	no data
	25%'ile	2.0	1.5	8	0.6	0.006	0.002	0.182	0.101	19	0.081	0.005	10.1	99	119	7.7	1.0	43.3	9.7	29.1	106.3	40.5
	Median	5.6	5.5	14	0.8	0.007	0.005	0.200	0.127	28	0.115	0.005	11.2	101	130	7.8	1.5	47.0	13.0	38.0	107.5	49.2
	75%'ile	8.4	9.1	21	2.5	0.013	0.006	0.258	0.186	49	0.174	0.005	11.8	104	146	8.0	1.8	52.3	15.2	64.9	109.4	53.6
	95%'ile	46.0	55.5	79	4.1	0.032	0.010	0.284	0.253	85	0.234	0.074	12.5	113	169	8.6	3.1	58.1	18.7	no data	no data	no data
	Maximum	52.0	63.0	100	4.2	0.033	0.011	0.286	0.262	98	0.250	0.091	12.5	114	174	8.7	3.1	59.0	19.3	96.5	110.8	53.8
	Mean	9.4	11.2	19	1.4	0.012	0.005	0.213	0.141	35	0.123	0.012	10.8	100	133	7.8	1.6	46.8	12.9	47.0	107.9	47.0
	Std. Dev.	13.6	16.7	23	1.3	0.010	0.003	0.052	0.060	22	0.064	0.022	1.4	7	18	0.3	0.8	6.6	3.4	31.7	2.2	8.4
	Count	16	16	16	15	16	16	15	16	16	16	16	15	14	16	16	11	13	16	5	4	4

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Waitio Strm	Minimum	0.4	1.5	1	0.1	0.015	0.013	0.170	0.123	2	0.111	0.005	7.5	72	3	7.3	1.1	72.0	10.7	0.2	95.0	37.5
	5%'ile	0.5	1.5	2	1.1	0.016	0.013	0.200	0.126	3	0.114	0.005	7.8	77	208	7.6	1.1	72.5	12.7	no data	no data	no data
	25%'ile	0.9	1.5	21	2.0	0.020	0.017	0.223	0.153	7	0.141	0.005	9.0	90	228	7.8	1.7	84.5	13.3	9.3	95.9	41.5
	Median	1.2	1.5	35	3.2	0.032	0.028	0.337	0.247	9	0.235	0.005	9.8	97	249	8.0	2.1	96.5	14.9	21.9	100.2	49.0
	75%'ile	2.3	1.5	85	4.0	0.052	0.042	0.610	0.410	11	0.360	0.014	10.5	105	299	8.2	3.2	109.0	15.9	213.1	103.8	53.8
	95%'ile	15.2	19.0	1670	4.7	0.257	0.210	1.109	0.576	27	0.550	0.059	12.6	128	317	8.8	5.0	124.6	16.7	no data	no data	no data
	Maximum	77.3	98.0	3200	4.9	0.390	0.220	1.701	0.728	28	0.660	0.075	13.0	130	341	8.8	5.0	126.0	17.2	438.5	104.0	55.0
	Mean	4.5	5.4	234	3.0	0.055	0.042	0.458	0.300	10	0.279	0.014	9.8	98	253	8.0	2.5	96.3	14.7	122.2	99.9	47.6
	Std. Dev.	14.4	17.8	651	1.2	0.078	0.050	0.333	0.169	6	0.162	0.018	1.3	13	59	0.3	1.2	15.9	1.5	185.3	4.6	7.9
	Count	28	30	28	28	29	29	30	30	29	30	30	30	29	30	30	11	12	30	5	4	4
Ohiwa Strm	Minimum	0.5	1.5	60	0.8	0.088	0.068	0.180	0.014	0	0.001	0.005	8.3	82	507	7.5	no data	no data	9.5	no data	84.2	29.2
	5%'ile	0.6	1.5	62	0.8	0.088	0.071	0.180	0.014	0	0.001	0.005	8.5	83	509	7.6	no data	no data	9.7	no data	no data	no data
	25%'ile	1.2	1.5	95	1.4	0.098	0.090	0.229	0.108	1	0.095	0.005	10.0	98	590	8.1	no data	no data	13.1	no data	no data	no data
	Median	1.9	1.5	180	3.0	0.114	0.111	0.785	0.499	4	0.480	0.005	10.4	106	607	8.2	no data	no data	15.0	no data	84.2	29.2
	75%'ile	3.2	1.5	478	3.9	0.149	0.143	1.090	0.804	6	0.772	0.015	11.3	116	627	8.5	no data	no data	18.5	no data	no data	no data
	95%'ile	7.9	6.6	1756	6.2	0.222	0.203	1.612	0.963	8	0.914	0.045	13.9	137	692	8.8	no data	no data	23.3	no data	no data	no data
	Maximum	7.9	7.0	1800	6.2	0.230	0.210	1.630	0.973	8	0.920	0.045	14.2	137	698	8.8	no data	no data	23.5	no data	84.2	29.2
	Mean	2.8	2.1	405	3.0	0.131	0.121	0.768	0.475	4	0.453	0.013	10.7	108	605	8.3	no data	no data	16.0	no data	84.2	29.2
	Std. Dev.	2.5	1.6	528	1.8	0.042	0.039	0.513	0.369	3	0.358	0.014	1.5	17	51	0.3	no data	no data	4.3	no data	0.0	0.0
	Count	12	12	11	12	13	13	13	13	13	13	13	13	13	13	13	no data	no data	13	no data	1	1
Ngaruroro Rv at Fernhill	Minimum	0.4	1.5	1	0.1	0.002	0.002	0.055	0.014	4	0.001	0.005	8.4	91	116	7.6	0.9	39.0	8.4	0.1	86.7	38.1
	5%'ile	0.6	1.5	1	0.3	0.002	0.002	0.055	0.014	6	0.001	0.005	8.5	96	126	7.6	0.9	39.3	8.7	0.1	no data	no data
	25%'ile	2.0	1.5	11	0.5	0.006	0.002	0.098	0.055	9	0.017	0.005	9.9	102	151	7.8	1.2	50.0	11.8	1.2	90.9	41.0
	Median	4.3	4.5	20	1.3	0.009	0.007	0.200	0.118	16	0.106	0.005	11.0	105	162	8.0	1.6	55.5	15.1	6.3	96.5	45.6
	75%'ile	7.6	12.5	44	1.9	0.017	0.012	0.264	0.206	23	0.194	0.005	11.5	108	174	8.4	1.8	61.5	18.1	120.8	99.9	48.7
	95%'ile	28.6	37.5	212	6.2	0.035	0.023	0.444	0.310	41	0.300	0.011	12.5	121	222	9.2	3.0	64.8	22.1	251.4	no data	no data
	Maximum	31.6	42.0	340	6.4	0.072	0.036	0.590	0.362	155	0.350	0.096	12.6	128	222	9.3	3.0	65.0	23.1	274.8	101.9	50.0
	Mean	6.8	8.6	42	1.8	0.013	0.008	0.208	0.133	21	0.116	0.008	10.8	106	165	8.2	1.6	54.6	15.3	60.3	95.4	44.8
	Std. Dev.	7.8	10.2	70	1.8	0.014	0.007	0.129	0.096	27	0.101	0.017	1.1	8	26	0.5	0.6	8.3	4.2	87.3	6.4	5.2
	Count	26	28	26	27	29	29	29	30	29	30	30	28	27	29	29	10	12	29	15	4	4
Ngaruroro Rv at Motorway	Minimum	0.5	1.5	1	0.1	0.004	0.002	0.087	0.027	6	0.015	0.005	7.7	83	115	7.7	0.3	36.0	8.7	2.9	90.0	30.8
	5%'ile	0.5	1.5	1	0.2	0.004	0.002	0.095	0.030	7	0.018	0.005	7.9	83	119	7.7	0.3	36.8	8.8	no data	no data	no data
	25%'ile	2.2	1.5	1	0.6	0.006	0.006	0.153	0.085	14	0.073	0.005	10.0	102	136	7.8	1.2	49.5	11.7	4.4	90.0	34.7
	Median	3.7	4.0	3	1.2	0.013	0.007	0.221	0.131	19	0.119	0.005	11.2	106	144	8.0	1.6	52.0	15.1	20.5	96.6	40.7
	75%'ile	7.5	8.8	17	2.0	0.017	0.008	0.249	0.198	26	0.170	0.005	12.4	114	156	8.1	1.9	56.0	18.6	62.5	111.6	42.9
	95%'ile	24.7	27.0	138	5.1	0.038	0.017	0.443	0.265	42	0.253	0.034	13.1	134	9496	8.8	5.7	63.6	23.1	no data	no data	no data
	Maximum	29.4	32.0	170	5.4	0.045	0.019	0.480	0.272	46	0.260	0.041	13.2	136	12600	8.9	5.7	64.0	23.7	90.0	120.0	42.9
	Mean	6.2	6.9	20	1.6	0.013	0.007	0.222	0.136	21	0.121	0.008	11.0	107	976	8.0	1.9	51.9	15.2	33.5	100.8	38.8
	Std. Dev.	7.2	7.8	43	1.5	0.010	0.004	0.098	0.075	10	0.073	0.009	1.6	13	3216	0.3	1.5	7.3	4.4	40.4	14.2	5.7
	Count	15	15	15	14	15	15	15	15	15	15	15	13	12	15	14	10	12	15	4	4	4

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri-Waimate Strm	Minimum	1.3	1.5	26	0.3	0.026	0.002	0.055	0.014	1	0.001	0.005	7.6	71	152	7.3	2.0	92.0	12.0	no data	74.7	21.1
	5%'ile	1.4	1.5	42	0.4	0.027	0.022	0.104	0.019	1	0.007	0.005	7.7	73	233	7.5	no data	92.0	12.1	no data	no data	no data
	25%'ile	3.1	5.0	60	0.6	0.036	0.026	0.263	0.179	6	0.165	0.005	9.7	93	258	7.7	2.3	100.0	13.3	no data	76.3	23.0
	Median	5.1	7.3	94	1.1	0.046	0.031	0.370	0.264	8	0.245	0.013	10.6	101	277	8.0	2.7	106.5	15.0	no data	81.1	28.6
	75%'ile	9.0	16.0	170	1.5	0.061	0.037	0.627	0.434	12	0.390	0.029	11.9	117	305	8.4	4.1	123.0	16.6	no data	87.8	32.1
	95%'ile	14.0	29.2	2720	2.6	0.122	0.069	1.226	0.771	29	0.683	0.080	14.0	144	385	8.8	no data	163.0	18.6	no data	no data	no data
	Maximum	14.1	31.0	4400	3.1	0.134	0.074	1.274	0.773	123	0.710	0.082	14.5	154	391	8.9	5.9	163.0	21.4	no data	90.0	33.3
	Mean	6.2	11.3	380	1.2	0.054	0.034	0.487	0.310	13	0.282	0.021	10.6	105	288	8.1	3.2	114.6	15.1	no data	81.9	27.7
	Std. Dev.	4.0	8.9	938	0.7	0.026	0.014	0.310	0.201	22	0.184	0.021	1.7	20	52	0.4	1.5	21.8	2.2	no data	7.7	6.2
	Count	27	28	26	23	28	28	28	28	28	28	28	26	25	28	28	8	10	28	no data	3	3
Ngaruroro Rv at Chesterhope (NIWA)	Minimum	0.4	no data	1	0.2	0.002	0.001	0.026	0.002	1	no data	0.001	8.6	96	61	7.7	no data	no data	7.5	no data	98.0	no data
	5%'ile	0.5	no data	2	0.2	0.008	0.002	0.052	0.004	1	no data	0.001	8.9	97	123	7.8	no data	no data	8.9	no data	no data	no data
	25%'ile	1.2	no data	10	0.6	0.011	0.004	0.104	0.011	3	no data	0.003	9.7	101	141	8.0	no data	no data	12.3	no data	99.5	no data
	Median	2.2	no data	23	1.9	0.014	0.007	0.163	0.092	13	no data	0.004	10.5	105	154	8.2	no data	no data	17.4	no data	103.2	no data
	75%'ile	7.5	no data	49	2.7	0.024	0.010	0.215	0.142	20	no data	0.006	11.1	112	168	8.3	no data	no data	21.0	no data	110.6	no data
	95%'ile	27.4	no data	318	6.1	0.043	0.013	0.407	0.299	31	no data	0.010	12.1	125	217	8.8	no data	no data	23.8	no data	no data	no data
	Maximum	32.7	no data	770	9.1	0.080	0.033	0.493	0.308	38	no data	0.017	13.4	128	238	8.9	no data	no data	25.5	no data	115.0	no data
	Mean	5.9	no data	60	2.1	0.019	0.007	0.179	0.099	13	no data	0.004	10.5	107	156	8.2	no data	no data	16.5	no data	105.1	no data
	Std. Dev.	7.9	no data	125	1.9	0.013	0.005	0.109	0.088	10	no data	0.003	1.1	8	29	0.3	no data	no data	5.0	no data	7.0	no data
	Count	51	no data	51	51	51	51	51	51	51	no data	51	51	51	51	51	no data	no data	51	no data	5	no data
Tutaekuri Rv at Lawrence Hut	Minimum	0.3	1.5	1	0.1	0.002	0.002	0.055	0.013	1	0.001	0.005	8.2	80	81	7.2	1.0	37.0	4.0	0.1	118.3	52.4
	5%'ile	0.4	1.5	1	0.9	0.002	0.002	0.055	0.014	3	0.001	0.005	9.0	93	90	7.5	1.0	37.5	4.6	0.1	no data	no data
	25%'ile	0.5	1.5	3	4.4	0.002	0.002	0.055	0.018	4	0.005	0.005	10.8	98	101	7.7	1.6	40.0	7.6	0.4	121.6	53.7
	Median	0.8	1.5	11	6.0	0.004	0.003	0.103	0.027	8	0.014	0.005	11.8	102	112	7.9	1.9	42.0	10.3	0.7	126.3	56.7
	75%'ile	1.2	1.5	19	8.8	0.007	0.005	0.136	0.043	14	0.025	0.005	12.0	107	120	8.0	2.3	43.0	13.3	8.2	127.9	59.7
	95%'ile	4.4	9.8	36	11.5	0.049	0.034	0.492	0.086	34	0.064	0.028	13.1	116	257	8.8	2.9	107.5	18.0	41.3	no data	no data
	Maximum	130.0	280.0	50	11.9	0.200	0.049	0.690	0.130	43	0.110	0.055	13.7	125	286	8.9	3.0	110.0	18.7	47.0	128.0	61.1
	Mean	5.4	11.0	13	6.3	0.013	0.007	0.131	0.035	11	0.020	0.008	11.4	103	121	7.9	1.9	50.1	10.5	6.7	124.7	56.7
	Std. Dev.	23.6	49.9	11	3.2	0.036	0.011	0.135	0.026	9	0.023	0.010	1.2	8	44	0.4	0.6	22.5	3.8	12.8	4.5	3.8
	Count	30	31	31	31	32	32	32	30	30	30	32	32	32	34	34	13	15	34	14	4	4
Mangatutu Strm	Minimum	1.1	1.5	1	0.3	0.010	0.002	0.300	0.155	13	0.141	0.005	10.2	99	223	8.1	no data	no data	7.2	590.0	111.8	52.9
	5%'ile	1.2	1.5	9	0.3	0.012	0.006	0.306	0.183	13	0.169	0.005	10.3	99	223	8.1	no data	no data	7.9	no data	no data	no data
	25%'ile	1.6	1.5	25	0.5	0.021	0.016	0.370	0.285	16	0.270	0.005	10.8	105	271	8.4	no data	no data	11.2	no data	no data	no data
	Median	2.8	4.5	42	1.4	0.024	0.018	0.460	0.334	20	0.320	0.005	11.8	109	302	8.6	no data	no data	12.4	590.0	111.8	52.9
	75%'ile	4.4	6.0	90	1.7	0.026	0.020	0.540	0.437	26	0.420	0.011	12.6	122	322	8.7	no data	no data	14.5	no data	no data	no data
	95%'ile	8.2	12.4	294	3.3	0.054	0.024	0.700	0.525	82	0.516	0.016	14.4	133	368	9.0	no data	no data	19.4	no data	no data	no data
	Maximum	8.6	16.0	410	3.4	0.055	0.025	0.740	0.545	112	0.540	0.017	14.4	136	383	9.0	no data	no data	20.3	590.0	111.8	52.9
	Mean	3.4	4.4	75	1.4	0.027	0.017	0.468	0.355	26	0.343	0.008	11.9	113	294	8.6	no data	no data	12.9	590.0	111.8	52.9
	Std. Dev.	2.1	3.6	91	0.9	0.012	0.005	0.121	0.103	22	0.105	0.004	1.3	11	44	0.2	no data	no data	3.2	0.0	0.0	0.0
	Count	17	18	18	18	18	18	18	18	18	18	18	19	19	19	19	no data	no data	19	1	1	1

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri Rv U/S Mangaone Rv	Minimum	0.8	1.5	1	0.1	0.002	0.002	0.055	0.014	3	0.001	0.005	9.1	92	151	6.9	0.6	97.0	8.4	0.1	80.0	27.3
	5%'ile	0.9	1.5	1	0.3	0.004	0.002	0.055	0.014	3	0.001	0.005	9.5	94	212	7.4	no data	97.0	8.6	0.2	no data	no data
	25%'ile	1.5	1.5	5	0.8	0.010	0.006	0.180	0.057	8	0.045	0.005	10.4	100	250	8.2	0.8	104.0	11.0	4.3	86.8	31.5
	Median	2.6	1.5	13	1.5	0.016	0.013	0.242	0.152	13	0.140	0.005	11.3	112	276	8.4	1.8	119.5	14.7	33.0	107.2	44.0
	75%'ile	3.7	4.8	29	2.7	0.024	0.017	0.361	0.270	25	0.258	0.005	12.2	121	304	8.8	3.0	133.0	16.9	46.0	114.6	48.5
	95%'ile	12.9	15.9	140	4.1	0.076	0.022	0.615	0.419	30	0.409	0.016	14.4	138	342	9.0	no data	152.0	21.3	81.6	no data	no data
	Maximum	45.8	66.0	1100	5.0	0.164	0.038	0.840	0.473	89	0.420	0.053	14.6	142	361	9.0	3.8	152.0	23.1	85.0	117.1	50.0
	Mean	5.0	5.7	62	1.8	0.024	0.012	0.282	0.182	18	0.169	0.007	11.5	113	275	8.4	1.9	121.4	14.4	31.0	101.4	40.4
	Std. Dev.	8.5	11.8	196	1.2	0.030	0.008	0.176	0.133	16	0.129	0.009	1.3	15	43	0.5	1.2	18.7	3.9	28.2	19.2	11.8
	Count	30	31	31	30	31	31	31	31	31	31	31	31	32	32	32	8	10	32	14	3	3
Mangaone Rv at Dartmoor	Minimum	0.8	1.5	31	1.2	0.019	0.006	0.110	0.014	1	0.001	0.005	8.3	93	344	8.1	no data	no data	6.9	no data	103.3	41.7
	5%'ile	0.8	1.5	31	1.2	0.020	0.008	0.114	0.014	1	0.001	0.005	8.5	93	345	8.1	no data	no data	7.3	no data	no data	no data
	25%'ile	1.5	1.5	40	1.6	0.029	0.021	0.178	0.068	3	0.053	0.005	9.7	96	372	8.3	no data	no data	12.0	no data	no data	no data
	Median	2.3	1.5	56	2.0	0.038	0.028	0.240	0.139	6	0.132	0.005	10.0	100	379	8.4	no data	no data	15.1	no data	103.3	41.7
	75%'ile	2.8	4.3	88	2.7	0.041	0.036	0.455	0.334	9	0.318	0.013	11.6	107	403	8.5	no data	no data	19.9	no data	no data	no data
	95%'ile	3.8	15.2	120	3.4	0.042	0.040	0.671	0.539	15	0.512	0.027	11.8	119	434	9.1	no data	no data	21.5	no data	no data	no data
	Maximum	3.8	17.0	120	3.4	0.042	0.040	0.700	0.567	16	0.540	0.028	11.8	121	435	9.2	no data	no data	21.6	no data	103.3	41.7
	Mean	2.2	3.4	67	2.1	0.034	0.027	0.316	0.202	6	0.187	0.010	10.3	102	385	8.5	no data	no data	15.1	no data	103.3	41.7
	Std. Dev.	0.9	4.3	32	0.7	0.007	0.010	0.180	0.170	4	0.166	0.008	1.1	8	27	0.2	no data	no data	4.7	no data	0.0	0.0
	Count	11	13	13	12	13	13	13	13	13	13	13	14	14	14	14	no data	no data	14	no data	1	1
Mangaone Rv at Rissington	Minimum	0.5	1.5	1	0.1	0.013	0.002	0.060	0.012	1	0.001	0.005	8.3	90	272	7.2	0.9	130.0	4.5	0.3	107.3	40.9
	5%'ile	0.7	1.5	2	0.3	0.014	0.007	0.143	0.022	2	0.010	0.005	8.8	93	290	7.4	0.9	130.4	6.4	0.9	no data	no data
	25%'ile	1.4	1.5	16	1.3	0.021	0.013	0.235	0.112	7	0.102	0.005	10.0	100	314	8.2	1.6	135.0	9.9	4.1	113.6	46.1
	Median	2.0	1.5	38	2.0	0.027	0.019	0.470	0.335	15	0.310	0.005	11.2	104	339	8.4	2.2	140.0	13.9	8.8	116.0	50.0
	75%'ile	3.0	4.8	85	2.4	0.039	0.027	0.613	0.455	24	0.440	0.011	12.0	115	354	8.6	3.0	145.0	17.0	49.0	122.5	53.7
	95%'ile	7.4	13.0	1426	3.0	0.095	0.039	1.007	0.746	42	0.722	0.022	13.5	135	392	8.9	3.4	167.6	22.5	143.2	no data	no data
	Maximum	19.0	116.0	2500	3.6	0.180	0.109	1.080	0.806	57	0.780	0.033	13.8	156	402	9.1	3.4	170.0	24.6	148.0	130.0	55.0
	Mean	2.9	6.5	175	1.8	0.035	0.022	0.473	0.318	17	0.302	0.009	11.1	108	335	8.3	2.2	142.6	13.4	36.3	117.8	49.4
	Std. Dev.	3.3	19.3	507	0.8	0.030	0.017	0.268	0.225	14	0.220	0.007	1.3	13	31	0.4	0.9	10.4	4.9	47.0	8.2	5.5
	Count	33	35	36	35	38	38	37	37	37	37	38	36	37	38	38	12	14	38	15	5	5
Tutaekuri Rv at Puketapu	Minimum	0.9	1.5	6	0.8	0.010	0.004	0.055	0.013	1	0.005	0.005	9.1	93	257	8.2	no data	no data	8.5	73.0	88.0	33.3
	5%'ile	0.9	1.5	6	0.8	0.010	0.004	0.063	0.014	1	0.005	0.005	9.1	94	260	8.2	no data	no data	8.7	no data	no data	no data
	25%'ile	1.4	1.5	10	1.2	0.014	0.010	0.119	0.026	3	0.014	0.005	9.9	95	300	8.3	no data	no data	12.2	no data	no data	no data
	Median	1.8	1.5	11	2.5	0.021	0.015	0.180	0.091	7	0.078	0.005	10.8	109	326	8.7	no data	no data	16.6	73.0	88.0	33.3
	75%'ile	2.6	3.5	29	2.9	0.027	0.022	0.315	0.197	9	0.184	0.005	11.5	128	335	9.0	no data	no data	20.7	no data	no data	no data
	95%'ile	7.0	9.7	48	3.6	0.200	0.024	0.399	0.318	13	0.305	0.014	12.4	137	357	9.2	no data	no data	24.0	no data	no data	no data
	Maximum	7.0	10.0	50	3.6	0.230	0.024	0.400	0.322	13	0.310	0.014	12.4	138	357	9.2	no data	no data	24.1	73.0	88.0	33.3
	Mean	2.6	3.0	18	2.2	0.036	0.015	0.218	0.121	7	0.110	0.006	10.8	112	318	8.7	no data	no data	16.9	73.0	88.0	33.3
	Std. Dev.	2.0	2.9	13	1.0	0.059	0.007	0.115	0.110	4	0.109	0.003	1.1	16	30	0.4	no data	no data	5.2	0.0	0.0	0.0
	Count	13	13	13	14	13	13	13	13	13	13	13	13	14	14	14	no data	no data	14	1	1	1

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Tutaekuri Rv at Brookfields Br	Minimum	0.3	1.5	1	0.3	0.002	0.002	0.055	0.015	1	0.003	0.005	8.6	92	151	7.3	0.6	120.0	9.0	58.0	81.9	27.8
	5%'ile	0.6	1.5	1	0.4	0.006	0.006	0.103	0.016	1	0.004	0.005	9.2	93	200	7.8	0.6	120.0	9.1	no data	no data	no data
	25%'ile	1.4	1.5	5	1.3	0.014	0.011	0.141	0.033	3	0.018	0.005	9.9	98	285	8.1	1.3	122.5	12.1	85.8	83.0	29.2
	Median	2.2	4.0	15	1.9	0.023	0.016	0.250	0.155	9	0.143	0.005	11.1	110	309	8.4	1.9	130.0	16.0	160.0	86.4	33.3
	75%'ile	4.3	6.3	28	2.5	0.029	0.024	0.432	0.326	15	0.313	0.012	11.8	128	325	8.6	2.8	135.0	19.5	340.0	89.1	38.3
	95%'ile	8.7	14.2	165	5.0	0.038	0.027	0.574	0.515	21	0.500	0.047	14.1	143	341	9.1	3.9	149.4	24.7	no data	no data	no data
	Maximum	10.0	17.0	250	6.0	0.048	0.035	0.643	0.547	22	0.500	0.048	14.3	144	349	9.1	3.9	150.0	25.4	460.0	90.0	40.0
	Mean	3.1	4.8	31	2.1	0.022	0.017	0.286	0.194	10	0.178	0.011	11.1	114	300	8.4	2.0	130.8	16.3	214.6	86.1	33.7
	Std. Dev.	2.4	4.0	53	1.3	0.011	0.008	0.164	0.165	7	0.162	0.012	1.4	17	42	0.4	1.0	9.6	4.9	165.3	4.1	6.1
	Count	27	29	29	30	29	29	29	29	29	29	29	29	29	29	30	11	13	30	5	3	3

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Ngaruroro Rv at Kuripapango (NIWA)	Minimum	0.3	no data	1	4.6	0.002	0.001	0.023	0.002	2	no data	0.001	8.4	97	64	7.8	no data	no data	4.2	no data	116.8	no data
	5%'ile	0.3	no data	1	4.8	0.002	0.001	0.025	0.002	2	no data	0.001	8.4	98	65	7.8	no data	no data	4.5	no data	no data	no data
	25%'ile	0.4	no data	2	6.1	0.002	0.001	0.032	0.004	3	no data	0.001	9.3	100	75	7.9	no data	no data	8.7	no data	120.1	no data
	Median	0.5	no data	3	7.6	0.003	0.002	0.036	0.005	4	no data	0.002	9.7	101	84	7.9	no data	no data	14.9	no data	130.0	no data
	75%'ile	0.7	no data	6	8.6	0.004	0.002	0.046	0.008	5	no data	0.003	11.3	101	97	8.0	no data	no data	16.1	no data	132.4	no data
	95%'ile	1.1	no data	49	10.9	0.008	0.003	0.109	0.017	17	no data	0.005	12.3	102	112	8.3	no data	no data	21.1	no data	no data	no data
	Maximum	1.2	no data	67	10.9	0.009	0.003	0.133	0.020	20	no data	0.005	12.4	103	113	8.3	no data	no data	21.6	no data	133.2	no data
	Mean	0.5	no data	8	7.6	0.004	0.002	0.044	0.007	5	no data	0.002	10.1	101	86	8.0	no data	no data	13.2	no data	126.7	no data
	Std. Dev.	0.3	no data	16	1.8	0.002	0.001	0.025	0.004	4	no data	0.001	1.2	1	14	0.2	no data	no data	5.1	no data	8.7	no data
	Count	16	no data	16	16	16	16	16	16	16	no data	16	16	16	16	16	no data	no data	16	no data	3	no data
Taruarau Rv	Minimum	0.5	1.5	2	2.5	0.002	0.002	0.055	0.014	2	0.003	0.005	8.8	91	100	7.8	no data	no data	9.8	5.9	120.7	55.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.6	1.5	5	3.4	0.002	0.002	0.055	0.016	8	0.005	0.005	9.2	93	107	7.9	no data	no data	10.2	no data	no data	no data
	Median	0.9	1.5	13	4.9	0.002	0.002	0.055	0.025	12	0.009	0.005	10.1	106	133	8.0	no data	no data	13.7	5.9	120.7	55.2
	75%'ile	1.5	1.5	23	6.1	0.003	0.002	0.055	0.032	16	0.018	0.005	12.6	112	188	8.0	no data	no data	16.2	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.8	6.0	250	6.6	0.006	0.008	0.055	0.051	26	0.020	0.041	13.2	117	203	8.2	no data	no data	20.2	5.9	120.7	55.2
	Mean	1.1	2.1	51	4.8	0.003	0.003	0.055	0.026	12	0.011	0.009	10.7	104	145	8.0	no data	no data	13.8	5.9	120.7	55.2
	Std. Dev.	0.5	1.6	98	1.6	0.001	0.002	0.000	0.012	7	0.007	0.013	1.8	10	43	0.1	no data	no data	3.7	0.0	0.0	0.0
	Count	8	8	6	7	8	8	8	8	8	8	8	8	8	8	8	no data	no data	8	1	1	1
Ngaruroro Rv at Whanawhana	Minimum	0.3	1.5	1	1.4	0.002	0.002	0.055	0.014	7	0.001	0.005	9.5	83	92	7.3	0.3	28.0	5.7	0.2	109.2	44.4
	5%'ile	0.4	1.5	1	1.6	0.002	0.002	0.055	0.014	7	0.001	0.005	9.5	85	92	7.3	no data	no data	6.2	0.3	no data	no data
	25%'ile	0.9	1.5	1	3.6	0.002	0.002	0.055	0.021	11	0.003	0.005	9.8	101	101	7.6	0.5	32.5	10.4	3.7	111.5	48.6
	Median	1.1	1.5	3	4.2	0.002	0.002	0.055	0.027	14	0.011	0.005	10.5	104	126	8.0	1.1	36.0	13.9	23.0	115.8	54.2
	75%'ile	1.7	1.5	3	7.8	0.005	0.002	0.118	0.055	26	0.017	0.005	11.2	110	159	8.3	2.1	39.5	17.3	28.9	122.9	58.9
	95%'ile	4.7	6.7	4	9.6	0.009	0.003	0.730	0.239	114	0.216	0.016	12.6	112	176	8.9	no data	no data	19.1	71.0	no data	no data
	Maximum	4.8	8.0	4	9.7	0.010	0.004	0.852	0.272	136	0.260	0.020	12.9	113	177	8.9	2.4	48.0	19.2	72.0	134.7	61.9
	Mean	1.6	2.0	2	5.0	0.004	0.002	0.145	0.053	25	0.029	0.006	10.6	104	131	8.0	1.3	36.6	13.6	22.8	118.2	53.7
	Std. Dev.	1.4	1.7	1	2.7	0.002	0.001	0.211	0.068	33	0.067	0.004	1.0	8	31	0.5	0.9	6.4	4.2	22.9	9.9	6.8
	Count	14	14	12	14	16	16	15	14	14	14	15	14	13	15	15	6	7	15	11	5	5
Poporangi Strm	Minimum	0.5	1.5	19	0.5	0.025	0.015	0.260	0.130	8	0.118	0.005	8.9	94	186	7.3	no data	no data	6.8	3.8	108.9	55.6
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.4	1.5	25	1.0	0.028	0.023	0.440	0.348	12	0.335	0.005	9.8	95	200	7.5	no data	no data	10.4	no data	no data	no data
	Median	1.6	3.0	41	2.1	0.029	0.025	0.515	0.427	17	0.410	0.005	10.1	99	241	7.8	no data	no data	14.5	3.8	108.9	55.6
	75%'ile	4.5	14.0	90	2.8	0.035	0.027	0.744	0.609	23	0.595	0.009	11.0	101	253	7.9	no data	no data	16.3	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	19.0	26.0	260	3.3	0.069	0.040	0.892	0.772	35	0.760	0.018	11.3	122	266	8.2	no data	no data	24.4	3.8	108.9	55.6
	Mean	4.3	8.1	79	2.0	0.034	0.026	0.569	0.459	18	0.445	0.007	10.3	101	230	7.8	no data	no data	14.2	3.8	108.9	55.6
	Std. Dev.	6.3	10.5	92	1.0	0.015	0.007	0.213	0.210	9	0.210	0.005	0.8	10	30	0.3	no data	no data	5.4	0.0	0.0	0.0
	Count	8	8	6	7	8	8	8	8	8	8	8	7	7	8	7	no data	no data	8	1	1	1

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ngaruroro Rv U/S HB Dairies	Minimum	0.4	1.5	1	1.5	0.002	0.002	0.055	0.021	4	0.009	0.005	9.0	97	97	6.8	0.3	34.0	7.1	6.1	107.0	44.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.7	1.5	2	2.7	0.002	0.002	0.116	0.027	11	0.014	0.005	9.6	97	105	7.6	0.3	37.3	11.4	14.3	108.3	44.2
	Median	1.5	1.5	7	3.9	0.002	0.002	0.121	0.031	14	0.020	0.005	10.6	101	121	7.8	1.2	40.0	13.3	105.2	113.2	47.2
	75%'ile	2.0	1.5	12	4.5	0.004	0.004	0.124	0.033	16	0.023	0.005	11.4	108	132	8.0	1.8	43.8	16.1	215.6	118.4	55.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	3.0	1.5	19	5.6	0.014	0.007	0.148	0.058	18	0.046	0.012	13.1	109	159	8.1	3.1	49.0	19.1	257.2	120.0	60.0
	Mean	1.5	1.5	7	3.6	0.004	0.003	0.115	0.033	13	0.021	0.006	10.8	102	121	7.7	1.3	40.7	13.5	117.5	113.3	49.6
	Std. Dev.	0.9	0.0	7	1.4	0.004	0.002	0.028	0.011	4	0.011	0.002	1.4	5	20	0.4	1.1	5.0	3.8	111.0	6.1	7.5
	Count	8	8	8	8	8	8	7	8	8	8	8	7	6	8	8	6	7	8	5	4	4
Ngaruroro Rv D/S HB Dairies	Minimum	0.4	1.5	1	1.1	0.002	0.002	0.055	0.032	16	0.026	0.005	8.6	81	109	6.4	0.3	40.0	7.6	0.1	92.5	42.9
	5%'ile	0.5	1.5	1	1.1	0.002	0.002	0.055	0.040	16	0.032	0.005	8.7	82	110	6.7	no data	no data	8.0	0.5	no data	no data
	25%'ile	1.2	1.5	3	1.5	0.002	0.002	0.055	0.068	17	0.057	0.005	9.1	98	123	7.7	0.8	41.3	13.4	13.6	105.0	45.4
	Median	1.6	1.5	5	2.2	0.005	0.002	0.127	0.074	32	0.067	0.005	10.4	107	146	8.2	1.6	47.0	15.6	29.0	110.0	50.0
	75%'ile	3.8	4.0	9	4.0	0.008	0.004	0.173	0.086	39	0.074	0.005	11.5	114	170	8.7	2.3	48.5	19.6	47.5	113.8	51.6
	95%'ile	6.5	6.0	34	6.6	0.028	0.007	0.303	0.118	56	0.106	0.009	12.6	129	192	9.2	no data	no data	21.0	250.9	no data	no data
	Maximum	7.0	6.0	36	6.7	0.036	0.007	0.335	0.119	60	0.107	0.010	12.8	131	193	9.3	3.1	56.0	21.2	260.0	116.3	56.3
	Mean	2.3	2.8	8	3.0	0.007	0.003	0.128	0.079	30	0.068	0.005	10.4	105	148	8.1	1.6	46.0	15.9	49.4	108.2	49.1
	Std. Dev.	1.9	1.8	10	1.9	0.008	0.002	0.083	0.022	13	0.021	0.001	1.3	13	28	0.7	1.0	5.6	4.2	73.1	9.2	5.0
	Count	14	14	12	14	16	16	15	15	15	15	16	14	13	15	15	6	7	15	11	5	5
Maraekakaho Strm	Minimum	0.3	1.5	15	1.4	0.007	0.005	0.160	0.091	4	0.078	0.005	7.9	80	503	7.1	no data	no data	8.8	7.3	107.4	52.6
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	29	3.0	0.010	0.007	0.200	0.111	13	0.097	0.005	8.0	82	545	7.7	no data	no data	13.9	no data	no data	no data
	Median	0.6	1.5	46	5.7	0.018	0.014	0.302	0.158	17	0.146	0.005	8.5	90	560	7.9	no data	no data	15.7	7.3	107.4	52.6
	75%'ile	1.0	1.5	130	8.1	0.028	0.025	0.502	0.312	23	0.300	0.005	9.4	94	575	8.0	no data	no data	16.0	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	25.0	59.0	130	9.3	0.036	0.030	0.990	0.802	34	0.790	0.012	11.3	97	600	8.2	no data	no data	21.2	7.3	107.4	52.6
	Mean	3.7	8.7	66	5.5	0.019	0.016	0.395	0.257	18	0.244	0.006	8.9	89	558	7.8	no data	no data	15.1	7.3	107.4	52.6
	Std. Dev.	8.6	20.3	52	3.0	0.011	0.010	0.281	0.238	9	0.238	0.002	1.2	6	29	0.3	no data	no data	3.4	0.0	0.0	0.0
	Count	8	8	6	6	8	8	8	8	8	8	8	8	8	8	8	no data	no data	8	1	1	1
Ngaruroro Rv at Ohiti	Minimum	0.3	1.5	3	0.8	0.002	0.002	0.113	0.052	11	0.012	0.005	8.4	94	118	7.6	0.6	45.0	8.4	11.0	105.6	36.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.0	1.5	11	1.4	0.005	0.002	0.152	0.076	19	0.046	0.005	9.0	94	127	7.8	0.7	46.3	12.7	29.1	106.3	40.5
	Median	2.0	1.5	15	2.7	0.006	0.005	0.181	0.101	22	0.081	0.005	10.4	100	146	8.0	1.6	49.0	14.3	38.0	107.5	49.2
	75%'ile	3.5	3.5	21	3.6	0.006	0.006	0.192	0.111	39	0.100	0.005	12.0	103	155	8.2	1.8	53.0	17.0	64.9	109.4	53.6
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	6.8	6.0	24	4.2	0.007	0.007	0.261	0.171	52	0.158	0.091	12.5	114	174	8.7	1.8	59.0	19.3	96.5	110.8	53.8
	Mean	2.5	2.6	15	2.5	0.006	0.004	0.178	0.100	28	0.078	0.016	10.5	101	143	8.0	1.3	50.3	14.4	47.0	107.9	47.0
	Std. Dev.	2.1	1.7	7	1.3	0.002	0.002	0.046	0.036	16	0.044	0.030	1.6	7	19	0.3	0.6	5.0	3.4	31.7	2.2	8.4
	Count	8	8	8	7	8	8	7	8	8	8	8	7	6	8	8	6	7	8	5	4	4

< Median flow

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Waitio Strm	Minimum	0.4	1.5	2	1.4	0.015	0.013	0.170	0.123	5	0.111	0.005	7.5	72	208	7.7	1.1	72.0	13.0	0.2	95.0	37.5
	5%'ile	0.4	1.5	3	1.4	0.015	0.013	0.175	0.123	5	0.111	0.005	7.6	73	209	7.7	no data	no data	13.1	no data	no data	no data
	25%'ile	0.6	1.5	21	2.8	0.017	0.014	0.215	0.130	7	0.119	0.005	8.9	90	222	7.8	1.6	75.8	14.1	9.3	95.9	41.5
	Median	1.0	1.5	33	3.5	0.020	0.017	0.221	0.153	10	0.141	0.005	9.5	97	230	8.1	1.7	83.0	15.7	21.9	100.2	49.0
	75%'ile	1.3	1.5	78	4.2	0.029	0.022	0.278	0.195	12	0.171	0.005	10.1	104	255	8.4	2.2	95.8	16.3	213.1	103.8	53.8
	95%'ile	7.7	16.9	90	4.6	0.042	0.038	0.426	0.321	14	0.308	0.048	12.4	127	295	8.7	no data	no data	17.1	no data	no data	no data
	Maximum	8.3	19.0	90	4.7	0.042	0.039	0.440	0.333	14	0.320	0.053	12.6	128	299	8.8	2.5	98.0	17.2	438.5	104.0	55.0
	Mean	1.6	3.1	47	3.3	0.024	0.020	0.251	0.175	10	0.159	0.010	9.6	98	239	8.1	1.8	85.0	15.3	122.2	99.9	47.6
	Std. Dev.	2.2	4.9	31	1.0	0.009	0.008	0.073	0.063	3	0.060	0.013	1.3	14	26	0.3	0.5	11.2	1.3	185.3	4.6	7.9
	Count	12	13	11	12	12	12	13	13	12	13	13	13	12	13	13	5	5	13	5	4	4
Ohiwa Strm	Minimum	1.1	1.5	110	0.8	0.088	0.068	0.180	0.014	0	0.001	0.005	8.3	82	519	7.5	no data	no data	9.5	no data	84.2	29.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.2	1.5	140	1.4	0.097	0.088	0.191	0.021	0	0.009	0.005	10.2	94	611	8.1	no data	no data	11.7	no data	no data	no data
	Median	1.3	1.5	290	3.1	0.105	0.092	0.290	0.147	2	0.135	0.005	10.4	106	622	8.1	no data	no data	16.9	no data	84.2	29.2
	75%'ile	2.0	1.5	1133	4.2	0.114	0.110	0.969	0.660	6	0.645	0.005	11.3	127	631	8.5	no data	no data	19.4	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	7.7	7.0	1800	6.1	0.134	0.130	1.050	0.773	8	0.750	0.014	12.5	136	658	8.8	no data	no data	23.5	no data	84.2	29.2
	Mean	2.4	2.4	652	3.1	0.107	0.098	0.534	0.315	3	0.300	0.006	10.6	108	612	8.2	no data	no data	16.2	no data	84.2	29.2
	Std. Dev.	2.6	2.2	718	1.9	0.015	0.020	0.404	0.338	3	0.335	0.003	1.3	20	44	0.4	no data	no data	5.0	no data	0.0	0.0
	Count	6	6	5	6	7	7	7	7	7	7	7	7	7	7	7	no data	no data	7	no data	1	1
Ngaruroro Rv at Fernhill	Minimum	0.4	1.5	3	1.3	0.002	0.002	0.055	0.014	4	0.001	0.005	8.4	97	128	7.6	0.9	49.0	8.4	0.6	86.7	38.1
	5%'ile	0.4	1.5	3	1.3	0.002	0.002	0.055	0.014	5	0.001	0.005	8.5	97	130	7.6	no data	no data	9.1	0.6	no data	no data
	25%'ile	1.0	1.5	7	1.7	0.004	0.002	0.055	0.018	7	0.003	0.005	9.8	101	162	8.0	1.1	51.0	15.4	2.4	90.9	41.0
	Median	2.0	1.5	17	1.9	0.006	0.005	0.109	0.058	10	0.021	0.005	10.2	105	172	8.2	1.6	56.5	17.8	19.8	96.5	45.6
	75%'ile	3.1	3.0	33	4.6	0.008	0.007	0.194	0.113	17	0.100	0.005	11.1	111	197	8.9	1.7	62.0	20.6	143.8	99.9	48.7
	95%'ile	6.8	15.6	311	6.4	0.027	0.019	0.276	0.147	27	0.135	0.069	12.3	127	222	9.3	no data	no data	22.8	260.7	no data	no data
	Maximum	7.1	17.0	340	6.4	0.033	0.022	0.280	0.150	28	0.138	0.096	12.5	128	222	9.3	1.8	65.0	23.1	274.8	101.9	50.0
	Mean	2.4	3.5	45	3.0	0.008	0.006	0.130	0.070	13	0.048	0.011	10.4	107	178	8.4	1.4	56.7	17.4	69.5	95.4	44.8
	Std. Dev.	2.0	4.5	94	1.9	0.007	0.005	0.081	0.049	7	0.052	0.023	1.1	9	28	0.6	0.4	6.8	4.0	90.5	6.4	5.2
	Count	13	14	12	13	15	15	15	16	15	16	16	14	13	15	15	5	6	15	13	4	4
Ngaruroro Rv at Motorway	Minimum	0.5	1.5	2	1.4	0.004	0.002	0.087	0.038	6	0.028	0.005	8.9	91	130	7.9	0.3	49.0	15.1	2.9	90.0	30.8
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.7	1.5	3	1.4	0.006	0.006	0.128	0.055	13	0.037	0.005	9.4	95	144	8.0	1.2	50.0	15.7	4.4	90.0	34.7
	Median	2.0	1.5	3	2.0	0.007	0.007	0.181	0.091	17	0.079	0.005	10.0	106	155	8.1	1.7	53.0	18.6	20.5	96.6	40.7
	75%'ile	2.9	4.0	9	3.9	0.009	0.008	0.240	0.150	22	0.130	0.005	10.8	114	171	8.4	2.9	60.0	21.4	62.5	111.6	42.9
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	3.0	4.8	20	5.4	0.013	0.008	0.246	0.156	28	0.143	0.005	11.6	117	183	8.5	5.7	64.0	23.7	90.0	120.0	42.9
	Mean	1.8	2.5	7	2.7	0.008	0.006	0.177	0.097	17	0.083	0.005	10.1	105	156	8.2	2.2	54.8	18.8	33.5	100.8	38.8
	Std. Dev.	1.1	1.5	7	1.7	0.003	0.002	0.062	0.048	8	0.047	0.000	1.1	13	19	0.2	2.1	6.0	3.3	40.4	14.2	5.7
	Count	6	6	6	6	6	6	6	6	6	6	6	4	3	6	6	5	6	6	4	4	4

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri-Waimate Strm	Minimum	1.3	1.5	46	0.7	0.026	0.002	0.055	0.014	1	0.001	0.005	9.8	94	152	7.6	2.0	92.0	12.0	no data	74.7	21.1
	5%'ile	1.4	1.5	47	0.7	0.027	0.005	0.063	0.015	1	0.002	0.005	9.8	94	166	7.6	no data	no data	12.2	no data	no data	no data
	25%'ile	2.5	4.0	65	1.1	0.034	0.026	0.229	0.105	3	0.088	0.005	10.7	110	251	8.2	2.1	97.3	14.4	no data	76.3	23.0
	Median	3.7	6.0	100	1.5	0.037	0.030	0.266	0.176	6	0.162	0.005	12.2	123	258	8.4	2.3	100.0	16.4	no data	81.1	28.6
	75%'ile	5.4	10.8	128	2.2	0.046	0.033	0.326	0.236	8	0.223	0.011	12.5	134	276	8.7	2.5	104.0	17.0	no data	87.8	32.1
	95%'ile	9.1	22.8	4192	2.3	0.062	0.046	0.421	0.304	106	0.277	0.027	14.4	154	283	8.8	no data	no data	20.9	no data	no data	no data
	Maximum	9.2	24.0	4400	2.3	0.062	0.048	0.430	0.309	123	0.280	0.029	14.5	154	283	8.9	2.6	104.0	21.4	no data	90.0	33.3
	Mean	4.3	7.8	492	1.6	0.041	0.029	0.265	0.165	14	0.150	0.009	11.9	122	255	8.4	2.3	99.8	16.2	no data	81.9	27.7
	Std. Dev.	2.4	6.4	1297	0.6	0.011	0.010	0.101	0.093	33	0.090	0.007	1.4	18	34	0.4	0.3	4.9	2.4	no data	7.7	6.2
	Count	13	13	11	10	13	13	13	13	13	13	13	11	10	13	13	4	5	13	no data	3	3
Ngaruroro Rv at Chesterhope (NIWA)	Minimum	0.4	no data	1	0.9	0.002	0.001	0.026	0.002	1	no data	0.001	8.9	99	61	7.7	no data	no data	7.5	no data	98.0	no data
	5%'ile	0.5	no data	2	1.2	0.007	0.002	0.035	0.003	1	no data	0.001	9.2	102	135	7.8	no data	no data	10.0	no data	no data	no data
	25%'ile	0.8	no data	9	2.0	0.010	0.004	0.082	0.007	1	no data	0.003	9.8	105	153	8.2	no data	no data	14.7	no data	99.5	no data
	Median	1.4	no data	17	2.3	0.011	0.005	0.111	0.016	7	no data	0.004	10.4	110	160	8.3	no data	no data	19.8	no data	103.2	no data
	75%'ile	1.8	no data	45	3.5	0.013	0.008	0.151	0.081	14	no data	0.005	11.2	118	182	8.5	no data	no data	21.8	no data	110.6	no data
	95%'ile	3.3	no data	329	7.6	0.028	0.012	0.222	0.124	21	no data	0.010	12.7	126	229	8.9	no data	no data	24.1	no data	no data	no data
	Maximum	3.5	no data	387	9.1	0.029	0.012	0.229	0.128	26	no data	0.011	13.4	128	238	8.9	no data	no data	25.5	no data	115.0	no data
	Mean	1.4	no data	52	3.1	0.013	0.006	0.115	0.042	8	no data	0.004	10.6	112	168	8.3	no data	no data	18.2	no data	105.1	no data
	Std. Dev.	0.8	no data	91	1.9	0.006	0.003	0.052	0.043	7	no data	0.003	1.1	8	32	0.3	no data	no data	4.7	no data	7.0	no data
	Count	29	no data	29	29	29	29	29	29	29	no data	29	29	29	29	29	no data	no data	29	no data	5	no data
Tutaekuri Rv at Lawrence Hut	Minimum	0.3	1.5	1	1.2	0.002	0.002	0.055	0.014	4	0.001	0.005	8.2	80	96	7.2	1.8	39.0	5.3	0.2	118.3	58.3
	5%'ile	0.3	1.5	1	1.5	0.002	0.002	0.055	0.014	4	0.001	0.005	8.4	84	97	7.3	no data	no data	5.8	no data	no data	no data
	25%'ile	0.5	1.5	6	4.2	0.002	0.002	0.055	0.018	5	0.006	0.005	10.1	98	112	7.7	1.8	41.3	9.8	0.5	118.3	58.3
	Median	0.6	1.5	13	6.3	0.004	0.002	0.080	0.027	9	0.015	0.005	10.9	99	118	8.0	2.1	43.0	11.7	4.0	123.1	59.7
	75%'ile	1.0	1.5	20	10.4	0.006	0.005	0.131	0.046	15	0.021	0.005	11.7	103	128	8.1	2.3	44.5	14.1	8.4	127.8	61.1
	95%'ile	3.9	3.4	46	11.9	0.008	0.009	0.585	0.075	33	0.063	0.014	13.3	122	149	8.8	no data	no data	18.5	no data	no data	no data
	Maximum	4.0	3.7	50	11.9	0.008	0.009	0.690	0.076	34	0.064	0.015	13.7	125	153	8.9	2.3	49.0	18.7	18.7	127.8	61.1
	Mean	0.9	1.7	15	6.7	0.004	0.004	0.133	0.034	12	0.019	0.006	10.8	101	119	7.9	2.1	43.2	12.0	5.6	123.1	59.7
	Std. Dev.	1.0	0.6	13	3.5	0.002	0.002	0.165	0.020	9	0.020	0.003	1.4	10	15	0.4	0.3	3.6	3.7	6.4	6.7	2.0
	Count	11	13	13	13	14	14	14	13	13	13	14	15	15	15	15	4	5	15	8	2	2
Mangatutu Strm	Minimum	1.1	1.5	1	0.8	0.010	0.002	0.300	0.155	13	0.141	0.005	10.2	99	282	8.1	no data	no data	7.2	590.0	111.8	52.9
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.5	1.5	23	1.3	0.018	0.012	0.322	0.226	14	0.210	0.005	11.5	107	305	8.4	no data	no data	11.3	no data	no data	no data
	Median	1.6	1.5	36	2.1	0.021	0.016	0.400	0.322	17	0.300	0.005	11.9	111	325	8.6	no data	no data	12.8	590.0	111.8	52.9
	75%'ile	2.1	4.3	54	2.9	0.024	0.021	0.431	0.332	25	0.320	0.006	11.9	124	349	8.7	no data	no data	17.2	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	5.1	7.0	120	3.4	0.046	0.025	0.540	0.445	112	0.430	0.017	14.4	129	383	8.9	no data	no data	20.3	590.0	111.8	52.9
	Mean	2.1	2.9	44	2.1	0.023	0.016	0.395	0.294	29	0.279	0.007	11.9	114	327	8.6	no data	no data	13.7	590.0	111.8	52.9
	Std. Dev.	1.4	2.0	37	1.0	0.010	0.007	0.077	0.084	32	0.084	0.004	1.1	10	31	0.2	no data	no data	4.1	0.0	0.0	0.0
	Count	7	9	9	8	9	9	9	9	9	9	9	9	9	9	9	no data	no data	9	1	1	1

< Median flow

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri Rv U/S Mangaone Rv	Minimum	0.8	1.5	4	0.7	0.002	0.002	0.055	0.014	3	0.001	0.005	9.1	92	256	8.1	0.7	119.0	8.5	0.6	80.0	27.3
	5%'ile	0.8	1.5	4	0.7	0.002	0.002	0.055	0.014	3	0.001	0.005	9.2	93	257	8.1	no data	no data	8.8	no data	no data	no data
	25%'ile	1.0	1.5	9	1.9	0.007	0.004	0.105	0.015	5	0.004	0.005	10.5	111	283	8.4	0.7	119.3	13.5	5.7	80.0	27.3
	Median	1.5	1.5	13	2.5	0.013	0.006	0.149	0.053	8	0.044	0.005	11.3	120	304	8.7	0.8	120.0	16.1	31.0	98.6	38.7
	75%'ile	2.6	3.0	18	3.1	0.017	0.012	0.236	0.143	12	0.132	0.005	11.8	132	317	8.9	0.9	129.8	19.8	66.5	117.1	50.0
	95%'ile	3.4	4.8	122	3.5	0.071	0.016	0.285	0.195	28	0.183	0.005	14.3	138	331	9.0	no data	no data	22.9	no data	no data	no data
	Maximum	3.4	5.0	130	3.5	0.077	0.016	0.290	0.200	28	0.188	0.005	14.4	138	332	9.0	0.9	133.0	23.1	85.0	117.1	50.0
	Mean	1.7	2.2	25	2.4	0.016	0.008	0.160	0.078	11	0.066	0.005	11.4	119	299	8.6	0.8	124.0	16.2	35.6	98.6	38.7
	Std. Dev.	0.9	1.1	35	0.9	0.020	0.005	0.079	0.067	8	0.067	0.000	1.4	15	23	0.3	0.1	7.8	4.3	31.8	26.2	16.1
	Count	10	12	12	10	12	12	12	12	12	12	12	11	12	12	12	2	3	12	9	2	2
Mangaone Rv at Dartmoor	Minimum	0.8	1.5	31	1.3	0.019	0.006	0.110	0.014	1	0.001	0.005	8.3	95	349	8.3	no data	no data	10.5	no data	103.3	41.7
	5%'ile	no data	1.5	31	no data	0.019	0.006	0.110	0.014	1	0.001	0.005	8.3	95	349	8.3	no data	no data	10.5	no data	no data	no data
	25%'ile	1.2	1.5	39	1.8	0.027	0.020	0.144	0.019	3	0.003	0.005	9.5	99	378	8.4	no data	no data	14.4	no data	no data	no data
	Median	1.6	1.5	50	2.4	0.032	0.024	0.214	0.115	5	0.104	0.005	9.9	104	384	8.5	no data	no data	16.8	no data	103.3	41.7
	75%'ile	2.3	1.5	70	3.1	0.039	0.030	0.310	0.223	7	0.210	0.013	11.7	110	405	8.5	no data	no data	21.2	no data	no data	no data
	95%'ile	no data	17.0	120	no data	0.042	0.040	0.500	0.382	11	0.350	0.028	11.8	121	435	9.2	no data	no data	21.6	no data	no data	no data
	Maximum	3.8	17.0	120	3.4	0.042	0.040	0.500	0.382	11	0.350	0.028	11.8	121	435	9.2	no data	no data	21.6	no data	103.3	41.7
	Mean	1.9	3.4	58	2.4	0.032	0.025	0.246	0.138	5	0.123	0.009	10.2	105	391	8.5	no data	no data	17.0	no data	103.3	41.7
	Std. Dev.	1.0	4.9	27	0.8	0.007	0.010	0.125	0.122	3	0.118	0.008	1.2	8	26	0.2	no data	no data	4.0	no data	0.0	0.0
	Count	7	10	10	8	10	10	10	10	10	10	10	10	10	10	10	no data	no data	10	no data	1	1
Mangaone Rv at Rissington	Minimum	0.5	1.5	14	0.9	0.013	0.007	0.060	0.012	1	0.001	0.005	8.3	90	297	8.2	0.9	140.0	7.1	2.7	107.3	40.9
	5%'ile	0.5	1.5	14	1.0	0.013	0.007	0.090	0.016	1	0.005	0.005	8.4	91	309	8.2	no data	no data	8.0	2.7	no data	no data
	25%'ile	1.1	1.5	24	2.0	0.018	0.011	0.182	0.070	4	0.064	0.005	9.7	107	342	8.4	1.4	140.0	14.1	4.2	109.5	43.2
	Median	1.5	1.5	38	2.3	0.026	0.019	0.230	0.116	7	0.103	0.005	11.0	111	353	8.5	1.8	144.5	17.0	17.4	116.0	50.0
	75%'ile	2.2	2.3	56	2.8	0.031	0.023	0.340	0.274	10	0.260	0.010	11.5	117	367	8.8	2.0	158.0	19.3	49.7	126.5	53.8
	95%'ile	3.5	6.4	138	3.4	0.044	0.036	0.537	0.429	32	0.412	0.018	13.1	142	401	9.0	no data	no data	23.8	148.0	no data	no data
	Maximum	3.6	7.0	150	3.6	0.047	0.039	0.542	0.442	41	0.420	0.022	13.2	156	402	9.1	2.4	170.0	24.6	148.0	130.0	55.0
	Mean	1.7	2.3	48	2.3	0.026	0.019	0.278	0.163	9	0.150	0.007	10.7	112	354	8.6	1.7	149.5	16.2	35.9	117.8	48.6
	Std. Dev.	0.9	1.6	37	0.7	0.010	0.009	0.140	0.137	9	0.135	0.004	1.4	14	25	0.3	0.5	12.0	4.9	45.9	11.5	7.1
	Count	13	16	16	15	18	18	18	18	18	18	18	17	18	18	18	6	6	18	10	3	3
Tutaekuri Rv at Puketapu	Minimum	0.9	1.5	6	1.1	0.010	0.004	0.110	0.017	1	0.005	0.005	9.3	93	309	8.2	no data	no data	8.5	73.0	88.0	33.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.0	1.5	9	1.7	0.013	0.009	0.117	0.026	3	0.013	0.005	10.2	108	325	8.6	no data	no data	15.5	no data	no data	no data
	Median	1.6	1.5	11	2.8	0.019	0.013	0.153	0.033	5	0.021	0.005	11.1	120	334	8.8	no data	no data	20.4	73.0	88.0	33.3
	75%'ile	1.8	2.3	24	3.4	0.026	0.016	0.205	0.115	8	0.103	0.005	12.1	129	351	9.0	no data	no data	21.6	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	2.8	10.0	34	3.6	0.230	0.021	0.290	0.191	9	0.175	0.014	12.4	138	357	9.1	no data	no data	24.1	73.0	88.0	33.3
	Mean	1.6	2.8	16	2.6	0.045	0.013	0.169	0.069	5	0.057	0.006	11.1	118	336	8.8	no data	no data	18.4	73.0	88.0	33.3
	Std. Dev.	0.7	3.0	11	1.0	0.075	0.005	0.063	0.065	3	0.064	0.003	1.2	15	17	0.3	no data	no data	5.1	0.0	0.0	0.0
	Count	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	no data	no data	8	1	1	1

< Median flow

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Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri Rv at Brookfields Br	Minimum	0.3	1.5	1	0.4	0.002	0.002	0.055	0.015	1	0.003	0.005	8.6	93	151	8.1	0.6	120.0	9.1	58.0	81.9	33.3
	5%'ile	0.3	1.5	2	0.6	0.003	0.003	0.063	0.015	1	0.003	0.005	8.7	94	172	8.1	no data	no data	9.6	no data	no data	no data
	25%'ile	1.1	1.5	12	2.1	0.009	0.008	0.110	0.017	2	0.005	0.005	10.0	108	306	8.5	0.9	130.5	15.0	76.5	81.9	33.3
	Median	1.3	1.5	21	2.7	0.015	0.013	0.147	0.037	3	0.021	0.005	11.8	119	323	8.6	1.3	135.0	19.5	127.5	84.2	36.7
	75%'ile	1.9	3.3	31	3.6	0.023	0.016	0.203	0.135	8	0.102	0.011	12.1	141	332	9.0	2.2	147.0	21.9	310.0	86.4	40.0
	95%'ile	4.4	10.0	148	5.8	0.031	0.023	0.260	0.168	19	0.153	0.043	14.1	144	347	9.1	no data	no data	25.3	no data	no data	no data
	Maximum	4.4	11.0	160	6.0	0.032	0.023	0.262	0.169	21	0.154	0.048	14.3	144	349	9.1	3.0	150.0	25.4	460.0	86.4	40.0
	Mean	1.6	2.7	33	2.9	0.016	0.013	0.160	0.069	6	0.053	0.010	11.3	121	309	8.7	1.6	137.0	18.6	193.3	84.2	36.7
	Std. Dev.	1.1	2.7	43	1.5	0.009	0.006	0.064	0.063	5	0.061	0.012	1.6	18	50	0.3	1.0	11.7	4.9	182.8	3.2	4.7
	Count	10	13	13	13	13	13	13	13	13	13	13	13	13	13	13	4	5	13	4	2	2

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Ngaruroro Rv at Kuripapango (NIWA)	Minimum	0.3	no data	1	5.3	0.002	0.001	0.023	0.002	2	no data	0.001	8.5	99	82	7.9	no data	no data	15.7	no data	116.8	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.3	no data	3	7.6	0.002	0.001	0.029	0.003	2	no data	0.001	9.2	101	96	8.0	no data	no data	15.8	no data	116.8	no data
	Median	0.4	no data	3	8.4	0.003	0.001	0.035	0.004	3	no data	0.002	9.3	102	98	8.1	no data	no data	16.1	no data	125.0	no data
	75%'ile	0.5	no data	6	8.6	0.004	0.002	0.044	0.005	4	no data	0.002	9.6	102	111	8.2	no data	no data	16.8	no data	133.2	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	0.6	no data	67	10.8	0.004	0.003	0.047	0.005	5	no data	0.003	9.6	103	113	8.3	no data	no data	21.6	no data	133.2	no data
	Mean	0.4	no data	14	8.2	0.003	0.002	0.035	0.004	3	no data	0.002	9.2	101	100	8.1	no data	no data	17.0	no data	125.0	no data
	Std. Dev.	0.1	no data	26	1.8	0.001	0.001	0.009	0.001	1	no data	0.001	0.4	1	11	0.1	no data	no data	2.3	no data	11.6	no data
	Count	6	no data	6	6	6	6	6	6	6	no data	6	6	6	6	6	no data	no data	6	no data	2	no data
Taruarau Rv	Minimum	0.5	1.5	2	2.5	0.002	0.002	0.055	0.017	9	0.005	0.005	8.8	91	125	7.8	no data	no data	10.3	5.9	120.7	55.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.6	1.5	4	3.7	0.002	0.002	0.055	0.020	10	0.006	0.005	9.0	92	137	7.9	no data	no data	12.5	no data	no data	no data
	Median	0.9	1.5	8	5.4	0.002	0.002	0.055	0.028	14	0.009	0.005	9.3	93	173	8.0	no data	no data	15.1	5.9	120.7	55.2
	75%'ile	1.4	2.6	13	6.0	0.003	0.002	0.055	0.036	18	0.017	0.014	10.2	109	202	8.1	no data	no data	18.0	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.7	6.0	15	6.2	0.004	0.002	0.055	0.051	26	0.019	0.041	12.2	109	203	8.2	no data	no data	20.2	5.9	120.7	55.2
	Mean	1.0	2.4	8	4.8	0.002	0.002	0.055	0.030	15	0.011	0.012	9.8	99	169	8.0	no data	no data	15.2	5.9	120.7	55.2
	Std. Dev.	0.5	2.0	6	1.7	0.001	0.000	0.000	0.013	7	0.006	0.016	1.4	9	35	0.2	no data	no data	3.8	0.0	0.0	0.0
	Count	5	5	4	4	5	5	5	5	5	5	5	5	5	5	5	no data	no data	5	1	1	1
Ngaruroro Rv at Whanawhana	Minimum	0.3	1.5	1	2.2	0.002	0.002	0.055	0.014	7	0.001	0.005	9.5	97	120	7.6	0.6	32.0	9.7	2.8	109.2	44.4
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.8	1.5	1	4.7	0.002	0.002	0.055	0.018	9	0.002	0.005	9.7	99	131	7.9	0.9	34.0	15.1	10.6	110.7	47.2
	Median	1.0	1.5	2	7.8	0.002	0.002	0.055	0.036	18	0.006	0.005	9.9	104	159	8.2	1.7	40.0	17.2	26.3	114.0	52.1
	75%'ile	1.1	1.5	3	8.9	0.006	0.002	0.083	0.055	27	0.014	0.005	10.7	109	174	8.8	2.2	46.0	18.2	28.9	125.3	56.1
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	4.8	8.0	3	9.7	0.010	0.004	0.118	0.105	28	0.039	0.005	11.2	113	177	8.9	2.4	48.0	19.2	72.0	134.7	57.9
	Mean	1.4	2.4	2	6.8	0.004	0.002	0.070	0.042	18	0.010	0.005	10.2	104	153	8.3	1.6	40.0	16.2	26.9	118.0	51.6
	Std. Dev.	1.5	2.5	1	2.7	0.003	0.001	0.028	0.031	10	0.013	0.000	0.7	6	23	0.5	0.9	8.0	3.0	22.6	11.5	5.8
	Count	7	7	6	7	9	9	8	8	8	8	8	8	7	8	8	3	3	8	7	4	4
Poporangi Strm	Minimum	1.4	1.5	19	0.7	0.025	0.015	0.260	0.130	9	0.118	0.005	8.9	95	237	7.3	no data	no data	11.4	3.8	108.9	55.6
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.4	1.5	28	1.6	0.026	0.022	0.358	0.304	13	0.292	0.005	9.3	97	243	7.5	no data	no data	14.2	no data	no data	no data
	Median	1.6	3.0	56	2.1	0.028	0.025	0.490	0.422	18	0.400	0.005	9.9	100	249	7.8	no data	no data	16.2	3.8	108.9	55.6
	75%'ile	3.1	9.5	82	3.0	0.033	0.026	0.704	0.547	21	0.532	0.008	10.6	112	259	8.0	no data	no data	18.4	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	7.4	26.0	90	3.3	0.038	0.027	0.822	0.732	27	0.720	0.018	11.1	122	266	8.2	no data	no data	24.4	3.8	108.9	55.6
	Mean	2.7	7.2	55	2.2	0.030	0.023	0.525	0.426	17	0.412	0.008	9.9	104	250	7.8	no data	no data	16.7	3.8	108.9	55.6
	Std. Dev.	2.6	10.6	36	1.0	0.005	0.005	0.222	0.217	7	0.217	0.006	0.9	12	11	0.4	no data	no data	4.8	0.0	0.0	0.0
	Count	5	5	3	5	5	5	5	5	5	5	5	4	4	5	4	no data	no data	5	1	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ngaruroro Rv U/S HB Dairies	Minimum	0.4	1.5	2	4.3	0.002	0.002	0.115	0.027	4	0.013	0.005	9.0	97	131	7.7	0.7	37.0	12.0	6.1	107.0	44.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.4	1.5	3	4.4	0.002	0.002	0.115	0.028	7	0.015	0.005	9.1	97	131	7.8	1.0	38.8	13.4	55.0	107.7	45.5
	Median	0.4	1.5	7	4.5	0.002	0.002	0.118	0.031	13	0.020	0.005	9.3	97	133	7.9	1.7	44.0	17.4	201.7	109.6	50.0
	75%'ile	1.7	1.5	14	5.3	0.004	0.006	0.121	0.031	15	0.021	0.010	10.8	97	153	8.1	2.8	47.8	18.7	243.4	117.4	57.5
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	2.2	1.5	16	5.6	0.004	0.007	0.121	0.031	16	0.021	0.012	11.3	97	159	8.1	3.1	49.0	19.1	257.2	120.0	60.0
	Mean	1.0	1.5	8	4.8	0.003	0.004	0.118	0.030	11	0.018	0.007	9.9	97	141	7.9	1.8	43.3	16.2	155.0	112.2	51.3
	Std. Dev.	1.0	0.0	7	0.7	0.001	0.003	0.004	0.002	6	0.004	0.004	1.2	0	16	0.2	1.2	6.0	3.7	131.9	6.9	8.1
	Count	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3	3	3	3
Ngaruroro Rv D/S HB Dairies	Minimum	0.4	1.5	1	2.0	0.002	0.002	0.055	0.032	16	0.026	0.005	8.6	92	146	7.7	0.3	41.0	13.3	0.1	92.5	46.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.7	1.5	4	3.4	0.002	0.002	0.055	0.064	17	0.053	0.005	9.1	101	150	8.2	0.8	43.0	18.2	13.5	100.9	48.1
	Median	1.2	1.5	9	4.0	0.002	0.002	0.059	0.068	32	0.058	0.005	10.3	107	169	8.6	2.3	49.0	19.4	30.4	109.6	50.0
	75%'ile	1.4	4.9	16	6.0	0.006	0.003	0.134	0.071	34	0.065	0.005	11.0	115	185	9.0	2.9	54.3	20.4	70.2	113.2	53.2
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	4.4	6.0	36	6.7	0.007	0.007	0.335	0.115	37	0.103	0.005	11.8	131	193	9.3	3.1	56.0	21.2	260.0	116.3	56.3
	Mean	1.4	2.8	13	4.4	0.004	0.003	0.111	0.069	27	0.060	0.005	10.1	109	168	8.5	1.9	48.7	18.8	64.9	107.0	50.6
	Std. Dev.	1.4	2.2	13	1.7	0.002	0.002	0.097	0.023	9	0.021	0.000	1.1	13	19	0.5	1.5	7.5	2.5	89.7	10.2	4.2
	Count	7	7	6	7	9	9	8	8	8	8	9	8	7	8	8	3	3	8	7	4	4
Maraekakaho Strm	Minimum	0.5	1.5	32	6.4	0.007	0.005	0.170	0.095	12	0.078	0.005	8.0	83	535	7.8	no data	no data	15.6	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	32	6.4	0.007	0.006	0.185	0.103	13	0.087	0.005	8.0	84	542	7.8	no data	no data	15.6	no data	no data	no data
	Median	0.6	1.5	81	7.2	0.009	0.008	0.230	0.127	16	0.115	0.005	8.3	88	564	7.9	no data	no data	15.7	no data	no data	no data
	75%'ile	1.2	1.5	130	8.1	0.013	0.011	0.249	0.140	18	0.129	0.010	8.6	93	573	8.2	no data	no data	19.8	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.4	1.5	130	8.1	0.014	0.012	0.255	0.145	19	0.133	0.012	8.7	94	576	8.2	no data	no data	21.2	no data	no data	no data
	Mean	0.8	1.5	81	7.2	0.010	0.008	0.218	0.122	16	0.109	0.007	8.3	88	558	8.0	no data	no data	17.5	no data	no data	no data
	Std. Dev.	0.5	0.0	69	1.2	0.004	0.004	0.044	0.025	3	0.028	0.004	0.4	6	21	0.2	no data	no data	3.2	no data	no data	no data
	Count	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	no data	no data	3	no data	no data	no data
Ngaruroro Rv at Ohiti	Minimum	0.3	1.5	15	2.7	0.002	0.002	0.113	0.052	24	0.012	0.005	8.4	94	154	7.8	0.6	46.0	12.1	38.0	105.6	36.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	16	3.0	0.003	0.002	0.113	0.065	25	0.020	0.005	8.5	94	155	7.9	0.8	47.8	12.7	42.1	106.0	38.3
	Median	0.8	1.5	20	3.9	0.005	0.002	0.187	0.104	26	0.042	0.005	8.7	94	156	8.1	1.4	53.0	14.4	54.4	107.0	45.0
	75%'ile	1.3	1.5	23	4.1	0.006	0.006	0.261	0.154	46	0.129	0.069	11.3	94	170	8.6	1.6	57.5	18.1	85.9	107.8	51.2
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.4	1.5	24	4.2	0.006	0.007	0.261	0.171	52	0.158	0.091	12.2	94	174	8.7	1.7	59.0	19.3	96.5	108.0	53.3
	Mean	0.9	1.5	20	3.6	0.004	0.004	0.187	0.109	34	0.071	0.034	9.7	94	161	8.2	1.2	52.7	15.3	62.9	106.9	44.8
	Std. Dev.	0.6	0.0	5	0.8	0.002	0.003	0.105	0.060	15	0.077	0.050	2.1	0	11	0.5	0.6	6.5	3.7	30.2	1.2	8.7
	Count	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3	3	3	3

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Waitio Strm	Minimum	0.4	1.5	2	2.5	0.015	0.013	0.170	0.123	6	0.111	0.005	7.8	84	208	7.7	1.1	72.0	13.6	12.3	95.0	37.5
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	21	3.2	0.017	0.014	0.207	0.132	9	0.121	0.005	8.8	90	217	7.8	1.3	73.3	14.1	17.1	95.5	41.3
	Median	0.8	1.5	32	3.6	0.019	0.015	0.221	0.163	11	0.148	0.005	9.3	94	224	8.1	1.7	77.0	15.3	80.0	96.8	52.6
	75%'ile	1.5	1.5	66	4.4	0.022	0.017	0.247	0.182	13	0.171	0.011	9.8	99	233	8.3	1.7	81.5	16.0	288.2	102.2	54.4
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	8.3	19.0	90	4.7	0.029	0.020	0.300	0.227	14	0.172	0.053	10.1	105	271	8.4	1.7	83.0	17.2	438.5	104.0	55.0
	Mean	1.8	3.7	41	3.7	0.020	0.015	0.227	0.163	11	0.145	0.013	9.2	94	228	8.0	1.5	77.3	15.2	152.7	98.6	48.4
	Std. Dev.	2.7	6.2	31	0.8	0.005	0.002	0.040	0.035	3	0.025	0.017	0.8	7	20	0.3	0.3	5.5	1.2	198.9	4.8	9.5
	Count	8	8	7	8	8	8	8	8	8	8	8	8	7	8	8	3	3	8	4	3	3
Ohiwa Strm	Minimum	1.1	1.5	110	2.8	0.088	0.068	0.180	0.014	0	0.001	0.005	8.3	82	607	7.5	no data	no data	14.8	no data	84.2	29.2
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.1	1.5	120	3.0	0.092	0.078	0.180	0.014	0	0.001	0.005	9.2	94	615	7.8	no data	no data	16.5	no data	no data	no data
	Median	1.2	1.5	150	3.4	0.101	0.089	0.202	0.029	0	0.016	0.005	10.7	119	622	8.4	no data	no data	19.0	no data	84.2	29.2
	75%'ile	1.3	1.5	720	4.0	0.110	0.099	0.257	0.096	1	0.083	0.005	11.9	135	624	8.7	no data	no data	21.7	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.4	1.5	910	4.2	0.114	0.108	0.290	0.147	2	0.135	0.005	12.5	136	625	8.8	no data	no data	23.5	no data	84.2	29.2
	Mean	1.2	1.5	390	3.5	0.101	0.088	0.219	0.055	1	0.042	0.005	10.6	114	619	8.3	no data	no data	19.1	no data	84.2	29.2
	Std. Dev.	0.2	0.0	451	0.7	0.011	0.016	0.052	0.063	1	0.064	0.000	1.8	26	8	0.6	no data	no data	3.6	no data	0.0	0.0
	Count	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	no data	no data	4	no data	1	1
Ngaruroro Rv at Fernhill	Minimum	0.4	1.5	3	1.8	0.002	0.002	0.055	0.014	4	0.001	0.005	8.4	97	167	7.7	0.9	52.0	15.1	2.5	86.7	38.1
	5%'ile	no data	no data	no data	no data	0.002	0.002	no data	0.014	4	0.001	0.005	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.7	1.5	6	2.0	0.004	0.002	0.055	0.015	7	0.002	0.005	9.6	103	171	8.3	1.0	54.5	17.6	5.5	88.8	39.5
	Median	1.1	1.5	15	4.4	0.005	0.002	0.055	0.026	9	0.005	0.005	9.9	107	182	8.8	1.2	62.0	19.7	28.9	95.0	43.8
	75%'ile	2.1	2.3	21	5.9	0.006	0.006	0.077	0.055	17	0.017	0.005	11.2	115	199	9.1	1.5	64.3	21.4	126.6	100.2	48.5
	95%'ile	no data	no data	no data	no data	0.008	0.007	no data	0.122	28	0.111	0.096	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	7.1	17.0	44	6.4	0.008	0.007	0.262	0.122	28	0.111	0.096	12.5	128	222	9.3	1.6	65.0	23.1	274.8	101.9	50.0
	Mean	2.0	3.6	17	4.0	0.005	0.004	0.085	0.046	12	0.017	0.014	10.2	109	186	8.6	1.2	59.7	19.4	74.9	94.5	44.0
	Std. Dev.	2.3	5.4	14	2.0	0.002	0.002	0.069	0.041	7	0.034	0.029	1.3	10	19	0.6	0.4	6.8	2.7	100.4	7.6	6.0
	Count	7	8	7	7	10	10	9	10	10	10	10	9	8	9	9	3	3	9	8	3	3
Ngaruroro Rv at Motorway	Minimum	0.5	1.5	3	3.4	0.004	0.002	0.087	0.055	22	0.037	0.005	9.9	117	171	8.1	1.5	60.0	15.1	5.8	103.1	38.5
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	3	3.4	0.004	0.002	0.087	0.055	22	0.037	0.005	9.9	no data	171	8.1	1.5	60.0	15.1	5.8	103.1	38.5
	Median	0.9	1.5	3	4.4	0.005	0.005	0.166	0.105	25	0.090	0.005	10.8	117	177	8.3	3.6	62.0	19.4	20.5	111.6	40.7
	75%'ile	1.4	1.5	3	5.4	0.006	0.007	0.246	0.156	28	0.143	0.005	11.6	no data	183	8.5	5.7	64.0	23.7	35.1	120.0	42.9
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.4	1.5	3	5.4	0.006	0.007	0.246	0.156	28	0.143	0.005	11.6	117	183	8.5	5.7	64.0	23.7	35.1	120.0	42.9
	Mean	0.9	1.5	3	4.4	0.005	0.005	0.166	0.105	25	0.090	0.005	10.8	117	177	8.3	3.6	62.0	19.4	20.5	111.6	40.7
	Std. Dev.	0.7	0.0	0	1.4	0.001	0.004	0.112	0.071	4	0.075	0.000	1.2	0	9	0.3	3.0	2.8	6.1	20.7	12.0	3.1
	Count	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Tutaekuri-Waimate Strm	Minimum	1.3	1.5	46	0.7	0.026	0.002	0.055	0.014	1	0.001	0.005	9.8	100	253	7.6	2.3	92.0	13.2	no data	81.1	33.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	3.6	4.5	80	0.9	0.036	0.025	0.139	0.036	1	0.024	0.005	10.6	108	254	7.9	2.3	92.0	14.1	no data	no data	no data
	Median	5.1	10.4	110	1.6	0.039	0.026	0.256	0.111	3	0.094	0.005	12.0	120	258	8.6	2.5	96.0	16.4	no data	81.1	33.3
	75%'ile	7.8	15.0	230	2.2	0.056	0.033	0.353	0.242	11	0.228	0.012	12.3	128	273	8.7	2.6	100.0	17.0	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	9.2	24.0	4400	2.3	0.062	0.048	0.430	0.309	123	0.280	0.029	12.5	134	283	8.8	2.6	100.0	21.4	no data	81.1	33.3
	Mean	5.5	10.6	829	1.6	0.044	0.027	0.251	0.145	21	0.129	0.010	11.6	118	263	8.4	2.5	96.0	16.2	no data	81.1	33.3
	Std. Dev.	2.8	7.7	1750	0.7	0.013	0.014	0.134	0.117	45	0.113	0.009	1.1	13	12	0.5	0.2	5.7	2.7	no data	0.0	0.0
	Count	7	7	6	6	7	7	7	7	7	7	7	6	5	7	7	2	2	7	no data	1	1
Ngaruroro Rv at Chesterhope (NIWA)	Minimum	0.4	no data	1	1.9	0.007	0.003	0.035	0.002	1	no data	0.001	9.2	105	152	8.1	no data	no data	16.0	no data	98.0	no data
	5%'ile	0.4	no data	2	1.9	0.007	0.003	0.037	0.002	1	no data	0.001	9.2	105	153	8.1	no data	no data	16.3	no data	no data	no data
	25%'ile	0.6	no data	16	2.5	0.010	0.004	0.063	0.005	1	no data	0.002	9.6	111	171	8.2	no data	no data	19.9	no data	98.5	no data
	Median	0.9	no data	23	3.2	0.013	0.005	0.085	0.007	1	no data	0.004	10.3	117	184	8.3	no data	no data	21.8	no data	100.0	no data
	75%'ile	1.6	no data	30	5.0	0.024	0.010	0.112	0.011	2	no data	0.005	10.9	120	213	8.5	no data	no data	22.4	no data	102.4	no data
	95%'ile	3.2	no data	301	7.4	0.029	0.012	0.215	0.080	8	no data	0.009	11.6	128	237	8.9	no data	no data	25.4	no data	no data	no data
	Maximum	3.3	no data	326	7.6	0.029	0.012	0.222	0.087	9	no data	0.009	11.7	128	238	8.9	no data	no data	25.5	no data	103.2	no data
	Mean	1.2	no data	49	3.8	0.016	0.007	0.097	0.015	2	no data	0.004	10.3	116	190	8.4	no data	no data	21.3	no data	100.4	no data
	Std. Dev.	0.8	no data	89	1.8	0.008	0.003	0.050	0.023	2	no data	0.002	0.8	7	27	0.2	no data	no data	2.4	no data	2.6	no data
	Count	12	no data	12	12	12	12	12	12	12	no data	12	12	12	12	12	no data	no data	12	no data	3	no data
Tutaekuri Rv at Lawrence Hut	Minimum	0.5	1.5	8	1.2	0.002	0.002	0.055	0.014	4	0.001	0.005	8.2	80	96	7.2	1.8	39.0	7.4	0.2	118.3	58.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.5	1.5	11	4.2	0.002	0.002	0.055	0.018	5	0.005	0.005	9.2	97	118	7.7	1.8	39.0	9.1	0.4	no data	no data
	Median	0.6	1.5	19	10.3	0.004	0.002	0.080	0.029	7	0.006	0.005	10.9	101	126	8.0	2.1	44.0	13.7	3.7	118.3	58.3
	75%'ile	1.1	1.5	21	11.3	0.007	0.006	0.123	0.040	13	0.017	0.008	11.6	104	133	8.3	2.3	49.0	15.4	7.7	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	4.0	3.7	25	11.9	0.008	0.009	0.690	0.055	28	0.031	0.015	11.8	111	153	8.9	2.3	49.0	18.7	8.6	118.3	58.3
	Mean	1.2	1.8	16	8.0	0.004	0.004	0.158	0.030	10	0.012	0.007	10.4	100	126	8.0	2.1	44.0	12.8	4.0	118.3	58.3
	Std. Dev.	1.4	0.8	6	4.3	0.003	0.003	0.217	0.015	9	0.010	0.004	1.3	9	16	0.5	0.3	7.1	4.1	4.3	0.0	0.0
	Count	6	7	7	7	8	8	8	7	7	7	8	9	9	9	9	2	2	9	4	1	1
Mangatutu Strm	Minimum	1.1	1.5	21	1.5	0.015	0.002	0.300	0.155	13	0.141	0.005	10.2	107	314	8.6	no data	no data	11.3	590.0	111.8	52.9
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.3	1.5	23	2.3	0.018	0.009	0.311	0.207	14	0.193	0.005	11.3	108	329	8.6	no data	no data	12.7	no data	no data	no data
	Median	1.6	1.5	25	2.7	0.021	0.013	0.324	0.226	17	0.210	0.005	11.8	116	349	8.6	no data	no data	16.8	590.0	111.8	52.9
	75%'ile	1.6	3.3	60	3.2	0.022	0.021	0.393	0.297	41	0.283	0.006	11.9	124	358	8.8	no data	no data	18.8	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.6	4.0	120	3.4	0.024	0.022	0.460	0.333	112	0.320	0.011	12.0	128	383	8.9	no data	no data	20.3	590.0	111.8	52.9
	Mean	1.5	2.3	46	2.6	0.020	0.014	0.354	0.245	35	0.230	0.006	11.5	116	346	8.7	no data	no data	16.0	590.0	111.8	52.9
	Std. Dev.	0.3	1.2	42	0.7	0.003	0.008	0.065	0.068	43	0.068	0.003	0.7	9	25	0.1	no data	no data	3.7	0.0	0.0	0.0
	Count	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	no data	no data	5	1	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Tutaekuri Rv U/S Mangaone Rv	Minimum	0.8	1.5	10	3.0	0.002	0.002	0.055	0.014	3	0.001	0.005	10.4	117	295	8.4	0.9	133.0	12.0	6.1	117.1	50.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	13	3.0	0.004	0.002	0.055	0.014	3	0.001	0.005	10.9	121	308	8.7	no data	no data	14.9	11.8	no data	no data
	Median	1.3	1.5	13	3.0	0.008	0.005	0.105	0.015	6	0.004	0.005	11.7	126	312	8.9	0.9	133.0	19.8	46.0	117.1	50.0
	75%'ile	1.5	3.0	17	3.2	0.014	0.006	0.110	0.056	8	0.044	0.005	12.6	134	322	8.9	no data	no data	20.8	66.5	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.5	3.0	19	3.2	0.077	0.010	0.242	0.152	28	0.140	0.005	14.4	136	332	9.0	0.9	133.0	23.1	68.0	117.1	50.0
	Mean	1.2	2.0	14	3.1	0.019	0.005	0.112	0.044	9	0.032	0.005	11.9	127	314	8.8	0.9	133.0	18.4	40.0	117.1	50.0
	Std. Dev.	0.3	0.8	3	0.1	0.029	0.003	0.069	0.055	10	0.055	0.000	1.4	8	13	0.2	0.0	0.0	4.1	28.9	0.0	0.0
	Count	5	6	6	4	6	6	6	6	6	6	6	6	6	6	6	1	1	6	5	1	1
Mangaone Rv at Dartmoor	Minimum	0.8	1.5	33	1.3	0.019	0.019	0.110	0.014	1	0.001	0.005	8.3	95	349	8.4	no data	no data	10.5	no data	103.3	41.7
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	38	1.8	0.024	0.020	0.129	0.015	1	0.003	0.005	9.4	103	377	8.5	no data	no data	11.6	no data	no data	no data
	Median	1.7	1.5	40	2.6	0.027	0.021	0.190	0.084	4	0.070	0.005	11.7	107	405	8.5	no data	no data	16.8	no data	103.3	41.7
	75%'ile	3.1	2.4	58	3.3	0.033	0.032	0.357	0.263	8	0.245	0.011	11.8	113	430	8.5	no data	no data	20.3	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	3.8	5.0	80	3.4	0.042	0.036	0.500	0.382	11	0.350	0.028	11.8	121	435	8.6	no data	no data	21.6	no data	103.3	41.7
	Mean	2.0	2.2	48	2.5	0.029	0.025	0.249	0.144	5	0.127	0.010	10.7	108	401	8.5	no data	no data	16.2	no data	103.3	41.7
	Std. Dev.	1.4	1.6	19	0.9	0.008	0.007	0.160	0.158	4	0.151	0.010	1.6	9	35	0.1	no data	no data	4.8	no data	0.0	0.0
	Count	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	no data	no data	5	no data	1	1
Mangaone Rv at Rissington	Minimum	0.6	1.5	14	1.6	0.013	0.011	0.060	0.022	1	0.010	0.005	8.3	90	297	8.3	1.7	140.0	10.0	2.7	107.3	40.9
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	29	1.9	0.019	0.015	0.189	0.039	2	0.027	0.005	8.8	101	353	8.3	no data	no data	13.7	7.3	107.3	40.9
	Median	1.3	1.5	41	2.1	0.026	0.023	0.240	0.129	8	0.116	0.005	10.4	115	359	8.5	1.7	140.0	18.3	26.0	111.7	48.0
	75%'ile	2.0	5.0	70	2.8	0.036	0.026	0.333	0.250	11	0.237	0.005	12.1	117	388	8.9	no data	no data	21.3	47.3	116.0	55.0
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	2.6	7.0	150	3.6	0.039	0.032	0.520	0.364	16	0.350	0.010	13.2	121	402	9.1	1.7	140.0	24.6	72.0	116.0	55.0
	Mean	1.4	3.0	58	2.4	0.027	0.021	0.266	0.154	7	0.141	0.006	10.5	110	362	8.6	1.7	140.0	17.6	29.7	111.7	48.0
	Std. Dev.	0.8	2.4	49	0.7	0.010	0.008	0.144	0.128	6	0.128	0.002	1.9	12	33	0.3	0.0	0.0	5.2	27.6	6.2	10.0
	Count	4	6	6	5	7	7	7	7	7	7	7	8	8	8	8	1	1	8	5	2	2
Tutaekuri Rv at Puketapu	Minimum	0.9	1.5	8	2.2	0.010	0.004	0.110	0.017	1	0.005	0.005	9.7	112	328	8.7	no data	no data	14.8	73.0	88.0	33.3
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	9	2.6	0.012	0.006	0.114	0.023	2	0.011	0.005	10.5	121	332	8.8	no data	no data	18.9	no data	no data	no data
	Median	1.1	1.5	10	2.9	0.014	0.010	0.120	0.026	3	0.014	0.005	11.8	128	335	8.9	no data	no data	20.5	73.0	88.0	33.3
	75%'ile	1.5	4.8	12	3.6	0.023	0.013	0.151	0.029	4	0.018	0.005	12.4	132	356	9.0	no data	no data	22.9	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	1.8	10.0	15	3.6	0.029	0.014	0.156	0.040	7	0.028	0.005	12.4	138	357	9.0	no data	no data	24.1	73.0	88.0	33.3
	Mean	1.2	3.5	11	3.0	0.017	0.010	0.130	0.027	3	0.015	0.005	11.4	126	342	8.9	no data	no data	20.4	73.0	88.0	33.3
	Std. Dev.	0.4	3.7	3	0.6	0.008	0.004	0.021	0.008	2	0.008	0.000	1.2	9	13	0.1	no data	no data	3.5	0.0	0.0	0.0
	Count	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	no data	no data	5	1	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Tutaekuri Rv at Brookfields Br	Minimum	0.3	1.5	1	1.7	0.002	0.002	0.055	0.015	1	0.003	0.005	9.8	116	151	8.6	1.3	146.0	12.4	58.0	86.4	40.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	9	2.5	0.007	0.006	0.107	0.016	2	0.004	0.005	11.8	119	322	8.6	1.3	146.0	14.7	83.5	no data	no data
	Median	1.1	1.5	21	3.2	0.009	0.009	0.124	0.017	3	0.005	0.005	11.9	141	326	8.9	2.1	148.0	21.1	160.0	86.4	40.0
	75%'ile	1.5	1.5	29	4.9	0.013	0.014	0.173	0.035	6	0.017	0.013	13.0	143	335	9.0	3.0	150.0	24.6	385.0	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	2.2	3.0	160	6.0	0.026	0.016	0.190	0.130	21	0.081	0.048	14.3	144	338	9.1	3.0	150.0	25.4	460.0	86.4	40.0
	Mean	1.2	1.7	37	3.7	0.011	0.009	0.131	0.036	5	0.018	0.013	12.2	133	304	8.9	2.1	148.0	19.6	226.0	86.4	40.0
	Std. Dev.	0.7	0.6	55	1.5	0.008	0.005	0.047	0.042	7	0.029	0.016	1.4	13	68	0.2	1.2	2.8	5.5	209.0	0.0	0.0
	Count	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	2	2	7	3	1	1

Appendix B Summary statistics by flow in the Karamu and Ahuriri catchments

All flows

All flows																					
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Ruahapia Strm	Minimum	1.2	1.5	7	0.3	0.035	0.002	0.337	0.019	3	0.003	0.005	1.0	10	21	6.7	1.4	67.0	7.8	no data	58.5	0.0
	5%'ile	1.3	1.5	22	0.3	0.037	0.004	0.345	0.062	3	0.028	0.005	1.3	14	48	6.8	1.4	67.0	9.4	no data	no data	no data
	25%'ile	2.2	1.5	138	0.7	0.052	0.024	0.573	0.273	9	0.234	0.005	4.0	40	193	7.1	1.9	68.0	15.2	no data	60.1	0.0
	Median	3.0	4.3	280	1.1	0.069	0.034	0.850	0.588	18	0.420	0.024	4.6	49	234	7.4	2.3	76.0	17.1	no data	62.7	0.0
	75%'ile	8.9	13.0	878	1.3	0.101	0.043	1.044	0.774	27	0.698	0.081	6.6	67	259	7.5	14.0	82.0	18.7	no data	65.3	5.8
	95%'ile	22.3	33.1	5730	2.3	0.204	0.059	2.603	2.424	93	2.224	0.278	8.4	92	450	7.7	36.8	110.2	20.6	no data	no data	no data
	Maximum	24.0	38.0	6500	2.3	0.230	0.064	3.300	3.089	124	2.900	0.320	8.5	93	499	7.8	38.0	114.0	20.9	no data	67.0	7.7
	Mean	6.5	8.7	1031	1.1	0.086	0.033	0.944	0.661	23	0.580	0.061	5.0	53	231	7.3	9.3	79.1	16.6	no data	62.7	2.6
	Std. Dev.	7.1	10.4	1759	0.6	0.050	0.015	0.667	0.699	28	0.657	0.083	2.2	23	101	0.3	11.9	13.1	3.3	no data	3.6	4.4
	Count	16	17	17	10	17	17	17	17	17	17	17	17	17	17	17	13	14	17	no data	4	3
Karewarewa Strm	Minimum	0.9	1.5	4	0.0	0.095	0.067	0.435	0.087	1	0.001	0.005	0.4	4	67	7.2	5.7	130.0	7.6	no data	66.7	0.0
	5%'ile	1.0	1.5	17	0.1	0.097	0.069	0.738	0.263	1	0.005	0.006	0.4	4	381	7.3	5.8	147.5	9.1	no data	no data	no data
	25%'ile	1.7	1.5	110	0.7	0.141	0.106	1.928	1.011	5	0.693	0.047	4.8	41	616	7.5	7.5	250.0	11.4	no data	66.7	0.0
	Median	4.0	5.0	330	1.2	0.171	0.140	2.800	1.706	15	1.520	0.075	7.3	71	757	7.7	8.0	290.0	14.3	no data	68.7	6.7
	75%'ile	5.6	8.5	700	1.9	0.263	0.188	4.025	3.133	20	3.025	0.170	8.9	85	827	7.9	10.3	315.0	17.1	no data	70.7	13.3
	95%'ile	62.9	109.1	4310	3.4	1.097	0.792	5.368	4.289	32	4.185	0.497	10.1	96	926	8.2	22.3	345.0	21.3	no data	no data	no data
	Maximum	346.0	320.0	14000	3.6	1.210	1.290	7.200	6.174	37	6.000	0.980	10.8	117	945	8.2	23.0	350.0	22.7	no data	70.7	13.3
	Mean	18.8	20.5	1015	1.3	0.308	0.217	2.976	2.046	14	1.868	0.152	6.3	60	716	7.7	9.9	272.0	14.4	no data	68.7	6.7
	Std. Dev.	63.8	58.0	2540	0.9	0.308	0.248	1.565	1.407	10	1.464	0.203	3.1	32	176	0.3	4.9	57.0	3.8	no data	2.8	9.4
	Count	29	33	32	28	33	33	33	33	33	33	33	31	31	32	33	12	15	32	no data	2	2
Awanui Strm	Minimum	1.0	1.5	5	0.1	0.090	0.065	0.958	0.240	0	0.001	0.005	0.2	2	8	7.1	4.8	150.0	7.5	no data	67.3	0.0
	5%'ile	1.1	1.5	49	0.1	0.122	0.089	1.012	0.256	1	0.003	0.005	1.1	12	202	7.5	5.1	175.0	8.4	no data	no data	no data
	25%'ile	1.7	1.5	140	0.8	0.153	0.121	1.453	0.607	4	0.538	0.034	4.0	40	645	7.7	10.1	265.0	10.7	no data	67.3	0.0
	Median	2.8	3.0	250	1.1	0.215	0.182	2.100	0.887	6	0.840	0.066	6.4	65	719	7.8	15.9	280.0	15.1	no data	67.7	9.1
	75%'ile	4.4	8.8	360	1.9	0.300	0.250	3.000	1.766	11	1.692	0.110	8.2	74	792	7.9	18.6	347.5	17.6	no data	68.0	18.2
	95%'ile	56.1	86.5	3060	2.4	0.776	0.656	4.895	3.457	27	3.265	0.428	9.7	90	931	8.1	24.8	370.0	21.2	no data	no data	no data
	Maximum	185.0	172.0	9000	2.9	0.920	0.820	5.770	4.736	44	4.700	0.570	10.2	123	1080	8.1	25.0	370.0	24.3	no data	68.0	18.2
	Mean	10.8	12.8	644	1.3	0.297	0.233	2.359	1.251	8	1.130	0.097	6.0	58	696	7.8	15.0	296.0	14.7	no data	67.7	9.1
	Std. Dev.	32.5	32.2	1538	0.7	0.214	0.171	1.179	0.962	9	0.981	0.124	2.7	26	202	0.2	6.1	58.0	4.3	no data	0.5	12.9
	Count	35	39	38	29	38	38	39	39	38	39	39	37	37	38	38	12	15	38	no data	2	2
Poukawa Strm	Minimum	0.6	1.5	8	0.3	0.041	0.021	0.255	0.014	0	0.001	0.005	0.6	7	86	7.2	3.5	240.0	7.4	no data	65.0	8.3
	5%'ile	0.7	1.5	17	0.4	0.051	0.034	0.420	0.015	0	0.003	0.005	1.1	12	451	7.4	3.5	242.5	7.7	no data	no data	no data
	25%'ile	1.0	1.5	50	0.9	0.099	0.072	1.195	0.097	0	0.047	0.005	3.1	32	655	7.6	14.0	282.5	10.7	no data	65.0	8.3
	Median	1.5	1.5	130	1.3	0.188	0.134	1.460	0.173	1	0.130	0.018	4.5	44	713	7.7	22.0	290.0	14.6	no data	68.0	8.7
	75%'ile	2.0	5.0	210	2.0	0.292	0.245	1.995	0.471	6	0.443	0.042	6.2	57	782	7.8	24.5	370.0	18.4	no data	70.9	9.1
	95%'ile	11.6	46.0	634	3.4	0.472	0.366	2.476	1.219	18	1.131	0.105	8.8	79	895	8.0	35.3	407.5	20.8	no data	no data	no data
	Maximum	20.0	106.0	740	3.5	1.500	1.300	5.400	3.580	28	3.500	0.140	9.2	86	1186	8.1	36.0	410.0	21.2	no data	70.9	9.1
	Mean	2.6	7.9	177	1.5	0.234	0.188	1.594	0.373	4	0.334	0.030	4.6	44	708	7.7	19.7	314.7	14.6	no data	68.0	8.7
	Std. Dev.	3.8	19.1	184	0.9	0.243	0.212	0.831	0.611	6	0.600	0.032	2.3	20	163	0.2	9.6	57.2	4.3	no data	4.2	0.6
	Count	35	39	38	35	37	37	39	39	37	39	39	37	37	38	39	12	15	38	no data	2	2

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Herehere Strm	Minimum	0.9	1.5	4	0.2	0.027	0.011	0.160	0.014	0	0.001	0.005	0.3	3	46	7.8	1.5	190.0	7.7	17.2	66.4	10.5
	5%'ile	0.9	1.5	33	0.2	0.032	0.017	0.221	0.015	0	0.003	0.005	4.8	49	86	7.8	1.6	192.0	8.6	no data	no data	no data
	25%'ile	1.7	1.5	285	1.3	0.060	0.042	0.280	0.054	1	0.037	0.005	9.4	93	539	8.0	3.1	250.0	11.8	no data	67.6	10.8
	Median	2.1	1.5	540	1.6	0.074	0.057	0.660	0.300	5	0.275	0.017	10.8	99	584	8.3	4.7	265.0	14.3	17.2	68.9	11.8
	75%'ile	5.6	4.5	1275	2.4	0.095	0.074	1.045	0.680	11	0.640	0.026	11.6	114	626	8.4	6.2	280.0	16.4	no data	74.3	16.3
	95%'ile	36.3	52.5	2945	3.8	0.441	0.110	3.593	2.143	88	2.100	0.057	12.8	135	678	8.6	13.3	298.0	21.0	no data	no data	no data
	Maximum	39.2	130.0	3100	4.2	0.750	0.115	6.000	5.610	106	5.500	0.122	14.3	168	789	8.7	14.0	300.0	23.1	17.2	75.8	20.0
	Mean	6.9	10.0	826	1.8	0.118	0.058	1.027	0.648	13	0.619	0.021	10.0	99	546	8.2	5.3	257.1	14.3	17.2	70.6	13.5
	Std. Dev.	10.4	25.1	802	1.0	0.145	0.026	1.238	1.082	25	1.067	0.023	2.7	28	159	0.3	3.4	35.6	3.7	0.0	4.0	4.4
	Count	28	31	31	22	32	32	32	32	32	32	32	31	31	32	31	13	14	32	1	5	4
Mangarau Strm at Keirunga Rd	Minimum	0.7	1.5	1	0.1	0.044	0.032	0.231	0.012	0	0.001	0.005	7.4	12	68	7.9	2.1	200.0	8.4	64.0	73.6	18.2
	5%'ile	1.0	1.5	6	0.1	0.045	0.032	0.282	0.025	1	0.011	0.005	7.8	34	182	7.9	2.2	208.0	8.7	no data	no data	no data
	25%'ile	2.6	1.5	80	0.8	0.053	0.040	0.400	0.131	3	0.134	0.005	9.5	91	575	8.1	3.6	260.0	10.5	90.4	77.9	22.4
	Median	3.3	4.0	240	1.1	0.060	0.048	0.534	0.191	4	0.199	0.010	10.4	98	621	8.2	4.6	285.0	13.0	169.5	82.7	29.1
	75%'ile	8.5	13.5	415	1.2	0.095	0.053	1.128	0.369	7	0.405	0.015	11.1	102	646	8.3	5.9	290.0	15.2	237.5	87.2	35.8
	95%'ile	79.8	178.2	21535	1.7	0.413	0.129	3.547	0.920	21	2.848	0.074	12.2	110	677	8.3	17.1	308.0	18.1	no data	no data	no data
	Maximum	84.0	230.0	32000	1.8	0.420	0.139	4.100	1.090	27	3.800	0.085	12.3	111	679	8.3	18.0	310.0	18.9	260.2	91.0	40.0
	Mean	13.4	24.5	2196	1.0	0.106	0.055	0.994	0.284	6	0.483	0.016	10.2	92	569	8.2	5.9	274.3	13.1	164.6	82.5	29.1
	Std. Dev.	25.1	56.6	7695	0.5	0.116	0.028	1.018	0.266	6	0.892	0.021	1.3	23	148	0.1	4.3	30.1	2.9	98.2	7.1	9.1
	Count	16	17	17	11	17	17	17	17	17	17	17	17	17	17	17	13	14	17	3	4	4
Mangarau Strm at Te Aute Rd	Minimum	0.8	1.5	2	0.1	0.036	0.032	0.520	0.250	3	0.240	0.005	7.7	11	68	7.8	1.8	194.0	8.9	7.6	63.8	16.7
	5%'ile	1.0	1.5	9	0.2	0.048	0.035	0.696	0.340	4	0.325	0.005	8.3	59	197	7.9	2.1	195.2	9.1	no data	no data	no data
	25%'ile	1.4	1.5	98	0.7	0.063	0.056	1.091	0.740	8	0.705	0.005	9.5	94	528	8.0	3.8	240.0	10.8	7.6	68.8	17.8
	Median	2.5	1.5	270	1.3	0.084	0.070	1.260	0.817	13	0.790	0.015	10.6	99	613	8.2	4.7	265.0	13.5	85.6	75.2	21.1
	75%'ile	4.0	5.5	430	1.6	0.116	0.084	1.462	0.988	20	0.940	0.024	11.7	111	636	8.3	6.7	280.0	16.3	163.7	81.5	24.0
	95%'ile	50.3	62.0	2711	3.1	0.207	0.123	3.201	2.904	44	2.890	0.066	12.7	123	683	8.4	13.6	298.0	19.1	no data	no data	no data
	Maximum	76.8	86.0	6000	3.3	0.240	0.130	4.040	3.810	61	3.800	0.082	13.3	126	693	8.4	14.0	300.0	19.6	163.7	86.3	25.0
	Mean	7.6	8.9	542	1.3	0.097	0.072	1.420	1.016	16	0.989	0.021	10.6	98	555	8.1	5.8	258.9	13.8	85.6	75.1	20.9
	Std. Dev.	16.7	19.6	1214	0.8	0.049	0.024	0.709	0.746	13	0.752	0.021	1.4	22	152	0.2	3.3	32.4	3.2	110.4	9.3	4.2
	Count	23	23	23	15	23	23	23	23	23	23	23	24	24	24	23	13	14	24	2	4	3
Clive Rv	Minimum	0.9	1.5	4	0.2	0.067	0.043	0.190	0.014	0	0.001	0.005	4.9	50	45	7.3	1.4	95.0	8.8	no data	76.8	21.1
	5%'ile	1.1	1.5	26	0.2	0.073	0.050	0.220	0.025	0	0.013	0.005	5.3	53	261	7.4	1.4	95.4	11.3	no data	no data	no data
	25%'ile	2.0	1.5	72	0.8	0.101	0.079	0.497	0.197	2	0.179	0.005	6.6	64	305	7.6	3.3	116.0	12.8	no data	no data	no data
	Median	3.8	3.0	190	1.2	0.142	0.101	1.034	0.673	7	0.620	0.036	8.1	81	384	7.8	6.0	140.5	15.9	no data	76.8	21.1
	75%'ile	5.6	8.8	328	2.3	0.225	0.132	2.057	1.477	13	1.368	0.080	9.2	97	514	8.0	8.0	180.0	19.6	no data	no data	no data
	95%'ile	26.2	45.8	1585	2.9	0.345	0.208	3.219	2.681	21	2.663	0.159	13.1	152	666	8.4	8.5	236.0	22.4	no data	no data	no data
	Maximum	37.6	104.0	2100	3.0	0.540	0.210	4.900	3.208	34	3.000	0.190	13.9	154	693	8.5	8.5	240.0	22.6	no data	76.8	21.1
	Mean	6.3	10.9	367	1.5	0.171	0.111	1.353	0.884	9	0.816	0.049	8.3	85	411	7.8	5.4	148.4	16.2	no data	76.8	21.1
	Std. Dev.	8.3	20.7	505	0.9	0.098	0.046	1.097	0.830	8	0.792	0.049	2.3	26	138	0.3	2.7	45.4	3.8	no data	0.0	0.0
	Count	26	32	31	19	32	32	31	31	31	31	32	31	31	32	31	12	14	32	no data	1	1

All flows

All flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^{o}C)	Chla (mg/m^{2})	MCI (Unit)	% EPT taxa
Taipo Strm	Minimum	1.0	1.5	1	0.1	0.161	0.128	0.340	0.016	0	0.001	0.005	0.3	3	33	7.0	4.3	82.0	8.6	no data	58.6	0.0
	5%'ile	1.8	1.5	3	0.2	0.170	0.161	0.393	0.019	0	0.003	0.005	0.3	3	70	7.3	4.3	85.6	8.7	no data	no data	no data
	25%'ile	3.6	5.0	92	0.3	0.295	0.215	0.614	0.095	0	0.035	0.013	2.4	26	431	7.5	4.9	149.0	11.5	no data	62.3	3.8
	Median	5.8	14.0	330	0.5	0.410	0.270	0.980	0.471	2	0.320	0.034	5.2	54	547	7.6	6.4	173.5	14.7	no data	66.7	5.9
	75%'ile	16.0	27.5	775	0.9	0.638	0.453	1.278	0.716	3	0.555	0.205	7.1	75	603	7.8	8.0	190.0	18.3	no data	75.5	10.7
	95%'ile	45.2	71.4	2360	2.2	0.839	0.677	2.484	3.007	10	2.954	0.370	10.0	104	674	8.0	9.5	210.0	21.9	no data	no data	no data
	Maximum	160.0	156.0	5300	2.4	0.940	0.680	3.756	10.013	18	10.000	0.380	12.5	109	696	8.1	9.5	210.0	22.3	no data	79.0	14.3
	Mean	16.4	22.1	657	0.7	0.462	0.330	1.126	0.850	3	0.723	0.112	5.1	50	480	7.6	6.4	166.1	15.0	no data	68.4	6.9
	Std. Dev.	29.2	29.7	1021	0.6	0.213	0.161	0.701	1.787	4	1.798	0.124	3.3	31	179	0.2	1.8	38.0	4.0	no data	8.2	5.3
	Count	30	32	31	19	31	31	31	32	31	32	32	30	31	32	31	13	14	32	no data	5	5

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ruahapia Strm	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Karewarewa Strm	Minimum	0.9	1.5	4	0.7	0.095	0.067	0.435	0.087	1	0.001	0.005	0.4	4	67	7.2	6.7	200.0	9.8	no data	66.7	13.3
	5%'ile	1.0	1.5	23	0.7	0.095	0.071	0.598	0.183	1	0.002	0.005	0.6	6	332	7.2	no data	201.5	9.9	no data	no data	no data
	25%'ile	1.3	1.5	135	1.0	0.139	0.104	1.366	0.693	3	0.257	0.021	3.5	17	638	7.4	7.5	250.0	12.3	no data	no data	no data
	Median	2.4	1.5	405	1.6	0.171	0.121	2.200	1.323	14	1.290	0.057	6.1	55	743	7.7	8.0	270.0	14.9	no data	66.7	13.3
	75%'ile	4.3	5.5	720	2.2	0.228	0.161	3.271	2.427	17	2.350	0.233	7.8	76	801	7.9	9.1	290.0	17.8	no data	no data	no data
	95%'ile	11.1	21.5	3550	3.5	1.045	0.899	6.210	5.120	34	4.955	0.716	9.6	104	876	8.2	no data	319.0	22.1	no data	no data	no data
	Maximum	15.7	22.0	4500	3.6	1.210	1.290	7.200	6.174	37	6.000	0.980	10.1	117	898	8.2	16.0	320.0	22.7	no data	66.7	13.3
	Mean	3.4	5.1	702	1.7	0.269	0.204	2.552	1.764	13	1.568	0.166	5.5	52	704	7.7	9.0	267.3	15.1	no data	66.7	13.3
	Std. Dev.	3.3	6.0	1062	0.9	0.279	0.270	1.628	1.506	11	1.557	0.240	2.9	33	174	0.3	3.0	35.0	3.8	no data	0.0	0.0
	Count	19	21	20	17	21	21	21	21	21	21	21	20	20	20	21	8	11	20	no data	1	1
Awanui Strm	Minimum	1.0	1.5	5	0.1	0.090	0.065	0.958	0.240	1	0.002	0.005	0.2	2	8	7.1	4.8	150.0	8.4	no data	67.3	18.2
	5%'ile	1.1	1.5	48	0.4	0.121	0.084	1.005	0.254	1	0.005	0.005	1.0	12	156	7.5	5.1	175.0	8.5	no data	no data	no data
	25%'ile	1.7	1.5	140	0.8	0.152	0.120	1.456	0.609	4	0.545	0.034	4.1	41	649	7.7	10.1	265.0	10.9	no data	no data	no data
	Median	2.9	1.5	250	1.1	0.210	0.177	2.100	0.933	6	0.865	0.065	6.4	65	717	7.8	15.9	280.0	15.1	no data	67.3	18.2
	75%'ile	4.4	7.5	358	1.9	0.278	0.237	3.000	1.761	11	1.685	0.104	8.1	74	810	7.9	18.6	347.5	17.6	no data	no data	no data
	95%'ile	56.6	74.8	3150	2.5	0.710	0.628	4.311	2.977	27	2.800	0.450	9.8	90	939	8.1	24.8	370.0	21.2	no data	no data	no data
	Maximum	185.0	172.0	9000	2.9	0.920	0.820	5.770	4.736	44	4.700	0.570	10.2	123	1080	8.1	25.0	370.0	24.3	no data	67.3	18.2
	Mean	10.5	11.4	666	1.3	0.282	0.223	2.322	1.228	8	1.111	0.093	6.0	59	694	7.8	15.0	296.0	14.7	no data	67.3	18.2
	Std. Dev.	33.5	32.0	1600	0.7	0.201	0.163	1.102	0.904	9	0.925	0.124	2.6	25	210	0.2	6.1	58.0	4.2	no data	0.0	0.0
	Count	32	36	35	26	35	35	36	36	35	36	36	35	35	35	35	12	15	35	no data	1	1
Poukawa Strm	Minimum	0.7	1.5	20	0.4	0.061	0.052	0.255	0.014	0	0.001	0.005	0.6	7	556	7.5	3.5	240.0	8.4	no data	65.0	8.3
	5%'ile	0.8	1.5	27	0.5	0.067	0.052	0.370	0.014	0	0.002	0.005	0.9	10	580	7.5	no data	no data	9.1	no data	no data	no data
	25%'ile	0.9	1.5	70	1.0	0.106	0.074	0.945	0.087	0	0.036	0.005	2.7	30	663	7.6	3.8	270.0	12.6	no data	65.0	8.3
	Median	1.3	1.5	130	1.4	0.188	0.134	1.355	0.140	1	0.106	0.021	3.9	38	697	7.7	10.7	290.0	15.1	no data	68.0	8.7
	75%'ile	1.6	3.0	225	2.1	0.297	0.253	1.578	0.435	5	0.395	0.045	5.8	56	777	7.8	18.2	290.0	19.5	no data	70.9	9.1
	95%'ile	10.9	73.1	682	3.4	0.458	0.363	2.230	1.058	15	1.003	0.104	8.7	82	943	8.0	no data	no data	21.1	no data	no data	no data
	Maximum	20.0	106.0	740	3.5	0.490	0.370	2.300	1.509	21	1.360	0.107	8.8	86	1186	8.1	21.0	310.0	21.2	no data	70.9	9.1
	Mean	2.2	9.4	192	1.6	0.211	0.162	1.292	0.297	3	0.257	0.030	4.2	41	724	7.7	11.3	281.3	15.6	no data	68.0	8.7
	Std. Dev.	4.2	23.8	197	0.9	0.126	0.103	0.555	0.357	5	0.342	0.030	2.3	21	121	0.1	7.8	21.7	4.0	no data	4.2	0.6
	Count	20	24	23	20	23	23	24	24	23	24	24	23	23	23	24	5	8	23	no data	2	2

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Herehere Strm	Minimum	0.9	1.5	4	0.9	0.027	0.011	0.160	0.015	0	0.003	0.005	0.3	3	62	7.8	1.5	200.0	8.6	17.2	66.4	0.0
	5%'ile	0.9	1.5	24	1.0	0.030	0.016	0.208	0.015	0	0.003	0.005	3.8	39	254	7.8	1.5	200.0	8.8	no data	no data	no data
	25%'ile	1.4	1.5	273	1.3	0.060	0.041	0.265	0.050	1	0.036	0.005	9.5	94	555	8.1	2.9	255.0	11.8	no data	67.2	5.3
	Median	2.0	1.5	530	1.6	0.071	0.055	0.521	0.253	4	0.227	0.014	10.8	101	584	8.3	4.2	265.0	14.3	17.2	70.9	11.5
	75%'ile	2.9	1.9	900	2.6	0.083	0.065	1.020	0.623	11	0.610	0.023	11.7	115	646	8.4	6.0	285.0	16.0	no data	74.8	16.3
	95%'ile	16.6	18.0	2175	3.9	0.510	0.085	4.110	2.812	95	2.780	0.032	13.1	142	701	8.7	9.4	299.0	21.6	no data	no data	no data
	Maximum	24.8	42.0	3000	4.2	0.750	0.115	6.000	5.610	106	5.500	0.034	14.3	168	789	8.7	9.6	300.0	23.1	17.2	75.8	20.0
	Mean	3.7	4.0	718	2.0	0.110	0.053	0.963	0.637	15	0.613	0.015	10.1	99	571	8.3	4.5	260.8	14.4	17.2	71.0	10.8
	Std. Dev.	5.3	8.2	705	1.0	0.152	0.022	1.287	1.154	27	1.137	0.010	2.8	30	134	0.3	2.3	32.0	3.6	0.0	4.5	8.3
	Count	22	25	25	18	26	26	26	26	26	26	26	26	26	26	25	11	12	26	1	4	4
Mangarau Strm at Keirunga Rd	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Mangarau Strm at Te Aute Rd	Minimum	0.8	1.5	2	0.4	0.036	0.032	0.520	0.250	3	0.240	0.005	7.7	11	68	7.8	1.8	194.0	8.9	7.6	63.8	16.7
	5%'ile	1.0	1.5	8	0.4	0.047	0.034	0.682	0.333	4	0.318	0.005	8.2	55	237	7.9	2.1	195.2	9.1	no data	no data	no data
	25%'ile	1.3	1.5	90	1.0	0.062	0.055	1.084	0.742	9	0.720	0.005	9.5	93	577	8.0	3.8	240.0	11.1	7.6	68.8	17.8
	Median	2.5	1.5	260	1.3	0.081	0.070	1.245	0.836	13	0.795	0.014	10.5	98	615	8.2	4.7	265.0	13.6	85.6	75.2	21.1
	75%'ile	3.7	4.0	400	1.6	0.110	0.084	1.467	1.017	21	0.960	0.018	11.8	113	638	8.3	6.7	280.0	16.4	163.7	81.5	24.0
	95%'ile	20.3	28.0	892	3.1	0.172	0.124	3.266	2.973	45	2.960	0.068	12.8	123	684	8.4	13.6	298.0	19.1	no data	no data	no data
	Maximum	36.0	49.0	940	3.3	0.190	0.130	4.040	3.810	61	3.800	0.082	13.3	126	693	8.4	14.0	300.0	19.6	163.7	86.3	25.0
	Mean	4.5	5.4	294	1.4	0.091	0.072	1.419	1.043	17	1.016	0.020	10.6	98	568	8.2	5.8	258.9	14.0	85.6	75.1	20.9
	Std. Dev.	7.4	10.3	246	0.8	0.038	0.024	0.725	0.752	13	0.757	0.021	1.4	23	140	0.2	3.3	32.4	3.2	110.4	9.3	4.2
	Count	22	22	22	14	22	22	22	22	22	22	22	23	23	23	22	13	14	23	2	4	3
Clive Rv	Minimum	0.9	1.5	4	0.2	0.067	0.043	0.190	0.025	0	0.013	0.005	4.9	50	45	7.3	1.4	95.0	11.3	no data	no data	no data
	5%'ile	1.1	1.5	18	0.3	0.071	0.046	0.209	0.028	0	0.016	0.005	5.4	52	196	7.4	1.4	95.2	11.5	no data	no data	no data
	25%'ile	2.0	1.5	70	0.8	0.094	0.067	0.400	0.176	2	0.156	0.005	6.8	69	303	7.6	2.8	117.0	13.3	no data	no data	no data
	Median	3.0	1.5	180	1.3	0.135	0.096	0.950	0.574	7	0.450	0.032	8.4	82	378	7.8	4.6	140.5	15.5	no data	no data	no data
	75%'ile	4.9	7.0	235	2.2	0.163	0.112	1.924	1.454	16	1.345	0.060	10.1	105	494	8.1	8.1	184.0	19.6	no data	no data	no data
	95%'ile	14.8	62.0	1003	2.9	0.337	0.190	2.658	2.079	26	2.070	0.131	13.4	154	678	8.4	8.5	238.0	22.5	no data	no data	no data
	Maximum	20.4	104.0	1100	3.0	0.540	0.210	3.100	2.710	34	2.700	0.190	13.9	154	693	8.5	8.5	240.0	22.6	no data	no data	no data
	Mean	4.2	9.7	233	1.5	0.153	0.099	1.174	0.778	9	0.720	0.043	8.6	88	398	7.9	5.1	152.2	16.4	no data	no data	no data
	Std. Dev.	4.3	22.0	275	0.9	0.097	0.040	0.867	0.729	9	0.707	0.044	2.5	28	145	0.3	2.8	46.8	3.7	no data	no data	no data
	Count	20	24	23	16	24	24	23	23	23	23	24	24	24	24	23	10	12	24	no data	no data	no data

< 3X Median flow

< 3 x Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^{o}C)	Chla (mg/m^{2})	MCI (Unit)	% EPT taxa
Taipo Strm	Minimum	1.0	1.5	1	0.1	0.161	0.128	0.340	0.016	0	0.001	0.005	0.3	3	33	7.0	4.3	82.0	8.6	no data	58.6	0.0
	5%'ile	1.7	1.5	1	0.2	0.169	0.158	0.385	0.019	0	0.003	0.005	0.3	3	64	7.2	4.3	84.7	9.7	no data	no data	no data
	25%'ile	3.4	5.0	94	0.3	0.300	0.220	0.596	0.070	0	0.026	0.013	2.4	26	439	7.5	4.9	148.5	12.2	no data	61.1	3.0
	Median	5.7	15.0	360	0.5	0.465	0.310	0.930	0.450	1	0.210	0.025	5.2	54	559	7.6	5.8	176.0	14.7	no data	65.1	7.7
	75%'ile	15.9	27.3	750	0.8	0.670	0.480	1.196	0.635	3	0.477	0.158	7.1	68	614	7.8	7.4	192.5	17.8	no data	70.5	11.9
	95%'ile	62.4	77.2	2690	2.3	0.850	0.680	2.335	3.478	11	3.445	0.370	10.3	105	679	8.0	9.1	210.0	22.0	no data	no data	no data
	Maximum	160.0	156.0	5300	2.4	0.940	0.680	3.756	10.013	18	10.000	0.380	12.5	109	696	8.1	9.2	210.0	22.3	no data	74.3	14.3
	Mean	16.5	22.6	688	0.7	0.472	0.342	1.048	0.811	2	0.700	0.097	5.0	49	485	7.6	6.1	165.8	15.2	no data	65.8	7.4
	Std. Dev.	30.6	30.9	1066	0.6	0.221	0.165	0.673	1.868	4	1.882	0.119	3.3	31	181	0.2	1.6	39.5	3.9	no data	6.6	6.0
	Count	27	29	28	17	28	28	28	29	28	29	29	28	29	29	28	12	13	29	no data	4	4

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Ruahapia Strm	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Karewarewa Strm	Minimum	1.2	1.5	41	0.8	0.095	0.067	0.435	0.087	1	0.001	0.005	0.4	4	614	7.2	6.7	230.0	10.5	no data	66.7	13.3
	5%'ile	1.2	1.5	44	0.8	0.103	0.074	0.494	0.122	1	0.001	0.005	0.5	5	614	7.2	no data	no data	10.7	no data	no data	no data
	25%'ile	1.4	1.5	190	1.4	0.156	0.120	1.100	0.350	2	0.039	0.014	1.2	9	706	7.4	7.2	250.0	13.2	no data	no data	no data
	Median	2.4	1.5	440	1.9	0.210	0.147	2.125	1.168	7	0.885	0.080	5.0	49	756	7.6	7.9	270.0	15.1	no data	66.7	13.3
	75%'ile	4.1	5.0	900	2.3	0.260	0.181	3.455	2.349	15	2.300	0.410	6.4	58	803	7.7	12.1	290.0	18.5	no data	no data	no data
	95%'ile	14.1	21.8	4120	3.6	1.150	1.148	6.840	5.791	35	5.620	0.884	7.9	87	891	7.9	no data	no data	21.2	no data	no data	no data
	Maximum	15.7	22.0	4500	3.6	1.210	1.290	7.200	6.174	37	6.000	0.980	7.9	88	898	7.9	16.0	300.0	21.4	no data	66.7	13.3
	Mean	3.7	5.4	879	1.8	0.331	0.252	2.584	1.713	11	1.451	0.222	4.3	39	749	7.6	9.6	268.3	15.7	no data	66.7	13.3
	Std. Dev.	3.8	7.1	1227	0.8	0.327	0.323	1.924	1.759	11	1.822	0.279	2.8	30	86	0.3	4.3	28.6	3.3	no data	0.0	0.0
	Count	13	14	14	10	14	14	14	14	14	14	14	13	13	13	14	4	6	13	no data	1	1
Awanui Strm	Minimum	1.0	1.5	5	0.6	0.090	0.065	0.958	0.240	1	0.002	0.005	0.2	2	8	7.1	4.8	250.0	8.4	no data	67.3	18.2
	5%'ile	1.1	1.5	47	0.6	0.119	0.079	0.995	0.250	1	0.005	0.005	0.9	10	107	7.5	4.8	251.5	8.5	no data	no data	no data
	25%'ile	1.6	1.5	125	1.0	0.152	0.118	1.420	0.609	4	0.545	0.033	4.3	44	670	7.7	9.1	275.0	10.9	no data	no data	no data
	Median	2.7	1.5	230	1.3	0.187	0.162	1.950	0.887	6	0.830	0.055	6.4	65	720	7.8	14.9	280.0	15.1	no data	67.3	18.2
	75%'ile	3.4	6.0	338	1.9	0.268	0.210	2.737	1.628	11	1.545	0.097	8.2	74	810	7.9	17.2	342.5	17.4	no data	no data	no data
	95%'ile	5.6	9.0	1071	2.6	0.519	0.467	4.310	3.200	28	3.000	0.510	10.0	92	949	8.1	25.0	370.0	21.3	no data	no data	no data
	Maximum	6.2	10.0	2700	2.9	0.710	0.680	5.770	4.736	44	4.700	0.570	10.2	123	1080	8.1	25.0	370.0	24.3	no data	67.3	18.2
	Mean	2.8	3.7	334	1.5	0.236	0.197	2.189	1.193	9	1.079	0.091	6.1	60	711	7.8	14.1	302.3	14.6	no data	67.3	18.2
	Std. Dev.	1.4	3.1	482	0.6	0.134	0.128	1.074	0.926	9	0.954	0.131	2.6	25	206	0.2	6.1	42.1	4.2	no data	0.0	0.0
	Count	28	32	31	23	31	31	32	32	31	32	32	31	31	31	31	10	13	31	no data	1	1
Poukawa Strm	Minimum	0.7	1.5	20	0.4	0.061	0.052	0.255	0.014	0	0.001	0.005	0.6	7	556	7.6	3.5	260.0	8.4	no data	65.0	8.3
	5%'ile	0.7	1.5	24	0.5	0.064	0.053	0.312	0.014	0	0.002	0.005	0.7	8	567	7.6	no data	no data	9.0	no data	no data	no data
	25%'ile	0.9	1.5	61	1.2	0.087	0.071	0.718	0.107	0	0.049	0.005	1.7	19	655	7.6	3.7	275.0	14.1	no data	no data	no data
	Median	1.3	1.5	130	1.6	0.159	0.104	1.185	0.173	2	0.137	0.021	3.5	39	724	7.8	7.3	290.0	17.2	no data	65.0	8.3
	75%'ile	1.4	3.5	215	2.4	0.310	0.270	1.485	0.488	6	0.460	0.044	5.6	55	781	7.8	15.9	290.0	20.4	no data	no data	no data
	95%'ile	1.7	74.9	583	3.4	0.475	0.352	2.165	1.284	18	1.181	0.106	8.8	84	1074	8.1	no data	no data	21.1	no data	no data	no data
	Maximum	1.7	106.0	740	3.5	0.490	0.370	2.200	1.509	21	1.360	0.107	8.8	86	1186	8.1	21.0	290.0	21.2	no data	65.0	8.3
	Mean	1.2	9.2	161	1.8	0.210	0.163	1.178	0.341	4	0.298	0.032	4.0	40	735	7.8	9.8	282.0	16.5	no data	65.0	8.3
	Std. Dev.	0.3	25.2	170	0.9	0.140	0.109	0.572	0.393	6	0.378	0.034	2.6	24	143	0.1	8.2	13.0	4.0	no data	0.0	0.0
	Count	13	17	17	15	16	16	17	17	16	17	17	16	16	16	17	4	5	16	no data	1	1

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m²)	MCI (Unit)	% EPT taxa
Herehere Strm	Minimum	1.1	1.5	30	1.3	0.027	0.020	0.160	0.015	0	0.003	0.005	4.7	49	302	7.8	2.0	200.0	11.7	17.2	66.4	0.0
	5%'ile	no data	1.5	42	no data	0.029	0.022	0.167	0.015	0	0.003	0.005	5.0	51	324	7.8	no data	no data	11.7	no data	no data	no data
	25%'ile	1.3	1.5	350	1.6	0.060	0.045	0.249	0.033	1	0.020	0.005	8.8	87	539	8.0	3.1	237.5	13.1	no data	67.2	5.3
	Median	1.8	1.5	570	2.4	0.072	0.057	0.310	0.076	1	0.053	0.005	10.0	100	570	8.2	4.5	260.0	14.6	17.2	70.9	11.5
	75%'ile	4.9	5.5	1050	3.3	0.081	0.061	1.320	0.953	13	0.930	0.024	11.3	116	588	8.4	5.5	270.0	17.2	no data	74.8	16.3
	95%'ile	no data	38.8	1760	no data	0.098	0.074	5.630	5.260	104	5.160	0.031	12.7	134	637	8.6	no data	no data	21.0	no data	no data	no data
	Maximum	24.8	42.0	1800	4.2	0.100	0.075	6.000	5.610	106	5.500	0.031	12.8	136	642	8.7	6.2	270.0	21.2	17.2	75.8	20.0
	Mean	5.4	6.4	707	2.5	0.069	0.054	1.093	0.837	19	0.810	0.013	9.8	99	549	8.2	4.3	250.0	15.3	17.2	71.0	10.8
	Std. Dev.	7.9	11.6	535	1.0	0.019	0.014	1.696	1.658	38	1.636	0.011	2.2	24	84	0.3	1.7	29.2	2.9	0.0	4.5	8.3
	Count	9	12	12	8	12	12	12	12	12	12	12	12	12	12	11	4	5	12	1	4	4
Mangarau Strm at Keirunga Rd	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Mangarau Strm at Te Aute Rd	Minimum	0.8	1.5	12	1.1	0.071	0.059	0.520	0.250	3	0.240	0.005	7.7	79	571	8.0	3.5	230.0	8.9	7.6	63.8	16.7
	5%'ile	0.8	1.5	12	no data	0.071	0.059	0.520	0.250	3	0.240	0.005	7.7	79	572	8.0	no data	no data	9.0	no data	no data	no data
	25%'ile	1.1	1.5	120	1.2	0.077	0.070	1.140	0.758	9	0.700	0.012	9.3	95	599	8.1	3.7	252.5	12.4	7.6	68.8	17.8
	Median	1.5	1.5	240	1.4	0.086	0.074	1.205	0.800	11	0.775	0.015	10.1	98	617	8.2	4.2	260.0	15.0	85.6	75.2	21.1
	75%'ile	4.1	4.0	370	2.7	0.110	0.086	1.290	1.017	13	0.960	0.026	11.8	113	635	8.2	5.5	270.0	17.6	163.7	81.5	24.0
	95%'ile	8.6	49.0	500	no data	0.160	0.100	2.750	2.416	35	2.400	0.057	13.2	126	692	8.4	no data	no data	19.5	no data	no data	no data
	Maximum	8.6	49.0	500	3.3	0.160	0.100	2.750	2.416	35	2.400	0.057	13.3	126	693	8.4	6.5	270.0	19.6	163.7	86.3	25.0
	Mean	2.7	7.5	240	1.9	0.096	0.078	1.322	0.970	13	0.942	0.020	10.4	102	623	8.2	4.6	258.0	14.6	85.6	75.1	20.9
	Std. Dev.	2.6	14.8	154	0.9	0.026	0.013	0.571	0.569	9	0.571	0.016	1.6	15	36	0.1	1.4	16.4	3.4	110.4	9.3	4.2
	Count	10	10	10	5	10	10	10	10	10	10	10	11	11	11	10	4	5	11	2	4	3
Clive Rv	Minimum	0.9	1.5	27	1.2	0.067	0.048	0.190	0.025	0	0.013	0.005	4.9	50	260	7.3	1.4	95.0	12.0	no data	no data	no data
	5%'ile	no data	1.5	28	no data	0.068	0.051	0.195	0.026	0	0.014	0.005	5.0	51	261	7.3	no data	no data	12.1	no data	no data	no data
	25%'ile	1.7	1.5	57	1.5	0.089	0.068	0.302	0.044	0	0.024	0.005	5.7	61	296	7.6	1.5	96.5	15.2	no data	no data	no data
	Median	2.0	1.5	165	2.5	0.134	0.102	0.550	0.192	2	0.178	0.011	7.3	81	307	7.8	2.7	116.0	19.2	no data	no data	no data
	75%'ile	2.6	1.5	390	2.9	0.184	0.130	0.922	0.561	9	0.512	0.030	9.7	110	383	8.2	5.9	135.3	21.5	no data	no data	no data
	95%'ile	no data	89.9	1085	no data	0.495	0.206	2.930	2.564	21	2.554	0.048	13.8	154	486	8.5	no data	no data	22.6	no data	no data	no data
	Maximum	4.0	104.0	1100	3.0	0.540	0.210	3.100	2.710	21	2.700	0.050	13.9	154	494	8.5	8.1	148.0	22.6	no data	no data	no data
	Mean	2.2	10.0	304	2.3	0.166	0.109	0.803	0.543	6	0.516	0.018	8.1	88	341	7.9	3.7	117.4	18.3	no data	no data	no data
	Std. Dev.	0.9	28.3	361	0.7	0.125	0.047	0.847	0.805	7	0.808	0.016	3.0	36	70	0.4	3.1	22.6	3.6	no data	no data	no data
	Count	9	13	12	6	13	13	13	13	13	13	13	13	13	13	12	4	5	13	no data	no data	no data

< Median flow

< Median Flow																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^{o}C)	Chla (mg/m^{2})	MCI (Unit)	% EPT taxa
Taipo Strm	Minimum	1.0	1.5	1	0.3	0.161	0.128	0.340	0.016	0	0.003	0.005	0.3	3	33	7.3	4.3	82.0	10.9	no data	58.6	0.0
	5%'ile	1.1	1.5	8	no data	0.163	0.135	0.348	0.017	0	0.003	0.005	0.3	3	49	7.3	no data	no data	11.4	no data	no data	no data
	25%'ile	3.2	5.0	85	0.6	0.250	0.189	0.523	0.023	0	0.007	0.005	1.1	13	267	7.6	4.8	100.0	14.1	no data	61.1	3.0
	Median	4.1	11.5	150	0.6	0.530	0.390	0.583	0.095	0	0.035	0.013	2.4	26	503	7.6	5.2	148.5	16.4	no data	65.1	7.7
	75%'ile	13.2	28.0	725	1.0	0.780	0.530	0.953	0.370	1	0.140	0.030	3.4	35	559	7.8	7.2	171.0	20.4	no data	70.5	11.9
	95%'ile	145.6	139.4	2205	no data	0.920	0.680	1.435	8.135	15	8.122	0.338	8.1	90	580	8.1	no data	no data	22.2	no data	no data	no data
	Maximum	160.0	156.0	2400	2.1	0.940	0.680	1.472	10.013	18	10.000	0.370	8.6	91	584	8.1	9.2	185.0	22.3	no data	74.3	14.3
	Mean	19.0	26.9	502	0.9	0.523	0.386	0.728	0.878	2	0.815	0.054	2.8	31	421	7.7	6.0	139.2	17.1	no data	65.8	7.4
	Std. Dev.	44.7	41.8	670	0.7	0.276	0.196	0.343	2.637	5	2.649	0.105	2.3	27	179	0.2	2.0	40.2	3.7	no data	6.6	6.0
	Count	12	14	13	6	14	14	13	14	14	14	14	13	14	14	13	5	6	14	no data	4	4

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Ruahapia Strm	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Karewarewa Strm	Minimum	1.4	1.5	41	1.0	0.164	0.120	0.731	0.261	1	0.001	0.005	0.4	4	724	7.2	7.6	290.0	12.0	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	2.1	1.5	275	1.3	0.210	0.135	1.328	0.411	2	0.028	0.046	0.9	9	743	7.3	7.6	290.0	13.0	no data	no data	no data
	Median	3.6	3.7	700	1.8	0.250	0.158	2.600	1.020	3	0.520	0.270	1.8	17	760	7.4	11.8	290.0	15.3	no data	no data	no data
	75%'ile	4.5	10.4	1400	2.3	0.580	0.302	3.616	2.539	16	2.475	0.448	6.6	73	817	7.7	16.0	297.5	19.4	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	15.7	22.0	4500	3.6	1.210	1.290	5.400	4.258	30	4.100	0.980	7.9	88	854	7.9	16.0	300.0	21.4	no data	no data	no data
	Mean	4.7	7.2	1173	1.9	0.434	0.328	2.643	1.619	10	1.254	0.321	3.4	36	777	7.5	11.8	293.3	16.1	no data	no data	no data
	Std. Dev.	4.6	8.3	1466	1.0	0.373	0.388	1.507	1.394	10	1.536	0.309	3.1	35	49	0.3	5.9	5.8	3.7	no data	no data	no data
	Count	8	9	9	5	9	9	9	9	9	9	9	8	8	8	9	2	3	8	no data	no data	no data
Awanui Strm	Minimum	1.2	1.5	51	0.7	0.129	0.110	0.958	0.248	1	0.002	0.005	0.2	2	642	7.1	4.8	250.0	9.8	no data	67.3	18.2
	5%'ile	1.2	1.5	54	0.8	0.134	0.110	0.968	0.337	1	0.003	0.005	0.3	4	642	7.2	no data	no data	10.0	no data	no data	no data
	25%'ile	1.6	1.5	128	1.2	0.152	0.118	1.165	0.589	3	0.500	0.024	3.9	37	670	7.7	7.0	270.0	12.3	no data	no data	no data
	Median	1.9	1.5	250	1.6	0.250	0.200	1.561	0.747	6	0.685	0.073	5.1	56	713	7.8	9.1	280.0	15.6	no data	67.3	18.2
	75%'ile	2.9	2.7	363	1.9	0.278	0.245	1.865	1.052	7	0.935	0.129	6.6	68	721	7.9	11.8	290.0	18.8	no data	no data	no data
	95%'ile	5.5	8.1	2130	2.8	0.662	0.628	3.890	2.844	23	2.671	0.561	9.7	111	1003	8.0	no data	no data	23.6	no data	no data	no data
	Maximum	5.6	9.0	2700	2.9	0.710	0.680	4.400	3.312	28	3.100	0.570	10.2	123	1080	8.0	14.0	310.0	24.3	no data	67.3	18.2
	Mean	2.5	2.7	402	1.6	0.280	0.240	1.725	0.971	6	0.813	0.131	5.1	52	724	7.7	9.3	280.0	15.8	no data	67.3	18.2
	Std. Dev.	1.4	2.3	647	0.6	0.167	0.161	0.851	0.717	6	0.752	0.177	2.7	30	105	0.2	3.5	19.3	4.2	no data	0.0	0.0
	Count	12	16	15	12	15	15	16	16	15	16	16	15	15	15	15	5	8	15	no data	1	1
Poukawa Strm	Minimum	0.7	1.5	20	0.4	0.061	0.052	0.255	0.014	0	0.001	0.005	0.6	7	556	7.6	3.5	260.0	10.5	no data	65.0	8.3
	5%'ile	no data	1.5	21	0.4	0.061	0.052	0.271	0.014	0	0.001	0.005	0.6	7	558	7.6	no data	no data	10.6	no data	no data	no data
	25%'ile	1.0	1.5	39	1.6	0.080	0.065	0.565	0.113	0	0.041	0.005	1.7	19	622	7.7	3.5	265.0	14.0	no data	no data	no data
	Median	1.3	1.5	85	2.1	0.100	0.079	0.945	0.229	5	0.204	0.015	4.5	44	719	7.8	3.7	280.0	18.0	no data	65.0	8.3
	75%'ile	1.4	2.3	155	2.8	0.265	0.222	1.560	0.632	8	0.605	0.028	5.8	56	777	7.9	3.9	287.5	20.5	no data	no data	no data
	95%'ile	no data	15.8	246	3.5	0.435	0.367	2.190	1.445	21	1.309	0.107	8.8	85	1166	8.1	no data	no data	21.2	no data	no data	no data
	Maximum	1.7	17.0	250	3.5	0.440	0.370	2.200	1.509	21	1.360	0.107	8.8	86	1186	8.1	3.9	290.0	21.2	no data	65.0	8.3
	Mean	1.2	3.2	105	2.1	0.171	0.139	1.078	0.413	6	0.371	0.028	4.3	43	737	7.8	3.7	276.7	17.0	no data	65.0	8.3
	Std. Dev.	0.3	4.5	76	0.9	0.131	0.116	0.654	0.447	6	0.426	0.037	2.8	26	169	0.2	0.3	15.3	3.8	no data	0.0	0.0
	Count	9	12	12	10	11	11	12	12	11	12	12	11	11	11	12	2	3	11	no data	1	1

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (°C)	Chla (mg/m^2)	MCI (Unit)	% EPT taxa
Herehere Strm	Minimum	1.1	1.5	30	1.6	0.027	0.020	0.160	0.015	0	0.003	0.005	4.7	49	302	7.8	2.0	200.0	11.7	no data	73.8	12.5
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.7	1.5	224	2.4	0.060	0.044	0.235	0.015	0	0.004	0.005	8.8	87	535	7.9	2.0	200.0	13.1	no data	no data	no data
	Median	2.2	2.3	520	2.9	0.072	0.056	0.282	0.068	1	0.049	0.005	9.9	95	562	8.2	3.4	225.0	15.1	no data	73.8	12.5
	75%'ile	2.8	5.5	700	3.7	0.081	0.064	1.125	0.861	12	0.835	0.020	10.6	112	594	8.4	4.7	250.0	17.9	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	11.2	10.0	1800	4.2	0.084	0.075	2.300	2.113	106	2.100	0.031	11.7	136	642	8.7	4.7	250.0	21.2	no data	73.8	12.5
	Mean	3.5	3.8	590	3.0	0.067	0.053	0.718	0.502	17	0.485	0.012	9.4	97	540	8.2	3.4	225.0	15.6	no data	73.8	12.5
	Std. Dev.	3.8	3.3	549	1.0	0.019	0.017	0.849	0.852	37	0.854	0.011	2.2	26	103	0.3	1.9	35.4	3.3	no data	0.0	0.0
	Count	6	8	8	5	8	8	8	8	8	8	8	8	8	8	7	2	2	8	no data	1	1
Mangarau Strm at Keirunga Rd	Minimum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Median	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	75%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Mean	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Std. Dev.	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Count	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Mangarau Strm at Te Aute Rd	Minimum	0.8	1.5	12	2.5	0.084	0.070	0.520	0.250	3	0.240	0.005	7.7	79	595	8.0	3.8	230.0	8.9	163.7	76.7	16.7
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	0.9	1.5	59	no data	0.084	0.072	0.705	0.442	5	0.420	0.008	8.4	87	596	8.0	3.8	230.0	10.6	no data	no data	no data
	Median	1.1	1.5	200	2.5	0.085	0.076	1.260	1.017	13	0.960	0.015	9.7	99	607	8.1	5.2	245.0	14.5	163.7	76.7	16.7
	75%'ile	4.4	7.0	328	no data	0.104	0.089	2.377	2.066	29	2.040	0.047	11.7	109	649	8.2	6.5	260.0	18.1	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	5.5	8.8	370	2.5	0.110	0.094	2.750	2.416	35	2.400	0.057	13.3	114	679	8.2	6.5	260.0	19.6	163.7	76.7	16.7
	Mean	2.4	3.9	194	2.5	0.093	0.080	1.510	1.228	17	1.200	0.026	10.1	98	622	8.1	5.2	245.0	14.3	163.7	76.7	16.7
	Std. Dev.	2.6	4.2	179	0.0	0.015	0.012	1.136	1.098	16	1.100	0.027	2.4	15	39	0.1	1.9	21.2	4.7	0.0	0.0	0.0
	Count	3	3	3	1	3	3	3	3	3	3	3	4	4	4	3	2	2	4	1	1	1
Clive Rv	Minimum	0.9	1.5	27	2.4	0.067	0.048	0.190	0.025	0	0.013	0.005	5.6	55	260	7.3	1.4	95.0	12.9	no data	no data	no data
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	1.6	1.5	57	2.5	0.089	0.067	0.270	0.038	0	0.018	0.005	6.4	69	273	7.8	1.5	95.5	15.2	no data	no data	no data
	Median	1.8	1.5	140	2.8	0.114	0.094	0.338	0.121	2	0.104	0.008	8.2	82	302	8.0	1.6	97.0	19.2	no data	no data	no data
	75%'ile	2.4	1.5	585	2.9	0.152	0.125	0.555	0.449	7	0.400	0.028	11.2	130	328	8.3	3.2	111.3	21.6	no data	no data	no data
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	3.3	10.0	1100	3.0	0.230	0.182	1.970	1.740	17	1.730	0.038	13.9	154	354	8.5	3.7	116.0	22.6	no data	no data	no data
	Mean	2.0	2.6	336	2.7	0.126	0.100	0.561	0.372	5	0.348	0.016	8.9	96	302	8.0	2.2	102.7	18.4	no data	no data	no data
	Std. Dev.	0.8	3.0	432	0.3	0.053	0.044	0.585	0.581	6	0.583	0.014	3.1	38	35	0.4	1.3	11.6	3.7	no data	no data	no data
	Count	6	8	8	4	8	8	8	8	8	8	8	8	8	8	7	3	3	8	no data	no data	no data

LQ flows

LQ Flows																						
Site name	Statistic	Turbidity (NTU)	SS (mg/l)	*E. coli* (CFU/ 100ml)	Black Disc (m)	TP (mg/l)	DRP (mg/l)	TN (mg/l)	DIN (mg/l)	DIN / DRP	NO3-N (mg/l)	NH4-N (mg/l)	DO (mg/l)	DO (%)	Elec. Cond. (uS/cm)	pH	TOC (mg/l)	Hardness (mg/l)	Temp (^{o}C)	Chla (mg/m^{2})	MCI (Unit)	% EPT taxa
Taipo Strm	Minimum	1.0	1.5	47	0.6	0.161	0.128	0.340	0.016	0	0.003	0.005	0.3	3	261	7.4	4.9	150.0	13.2	no data	58.6	0.0
	5%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	25%'ile	3.4	9.3	105	0.6	0.298	0.183	0.550	0.022	0	0.005	0.005	1.6	14	511	7.5	4.9	150.0	17.1	no data	59.8	1.5
	Median	7.4	28.0	150	0.8	0.700	0.510	0.830	0.030	0	0.012	0.005	2.4	25	524	7.7	7.1	167.5	20.4	no data	63.5	5.9
	75%'ile	15.0	62.5	548	1.0	0.818	0.552	1.223	0.486	1	0.465	0.022	2.7	27	559	8.0	9.2	185.0	20.5	no data	71.6	12.2
	95%'ile	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
	Maximum	160.0	156.0	700	1.0	0.940	0.680	1.472	10.013	18	10.000	0.030	3.4	31	566	8.1	9.2	185.0	22.0	no data	74.3	14.3
	Mean	32.4	45.2	290	0.8	0.609	0.403	0.874	1.543	3	1.524	0.012	2.1	20	499	7.7	7.1	167.5	18.9	no data	65.5	6.7
	Std. Dev.	62.8	54.2	270	0.3	0.315	0.219	0.441	3.741	7	3.744	0.011	1.0	10	107	0.3	3.0	24.7	3.1	no data	8.0	7.2
	Count	6	7	7	2	7	7	6	7	7	7	7	7	7	7	6	2	2	7	no data	3	3

Appendix C Trend analysis results for water quality variables

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Awanui Strm	TN (mg/L)	16/04-16/11/13	37	0.610	2.055	5.770	1.000	-0.81
	TP (mg/L)	16/04-16/11/13	37	0.090	0.220	1.810	0.549	-1.67
	DIN (mg/L)	16/04-16/11/13	37	0.030	0.979	4.736	0.618	1.15
	DRP (mg/L)	16/04-16/11/13	37	0.065	0.162	0.927	0.453	1.16
	NO3-N (mg/L)	16/04-16/11/13	37	0.004	0.845	4.700	0.842	0.78
	Black Disc	9/8/07-16/11/13	19	0	1.1	3.4	0.896	-4.21
	Turbidity (NTU)	16/04-16/11/13	37	1.1	2.8	95.6	0.920	0.24
	E. Coli (cfu/100mL)	10/8/04-16/11/13	35	3	172	4555	0.119	8.21
	DIN:DRP	16/04-16/11/13	37	0.1	7.3	44.3	0.764	-1.52
	NH4-N (mg/L)	16/04-16/11/13	36	0.005	0.070	0.420	**0.026**	**-6.10**
	SS (mg/L)	16/04-16/11/13	37	1.5	3.9	89.5	0.321	0.00
	TOC (mg/L)	16/04-17/11/11	29	4.8	11.0	25.0	0.116	6.53
	TON (mg/L)	16/04-16/11/13	37	0.370	0.930	2.265	0.271	1.26
	Conductivity (uS/cm)	16/04-16/11/13	37	8	720	890	0.653	-0.12
	HDT (mg/L)	16/04-27/2/13	32	150	283	370	0.171	1.18
Clive Rv	TN (mg/L)	16/04-16/11/13	36	0.191	1.000	3.100	0.144	2.54
	TP (mg/L)	16/04-16/11/13	37	0.073	0.135	0.540	0.549	1.36
	DIN (mg/L)	16/04-16/11/13	37	0.020	0.629	2.710	0.484	1.63
	DRP (mg/L)	16/04-16/11/13	38	0.043	0.097	0.180	0.530	0.99
	NO3-N (mg/L)	16/04-16/11/13	37	0.008	0.590	2.700	0.484	1.61
	Black Disc	27/04-2/10/13	32	0.2	1.5	3.4	0.099	-5.11
	Turbidity (NTU)	16/04-16/11/13	36	0.6	2.8	393.0	0.309	4.16
	E. Coli (cfu/100mL)	10/8/04-16/11/13	37	1	140	2100	0.072	7.33
	DIN:DRP	16/04-16/11/13	37	0.1	6.9	34.4	0.690	0.51
	NH4-N (mg/L)	16/04-16/11/13	38	0.005	0.038	0.210	0.286	0.00
	SS (mg/L)	16/04-16/11/13	38	1.5	2.6	540.0	0.517	0.00
	TOC (mg/L)	16/04-17/11/11	30	1.4	5.9	31.2	0.946	-0.92
	TON (mg/L)	16/04-16/11/13	37	0.050	0.370	1.390	0.394	0.88
	Conductivity (uS/cm)	16/04-16/11/13	38	45	341	812	**0.001**	**3.70**
	HDT (mg/L)	16/04-3/5/12	32	88	128	299	**0.012**	**3.96**

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Herehere Strm	TN (mg/L)	7/11/06-16/11/13	28	0.258	0.494	6.000	0.882	0.54
	TP (mg/L)	7/11/06-16/11/13	28	0.039	0.076	0.450	0.766	-0.99
	DIN (mg/L)	7/11/06-16/11/13	28	0.015	0.229	5.610	0.824	0.19
	DRP (mg/L)	7/11/06-16/11/13	28	0.011	0.059	0.115	0.334	1.71
	NO3-N (mg/L)	7/11/06-16/11/13	28	0.003	0.212	5.500	0.657	1.14
	Black Disc	4/11/08-16/11/13	15	0.4	1.6	3.6	0.499	16.60
	Turbidity (NTU)	7/11/06-16/11/13	28	0.2	2.0	36.0	**0.018**	**14.55**
	E. Coli (cfu/100mL)	7/11/06-16/11/13	28	1	450	3050	0.207	15.68
	DIN:DRP	7/11/06-16/11/13	28	0.3	3.6	92.0	0.767	-1.24
	NH4-N (mg/L)	7/11/06-16/11/13	28	0.005	0.019	0.122	0.333	0.00
	SS (mg/L)	7/11/06-16/11/13	28	1.5	1.5	130.0	0.916	0.00
	TOC (mg/L)	7/11/06-3/5/12	21	1.5	4.3	14.0	0.740	2.06
	TON (mg/L)	7/11/06-16/11/13	28	0.170	0.275	2.066	0.766	-0.91
	Conductivity (uS/cm)	7/11/06-16/11/13	28	46	597	789	0.824	-0.32
	HDT (mg/L)	7/11/06-3/5/12	22	190	260	300	**0.018**	2.52
Karewarewa Strm	TN (mg/L)	16/5/04-16/11/13	37	0.435	2.800	5.640	0.842	-0.95
	TP (mg/L)	16/5/04-16/11/13	38	0.082	0.178	2.780	0.268	-1.75
	DIN (mg/L)	16/5/04-16/11/13	37	0.032	1.857	4.730	0.690	-1.87
	DRP (mg/L)	16/5/04-16/11/13	38	0.036	0.132	2.460	0.290	-1.42
	NO3-N (mg/L)	16/5/04-16/11/13	37	0.003	1.540	4.600	1.000	0.00
	Black Disc	27/5/04-16/11/13	30	0.1	1.0	3.4	0.563	-2.56
	Turbidity (NTU)	16/5/04-16/11/13	38	0.7	3.4	174.9	**0.039**	**8.64**
	E. Coli (cfu/100mL)	10/8/04-16/11/13	37	1	210	28000	0.341	5.06
	DIN:DRP	16/5/04-16/11/13	37	0.2	13.4	50.6	0.318	1.81
	NH4-N (mg/L)	16/5/04-16/11/13	38	0.005	0.078	2.590	0.412	-2.34
	SS (mg/L)	16/5/04-16/11/13	38	1.5	3.1	162.0	**0.038**	**6.03**
	TOC (mg/L)	16/5/04-17/11/11	30	3.5	8.0	23.0	0.734	0.57
	TON (mg/L)	16/5/04-16/11/13	38	0.140	0.733	2.220	0.885	0.57
	Conductivity (uS/cm)	16/5/04-16/11/13	38	67	786	912	0.195	-0.79
	HDT (mg/L)	16/5/04-27/2/13	33	101	290	365	0.265	-1.17

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Mangaone Rv at Rissington	TN (mg/L)	3/2/04-16/11/13	39	0.060	0.550	1.539	0.139	-3.83
	TP (mg/L)	3/2/04-16/11/13	40	0.013	0.034	0.205	**0.017**	**-5.39**
	DIN (mg/L)	3/2/04-16/11/13	39	0.010	0.347	0.770	0.139	-2.91
	DRP (mg/L)	3/2/04-16/11/13	40	0.005	0.024	0.109	0.127	-5.02
	NO3-N (mg/L)	3/2/04-16/11/13	39	0.001	0.321	0.760	0.331	-2.49
	Black Disc	3/2/04-16/11/13	40	0.1	1.9	4.4	0.205	2.37
	Turbidity (NTU)	3/2/04-16/11/13	40	0.5	1.8	72.2	0.244	4.00
	E. Coli (cfu/100mL)	12/8/04-16/11/13	37	1	27	1500	0.249	8.47
	DIN:DRP	3/2/04-16/11/13	39	1.0	12.5	41.0	1.000	0.59
	NH4-N (mg/L)	3/2/04-16/11/13	40	0.005	0.005	0.070	**0.002**	**-5.82**
	SS (mg/L)	3/2/04-16/11/13	40	1.5	1.5	120.0	0.479	0.00
	TOC (mg/L)	3/2/04-7/11/11	32	0.9	2.3	10.2	0.215	-6.61
	TON (mg/L)	3/2/04-16/11/13	39	0.050	0.140	1.060	0.192	-4.38
	Conductivity (uS/cm)	3/2/04-16/11/13	40	183	334	386	0.754	-0.12
	HDT (mg/L)	3/2/04-21/5/12	34	77	141	170	0.689	-0.06
Ngaruroro Rv at Chesterhope NIWA	TN (mg/L)	15/2/04-16/11/13	40	0.063	0.169	0.551	0.325	1.48
	TP (mg/L)	15/2/04-16/11/13	40	0.009	0.016	0.111	1.000	0.00
	DIN (mg/L)	15/2/04-16/11/13	40	0.004	0.107	0.301	0.531	1.03
	DRP (mg/L)	15/2/04-16/11/13	40	0.003	0.007	0.015	0.680	0.00
	NO3-N (mg/L)							
	Black Disc	15/2/04-16/11/13	40	0.2	1.4	6.1	0.754	-0.92
	Turbidity (NTU)	15/2/04-16/11/13	40	0.4	2.7	69.0	0.446	3.05
	E. Coli (cfu/100mL)	15/2/05-16/11/13	36	6	26	248	0.715	3.34
	DIN:DRP	15/2/04-16/11/13	40	0.6	13.7	44.3	1.000	-0.23
	NH4-N (mg/L)	15/2/04-16/11/13	40	0.001	0.004	0.010	**0.002**	**8.86**
	SS (mg/L)							
	TOC (mg/L)							
	TON (mg/L)							
	Conductivity (uS/cm)	15/2/04-16/11/13	40	124	151	217	0.060	0.99
	HDT (mg/L)							

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Ngaruroro Rv at Fernhill	TN (mg/L)	26/3/04-16/11/13	39	0.055	0.250	0.500	0.355	-2.43
	TP (mg/L)	26/3/04-16/11/13	40	0.002	0.012	0.200	0.066	-7.94
	DIN (mg/L)	26/3/04-16/11/13	40	0.019	0.157	0.410	0.893	0.63
	DRP (mg/L)	26/3/04-16/11/13	40	0.002	0.007	0.036	0.927	0.00
	NO3-N (mg/L)	26/3/04-16/11/13	40	0.002	0.143	0.398	1.000	0.26
	Black Disc	26/3/04-16/11/13	38	0.1	1.3	6.2	0.259	1.80
	Turbidity (NTU)	26/3/04-16/11/13	40	0.4	3.8	200.0	0.823	1.17
	E. Coli (cfu/100mL)	26/8/04-16/11/13	38	1	18	460	0.122	5.64
	DIN:DRP	26/3/04-16/11/13	40	3.2	16.9	155.0	0.720	-0.62
	NH4-N (mg/L)	26/3/04-16/11/13	40	0.005	0.005	0.096	1.000	0.00
	SS (mg/L)	26/3/04-16/11/13	40	1.5	4.5	290.0	0.842	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	0.5	1.8	5.3	0.534	-2.55
	TON (mg/L)	26/3/04-16/11/13	40	0.050	0.050	0.274	0.590	0.00
	Conductivity (uS/cm)	26/3/04-16/11/13	40	116	154	222	**0.022**	**1.51**
	HDT (mg/L)	26/3/04-22/5/12	34	34	52	65	0.276	1.37
Ngaruroro Rv at Kuripapango	TN (mg/L)	15/2/04-16/11/13	40	0.027	0.050	0.110	0.590	-0.88
	TP (mg/L)	15/2/04-16/11/13	40	0.002	0.004	0.011	0.650	0.00
	DIN (mg/L)	15/2/04-16/11/13	40	0.004	0.008	0.030	**0.004**	**4.17**
	DRP (mg/L)	15/2/04-16/11/13	40	0.001	0.002	0.004	0.879	0.00
	NO3-N (mg/L)							
	Black Disc	15/2/04-16/11/13	40	0.7	5.6	12.0	0.117	-4.21
	Turbidity (NTU)	15/2/04-16/11/13	40	0.2	0.7	6.5	**0.016**	**8.08**
	E. Coli (cfu/100mL)	15/2/05-16/11/13	36	1	4	67	0.109	3.66
	DIN:DRP	15/2/04-16/11/13	40	1.7	4.0	30.0	0.232	2.08
	NH4-N (mg/L)	15/2/04-16/11/13	40	0.001	0.002	0.004	0.620	0.00
	SS (mg/L)							
	TOC (mg/L)							
	TON (mg/L)							
	Conductivity (uS/cm)	15/2/04-16/11/13	40	55	74	109	0.531	0.57
	HDT (mg/L)							

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Ngaruroro Rv at Motorway	TN (mg/L)	26/3/04-1/10/12	36	0.087	0.240	2.580	0.465	-2.19
	TP (mg/L)	26/3/04-1/10/12	36	0.002	0.013	0.200	0.190	-5.65
	DIN (mg/L)	26/3/04-1/10/12	36	0.012	0.150	0.373	0.958	-0.44
	DRP (mg/L)	26/3/04-1/10/12	36	0.002	0.007	0.019	0.588	0.00
	NO3-N (mg/L)	26/3/04-1/10/12	36	0.001	0.134	0.362	1.000	-0.14
	Black Disc	26/3/04-1/10/12	34	0.1	1.2	5.6	0.735	0.83
	Turbidity (NTU)	26/3/04-1/10/12	36	0.5	3.4	200.0	0.794	1.70
	E. Coli (cfu/100mL)	26/8/04-1/10/12	34	1	14	510	0.306	-6.61
	DIN:DRP	26/3/04-1/10/12	36	3.9	17.5	112.0	0.715	2.50
	NH4-N (mg/L)	26/3/04-1/10/12	36	0.005	0.005	0.046	0.935	0.00
	SS (mg/L)	26/3/04-1/10/12	35	1.5	4.8	310.0	0.952	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	0.5	2.1	6.0	0.386	-4.43
	TON (mg/L)	26/3/04-1/10/12	36	0.050	0.050	2.400	0.732	0.00
	Conductivity (uS/cm)	26/3/04-1/10/12	36	115	142	190	0.917	0.29
	HDT (mg/L)	26/3/04-22/5/12	34	34	50	66	0.395	0.50
Ngaruroro Rv at Ohiti	TN (mg/L)	26/3/04-1/10/12	35	0.113	0.230	0.458	0.212	-1.83
	TP (mg/L)	26/3/04-1/10/12	36	0.002	0.010	0.190	**0.036**	**-7.00**
	DIN (mg/L)	26/3/04-1/10/12	36	0.037	0.140	0.378	0.835	0.64
	DRP (mg/L)	26/3/04-1/10/12	36	0.002	0.005	0.011	0.258	-2.27
	NO3-N (mg/L)	26/3/04-1/10/12	36	0.012	0.130	0.356	1.000	-0.06
	Black Disc	26/3/04-1/10/12	34	0.1	1.0	5.6	0.692	2.16
	Turbidity (NTU)	26/3/04-1/10/12	36	0.0	3.9	180.0	0.715	4.79
	E. Coli (cfu/100mL)	26/8/04-1/10/12	34	1	13	470	0.208	7.63
	DIN:DRP	26/3/04-1/10/12	36	4.6	27.0	189.0	0.376	4.23
	NH4-N (mg/L)	26/3/04-1/10/12	36	0.005	0.005	0.091	0.185	0.00
	SS (mg/L)	26/3/04-1/10/12	36	1.5	4.5	260.0	1.000	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	0.5	1.9	520.0	0.574	-2.52
	TON (mg/L)	26/3/04-1/10/12	36	0.050	0.050	0.250	0.215	0.00
	Conductivity (uS/cm)	26/3/04-1/10/12	36	106	132	174	0.876	0.28
	HDT (mg/L)	26/3/04-22/5/12	34	32	46	59	0.690	0.35

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Ngaruroro Rv at Whanawhana	TN (mg/L)	26/3/04-16/11/13	38	0.055	0.121	0.857	**0.002**	**-5.45**
	TP (mg/L)	26/3/04-16/11/13	40	0.002	0.004	0.426	**0.003**	**-9.17**
	DIN (mg/L)	26/3/04-16/11/13	38	0.016	0.047	0.272	0.416	-3.84
	DRP (mg/L)	26/3/04-16/8/13	40	0.002	0.002	0.007	0.282	0.00
	NO3-N (mg/L)	26/3/04-16/11/13	38	0.002	0.024	0.260	0.094	-6.31
	Black Disc	26/3/04-16/11/13	39	0.0	3.4	9.1	0.376	2.69
	Turbidity (NTU)	26/3/04-16/11/13	40	0.1	1.2	339.0	**0.044**	**8.80**
	E. Coli (cfu/100mL)	26/8/04-16/11/13	38	1	3	120	**0.038**	**7.76**
	DIN:DRP	26/3/04-16/11/13	38	5.0	15.0	136.0	0.775	1.65
	NH4-N (mg/L)	26/3/04-16/11/13	38	0.005	0.005	0.040	0.111	0.00
	SS (mg/L)	26/3/04-16/11/13	40	1.5	1.5	557.0	0.750	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	0.5	0.9	3.6	0.080	13.39
	TON (mg/L)	26/3/04-16/11/13	38	0.050	0.050	0.760	0.171	0.00
	Conductivity (uS/cm)	26/3/04-16/11/13	40	46	102	166	0.420	0.78
	HDT (mg/L)	26/3/04-22/5/12	34	16	34	48	0.688	0.00
Ngaruroro Rv D/S HB Dairies	TN (mg/L)	26/8/04-16/8/13	38	0.055	0.199	0.949	0.201	-3.51
	TP (mg/L)	26/8/04-16/11/13	38	0.002	0.009	0.459	0.101	-5.92
	DIN (mg/L)	26/8/04-16/8/13	38	0.032	0.110	0.360	0.413	-2.71
	DRP (mg/L)	26/8/04-16/11/13	38	0.002	0.005	0.011	0.256	0.00
	NO3-N (mg/L)	26/8/04-16/8/13	38	0.026	0.100	0.348	0.470	-2.05
	Black Disc	26/8/04-16/11/13	37	0.1	1.4	6.4	0.765	-1.09
	Turbidity (NTU)	26/8/04-16/11/13	38	0.4	2.2	474.0	0.084	8.32
	E. Coli (cfu/100mL)	26/8/04-16/8/13	38	1	4	280	0.455	0.00
	DIN:DRP	26/8/04-16/8/13	38	6.5	25.1	88.0	1.000	0.72
	NH4-N (mg/L)	26/8/04-16/11/13	38	0.005	0.005	0.044	0.104	0.00
	SS (mg/L)	26/8/04-16/11/13	38	1.5	2.5	791.0	0.498	0.00
	TOC (mg/L)	26/8/04-9/11/11	30	0.5	1.9	6.8	0.786	-1.78
	TON (mg/L)	26/8/04-16/11/13	38	0.050	0.050	0.790	0.692	0.00
	Conductivity (uS/cm)	26/8/04-16/11/13	38	71	126	174	0.500	0.52
	HDT (mg/L)	26/8/04-22/5/12	32	26	42	57	0.491	0.80

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Ngaruroro Rv U/S HB Dairies	TN (mg/L)	26/3/04-1/10/12	35	0.055	0.145	0.960	**0.039**	**-3.31**
	TP (mg/L)	26/3/04-1/10/12	36	0.002	0.008	0.589	0.083	-8.92
	DIN (mg/L)	26/3/04-1/10/12	35	0.020	0.055	0.120	0.786	-0.77
	DRP (mg/L)	26/3/04-1/10/12	36	0.002	0.002	0.011	0.217	0.00
	NO3-N (mg/L)	26/3/04-1/10/12	35	0.008	0.045	0.101	0.744	-0.93
	Black Disc	26/3/04-1/10/12	35	0.1	3.4	6.1	0.663	0.76
	Turbidity (NTU)	26/3/04-1/10/12	36	0.4	1.6	437.0	0.231	7.54
	E. Coli (cfu/100mL)	26/8/04-1/10/12	34	1	4	290	0.131	14.09
	DIN:DRP	26/3/04-1/10/12	35	3.4	17.5	60.0	0.665	1.20
	NH4-N (mg/L)	26/3/04-1/10/12	36	0.005	0.005	0.029	0.682	0.00
	SS (mg/L)	26/3/04-1/10/12	35	1.5	1.5	757.0	0.769	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	0.5	1.1	4.3	0.145	9.31
	TON (mg/L)	26/3/04-1/10/12	36	0.050	0.050	0.890	0.077	0.00
	Conductivity (uS/cm)	26/3/04-1/10/12	36	52	115	160	0.159	-1.19
	HDT (mg/L)	26/3/04-22/5/12	34	18	38	53	0.690	0.43
Poukawa Strm	TN (mg/L)	16/5/04-16/11/13	38	0.159	1.475	2.240	0.810	0.28
	TP (mg/L)	16/5/04-16/11/13	38	0.041	0.205	0.767	**0.016**	**-5.45**
	DIN (mg/L)	16/5/04-16/11/13	38	0.015	0.242	0.758	0.666	1.09
	DRP (mg/L)	16/5/04-16/11/13	38	0.025	0.153	0.695	**0.016**	**-6.02**
	NO3-N (mg/L)	16/5/04-16/11/13	38	0.003	0.175	0.700	**0.049**	**5.13**
	Black Disc	16/5/04-16/11/13	34	0.4	1.9	5.2	**0.027**	**-8.87**
	Turbidity (NTU)	16/5/04-16/11/13	37	0.5	1.6	5.9	0.372	2.79
	E. Coli (cfu/100mL)	10/8/04-16/11/13	37	1	90	550	0.516	4.45
	DIN:DRP	16/5/04-16/11/13	38	0.2	1.4	11.2	0.113	5.29
	NH4-N (mg/L)	16/5/04-16/11/13	38	0.005	0.023	0.560	**0.040**	**-14.53**
	SS (mg/L)	16/5/04-16/11/13	38	1.5	1.5	106.0	0.619	0.00
	TOC (mg/L)	16/5/04-17/11/11	30	3.5	19.7	36.0	0.588	1.35
	TON (mg/L)	16/5/04-16/11/13	38	0.140	1.254	2.079	0.336	1.99
	Conductivity (uS/cm)	16/5/04-16/11/13	38	449	702	894	1.000	0.02
	HDT (mg/L)	16/5/04-27/2/13	33	234	287	410	**0.026**	**1.75**

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Taipo Strm	TN (mg/L)	7/11/06-16/11/13	28	0.327	0.915	3.756	0.139	8.09
	TP (mg/L)	7/11/06-16/11/13	28	0.170	0.425	0.940	0.374	-4.65
	DIN (mg/L)	7/11/06-16/11/13	28	0.021	0.362	3.134	0.207	5.62
	DRP (mg/L)	7/11/06-16/11/13	28	0.145	0.300	0.630	0.882	-1.66
	NO3-N (mg/L)	7/11/06-16/11/13	28	0.003	0.201	3.100	0.183	5.75
	Black Disc	23/11/07-2/10/13	17	0.2	0.6	4.7	1.000	-2.74
	Turbidity (NTU)	7/11/06-16/11/13	28	1.0	5.0	160.0	0.374	7.38
	E. Coli (cfu/100mL)	7/11/06-16/11/13	28	1	106	1900	**0.007**	**45.19**
	DIN:DRP	7/11/06-16/11/13	28	0.0	1.0	10.1	0.300	5.20
	NH4-N (mg/L)	7/11/06-16/11/13	28	0.005	0.028	0.380	0.710	7.38
	SS (mg/L)	7/11/06-16/11/13	28	1.5	8.1	156.0	0.230	8.60
	TOC (mg/L)	7/11/06-3/5/12	21	4.3	6.4	9.5	0.314	-2.30
	TON (mg/L)	7/11/06-16/11/13	28	0.220	0.486	1.200	0.236	2.79
	Conductivity (uS/cm)	7/11/06-16/11/13	28	33	530	641	0.882	-0.19
	HDT (mg/L)	7/11/06-3/5/12	22	82	174	210	0.525	0.90
Tutaekuri Rv at Brookfields Br	TN (mg/L)	3/2/04-16/11/13	40	0.055	0.300	1.878	0.128	-6.01
	TP (mg/L)	3/2/04-16/11/13	40	0.006	0.028	0.450	**0.005**	**-5.67**
	DIN (mg/L)	3/2/04-16/11/13	40	0.012	0.195	0.547	0.195	-3.99
	DRP (mg/L)	3/2/04-16/11/13	40	0.002	0.020	0.051	0.177	-3.14
	NO3-N (mg/L)	3/2/04-16/11/13	40	0.001	0.182	0.530	0.370	-2.67
	Black Disc	3/2/04-16/11/13	40	0.0	1.7	6.0	0.298	3.52
	Turbidity (NTU)	3/2/04-16/11/13	39	0.1	2.5	330.0	0.781	-1.08
	E. Coli (cfu/100mL)	12/8/04-16/11/13	38	1	13	1900	0.358	4.40
	DIN:DRP	3/2/04-16/11/13	40	1.0	10.6	27.5	0.687	-1.08
	NH4-N (mg/L)	3/2/04-16/11/13	40	0.005	0.009	0.090	**0.001**	**-8.94**
	SS (mg/L)	3/2/04-16/11/13	40	1.5	4.0	442.0	0.191	-3.54
	TOC (mg/L)	3/2/04-7/11/11	32	0.5	1.9	13.4	0.386	-4.67
	TON (mg/L)	3/2/04-16/11/13	40	0.050	0.090	1.340	**0.044**	**-6.99**
	Conductivity (uS/cm)	3/2/04-16/11/13	40	172	301	349	0.929	0.02
	HDT (mg/L)	3/2/04-21/5/12	34	71	129	150	**0.035**	**1.00**

Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Tutaekuri Rv at Lawrence Hut	TN (mg/L)	3/2/04-16/11/13	40	0.055	0.117	0.330	**0.008**	**-3.55**
	TP (mg/L)	3/2/04-16/11/13	40	0.002	0.006	0.200	**0.007**	**-7.86**
	DIN (mg/L)	3/2/04-16/11/13	40	0.013	0.031	0.152	**0.022**	**-5.37**
	DRP (mg/L)	3/2/04-16/11/13	40	0.002	0.004	0.049	0.103	0.00
	NO3-N (mg/L)	3/2/04-16/11/13	40	0.001	0.018	0.084	**0.003**	**-8.09**
	Black Disc	3/2/04-16/11/13	40	0.1	5.1	11.5	**0.001**	**9.34**
	Turbidity (NTU)	3/2/04-16/11/13	39	0.2	0.9	130.0	0.404	-5.19
	E. Coli (cfu/100mL)	12/8/04-16/11/13	38	1	10	60	0.283	4.93
	DIN:DRP	3/2/04-16/11/13	40	1.1	8.7	69.0	0.893	-0.38
	NH4-N (mg/L)	3/2/04-16/11/13	40	0.005	0.005	0.120	0.124	0.00
	SS (mg/L)	3/2/04-16/11/13	40	1.5	1.5	280.0	0.486	0.00
	TOC (mg/L)	3/2/04-7/11/11	32	0.5	1.5	3.0	**0.017**	**11.88**
	TON (mg/L)	3/2/04-16/11/13	39	0.050	0.050	0.180	0.494	0.00
	Conductivity (uS/cm)	3/2/04-16/11/13	40	54	107	198	0.244	0.92
	HDT (mg/L)	3/2/04-21/5/12	34	19	41	77	**0.006**	**2.46**
Tutaekuri-Waimate Strm	TN (mg/L)	26/3/04-16/11/13	37	0.069	0.368	1.274	0.690	-0.46
	TP (mg/L)	26/3/04-16/11/13	36	0.030	0.048	0.121	0.252	-1.41
	DIN (mg/L)	26/3/04-16/11/13	37	0.008	0.254	0.773	0.484	-1.17
	DRP (mg/L)	26/3/04-16/11/13	37	0.002	0.033	0.068	0.393	-0.68
	NO3-N (mg/L)	26/3/04-16/11/13	37	0.001	0.239	0.710	0.515	-1.20
	Black Disc	26/3/04-16/11/13	33	0.3	1.0	4.0	0.599	1.30
	Turbidity (NTU)	26/3/04-16/11/13	37	0.5	4.9	15.2	**0.024**	**4.11**
	E. Coli (cfu/100mL)	26/8/04-16/11/13	35	24	84	2240	0.128	4.77
	DIN:DRP	26/3/04-16/11/13	37	0.3	8.0	35.6	0.764	-0.56
	NH4-N (mg/L)	26/3/04-16/11/13	37	0.005	0.015	0.082	0.121	0.00
	SS (mg/L)	26/3/04-16/11/13	37	1.5	6.6	35.0	0.800	0.00
	TOC (mg/L)	26/3/04-9/11/11	29	0.5	2.9	5.9	0.616	-3.46
	TON (mg/L)	26/3/04-16/11/13	37	0.050	0.130	0.501	0.877	0.00
	Conductivity (uS/cm)	26/3/04-16/11/13	37	152	274	391	0.271	0.72
	HDT (mg/L)	26/3/04-22/5/12	31	89	100	163	0.072	1.02

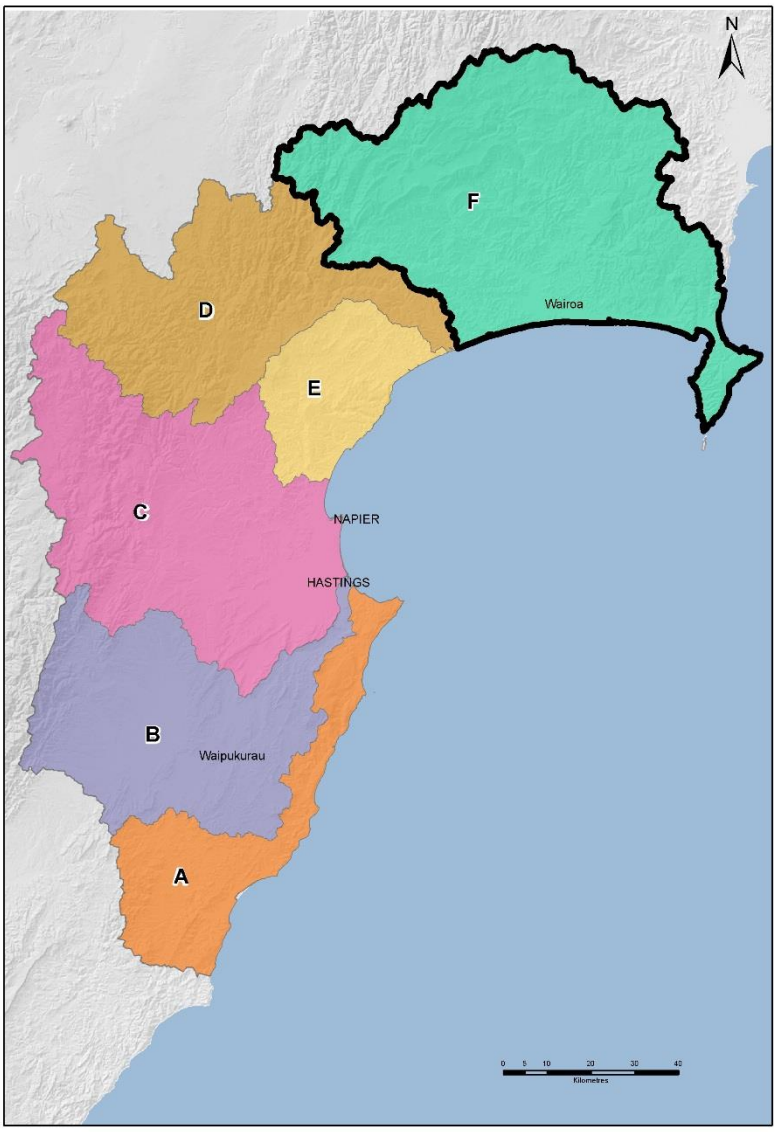
Site	Variable	Sample Period	n	Min	Median	Max	Trend p	Trend PAC
Waitio Strm	TN (mg/L)	26/3/04-16/11/13	39	0.170	0.350	1.109	0.105	-2.83
	TP (mg/L)	26/3/04-16/11/13	40	0.015	0.029	0.257	0.367	-1.73
	DIN (mg/L)	26/3/04-16/11/13	40	0.108	0.247	0.728	0.420	-2.02
	DRP (mg/L)	26/3/04-16/11/13	40	0.002	0.023	0.220	0.928	0.00
	NO3-N (mg/L)	26/3/04-16/11/13	40	0.091	0.235	0.660	0.720	-0.90
	Black Disc	26/3/04-16/11/13	38	1.2	3.4	4.8	1.000	0.00
	Turbidity (NTU)	26/3/04-16/11/13	40	0.1	1.0	5.2	**0.041**	**7.02**
	E. Coli (cfu/100mL)	26/8/04-16/8/13	38	1	31	310	0.361	6.46
	DIN:DRP	26/3/04-16/8/13	40	3.3	10.2	54.0	0.824	-1.00
	NH4-N (mg/L)	26/3/04-16/11/13	40	0.005	0.005	0.100	0.320	0.00
	SS (mg/L)	26/3/04-16/11/13	40	1.5	1.5	6.0	0.260	0.00
	TOC (mg/L)	26/3/04-9/11/11	32	1.1	2.6	250.0	0.453	-3.81
	TON (mg/L)	26/3/04-16/11/13	40	0.050	0.085	0.381	0.393	0.00
	Conductivity (uS/cm)	26/3/04-16/11/13	40	28	237	310	**0.000**	**2.15**
	HDT (mg/L)	26/3/04-22/5/12	34	72	89	126	**0.023**	**3.28**

The tables presented in Trend analysis results for water quality variables presents the state and trend of water quality variables from sites within the Ngaruroro, Tutaekuri, Karamu and Ahuriri catchments. The minima, medians and maxima are given for each variable at each site. We explored whether any trends over time were evident by using Kendall tests with a significance level (α) of 0.05. If the data exhibited seasonality ('seasons' column), a seasonal Kendall test was used. If the data did not exhibit seasonality, a Mann-Kendall test was used. Sen slope was used to estimate the percent annual change (PAC) and gives an indication of the magnitude of change over time. An * indicates that the Sen Slope could not be calculated due to data limitations. A statistically significant ($p<0.05$) change of 1% or more was considered 'meaningful'. Cells are coloured green when a meaningfully significant improvement in water quality was observed ('sig better'), and are coloured red when a meaningfully significant deterioration in water quality was observed ('sig worse'). The amber colour indicates no significant trend was detected. If a trend was marginally non-significant (MNS, $0.05<p<0.10$), the text in the 'trend result' column is highlighted green (for better) or red (for worse). If the test was not marginally significant ($p>0.10$), but a PAC greater than 5% was estimated, the text was also highlighted in green (for better) or red (for worse).

Appendix D Regional ranking tables for select water quality variables

Tables in the following pages are coloured and coded in line with the major regional water management zones identified below. Letters relate to:

- (A) Porangahau River/Southern Coastal
- (B) Tukituki River
- (C) TANK (Tutaekuri River, Ahuriri Estuary, Ngaruroro River, Karamu Stream)
- (D) Mohaka River (bordered in black)
- (E) Waikari River/Esk River/Aropaoanui River
- (F) Wairoa River/Northern Coastal



Sites ranked by median Total Nitrogen (TN, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TN	Sample size (n)	Rank	Catchment	Reporting Zone
Ngaruroro Rv at Kuripapango (NIWA)	0.046	60	1	Ngaruroro	C
Taruarau Rv	0.055	14	2	Ngaruroro	C
Mokau Strm	0.055	12	2	Wairoa	F
Makaroro Rv (NIWA)	0.086	60	4	Tukituki	B
Tutaekuri Rv at Lawrence Hut	0.102	34	5	Tutaekuri	C
Mohaka Rv U/S Taharua Rv	0.109	61	6	Mohaka	E
Ngaruroro Rv at Whanawhana	0.110	33	7	Ngaruroro	C
Waikaretaheke Rv	0.116	13	8	Wairoa	F
Aniwaniwa Strm	0.117	29	9	Wairoa	F
Waiau Rv	0.120	25	10	Wairoa	F
Ripia Rv U/S Mohaka Rv	0.134	36	11	Mohaka	E
Mokomokonui Rv	0.136	28	12	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.141	16	13	Ngaruroro	C
Ngaruroro Rv at Chesterhope (NIWA)	0.173	60	14	Ngaruroro	C
Tukituki Rv at SH50	0.175	64	15	Tukituki	B
Ngaruroro Rv D/S HB Dairies	0.180	33	16	Ngaruroro	C
Tutaekuri Rv at Puketapu	0.180	13	16	Tutaekuri	C
Anaura Strm	0.189	15	18	Waikari	D
Te Kumi Strm	0.193	17	19	Wairoa	F
Ngaruroro Rv at Fernhill	0.212	32	20	Ngaruroro	C
Ngaruroro Rv at Ohiti	0.213	16	21	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.219	14	22	Tukituki	B
Waipawa Rv at SH50	0.220	58	23	Tukituki	B
Mangaone Rv at Dartmoor	0.240	13	24	Tutaekuri	C
Ngaruroro Rv at Motorway	0.240	17	24	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	0.244	60	26	Mohaka	E
Tutaekuri Rv at Brookfields Br	0.250	31	27	Tutaekuri	C
Tutaekuri Rv U/S Mangaone Rv	0.251	32	28	Tutaekuri	C
Kopuawhara Strm	0.261	31	29	Northern Coastal	F
Wairoa Rv U/S Wairoa	0.265	27	30	Wairoa	F
Ruakituri Rv	0.269	30	31	Wairoa	F
Makaretu Rv at SH50	0.278	59	32	Tukituki	B
Arawapanui Rv	0.290	31	33	Aropoanui	D
Waipunga Rv at Pohokura Rd	0.293	24	34	Mohaka	E
Mohaka Rv at Willowflat	0.295	35	35	Mohaka	E
Te Iringaowhare Strm	0.295	5	35	Wairoa	F
Mohaka Rv at Raupunga	0.298	42	37	Mohaka	E
Mangaorapa Strm	0.300	31	38	Porangahau	A
Mangakuri Rv	0.310	31	39	Southern Coastal	A
Makaretu Rv U/S Maharakeke Strm	0.327	14	40	Tukituki	B
Porangahau Rv	0.332	29	41	Porangahau	A
Mohaka Rv D/S Waipunga Rv	0.332	52	41	Mohaka	E
Waitio Strm	0.337	32	43	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.342	60	44	Mohaka	E
Waikari Rv	0.353	31	45	Waikari	D
Hangaroa Rv	0.355	28	46	Wairoa	F
Tutaekuri-Waimate Strm	0.368	29	47	Ngaruroro	C
Esk Rv at Waipunga Br	0.370	30	48	Esk	D
Mohaka Rv D/S Ripia Rv	0.372	43	49	Mohaka	E
Mangapoike Rv	0.379	25	50	Wairoa	F
Esk Rv at Berry Rd	0.406	26	51	Esk	D
Makara Strm	0.414	13	52	Tukituki	B
Mangatewai Strm at SH50	0.440	14	53	Tukituki	B
Mangatutu Strm	0.460	18	54	Tutaekuri	C
Mangaone Rv at Rissington	0.470	37	55	Tutaekuri	C
Mangamahaki Strm	0.524	12	56	Tukituki	B
Mangarau Strm at Keirunga Rd	0.534	17	57	Karamu/Clive	C
Opoutama Strm	0.559	18	58	Northern Coastal	F
Maraetotara Rv at Te Awanga	0.586	31	59	Maraetotara / Waimarama	A
Taurekaitai Strm	0.620	31	60	Porangahau	A
Maraekakaho Strm	0.646	14	61	Ngaruroro	C
Herehere Strm	0.660	32	62	Karamu/Clive	C
Mahiaruhe Strm	0.670	11	63	Aropoanui	D
Waiarua Strm	0.670	34	63	Mohaka	E
Poporangi Strm	0.688	14	65	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.695	44	66	Tukituki	B
Sandy Ck	0.700	35	67	Aropoanui	D
Waipawa Rv U/S Tukituki Rv	0.705	44	68	Tukituki	B
Mohaka Rv D/S Taharua Rv	0.721	64	69	Mohaka	E
Waipawa Rv at SH2	0.740	58	70	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.750	44	71	Tukituki	B
Tukituki Rv at Black Br	0.783	58	72	Tukituki	B
Tukituki Rv at Red Br	0.783	64	72	Tukituki	B
Ohiwa Strm	0.785	13	74	Ngaruroro	C
Ruahapia Strm	0.850	17	75	Karamu/Clive	C
Tukituki Rv at Red Br (NIWA)	0.874	60	76	Tukituki	B
Pouhokio Strm	0.937	32	77	Maraetotara / Waimarama	A
Mangatarata Strm	0.978	58	78	Tukituki	B
Taipo Strm	0.980	31	79	Karamu/Clive	C
Tukipo Rv at SH50	1.008	62	80	Tukituki	B
Clive Rv	1.034	31	81	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	1.039	31	82	Maraetotara / Waimarama	A
Tukituki Rv at Tamumu Br	1.100	57	83	Tukituki	B
Tukituki Rv at SH2	1.220	78	84	Tukituki	B
Mangarau Strm at Te Aute Rd	1.260	23	85	Karamu/Clive	C
Papanui Strm	1.345	35	86	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.370	13	87	Tukituki	B
Taharua Rv at Red Hut	1.450	62	88	Mohaka	E
Tukituki Rv at Tapairu Rd	1.460	49	89	Tukituki	B
Poukawa Strm	1.460	39	89	Karamu/Clive	C
Tukituki Rv 50m U/S oxi pond	1.540	44	91	Tukituki	B
Porangahau Strm	1.780	63	92	Tukituki	B
Taharua Rv at Poronui Stn	1.852	42	93	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	1.864	14	94	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.950	44	95	Tukituki	B
Mangaonuku Strm	2.072	57	96	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	2.087	14	97	Tukituki	B
Awanui Strm	2.100	39	98	Karamu/Clive	C
Waingongoro Strm	2.117	32	99	Southern Coastal	A
Taharua Rv at Henry's Br	2.302	17	100	Mohaka	E
Karewarewa Strm	2.800	33	101	Karamu/Clive	C
Kahahakuri Strm	2.988	27	102	Tukituki	B
Taharua Rv at Wairango	3.403	58	103	Mohaka	E
Taharua Rv at Twin Culv	3.700	60	104	Mohaka	E

Sites ranked by median Total Phosphorus (TP, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TP	Sample size (n)	Rank	Catchment	Reporting Zone
Taruarau Rv	0.002	14	1	Ngaruroro	C
Ngaruroro Rv at Whanawhana	0.003	34	2	Ngaruroro	C
Ngaruroro Rv at Kuripapango (NIWA)	0.004	60	3	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	0.005	34	4	Tutaekuri	C
Ngaruroro Rv U/S HB Dairies	0.006	17	5	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	0.006	65	5	Mohaka	E
Waipawa Rv at SH50	0.007	59	7	Tukituki	B
Aniwaniwa Strm	0.007	30	7	Wairoa	F
Mokau Strm	0.007	11	7	Wairoa	F
Waikaretaheke Rv	0.007	14	7	Wairoa	F
Makaroro Rv (NIWA)	0.008	60	11	Tukituki	B
Tukituki Rv at SH50	0.008	67	11	Tukituki	B
Ngaruroro Rv at Ohiti	0.008	17	11	Ngaruroro	C
Ngaruroro Rv D/S HB Dairies	0.008	34	11	Ngaruroro	C
Mohaka Rv D/S Ripia Rv	0.008	48	11	Mohaka	E
Tukituki Rv at Waipukurau Ongaonga Rd	0.009	14	16	Tukituki	B
Anaura Strm	0.009	17	16	Waikari	D
Kopuawhara Strm	0.009	31	16	Northern Coastal	F
Te Kumi Strm	0.009	17	16	Wairoa	F
Ngaruroro Rv at Fernhill	0.010	33	20	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.010	60	20	Mohaka	E
Mohaka Rv D/S Taharua Rv	0.010	68	20	Mohaka	E
Ripia Rv U/S Mohaka Rv	0.010	36	20	Mohaka	E
Mangaorapa Strm	0.012	31	24	Porangahau	A
Taharua Rv at Henry's Br	0.012	17	24	Mohaka	E
Pouhokio Strm	0.013	32	26	Maraetotara / Waimarama	A
Ngaruroro Rv at Motorway	0.013	17	26	Ngaruroro	C
Taharua Rv at Red Hut	0.014	64	28	Mohaka	E
Waiarua Strm	0.014	34	28	Mohaka	E
Waipunga Rv at Pohokura Rd	0.014	24	28	Mohaka	E
Mohaka Rv D/S Waipunga Rv	0.015	53	31	Mohaka	E
Waipawa Rv 50m U/S oxi pond	0.016	43	32	Tukituki	B
Waipawa Rv at SH2	0.016	58	32	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.016	32	32	Tutaekuri	C
Mangakuri Rv	0.017	31	35	Southern Coastal	A
Maraetotara Rv at Te Awanga	0.017	32	35	Maraetotara / Waimarama	A
Porangahau Rv	0.017	31	35	Porangahau	A
Makaretu Rv U/S Maharakeke Strm	0.017	14	35	Tukituki	B
Tukituki Rv at Black Br	0.017	58	35	Tukituki	B
Ruakituri Rv	0.017	30	35	Wairoa	F
Maraetotara Rv at Waimarama Rd	0.018	31	41	Maraetotara / Waimarama	A
Makaretu Rv at SH50	0.018	62	41	Tukituki	B
Mangaonuku Strm	0.018	59	41	Tukituki	B
Tukituki Rv at Red Br	0.018	64	41	Tukituki	B
Ngaruroro Rv at Chesterhope (NIWA)	0.018	60	41	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	0.018	60	41	Mohaka	E
Mokomokonui Rv	0.018	30	41	Mohaka	E
Taharua Rv at Wairango	0.018	58	41	Mohaka	E
Taharua Rv at Twin Culv	0.019	59	49	Mohaka	E
Waiau Rv	0.019	25	49	Wairoa	F
Tukituki Rv at SH2	0.020	77	51	Tukituki	B
Mangapoike Rv	0.020	25	51	Wairoa	F

Site	Median TP	Sample size (n)	Rank	Catchment	Reporting Zone
Tutaekuri Rv at Puketapu	0.021	13	53	Tutaekuri	C
Taharua Rv at Poronui Stn	0.021	46	53	Mohaka	E
Tukituki Rv at Red Br (NIWA)	0.022	60	55	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.023	43	56	Tukituki	B
Tutaekuri Rv at Brookfields Br	0.023	31	56	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	0.024	13	58	Tukituki	B
Tukituki Rv 50m U/S oxi pond	0.024	43	58	Tukituki	B
Mangatutu Strm	0.024	18	58	Tutaekuri	C
Mohaka Rv at Raupunga	0.024	45	58	Mohaka	E
Hangaroa Rv	0.024	29	58	Wairoa	F
Tukituki Rv at Tamumu Br	0.025	58	63	Tukituki	B
Esk Rv at Berry Rd	0.026	27	64	Esk	D
Waikari Rv	0.026	32	64	Waikari	D
Mangaone Rv at Rissington	0.027	38	66	Tutaekuri	C
Tukipo Rv at SH50	0.028	63	67	Tukituki	B
Wairoa Rv U/S Wairoa	0.028	29	67	Wairoa	F
Maraekakaho Strm	0.029	14	69	Ngaruroro	C
Arawapanui Rv	0.029	31	69	Aropoanui	D
Waitio Strm	0.031	31	71	Ngaruroro	C
Mangamahaki Strm	0.032	12	72	Tukituki	B
Poporangi Strm	0.032	14	72	Ngaruroro	C
Esk Rv at Waipunga Br	0.032	30	72	Esk	D
Mohaka Rv at Willowflat	0.032	40	72	Mohaka	E
Waingongoro Strm	0.033	32	76	Southern Coastal	A
Tukituki Rv at Tapairu Rd	0.033	48	76	Tukituki	B
Maharakeke Strm U/S Makaretu Rv	0.035	14	78	Tukituki	B
Opoutama Strm	0.035	18	78	Northern Coastal	F
Kahahakuri Strm	0.036	27	80	Tukituki	B
Mangaone Rv at Dartmoor	0.038	13	81	Tutaekuri	C
Waipawa Rv 400m D/S oxi pond	0.040	42	82	Tukituki	B
Porangahau Strm	0.043	63	83	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	0.046	14	84	Tukituki	B
Tutaekuri-Waimate Strm	0.046	28	84	Ngaruroro	C
Taurekaitai Strm	0.049	31	86	Porangahau	A
Makara Strm	0.050	13	87	Tukituki	B
Mangatewai Strm at SH50	0.051	14	88	Tukituki	B
Te Iringaowhare Strm	0.053	5	89	Wairoa	F
Mahiaruhe Strm	0.058	12	90	Aropoanui	D
Mangarau Strm at Keirunga Rd	0.060	17	91	Karamu/Clive	C
Ruahapia Strm	0.069	17	92	Karamu/Clive	C
Tukituki Rv 400m D/S oxi pond	0.070	43	93	Tukituki	B
Sandy Ck	0.072	35	94	Aropoanui	D
Herehere Strm	0.074	32	95	Karamu/Clive	C
Mangarau Strm at Te Aute Rd	0.084	23	96	Karamu/Clive	C
Ohiwa Strm	0.114	13	97	Ngaruroro	C
Clive Rv	0.142	32	98	Karamu/Clive	C
Karewarewa Strm	0.171	33	99	Karamu/Clive	C
Poukawa Strm	0.188	37	100	Karamu/Clive	C
Papanui Strm	0.192	35	101	Tukituki	B
Awanui Strm	0.215	38	102	Karamu/Clive	C
Mangatarata Strm	0.260	59	103	Tukituki	B
Taipo Strm	0.410	31	104	Karamu/Clive	C

Sites ranked by median Dissolved Inorganic Nitrogen (DIN, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median DIN	Sample size (n)	Rank	Catchment	Reporting Zone
Ngaruroro Rv at Kuripapango (NIWA)	0.009	60	1	Ngaruroro	C
Mangamahaki Strm	0.018	12	2	Tukituki	B
Taruarau Rv	0.026	14	3	Ngaruroro	C
Waikaretaheke Rv	0.026	13	3	Wairoa	F
Tutaekuri Rv at Lawrence Hut	0.027	32	5	Tutaekuri	C
Aniwaniwa Strm	0.027	29	5	Wairoa	F
Mokau Strm	0.032	11	7	Wairoa	F
Anaura Strm	0.036	16	8	Waikari	D
Waiau Rv	0.037	25	9	Wairoa	F
Mohaka Rv U/S Taharua Rv	0.040	65	10	Mohaka	E
Taurekaitai Strm	0.041	31	11	Porangahau	A
Porangahau Rv	0.042	30	12	Porangahau	A
Ngaruroro Rv at Whanawhana	0.044	32	13	Ngaruroro	C
Mokomokonui Rv	0.050	30	14	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.052	16	15	Ngaruroro	C
Mangakuri Rv	0.053	31	16	Southern Coastal	A
Makara Strm	0.055	13	17	Tukituki	B
Makaroro Rv (NIWA)	0.056	60	18	Tukituki	B
Wairoa Rv U/S Wairoa	0.060	27	19	Wairoa	F
Hangaroa Rv	0.064	28	20	Wairoa	F
Mangatarata Strm	0.070	58	21	Tukituki	B
Ripia Rv U/S Mohaka Rv	0.079	37	22	Mohaka	E
Tukituki Rv at SH50	0.084	64	23	Tukituki	B
Tutaekuri Rv at Puketapu	0.091	13	24	Tutaekuri	C
Ngaruroro Rv at Chesterhope (NIWA)	0.106	60	25	Ngaruroro	C
Te Kumi Strm	0.106	17	25	Wairoa	F
Ngaruroro Rv D/S HB Dairies	0.107	33	27	Ngaruroro	C
Aropaoanui Rv	0.110	31	28	Aropoanui	D
Te Iringaowhare Strm	0.110	5	28	Wairoa	F
Ruakituri Rv	0.111	30	30	Wairoa	F
Mangaorapa Strm	0.120	31	31	Porangahau	A
Ngaruroro Rv at Ohiti	0.130	17	32	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.132	14	33	Tukituki	B
Ngaruroro Rv at Fernhill	0.134	34	34	Ngaruroro	C
Waipawa Rv at SH50	0.135	59	35	Tukituki	B
Mangaone Rv at Dartmoor	0.139	13	36	Tutaekuri	C
Ngaruroro Rv at Motorway	0.140	17	37	Ngaruroro	C
Tutaekuri Rv at Brookfields Br	0.155	31	38	Tutaekuri	C
Mohaka Rv at Raupunga (NIWA)	0.161	60	39	Mohaka	E
Makaretu Rv at SH50	0.163	60	40	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.165	32	41	Tutaekuri	C
Kopuawhara Strm	0.171	31	42	Northern Coastal	F
Poukawa Strm	0.173	39	43	Karamu/Clive	C
Mangapoike Rv	0.173	25	43	Wairoa	F
Waikari Rv	0.180	32	45	Waikari	D
Mohaka Rv at Raupunga	0.188	46	46	Mohaka	E
Mohaka Rv at Willowflat	0.190	39	47	Mohaka	E
Mangarau Strm at Keirunga Rd	0.191	17	48	Karamu/Clive	C
Waipunga Rv at Pohokura Rd	0.206	25	49	Mohaka	E
Makaretu Rv U/S Maharakeke Strm	0.212	14	50	Tukituki	B
Mohaka Rv D/S Waipunga Rv	0.233	53	51	Mohaka	E
Waitio Strm	0.247	32	52	Ngaruroro	C
Tutaekuri-Waimate Strm	0.253	29	53	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.265	60	54	Mohaka	E
Esk Rv at Waipunga Br	0.271	30	55	Esk	D
Mohaka Rv D/S Ripia Rv	0.282	47	56	Mohaka	E
Mangatewai Strm at SH50	0.286	14	57	Tukituki	B
Herehere Strm	0.300	32	58	Karamu/Clive	C
Esk Rv at Berry Rd	0.305	27	59	Esk	D
Opoutama Strm	0.309	18	60	Northern Coastal	F
Mangatutu Strm	0.334	18	61	Tutaekuri	C
Mangaone Rv at Rissington	0.335	37	62	Tutaekuri	C
Mahiaruhe Strm	0.365	11	63	Aropoanui	D
Papanui Strm	0.393	35	64	Tukituki	B
Maraetotara Rv at Te Awanga	0.418	31	65	Maraetotara / Waimarama	A
Maraekakaho Strm	0.419	14	66	Ngaruroro	C
Sandy Ck	0.438	35	67	Aropoanui	D
Taipo Strm	0.471	32	68	Karamu/Clive	C
Ohiwa Strm	0.499	13	69	Ngaruroro	C
Poporangi Strm	0.538	14	70	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.582	44	71	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.583	44	72	Tukituki	B
Ruahapia Strm	0.588	17	73	Karamu/Clive	C
Waiarua Strm	0.598	34	74	Mohaka	E
Tukituki Rv at Black Br	0.601	58	75	Tukituki	B
Tukituki Rv at Red Br	0.604	64	76	Tukituki	B
Tukituki Rv at Red Br (NIWA)	0.607	60	77	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.620	44	78	Tukituki	B
Mohaka Rv D/S Taharua Rv	0.635	68	79	Mohaka	E
Waipawa Rv at SH2	0.652	58	80	Tukituki	B
Clive Rv	0.673	31	81	Karamu/Clive	C
Pouhokio Strm	0.734	32	82	Maraetotara / Waimarama	A
Tukipo Rv at SH50	0.737	62	83	Tukituki	B
Mangarau Strm at Te Aute Rd	0.817	23	84	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	0.830	31	85	Maraetotara / Waimarama	A
Tukituki Rv at Tamumu Br	0.867	57	86	Tukituki	B
Awanui Strm	0.887	39	87	Karamu/Clive	C
Tukituki Rv at SH2	1.014	78	88	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.180	13	89	Tukituki	B
Porangahau Strm	1.210	63	90	Tukituki	B
Tukituki Rv at Tapairu Rd	1.277	49	91	Tukituki	B
Tukituki Rv 50m U/S oxi pond	1.307	44	92	Tukituki	B
Taharua Rv at Red Hut	1.317	64	93	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	1.560	14	94	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.608	44	95	Tukituki	B
Karewarewa Strm	1.706	33	96	Karamu/Clive	C
Taharua Rv at Poronui Stn	1.710	47	97	Mohaka	E
Maharakeke Strm at Limeworks Station Rd	1.761	14	98	Tukituki	B
Mangaonuku Strm	1.873	57	99	Tukituki	B
Waingongoro Strm	1.925	32	100	Southern Coastal	A
Taharua Rv at Henry's Br	2.212	19	101	Mohaka	E
Kahahakuri Strm	2.700	27	102	Tukituki	B
Taharua Rv at Wairango	3.311	58	103	Mohaka	E
Taharua Rv at Twin Culv	3.614	60	104	Mohaka	E

Sites ranked by median Dissolved Reactive Phosphorus (DRP, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median DRP	Sample size (n)	Rank	Catchment	Reporting Zone
Mangakuri Rv	0.002	31	1	Southern Coastal	A
Mangaorapa Strm	0.002	31	1	Porangahau	A
Tukituki Rv at Waipukurau Ongaonga Rd	0.002	14	1	Tukituki	B
Waipawa Rv at SH50	0.002	60	1	Tukituki	B
Ngaruroro Rv at Kuripapango (NIWA)	0.002	60	1	Ngaruroro	C
Ngaruroro Rv at Whanawhana	0.002	34	1	Ngaruroro	C
Ngaruroro Rv U/S HB Dairies	0.002	17	1	Ngaruroro	C
Taruarau Rv	0.002	14	1	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	0.002	66	1	Mohaka	E
Aniwaniwa Strm	0.002	30	1	Wairoa	F
Kopuawhara Strm	0.002	31	1	Northern Coastal	F
Mokau Strm	0.002	11	1	Wairoa	F
Waikaretaheke Rv	0.002	14	1	Wairoa	F
Porangahau Rv	0.004	31	14	Porangahau	A
Tukituki Rv at SH50	0.004	66	14	Tukituki	B
Tutaekuri Rv at Lawrence Hut	0.004	34	14	Tutaekuri	C
Mohaka Rv D/S Taharua Rv	0.004	68	14	Mohaka	E
Pouhokio Strm	0.005	32	18	Maraetotara / Waimarama	A
Makaroro Rv (NIWA)	0.005	60	18	Tukituki	B
Ngaruroro Rv at Ohiti	0.005	17	18	Ngaruroro	C
Ngaruroro Rv D/S HB Dairies	0.005	34	18	Ngaruroro	C
Mohaka Rv at SH5 (NIWA)	0.005	60	18	Mohaka	E
Mohaka Rv D/S Ripia Rv	0.005	48	18	Mohaka	E
Hangaroa Rv	0.005	29	18	Wairoa	F
Ruakituri Rv	0.005	30	18	Wairoa	F
Anaura Strm	0.006	17	26	Waikari	D
Mohaka Rv D/S Waipunga Rv	0.006	53	26	Mohaka	E
Ripia Rv U/S Mohaka Rv	0.006	37	26	Mohaka	E
Waiarua Strm	0.006	35	26	Mohaka	E
Mangapoike Rv	0.006	25	26	Wairoa	F
Ngaruroro Rv at Fernhill	0.007	33	31	Ngaruroro	C
Taharua Rv at Red Hut	0.007	64	31	Mohaka	E
Waipunga Rv at Pohokura Rd	0.007	25	31	Mohaka	E
Opoutama Strm	0.007	18	31	Northern Coastal	F
Ngaruroro Rv at Chesterhope (NIWA)	0.008	60	35	Ngaruroro	C
Ngaruroro Rv at Motorway	0.008	17	35	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	0.008	60	35	Mohaka	E
Te Kumi Strm	0.008	17	35	Wairoa	F
Wairoa Rv U/S Wairoa	0.008	29	35	Wairoa	F
Tukituki Rv at Red Br	0.009	64	40	Tukituki	B
Mohaka Rv at Raupunga	0.009	46	40	Mohaka	E
Mohaka Rv at Willowflat	0.009	40	40	Mohaka	E
Maraetotara Rv at Te Awanga	0.010	32	43	Maraetotara / Waimarama	A
Maraetotara Rv at Waimarama Rd	0.010	31	43	Maraetotara / Waimarama	A
Makaretu Rv U/S Maharakeke Strm	0.010	14	43	Tukituki	B
Tukituki Rv at Black Br	0.010	58	43	Tukituki	B
Taharua Rv at Henry's Br	0.010	19	43	Mohaka	E
Mangamahaki Strm	0.011	12	48	Tukituki	B
Taharua Rv at Poronui Stn	0.011	46	48	Mohaka	E
Makaretu Rv at SH50	0.012	62	50	Tukituki	B
Tukituki Rv at Red Br (NIWA)	0.012	60	50	Tukituki	B
Waipawa Rv 50m U/S oxi pond	0.012	44	50	Tukituki	B
Waiau Rv	0.012	25	50	Wairoa	F
Tukituki Rv at SH2	0.013	76	54	Tukituki	B
Waipawa Rv at SH2	0.013	59	54	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.013	32	54	Tutaekuri	C
Taharua Rv at Twin Culv	0.013	60	54	Mohaka	E
Mangaonuku Strm	0.014	59	58	Tukituki	B
Tukipo Rv U/S Makaretu Rv	0.014	13	58	Tukituki	B
Mokomokonui Rv	0.014	30	58	Mohaka	E
Tutaekuri Rv at Puketapu	0.015	13	61	Tutaekuri	C
Taharua Rv at Wairango	0.015	59	61	Mohaka	E
Tutaekuri Rv at Brookfields Br	0.016	31	63	Tutaekuri	C
Te Iringaowhare Strm	0.016	5	63	Wairoa	F
Tukituki Rv 50m U/S oxi pond	0.017	43	65	Tukituki	B
Tukituki Rv at Tamumu Br	0.017	58	65	Tukituki	B
Waikari Rv	0.017	32	65	Waikari	D
Mangatutu Strm	0.018	18	68	Tutaekuri	C
Tukipo Rv at SH50	0.019	63	69	Tukituki	B
Mangaone Rv at Rissington	0.019	38	69	Tutaekuri	C
Aropaoanui Rv	0.019	31	69	Aropoanui	D
Makara Strm	0.020	13	72	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.020	44	72	Tukituki	B
Waingongoro Strm	0.021	32	74	Southern Coastal	A
Tukituki Rv at Tapairu Rd	0.022	49	75	Tukituki	B
Esk Rv at Berry Rd	0.022	27	75	Esk	D
Kahahakuri Strm	0.023	27	77	Tukituki	B
Taurekaitai Strm	0.024	31	78	Porangahau	A
Esk Rv at Waipunga Br	0.024	30	78	Esk	D
Maraekakaho Strm	0.025	14	80	Ngaruroro	C
Poporangi Strm	0.025	14	80	Ngaruroro	C
Waitio Strm	0.025	31	80	Ngaruroro	C
Maharakeke Strm U/S Makaretu Rv	0.026	14	83	Tukituki	B
Mahiaruhe Strm	0.026	12	83	Aropoanui	D
Porangahau Strm	0.028	63	85	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.028	44	85	Tukituki	B
Mangaone Rv at Dartmoor	0.028	13	85	Tutaekuri	C
Maharakeke Strm at Limeworks Station Rd	0.029	14	88	Tukituki	B
Tutaekuri-Waimate Strm	0.031	29	89	Ngaruroro	C
Ruahapia Strm	0.034	17	90	Karamu/Clive	C
Mangatewai Strm at SH50	0.040	14	91	Tukituki	B
Sandy Ck	0.044	34	92	Aropoanui	D
Mangarau Strm at Keirunga Rd	0.048	17	93	Karamu/Clive	C
Tukituki Rv 400m D/S oxi pond	0.051	44	94	Tukituki	B
Herehere Strm	0.057	32	95	Karamu/Clive	C
Mangarau Strm at Te Aute Rd	0.070	23	96	Karamu/Clive	C
Clive Rv	0.101	32	97	Karamu/Clive	C
Ohiwa Strm	0.111	13	98	Ngaruroro	C
Poukawa Strm	0.134	37	99	Karamu/Clive	C
Karewarewa Strm	0.140	33	100	Karamu/Clive	C
Papanui Strm	0.154	35	101	Tukituki	B
Mangatarata Strm	0.167	59	102	Tukituki	B
Awanui Strm	0.182	38	103	Karamu/Clive	C
Taipo Strm	0.270	31	104	Karamu/Clive	C

Sites ranked by median Nitrate-Nitrogen (NO_3-N, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median NO_3-N	Sample size (n)	Rank	Catchment	Reporting Zone
Mangamahaki Strm	0.001	12	1	Tukituki	B
Taruarau Rv	0.010	14	2	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	0.014	32	3	Tutaekuri	C
Waikaretaheke Rv	0.014	13	3	Wairoa	F
Aniwaniwa Strm	0.015	28	5	Wairoa	F
Ngaruroro Rv at Whanawhana	0.018	32	6	Ngaruroro	C
Taurekaitai Strm	0.020	31	7	Porangahau	A
Mokau Strm	0.021	12	8	Wairoa	F
Anaura Strm	0.025	16	9	Waikari	D
Waiau Rv	0.025	25	9	Wairoa	F
Makara Strm	0.027	13	11	Tukituki	B
Mohaka Rv U/S Taharua Rv	0.028	65	12	Mohaka	E
Mangakuri Rv	0.031	31	13	Southern Coastal	A
Porangahau Rv	0.036	30	14	Porangahau	A
Mokomokonui Rv	0.037	30	15	Mohaka	E
Ngaruroro Rv U/S HB Dairies	0.040	16	16	Ngaruroro	C
Wairoa Rv U/S Wairoa	0.040	27	16	Wairoa	F
Hangaroa Rv	0.050	28	18	Wairoa	F
Mangatarata Strm	0.056	58	19	Tukituki	B
Tukituki Rv at SH50	0.066	64	20	Tukituki	B
Ripia Rv U/S Mohaka Rv	0.067	37	21	Mohaka	E
Tutaekuri Rv at Puketapu	0.078	13	22	Tutaekuri	C
Te Kumi Strm	0.093	16	23	Wairoa	F
Ruakituri Rv	0.094	30	24	Wairoa	F
Ngaruroro Rv D/S HB Dairies	0.095	33	25	Ngaruroro	C
Arawapanui Rv	0.097	31	26	Aropoanui	D
Te Iringaowhare Strm	0.098	5	27	Wairoa	F
Mangaorapa Strm	0.113	31	28	Porangahau	A
Ngaruroro Rv at Motorway	0.120	17	29	Ngaruroro	C
Ngaruroro Rv at Ohiti	0.120	17	29	Ngaruroro	C
Ngaruroro Rv at Fernhill	0.121	34	31	Ngaruroro	C
Tukituki Rv at Waipukurau Ongaonga Rd	0.125	14	32	Tukituki	B
Waipawa Rv at SH50	0.126	59	33	Tukituki	B
Poukawa Strm	0.130	39	34	Karamu/Clive	C
Mangaone Rv at Dartmoor	0.132	13	35	Tutaekuri	C
Waikari Rv	0.141	32	36	Waikari	D
Tutaekuri Rv at Brookfields Br	0.143	31	37	Tutaekuri	C
Mangapoike Rv	0.146	25	38	Wairoa	F
Makaretu Rv at SH50	0.152	60	39	Tukituki	B
Tutaekuri Rv U/S Mangaone Rv	0.154	32	40	Tutaekuri	C
Kopuawhara Strm	0.159	31	41	Northern Coastal	F
Mohaka Rv at Willowflat	0.172	39	42	Mohaka	E
Mohaka Rv at Raupunga	0.174	46	43	Mohaka	E
Waipunga Rv at Pohokura Rd	0.194	25	44	Mohaka	E
Mangarau Strm at Keirunga Rd	0.199	17	45	Karamu/Clive	C
Makaretu Rv U/S Maharakeke Strm	0.200	14	46	Tukituki	B
Mohaka Rv D/S Waipunga Rv	0.220	53	47	Mohaka	E
Tutaekuri-Waimate Strm	0.230	29	48	Ngaruroro	C
Waitio Strm	0.235	32	49	Ngaruroro	C
Opoutama Strm	0.245	18	50	Northern Coastal	F
Esk Rv at Waipunga Br	0.260	29	51	Esk	D
Mohaka Rv D/S Ripia Rv	0.270	47	52	Mohaka	E
Herehere Strm	0.275	32	53	Karamu/Clive	C
Mangatewai Strm at SH50	0.280	14	54	Tukituki	B
Papanui Strm	0.280	35	54	Tukituki	B
Esk Rv at Berry Rd	0.290	24	56	Esk	D
Mangaone Rv at Rissington	0.310	37	57	Tutaekuri	C
Mangatutu Strm	0.320	18	58	Tutaekuri	C
Taipo Strm	0.320	32	58	Karamu/Clive	C
Mahiaruhe Strm	0.320	11	58	Aropoanui	D
Sandy Ck	0.390	35	61	Aropoanui	D
Maraetotara Rv at Te Awanga	0.400	31	62	Maraetotara / Waimarama	A
Maraekakaho Strm	0.405	14	63	Ngaruroro	C
Ruahapia Strm	0.420	17	64	Karamu/Clive	C
Ohiwa Strm	0.480	13	65	Ngaruroro	C
Poporangi Strm	0.525	14	66	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	0.575	44	67	Tukituki	B
Waipawa Rv U/S Tukituki Rv	0.575	44	67	Tukituki	B
Tukituki Rv at Black Br	0.580	58	69	Tukituki	B
Waiarua Strm	0.585	34	70	Mohaka	E
Tukituki Rv at Red Br	0.590	64	71	Tukituki	B
Waipawa Rv 400m D/S oxi pond	0.611	44	72	Tukituki	B
Clive Rv	0.620	31	73	Karamu/Clive	C
Mohaka Rv D/S Taharua Rv	0.620	68	73	Mohaka	E
Waipawa Rv at SH2	0.640	58	75	Tukituki	B
Pouhokio Strm	0.710	31	76	Maraetotara / Waimarama	A
Tukipo Rv at SH50	0.715	62	77	Tukituki	B
Mangarau Strm at Te Aute Rd	0.790	23	78	Karamu/Clive	C
Maraetotara Rv at Waimarama Rd	0.800	31	79	Maraetotara / Waimarama	A
Awanui Strm	0.840	39	80	Karamu/Clive	C
Tukituki Rv at Tamumu Br	0.850	57	81	Tukituki	B
Tukituki Rv at SH2	0.955	78	82	Tukituki	B
Tukipo Rv U/S Makaretu Rv	1.170	13	83	Tukituki	B
Porangahau Strm	1.200	63	84	Tukituki	B
Tukituki Rv at Tapairu Rd	1.230	49	85	Tukituki	B
Tukituki Rv 400m D/S oxi pond	1.235	44	86	Tukituki	B
Tukituki Rv 50m U/S oxi pond	1.260	44	87	Tukituki	B
Taharua Rv at Red Hut	1.300	64	88	Mohaka	E
Karewarewa Strm	1.520	33	89	Karamu/Clive	C
Maharakeke Strm U/S Makaretu Rv	1.540	14	90	Tukituki	B
Taharua Rv at Poronui Stn	1.700	47	91	Mohaka	E
Maharakeke Strm at Limeworks Station Rd	1.740	14	92	Tukituki	B
Mangaonuku Strm	1.860	57	93	Tukituki	B
Waingongoro Strm	1.910	31	94	Southern Coastal	A
Taharua Rv at Henry's Br	2.200	19	95	Mohaka	E
Kahahakuri Strm	2.600	27	96	Tukituki	B
Taharua Rv at Wairango	3.300	58	97	Mohaka	E
Taharua Rv at Twin Culv	3.600	60	98	Mohaka	E

Sites ranked by median Black disc (m), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median Black Disk	Sample Size (n)	Rank	Catchment	Reporting Zone
Tutaekuri Rv at Lawrence Hut	5.9	33	1	Tutaekuri	C
Ngaruroro Rv at Kuripapango (NIWA)	5.3	59	2	Ngaruroro	C
Taharua Rv at Wairango	4.7	55	3	Mohaka	E
Taruarau Rv	4.7	13	4	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	4.3	57	5	Mohaka	E
Taharua Rv at Henry's Br	4.3	9	6	Mohaka	E
Taharua Rv at Twin Culv	3.5	54	7	Mohaka	E
Maraekakaho Strm	3.4	12	8	Ngaruroro	C
Ngaruroro Rv at Whanawhana	3.4	31	9	Ngaruroro	C
Ohiwa Strm	3.4	12	9	Ngaruroro	C
Waitio Strm	3.4	30	9	Ngaruroro	C
Mangaonuku Strm	3.2	53	12	Tukituki	B
Aniwaniwa Strm	3.1	29	13	Wairoa	F
Mokau Strm	3.0	12	14	Wairoa	F
Mohaka Rv at SH5 (NIWA)	2.8	60	15	Mohaka	E
Tutaekuri Rv at Puketapu	2.8	14	16	Tutaekuri	C
Ngaruroro Rv U/S HB Dairies	2.8	16	17	Ngaruroro	C
Ripia Rv U/S Mohaka Rv	2.5	29	18	Mohaka	E
Te Kumi Strm	2.5	18	19	Wairoa	F
Makaroro Rv (NIWA)	2.3	60	20	Tukituki	B
Mohaka Rv D/S Ripia Rv	2.3	45	20	Mohaka	E
Mokomokonui Rv	2.3	29	20	Mohaka	E
Mohaka Rv D/S Taharua Rv	2.3	59	23	Mohaka	E
Tukituki Rv at Red Br (NIWA)	2.3	60	24	Tukituki	B
Maraetotara Rv at Waimarama Rd	2.2	29	25	Maraetotara / Waimarama	A
Maraetotara Rv at Te Awanga	2.2	31	26	Maraetotara / Waimarama	A
Waikaretaheke Rv	2.1	13	27	Wairoa	F
Maharakeke Strm U/S Makaretu Rv	2.1	13	28	Tukituki	B
Porangahau Strm	2.1	59	29	Tukituki	B
Mangaone Rv at Dartmoor	2.0	12	30	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	2.0	12	31	Tukituki	B
Mangaone Rv at Rissington	2.0	35	32	Tutaekuri	C
Maharakeke Strm at Limeworks Station Rd	1.9	13	33	Tukituki	B
Waikari Rv	1.9	31	34	Waikari	D
Tutaekuri Rv at Brookfields Br	1.9	32	35	Tutaekuri	C
Tukipo Rv at SH50	1.8	57	36	Tukituki	B
Taharua Rv at Red Hut	1.8	52	37	Mohaka	E
Tukituki Rv at Red Br	1.8	53	38	Tukituki	B
Kopuawhara Strm	1.8	30	39	Northern Coastal	F
Aropaoanui Rv	1.7	30	40	Aropoanui	D
Kahahakuri Strm	1.7	24	41	Tukituki	B
Poporangi Strm	1.7	13	42	Ngaruroro	C
Tukituki Rv at Tamumu Br	1.6	54	43	Tukituki	B
Makaretu Rv at SH50	1.6	58	44	Tukituki	B
Herehere Strm	1.6	22	45	Karamu/Clive	C
Tukituki Rv at Black Br	1.6	50	46	Tukituki	B
Waiarua Strm	1.6	28	47	Mohaka	E
Tukituki Rv at SH2	1.5	13	48	Tukituki	B
Anaura Strm	1.5	15	49	Waikari	D

Site	Median Black Disk	Sample Size (n)	Rank	Catchment	Reporting Zone
Waipawa Rv at SH50	1.5	56	50	Tukituki	B
Esk Rv at Waipunga Br	1.5	26	51	Esk	D
Tutaekuri Rv U/S Mangaone Rv	1.5	31	52	Tutaekuri	C
Porangahau Rv	1.4	28	53	Porangahau	A
Makaretu Rv U/S Maharakeke Strm	1.4	14	54	Tukituki	B
Pouhokio Strm	1.4	31	55	Maraetotara / Waimarama	A
Tukituki Rv at Waipukurau Ongaonga Rd	1.4	13	55	Tukituki	B
Taharua Rv at Poronui Stn	1.4	46	57	Mohaka	E
Mangatutu Strm	1.4	18	58	Tutaekuri	C
Esk Rv at Berry Rd	1.4	26	59	Esk	D
Poukawa Strm	1.3	35	60	Karamu/Clive	C
Ngaruroro Rv at Chesterhope (NIWA)	1.3	60	61	Ngaruroro	C
Te Iringaowhare Strm	1.3	3	62	Wairoa	F
Mangarau Strm at Te Aute Rd	1.3	15	63	Karamu/Clive	C
Clive Rv	1.2	19	64	Karamu/Clive	C
Karewarewa Strm	1.2	28	65	Karamu/Clive	C
Mohaka Rv D/S Waipunga Rv	1.2	48	65	Mohaka	E
Tukituki Rv at SH50	1.2	58	67	Tukituki	B
Ngaruroro Rv D/S HB Dairies	1.2	30	68	Ngaruroro	C
Ngaruroro Rv at Fernhill	1.2	28	69	Ngaruroro	C
Sandy Ck	1.2	28	70	Aropoanui	D
Mahiaruhe Strm	1.2	12	71	Aropoanui	D
Awanui Strm	1.1	29	72	Karamu/Clive	C
Waipunga Rv at Pohokura Rd	1.1	18	73	Mohaka	E
Mangaorapa Strm	1.1	31	74	Porangahau	A
Mangakuri Rv	1.1	30	75	Southern Coastal	A
Ruahapia Strm	1.1	10	76	Karamu/Clive	C
Tutaekuri-Waimate Strm	1.1	24	77	Ngaruroro	C
Mangarau Strm at Keirunga Rd	1.1	11	78	Karamu/Clive	C
Hangaroa Rv	1.1	29	78	Wairoa	F
Ngaruroro Rv at Motorway	1.0	15	80	Ngaruroro	C
Mangatewai Strm at SH50	1.0	14	81	Tukituki	B
Mangamahaki Strm	1.0	11	82	Tukituki	B
Mohaka Rv at Raupunga (NIWA)	1.0	59	82	Mohaka	E
Papanui Strm	0.9	23	84	Tukituki	B
Waipawa Rv at SH2	0.9	12	84	Tukituki	B
Opoutama Strm	0.9	18	84	Northern Coastal	F
Waingongoro Strm	0.9	31	87	Southern Coastal	A
Ngaruroro Rv at Ohiti	0.8	15	88	Ngaruroro	C
Makara Strm	0.8	12	89	Tukituki	B
Mangatarata Strm	0.7	50	90	Tukituki	B
Taurekaitai Strm	0.7	21	91	Porangahau	A
Ruakituri Rv	0.7	29	92	Wairoa	F
Waiau Rv	0.6	25	93	Wairoa	F
Taipo Strm	0.5	19	94	Karamu/Clive	C
Wairoa Rv U/S Wairoa	0.4	27	95	Wairoa	F
Mangapoike Rv	0.4	24	96	Wairoa	F
Mohaka Rv at Raupunga	0.3	36	97	Mohaka	E
Mohaka Rv at Willowflat	0.3	37	98	Mohaka	E

Sites ranked by median Turbidity (NTU), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median Turbidity	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	0.6	17	1	Wairoa	F
Taharua Rv at Wairango	0.7	57	2	Mohaka	E
Mohaka Rv U/S Taharua Rv	0.7	60	3	Mohaka	E
Maraekakaho Strm	0.7	13	4	Ngaruroro	C
Ngaruroro Rv at Kuripapango (NIWA)	0.8	60	5	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	0.8	32	6	Tutaekuri	C
Taharua Rv at Twin Culv	0.9	59	7	Mohaka	E
Mangaonuku Strm	1.0	58	8	Tukituki	B
Waipawa Rv 50m U/S oxi pond	1.0	44	9	Tukituki	B
Waipawa Rv U/S Tukituki Rv	1.1	44	10	Tukituki	B
Waipawa Rv 400m D/S oxi pond	1.1	44	11	Tukituki	B
Waipawa Rv at SH2	1.2	57	12	Tukituki	B
Maraetotara Rv at Te Awanga	1.2	30	13	Maraetotara / Waimarama	A
Waitio Strm	1.2	30	14	Ngaruroro	C
Mohaka Rv D/S Ripia Rv	1.2	46	14	Mohaka	E
Aniwaniwa Strm	1.2	27	14	Wairoa	F
Mohaka Rv at SH5 (NIWA)	1.3	60	17	Mohaka	E
Mohaka Rv D/S Taharua Rv	1.3	63	18	Mohaka	E
Taharua Rv at Henry's Br	1.3	13	19	Mohaka	E
Porangahau Strm	1.3	62	20	Tukituki	B
Taruarau Rv	1.4	14	21	Ngaruroro	C
Mokomokonui Rv	1.4	30	22	Mohaka	E
Maraetotara Rv at Waimarama Rd	1.5	30	23	Maraetotara / Waimarama	A
Tukituki Rv 50m U/S oxi pond	1.5	44	24	Tukituki	B
Poukawa Strm	1.5	35	24	Karamu/Clive	C
Maharakeke Strm U/S Makaretu Rv	1.6	14	26	Tukituki	B
Ripia Rv U/S Mohaka Rv	1.6	30	27	Mohaka	E
Mokau Strm	1.7	10	28	Wairoa	F
Tukituki Rv at Tapairu Rd	1.7	49	29	Tukituki	B
Tutaekuri Rv at Puketapu	1.8	13	30	Tutaekuri	C
Taharua Rv at Poronui Stn	1.8	45	31	Mohaka	E
Tukituki Rv at Red Br (NIWA)	1.8	60	32	Tukituki	B
Esk Rv at Waipunga Br	1.8	27	33	Esk	D
Taharua Rv at Red Hut	1.9	60	34	Mohaka	E
Waikaretaheke Rv	1.9	14	35	Wairoa	F
Ohiwa Strm	1.9	12	36	Ngaruroro	C
Tukituki Rv at Red Br	2.0	59	37	Tukituki	B
Mangaone Rv at Rissington	2.0	33	38	Tutaekuri	C
Aropaoanui Rv	2.0	29	39	Aropoanui	D
Poporangi Strm	2.1	14	40	Ngaruroro	C
Ngaruroro Rv at Whanawhana	2.1	32	41	Ngaruroro	C
Tukituki Rv 400m D/S oxi pond	2.1	44	42	Tukituki	B
Tukituki Rv at SH2	2.1	56	43	Tukituki	B
Maharakeke Strm at Limeworks Station Rd	2.1	13	44	Tukituki	B
Kopuawhara Strm	2.1	29	44	Northern Coastal	F
Herehere Strm	2.1	28	46	Karamu/Clive	C
Tukipo Rv at SH50	2.2	55	47	Tukituki	B
Ngaruroro Rv U/S HB Dairies	2.2	17	48	Ngaruroro	C
Makaroro Rv (NIWA)	2.2	60	49	Tukituki	B
Tutaekuri Rv at Brookfields Br	2.2	29	50	Tutaekuri	C
Tukituki Rv at Waipukurau Ongaonga Rd	2.2	14	51	Tukituki	B
Waipawa Rv at SH50	2.3	57	52	Tukituki	B
Kahahakuri Strm	2.3	25	53	Tukituki	B
Mangaone Rv at Dartmoor	2.3	11	53	Tutaekuri	C
Tukipo Rv U/S Makaretu Rv	2.4	13	55	Tukituki	B
Waipunga Rv at Pohokura Rd	2.4	20	55	Mohaka	E
Waiarua Strm	2.4	30	57	Mohaka	E
Tukituki Rv at Black Br	2.5	52	58	Tukituki	B
Makaretu Rv at SH50	2.5	61	59	Tukituki	B
Mangarau Strm at Te Aute Rd	2.5	23	59	Karamu/Clive	C
Esk Rv at Berry Rd	2.7	26	61	Esk	D
Tutaekuri Rv U/S Mangaone Rv	2.7	31	62	Tutaekuri	C
Anaura Strm	2.7	17	63	Waikari	D
Tukituki Rv at Tamumu Br	2.8	57	64	Tukituki	B
Awanui Strm	2.8	35	65	Karamu/Clive	C
Mangatutu Strm	2.8	17	66	Tutaekuri	C
Mangamahaki Strm	2.9	10	67	Tukituki	B
Porangahau Rv	2.9	29	68	Porangahau	A
Waikari Rv	2.9	30	69	Waikari	D
Ruahapia Strm	3.0	16	70	Karamu/Clive	C
Mangatewai Strm at SH50	3.2	14	71	Tukituki	B
Mangarau Strm at Keirunga Rd	3.3	16	72	Karamu/Clive	C
Te Iringaowhare Strm	3.3	5	73	Wairoa	F
Makaretu Rv U/S Maharakeke Strm	3.3	13	74	Tukituki	B
Ngaruroro Rv at Chesterhope (NIWA)	3.4	60	75	Ngaruroro	C
Mohaka Rv D/S Waipunga Rv	3.4	53	76	Mohaka	E
Pouhokio Strm	3.5	31	77	Maraetotara / Waimarama	A
Mahiaruhe Strm	3.8	12	78	Aropoanui	D
Clive Rv	3.8	26	79	Karamu/Clive	C
Sandy Ck	4.0	29	80	Aropoanui	D
Karewarewa Strm	4.0	29	81	Karamu/Clive	C
Papanui Strm	4.1	25	82	Tukituki	B
Tukituki Rv at SH50	4.2	61	83	Tukituki	B
Ngaruroro Rv D/S HB Dairies	4.5	32	84	Ngaruroro	C
Mohaka Rv at Raupunga (NIWA)	4.6	60	85	Mohaka	E
Hangaroa Rv	4.8	28	86	Wairoa	F
Ngaruroro Rv at Motorway	4.9	17	87	Ngaruroro	C
Mangatarata Strm	5.0	58	88	Tukituki	B
Waingongoro Strm	5.0	31	89	Southern Coastal	A
Tutaekuri-Waimate Strm	5.1	28	90	Ngaruroro	C
Ngaruroro Rv at Fernhill	5.2	30	91	Ngaruroro	C
Makara Strm	5.4	12	92	Tukituki	B
Mangaorapa Strm	5.7	29	93	Porangahau	A
Taipo Strm	5.8	30	94	Karamu/Clive	C
Taurekaitai Strm	6.3	29	95	Porangahau	A
Ngaruroro Rv at Ohiti	6.4	17	96	Ngaruroro	C
Ruakituri Rv	7.3	27	97	Wairoa	F
Opoutama Strm	7.6	17	98	Northern Coastal	F
Mangakuri Rv	7.8	27	99	Southern Coastal	A
Waiau Rv	9.1	24	100	Wairoa	F
Mohaka Rv at Raupunga	16.3	39	101	Mohaka	E
Mohaka Rv at Willowflat	17.5	37	102	Mohaka	E
Mangapoike Rv	18.3	24	103	Wairoa	F
Wairoa Rv U/S Wairoa	18.9	26	104	Wairoa	F

Sites ranked by median *E. coli* (CFU/100ml), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median *E. coli*	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	1.0	17	1	Wairoa	F
Mohaka Rv U/S Taharua Rv	2.0	59	2	Mohaka	E
Ngaruroro Rv at Whanawhana	3.0	30	3	Ngaruroro	C
Waipunga Rv at Pohokura Rd	3.0	19	3	Mohaka	E
Ngaruroro Rv at Kuripapango (NIWA)	3.1	60	5	Ngaruroro	C
Mokau Strm	4.0	11	6	Wairoa	F
Aniwaniwa Strm	6.0	29	7	Wairoa	F
Ngaruroro Rv D/S HB Dairies	6.5	30	8	Ngaruroro	C
Ngaruroro Rv at Motorway	7.0	17	9	Ngaruroro	C
Ngaruroro Rv U/S HB Dairies	7.0	17	9	Ngaruroro	C
Mokomokonui Rv	7.0	30	9	Mohaka	E
Taharua Rv at Henry's Br	7.0	12	9	Mohaka	E
Taharua Rv at Wairango	7.0	58	9	Mohaka	E
Mohaka Rv D/S Taharua Rv	7.5	62	14	Mohaka	E
Mohaka Rv D/S Ripia Rv	8.0	48	15	Mohaka	E
Mohaka Rv D/S Waipunga Rv	8.0	53	15	Mohaka	E
Taharua Rv at Twin Culv	9.0	59	17	Mohaka	E
Te Iringaowhare Strm	9.0	5	17	Wairoa	F
Taharua Rv at Poronui Stn	9.5	46	19	Mohaka	E
Tukituki Rv at SH50	10.0	57	20	Tukituki	B
Anaura Strm	10.0	17	20	Waikari	D
Ripia Rv U/S Mohaka Rv	10.0	31	20	Mohaka	E
Tutaekuri Rv at Lawrence Hut	11.0	33	23	Tutaekuri	C
Tutaekuri Rv at Puketapu	11.0	13	23	Tutaekuri	C
Taruarau Rv	11.5	12	25	Ngaruroro	C
Waiarua Strm	12.0	29	26	Mohaka	E
Makaroro Rv (NIWA)	12.1	60	27	Tukituki	B
Taharua Rv at Red Hut	13.0	59	28	Mohaka	E
Mohaka Rv at Willowflat	14.0	39	29	Mohaka	E
Tutaekuri Rv U/S Mangaone Rv	14.5	32	30	Tutaekuri	C
Ngaruroro Rv at Ohiti	15.0	17	31	Ngaruroro	C
Tutaekuri Rv at Brookfields Br	15.0	31	31	Tutaekuri	C
Waikaretaheke Rv	15.0	14	31	Wairoa	F
Mohaka Rv at Raupunga (NIWA)	15.2	60	34	Mohaka	E
Mohaka Rv at Raupunga	16.0	39	35	Mohaka	E
Mohaka Rv at SH5 (NIWA)	16.6	60	36	Mohaka	E
Tukituki Rv at Tamumu Br	20.0	57	37	Tukituki	B
Esk Rv at Berry Rd	21.0	27	38	Esk	D
Waipawa Rv at SH50	22.0	57	39	Tukituki	B
Ngaruroro Rv at Fernhill	25.5	30	40	Ngaruroro	C
Ngaruroro Rv at Chesterhope (NIWA)	27.5	60	41	Ngaruroro	C
Tukituki Rv at Black Br	29.0	55	42	Tukituki	B
Tukituki Rv at Red Br	32.0	59	43	Tukituki	B
Waiau Rv	33.0	24	44	Wairoa	F
Tukituki Rv at Red Br (NIWA)	34.3	60	45	Tukituki	B
Waitio Strm	35.0	30	46	Ngaruroro	C
Waipawa Rv 50m U/S oxi pond	37.0	44	47	Tukituki	B
Mangaone Rv at Rissington	37.5	36	48	Tutaekuri	C
Waikari Rv	39.5	28	49	Waikari	D
Esk Rv at Waipunga Br	40.0	30	50	Esk	D
Waipawa Rv at SH2	40.5	58	51	Tukituki	B
Maraetotara Rv at Waimarama Rd	41.0	31	52	Maraetotara / Waimarama	A
Mangaonuku Strm	41.0	59	52	Tukituki	B
Mangatutu Strm	41.5	18	54	Tutaekuri	C
Waipawa Rv U/S Tukituki Rv	42.0	43	55	Tukituki	B
Arawapanui Rv	43.0	29	56	Aropoanui	D
Makaretu Rv at SH50	45.0	57	57	Tukituki	B
Maraetotara Rv at Te Awanga	46.5	32	58	Maraetotara / Waimarama	A
Tukituki Rv at SH2	53.0	57	59	Tukituki	B
Mangaone Rv at Dartmoor	56.0	13	60	Tutaekuri	C
Tukituki Rv 50m U/S oxi pond	57.0	44	61	Tukituki	B
Poporangi Strm	57.5	12	62	Ngaruroro	C
Maraekakaho Strm	61.0	12	63	Ngaruroro	C
Hangaroa Rv	64.0	28	64	Wairoa	F
Tukituki Rv 400m D/S oxi pond	72.0	44	65	Tukituki	B
Waipawa Rv 400m D/S oxi pond	77.5	44	66	Tukituki	B
Tukituki Rv at Tapairu Rd	78.5	44	67	Tukituki	B
Ruakituri Rv	79.0	29	68	Wairoa	F
Mangapoike Rv	85.0	24	69	Wairoa	F
Wairoa Rv U/S Wairoa	85.0	28	69	Wairoa	F
Tutaekuri-Waimate Strm	87.0	27	71	Ngaruroro	C
Kahahakuri Strm	90.0	14	72	Tukituki	B
Kopuawhara Strm	91.5	30	73	Northern Coastal	F
Waingongoro Strm	105.0	32	74	Southern Coastal	A
Porangahau Rv	110.0	31	75	Porangahau	A
Porangahau Strm	110.0	57	75	Tukituki	B
Tukipo Rv at SH50	110.0	59	75	Tukituki	B
Pouhokio Strm	120.0	32	78	Maraetotara / Waimarama	A
Poukawa Strm	130.0	38	79	Karamu/Clive	C
Mangakuri Rv	140.0	31	80	Southern Coastal	A
Mahiaruhe Strm	149.0	10	81	Aropoanui	D
Mangaorapa Strm	160.0	31	82	Porangahau	A
Ohiwa Strm	180.0	11	83	Ngaruroro	C
Clive Rv	190.0	31	84	Karamu/Clive	C
Sandy Ck	220.0	27	85	Aropoanui	D
Opoutama Strm	220.0	18	85	Northern Coastal	F
Mangatarata Strm	235.0	54	87	Tukituki	B
Mangarau Strm at Keirunga Rd	240.0	17	88	Karamu/Clive	C
Awanui Strm	250.0	38	89	Karamu/Clive	C
Taurekaitai Strm	260.0	31	90	Porangahau	A
Mangarau Strm at Te Aute Rd	270.0	23	91	Karamu/Clive	C
Ruahapia Strm	280.0	17	92	Karamu/Clive	C
Papanui Strm	295.0	20	93	Tukituki	B
Karewarewa Strm	330.0	32	94	Karamu/Clive	C
Taipo Strm	330.0	31	94	Karamu/Clive	C
Herehere Strm	540.0	31	96	Karamu/Clive	C

Sites ranked by median Macroinvertebrate Community Index (MCI), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median MCI	Sample size (n)	Rank	Catchment	Reporting Zone
Te Kumi Strm	136.1	4	1	Wairoa	F
Mokomokonui Rv	132.6	5	2	Mohaka	E
Mokau Strm	131.3	1	3	Wairoa	F
Ngaruroro Rv at Kuripapango (NIWA)	130.0	5	4	Ngaruroro	C
Mohaka Rv D/S Ripia Rv	129.5	3	5	Mohaka	E
Taharua Rv at Henry's Br	129.2	1	6	Mohaka	E
Tutaekuri Rv at Lawrence Hut	127.8	5	7	Tutaekuri	C
Mohaka Rv U/S Taharua Rv	127.6	6	8	Mohaka	E
Ripia Rv U/S Mohaka Rv	127.3	5	9	Mohaka	E
Aniwaniwa Strm	126.5	5	10	Wairoa	F
Mohaka Rv at Willowflat	125.0	3	11	Mohaka	E
Taruarau Rv	120.7	1	12	Ngaruroro	C
Mohaka Rv D/S Taharua Rv	119.8	6	13	Mohaka	E
Waipunga Rv at Pohokura Rd	119.3	3	14	Mohaka	E
Waiarua Strm	119.1	5	15	Mohaka	E
Makaretu Rv at SH50	118.4	5	16	Tukituki	B
Taharua Rv at Poronui Stn	118.2	3	17	Mohaka	E
Mohaka Rv at SH5 (NIWA)	117.3	5	18	Mohaka	E
Makaroro Rv (NIWA)	116.6	5	19	Tukituki	B
Waiau Rv	116.4	3	20	Wairoa	F
Mohaka Rv D/S Waipunga Rv	116.3	3	21	Mohaka	E
Mangaone Rv at Rissington	116.0	5	22	Tutaekuri	C
Ngaruroro Rv at Whanawhana	115.8	5	23	Ngaruroro	C
Ruakituri Rv	115.7	4	24	Wairoa	F
Ngaruroro Rv U/S HB Dairies	113.2	4	25	Ngaruroro	C
Waipawa Rv at SH50	112.9	5	26	Tukituki	B
Mangatutu Strm	111.8	1	27	Tutaekuri	C
Anaura Strm	111.7	4	28	Waikari	D
Tukipo Rv at SH50	110.9	4	29	Tukituki	B
Waipawa Rv at SH2	110.7	1	30	Tukituki	B
Esk Rv at Berry Rd	110.5	4	31	Esk	D
Ngaruroro Rv D/S HB Dairies	110.0	5	32	Ngaruroro	C
Tukituki Rv at SH50	108.9	5	33	Tukituki	B
Poporangi Strm	108.9	1	33	Ngaruroro	C
Ngaruroro Rv at Ohiti	107.5	4	35	Ngaruroro	C
Maraekakaho Strm	107.4	1	36	Ngaruroro	C
Tutaekuri Rv U/S Mangaone Rv	107.2	3	37	Tutaekuri	C
Aropaoanui Rv	107.2	5	37	Aropoanui	D
Waikaretaheke Rv	106.7	3	39	Wairoa	F
Mohaka Rv at Raupunga (NIWA)	105.9	4	40	Mohaka	E
Esk Rv at Waipunga Br	104.6	5	41	Esk	D
Taharua Rv at Twin Culv	103.8	5	42	Mohaka	E
Mangaone Rv at Dartmoor	103.3	1	43	Tutaekuri	C
Ngaruroro Rv at Chesterhope (NIWA)	103.2	5	44	Ngaruroro	C
Mohaka Rv at Raupunga	102.0	5	45	Mohaka	E

Site	Median MCI	Sample size (n)	Rank	Catchment	Reporting Zone
Maraetotara Rv at Waimarama Rd	101.0	5	46	Maraetotara / Waimarama	A
Tukituki Rv at SH2	101.0	1	46	Tukituki	B
Te Iringaowhare Strm	100.1	2	48	Wairoa	F
Waitio Strm	99.1	5	49	Ngaruroro	C
Porangahau Strm	98.2	5	50	Tukituki	B
Sandy Ck	98.1	4	51	Aropoanui	D
Kopuawhara Strm	98.0	5	52	Northern Coastal	F
Tukituki Rv at Tamumu Br	97.9	5	53	Tukituki	B
Hangaroa Rv	97.3	5	54	Wairoa	F
Pouhokio Strm	96.7	5	55	Maraetotara / Waimarama	A
Mangaonuku Strm	96.7	4	55	Tukituki	B
Ngaruroro Rv at Motorway	96.6	4	57	Ngaruroro	C
Ngaruroro Rv at Fernhill	96.5	4	58	Ngaruroro	C
Kahahakuri Strm	96.3	1	59	Tukituki	B
Waikari Rv	95.8	5	60	Waikari	D
Taharua Rv at Wairango	95.4	5	61	Mohaka	E
Taharua Rv at Red Hut	95.2	5	62	Mohaka	E
Waingongoro Strm	94.1	5	63	Southern Coastal	A
Mangapoike Rv	92.8	2	64	Wairoa	F
Tukituki Rv at Red Br (NIWA)	92.3	5	65	Tukituki	B
Opoutama Strm	91.3	4	66	Northern Coastal	F
Tutaekuri Rv at Puketapu	88.0	1	67	Tutaekuri	C
Maraetotara Rv at Te Awanga	86.7	5	68	Maraetotara / Waimarama	A
Tutaekuri Rv at Brookfields Br	86.0	4	69	Tutaekuri	C
Mahiaruhe Strm	85.2	2	70	Aropoanui	D
Tukituki Rv at Red Br	84.2	5	71	Tukituki	B
Ohiwa Strm	84.2	1	71	Ngaruroro	C
Mangarau Strm at Keirunga Rd	82.7	4	73	Karamu/Clive	C
Tutaekuri-Waimate Strm	81.1	3	74	Ngaruroro	C
Mangakuri Rv	80.0	5	75	Southern Coastal	A
Mangaorapa Strm	79.2	5	76	Porangahau	A
Clive Rv	76.8	1	77	Karamu/Clive	C
Wairoa Rv U/S Wairoa	76.7	1	78	Wairoa	F
Porangahau Rv	76.0	5	79	Porangahau	A
Mangatarata Strm	75.9	4	80	Tukituki	B
Taurekaitai Strm	75.6	5	81	Porangahau	A
Tukituki Rv at Black Br	75.6	5	81	Tukituki	B
Mangarau Strm at Te Aute Rd	75.2	4	83	Karamu/Clive	C
Papanui Strm	72.5	1	84	Tukituki	B
Herehere Strm	68.9	5	85	Karamu/Clive	C
Karewarewa Strm	68.7	2	86	Karamu/Clive	C
Poukawa Strm	68.0	2	87	Karamu/Clive	C
Awanui Strm	67.7	2	88	Karamu/Clive	C
Taipo Strm	66.7	5	89	Karamu/Clive	C
Ruahapia Strm	62.7	4	90	Karamu/Clive	C

Sites ranked by median Total Suspended Solids (TSS, mg/L), 2009-2013, with colours signifying reporting zone. Lower ranks are 'better'. Medians generated from sample sizes of at least 30 are considered robust (Snelder pers. comm. 2014). Medians generated from sample sizes less than 30 should be treated with caution.

Site	Median TSS	Sample size (n)	Rank	Catchment	Reporting Zone
Mangaonuku Strm	1.5	59	1	Tukituki	B
Tukituki Rv at Waipukurau Ongaonga Rd	1.5	14	1	Tukituki	B
Maraekakaho Strm	1.5	14	1	Ngaruroro	C
Ohiwa Strm	1.5	12	1	Ngaruroro	C
Taruarau Rv	1.5	14	1	Ngaruroro	C
Tutaekuri Rv at Lawrence Hut	1.5	33	1	Tutaekuri	C
Waitio Strm	1.5	32	1	Ngaruroro	C
Mohaka Rv U/S Taharua Rv	1.5	64	1	Mohaka	E
Taharua Rv at Wairango	1.5	58	1	Mohaka	E
Te Kumi Strm	1.5	17	1	Wairoa	F
Taharua Rv at Henry's Br	1.9	17	11	Mohaka	E
Maharakeke Strm U/S Makaretu Rv	3.0	14	12	Tukituki	B
Aniwaniwa Strm	3.0	30	12	Wairoa	F
Mohaka Rv D/S Ripia Rv	3.3	48	14	Mohaka	E
Waipawa Rv 400m D/S oxi pond	3.3	44	15	Tukituki	B
Tutaekuri Rv at Puketapu	3.5	13	16	Tutaekuri	C
Porangahau Strm	3.7	63	17	Tukituki	B
Waikari Rv	4.0	32	18	Waikari	D
Maharakeke Strm at Limeworks Station Rd	4.3	13	19	Tukituki	B
Tukipo Rv U/S Makaretu Rv	4.3	13	19	Tukituki	B
Mangaone Rv at Dartmoor	4.3	13	19	Tutaekuri	C
Herehere Strm	4.5	31	22	Karamu/Clive	C
Ngaruroro Rv at Whanawhana	4.5	32	22	Ngaruroro	C
Ripia Rv U/S Mohaka Rv	4.5	36	22	Mohaka	E
Waipawa Rv 50m U/S oxi pond	4.8	44	25	Tukituki	B
Mangaone Rv at Rissington	4.8	35	25	Tutaekuri	C
Maraetotara Rv at Te Awanga	5.0	32	27	Maraetotara / Waimarama	A
Makaretu Rv U/S Maharakeke Strm	5.0	14	27	Tukituki	B
Poukawa Strm	5.0	39	27	Karamu/Clive	C
Tutaekuri Rv U/S Mangaone Rv	5.0	32	27	Tutaekuri	C
Mohaka Rv D/S Taharua Rv	5.0	66	27	Mohaka	E
Anaura Strm	5.1	17	32	Waikari	D
Ngaruroro Rv U/S HB Dairies	5.3	17	33	Ngaruroro	C
Mangarau Strm at Te Aute Rd	5.5	23	34	Karamu/Clive	C
Kahahakuri Strm	5.8	27	35	Tukituki	B
Mangatutu Strm	6.0	18	36	Tutaekuri	C
Arawapanui Rv	6.0	31	36	Aropoanui	D
Taharua Rv at Twin Culv	6.0	59	36	Mohaka	E
Maraetotara Rv at Waimarama Rd	6.3	31	39	Maraetotara / Waimarama	A
Tutaekuri Rv at Brookfields Br	6.8	31	40	Tutaekuri	C
Mokau Strm	6.8	11	40	Wairoa	F
Waipawa Rv U/S Tukituki Rv	7.0	44	42	Tukituki	B
Mokomokonui Rv	7.0	30	42	Mohaka	E
Tukituki Rv at Tapairu Rd	7.5	44	44	Tukituki	B
Tukipo Rv at SH50	7.6	63	45	Tukituki	B
Taharua Rv at Red Hut	7.6	63	45	Mohaka	E
Makaretu Rv at SH50	8.0	62	47	Tukituki	B
Esk Rv at Berry Rd	8.0	27	47	Esk	D
Esk Rv at Waipunga Br	8.0	30	47	Esk	D

Site	Median TSS	Sample size (n)	Rank	Catchment	Reporting Zone
Tukituki Rv 50m U/S oxi pond	8.4	44	50	Tukituki	B
Mangamahaki Strm	8.5	12	51	Tukituki	B
Karewarewa Strm	8.5	33	51	Karamu/Clive	C
Mangatewai Strm at SH50	8.8	13	53	Tukituki	B
Awanui Strm	8.8	39	53	Karamu/Clive	C
Clive Rv	8.8	32	55	Karamu/Clive	C
Waipawa Rv at SH2	9.0	58	56	Tukituki	B
Waiarua Strm	9.0	34	56	Mohaka	E
Tukituki Rv at Tamumu Br	9.2	58	58	Tukituki	B
Tukituki Rv 400m D/S oxi pond	9.5	44	59	Tukituki	B
Tukituki Rv at Red Br	10.5	60	60	Tukituki	B
Waikaretaheke Rv	11.0	14	61	Wairoa	F
Ngaruroro Rv at Motorway	11.3	17	62	Ngaruroro	C
Ngaruroro Rv at Ohiti	11.8	17	63	Ngaruroro	C
Tukituki Rv at Black Br	12.0	58	64	Tukituki	B
Waipawa Rv at SH50	12.0	58	64	Tukituki	B
Ngaruroro Rv D/S HB Dairies	12.5	32	66	Ngaruroro	C
Sandy Ck	12.5	35	66	Aropoanui	D
Tukituki Rv at SH50	13.0	62	68	Tukituki	B
Ruahapia Strm	13.0	17	68	Karamu/Clive	C
Mahiaruhe Strm	13.0	12	68	Aropoanui	D
Mangarau Strm at Keirunga Rd	13.5	17	71	Karamu/Clive	C
Mangatarata Strm	13.8	59	72	Tukituki	B
Papanui Strm	13.8	33	72	Tukituki	B
Tukituki Rv at SH2	13.8	57	72	Tukituki	B
Waipunga Rv at Pohokura Rd	14.3	25	75	Mohaka	E
Waingongoro Strm	15.0	32	76	Southern Coastal	A
Mohaka Rv D/S Waipunga Rv	15.3	53	77	Mohaka	E
Tutaekuri-Waimate Strm	16.0	29	78	Ngaruroro	C
Ngaruroro Rv at Fernhill	16.5	32	79	Ngaruroro	C
Taurekaitai Strm	18.5	31	80	Porangahau	A
Te Iringaowhare Strm	20.3	5	81	Wairoa	F
Taharua Rv at Poronui Stn	22.0	46	82	Mohaka	E
Poporangi Strm	24.0	14	83	Ngaruroro	C
Taipo Strm	27.5	32	84	Karamu/Clive	C
Kopuawhara Strm	28.0	31	85	Northern Coastal	F
Mangaorapa Strm	31.5	31	86	Porangahau	A
Makara Strm	33.5	13	87	Tukituki	B
Pouhokio Strm	40.0	32	88	Maraetotara / Waimarama	A
Porangahau Rv	40.3	31	89	Porangahau	A
Mangakuri Rv	42.5	31	90	Southern Coastal	A
Waiau Rv	65.8	25	91	Wairoa	F
Mohaka Rv at Raupunga	68.0	45	92	Mohaka	E
Wairoa Rv U/S Wairoa	70.3	29	93	Wairoa	F
Mohaka Rv at Willowflat	84.0	40	94	Mohaka	E
Hangaroa Rv	91.5	29	95	Wairoa	F
Mangapoike Rv	96.5	25	96	Wairoa	F
Ruakituri Rv	97.0	30	97	Wairoa	F
Opoutama Strm	131.0	18	98	Northern Coastal	F

Appendix E NPS-FW (2014) NOF attribute tables

Periphyton NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Periphyton (Trophic state)		
Attribute Unit	mg chl-a/m² (milligrams chlorophyll-a per square metre)		
Attribute State	Numeric Attribute State (Default Class)	Numeric Attribute State (Productive Class[1])	Narrative Attribute State
	Exceeded no more than 8% of samples[2]	Exceeded no more than 17% of samples[2]	
A	≤50	≤50	Rare blooms reflecting negligible nutrient enrichment and/or alteration of the natural flow regime or habitat.
B	>50 and ≤120	>50 and ≤120	Occasional blooms reflecting low nutrient enrichment and/ or alteration of the natural flow regime or habitat.
C	>120 and ≤200	>120 and ≤200	Periodic short-duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat.
National Bottom Line	200	200	
D	>200	>200	Regular and/or extended-duration nuisance blooms reflecting high nutrient enrichment and/or significant alteration of the natural flow regime or habitat.

1. Classes are streams and rivers defined according to types in the River Environment Classification (REC). The Productive periphyton class is defined by the combination of REC "Dry" Climate categories (i.e. Warm-Dry (WD) and Cool-Dry (CD)) and REC Geology categories that have naturally high levels of nutrient enrichment due to their catchment geology (i.e. Soft-Sedimentary (SS), Volcanic Acidic (VA) and Volcanic Basic (VB)). Therefore the productive category is defined by the following REC defined types: WD/SS, WD/VB, WD/VA, CD/SS, CD/VB, CD/VA. The Default class includes all REC types not in the Productive class.

2. Based on a monthly monitoring regime. The minimum record length for grading a site based on periphyton (chl-a) is 3 years.

Nitrate NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers		
Attribute	Nitrate (Toxicity)		
Attribute Unit	mg NO_3-N/L (milligrams nitrate-nitrogen per litre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	Annual Median	Annual 95th Percentile	
A	≤1.0	≤1.5	High conservation value system. Unlikely to be effects even on sensitive species
B	>1.0 and ≤2.4	>1.5 and ≤3.5	Some growth effect on up to 5% of species.
C	>2.4 and ≤6.9	>3.5 and ≤9.8	Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects.
National Bottom Line	6.9	9.8	
D	>6.9	>9.8	Impacts on growth of multiple species, and starts approaching acute impact level (ie risk of death) for sensitive species at higher concentrations (>20 mg/L)

Ammonia NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Lakes and rivers		
Attribute	Ammonia (Toxicity)		
Attribute Unit	mg NH_4-N/L (milligrams ammoniacal-nitrogen per litre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	Annual Median*	**Annual Maximum***	
A	≤0.03	≤0.05	99% species protection level: No observed effect on any species tested
B	>0.03 and ≤0.24	>0.05 and ≤0.40	95% species protection level: Starts impacting occasionally on the 5% most sensitive species
C	>0.24 and ≤1.30	>0.40 and ≤2.20	80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)
National Bottom Line	**1.30**	**2.20**	
D	>1.30	>2.20	Starts approaching acute impact level (ie risk of death) for sensitive species

* Based on pH 8 and temperature of 20°C.

Compliance with the numeric attribute states should be undertaken after pH adjustment.

Dissolved Oxygen NOF attribute table

Value	Ecosystem health		
Freshwater Body Type	Rivers (below point sources)		
Attribute	Dissolved Oxygen		
Attribute Unit	mg/L (milligrams per litre)		
Attribute State	Numeric Attribute State		Narrative Attribute State
	7-day mean minimum[1] (Summer Period: 1 November to 30th April)	1-day minimum[2] (Summer Period: 1 November to 30th April)	
A	≥8.0	≥7.5	No stress caused by low dissolved oxygen on any aquatic organisms that are present at matched reference (near-pristine) sites.
B	≥7.0 and <8.0	≥5.0 and <7.5	Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.
C	≥5.0 and <7.0	≥4.0 and <5.0	Moderate stress on a number of aquatic organisms caused by dissolved oxygen levels exceeding preference levels for periods of several hours each day. Risk of sensitive fish and macroinvertebrate species being lost.
National Bottom Line	**5.0**	**4.0**	
D	<5.0	<4.0	Significant, persistent stress on a range of aquatic organisms caused by dissolved oxygen exceeding tolerance levels. Likelihood of local extinctions of keystone species and loss of ecological integrity.

1. The mean value of 7 consecutive daily minimum values.

2. The lowest daily minimum across the whole summer period.

Escherichia coli NOF attribute table

Value	Human health for recreation		
Freshwater Body Type	Lakes and rivers		
Attribute	*E. coli**		
Attribute Unit	*E. coli*/100 mL (number of *E. coli* per hundred millilitres)		
Attribute State	**Numeric Attribute State**	**Sampling Statistic**	**Narrative Attribute State**
A	≤260	Annual median	People are exposed to a very low risk of infection (less than 0.1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating)
		95th percentile	People are exposed to a low risk of infection (up to 1% risk) when undertaking activities likely to involve full immersion.
B	>260 and ≤540	Annual median	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).
		95th percentile	People are exposed to a moderate risk of infection (less than 5% risk) when undertaking activities likely to involve full immersion. 540 / 100ml is the **minimum acceptable state** for activities likely to involve full immersion.
C	>540 and ≤1000	Annual median	People are exposed to a moderate risk of infection (less than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating). People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities likely to involve immersion.
National Bottom Line	1000	Annual median	
D	>1000	Annual median	People are exposed to a high risk of infection (greater than 5% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).

Appendix F Summary of NOF bands for *E.coli*, Nitrate-nitrogen and Ammonia.

Table F-1: NPS-FW (2014) NOF bands for the *E. coli* attribute for Ngaruroro and Tutaekuri catchment monitoring sites. . Cells are coloured as per the Attribute State gradings shown.

A	B	C	D

Site	Annual Medians E.coli					5 year median	5 Year 95th percentile
	2009	2010	2011	2012	2013		
Ngaruroro Rv at Kuripapango (NIWA)	NA	NA	6.3	3.1	2.55	3.1	60.95
Taruarau Rv	NA	NA	NA	15	8.5	11.75	250
Ngaruroro Rv at Whanawhana	1	3	3	4	3.5	3	3
Poporangi Strm	NA	NA	NA	57.5	57.5	57.5	90
Ngaruroro Rv U/S HB Dairies	4	7	4	7	NA	5.5	19
Ngaruroro Rv D/S HB Dairies	2	2	2.5	5	19	2.5	36
Maraekakaho Strm	NA	NA	NA	95	46	70.5	130
Ngaruroro Rv at Ohiti	6	17	15	13	NA	14	24
Waitio Strm	4	22	74.5	31.5	64	31.5	90
Ohiwa Strm	NA	NA	NA	NA	180	180	910
Ngaruroro Rv at Fernhill	2	18.5	27.5	17.5	32.5	18.5	44
Ngaruroro Rv at Motorway	1.5	2	3	9	NA	2.5	20
Tutaekuri-Waimate Strm	230	65	108.5	100	80	100	4400
Ngaruroro Rv at Chesterhope (NIWA)	24.3	19.35	16.9	17.3	28.3	19.35	237.995
Tutaekuri Rv at Lawrence Hut	1	7.5	6.5	8	18	7.5	50
Mangatutu Strm	NA	NA	80	78	40	78	120
Tutaekuri Rv U/S Mangaone Rv	NA	11.5	28	5	17	14.25	130
Mangaone Rv at Rissington	15.5	18	35	49.5	60	35	146
Mangaone Rv at Dartmoor	NA	NA	NA	50.5	56	53.25	120
Tutaekuri Rv at Puketapu	NA	NA	NA	8.5	15	11.75	32
Tutaekuri Rv at Brookfields Br	1	16.5	14.5	10	21	14.5	160

Table F-2: NPS-FW (2014) NOF bands for the *E. coli* attribute for Karamu and Ahuriri catchment monitoring sites. Cells are coloured as per the Attribute State gradings shown.

A	B	C	D

Site	Annual Medians E.coli					5 year median	5 Year 95th percentile
	2009	2010	2011	2012	2013		
Karewarewa Strm	43	550	243	620	450	450	4405
Awanui Strm	62	320	275	180	285	275	884
Poukawa Strm	67	550	185	130	85	130	672.5
Herehere Strm	59.5	1075	605	1000	530	605	1800
Mangarau Strm at Te Aute Rd	52	340	365	225	NA	282.5	500
Clive Rv	26.5	140.5	83	285	200	140.5	1100
Taipo Strm	24	600	113.5	1000	415	415	2400

Table F-3: NPS-FW (2014) NOF bands for the Nitrate (Toxicity) attribute for Ngaruroro and Tutaekuri catchment monitoring sites. . Cells are coloured as per the Attribute State gradings shown:.

A	B	C	D

Site	Annual Medians					Annual 95th Percentiles					5 Year Median	5 Year 95th Percentile	5 Year Maximum
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013			
Ngaruroro Rv at Kuripapango (NIW	0.0085	0.0055	0.0045	0.007	0.0075	0.0199	0.0267	0.0191	0.0252	0.0416	NA	NA	NA
Taruarau Rv	NA	NA	NA	0.018	0.01	NA	NA	NA	0.02	0.0411	0.01	0.04	0.042
Ngaruroro Rv at Whanawhana	0.038	0.031	0.04	0.016	0.0155	0.15	0.052	0.26	0.082	0.0706	0.018	0.143	0.26
Poporangi Strm	NA	NA	NA	0.74	0.445	NA	NA	NA	0.76	1.003	0.525	0.986	1.02
Ngaruroro Rv U/S HB Dairies	0.0385	0.052	0.046	0.04	NA	0.08	0.089	0.062	0.1	NA	0.04	0.097	0.1
Ngaruroro Rv D/S HB Dairies	0.085	0.0815	0.136	0.101	0.075	0.1	0.138	0.174	0.28	0.1901	0.095	0.192	0.28
Maraekakaho Strm	NA	NA	NA	0.3	0.495	NA	NA	NA	0.33	2.599	0.405	2.498	2.7
Ngaruroro Rv at Ohiti	0.074	0.1065	0.1675	0.124	NA	0.14	0.197	0.184	0.25	NA	0.12	0.231	0.25
Waitio Strm	0.23	0.3355	0.2105	0.235	0.23	0.55	0.5	0.66	0.36	0.539	0.235	0.549	0.66
Ohiwa Strm	NA	NA	NA	0.48	0.515	NA	NA	NA	0.48	0.916	0.48	0.914	0.92
Ngaruroro Rv at Fernhill	0.105	0.0995	0.1655	0.1355	0.089	0.3	0.22	0.23	0.27	0.334	0.121	0.294	0.35
Ngaruroro Rv at Motorway	0.1045	0.0785	0.17	0.119	NA	0.15	0.22	0.23	0.26	NA	0.12	0.25	0.26
Tutaekuri-Waimate Strm	0.28	0.32	0.241	0.245	0.2005	0.28	0.48	0.71	0.68	0.51	0.23	0.681	0.71
Ngaruroro Rv at Chesterhope (NIW	0.0885	0.1165	0.1175	0.095	0.0765	0.2085	0.2575	0.2857	0.3157	0.2941	NA	NA	NA
Tutaekuri Rv at Lawrence Hut	0.036	0.0305	0.0145	0.0055	0.008	0.11	0.037	0.064	0.025	0.0218	0.014	0.063	0.11
Mangatutu Strm	NA	NA	0.43	0.265	0.31	NA	NA	0.54	0.32	0.477	0.32	0.516	0.54
Tutaekuri Rv U/S Mangaone Rv	NA	0.2885	0.188	0.245	0.086	NA	0.42	0.39	0.44	0.2485	0.154	0.419	0.44
Mangaone Rv at Rissington	0.075	0.365	0.32	0.47	0.167	0.59	0.67	0.75	0.78	0.53	0.31	0.722	0.78
Mangaone Rv at Dartmoor	NA	NA	NA	0.0585	0.21	NA	NA	NA	0.116	0.5305	0.132	0.512	0.54
Tutaekuri Rv at Puketapu	NA	NA	NA	0.07	0.078	NA	NA	NA	0.127	0.3085	0.078	0.305	0.31
Tutaekuri Rv at Brookfields Br	0.0805	0.2265	0.283	0.227	0.025	0.4	0.5	0.5	0.53	0.318	0.143	0.5	0.53

Table F-4: NPS-FW (2014) NOF bands for the Nitrate (Toxicity) attribute for Karamu and Ahuriri catchment monitoring sites . Cells are coloured as per the Attribute State gradings shown:.

A	B	C	D

Site	Annual Medians					Annual 95th Percentiles					5 Year Median	5 Year 95th Percentile	5 Year Maximum
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013			
Karewarewa Strm	0.6695	2.1	2.095	1.49	1.29	3.2	3.3	4.2	4.1	5.595	1.52	4.185	6
Awanui Strm	0.59	0.76	1.5	1.035	0.77	1.2	1.91	4.7	1.7	3.355	0.84	3.265	4.7
Poukawa Strm	0.059	0.045	0.154	0.1165	0.46	0.22	0.7	0.55	0.39	3.179	0.13	1.131	3.5
Herehere Strm	0.2435	0.495	1.06	0.113	0.165	1.6	0.7	5.5	0.72	2.1	0.275	2.1	5.5
Mangarau Strm at Te Aute Rd	0.86	0.75	0.84	0.84	NA	1.5	2.4	1.21	3.8	NA	0.79	2.89	3.8
Clive Rv	0.35	0.795	1.73	0.59	0.335	0.71	1.43	2.7	1.96	2.851	0.62	2.663	3
Taipo Strm	0.175	0.325	0.5595	0.38	0.256	0.44	0.62	3.1	0.88	9.164	0.32	2.954	10

Table F-5: NPS-FW (2014) NOF bands for the Ammonia (Toxicity) attribute for Ngaruroro and Tutaekuri catchment monitoring sites. Cells are coloured as per the Attribute State gradings shown:.

Site	Medians					Maxima					5 Year Median	5 Year Maximum
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013		
Ngaruroro Rv at Kuripapango (NIWA)	0.002	0.003	0.003	0.002	0.002	0.005	0.006	0.006	0.011	0.004	0.002	0.011
Taruarau Rv	NA	NA	NA	0.005	0.005	NA	NA	NA	0.005	0.041	0.005	0.041
Ngaruroro Rv at Whanawhana	0.016	0.014	0.005	0.005	0.005	0.02	0.014	0.005	0.013	0.015	0.005	0.020
Poporangi Strm	NA	NA	NA	0.005	0.005	NA	NA	NA	0.005	0.018	0.005	0.018
Ngaruroro Rv U/S HB Dairies	0.005	0.0085	0.005	0.005	NA	0.005	0.029	0.005	0.005	NA	0.005	0.029
Ngaruroro Rv D/S HB Dairies	0.005	0.005	0.005	0.005	0.005	0.01	0.044	0.005	0.014	0.005	0.005	0.044
Maraekakaho Strm	NA	NA	NA	0.005	0.005	NA	NA	NA	0.005	0.012	0.005	0.012
Ngaruroro Rv at Ohiti	0.005	0.02	0.005	0.005	NA	0.005	0.091	0.005	0.005		0.005	0.091
Waitio Strm	0.0105	0.013	0.005	0.005	0.005	0.075	0.053	0.059	0.039	0.021	0.005	0.075
Ohiwa Strm	NA	NA	NA	0.014	0.005	NA	NA	NA	0.014	0.045	0.005	0.045
Ngaruroro Rv at Fernhill	0.005	0.029	0.005	0.005	0.005	0.011	0.096	0.005	0.037	0.005	0.005	0.096
Ngaruroro Rv at Motorway	0.005	0.005	0.005	0.005	NA	0.005	0.046	0.005	0.041	NA	0.005	0.046
Tutaekuri-Waimate Strm	0.029	0.0075	0.0125	0.0175	0.008	0.029	0.082	0.039	0.08	0.044	0.013	0.082
Ngaruroro Rv at Chesterhope (NIWA)	0.003	0.0045	0.0045	0.0055	0.004	0.008	0.011	0.017	0.015	0.009	0.004	0.017
Tutaekuri Rv at Lawrence Hut	0.005	0.0084	0.005	0.005	0.005	0.024	0.055	0.028	0.005	0.005	0.005	0.055
Mangatutu Strm	NA	NA	0.005	0.005	0.005	NA	NA	0.014	0.005	0.017	0.005	0.017
Tutaekuri Rv U/S Mangaone Rv	NA	0.005	0.005	0.005	0.005	NA	0.053	0.016	0.005	0.005	0.005	0.053
Mangaone Rv at Rissington	0.0085	0.0135	0.005	0.005	0.005	0.018	0.033	0.02	0.02	0.022	0.005	0.033
Mangaone Rv at Dartmoor	NA	NA	NA	0.014	0.005	NA	NA	NA	0.015	0.028	0.005	0.028
Tutaekuri Rv at Puketapu	NA	NA	NA	0.005	0.005	NA	NA	NA	0.005	0.014	0.005	0.014
Tutaekuri Rv at Brookfields Br	0.0105	0.029	0.005	0.005	0.005	0.025	0.048	0.005	0.016	0.02	0.005	0.048

Table F-6: NPS-FW (2014) NOF bands for the Ammonia (Toxicity) attribute for Karamu and Ahuriri catchment monitoring sites. Cells are coloured as per the Attribute State gradings shown:.

Site	Medians					Maxima					5 Year Median	5 Year Maximum
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013		
Karewarewa Strm	0.148	0.0865	0.0535	0.0475	0.103	0.27	0.18	0.072	0.144	0.98	0.075	0.980
Awanui Strm	0.035	0.066	0.0375	0.0225	0.099	0.24	0.15	0.063	0.126	0.57	0.066	0.570
Poukawa Strm	0.016	0.046	0.01	0.016	0.018	0.044	0.14	0.028	0.053	0.107	0.018	0.140
Herehere Strm	0.01	0.0395	0.013	0.0195	0.009	0.026	0.122	0.034	0.052	0.038	0.017	0.122
Mangarau Strm at Te Aute Rd	0.005	0.018	0.0085	0.015	NA	0.057	0.082	0.012	0.04	NA	0.015	0.082
Clive Rv	0.021	0.0895	0.035	0.014	0.0315	0.038	0.19	0.105	0.127	0.163	0.036	0.190
Taipo Strm	0.29	0.087	0.0155	0.198	0.0275	0.38	0.31	0.037	0.37	0.2	0.034	0.380

Appendix G MfE benthic cyanobacteria alert-level framework

Taken from page 17 of the "Ministry for the Environment and Ministry of Health. 2009. *New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters – Interim Guidelines*. Prepared for the Ministry for the Environment and the Ministry of Health by SA Wood, DP Hamilton, WJ Paul, KA Safi and WM Williamson. Wellington: Ministry for the Environment."

3.5 Alert-level framework: benthic cyanobacteria

Decision Chart 2: Alert-level framework for benthic cyanobacteria

Alert level[a]	Actions (See section 2.4 for the recommended framework for roles and responsibilities relating to actions, and the text box at the beginning of Section 3 for advice on interpreting the guidance in this table.)
Surveillance (green mode) Up to 20% coverage[b] of potentially toxigenic cyanobacteria (see Table 1) attached to substrate.	• Undertake fortnightly surveys between spring and autumn at representative locations in the water body where known mat proliferations occur and where there is recreational use.
Alert (amber mode) 20–50% coverage of potentially toxigenic cyanobacteria (see Table 1) attached to substrate.	• Notify the public health unit. • Increase sampling to weekly. • Recommend erecting an information sign that provides the public with information on the appearance of mats and the potential risks. • Consider increasing the number of survey sites to enable risks to recreational users to be more accurately assessed. • If toxigenic cyanobacteria (see Table 2) dominate the samples, testing for cyanotoxins is advised. If cyanotoxins are detected in mats or water samples, consult the testing laboratory to determine if levels are hazardous.
Action (red mode) *Situation 1:* Greater than 50% coverage of potentially toxigenic cyanobacteria (see Table 1) attached to substrate; or *Situation 2:* up to 50% where potentially toxigenic cyanobacteria are visibly detaching from the substrate, accumulating as scums along the river's edge or becoming exposed on the river's edge as the river level drops.	• Immediately notify the public health unit. • If potentially toxic taxa are present (see Table 2) then consider testing samples for cyanotoxins.. • Notify the public of the potential risk to health.

a The alert-level framework is based on an assessment of the percentage of river bed that a cyanobacterial mat covers at each site. However, local knowledge of other factors that indicate an increased risk of toxic cyanobacteria (eg, human health effects, animal illnesses, prolonged low flows) should be taken into account when assessing a site status and may, in some cases, lead to an elevation of site status (eg, from surveillance to action), irrespective of mat coverage.

b This should be assessed by undertaking a site survey as documented in Section 4.4.