HAWKE'S BAY
REGIONAL COUNCIL

# Waikari, Aropaoanui and Esk Catchments

## State and Trends of River Water Quality and Ecology

May 2016
HBRC Report No. RM16-10 – 4789

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Environmental Science - Water Quality and Ecology

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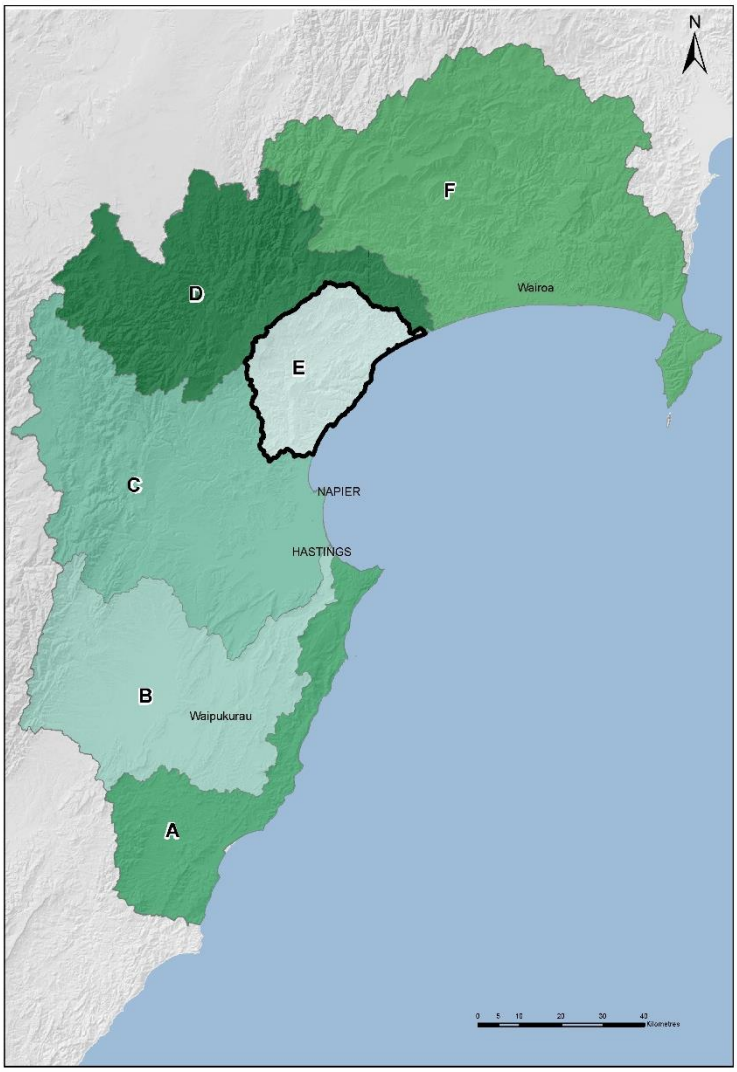
# Executive summary

This report summarises states and trends in river water quality and ecology in the Waikari, Aropaoanui and Esk catchments. The report is 1 of 6 State of the Environment (SOE) reports for the Hawke's Bay region summarising river water quality and ecology data. The 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.

The 6 SoE reports cover the following subregions:

- Porangahau River/Southern Coastal
- Tukituki River
- TANK (Tutaekuri River, Ahuriri Estuary, Ngaruroro River, Karamu Stream)
- Mohaka River
- **This report**: Waikari River/Esk River/Aropaoanui River (subregion "E", bordered in black on the map below)
- Wairoa River/Northern Coastal



The combined Esk, Aropaoanui and Waikari catchments form the smallest of the subregions in this technical report series, covering a total area of 761 $km^2$, with the Waikari the largest (at 324 $km^2$) and Aropaoanui the smallest (168 $km^2$) of the 3 catchments.

There are currently 7 SOE monitoring sites in the Esk, Aropaoanui and Waikari catchments, which were used for analyses in this report:

- Two sites on the Esk River: at Berry Road in the upper catchment and at Waipunga Bridge on the lower River.
- Three sites in the Lake Tutira/ Aropaoanui catchment: at Sandy Creek, which used to flow into the lake but is now diverted directly to the lake outlet, the Mahiaruhe Stream, where the second monitoring site is located and on the lower Aropaoanui River, just inland from Waipatiki Beach
- Two sites in the Waikari catchment: on the Anaura Stream, an upper catchment tributary and on the lower Waikari River main stem.

Water quality and ecological indicators monitored as part of the SOE monitoring programme may be considered in the following groups:

1. Microbiological water quality indicators, such as *Escherichia coli (E. coli)*, which provides an indication of the level of health risk to recreational users of the water,
2. Basic physico-chemical indicators, such as temperature, dissolved oxygen and pH,
3. Indicators associated with the visual appearance of the water, such as visual water clarity and turbidity,
4. Toxicants, such as nitrate-nitrogen and ammoniacal nitrogen,
5. Nutrients, such as nitrogen and phosphorus, as controlling factors, or indicators of risk of eutrophication (excessive plant/algae growth),
6. Biological indicators of eutrophication (periphyton biomass) and ecological health (macroinvertebrate communities).

The various water quality and ecological indicators were compared with appropriate environmental guidelines and trigger values to provide an indication of the state of water quality. Statistical analyses of trends through time were performed to determine whether the water quality indicators have been improving or degrading. For the relevant indicators, and where data were available, the various indicators were compared with the Regional Plan (RRMP) Guidelines, and with the National Policy Statement for Freshwater management (NPS-FM) (2014) Attribute States. Monitoring data collected during the 2004-2013 period indicate the following:

1. <u>Microbiological water quality</u>:

   All 7 monitoring sites fall into the NPSFM 'A' Attribute State, indicating that water quality is generally suitable for secondary (e.g. wading, boating) contact recreation at all sites across the Esk, Aropaoanui and Waikari catchments. All 7 sites are also generally suitable for primary contact recreation, with 4 sites presenting a low risk (NPSFM A Band), and 3 (Sandy Creek, Mahiaruhe Stream and the Aropaoanui River) presenting a moderate risk (NPSFM B Band) to water users.

2. Dissolved Oxygen

Data available do not point to any significant issues associated with dissolved oxygen (DO) concentration or saturation at any of the sites, although it should be noted that the data are limited to 'spot' measurements, which are unlikely to capture the daily minima.

3. Water clarity and turbidity

Water clarity is generally relatively low in the Esk, Aropaoanui and Waikari catchments. Water clarity is better than the ANZECC guideline for recreational waters of 1.6 m only at the Aropaoanui River and the Waikari River. Sandy Creek and the Mahiaruhe Stream have the worst water clarity of all sites in this sub-region.

The sites examined in this study are in the middle of other sites in the Hawke's Bay region for water clarity and turbidity.

A deterioration in water clarity (black disc) over time was detected at only 1 site (Mahiaruhe Stream) while deteriorating trends in turbidity (i.e. an increase over time) were detected at 3 sites, including the Esk River at Berry Road, Mahiaruhe Stream and the Aropaoanui River.

4. Toxicants

Nitrate nitrogen and ammoniacal nitrogen concentrations were always low at all sites, well below guideline values indicating that the risk of toxic effects from either nitrate or ammonia can be considered low at all SOE monitoring sites in the Esk, Aropaoanui and Waikari catchments. All sites fall within the NPSFM A Band for nitrate and 'A' or 'B' Bands for ammonia.

Nitrate concentrations improve (i.e., reduce) over time at the 2 sites in the Waikari catchment, with no change at any of the sites within the other 2 catchments.

5. Nutrients

Nutrient concentrations vary in the following ways:

- Nitrogen concentrations, both Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN), were generally moderate and better than the relevant ANZECC trigger values, with the exception of Sandy Creek and the Mahiaruhe Stream;
- Median Total Phosphorus (TP) concentrations were better than the ANZECC trigger values at all sites except Sandy Creek and Mahiaruhe Stream. However, only the Anaura Stream was better than the ANZECC trigger value for Dissolved Reactive Phosphorus (DRP) concentrations;
- The Anaura Stream had the lowest nutrient (N and P) concentrations of all sites
- Sandy Creek and the Mahiaruhe Stream had the highest nutrient concentrations (both nitrogen and phosphorus), and often exceeded ANZEEC trigger values and RRMP guidelines;
- Nutrient concentrations at the 2 Esk River sites were very similar, indicating no change in nutrient status along the course of the Esk River;
- DIN/DRP ratios suggested co-limited conditions occurred at all sites except the Aropaoanui River and the Anaura Stream. Nitrogen-limited conditions were likely to occur at times in the Aropaoanui River, whilst a mix of co-limited and P-limited conditions were likely to occur in the Anaura Stream. In Sandy Creek and the Mahiaruhe Stream, any nutrient limitation was likely to be very weak or absent (unlimited

conditions). By contrast, moderate to strong co-limitation of periphyton growth was likely in the Aropaoanui, Esk and Waikari main stems. Strong nutrient limitation of periphyton growth (a mix of co- and P-limited conditions) was likely in the Anaura Stream.

Compared with other SOE sites in the region, most Esk, Aropaoanui and Waikari sites ranked in the bottom 40% for the region for both DIN and DRP.

Nutrient concentrations were generally stable over time across the study area, although improvements in DIN were detected in the Aropaoanui River, Anaura Stream and Waikari River. No changes in DRP (improvements or deterioration) occurred at any sites in the Esk, Aropaoanui and Waikari catchments. Significant improvements in TN and TP were observed, but only in the Esk River at Berry Road and Anaura Stream, and for TP in the Aropaoanui River. TN concentrations significantly increased in the Mahiaruhe Stream, which is the combination of Sandy Creek and the outlet of Lake Tutira.

6. Biological indicators

MCI scores at both Esk River sites, in the Aropaoanui River and the Anaura Stream were indicative of good water quality, while those in Sandy Creek and the Mahiaruhe Stream and the Waikari River had in-stream macroinvertebrate communities indicative of 'fair' water quality. The Mahiaruhe Stream had the worst median MCI score and was the only site where MCI scores indicative of 'poor' water quality (<80) were observed.

Periphyton biomass was generally under both the 120 mg/$m^2$ 'recreational' and 50 mg/$m^2$ 'biodiversity' thresholds in the Anaura Stream, Sandy Creek and Aropaoanui River, indicating good water quality. However, Sandy Creek and the Mahiaruhe Stream are unsuited to periphyton development.

Both sites on the Esk River and the Waikari River site had higher median periphyton biomass levels, exceeding the threshold for the protection of aquatic biodiversity values, but within or just exceeding the threshold for the protection of aesthetics and recreational values. At all 3 sites, periphyton biomass at times largely exceeded the 120 mg/$m^2$ 'recreational' threshold. The highest levels (represented by 90$^{th}$ percentile whiskers) were observed in the Waikari River.

Data at all sites were limited to annual measurements (1 to 5 annual measurements available at each site), and were insufficient to provide a robust indication of periphyton biomass patterns at these sites, particularly if, or how often "nuisance" levels of periphyton growth occurred.

# 1 Introduction

Hawke's Bay Regional Council (HBRC) monitors water quality and river flow at several points across the Hawke's Bay Region and has produced a regional summary report on the state and trends of water quality for sites within these catchments (HBRC 2009-2013), based on data collected between 2009 and 2013.

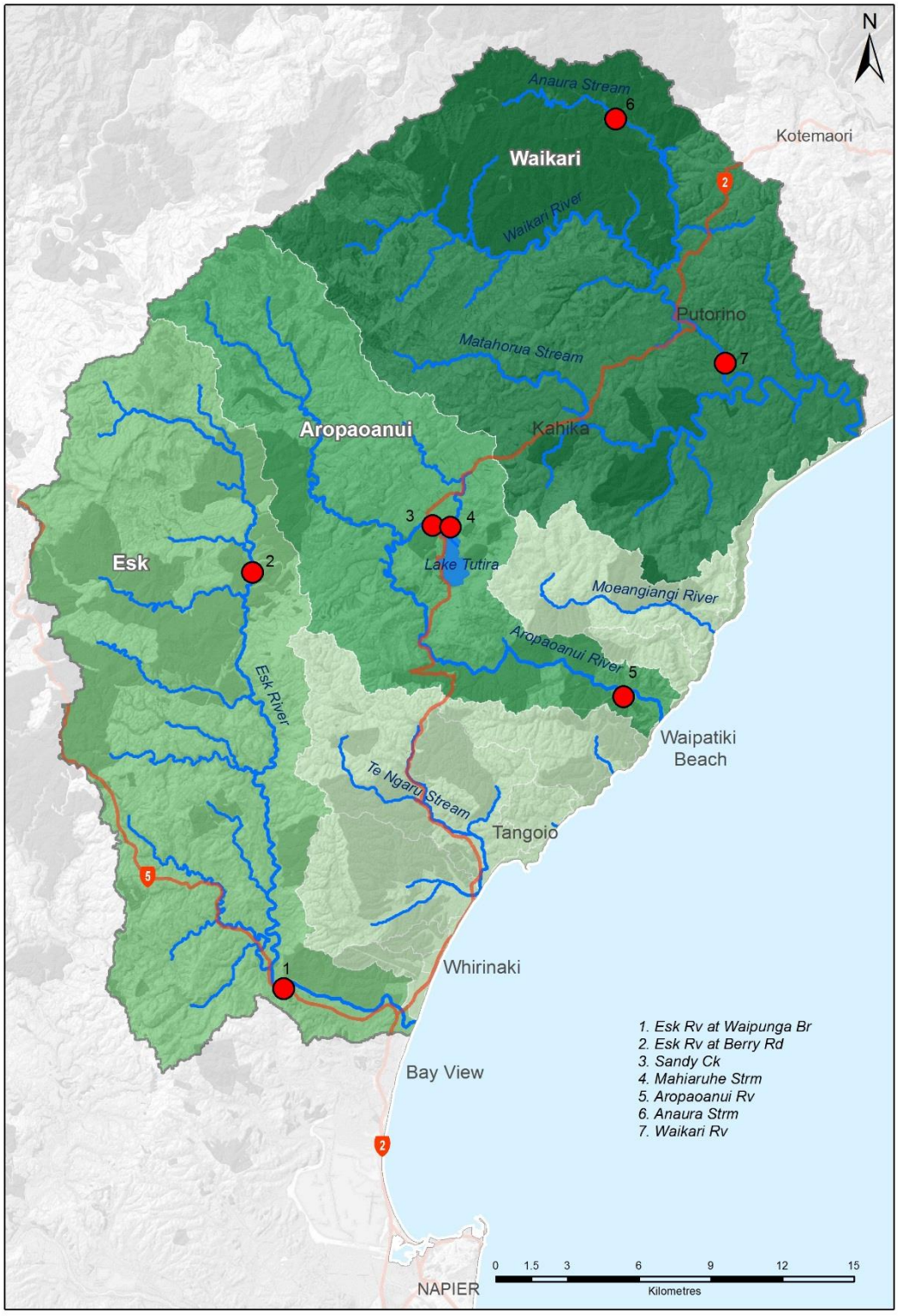
This report provides detailed technical information from the Waikari, Aropaoanui and Esk Catchments. It forms part of a series of technical reports covering all major catchments in the Hawke's Bay Region, which served as a base for the regional summary report.

Each technical report within the series aims to provide an analysis and summary of the water quality and biomonitoring data collected by HBRC up until 2013, covering in particular the following points:

- the state of water quality and aquatic ecology in the rivers and streams within the subregion or water management zone considered;
- Compliance of the sites with relevant guidelines that are stipulated in either the regional resource management plan (RRMP), the resource management act (RMA) or ANZECC (Australia and New Zealand Environment and Conservation Council) guidelines;
- Trends through time, *i.e.* are the water quality or the ecological indicators getting better or worse over time?
- Recommendations for further analysis of the data and future water quality monitoring in these catchments.

## 1.1 Physical Geography

This report is based on water quality and ecological data collected at 7 State of the Environment (''SOE") monitoring sites across 3 catchments. Two monitoring sites are located in the Esk catchment, three in the Aropaoanui catchment, which includes Lake Tutira, and two in the Waikari catchment.




The Esk River is a 5th order river with headwaters near the Mangahaururu Range and discharging to sea near Whirinaki approximately 15 km north of Napier.

Sandy Creek is a channel diverting flows from Papakiri Stream before it enters Lake Tutira. This diversion was established in 1980-1981 due to ongoing water quality problems in the lake that were attributed to poor water quality flowing from the Papakiri catchment. Sandy Creek joins the Mahiaruhe Stream at the outlet of Lake Tutira. The Mahiaruhe Stream forms the outflow of Lake Tutira, then joins the Waikoau River approximately 2 km south of the lake, and then becomes the Aropaoanui River to the east of SH2 flowing out to the Pacific Ocean.

The Waikari River is located approximately 15 km north east of Lake Tutira and flows through Putorino, and then to the Pacific Ocean.

The Esk River has good quality habitat for most of its length, with regular riffles, pools and bends and a mostly large cobble/ cobble streambed. Riparian margins are well protected in the upper reaches, with few breaks or signs of erosion, while the lower reaches are characterised by less riparian protection with intermittent patches of stream bank erosion.

In the Aropaoanui catchment, the Mahiaruhe Stream and Sandy Creek (Papakiri Stream) are spring-fed systems with slow water velocities that are usually dominated by a muddy bottom substrate. Sandy Creek contains aquatic macrophyte communities while the Mahiaruhe Stream has little growing in it.

The Aropaoanui and Waikare rivers are run-off fed systems with moderate water velocities that are usually dominated by a cobble/gravel bottom substrate. Both rivers contain periphyton growth with aquatic macrophytes occasionally appearing at the edges during low flow periods.

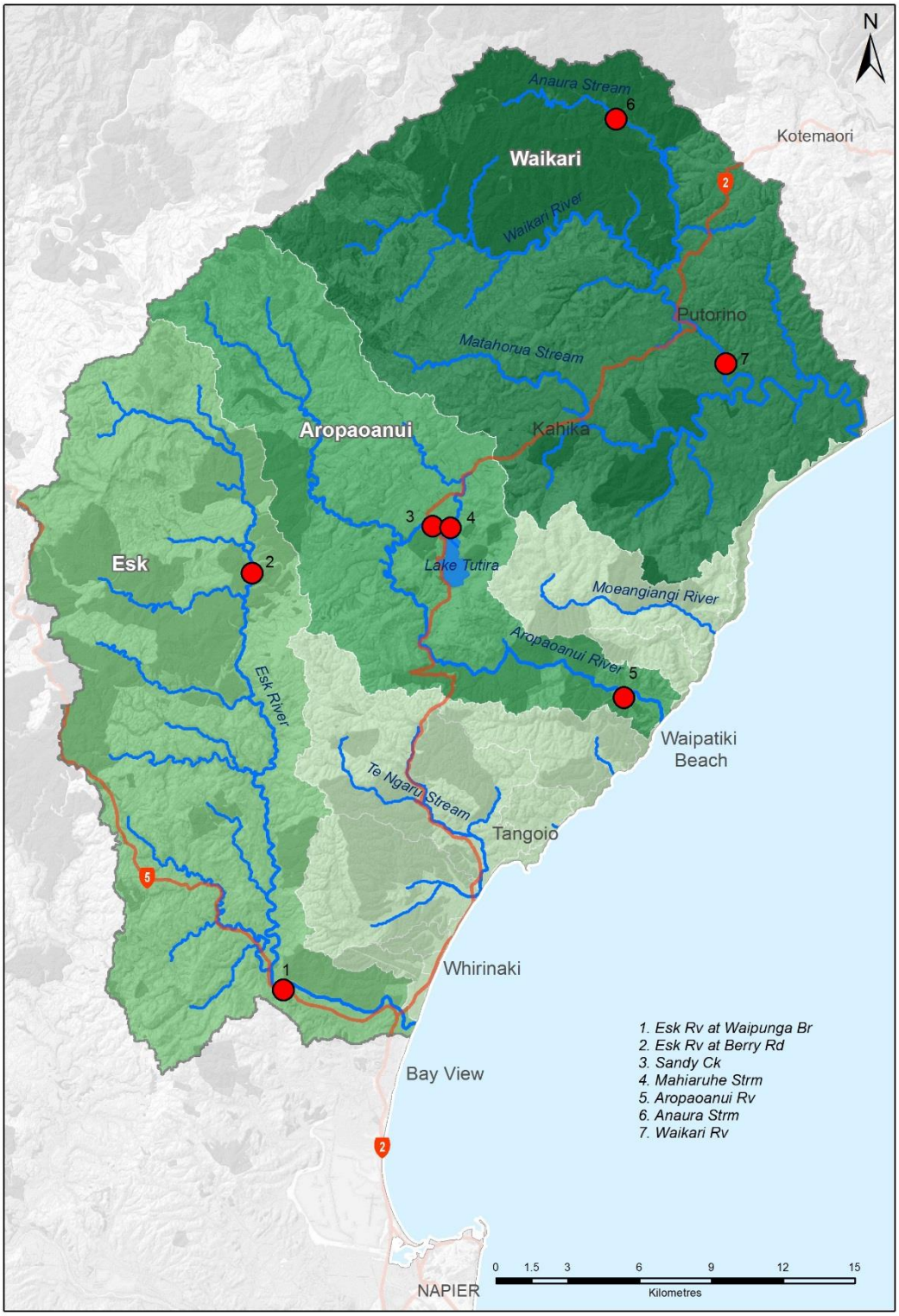



**Figure 1-1: SOE sites of the Esk, Aropaoanui and Waikari catchments referred to in this report.**

## 1.2 Land Use and Development

Some physical and land use characteristics of the Esk, Aropaoanui and Waikari catchments are summarised in Table 1-1. Information on flow and geology attributes was drawn from the River Environment Classification system (REC), which maps physical characteristics of New Zealand rivers (Snelder et al., 2010). This information reflects underlying geology and source of river water. Table 1-1 also includes the proportions of individual land cover types in the catchment, derived from the Land Cover Database (New Zealand) version 4 (LCDB4) (refer Appendix A for LCDB4 and LUC descriptions).

The upper reaches of the Esk River are classified as a cool wet hill river of volcanic acidic geology surrounded by pastoral land use, while the lower reaches are classified as warm wet low elevation miscellaneous geology with pastoral land use. These river environment classifications make the upstream site (Berry Rd) and the downstream site (Waipunga Rd) in many ways incomparable as it is expected that these reaches will have very river different environments for the biota they contain.

The Aropaoanui catchment sites (Sandy Creek, Mahiaruhe Stream and Aropaoanui River) are classified as warm wet low elevation miscellaneous geology pastoral streams, while the Waikari River is classified as a warm dry low elevation stream of soft sedimentary geology with pastoral landcover.

Records from the New Zealand Freshwater Fish Database (NZFFDB) show that the Esk catchment supports, koura, torrentfish, redfin bully, bluegill bully, common bully, giant bully, patiki (black flounder), inanga, koaro, banded kokopu, smelt, shortfin and longfin eels. In addition to this the Esk supports a healthy fishery of rainbow and brown trout.

The Aropaoanui and Waikari catchments also support many native fish species including longfin eel, shortfin eel, koura (freshwater crayfish), inanga, torrentfish, bluegill bully, and common bully. In addition to this the Aropaoanui River also supports the redfin bully, banded kokopu and patiki (black flounder) while the Waikari River supports giant bully, yellow eyed mullet, and estuarine triple fin. Both catchments support an average stock of rainbow trout and because they're not considered to be regionally significant fisheries, they are assessed against criteria for 'fisheries of lesser significance'. These catchments have value as an eel fishery (Stansfield, 2009).

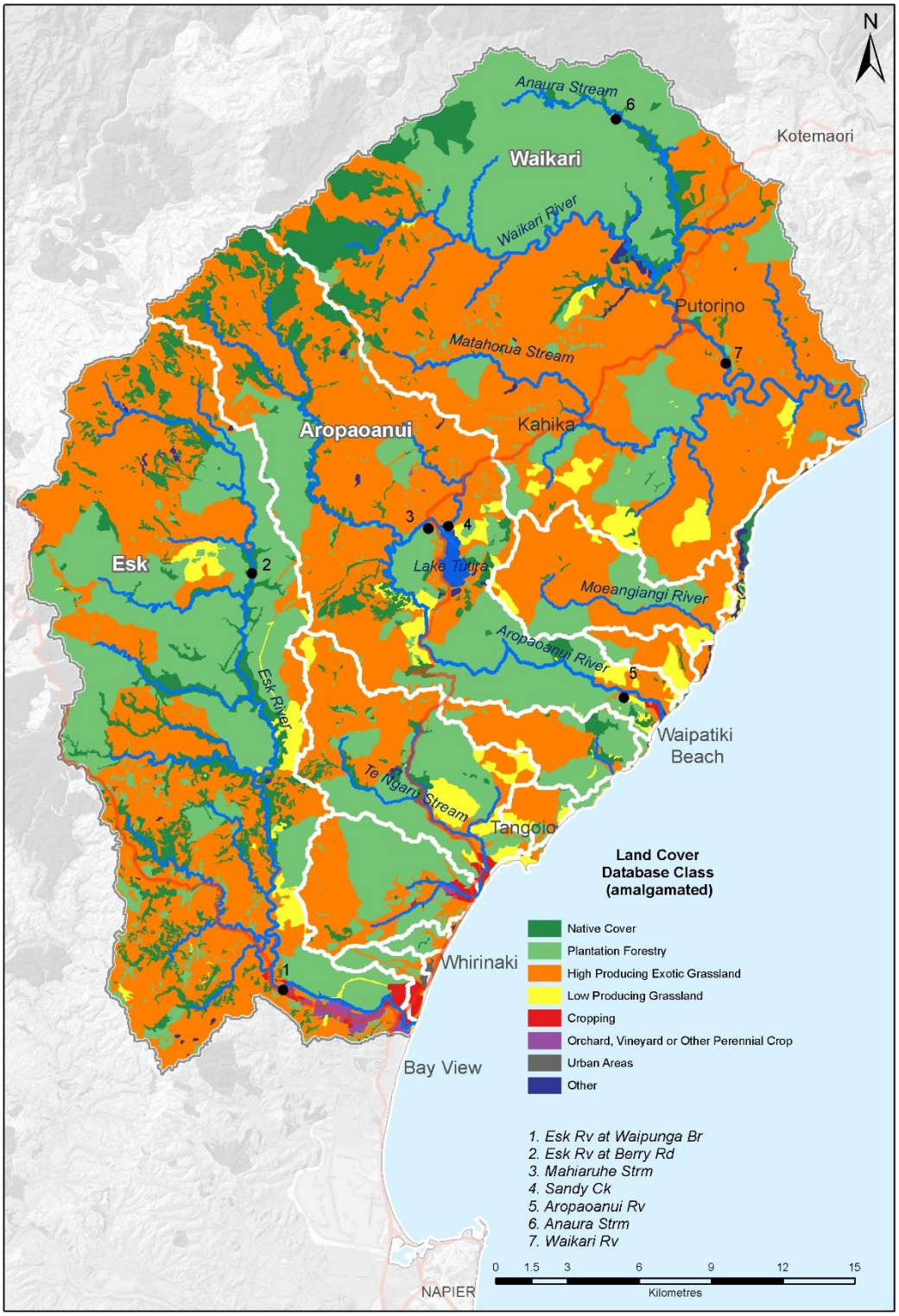



**Figure 1-2: Esk, Aropaoanui and Waikari Land cover database classes.**

**Table 1-1: Catchment characteristics of the Esk, Aropaoanui and Waikari catchment zones.** Information has been taken from the River Environment Classification (REC), the Land Cover Data Base (New Zealand) version 4 (LCDB4) and Agribase.

| Zone | Source of flow (REC) | Geology (REC) | Land cover (LCDB4) | Land Use Capability Class (LUC) |
|---|---|---|---|---|
| Esk Catchment<br><br>Total catchment area<br><br>26785.5 ha | Warm wet (55%)/ Warm dry (8%)/ Cool wet (6%) climate with flow originating from lowland country, and<br><br>Cool wet (26%)/ Warm wet (1%) climate with flow originating from hill country, and<br><br>Cool wet (4%) climate with source of flow originating from mountain country. | Miscellaneous 55%<br>Volcanic acidic 42%<br>Soft sedimentary 2%<br>Alluvium 0.5%<br>Hard Sedimentary 0.5% | Native Cover 14%<br>Plantation forestry 33%<br>High producing 48%<br>Low producing 3%<br>Orchards/Vineyards 1%<br>Cropping 1%<br>Urban areas 0% | Class 1 0%<br>Class 2 3%<br>Class 3 4%<br>Class 4 10%<br>Class 6 66%<br>Class 7 15%<br>Class 8 2%<br>Lake 0%<br>River 0%<br>Town 0% |
| Aropaoanui catchment<br><br>Total catchment area<br><br>16809 ha | Warm wet (59%) / Cool wet (1%) climate with flow originating from lowland country, and<br><br>Cool wet (35%) / Warm wet (1%) climate with flow originating from hill country, and<br><br>Cool wet (2%) climate with flow originating from mountain country, and | Miscellaneous 54%<br>Volcanic acidic 23%<br>Soft sedimentary 21%<br>Hard sedimentary 1.5%<br>Alluvium 0.5% | Native Cover 13%<br>Plantation forestry 29%<br>High producing 53%<br>Low producing 4%<br>Orchards/Vineyards 0%<br>Cropping 0%<br>Urban areas 0% | Class 1 0%<br>Class 2 1%<br>Class 3 3%<br>Class 4 13%<br>Class 6 57%<br>Class 7 21%<br>Class 8 3%<br>Lake 1%<br>River 0%<br>Town 0% |

| | | | | |
|---|---|---|---|---|
| | Warm wet (2%) climate with flow originating from lakes. | | | |
| Waikari Catchment<br><br>Total catchment area<br><br>32495 ha | Warm wet (67%)/ Warm dry (4%) climate with flow originating from lowland country, and<br><br>Cold wet (28%) climate with flow originating from hill country | Miscellaneous 52%<br>Soft sedimentary 29%<br>Volcanic acidic 18% | Native Cover 9%<br>Plantation forestry 31%<br>High producing 57%<br>Low producing 3%<br>Orchards/Vineyards 0%<br>Cropping 0%<br>Urban areas 0% | Class 1 0%<br>Class 2 0%<br>Class 3 8%<br>Class 4 6%<br>Class 5 0%<br>Class 6 73%<br>Class 7 11%<br>Class 8 1%<br>Lake 0%<br>River 0%<br>Town 0% |

# 2 Methodology and Rationale

## 2.1 Sampling

Water quality monitoring in the Waikari, Aropaoanui and Esk 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. Seven sites are sampled in the Waikari, Aropaoanui and Esk river catchments as part of the SOE monitoring programme.  shows the location of the SOE monitoring sites that are discussed in this report.

Water quality indicators routinely measured across SoE monitoring sites include the following field-based measurements:

- Turbidity (NTU)
- Visual clarity (as black disc sighting distance)
- Dissolved oxygen (mg/l)
- Conductivity (μS/cm)
- pH
- Water temperature ($^{o}$C)

Macroinvertebrate samples were collected according to the Stark et. al. (2001) 'Protocol C2 – soft-bottomed, semi-quantitative' or 'Protocol C3 – hard bottomed, quantitative', depending on whether the sediment characteristics at a site were hard (e.g. gravels and cobbles) or soft bottomed (e.g. silt with macrophytes). Five replicate 0.1m surbers were taken at riffles in hard bottomed sites. A 0.3m$^2$ D-net, scooped 3 times through key habitat features, was used at soft bottomed sites. For calculating metrics, all samples were assessed according to the hard bottomed MCI taxon scores, because there is uncertainty around whether soft-bottomed metrics can be compared with the hard-bottomed metrics (Unwid and Larned, 2013). The vast majority of SOE sites in the region where macroinvertebrate samples are collected are hard-bottomed, and so hard bottomed metrics were used for consistency.

Visual periphyton assessments were introduced to the programme in 2011 and are undertaken at most sites, subject to flow conditions and substrate type. Periphyton biomass estimates (as chlorophyll-*a*) are made from rock scrapes that are collected during the visual assessment. The method is a modification of Biggs and Kilroy (2000), and involves using an underwater viewer to estimate the proportional cover of different algal growth forms in 20 quadrats randomly distributed in the wadeable, hard-bottomed sections of the sites. When possible, 5 quadrats are distributed along 4 transects that traverse the width of the waterway. However, for logistical reasons, the distribution of quadrats is adjusted at deeper and/or faster flowing sites. A single rock is taken from each of these 20 quadrats, and analysed for periphyton biomass following the QM-1B method outlined in Biggs and Kilroy (2000).

Water samples are collected at each site and kept in chilled containers while being freighted overnight to RJ Hill Laboratories in Hamilton, where they are analysed for total and dissolved nutrients (nitrogen and phosphorus), suspended solids, and faecal bacteria (as *E. coli*).

## 2.2 Water Quality Guidelines

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. In the following analysis, several environmental guidelines (Table 2-1) are used to provide context for the observations made in the Esk, Aropaoanui and Waikari catchments. These guidelines are not intended to represent standards or limits for the quality of freshwater bodies, but are included for context. The various trigger values and guidelines referred to in this report are discussed in the following paragraphs.

The 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 80$^{th}$ percentile or 20$^{th}$ percentile values for the data range in the NRWQMN. The main aim of the ANZECC guidelines is 'to provide an authoritative guide for setting water quality objectives required to sustain current, or likely future, environmental values for natural and semi-natural water resources in Australia and New Zealand' (ANZECC 2000).

In the development of the ANZECC (2000) trigger values, Davies-Colley (2000) states: 'running 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 Protection Guidelines are the most up-to-date assessment of nitrate toxicity. They also provide guidance on nitrate concentration thresholds, both as annual median and annual concentration peaks (95$^{th}$ percentile), for managing nitrate toxicity risk.

Hay et al. (2006) identified several 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 their One Plan.

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

The HBRC (2006) Regional Resource Management Plan (RRMP) identifies several water quality guidelines for nutrients and other water quality variables, including the limit for dissolved oxygen saturation (Table 2-2). This limit also aligns with the limit identified in the RMA 1991 for the protection of trout fisheries.

**Table 2-1: Summary of water quality guidelines for attributes observed in the Esk, Aropaoanui and Waikari catchments.**

| Variable[1] | Guideline / Trigger | Source |
|---|---|---|
| TN – ANZECC Lowland | 0.614 mg/l | ANZECC (2000) |

[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 (CFU) / 100ml; MCI = Macroinvertebrate Community Index; DO% saturation = % dissolved oxygen saturation.

| Variable[1] | Guideline / Trigger | Source |
|---|---|---|
| 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 – Tukituki Plan Change 6 | 0.800 mg/l | HBRC (2014) |
| 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 (2013) |
| $NO_3$-N Toxicity '95% species protection' | < 2.4 mg/l | Hickey (2013) |
| $NO_3$-N Toxicity '99% species protection' | < 1.0 mg/l | Hickey (2013) |
| Clarity – contact recreation | > 1.6 m | ANZECC (2000); HBRC RRMP 2006 |
| Clarity – 'Significant' trout fishery | > 3.5 m | Hay and Hayes (2006) |
| Clarity – 'Outstanding' trout fishery | > 5.0 m | Hay and Hayes (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) |
| Periphyton biomass – biodiversity | < 50 mg/$m^2$ | Biggs (2000) |
| Periphyton biomass – aesthetic/recreation | < 120 mg/$m^2$ | Biggs (2000) |
| MCI 'Outstanding' trout fishery; Excellent quality | > 120 | Hay and Hayes (2006); Stark and Maxted (2007) |
| MCI 'Significant' trout fishery; Good quality | > 100 | Hay and Hayes (2006); Stark and Maxted (2007) |
| DO % saturation – protection of trout fisheries | > 80% | RMA (1991); HBRC RRMP 2006 |

**Table 2-2: HBRC Regional Resource Management Plan (2006) water quality limits – "Environmental Guidelines – Surface Water Quality". 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 2-2 apply "at or below median flows".**

| 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 nitrogen ($NH_4$-N) should not exceed 0.1 mg/l |

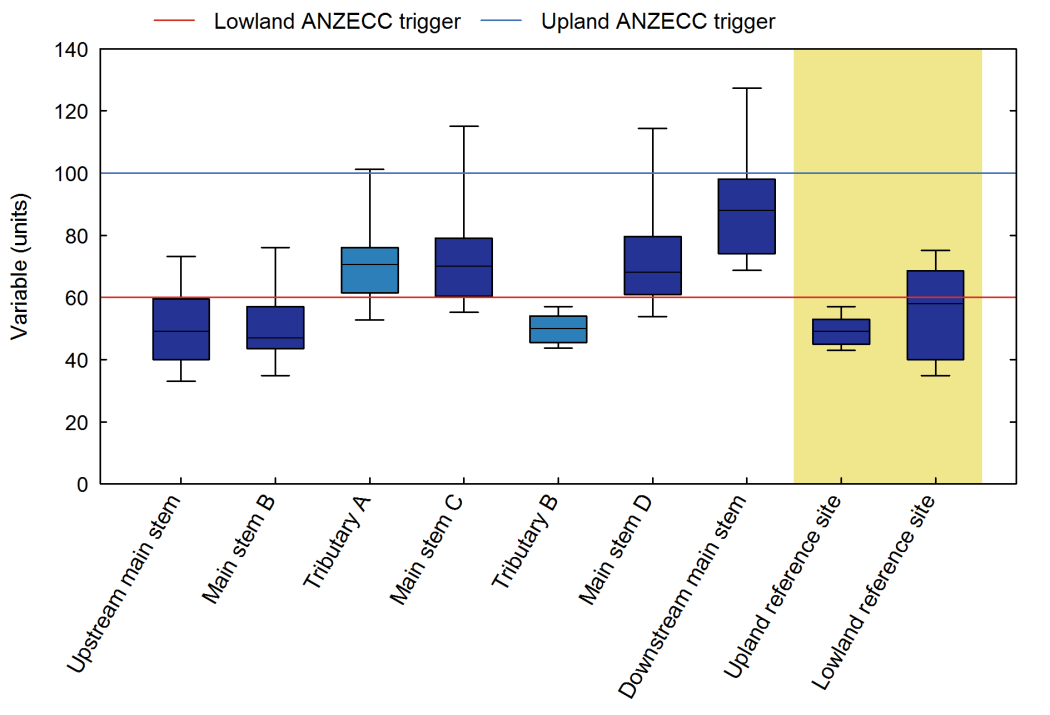
[2] These guidelines apply after reasonable mixing and disregarding the effect of any natural perturbations that may affect the water body, as set out in Policy 72 of the HBRC RRMP 2006 that states that the guidelines for the variables included in Table 2-2 apply "at or below median flows".

| Variable | Guideline[2] |
|---|---|
| Dissolved reactive phosphorus | The concentration of dissolved 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 |

## 2.3 Data Summaries and Visualisations

Box plots have been used throughout Section 3 to summarise water quality data. The sites are ordered from right to left in ascending order based on distance from the sea along the river channel. Sites are grouped by their position in the same major sub-catchment. For example, the Waikari River monitoring site is closer to the sea than the Anaura Stream, so the Waikari River site appears to the right of the Anaura Stream monitoring site in the graph.

**KEY POINT:** Box plots graph data as a box representing statistical values. The lower boundary of each box indicates the 25$^{th}$ percentile, a line within the box marks the median, and the higher boundary of each box indicates the 75$^{th}$ percentile (the box represents the interquartile range). The line at the end of the whiskers (error bars) above and below the box indicate the 90$^{th}$ and 10$^{th}$ percentiles respectively, i.e. the whiskers represent the interdecile range.




Water quality data are shown on catchment maps, based on the median value of observations taken over the last 5 years for the water quality indicator in question (from January 2009 to December 2013). The catchment maps include arrows indicating the direction of statistically significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a horizontal dash

did not exhibit a statistically significant trend. No symbol (arrow/horizontal dash) indicate sites where the required 8 years of data record between 2004 and 2013 were not available (Section 2.4 below).

Tables of summary statistics in Appendix B provide additional context to the changes in water quality indicators under differing flow conditions. For example, 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).

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

## 2.4 Trend Analyses

Trend analysis of environmental monitoring data through time is important because environmental characteristics may exhibit trends which indicate particular issues are changing in significance. 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 (seasonal Kendall trend tests). This approach is consistent with the approach used in recent nationwide water quality analyses undertaken for the Land and Water Aotearoa (LAWA) project (LAWA, Ballantine, 2012). LAWA is a national initiative that collects and analyses environmental datasets from all regional councils around New Zealand, including river water quality. LAWA presents trend results for many of the same sites presented in this technical report, and so it was appropriate to use the same trend analyses.

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? A 'significant' trend exists where there is a less than 5% probability ($p< 0.05$) that the observed data were obtained by chance.

Some sites had a long term monthly record, but others only had monthly sampling for the latter part of the record, but quarterly sampling earlier. For these latter sites, the record was resampled with 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 different time periods. For this reporting, we adopted an 8 out of 10 year requirement, in which any datasets with samples from at least 8 years of time period between January 2004 and December 2013 were considered comparable.

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

To estimate the strength of trends over time, an adaptation of the Theil-Sen slope estimator was used, the 'seasonal sen slope estimator' (SSSE). The SSSE estimates the median slope amongst lines through all pairs of points in the dataset, on a seasonal basis. 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 SSSE 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 (e.g., 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 increase or decrease in a water quality variable. The cause of water quality trends can be difficult to identify from SOE monitoring alone, but possible explanations of observed patterns are provided where appropriate. When possible, trends at impacted sites are compared to trends at reference sites. This is to explore whether any potentially concerning trends may be due to natural patterns, rather than assuming they are anthropogenic. But, trends detected during SOE analyses are often difficult to explain without further investigations being undertaken, and hence a concerning trend identified during analyses of SOE data serves as a prompt to undertake further work to identify the drivers of such trends.

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 fewer than 8 years of data are presented in Appendix C, and the different time period noted.

# 3 Results and Discussion

## 3.1 Total Nutrients (TN and TP)

Nitrogen (N) and phosphorus (P) are key 'growth limiting' nutrients that influence the growth rate and biomass of algae (or periphyton) and aquatic plants. Low availability of these two nutrients often limits plant biomass development (Mathieson 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, but is often 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 they are key elements in proteins and DNA. DIN includes nitrogen in the form of nitrate, nitrite and ammoniacal nitrogen. DRP includes orthophosphates, the filterable fraction of total phosphorus. 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 growths in rivers. The terms total nitrogen (TN) and total phosphorus (TP) 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, because even the less 'available' forms of these nutrients can be recycled and become available in these slower flowing habitats, where there is more time for biology to use the nutrient pool before it gets 'flushed' through the system. At sufficiently elevated concentrations, nitrate and ammonia forms of nitrogen can 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).

Figure 3-1 and Figure 3-2 are box-plots of total nitrogen (TN) and total phosphorus (TP) concentrations for SOE monitoring sites across the Waikari, Aropaoanui and Esk catchments. ANZECC trigger levels are included on the plots for upland (> 150 m altitude) and lowland sites (< 150 m altitude). Using the ANZECC guidelines criterion, 4 of the 7 SOE sites (Esk River at Berry Rd, Esk River at Waipunga Bridge, Aropaoanui River and Waikari River) are classified lowland, with the remaining 3 sites classified as upland sites (Sandy Creek, Mahiaruhe Stream and Anaura Stream).

The Anaura Stream, in the upper Waikari catchment had the lowest median TN concentrations of all 7 sites (0.189 mg/l in the Anaura Stream) and was better than the relevant ANZECC trigger value for upland rivers. The Waikari River main stem had higher median TN concentrations than the Anaura Stream, although it was still better than its relevant (lowland) ANZECC trigger value.

In the Aropaoanui catchment, the two upland sites, had the highest TN concentrations of all 7 sites (0.700 mg/l for Sandy Creek and 0.670 mg/l for Mahiaruhe Stream), in excess of both the upland and lowland ANZECC trigger values. Median TN concentration in the lower Aropaoanui River main stem was lower than in the tributaries and was better than the lowland ANZECC trigger value.

In the Esk River, the upper and lower river monitoring sites had very similar median TN concentrations, and both were better than the ANZECC trigger value for lowland rivers.

TN concentrations in all 3 catchments were generally higher than those seen at the Mohaka and Ngaruroro reference sites.

Significant and meaningful trends in TN concentrations were detected over the 10 year period 2004-2013, at Berry Road on the upper Esk River, where an annual average improvement of 2% was observed, and at Anaura Stream in the upper Waikari catchment where an annual average improvement of 15% was seen (). A deterioration (increase) was observed at Mahiaruhe Stream in the upper Aropaoanui River catchment (3% per annum). No changes (improvements or deterioration) were seen at any of the remaining sites in these three catchments.

Sites in the Esk, Aropaoanui and Waikari catchments ranked in the middle of the SOE monitoring sites for the Hawke's Bay region (Refer Appendix D).

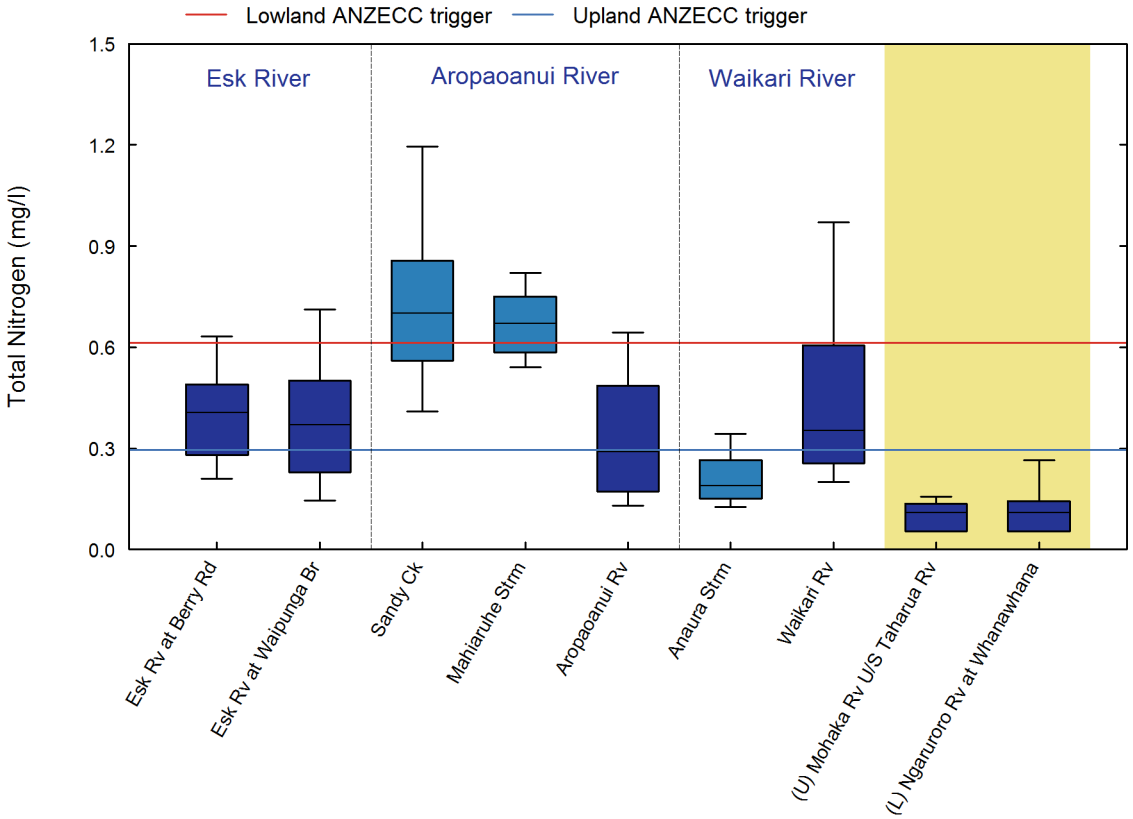



**Figure 3-1: Total nitrogen (TN) concentrations at SOE monitoring sites.** SOE sites for the Mohaka River upstream (U/S) Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the ANZECC (2000)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

Median Total Phosphorus (TP) concentrations in the Esk, Aropaoanui and Waikari catchments followed patterns similar to those observed for TN. The lowest TP concentrations occurred in the Anaura Stream in the upper Waikari catchment, with slightly higher concentrations in the lower Waikari River. Both sites were better than their relevant ANZECC trigger values (Figure 3-2).

Sandy Creek and the Mahiaruhe Stream had the highest TP concentrations of all 7 sites (0.072 and 0.058 mg/l, respectively), well over ANZECC trigger values. The lower site on the Aropaoanui River had much lower TP concentrations and was better than the lowland ANZECC trigger value.

The Esk River sites had very similar patterns of TP concentrations as their TN concentrations, and both meet the lowland ANZECC trigger value.

Apart from the Anaura Stream (which ranks in the top 15%), sites in the Esk, Aropaoanui and Waikari catchments rank in the bottom 40% of the region for TP (Appendix D). Mahiaruhe Stream and Sandy Creek rank particularly poorly, at 90$^{th}$ and 94$^{th}$ respectively, out of 104 regional sites.

Improving trends (decrease) in TP concentrations were observed at 3 sites and no deterioration was seen at any sites within the 3 catchments (Appendix C). Improvements in TP were seen in the Esk River at Berry Road (3.5% annual decrease), the Aropaoanui River (3% annual decrease), and at Anaura Stream (8.6% annual decrease).

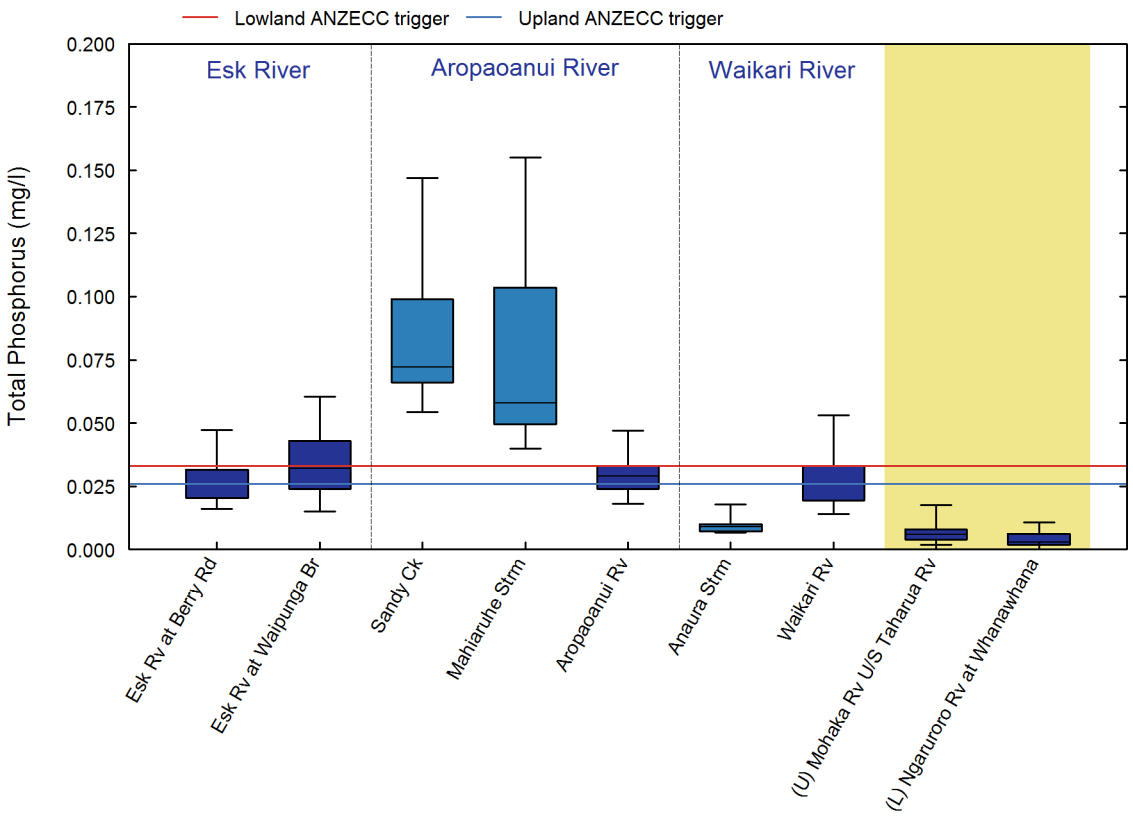



**Figure 3-2: Total phosphorus (TP) concentrations at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the ANZECC (2000) 'Upland'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

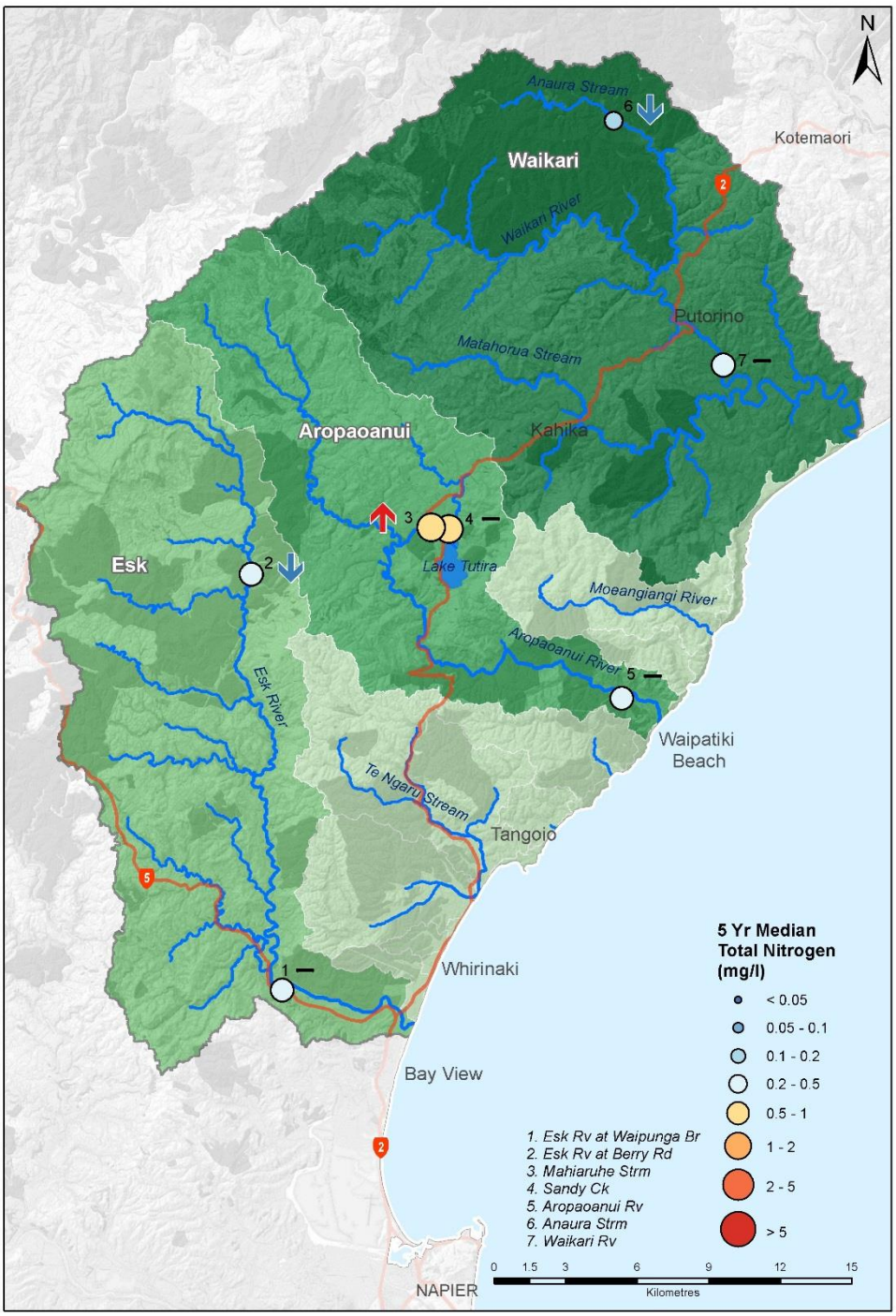



**Figure 3-3: 5 year median and trends in total nitrogen (TN) concentrations at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

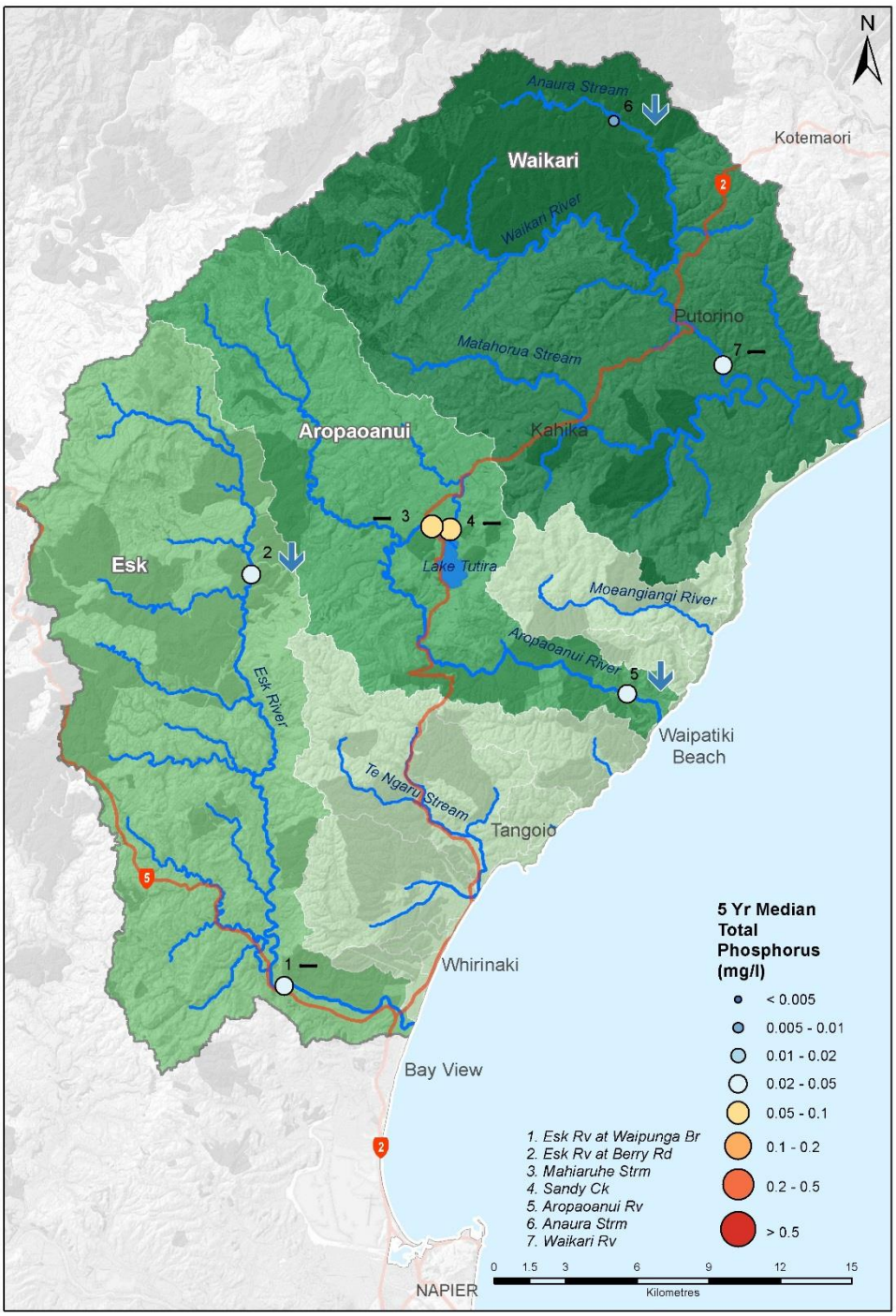



**Figure 3-4: 5 year median and trends in total phosphorus (TP) concentrations at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

## 3.2 Dissolved Nutrients (DIN and DRP)

Dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) concentrations were also examined at SOE monitoring sites across the Esk, Aropaoanui and Waikari catchments.

As discussed in the 'Key Point' on Page 18, DIN and DRP are important because they represent the 2 most significant nutrients that stimulate or limit periphyton growth, since they are immediately available to fuel plant and algal growth (they are 'bioavailable'). By contrast, forms of nitrogen and phosphorus such as organic nitrogen and particulate phosphorus, are not immediately available to algae and plants and need to decompose through processes such as re-mineralisation to become bio-available.

In situations where other growth constraints such as long periods of low flow and high light availability are less significant, increases in DIN and DRP supply can lead to increased periphyton growth and eutrophication of a waterway. For this reason, setting nutrient concentration guidelines or standards is generally used as a way to guide the actions necessary to maintain periphyton growth below acceptable levels. However, because DIN and DRP are immediately available to plants, they can be removed from the water rapidly, for example during summer low flows. This means DIN and DRP concentrations may be a poor indicator of eutrophication status.

Since periphyton require hard substrate to attach to, excessive periphyton growth is unlikely in soft-bottomed rivers such as Sandy Creek, or the Mahiaruhe Stream, regardless of dissolved nutrient concentrations.

The pattern of DIN concentration in the 3 catchments followed a very similar pattern to that of TN. Median DIN concentrations for lowland sites (Esk River sites, Aropaoanui and Waikari rivers) were better than the relevant ANZECC trigger value for lowland rivers. However of the upland sites, only the Anaura Stream was better than the ANZECC trigger value for upland rivers. Sandy Creek and the Mahiaruhe Stream had the highest concentrations of all 7 sites, and exceeded both the ANZECC trigger value for upland rivers. They also exceeded the concentration likely to begin to limit periphyton growth rates (Biggs, 2000) (orange line on Figure 3-5).

With the exception of the Anaura Stream, DRP concentrations were moderate to high at all sites and exceeded relevant ANZECC trigger values for both upland and lowland rivers (Figure 3-6). Within catchments, DRP patterns similar to TP patterns were observed, with lower concentrations in the lower Aropaoanui River main stem than in its tributaries, comparable concentrations in the upper and the lower Esk River sites, and higher concentrations in the Waikari River main stem than in its tributary, the Anaura Stream. Sandy Creek and the Mahiaruhe Stream again had the highest DRP concentrations of all 7 sites and largely exceeded both the upland and lowland ANZECC trigger values.

Improvements in DIN concentrations over time were seen at Aropaoanui River (4.6% annual decrease), and at both the Anaura Stream and Waikari River in the Waikari catchment (22.8% and 3.4% annual decreases, respectively) (Figure 3-7, Appendix C). No significant changes were observed at the remaining sites.

In contrast, no significant changes (improvements or deterioration) in DRP concentrations were seen at any of the 7 monitoring sites.

Apart from the Anaura Stream (which ranked in the top 10%), sites in the Esk, Aropaoanui and Waikari catchments ranked in the middle of the SOE monitoring sites for the Hawke's Bay region for DIN (Refer Appendix D).

Rankings within the region for DRP were lower than for DIN. The Anaura Stream still ranked at the top of sites within these catchments (but at 26$^{th}$ out of 104, compared with 8$^{th}$ for DIN), while remaining sites ranked

in the bottom 40% for the region (Refer Appendix D). The two Lake Tutira sites, Mahiaruhe Stream and Sandy Creek, also ranked the lowest of catchment sites for both DIN (63rd and 67th, respectively out of 104) and DRP (83rd and 92nd, respectively out of 104).

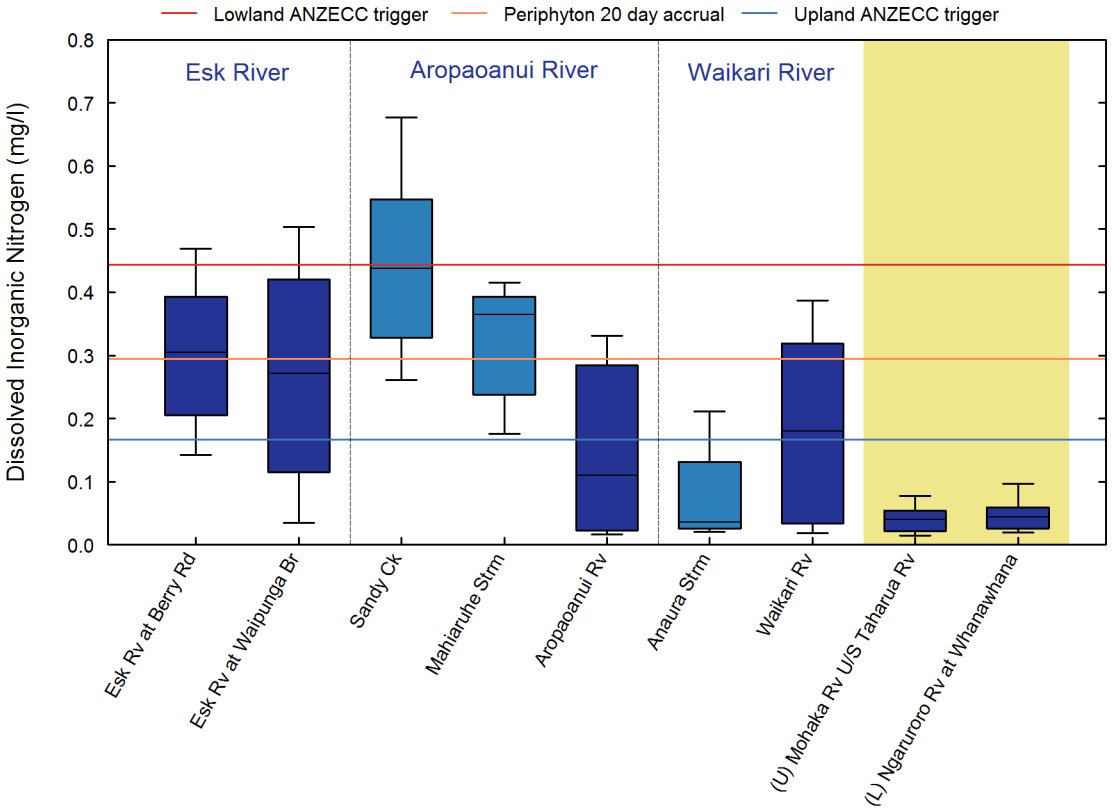



**Figure 3-5: Dissolved inorganic nitrogen (DIN) concentrations at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the ANZECC (2000) 'Upland' DIN trigger value; the orange line 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.

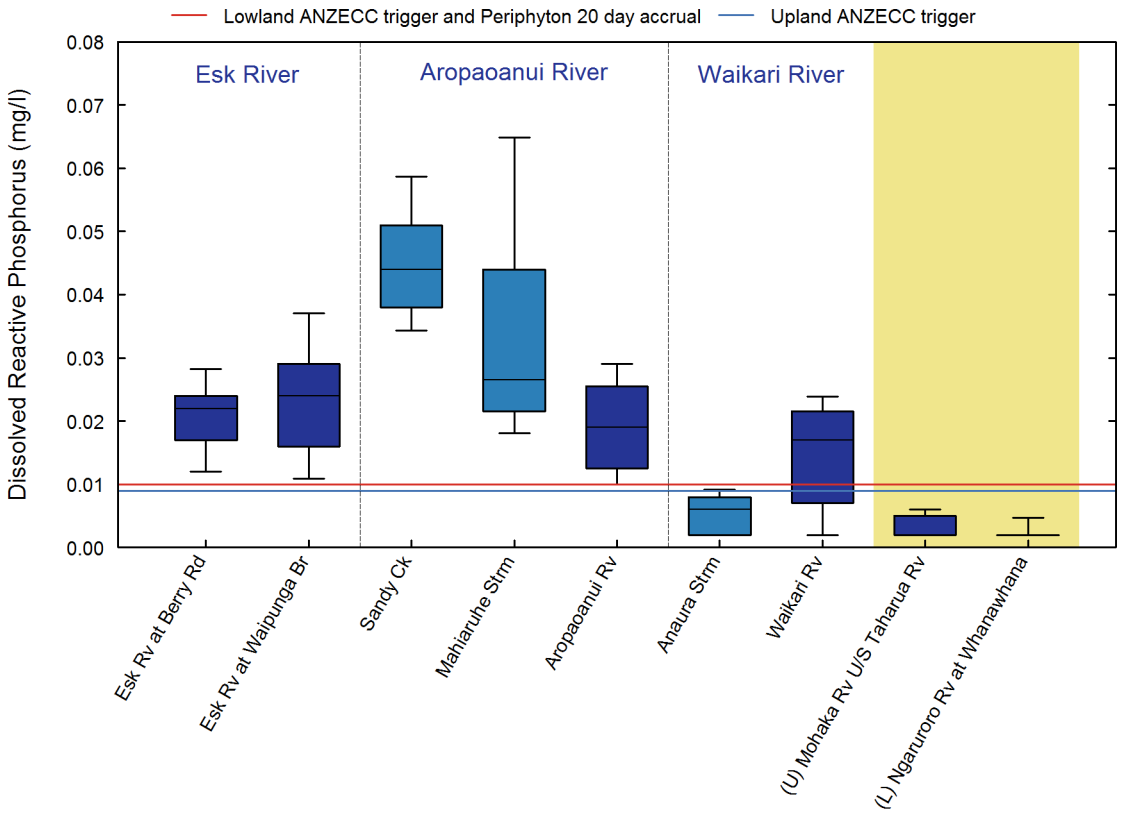



**Figure 3-6: Dissolved reactive phosphorus (DRP) concentrations at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the ANZECC (2000) 'Upland' DRP trigger value; the red line 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.

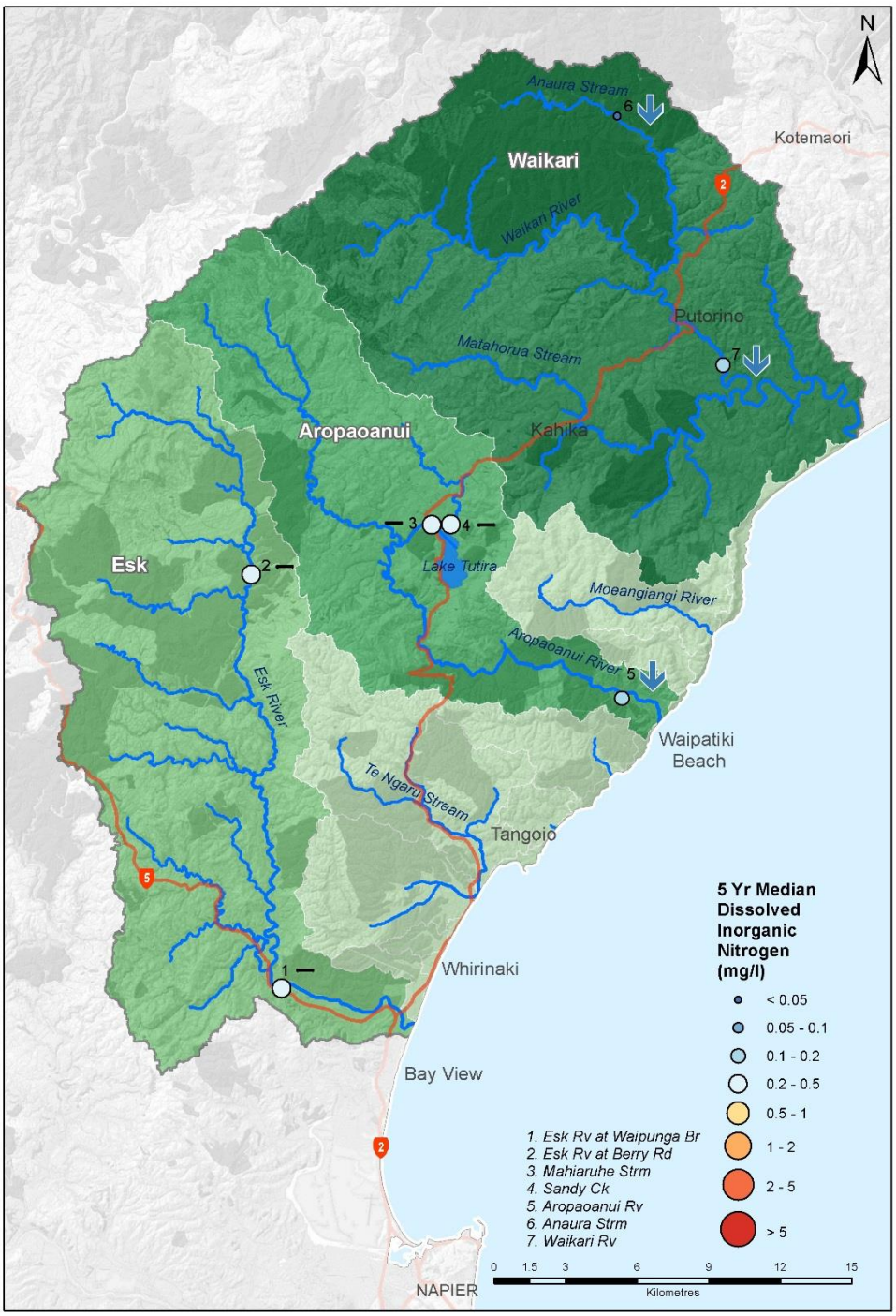



**Figure 3-7: 5 year median and trends in dissolved inorganic nitrogen (DIN) concentrations at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

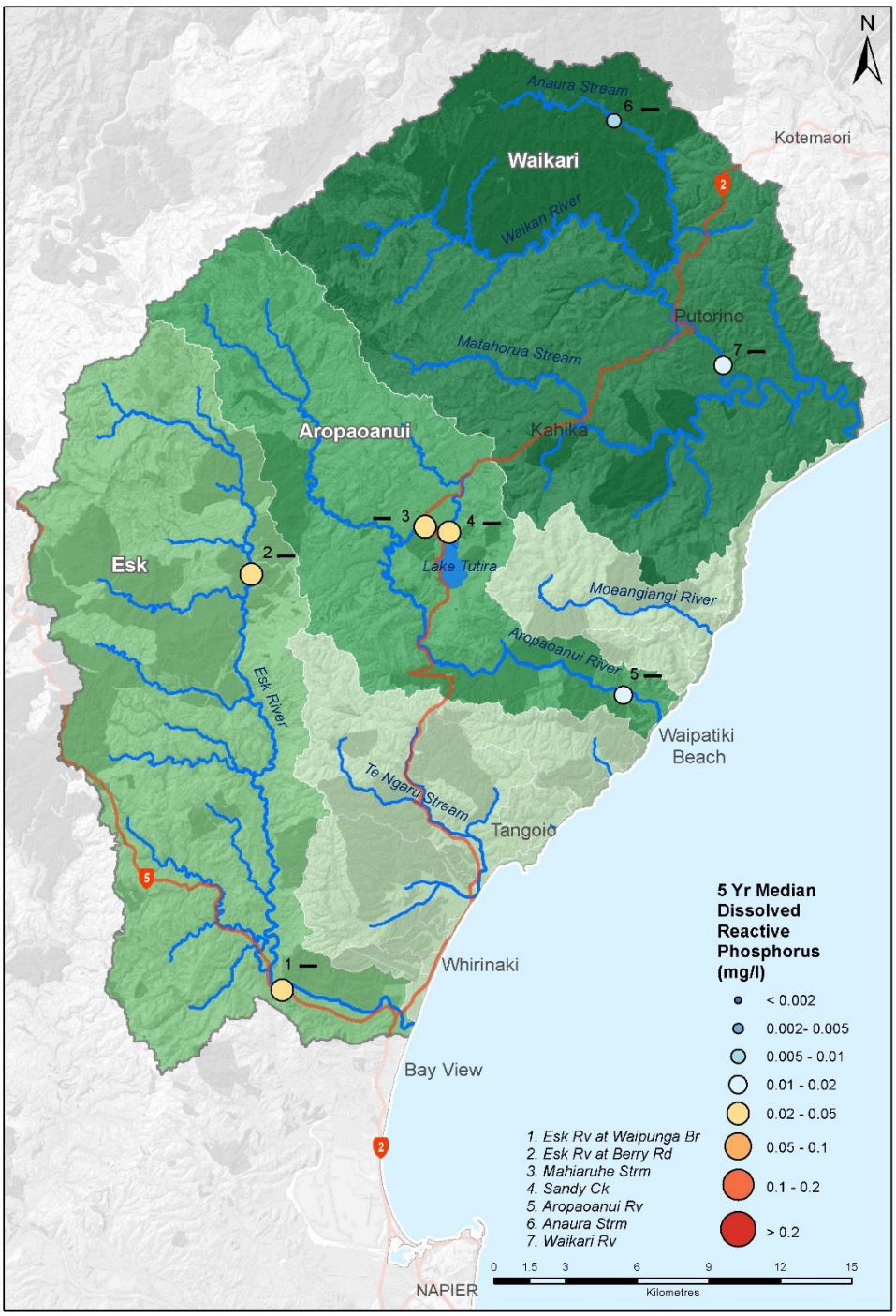



**Figure 3-8: 5 year median and trends in dissolved reactive phosphorus (DRP) concentrations at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

A plot of DIN/DRP ratios (Figure 3-9) indicates that all sites in the Esk, Aropaoanui and Waikari catchments, except the Aropaoanui River and the Anaura Stream, had nutrient ratios indicative of co-limited conditions. The DIN/DRP ratios indicate that nitrogen-limited conditions were likely at times in the Aropaoanui River, whilst a mix of co-limited and P-limited conditions were likely in the Anaura Stream. Further analysis of the nutrient ratios as a function of river flow would be useful to better understand the timing of the different nutrient limitation conditions in these streams.

It should be noted that nutrient ratios should be considered in parallel with the actual nutrient concentrations, to provide an indication of the likely strength of any nutrient limitation. For example, in Sandy Creek and the Mahiaruhe Stream, concentrations of both DIN and DRP are elevated, meaning that any nutrient limitation is likely to be very weak or absent (unlimited conditions). By contrast, nutrient concentrations in the Aropaoanui, Esk and Waikari Rivers were low to moderate, meaning that actual co-limited conditions are likely to dominate at these sites. Similarly, nutrient limitation of periphyton growth (a mix of co- and P-limited conditions) is likely to be strong in the Anaura Stream.

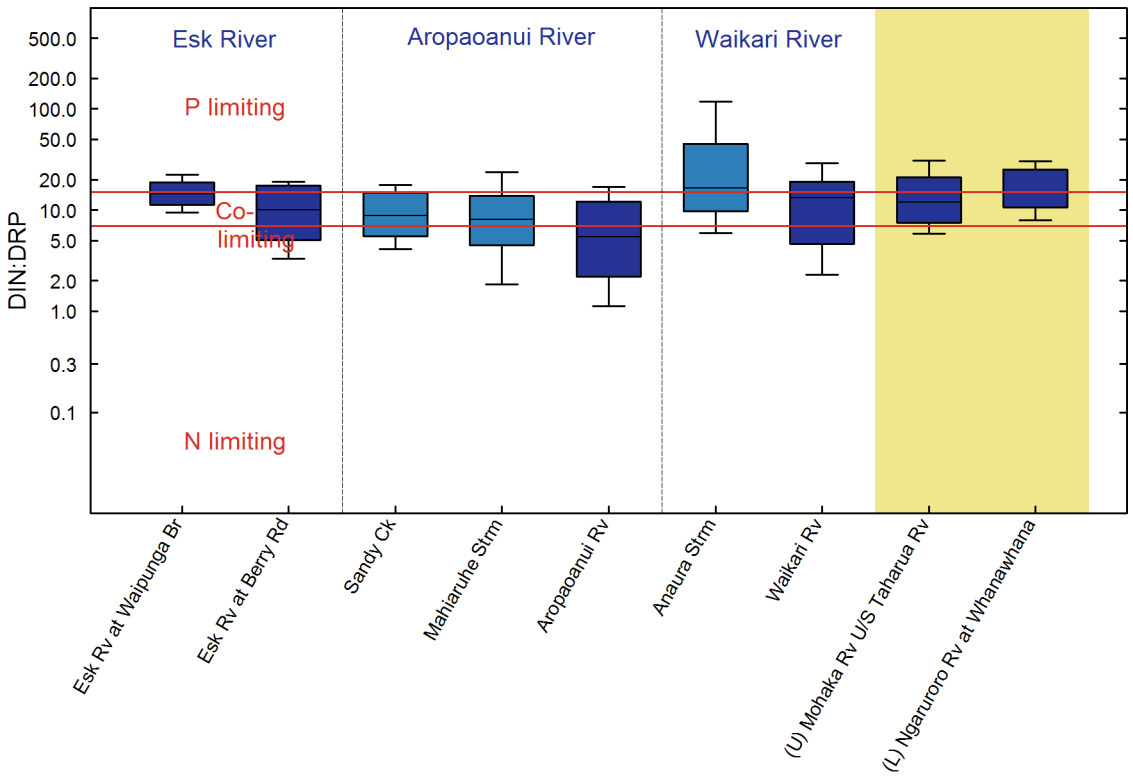



**Figure 3-9: DIN/DRP ratio for SOE monitoring sites.** Red lines indicate DIN:DRP ratios indicative of P-limiting conditions (above 20), N-limiting conditions (below 7.5). Ratios between 7.5 and 20 are generally inconclusive or may indicate that nutrient limitation may "switch" between the two nutrients at different times of the year/ flows

## 3.3 Risk of toxic effects – Ammoniacal nitrogen

Ammoniacal nitrogen can be toxic to many aquatic species, and is a common pollutant in treated domestic, agricultural and industrial wastewater discharges. In aqueous solution, ammoniacal nitrogen exists in 2 chemical forms: the ammonium cation ($NH_4^+$) and un-ionised ammonia ($NH_3$). The respective proportion of these forms is determined by a chemical equilibrium governed by pH and temperature. The higher the pH and temperature, the higher the proportion of un-ionised ammonia. Un-ionised ammonia is the most toxic form to aquatic life, and ammonia toxicity increases with pH and temperature. The ANZECC (2000) guidelines define trigger values of 0.900 mg/l of total ammoniacal nitrogen for the 95% species protection level and 0.320 mg/l for the 99% species protection level. These trigger values are provided at pH 8 and temperature 20°C. The guidelines also provide tables and formulas to calculate the concentration of total ammoniacal nitrogen corresponding to this threshold under different temperature and pH conditions. The 95% species protection level is the "default" protection level defined in the ANZECC Guidelines, applicable to slightly to moderately disturbed systems, whilst the 99% protection level is applicable to "High conservation/ecological values" systems.

All the SOE monitoring sites in the Esk, Aropaoanui and Waikari drain developed catchments, and the approach taken in this report is that the "default" 95% protection level should be applicable to all sites.

Total ammoniacal nitrogen concentrations at all sites were always low, far better than both the 99% and the 95% protection level trigger values ( Appendix B), thus the risk of toxic effects from ammonia can be considered low at all SOE monitoring sites in the Esk, Aropaoanui and Waikari catchments.

The only significant and meaningful trend through time in total ammoniacal nitrogen concentrations was identified at Sandy Creek over the 5 years between 2009 and 2013, with a 5.6% average decrease (improvement) per year (Appendix C).

## 3.4 Risk of toxic effects – Nitrate nitrogen

At high concentrations, nitrate can be toxic to aquatic animals (Hickey and Martin, 2009). The 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 outside New Zealand, although some of the species are now resident in New Zealand. No native New Zealand species were included in the 2009 review (Hickey, 2013b).

To assist with the development of a set 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 native species, including Inanga, *Deleatidium* mayfly and early life stages (eggs and early life stages) 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 the New Zealand trials;
- Support the development of nitrate-nitrogen toxicity guidelines applicable to the Hawke's Bay region.

DIN (discussed in the previous section) 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 component of DIN in areas affected mainly by diffuse-source discharges and in catchments with limited areas of wetland with anoxic soils, as in the Esk, Aropaoanui and Waikari catchments. Nitrate-nitrogen concentrations in all three catchments (Figure 3-10) were similar to DIN concentrations (Figure 3-5) with nitrate-nitrogen contributing to over 80% of the dissolved inorganic nitrogen.

All monitoring sites in the Esk, Aropaoanui and Waikari catchments had median nitrate-nitrogen concentrations ranging from 0.079 to 0.370 mg/l, well below any toxicity threshold defined by Hickey (2013), i.e. a median concentration of 1.0 mg/l for the 99% species protection level, indicating minimal risk of toxic effects to aquatic life (Figure 3-10).

Trend analyses of these SOE monitoring sites showed improvements (decreases) in nitrate-nitrogen at the 2 sites in the Waikari catchment but no change at any of the sites within the other two catchments.

Comparison with other SoE monitoring sites in the Hawkes's Bay region showed Esk, Aropaoanui and Waikari catchment sites ranked similarly to DIN, with the Anaura Stream in the best 10% and the remaining sites in the middle of the range.

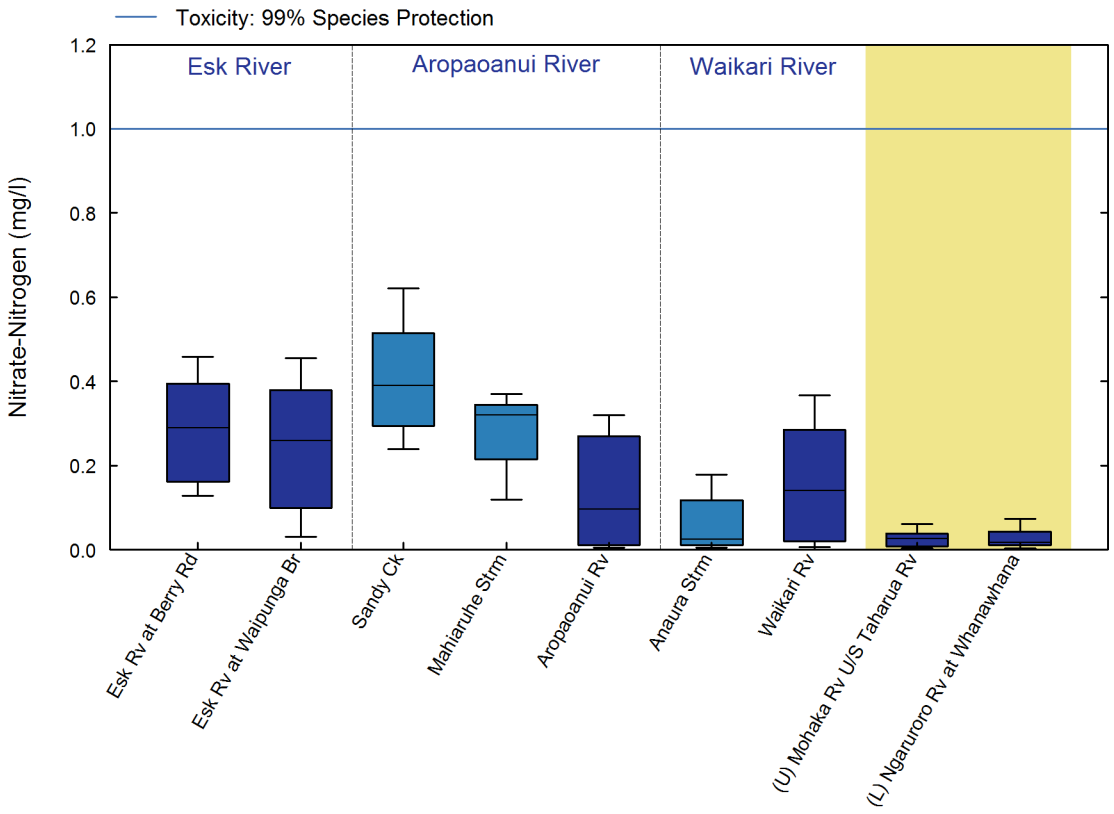



**Figure 3-10: Nitrate – nitrogen ($NO_3$-N) concentrations at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue, orange and red lines relate to the Hickey (2013) nitrate toxicity limits for 99%, 95% and 90% species protection respectively.

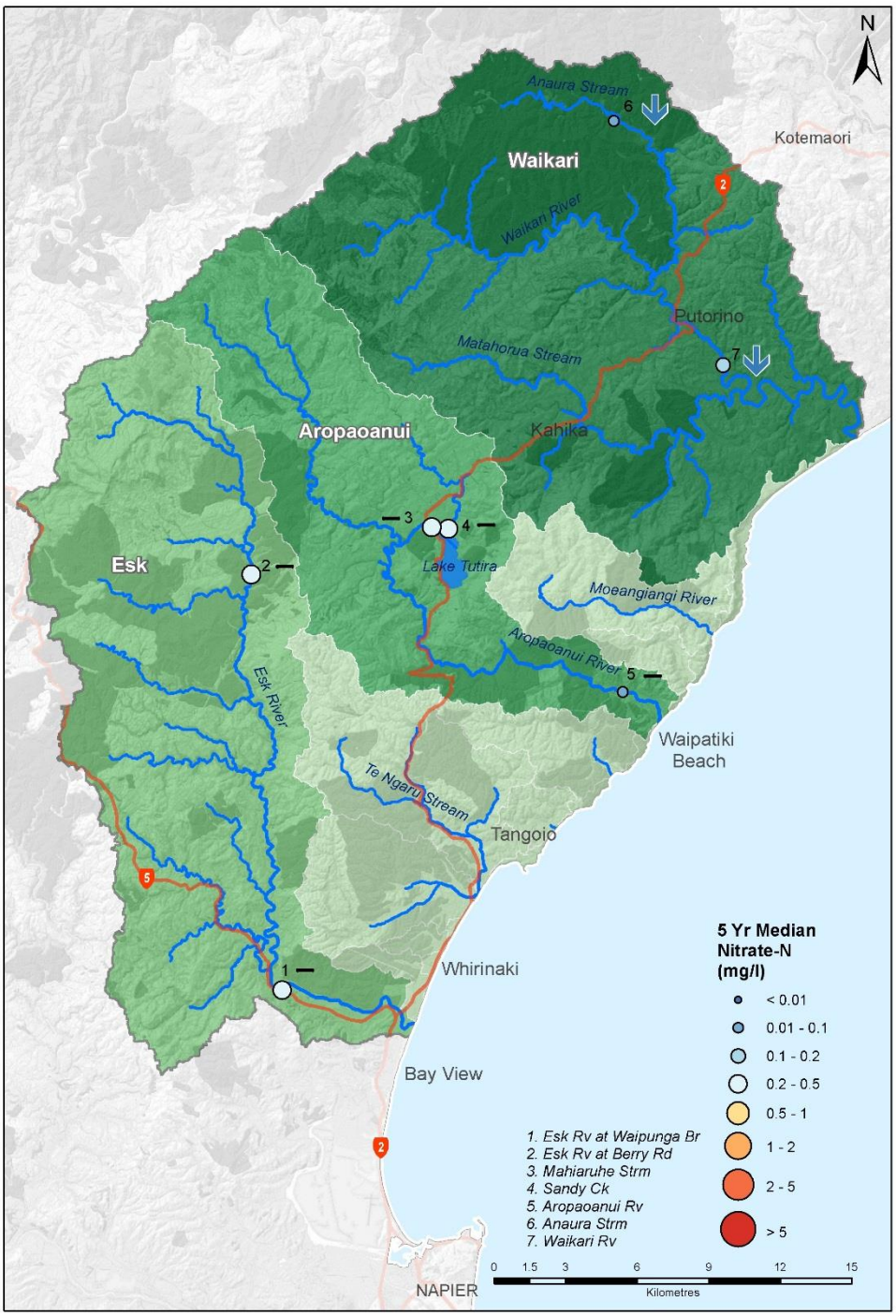



**Figure 3-11: 5 year median and trends in nitrate-nitrogen ($NO_3$-N) concentrations at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

## 3.5 Water Clarity – Black Disc and Turbidity

Water clarity is measured as the proportion of light transmitted through water. The concept has two important aspects, which are (1) visual clarity (sighting range for humans and aquatic animals), and (2) light penetration for growth of aquatic plants (Davies-Colley et al., 2003, Davies-Colley and Smith, 2001).

Water clarity is of considerable importance for the protection of contact recreation values, because it is perceived by recreational water users to directly affect the aesthetic quality of the water. In addition, adequate visual clarity allows swimmers to estimate depth and to 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). Trout are visual predators 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).

Visual water clarity is measured using a black disc. The measurement consists of measuring the horizontal distance that a black disc of standard size can be distinguished under water (Figure 3-12). Where the size of streams allow, black disc measurements are carried out routinely on a monthly basis across all HBRC SOE monitoring sites.

The ANZECC (2000) guidelines defined 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) recommended a minimum water clarity of 5 m for ‘outstanding trout fisheries’ and 3.5 m for ‘significant trout fisheries’.

**Figure 3-12: Hawke's Bay Regional Council staff measuring black disc sighting distance in the field.**

Water clarity in the three catchments (Esk, Aropaoanui and Waikari) was generally poor with median black disc sighting distances at 5 of the 7 sites worse than the ANZECC trigger value for recreational waters of 1.6 m. The Aropaoanui and Waikari River main stems had the highest median black disc sighting distances of 1.7 m and 1.9 m, respectively, although these were well below the recommended minimum 3.5 m for 'significant trout fisheries' (Figure 3-13).

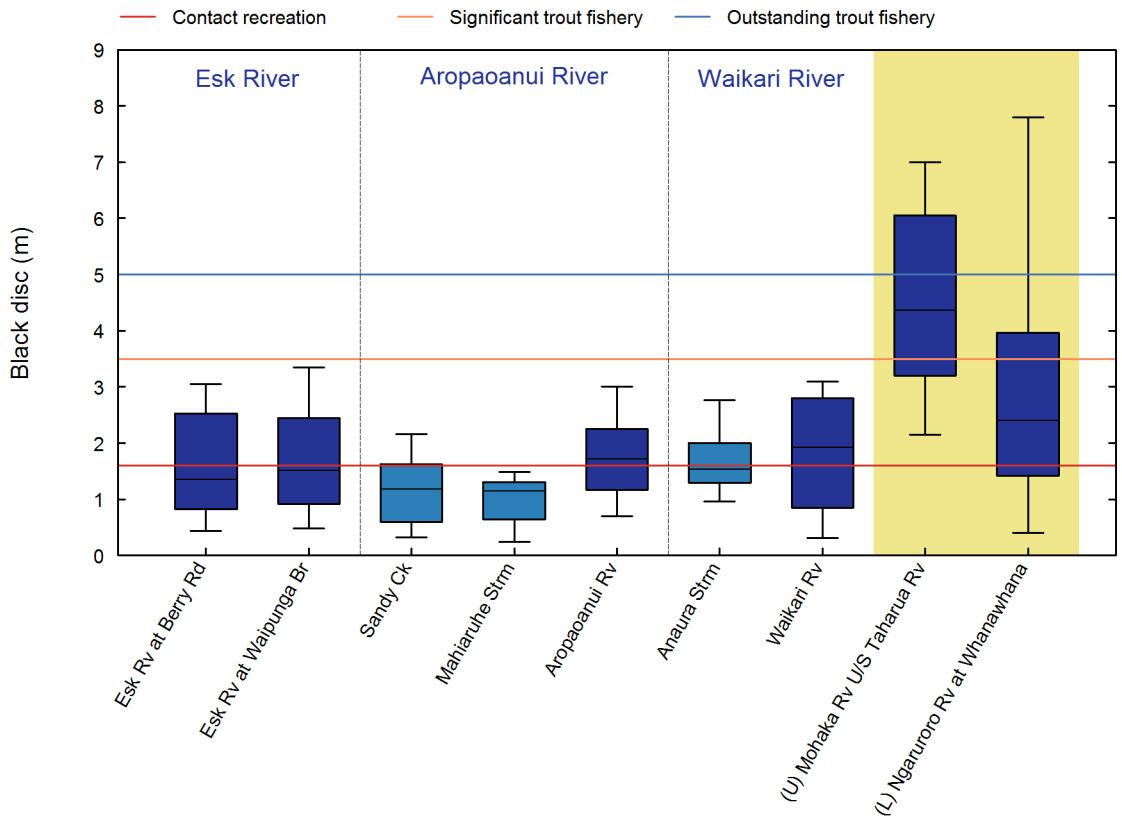



**Figure 3-13: Water clarity measured as black disc horizontal sighting distance for SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the Hay and Hayes (2006) 'Outstanding trout fishery' guideline; the orange line the 'Significant trout fishery' guideline. The red line is the ANZECC (2000)/ HBRC RRMP 2006 recreational amenity guideline.

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. 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.

Figure 3-14 shows turbidity measurements across SOE monitoring sites throughout the Esk, Aropaoanui and Waikari catchments. Turbidity ranges from 1.8 to 4.0 NTU with all sites better than the relevant ANZECC trigger values for upland and lowland rivers.

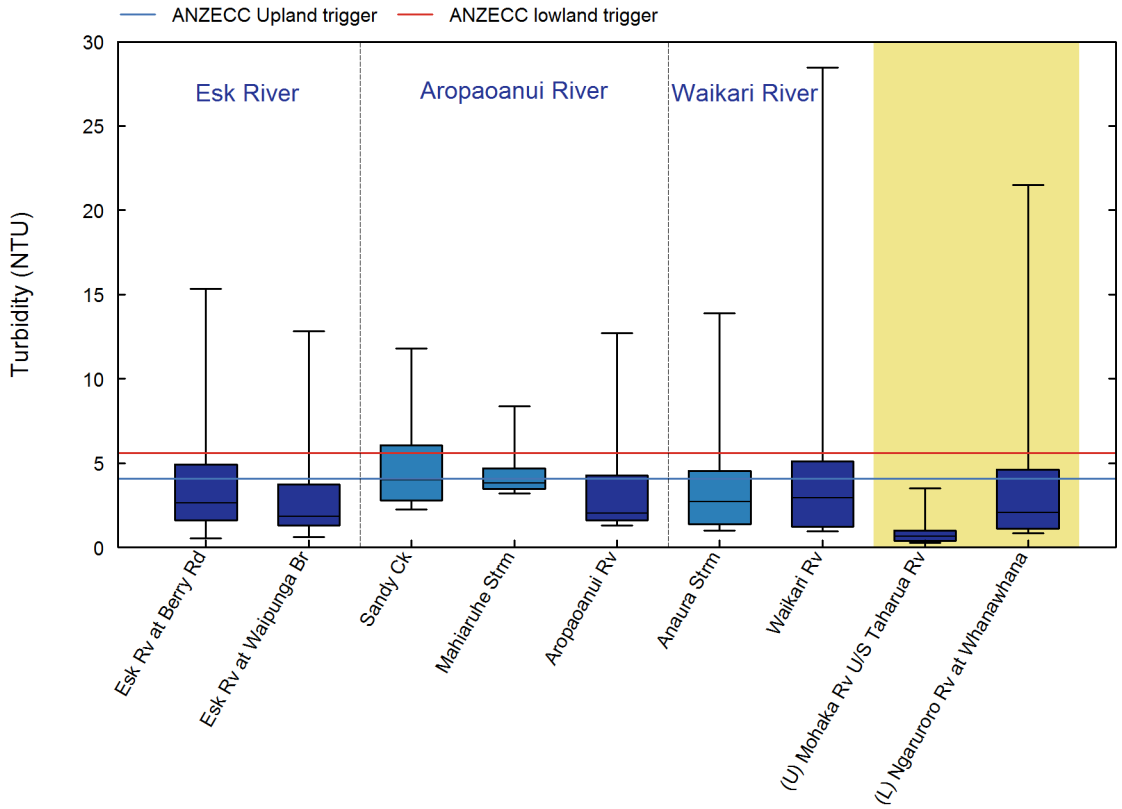



**Figure 3-14: Water clarity measured as turbidity (NTU) for SOE monitoring sites.** NTU stands for Nephelometric Turbidity Units. SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the ANZECC (2000) 'Upland' turbidity trigger value; the red line the ANZECC (2000) 'Lowland' turbidity trigger value.

The only significant trend observed in black disc water clarity, was a deterioration (7.2% annual decrease) in the Mahiaruhe Stream (Appendix C). Trend analysis results for turbidity showed increases (i.e. a deterioration) in turbidity at 3 sites, the Esk River at Berry Road (10.5% annual decrease), Mahiaruhe Stream (7.7% annual decrease) and the Aropaoanui River (6% annual decrease).

Esk, Aropaoanui and Waikari catchment sites ranked in the middle of all SOE monitoring sites across the Hawke's Bay region for water clarity (both black disc and turbidity).

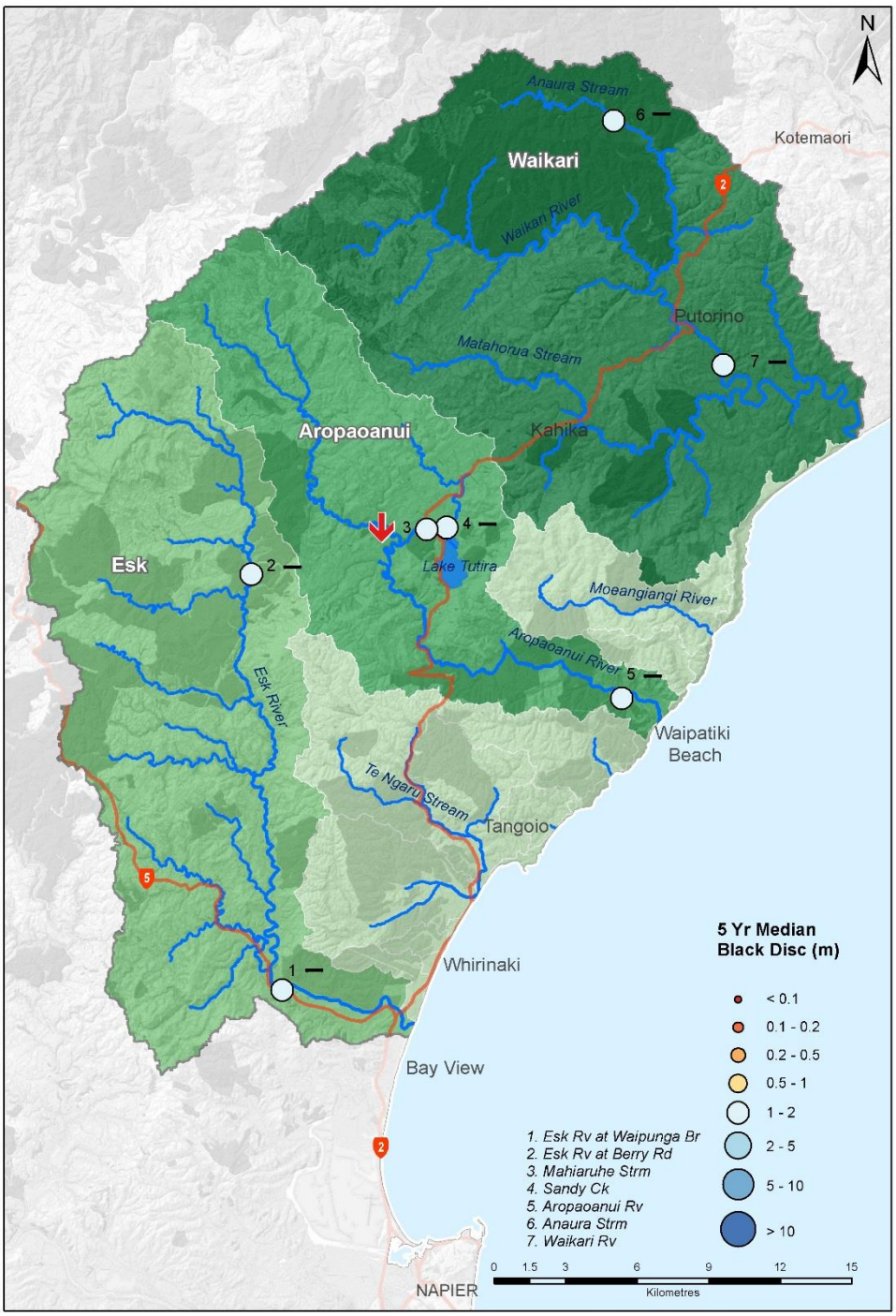



**Figure 3-15: 5 year median and trends for Black Disc (BD) water clarity levels at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

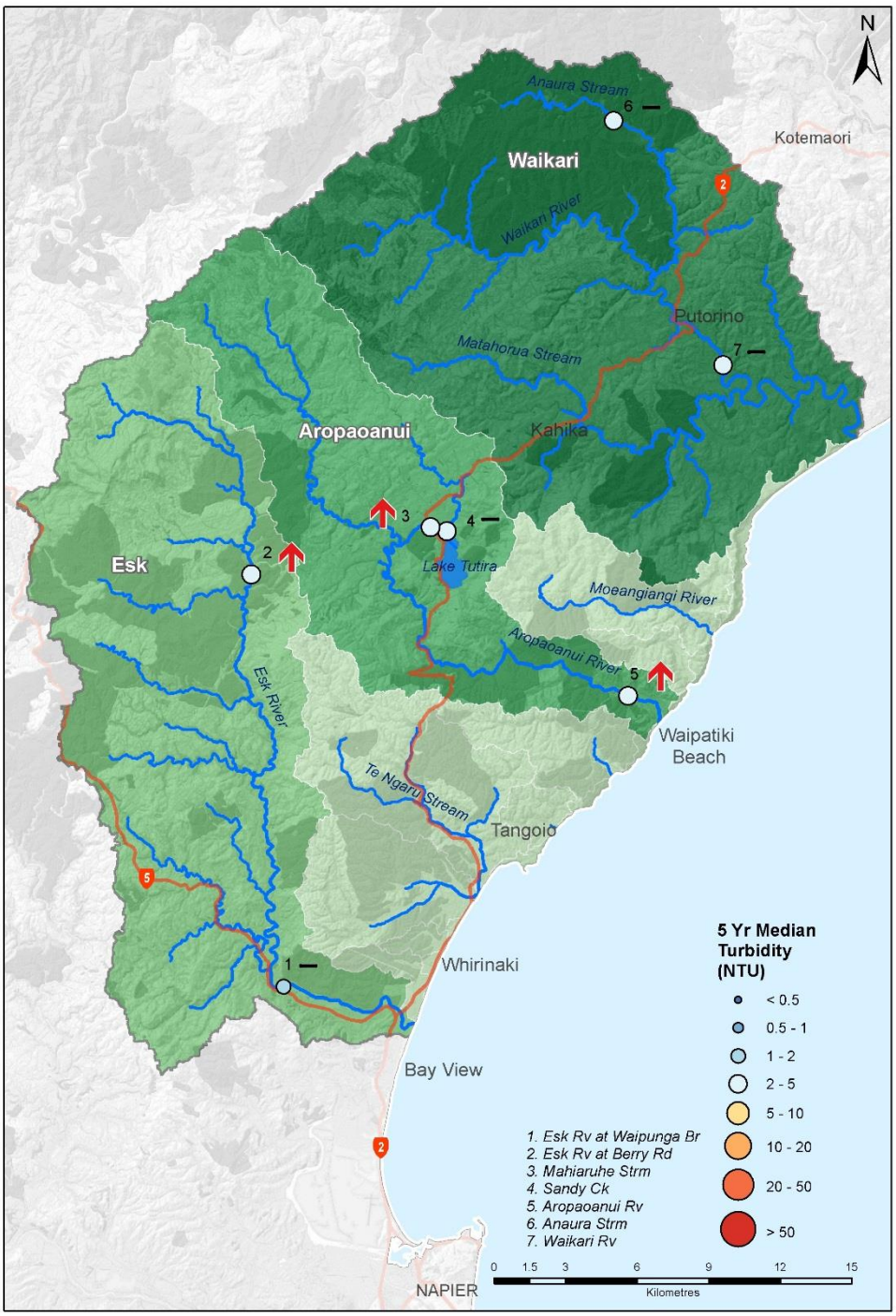



**Figure 3-16: 5 year median and trends for turbidity levels at SOE monitoring sites.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

## *3.6* Microbiological Water Quality Indicators – *E. coli*

*Escherichia coli* (commonly abbreviated *E. coli*) concentrations have been routinely monitored throughout the Esk, Aropaoanui and Waikari 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.

The 2002 microbiological water quality guidelines (MfE/MoH, 2003) define a three-mode risk management system for recreational freshwaters: Acceptable/Green (*E. coli* < 260 /100 ml); Alert/Amber (*E. coli* 260 /100 ml to 550 /100 ml) and Action/Red (*E. coli* > 550 /100 ml).

The red mode indicates an unacceptable level of health risk to contact recreational water users such as 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 amber mode (260 to 550 *E. coli* /100 ml) has been used in this report to assess suitability for swimming at all river flows.

Median *E. coli* concentrations at all monitoring sites across the Esk, Aropaoanui and Waikari catchments were low or very low and within the acceptable/green level suitable for contact recreation. Peak levels (represented by 90$^{th}$ percentile whiskers) did, however, exceed the Action/Red (*E. coli* > 550 /100 ml) level at 3 sites (Sandy Creek, Mahiaruhe Stream and the Waikari River), indicating that water quality was at times unsuitable for swimming at these sites.

These 3 sites showed no trends of increasing *E.coli* concentrations over time. Significant increasing trends were, however, detected at both sites on the Esk River (9.5% and 19.9% annual increases at Berry Road and Waipunga Bridge, respectively, Figure 3-18).

SOE sites in the Esk, Aropaoanui and Waikari catchments ranked across the middle of all Hawke's Bay regional sites; with the Anaura Stream the best in the 3 catchments and in the best 20% for the region, while Sandy Creek was the worst in the 3 catchments, and ranked in the worst 20% for the region.

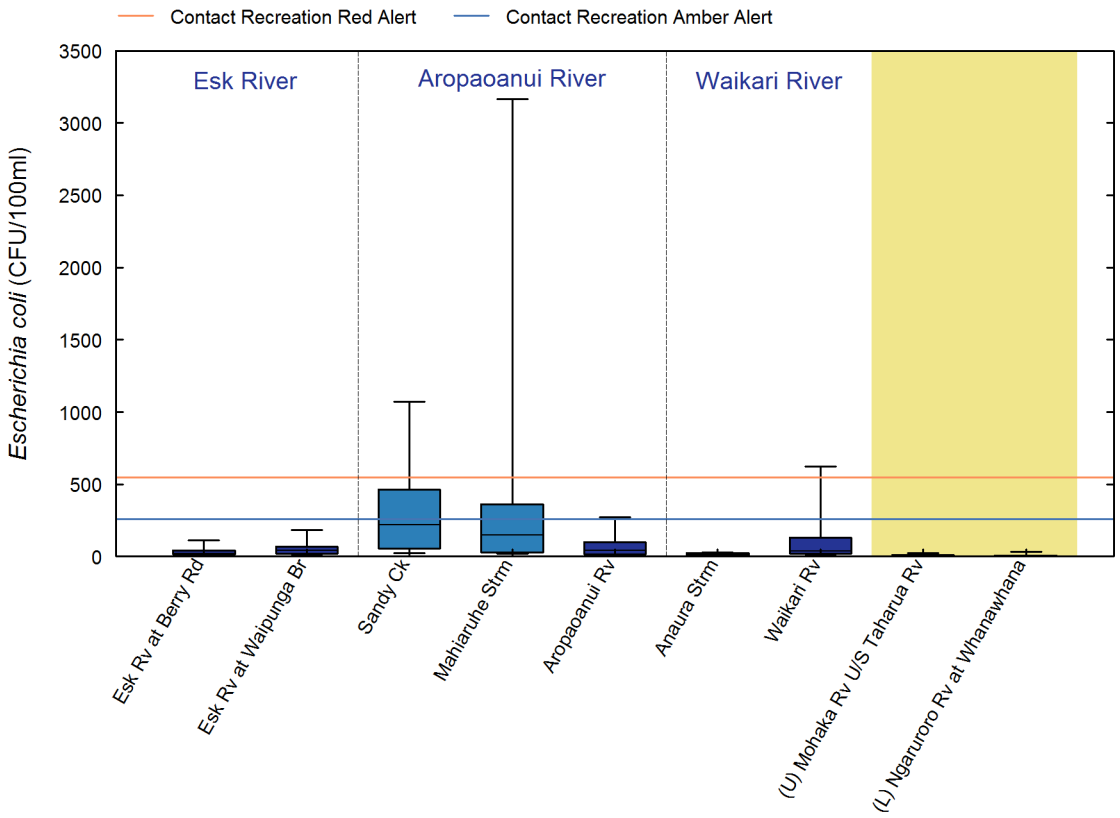



**Figure 3-17: Bacteriological water quality concentrations measured as *E. coli* counts (/ 100ml) at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the MfE and MoH (2003) amber alert level.

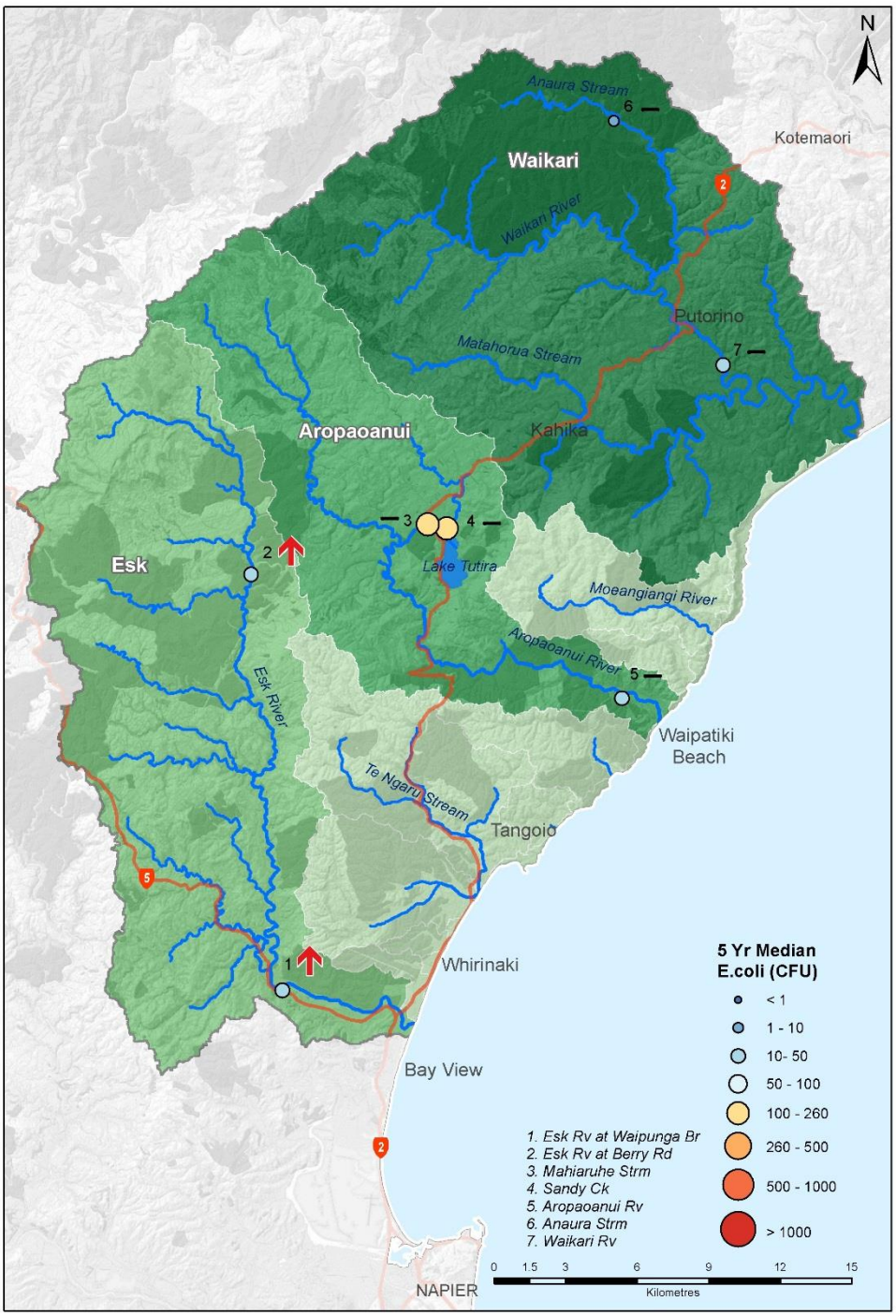



**Figure 3-18: 5 year median and trends for *E. coli* concentrations at SOE monitoring sites including trend direction.** Arrows indicate direction of significant trends, with blue arrows for improvement and red arrows for deterioration of the variable in question. Sites with a dash did not exhibit a statistically significant trend.

## 3.7 Biological Indicators – Macroinvertebrate Community Index

Benthic macroinvertebrate communities are the assemblages of insects, crustaceans, worms and molluscs that live on the bottom of streams and rivers. Macroinvertebrate communities are commonly used as state indicators 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. When under stress, the community composition changes as sensitive species are lost, and more tolerant species appear, 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 stream ecological health.

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 that more pollution 'intolerant' or sensitive species are present, which indicates better water quality. The MCI of a site can be used to assess the likely level of ecosystem degradation. 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). As an indicator the MCI signals changes in the stream environment that may warrant further investigation. One important limitation is that the MCI were developed, and are particularly suited, as indicators of organic enrichment. They have since been shown to be useful indicators of the effects of fine sediment deposition, but are not reliable indicators of chemical (e.g. metals) contamination, or habitat size or quantity (Collier et al., 2014).

The MCI summarises many aspects of stream health including habitat and water quality and provides a single numeric value that can be affected by 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 other territorial authorities.

The quality classes indicated by the MCI score are included in Table 3-1.

**Table 3-1: 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 |

Figure 3-19 and Figure 3-20 summarise MCI scores for the Esk, Aropaoanui and Waikari catchment SOE monitoring sites. The results show macroinvertebrate communities at Esk River sites, the Aropaoanui River and Anaura Stream were indicative of good water quality, while those in Sandy Creek and the Mahiaruhe Stream and the Waikari River have in-stream macroinvertebrate communities indicative of 'fair' water quality. The upper Esk river site and the Anaura Stream were the only two sites where median MCI scores were comparable with those at the Ngaruroro lowland reference site. The Mahiaruhe Stream had the worst median MCI score and is the only site where MCI scores indicative of "poor" water quality (<80) were observed.

Median MCI scores range from 85 to112 and rank across the middle third (28th to 70th) of all regional SOE monitoring sites (Appendix D).

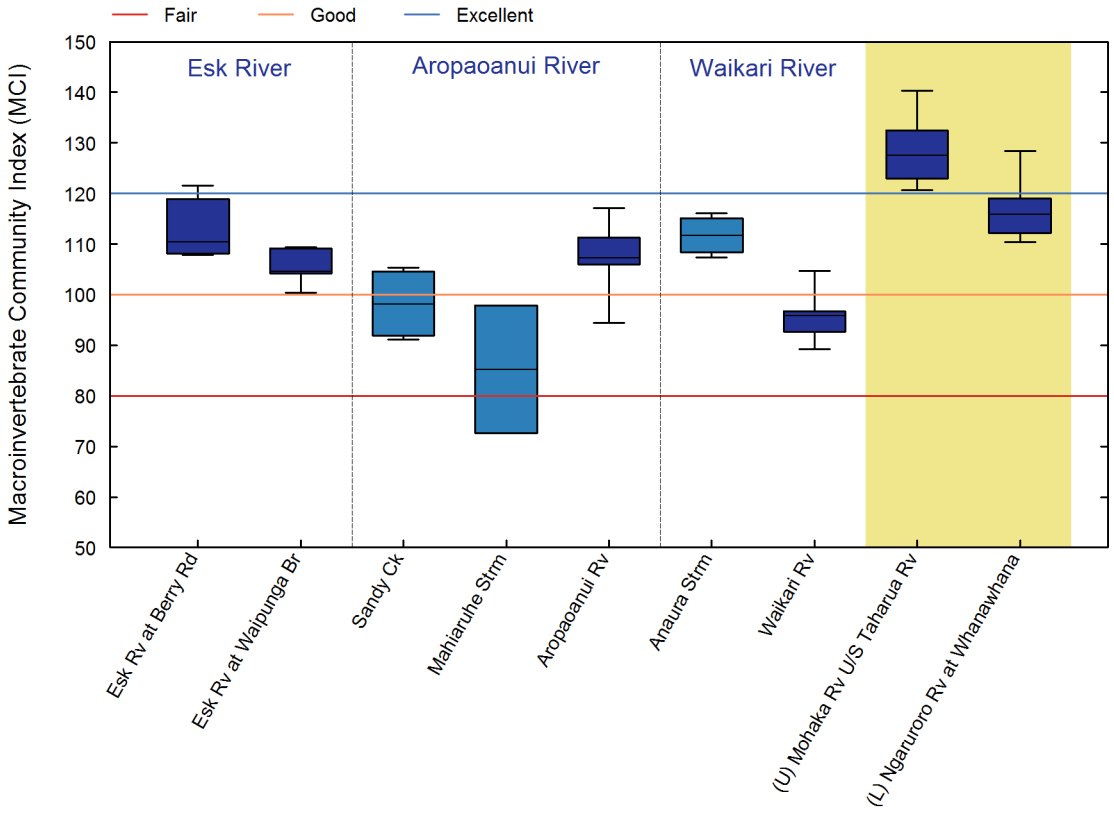



**Figure 3-19: Median MCI scores measured at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the Hay *et al.* (2006) 'Outstanding trout fishery' limit or the Stark and Maxted (2007) 'Excellent health' indicator level; the orange line the 'Significant trout fishery' limit or 'Good health' indicator level.

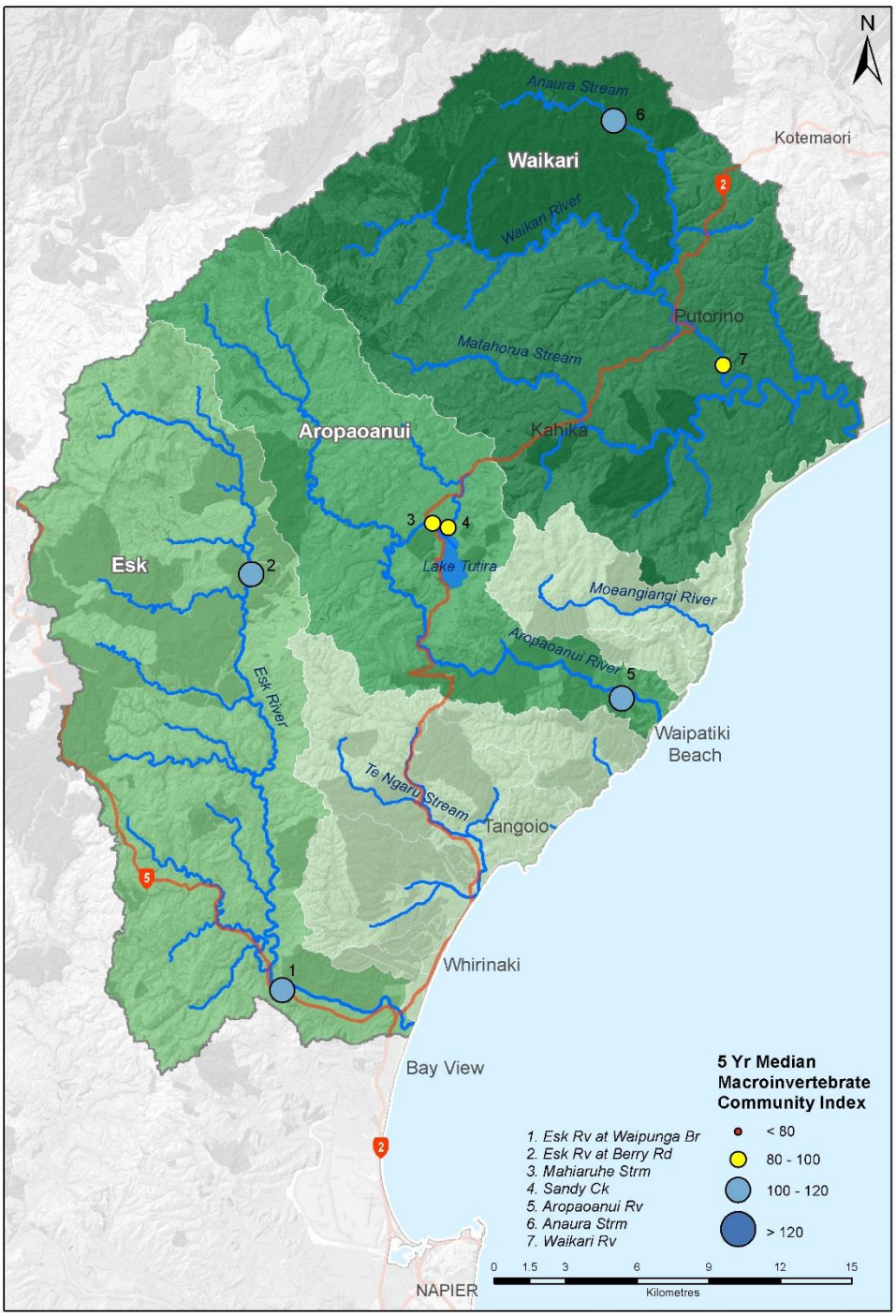



**Figure 3-20: 5 year median Macroinvertebrate Community Index (MCI) levels at SOE monitoring sites.**

## 3.8 Biological Indicators – Periphyton Biomass

Aquatic plants such as algae or periphyton are natural components of riverine environments. Periphyton is the brown or green slime or filamentous material coating stones, wood, or other stable surfaces in streams and rivers. It is a living community composed of a large number of different algae, bacteria and fungi species. As the main primary producers in streams and rivers, periphyton communities are fundamental to the functioning of aquatic ecosystems (Biggs and Kilroy, 2000). However, abundant growths can be problematic, affecting both human use of the river and ecological values (Mathieson et al., 2012). As a result, excessive growths are often termed "nuisance growths".

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 have detrimental effects on aquatic life (Biggs, 2000). This is distinct from benthic cyanobacteria such as Phormidium that can be hazardous as this species can produce toxins.

Excessively long filamentous algae and thick mats are unsightly and can also have a direct effect on the amenity/aesthetic values of a river, as well as on the quality of the fishing experience for the angler (by fouling fishing lures and lines) (Biggs, 2000, Wilcock et al., 2007).

Since periphyton and algae respond to changes in nutrient availability in streams, periphyton biomass or algal biomass limits are used to assess the effects of increased in-stream nutrient concentrations. Biggs (2000) developed the 'New Zealand Periphyton Guidelines', a document that identifies suitable limits of in-stream periphyton biomass and cover to support biodiversity and recreational amenity values. The guideline values are as follows:

- 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.

Periphyton biomass measured at the 7 SOE sites are shown in Figure 3-21. It should be noted that only a small number of monitoring results were available at each site (between 1 and 5). This means that the results obtained to date are unlikely to provide a robust representation of the range of conditions at each site, and that the calculated descriptive statistics (median, interquartile and interdecile ranges) should be taken with caution.

Estimated periphyton biomass was generally below both the 120 mg/m$^2$ 'recreational' and 50 mg/m$^2$ 'biodiversity' thresholds in the Anaura Stream and at all 3 Aropaoanui catchment sites, noting however that Sandy Creek and the Mahiaruhe Stream are unsuited to periphyton development.

Based on the data available, both sites on the Esk River and the Waikari River site had higher median periphyton biomass levels, exceeding the threshold for the protection of aquatic biodiversity values, but were within or just exceeding the threshold for the protection of aesthetics and recreational values. At all 3 sites, periphyton biomass at times largely exceeded the 120 mg/m$^2$ 'recreational' threshold. The highest levels (represented by 90$^{th}$ percentile whiskers) were observed in the Waikari River.

Data at all sites were insufficient to provide a robust indication of periphyton biomass patterns, in particular if, or how often "nuisance" levels of periphyton growth occurred.

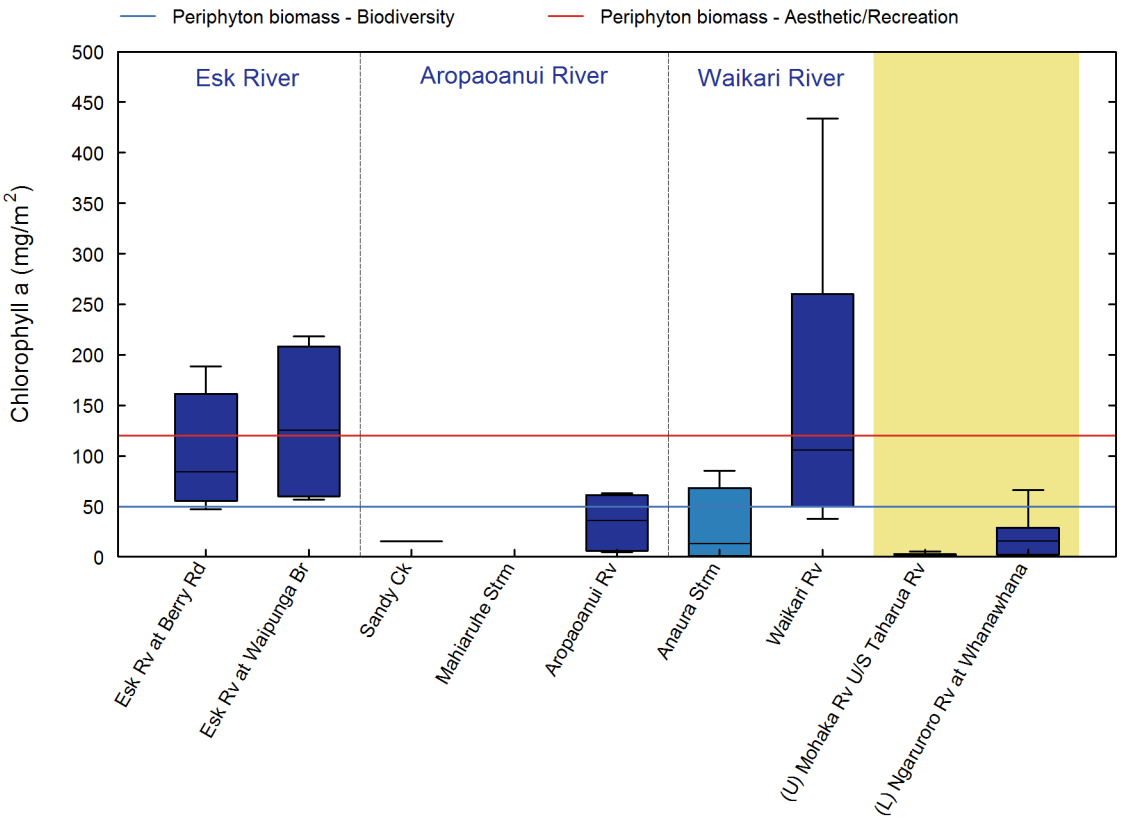



**Figure 3-21: Periphyton biomass concentrations measured at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The blue line is the Biggs (2000) 'Biodiversity' protection limit; the red line the 'Recreational amenity' limit for filamentous algae.

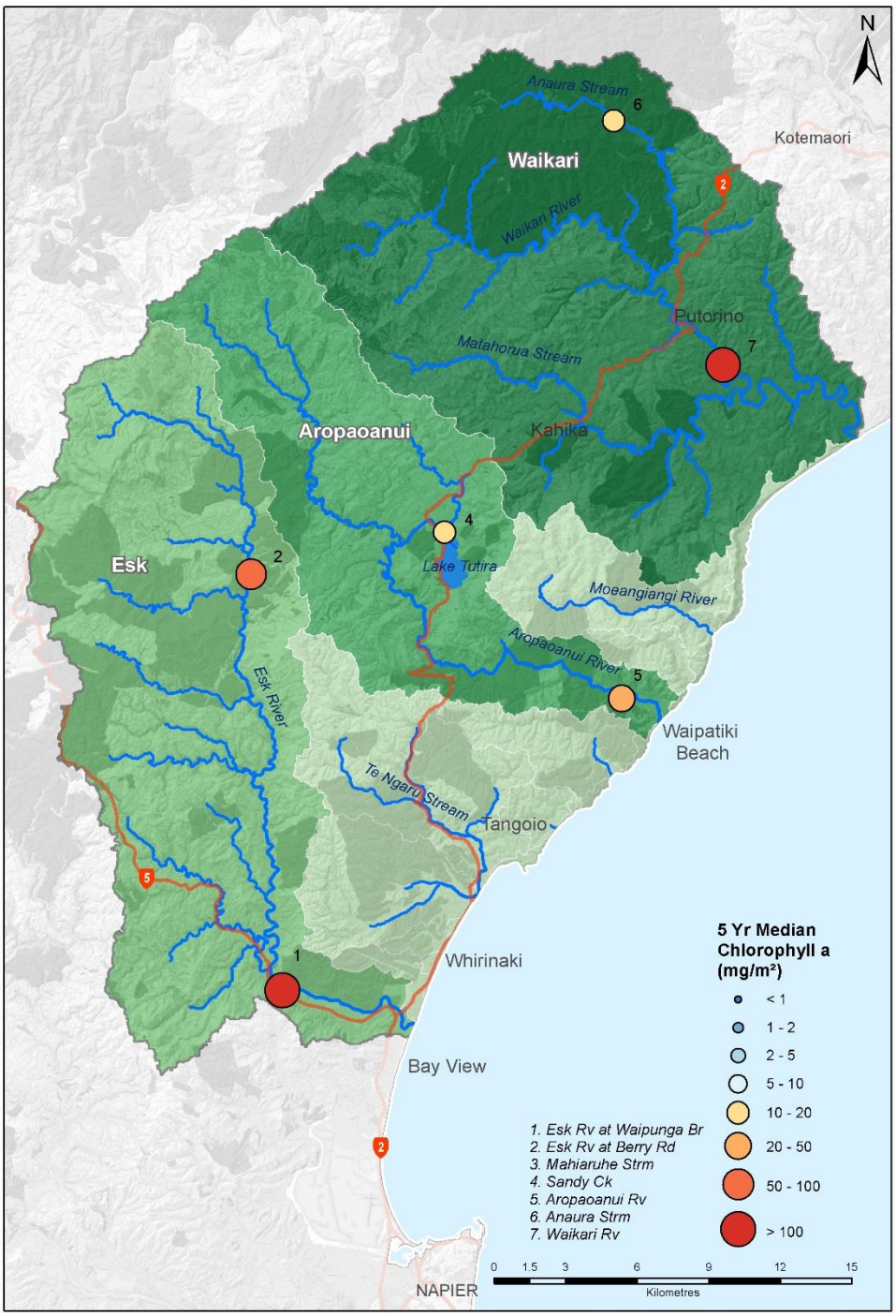



**Figure 3-22: 5 year median Chlorophyll a (mg/m²) levels at SOE monitoring sites.**

## 3.9 Dissolved Oxygen

Dissolved oxygen is a vitally important component in the life supporting capacity of freshwater ecosystems. Humans absorb oxygen from the air through their lungs, while aquatic organisms absorb oxygen from the water through their gills. Fish, invertebrates and other organisms are stressed when insufficient oxygen is dissolved in the 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 3-23). 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 3-23.

In slow-flowing, un-shaded streams with high nutrient inputs, excessive growth of plants and algae can result in extremely high dissolved oxygen levels during the day (super-saturation), and/or 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 3-23 is a schematic of the major processes that influence oxygen concentration in rivers and streams.

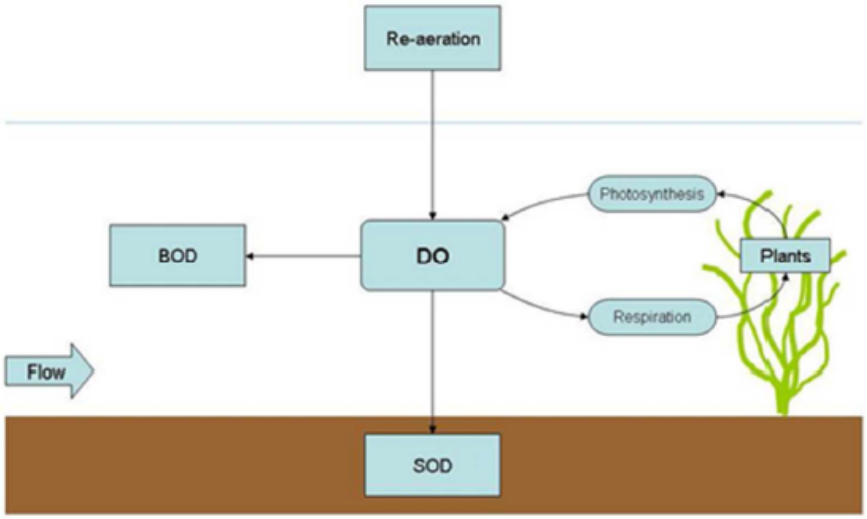



**Figure 3-23: Schematic of the major processes influencing dissolved oxygen concentration in rivers.** DO = dissolved oxygen; BOD = biochemical oxygen demand; SOD = sediment oxygen demand (Davies-Colley *et al.*, 2013).

A waterway with dissolved oxygen levels consistently below 5.0 mg/l is unable to support sensitive species and the ecological integrity of these systems is considered to be compromised. Dissolved oxygen levels that are greater than 8.0 mg/l are typically capable of supporting the full range of aquatic organisms (MfE, 2013).

Colder water can hold more oxygen than warmer water. Water warmer than 27°C cannot hold more than 8.0 mg/l of oxygen. Un-shaded systems that overheat during the day can also be depleted of oxygen.

The detrimental effects of increasing water temperature on trout are two-fold. First 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 dissolved oxygen 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). The 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".

As stated previously, rainbow trout are typically more sensitive to low dissolved oxygen levels than native fish. Research into the oxygen requirements of native fish is limited, but Dean and Richardson (1999) demonstrated that 7 native species of fish were less sensitive to low levels of DO than juvenile rainbow trout. This included longfin elvers and juvenile torrentfish, which are the life stages of species expected to be particularly sensitive given their preference for fast water habitats with typically higher DO concentrations. Landman et al. (2005) more recently found that the whitebait stage of inanga was more sensitive than juvenile rainbow trout (parr).

The contrast of inanga sensitivity between the studies of Landman et al. (2005) and Dean and Richardson (1999) may be related to experimental conditions that denied inanga the opportunity for aquatic surface respiration. When dissolved oxygen levels are low, inanga are able to obtain oxygen directly from the air which allows them to survive in low oxygen waters (Urbina et al., 2011). Although more research into the effects of low oxygen on native fish communities would be beneficial, a common assumption in New Zealand (also made here) is that if conditions satisfy the oxygen requirements of the well-studied rainbow trout, they should also satisfy the requirements of native species (Dean and Richardson, 1999, Franklin, 2013).

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

In river reaches where substantial upwelling of potentially low-oxygen or anoxic groundwater occurs, in-stream dissolved oxygen concentrations after mixing may also be low. Likewise, in wetland systems where bacterial respiration levels are high, oxygen levels can be very low. This is consequence of natural background conditions and is independent of human influences.

Dissolved oxygen levels throughout the Esk, Aropaoanui and Waikari catchments had DO saturation above 80% and concentrations above 7 mg/l (Figure 3-24 and Figure 3-25), therefore posing little risk to any native species at these sites.

It should be noted however that the data analysed in this report were limited to 'spot' measurements taken on site at the same time as water samples were collected. Such spot measurement data presents severe limitations because generally they are collected during the daylight hours, and are unlikely to include the daily DO minima, which typically occur before dawn.

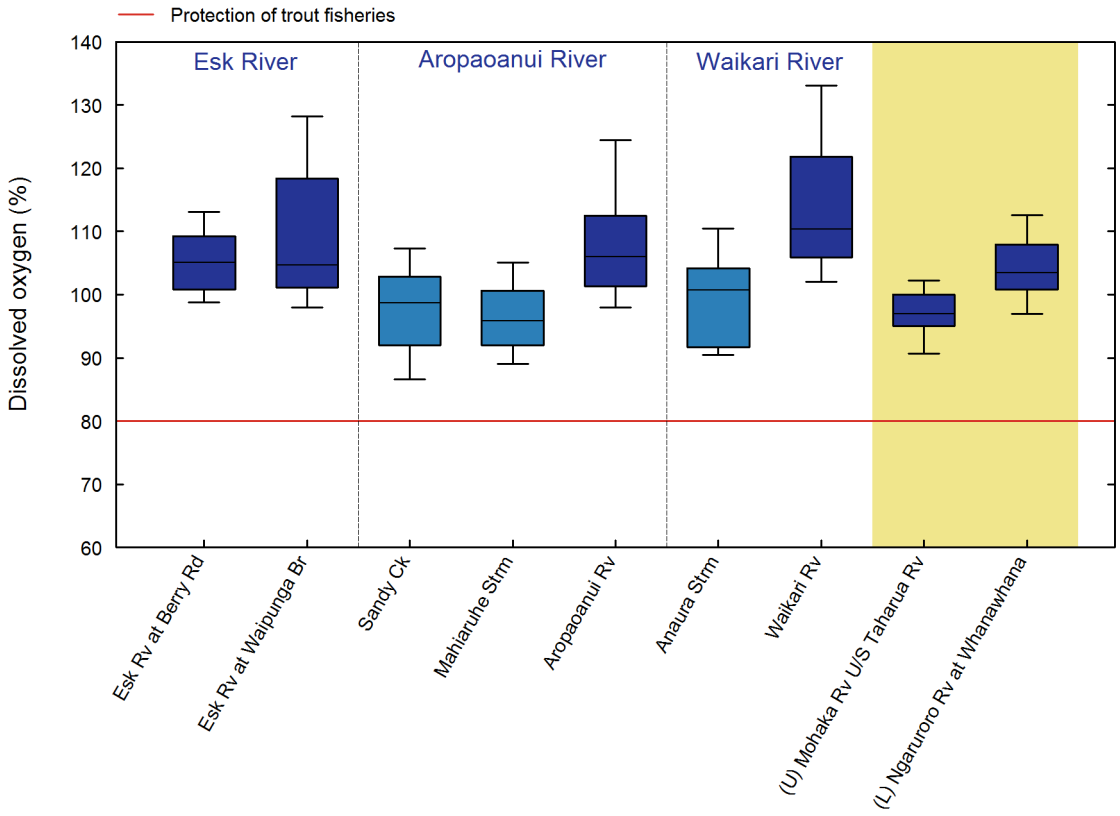



**Figure 3-24: Dissolved oxygen % saturation at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The red line is the RMA (1991) Schedule 3 lower limit of 80% for supporting salmonid (trout) fisheries.

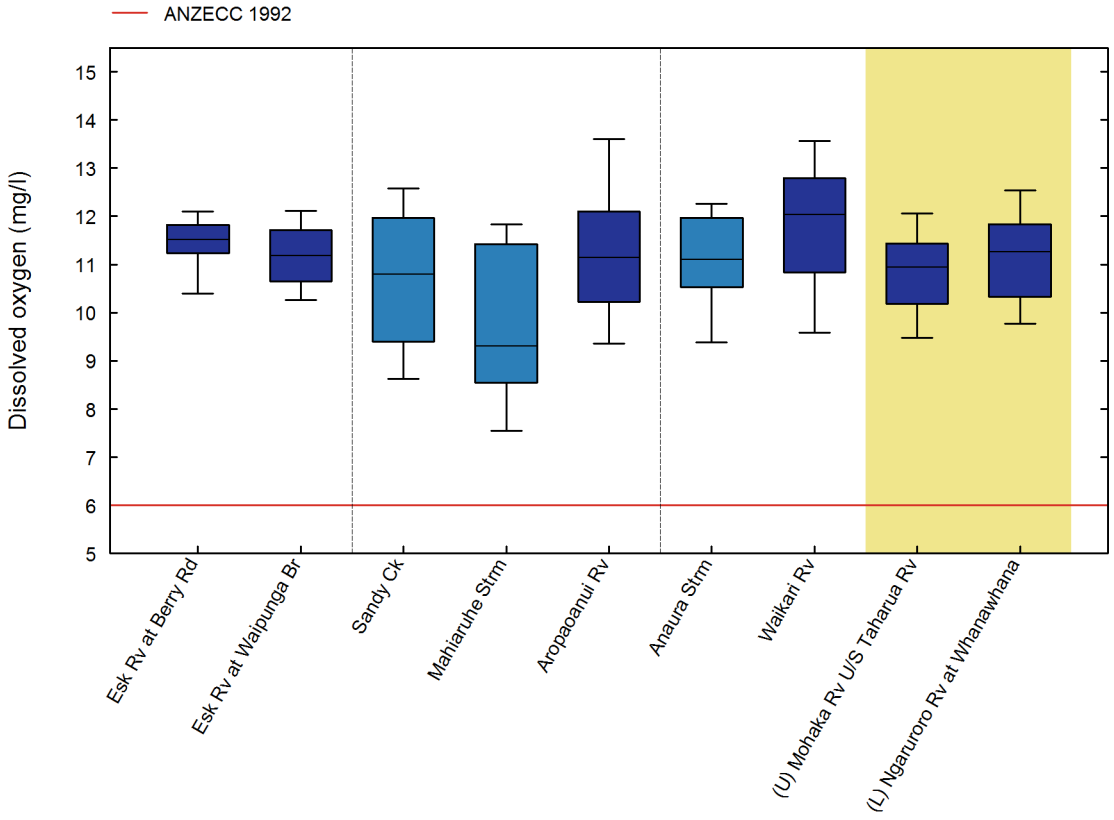



**Figure 3-25: Dissolved oxygen concentration at SOE monitoring sites.** SOE sites for the Mohaka River U/S Taharua confluence and the Ngaruroro River at Whanawhana (shaded) are included as Upland (U) and Lowland (L) reference sites for comparison purposes. The red line is the ANZECC (1992) guideline minimum DO concentration of 6 mg/l.

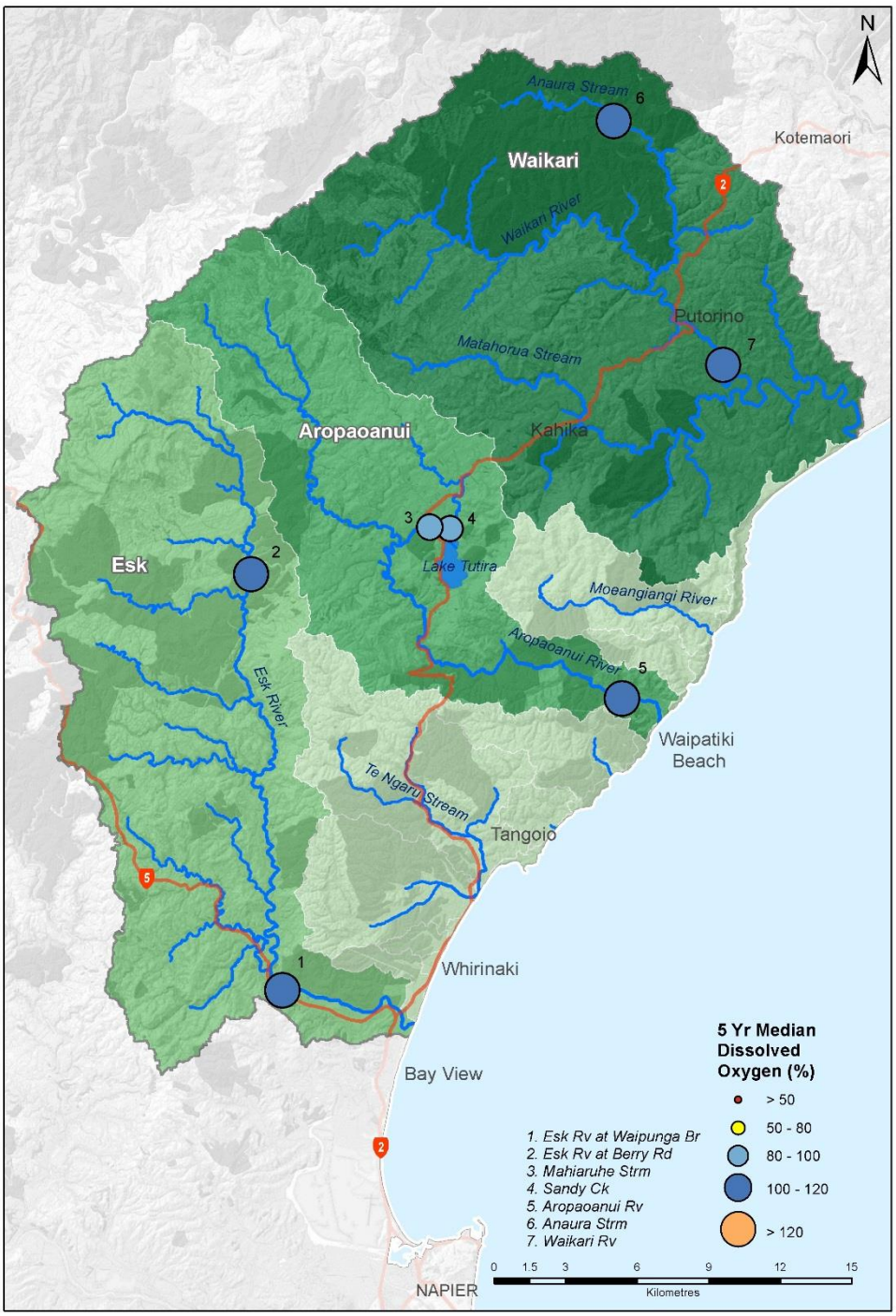



**Figure 3-26: 5 year median dissolved oxygen % saturation levels at SOE monitoring sites.**

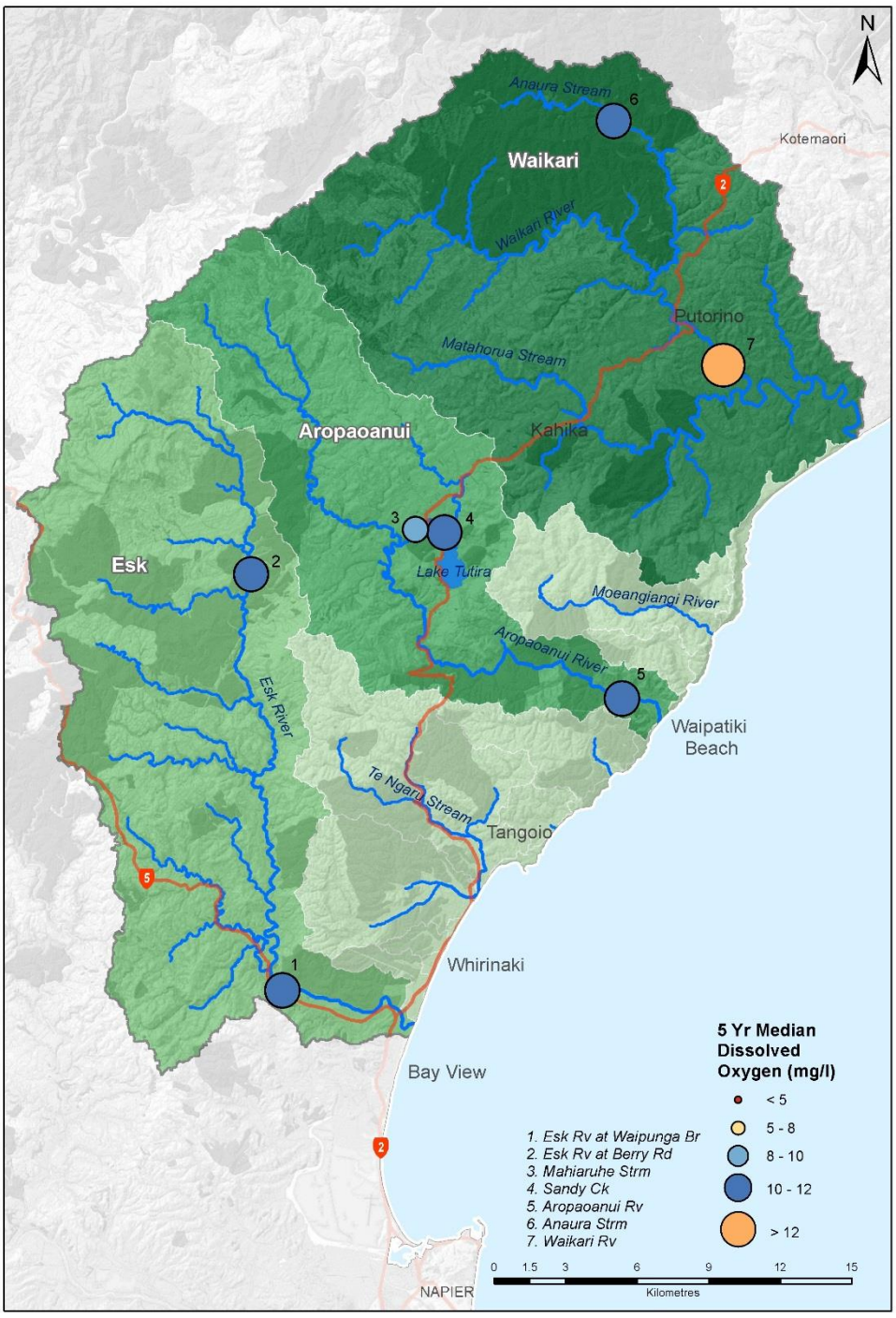



**Figure 3-27: 5 year median dissolved oxygen concentration levels at SOE monitoring sites.**

# 4 Compliance with NOF attribute bands under the NPS-FM (2014)

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 several 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 chl*a*/m$^2$), nitrate-nitrogen (mg/l), ammoniacal-nitrogen (mg/l), dissolved oxygen (mg/l – applicable to 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 bands 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 attributes could not 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 are presented in tables in Appendix F along with a general summary of overall bands in Table 4-1.

## 4.1 *Escherichia coli* Attribute

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 95$^{th}$ 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 whole reporting period), all sites throughout the Esk, Aropaoanui and Waikari catchments fall within the A band. Median concentrations calculated over individual years from 2009 to 2013 (refer Appendix F) also fall within the A band except for Sandy Creek (D band) and the Mahiaruhe Stream (B band) in 2010 (Appendix F).

The 95$^{th}$ percentile concentrations were calculated on the basis of the whole dataset available (as opposed to on an annual basis). Four of the 7 sites (Esk River at Berry Road and Waipunga Bridge, Anaura Stream and Waikari River) fell within the A band, with the other three sites (Sandy Creek, Mahiaruhe Stream and Aropaoanui River) in the B band.

The narrative Attribute State for the A band classification 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'.

With regards to primary contact recreation (i.e. activities likely to involve full immersion), the classification based on 95$^{th}$ percentile concentration means that people will be exposed to a low (<1%) risk of infection at the 4 sites graded 'A' and a moderate risk (<5% risk) in the other 3 sites (graded 'B').

## 4.2 Nitrate (Toxicity) Attribute

The nitrate 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, 2013b). Such a response may be reduced growth rate or reduced gonad development when compared to optimum growth conditions (a control). It does not relate to acute toxicity effects that result in the death of an animal. 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 (2013b), Hickey (2013a).

Median and 95$^{th}$ percentile nitrate-nitrogen concentrations for all Esk, Aropaoanui and Waikari catchment SOE monitoring sites are in the A band overall, and when considering individual calendar years from 2009 to 2013 (Appendix F). The narrative for this band states there is 'unlikely to be effects even on sensitive species' (NPS-FW 2014; Appendix E; Appendix F). The A band reflects a low level of risk to any aquatic species.

## 4.3 Ammonia (Toxicity) Attribute

The ammonia attribute aims to manage against chronic ammonia toxicity risk to aquatic animals. The attribute bands for a site are based on annual median and maximum concentrations (Appendix E).

Median ammonia concentrations for all Esk, Aropaoanui and Waikari catchment monitoring sites fall in the A band overall and for all individual years between 2009 and 2013 (Refer Appendix F).

When considering annual maximums, only 1 site (Aropaoanui River) retains the A grade for every year of record, whilst the remaining 6 sites are graded 'B' due to 1 or 2 annual exceedances of the annual maximum threshold.

The A band reflects an extremely low level of risk to 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).

**Table 4-1: NPS-FW 2014 NOF band summary for freshwater river attributes for Esk, Aropaoanui and Waikari river catchment monitoring sites for the period 2009 to 2013.**

| Site | | *E. coli* | | Nitrate (toxicity) | | Ammonia (toxicity) | |
|---|---|---|---|---|---|---|---|
| | | Median | 95th percentile | Median | 95th percentile | Median | Maximum |
| 1 | Esk Rv at Waipunga Br | A | A | A | A | A | B |
| 2 | Esk Rv at Berry Rd | A | A | A | A | A | B |
| 3 | Sandy Ck | A | B | A | A | A | B |
| 4 | Mahiaruhe Strm | A | B | A | A | A | B |
| 5 | Aropaoanui Rv | A | B | A | A | A | A |
| 6 | Anaura Strm | A | A | A | A | A | B |
| 7 | Waikari Rv | A | A | A | A | A | B |

# 5 Compliance with HBRC Regional Resource Management Plan (2006) surface water quality and 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 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 5-1),

(2) For samples collected at flows less than median flow, the total number of samples taken and the number of samples non-compliant with RRMP 2006 Environmental Guideline levels (Table 5-2).

All sites meet both the DO and ammoniacal nitrogen guidelines 100% of the time (Table 5-1 and Table 5-2).

Mean black disc clarity was better than the RRMP guideline at 5 out of the 7 sites. Sandy Creek and the Mahiaruhe Stream had the worst mean water clarity, with 1.41 and 1.14m respectively. When considering individual samples however, only the Waikari River was better than the guideline all the time. The Aropaoanui River and both sites on the Esk River also comply with the RRMP guideline more than 80% of the time. The Anaura Stream was better than the guideline about half of the time (56%). Sandy Creek was better than the guideline on 25% of sampling occasions, and the Mahiaruhe Stream always failed. It should be noted that only 4 observations were available at 3 sites (Waikari River, Sandy Creek and Mahiaruhe Stream), and conclusions for these sites should be treated with caution. As well as having the worst water clarity of all 7 sites, the Mahiaruhe Stream was also the only site with a significant deterioration (increasing trend) in black disc clarity (Section 3.5).

Mean DRP concentrations were worse than the RRMP guideline at all sites, except the Anaura Stream and Waikari Rivers. The highest mean DRP concentrations were measured in Sandy Creek and the Mahiaruhe Stream, where they exceeded the RRMP guideline DRP by a factor 3 to 4. When considering individual samples, only the Waikari River (75% of samples compliant) and the Anaura Stream (100%) had high levels

of compliance with the RRMP guideline. Sandy Creek and Mahiaruhe Stream never met the guideline, while Aropaoanui River met it 38% of the time (Table 5-2).

**Table 5-1: Measured dissolved oxygen, black disc, dissolved reactive phosphorus (DRP) and ammoniacal nitrogen levels with HBRC RRMP 2006 Environmental Guideline levels.** The data summarised in the table are for samples taken between January 2009 and December 2013 during times that flows in the river were below median flow as prescribed in Policy 72 of the HBRC RRMP 2006. Green cells are compliant, red cells are non-compliant.

| Site name | Mean DO (%) | Mean Black Disc Clarity (m) | Mean DRP (mg/l) | Mean / Max $NH_3$-N (mg/l) |
|---|---|---|---|---|
| Esk Rv at Waipunga Br | 113.5 | 2.82 | 0.022 | 0.010 / 0.048 |
| Esk Rv at Berry Rd | 106.1 | 2.55 | 0.022 | 0.012 / 0.024 |
| Sandy Ck | 95.9 | 1.41 | 0.064 | 0.032 / 0.039 |
| Mahiaruhe Strm | 94.5 | 1.14 | 0.056 | 0.033 / 0.066 |
| Aropaoanui Rv | 114.0 | 2.30 | 0.018 | 0.006 / 0.016 |
| Anaura Strm | 96.4 | 1.82 | 0.005 | 0.008 / 0.016 |
| Waikari Rv | 114.5 | 2.18 | 0.009 | 0.013 / 0.029 |
| **HBRC RRMP 2006 guideline level** | **80%** | **1.6 m** | **0.015 mg/l** | **0.100 mg/l** |
| Number of sites compliant | 7/7 | 5/7 | 2/7 | 7/7 |
| % site compliant | 100% | 71% | 29% | 100% |

**Table 5-2: Measured DO, BD clarity and DRP values with HBRC RRMP 2006 Environmental Guideline levels.** 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 being 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 | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. Samples | No. Samples < 80% saturation | % Compliance | No. Samples | No. Samples < 1.6m | % Compliance | No. Samples | No. Samples > 0.015 mg/l | % Compliance |
| Esk Rv at Waipunga Br | 11 | 0 | 100% | 9 | 1 | 89% | 12 | 10 | 17% |
| Esk Rv at Berry Rd | 11 | 0 | 100% | 11 | 2 | 82% | 12 | 9 | 25% |
| Sandy Ck | 1 | 0 | 100% | 4 | 3 | 25% | 4 | 4 | 0% |
| Mahiaruhe Strm | 1 | 0 | 100% | 4 | 4 | 0% | 4 | 4 | 0% |
| Aropaoanui Rv | 13 | 0 | 100% | 15 | 3 | 80% | 16 | 10 | 38% |
| Anaura Strm | 8 | 0 | 100% | 9 | 4 | 56% | 9 | 0 | 100% |
| Waikari Rv | 1 | 0 | 100% | 4 | 0 | 100% | 4 | 1 | 75% |

# 6 Summary and Conclusions

1. Microbiological water quality:

   All 7 monitoring sites fall into the NPSFM 'A' Attribute State, indicating that water quality is generally suitable for secondary (e.g. wading, boating) contact recreation at all sites across the Esk, Aropaoanui and Waikari catchments. All 7 sites are also generally suitable for primary contact recreation, with 4 sites having a low risk (NPSFM A Band), and Sandy Creek, Mahiaruhe Stream and the Aropaoanui River having a moderate risk (NPSFM B Band) to water users.

2. Dissolved Oxygen:

   Data available do not point to any significant issues associated with dissolved oxygen (DO) concentration or saturation at any of the sites, although the data are limited to 'spot' measurements, which are unlikely to capture the daily minima.

3. Water clarity and turbidity:

   Water clarity is generally relatively low in the Esk, Aropaoanui and Waikari catchments. The Aropaoanui River and the Waikari River are the only 2 sites meeting the ANZECC guideline for recreational waters of 1.6m (when compared with the median water clarity measured at each site). Sandy Creek and the Mahiaruhe Stream have the worst water clarity of all sites.

   Compared with other SOE sites in the region, these sites rank in the middle of the Hawke's Bay region for water clarity and turbidity.

   A deterioration in water clarity (black disc) over time was detected at only Mahiaruhe Stream, while deteriorating trends in turbidity (i.e. an increase over time) were detected at the Esk River at Berry Road, Mahiaruhe Stream and the Aropaoanui River.

4. Toxicants:

   Concentrations of nitrate nitrogen and ammoniacal nitrogen are always low at all sites, well below guideline values indicating that the risk of toxic effects from either nitrate or ammonia can be considered low at all SOE monitoring sites in the Esk, Aropaoanui and Waikari catchments. All sites fall within the NPSFM A Band for nitrate and 'A' or 'B' Bands for ammonia.

   Improving trends (i.e. a reduction over time) in nitrate concentrations were detected at the 2 sites in the Waikari catchment, with no change at any of the sites within the other 2 catchments.

5. Nutrients:

   The following patterns were noted with regards to nutrient concentrations:

   - Nitrogen concentrations, both Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN), were generally moderate and better than the relevant ANZECC trigger values, with the exception of Sandy Creek and the Mahiaruhe Stream;
   - Again with the notable exception of Sandy Creek and the Mahiaruhe Stream, median TP concentrations were better than the ANZECC trigger values at all sites. However, the same is not true when considering the DRP concentrations, for which only the Anaura Stream was better than the ANZECC trigger value;
   - The Anaura Stream had the lowest nutrient (both N and P) concentrations of all sites

- Sandy Creek and the Mahiaruhe Stream had by far the highest nutrients (both nitrogen and phosphorus) concentrations, and largely exceeded ANZEEC trigger values and RRMP guidelines;
- Nutrient concentrations at the 2 Esk River sites were very similar, indicating no change in nutrient status along the course of the Esk River;
- DIN/DRP ratios indicated that all sites except the Aropaoanui River and the Anaura Stream, had nutrient ratios indicative of co-limited conditions. Nitrogen-limited conditions were likely to occur at times in the Aropaoanui River, whilst a mix of co-limited and P-limited conditions were likely to occur in the Anaura Stream. In Sandy Creek and the Mahiaruhe Stream, any nutrient limitation was likely to be very weak or absent (unlimited conditions). By contrast, moderate to strong co-limitation of periphyton growth was likely in the Aropaoanui, Esk and Waikari main stems. Nutrient limitation of periphyton growth (a mix of co- and P-limited conditions) was likely to be strong in the Anaura Stream.

Compared with other SOE sites in the region, most Esk, Aropaoanui and Waikari River sites ranked in the bottom 40% for the region for both DIN and DRP.

Nutrient concentrations were generally stable over time across the study area, although improvements in DIN were detected in the Aropaoanui River, Anaura Stream and Waikari River. No changes (improvements or deterioration) were seen at any sites in the Esk, Aropaoanui and Waikari catchments for DRP. Significant improvements in TN and TP were also detected, but only in the Esk River at Berry Road and Anaura Stream, as well as in the Aropaoanui River for TP.

6. Biological indicators:

MCI (macroinvertebrate community index) scores at both Esk River sites, in the Aropaoanui River and the Anaura Stream indicated good water quality, while those in Sandy Creek and the Mahiaruhe Stream and the Waikari River had in-stream macroinvertebrate communities indicating 'fair' water quality. The Mahiaruhe Stream had the worst median MCI score and was the only site where MCI scores were observed indicating 'poor' water quality (< 80).

Periphyton is the brown or green slime or filamentous material coating stones, wood, or other stable surfaces in streams and rivers. It is a natural component of riverine environments, however, excessive ('nuisance') growths can affect both human use of the river and ecological values.

Periphyton biomasses were generally below both the 120 mg/m$^2$ 'recreational' and 50 mg/m$^2$ 'biodiversity' thresholds in the Anaura Stream, Sandy Creek and Aropaoanui River, although Sandy Creek and the Mahiaruhe Stream are unsuited to periphyton development.

Both sites on the Esk River and the Waikari River site had higher median periphyton biomass levels, exceeding the threshold for the protection of aquatic biodiversity values, but within or just exceeding the threshold for the protection of aesthetics and recreational values. At all 3 sites, periphyton biomass at times largely exceeded the 120 mg/m$^2$ 'recreational' threshold. The highest levels (represented by 90$^{th}$ percentile whiskers) were observed in the Waikari River.

Data at all sites were limited to annual measurements (1 to 5 annual measurements available at each site), and were insufficient to provide a robust indication of periphyton biomass patterns at these sites. In particular they did not show if – or how often – 'nuisance' periphyton growth occurs.

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# Appendix A Land Cover (LCDB4) and Land Use Capability (LUC) descriptions

**Table A1: LCDB4 land cover categories and summary principle land cover categories** The principal land cover categories have been adapted from Thompson et al 2003 and Walker et al 2007. (Thompson S, Grüner I, Gapare N, Ministry for the Environment 2003. New Zealand Land Cover Database Version 2, Illustrated Guide to Target Classes. Walker S, Ciegaard E, Grove P, Lloyd K, Myers S, Park T, Porteous T 2007. Guide for the Users of the Threatened Environment Classification Version 1.1, August 2007. Landcare Research Manaaki Whenua (p 35).

| Principal land cover category | LCDB4 Landuse Category Name_2012 | Comment |
|---|---|---|
| Native Cover | Broadleaved Indigenous Hardwoods<br>Depleted Grassland<br>Fernland<br>Herbaceous Freshwater Vegetation<br>Herbaceous Saline Vegetation<br>Indigenous Forest<br>Manuka and/or Kanuka<br>Matagouri or Grey Scrub<br>Sub Alpine Shrubland<br>Tall Tussock Grassland | These LCDB4 land use categories have all been classified as indigenous (Walker et al 2007). The assessment whether a land cover class is indigenous or exotic is based on a subjective examination of vegetation cover and whether it is mainly exotic or indigenous. Many of the cover classes, such as depleted grassland, contain a mixture of exotic and indigenous species (Walker et al 2007). For the purposes of this report, depleted grassland has been classified as indigenous. |
| Plantation forestry | Deciduous Hardwoods<br>Exotic Forest<br>Forest - Harvested | As well as including willow and poplar species, deciduous hardwoods have been included in this category, as this class, also includes planted exotic hardwoods (Thompson et al 2003) |

| | | |
|---|---|---|
| High producing grassland | High Producing Exotic Grassland | Land that is intensively managed and grazed for wool, lamb, beef, dairy or deer production. |
| Low producing grassland | Low Producing Grassland | Exotic and indigenous grasslands, grazed for wool, sheep or beef. Usually found on steep hill country. |
| Orchards/Vineyards | Orchard, Vineyard or Other Perennial Crop | Land used for perennial vines, areas cultivated less than annually and tree crops such as pip, stone and citrus fruit, olives and nuts as well as climbing plants such as berries, and kiwifruit. |
| Cropping | Short-rotation Cropland | Includes land used for cereal, root, annual seed and annual vegetable crops, hops, strawberries, flower crops and open ground nurseries. |
| Urban areas | Built-up Area (settlement)<br>Transport Infrastructure<br>Urban Parkland/Open Space<br>Surface Mine or Dump | Surfaces with high run off rates. Includes land associated with hard urban manmade surfaces, infrastructure and mown grass, and bare surfaces associated with gravel pits, quarries and dumps. |
| Unaccounted, <1% of total catchment area | Estuarine Open Water<br>Gorse and/or Broom<br>Gravel or Rock<br>Lake or Pond<br>Landslide<br>Mixed Exotic Shrubland<br>River<br>Sand or Gravel | These categories have not been included in the landuse summary tables in this report. They account for less than 1% of total catchment area and are perceived to have little or no contribution to eutrophication of water bodies. |

**Table A2: LUC Class descriptions** (Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF 2009. Land Use Capability Survey Handbook - a New Zealand handbook for the classification of land, 3rd ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science. P8-11, 48-75.)

| Class | LUC Description |
|---|---|
| Class 1 | Versatile arable land for multiple land uses |
| Class 2 | Arable land with only slight physical limitations to land uses |
| Class 3 | Arable land with moderate physical limitation to land uses |
| Class 4 | Arable land with severe physical limitation to land uses |
| Class 5 | High-producing land for pasture or forestry with minimal physical limitations |
| Class 6 | Moderate-producing pastoral or forestry with moderate physical limitations |
| Class 7 | Low-producing land for pastoral or forestry with severe physical limitations |
| Class 8 | Severe to extreme physical limitations, unsuitable for arable, pastoral or forestry land uses |
| River /Town/Lake | River open water and urban areas unsuitable for arable land uses, pasture or forestry. |

# Appendix B Summary statistics by flow

## 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla (mg/m$^2$) | MCI (Unit) | % EPT taxa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Anaura Strm | Minimum | 0.8 | 1.5 | 1 | 0.3 | 0.004 | 0.002 | 0.055 | 0.015 | 3 | 0.001 | 0.005 | 8.8 | 82 | 117 | 7.7 | 2.6 | 33.0 | 3.8 | 0.7 | 105.7 | 46.4 |
| | 5%'ile | 0.9 | 1.5 | 1 | 0.4 | 0.005 | 0.002 | 0.072 | 0.016 | 3 | 0.002 | 0.005 | 8.9 | 84 | 122 | 7.7 | 2.6 | 35.2 | 4.4 | no data | no data | no data |
| | 25%'ile | 1.3 | 1.5 | 5 | 1.3 | 0.007 | 0.002 | 0.151 | 0.026 | 9 | 0.012 | 0.005 | 10.5 | 91 | 182 | 7.9 | 2.8 | 77.0 | 8.0 | 1.0 | 108.4 | 47.4 |
| | Median | 2.7 | 1.5 | 10 | 1.5 | 0.009 | 0.006 | 0.189 | 0.036 | 13 | 0.025 | 0.005 | 11.1 | 101 | 214 | 8.2 | 3.5 | 86.5 | 9.8 | 13.1 | 111.7 | 53.5 |
| | 75%'ile | 4.8 | 5.1 | 23 | 2.1 | 0.011 | 0.008 | 0.268 | 0.131 | 18 | 0.117 | 0.014 | 12.0 | 105 | 236 | 8.2 | 5.1 | 93.0 | 14.8 | 68.0 | 115.1 | 59.9 |
| | 95%'ile | 26.1 | 45.8 | 122 | 3.2 | 0.036 | 0.011 | 0.987 | 0.675 | 78 | 0.651 | 0.043 | 13.0 | 116 | 291 | 8.3 | 9.4 | 108.6 | 17.0 | no data | no data | no data |
| | Maximum | 31.0 | 64.0 | 170 | 3.2 | 0.045 | 0.012 | 1.190 | 0.860 | 91 | 0.850 | 0.056 | 13.3 | 117 | 314 | 8.3 | 10.1 | 110.0 | 17.2 | 111.1 | 117.8 | 61.1 |
| | Mean | 5.6 | 6.6 | 22 | 1.7 | 0.012 | 0.005 | 0.263 | 0.123 | 20 | 0.107 | 0.011 | 11.1 | 99 | 207 | 8.1 | 4.2 | 80.1 | 10.8 | 34.5 | 111.7 | 53.6 |
| | Std. Dev. | 7.8 | 15.0 | 39 | 0.8 | 0.009 | 0.003 | 0.269 | 0.208 | 22 | 0.207 | 0.013 | 1.2 | 9 | 48 | 0.2 | 2.1 | 22.7 | 4.2 | 52.3 | 5.0 | 7.3 |
| | Count | 17 | 17 | 17 | 15 | 17 | 17 | 15 | 16 | 16 | 16 | 17 | 16 | 15 | 17 | 17 | 13 | 14 | 17 | 4 | 4 | 4 |
| Aropaoanui Rv | Minimum | 0.5 | 1.5 | 1 | 0.1 | 0.016 | 0.002 | 0.110 | 0.014 | 1 | 0.001 | 0.005 | 8.5 | 90 | 218 | 7.7 | 1.2 | 106.0 | 7.1 | 4.4 | 86.7 | 37.5 |
| | 5%'ile | 1.0 | 1.5 | 1 | 0.1 | 0.016 | 0.007 | 0.120 | 0.015 | 1 | 0.003 | 0.005 | 9.0 | 96 | 236 | 8.0 | 1.2 | 108.8 | 7.1 | no data | no data | no data |
| | 25%'ile | 1.6 | 1.5 | 13 | 1.2 | 0.024 | 0.012 | 0.170 | 0.022 | 2 | 0.011 | 0.005 | 10.2 | 101 | 297 | 8.2 | 1.5 | 130.0 | 10.7 | 5.5 | 101.2 | 43.1 |
| | Median | 2.0 | 3.0 | 43 | 1.7 | 0.029 | 0.019 | 0.290 | 0.110 | 6 | 0.097 | 0.005 | 11.1 | 106 | 311 | 8.5 | 2.0 | 138.5 | 15.1 | 36.0 | 107.2 | 52.0 |
| | 75%'ile | 4.5 | 6.0 | 99 | 2.3 | 0.033 | 0.026 | 0.487 | 0.286 | 12 | 0.270 | 0.009 | 12.1 | 114 | 348 | 8.6 | 3.1 | 141.0 | 18.9 | 62.1 | 113.7 | 58.9 |
| | 95%'ile | 50.7 | 58.4 | 3370 | 3.2 | 0.138 | 0.036 | 0.779 | 0.421 | 22 | 0.407 | 0.029 | 14.7 | 137 | 380 | 8.9 | 4.9 | 156.8 | 23.0 | no data | no data | no data |
| | Maximum | 139.0 | 320.0 | 4700 | 3.4 | 0.330 | 0.052 | 1.360 | 0.634 | 144 | 0.600 | 0.031 | 14.9 | 172 | 389 | 9.1 | 5.0 | 160.0 | 24.1 | 64.3 | 121.0 | 66.7 |
| | Mean | 9.7 | 16.8 | 335 | 1.8 | 0.042 | 0.020 | 0.358 | 0.164 | 11 | 0.149 | 0.009 | 11.3 | 110 | 314 | 8.5 | 2.4 | 135.1 | 14.8 | 34.4 | 106.4 | 51.5 |
| | Std. Dev. | 26.4 | 57.4 | 1035 | 0.9 | 0.058 | 0.010 | 0.264 | 0.159 | 25 | 0.155 | 0.007 | 1.7 | 15 | 43 | 0.3 | 1.3 | 12.8 | 5.0 | 28.9 | 12.5 | 11.1 |
| | Count | 29 | 31 | 29 | 30 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 28 | 27 | 31 | 31 | 13 | 14 | 30 | 5 | 5 | 5 |
| Esk Rv at Berry Rd | Minimum | 0.4 | 1.5 | 6 | 0.2 | 0.012 | 0.007 | 0.180 | 0.101 | 6 | 0.088 | 0.005 | 9.8 | 84 | 253 | 7.9 | 0.6 | 120.0 | 7.3 | 35.1 | 107.4 | 42.1 |
| | 5%'ile | 0.5 | 1.5 | 9 | 0.2 | 0.015 | 0.008 | 0.189 | 0.119 | 7 | 0.101 | 0.005 | 10.0 | 92 | 257 | 8.0 | 0.6 | 121.0 | 8.1 | no data | no data | no data |
| | 25%'ile | 1.6 | 1.5 | 16 | 0.8 | 0.020 | 0.017 | 0.281 | 0.198 | 12 | 0.162 | 0.005 | 11.2 | 101 | 277 | 8.3 | 1.2 | 133.0 | 9.1 | 55.5 | 108.2 | 46.1 |
| | Median | 2.7 | 4.0 | 21 | 1.4 | 0.026 | 0.022 | 0.406 | 0.305 | 15 | 0.290 | 0.011 | 11.5 | 105 | 290 | 8.4 | 1.5 | 139.0 | 11.0 | 84.0 | 110.5 | 52.8 |
| | 75%'ile | 4.9 | 8.0 | 41 | 2.5 | 0.032 | 0.024 | 0.490 | 0.398 | 18 | 0.395 | 0.014 | 11.8 | 109 | 304 | 8.6 | 2.8 | 144.5 | 14.1 | 161.0 | 118.9 | 56.4 |
| | 95%'ile | 22.4 | 51.0 | 192 | 4.1 | 0.059 | 0.033 | 0.692 | 0.550 | 23 | 0.533 | 0.030 | 12.4 | 115 | 321 | 8.9 | 3.6 | 157.4 | 15.9 | no data | no data | no data |
| | Maximum | 23.8 | 62.0 | 600 | 4.2 | 0.063 | 0.035 | 0.780 | 0.564 | 25 | 0.540 | 0.063 | 12.8 | 115 | 327 | 9.1 | 3.6 | 158.0 | 16.3 | 230.0 | 125.7 | 57.1 |
| | Mean | 5.0 | 9.7 | 56 | 1.7 | 0.029 | 0.021 | 0.407 | 0.303 | 15 | 0.288 | 0.012 | 11.4 | 105 | 290 | 8.4 | 1.9 | 139.3 | 11.6 | 108.3 | 113.5 | 51.2 |
| | Std. Dev. | 6.6 | 15.0 | 113 | 1.1 | 0.013 | 0.007 | 0.158 | 0.131 | 5 | 0.135 | 0.012 | 0.7 | 7 | 18 | 0.2 | 1.0 | 10.1 | 2.8 | 84.6 | 8.4 | 6.8 |
| | Count | 26 | 27 | 27 | 26 | 27 | 27 | 26 | 27 | 27 | 24 | 27 | 27 | 25 | 27 | 26 | 10 | 12 | 27 | 4 | 4 | 4 |
| Esk Rv at Waipunga Br | Minimum | 0.5 | 1.5 | 7 | 0.3 | 0.011 | 0.002 | 0.078 | 0.014 | 1 | 0.001 | 0.005 | 9.1 | 88 | 268 | 7.9 | 0.6 | 110.0 | 8.1 | 52.6 | 97.8 | 33.3 |
| | 5%'ile | 0.6 | 1.5 | 9 | 0.4 | 0.013 | 0.009 | 0.100 | 0.018 | 1 | 0.006 | 0.005 | 9.2 | 90 | 268 | 8.0 | 0.7 | 114.0 | 8.3 | no data | no data | no data |
| | 25%'ile | 1.3 | 1.5 | 21 | 0.9 | 0.024 | 0.016 | 0.230 | 0.115 | 5 | 0.099 | 0.005 | 10.7 | 101 | 310 | 8.2 | 1.6 | 140.0 | 10.5 | 59.9 | 102.6 | 35.6 |
| | Median | 1.8 | 3.6 | 40 | 1.5 | 0.032 | 0.024 | 0.370 | 0.271 | 11 | 0.260 | 0.008 | 11.2 | 105 | 328 | 8.3 | 2.0 | 148.0 | 12.4 | 125.1 | 104.6 | 37.5 |
| | 75%'ile | 4.0 | 8.0 | 70 | 2.5 | 0.043 | 0.029 | 0.500 | 0.420 | 18 | 0.385 | 0.023 | 11.7 | 118 | 345 | 8.4 | 3.2 | 151.0 | 18.1 | 208.4 | 109.2 | 39.3 |
| | 95%'ile | 23.6 | 41.0 | 380 | 4.1 | 0.069 | 0.039 | 0.812 | 0.618 | 30 | 0.591 | 0.090 | 12.4 | 141 | 369 | 9.0 | 4.4 | 162.6 | 22.5 | no data | no data | no data |
| | Maximum | 24.7 | 58.0 | 390 | 4.4 | 0.073 | 0.041 | 0.850 | 0.648 | 37 | 0.610 | 0.113 | 14.3 | 144 | 373 | 9.5 | 4.4 | 164.0 | 23.7 | 233.9 | 109.6 | 41.7 |
| | Mean | 4.6 | 8.2 | 77 | 1.7 | 0.035 | 0.023 | 0.392 | 0.270 | 12 | 0.252 | 0.019 | 11.2 | 110 | 324 | 8.4 | 2.3 | 145.5 | 14.1 | 134.2 | 105.1 | 37.5 |
| | Std. Dev. | 6.6 | 12.7 | 103 | 1.1 | 0.017 | 0.010 | 0.209 | 0.185 | 9 | 0.174 | 0.025 | 1.0 | 14 | 29 | 0.3 | 1.1 | 13.1 | 4.4 | 88.4 | 4.8 | 3.1 |
| | Count | 27 | 30 | 30 | 26 | 30 | 30 | 30 | 30 | 30 | 29 | 30 | 30 | 28 | 29 | 29 | 12 | 14 | 29 | 4 | 5 | 5 |

# 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla (mg/m$^2$) | MCI (Unit) | % EPT taxa |
| Mahiaruhe Strm | Minimum | 2.6 | 1.5 | 4 | 0.0 | 0.039 | 0.017 | 0.520 | 0.130 | 2 | 0.100 | 0.005 | 5.6 | 88 | 101 | 7.4 | 3.3 | 33.0 | 8.9 | no data | 72.6 | 22.2 |
| | 5%'ile | 2.7 | 1.7 | 4 | 0.1 | 0.039 | 0.017 | 0.521 | 0.132 | 2 | 0.101 | 0.005 | no data | no data | 107 | 7.4 | 3.3 | 36.0 | 8.9 | no data | no data | no data |
| | 25%'ile | 3.5 | 3.7 | 28 | 0.7 | 0.050 | 0.021 | 0.563 | 0.212 | 7 | 0.188 | 0.022 | 8.5 | 91 | 165 | 7.7 | 3.6 | 65.5 | 10.0 | no data | 72.6 | 22.2 |
| | Median | 3.8 | 5.2 | 149 | 1.2 | 0.058 | 0.026 | 0.670 | 0.365 | 9 | 0.320 | 0.030 | 9.3 | 96 | 188 | 7.8 | 4.2 | 73.5 | 13.5 | no data | 85.2 | 24.3 |
| | 75%'ile | 4.7 | 13.0 | 360 | 1.3 | 0.104 | 0.044 | 0.760 | 0.395 | 15 | 0.347 | 0.039 | 11.4 | 102 | 210 | 7.9 | 5.4 | 90.0 | 17.6 | no data | 97.8 | 26.3 |
| | 95%'ile | 243.9 | 496.9 | 24000 | 1.7 | 0.763 | 0.092 | 3.300 | 0.591 | 31 | 0.370 | 0.250 | no data | no data | 262 | 8.2 | 11.9 | 117.4 | 20.8 | no data | no data | no data |
| | Maximum | 270.0 | 550.0 | 24000 | 1.7 | 0.830 | 0.095 | 3.430 | 0.600 | 32 | 0.370 | 0.270 | 12.0 | 109 | 265 | 8.2 | 12.6 | 120.0 | 20.8 | no data | 97.8 | 26.3 |
| | Mean | 26.4 | 52.4 | 2587 | 1.0 | 0.135 | 0.037 | 0.911 | 0.334 | 12 | 0.276 | 0.049 | 9.5 | 97 | 189 | 7.8 | 5.0 | 76.7 | 14.0 | no data | 85.2 | 24.3 |
| | Std. Dev. | 76.7 | 156.8 | 7528 | 0.5 | 0.222 | 0.023 | 0.841 | 0.133 | 9 | 0.101 | 0.071 | 2.1 | 7 | 41 | 0.2 | 2.5 | 21.3 | 4.5 | no data | 17.8 | 2.9 |
| | Count | 12 | 12 | 10 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 12 | 8 | 7 | 12 | 12 | 12 | 12 | 12 | no data | 2 | 2 |
| Sandy Ck | Minimum | 1.9 | 1.5 | 4 | 0.1 | 0.047 | 0.028 | 0.320 | 0.169 | 2 | 0.120 | 0.005 | 7.7 | 83 | 102 | 7.2 | 2.4 | 33.0 | 4.6 | 15.8 | 90.0 | 33.3 |
| | 5%'ile | 2.0 | 1.5 | 6 | 0.3 | 0.048 | 0.029 | 0.385 | 0.220 | 4 | 0.204 | 0.005 | 7.8 | 83 | 162 | 7.2 | 2.5 | 39.3 | 5.9 | no data | no data | no data |
| | 25%'ile | 2.8 | 3.0 | 48 | 0.6 | 0.065 | 0.038 | 0.545 | 0.327 | 7 | 0.292 | 0.019 | 9.4 | 92 | 189 | 7.5 | 3.4 | 67.0 | 9.1 | no data | 91.9 | 34.0 |
| | Median | 4.0 | 7.0 | 220 | 1.2 | 0.072 | 0.044 | 0.700 | 0.438 | 9 | 0.390 | 0.028 | 10.8 | 99 | 213 | 7.8 | 3.5 | 82.0 | 13.2 | 15.8 | 98.1 | 36.3 |
| | 75%'ile | 6.1 | 12.5 | 478 | 1.6 | 0.100 | 0.051 | 0.868 | 0.550 | 16 | 0.518 | 0.039 | 12.0 | 103 | 231 | 7.9 | 4.9 | 91.0 | 16.6 | no data | 104.5 | 40.1 |
| | 95%'ile | 24.7 | 122.0 | 4075 | 2.8 | 0.565 | 0.064 | 1.526 | 0.918 | 20 | 0.882 | 0.062 | 13.1 | 127 | 268 | 8.3 | 10.6 | 115.8 | 20.3 | no data | no data | no data |
| | Maximum | 210.0 | 510.0 | 13000 | 3.0 | 0.790 | 0.100 | 2.450 | 1.230 | 23 | 1.230 | 0.117 | 13.2 | 141 | 276 | 8.4 | 11.3 | 120.0 | 20.6 | 15.8 | 106.7 | 42.3 |
| | Mean | 12.0 | 28.0 | 844 | 1.2 | 0.122 | 0.046 | 0.786 | 0.469 | 11 | 0.432 | 0.030 | 10.7 | 99 | 210 | 7.8 | 4.5 | 80.5 | 12.9 | 15.8 | 98.2 | 37.0 |
| | Std. Dev. | 38.2 | 87.7 | 2485 | 0.8 | 0.158 | 0.013 | 0.402 | 0.210 | 5 | 0.211 | 0.021 | 1.6 | 12 | 38 | 0.3 | 2.4 | 21.0 | 4.6 | 0.0 | 7.7 | 4.0 |
| | Count | 29 | 35 | 27 | 28 | 35 | 34 | 35 | 35 | 34 | 35 | 34 | 26 | 26 | 32 | 32 | 13 | 15 | 32 | 1 | 4 | 4 |
| Waikari Rv | Minimum | 0.6 | 1.5 | 1 | 0.0 | 0.012 | 0.002 | 0.176 | 0.014 | 2 | 0.001 | 0.005 | 9.0 | 96 | 137 | 7.7 | 2.2 | 49.0 | 6.2 | 29.2 | 86.9 | 20.7 |
| | 5%'ile | 0.7 | 1.5 | 1 | 0.1 | 0.012 | 0.002 | 0.181 | 0.015 | 2 | 0.003 | 0.005 | 9.4 | 96 | 182 | 7.7 | 2.2 | 53.3 | 6.5 | no data | no data | no data |
| | 25%'ile | 1.2 | 1.5 | 20 | 0.8 | 0.020 | 0.007 | 0.249 | 0.034 | 5 | 0.020 | 0.005 | 10.8 | 106 | 284 | 8.2 | 2.6 | 98.0 | 10.1 | 44.6 | 91.2 | 32.8 |
| | Median | 2.9 | 1.5 | 40 | 1.9 | 0.026 | 0.017 | 0.353 | 0.180 | 14 | 0.141 | 0.009 | 12.0 | 110 | 332 | 8.5 | 2.8 | 120.0 | 14.1 | 105.2 | 95.8 | 37.5 |
| | 75%'ile | 5.1 | 4.0 | 133 | 2.8 | 0.033 | 0.021 | 0.607 | 0.319 | 20 | 0.285 | 0.021 | 12.8 | 123 | 408 | 8.7 | 5.3 | 132.5 | 18.0 | 332.5 | 100.0 | 45.2 |
| | 95%'ile | 45.4 | 56.7 | 7000 | 3.2 | 0.143 | 0.029 | 1.352 | 0.634 | 66 | 0.584 | 0.051 | 14.6 | 137 | 479 | 9.0 | 17.9 | 157.5 | 22.7 | no data | no data | no data |
| | Maximum | 1890.0 | 3300.0 | 16000 | 3.3 | 1.610 | 0.032 | 5.010 | 1.185 | 110 | 1.160 | 0.053 | 15.3 | 146 | 483 | 9.1 | 20.0 | 160.0 | 23.9 | 550.0 | 110.0 | 45.8 |
| | Mean | 69.6 | 109.9 | 888 | 1.8 | 0.082 | 0.015 | 0.618 | 0.221 | 18 | 0.197 | 0.016 | 11.8 | 114 | 333 | 8.5 | 4.9 | 114.1 | 13.9 | 198.8 | 96.4 | 37.2 |
| | Std. Dev. | 344.0 | 582.3 | 3169 | 1.1 | 0.280 | 0.009 | 0.870 | 0.237 | 22 | 0.231 | 0.015 | 1.6 | 13 | 88 | 0.4 | 4.8 | 30.5 | 5.1 | 216.1 | 8.5 | 10.1 |
| | Count | 30 | 32 | 28 | 31 | 32 | 32 | 31 | 32 | 32 | 32 | 32 | 28 | 27 | 32 | 32 | 14 | 15 | 32 | 5 | 5 | 5 |

## < 3 X 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla (mg/m$^2$) | MCI (Unit) | % EPT taxa |
| Anaura Strm | Minimum | 0.8 | 1.5 | 1 | 0.3 | 0.004 | 0.002 | 0.055 | 0.015 | 3 | 0.001 | 0.005 | 8.8 | 82 | 117 | 7.7 | 2.6 | 33.0 | 3.8 | 0.7 | 105.7 | 46.4 |
| | 5%'ile | 0.9 | 1.5 | 1 | 0.4 | 0.005 | 0.002 | 0.072 | 0.016 | 3 | 0.002 | 0.005 | 8.9 | 84 | 122 | 7.7 | 2.6 | 35.2 | 4.4 | no data | no data | no data |
| | 25%'ile | 1.3 | 1.5 | 5 | 1.3 | 0.007 | 0.002 | 0.151 | 0.026 | 9 | 0.012 | 0.005 | 10.5 | 91 | 182 | 7.9 | 2.8 | 77.0 | 8.0 | 1.0 | 108.4 | 47.4 |
| | Median | 2.7 | 1.5 | 10 | 1.5 | 0.009 | 0.006 | 0.189 | 0.036 | 13 | 0.025 | 0.005 | 11.1 | 101 | 214 | 8.2 | 3.5 | 86.5 | 9.8 | 13.1 | 111.7 | 53.5 |
| | 75%'ile | 4.8 | 5.1 | 23 | 2.1 | 0.011 | 0.008 | 0.268 | 0.131 | 18 | 0.117 | 0.014 | 12.0 | 105 | 236 | 8.2 | 5.1 | 93.0 | 14.8 | 68.0 | 115.1 | 59.9 |
| | 95%'ile | 26.1 | 45.8 | 122 | 3.2 | 0.036 | 0.011 | 0.987 | 0.675 | 78 | 0.651 | 0.043 | 13.0 | 116 | 291 | 8.3 | 9.4 | 108.6 | 17.0 | no data | no data | no data |
| | Maximum | 31.0 | 64.0 | 170 | 3.2 | 0.045 | 0.012 | 1.190 | 0.860 | 91 | 0.850 | 0.056 | 13.3 | 117 | 314 | 8.3 | 10.1 | 110.0 | 17.2 | 111.1 | 117.8 | 61.1 |
| | Mean | 5.6 | 6.6 | 22 | 1.7 | 0.012 | 0.005 | 0.263 | 0.123 | 20 | 0.107 | 0.011 | 11.1 | 99 | 207 | 8.1 | 4.2 | 80.1 | 10.8 | 34.5 | 111.7 | 53.6 |
| | Std. Dev. | 7.8 | 15.0 | 39 | 0.8 | 0.009 | 0.003 | 0.269 | 0.208 | 22 | 0.207 | 0.013 | 1.2 | 9 | 48 | 0.2 | 2.1 | 22.7 | 4.2 | 52.3 | 5.0 | 7.3 |
| | Count | 17 | 17 | 17 | 15 | 17 | 17 | 15 | 16 | 16 | 16 | 17 | 16 | 15 | 17 | 17 | 13 | 14 | 17 | 4 | 4 | 4 |
| Aropaoanui Rv | Minimum | 0.5 | 1.5 | 1 | 0.8 | 0.016 | 0.002 | 0.110 | 0.014 | 1 | 0.001 | 0.005 | 8.5 | 90 | 263 | 7.7 | 1.2 | 123.0 | 7.1 | 4.4 | 86.7 | 37.5 |
| | 5%'ile | 0.9 | 1.5 | 1 | 1.0 | 0.016 | 0.006 | 0.118 | 0.015 | 1 | 0.003 | 0.005 | 8.9 | 95 | 267 | 8.0 | 1.2 | 123.7 | 7.1 | no data | no data | no data |
| | 25%'ile | 1.5 | 1.5 | 5 | 1.3 | 0.023 | 0.011 | 0.163 | 0.022 | 1 | 0.010 | 0.005 | 10.4 | 104 | 302 | 8.3 | 1.4 | 133.5 | 10.7 | 5.5 | 101.2 | 43.1 |
| | Median | 1.8 | 3.0 | 30 | 2.0 | 0.028 | 0.018 | 0.222 | 0.056 | 4 | 0.050 | 0.005 | 11.6 | 107 | 322 | 8.6 | 1.9 | 139.5 | 14.6 | 36.0 | 107.2 | 52.0 |
| | 75%'ile | 3.2 | 5.0 | 61 | 3.0 | 0.032 | 0.025 | 0.401 | 0.271 | 11 | 0.260 | 0.005 | 12.3 | 115 | 354 | 8.7 | 2.3 | 141.5 | 18.9 | 62.1 | 113.7 | 58.9 |
| | 95%'ile | 10.1 | 9.8 | 188 | 3.2 | 0.044 | 0.029 | 0.664 | 0.455 | 41 | 0.439 | 0.018 | 14.8 | 145 | 382 | 9.0 | 4.2 | 158.4 | 23.2 | no data | no data | no data |
| | Maximum | 21.6 | 14.0 | 360 | 3.4 | 0.047 | 0.029 | 0.780 | 0.634 | 144 | 0.600 | 0.029 | 14.9 | 172 | 389 | 9.1 | 4.3 | 160.0 | 24.1 | 64.3 | 121.0 | 66.7 |
| | Mean | 3.1 | 3.6 | 51 | 2.0 | 0.028 | 0.018 | 0.295 | 0.144 | 12 | 0.130 | 0.007 | 11.6 | 111 | 324 | 8.5 | 2.0 | 138.8 | 14.6 | 34.4 | 106.4 | 51.5 |
| | Std. Dev. | 4.1 | 3.0 | 73 | 0.8 | 0.008 | 0.008 | 0.172 | 0.160 | 27 | 0.157 | 0.006 | 1.7 | 16 | 34 | 0.3 | 0.9 | 9.1 | 5.2 | 28.9 | 12.5 | 11.1 |
| | Count | 25 | 27 | 25 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 24 | 23 | 27 | 27 | 11 | 12 | 26 | 5 | 5 | 5 |
| Esk Rv at Berry Rd | Minimum | 0.4 | 1.5 | 6 | 0.3 | 0.012 | 0.007 | 0.180 | 0.101 | 6 | 0.088 | 0.005 | 9.8 | 84 | 253 | 7.9 | 0.6 | 120.0 | 7.3 | 35.1 | 107.4 | 42.1 |
| | 5%'ile | 0.5 | 1.5 | 8 | 0.4 | 0.014 | 0.008 | 0.188 | 0.117 | 7 | 0.099 | 0.005 | 10.0 | 91 | 262 | 8.0 | 0.6 | 121.0 | 8.0 | no data | no data | no data |
| | 25%'ile | 1.6 | 1.5 | 17 | 0.9 | 0.020 | 0.017 | 0.276 | 0.184 | 11 | 0.146 | 0.005 | 11.2 | 102 | 282 | 8.3 | 1.2 | 133.0 | 9.2 | 55.5 | 108.2 | 46.1 |
| | Median | 2.3 | 4.0 | 21 | 1.4 | 0.026 | 0.020 | 0.391 | 0.302 | 14 | 0.285 | 0.011 | 11.6 | 106 | 291 | 8.4 | 1.5 | 139.0 | 11.4 | 84.0 | 110.5 | 52.8 |
| | 75%'ile | 3.7 | 8.0 | 44 | 2.5 | 0.030 | 0.024 | 0.461 | 0.358 | 18 | 0.330 | 0.015 | 11.8 | 109 | 304 | 8.6 | 2.8 | 144.5 | 14.3 | 161.0 | 118.9 | 56.4 |
| | 95%'ile | 15.5 | 24.3 | 240 | 4.1 | 0.053 | 0.034 | 0.661 | 0.486 | 23 | 0.474 | 0.034 | 12.4 | 115 | 322 | 8.9 | 3.6 | 157.4 | 15.9 | no data | no data | no data |
| | Maximum | 23.8 | 34.0 | 600 | 4.2 | 0.063 | 0.035 | 0.780 | 0.564 | 25 | 0.540 | 0.063 | 12.8 | 115 | 327 | 9.1 | 3.6 | 158.0 | 16.3 | 230.0 | 125.7 | 57.1 |
| | Mean | 3.7 | 6.0 | 59 | 1.8 | 0.027 | 0.020 | 0.386 | 0.286 | 14 | 0.269 | 0.012 | 11.4 | 105 | 292 | 8.4 | 1.9 | 139.3 | 11.8 | 108.3 | 113.5 | 51.2 |
| | Std. Dev. | 4.9 | 7.2 | 117 | 1.1 | 0.012 | 0.007 | 0.145 | 0.120 | 5 | 0.123 | 0.012 | 0.7 | 7 | 17 | 0.3 | 1.0 | 10.1 | 2.8 | 84.6 | 8.4 | 6.8 |
| | Count | 24 | 25 | 25 | 24 | 25 | 25 | 24 | 25 | 25 | 22 | 25 | 25 | 23 | 25 | 24 | 10 | 12 | 25 | 4 | 4 | 4 |
| Esk Rv at Waipunga Br | Minimum | 0.5 | 1.5 | 7 | 0.4 | 0.011 | 0.002 | 0.078 | 0.014 | 1 | 0.001 | 0.005 | 9.1 | 88 | 268 | 7.9 | 0.6 | 110.0 | 8.1 | 52.6 | 97.8 | 33.3 |
| | 5%'ile | 0.6 | 1.5 | 9 | 0.5 | 0.013 | 0.008 | 0.098 | 0.018 | 1 | 0.005 | 0.005 | 9.2 | 90 | 277 | 8.0 | 0.7 | 114.0 | 8.3 | no data | no data | no data |
| | 25%'ile | 1.2 | 1.5 | 21 | 1.1 | 0.024 | 0.016 | 0.227 | 0.094 | 5 | 0.096 | 0.005 | 10.6 | 102 | 311 | 8.2 | 1.6 | 140.0 | 10.8 | 59.9 | 102.6 | 35.6 |
| | Median | 1.8 | 2.4 | 36 | 1.7 | 0.030 | 0.023 | 0.367 | 0.266 | 10 | 0.240 | 0.005 | 11.2 | 105 | 329 | 8.3 | 2.0 | 148.0 | 13.4 | 125.1 | 104.6 | 37.5 |
| | 75%'ile | 3.2 | 7.8 | 65 | 2.5 | 0.040 | 0.030 | 0.460 | 0.367 | 18 | 0.335 | 0.019 | 11.8 | 119 | 346 | 8.5 | 3.2 | 151.0 | 18.4 | 208.4 | 109.2 | 39.3 |
| | 95%'ile | 12.0 | 15.4 | 381 | 4.1 | 0.065 | 0.039 | 0.736 | 0.552 | 31 | 0.530 | 0.092 | 12.6 | 141 | 369 | 9.0 | 4.4 | 162.6 | 22.6 | no data | no data | no data |
| | Maximum | 16.0 | 28.0 | 390 | 4.4 | 0.069 | 0.041 | 0.850 | 0.618 | 37 | 0.590 | 0.113 | 14.3 | 144 | 373 | 9.5 | 4.4 | 164.0 | 23.7 | 233.9 | 109.6 | 41.7 |
| | Mean | 3.0 | 5.3 | 75 | 1.9 | 0.033 | 0.023 | 0.365 | 0.250 | 12 | 0.233 | 0.019 | 11.2 | 110 | 328 | 8.4 | 2.3 | 145.5 | 14.4 | 134.2 | 105.1 | 37.5 |
| | Std. Dev. | 3.6 | 5.8 | 105 | 1.1 | 0.015 | 0.010 | 0.190 | 0.173 | 9 | 0.161 | 0.026 | 1.0 | 14 | 26 | 0.3 | 1.1 | 13.1 | 4.4 | 88.4 | 4.8 | 3.1 |
| | Count | 25 | 28 | 28 | 24 | 28 | 28 | 28 | 28 | 28 | 27 | 28 | 28 | 26 | 27 | 27 | 12 | 14 | 27 | 4 | 5 | 5 |

## < 3 X 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp ($^oC$) | Chla ($mg/m^2$) | MCI (Unit) | % EPT taxa |
| Mahiaruhe Strm | Minimum | 2.6 | 1.5 | 4 | 0.2 | 0.039 | 0.017 | 0.520 | 0.176 | 2 | 0.100 | 0.005 | 5.6 | 90 | 164 | 7.7 | 3.3 | 68.0 | 8.9 | no data | 72.6 | 22.2 |
| | 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 | 3.4 | 3.2 | 25 | 1.0 | 0.047 | 0.025 | 0.585 | 0.238 | 7 | 0.215 | 0.023 | 8.4 | 93 | 182 | 7.8 | 3.6 | 71.8 | 9.7 | no data | 72.6 | 22.2 |
| | Median | 3.6 | 4.1 | 64 | 1.2 | 0.054 | 0.027 | 0.655 | 0.372 | 9 | 0.340 | 0.026 | 9.9 | 96 | 197 | 7.8 | 4.1 | 81.0 | 11.5 | no data | 85.2 | 24.3 |
| | 75%'ile | 4.1 | 5.7 | 240 | 1.4 | 0.081 | 0.051 | 0.730 | 0.393 | 15 | 0.360 | 0.037 | 11.8 | 104 | 223 | 7.9 | 4.4 | 94.0 | 16.7 | no data | 97.8 | 26.3 |
| | 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 | 5.0 | 19.0 | 850 | 1.7 | 0.160 | 0.095 | 0.770 | 0.415 | 23 | 0.370 | 0.066 | 12.0 | 109 | 265 | 8.2 | 5.2 | 120.0 | 20.5 | no data | 97.8 | 26.3 |
| | Mean | 3.7 | 5.8 | 189 | 1.1 | 0.071 | 0.040 | 0.654 | 0.325 | 11 | 0.287 | 0.031 | 9.6 | 98 | 204 | 7.9 | 4.0 | 84.6 | 13.4 | no data | 85.2 | 24.3 |
| | Std. Dev. | 0.7 | 5.2 | 284 | 0.4 | 0.040 | 0.025 | 0.090 | 0.096 | 7 | 0.103 | 0.017 | 2.5 | 7 | 31 | 0.2 | 0.6 | 16.4 | 4.5 | no data | 17.8 | 2.9 |
| | Count | 9 | 9 | 8 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 9 | 6 | 5 | 9 | 9 | 9 | 9 | 9 | no data | 2 | 2 |
| Sandy Ck | Minimum | 1.9 | 1.5 | 4 | 0.3 | 0.055 | 0.035 | 0.520 | 0.169 | 2 | 0.120 | 0.027 | 9.1 | 92 | 162 | 7.5 | 2.4 | 61.0 | 7.6 | 15.8 | 93.8 | 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 | 2.8 | 2.3 | 36 | 0.8 | 0.069 | 0.040 | 0.560 | 0.377 | 7 | 0.335 | 0.029 | 9.2 | 94 | 193 | 7.6 | 3.1 | 75.0 | 8.6 | no data | 95.9 | 34.5 |
| | Median | 3.7 | 4.6 | 90 | 1.2 | 0.076 | 0.045 | 0.766 | 0.518 | 12 | 0.485 | 0.035 | 10.6 | 98 | 211 | 7.8 | 3.4 | 86.0 | 11.9 | 15.8 | 102.3 | 37.9 |
| | 75%'ile | 5.5 | 8.7 | 410 | 1.6 | 0.096 | 0.057 | 0.925 | 0.696 | 18 | 0.640 | 0.040 | 11.9 | 100 | 223 | 7.9 | 3.5 | 95.5 | 15.6 | no data | 105.6 | 41.2 |
| | 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 | 6.4 | 18.0 | 1300 | 2.1 | 0.140 | 0.100 | 1.394 | 0.991 | 23 | 0.960 | 0.050 | 12.0 | 102 | 267 | 8.0 | 4.0 | 120.0 | 20.6 | 15.8 | 106.7 | 42.3 |
| | Mean | 4.0 | 6.3 | 318 | 1.2 | 0.085 | 0.053 | 0.802 | 0.543 | 12 | 0.500 | 0.036 | 10.6 | 97 | 210 | 7.7 | 3.3 | 86.8 | 12.5 | 15.8 | 100.9 | 37.8 |
| | Std. Dev. | 1.7 | 5.5 | 463 | 0.6 | 0.027 | 0.021 | 0.291 | 0.256 | 7 | 0.258 | 0.008 | 1.6 | 4 | 31 | 0.2 | 0.5 | 18.0 | 4.7 | 0.0 | 6.6 | 4.5 |
| | Count | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 1 | 3 | 3 |
| Waikari Rv | Minimum | 0.6 | 1.5 | 1 | 0.2 | 0.012 | 0.002 | 0.242 | 0.022 | 2 | 0.010 | 0.005 | 9.6 | 105 | 179 | 7.9 | 2.2 | 66.0 | 7.4 | 29.2 | 86.9 | 20.7 |
| | 5%'ile | 0.6 | 1.5 | no data | 0.2 | 0.012 | 0.002 | 0.242 | 0.023 | 2 | 0.011 | 0.005 | no data | no data | 182 | 7.9 | 2.2 | 67.5 | 7.4 | no data | no data | no data |
| | 25%'ile | 0.8 | 1.5 | 12 | 0.9 | 0.018 | 0.003 | 0.307 | 0.070 | 16 | 0.053 | 0.005 | 10.1 | 106 | 293 | 8.1 | 2.6 | 105.5 | 8.3 | 34.3 | 89.4 | 26.8 |
| | Median | 1.6 | 1.5 | 53 | 1.9 | 0.022 | 0.013 | 0.497 | 0.269 | 19 | 0.230 | 0.017 | 11.7 | 110 | 337 | 8.4 | 2.7 | 120.0 | 12.4 | 49.7 | 96.7 | 45.0 |
| | 75%'ile | 4.4 | 2.6 | 124 | 2.1 | 0.039 | 0.022 | 0.950 | 0.375 | 28 | 0.345 | 0.021 | 12.6 | 115 | 350 | 8.5 | 3.6 | 141.5 | 17.3 | 91.3 | 106.7 | 45.6 |
| | 95%'ile | 40.2 | 51.9 | no data | 2.9 | 0.141 | 0.025 | 1.365 | 1.150 | 66 | 1.124 | 0.044 | no data | no data | 462 | 8.7 | 9.1 | 159.5 | 21.6 | no data | no data | no data |
| | Maximum | 41.7 | 54.0 | 210 | 2.9 | 0.146 | 0.025 | 1.365 | 1.185 | 67 | 1.160 | 0.045 | 14.6 | 120 | 463 | 8.7 | 9.3 | 160.0 | 21.7 | 105.2 | 110.0 | 45.8 |
| | Mean | 6.2 | 7.4 | 73 | 1.6 | 0.036 | 0.013 | 0.624 | 0.304 | 26 | 0.281 | 0.017 | 11.6 | 111 | 329 | 8.3 | 3.6 | 120.6 | 13.4 | 61.4 | 97.9 | 37.2 |
| | Std. Dev. | 12.2 | 15.8 | 78 | 0.9 | 0.038 | 0.009 | 0.388 | 0.332 | 20 | 0.327 | 0.012 | 1.7 | 6 | 80 | 0.3 | 2.1 | 26.7 | 5.1 | 39.3 | 11.6 | 14.3 |
| | Count | 11 | 11 | 8 | 11 | 11 | 11 | 10 | 11 | 11 | 11 | 11 | 7 | 6 | 11 | 11 | 11 | 11 | 11 | 3 | 3 | 3 |

## < 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla (mg/m$^2$) | MCI (Unit) | % EPT taxa |
| Anaura Strm | Minimum | 1.0 | 1.5 | 1 | 1.1 | 0.006 | 0.002 | 0.055 | 0.015 | 3 | 0.003 | 0.005 | 8.8 | 82 | 213 | 7.8 | 2.6 | 82.0 | 3.8 | 0.7 | 105.7 | 46.4 |
| | 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 | 1.1 | 1.5 | 6 | 1.4 | 0.007 | 0.002 | 0.125 | 0.022 | 4 | 0.011 | 0.005 | 10.1 | 91 | 214 | 8.0 | 2.6 | 91.0 | 8.6 | 6.8 | 107.0 | 46.9 |
| | Median | 2.3 | 1.5 | 15 | 1.8 | 0.008 | 0.005 | 0.151 | 0.029 | 11 | 0.017 | 0.005 | 10.9 | 94 | 225 | 8.2 | 3.4 | 91.0 | 11.5 | 25.0 | 111.0 | 48.4 |
| | 75%'ile | 4.8 | 1.5 | 23 | 2.2 | 0.011 | 0.007 | 0.163 | 0.036 | 15 | 0.025 | 0.012 | 11.5 | 102 | 239 | 8.2 | 3.7 | 100.5 | 15.2 | 89.6 | 112.0 | 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 | 16.9 | 1.5 | 29 | 3.2 | 0.017 | 0.008 | 0.262 | 0.102 | 19 | 0.079 | 0.016 | 12.3 | 117 | 314 | 8.3 | 5.0 | 110.0 | 17.2 | 111.1 | 112.3 | 58.6 |
| | Mean | 4.1 | 1.5 | 14 | 1.8 | 0.009 | 0.005 | 0.150 | 0.037 | 10 | 0.023 | 0.008 | 10.7 | 96 | 236 | 8.1 | 3.4 | 94.4 | 11.3 | 45.6 | 109.7 | 51.1 |
| | Std. Dev. | 5.1 | 0.0 | 10 | 0.6 | 0.003 | 0.003 | 0.062 | 0.027 | 6 | 0.024 | 0.005 | 1.2 | 11 | 32 | 0.2 | 0.9 | 9.2 | 4.7 | 58.0 | 3.5 | 6.5 |
| | Count | 9 | 9 | 9 | 9 | 9 | 9 | 7 | 8 | 8 | 8 | 9 | 9 | 8 | 9 | 9 | 6 | 7 | 9 | 3 | 3 | 3 |
| Aropaoanui Rv | Minimum | 0.5 | 1.5 | 1 | 1.3 | 0.016 | 0.007 | 0.110 | 0.014 | 1 | 0.001 | 0.005 | 8.5 | 90 | 302 | 7.7 | 1.5 | 130.0 | 7.1 | 4.4 | 86.7 | 37.5 |
| | 5%'ile | 0.7 | 1.5 | 1 | 1.3 | 0.017 | 0.007 | 0.113 | 0.014 | 1 | 0.002 | 0.005 | 8.7 | 92 | 302 | 7.9 | no data | no data | 8.2 | no data | no data | no data |
| | 25%'ile | 1.4 | 1.5 | 8 | 2.0 | 0.024 | 0.013 | 0.133 | 0.017 | 1 | 0.005 | 0.005 | 10.3 | 103 | 317 | 8.6 | 1.8 | 136.8 | 13.6 | 5.1 | 96.4 | 41.3 |
| | Median | 1.7 | 1.5 | 41 | 2.1 | 0.029 | 0.017 | 0.172 | 0.023 | 2 | 0.011 | 0.005 | 11.0 | 106 | 342 | 8.6 | 2.2 | 140.0 | 17.5 | 20.9 | 106.6 | 48.5 |
| | 75%'ile | 1.9 | 3.0 | 59 | 3.0 | 0.032 | 0.022 | 0.256 | 0.055 | 4 | 0.043 | 0.005 | 12.1 | 120 | 366 | 8.8 | 3.3 | 145.8 | 20.5 | 50.2 | 109.3 | 54.2 |
| | 95%'ile | 17.0 | 11.3 | 295 | 3.4 | 0.045 | 0.029 | 0.321 | 0.228 | 11 | 0.213 | 0.015 | 14.6 | 165 | 387 | 9.1 | no data | no data | 23.8 | no data | no data | no data |
| | Maximum | 21.6 | 14.0 | 360 | 3.4 | 0.047 | 0.029 | 0.330 | 0.245 | 12 | 0.230 | 0.016 | 14.7 | 172 | 389 | 9.1 | 4.3 | 160.0 | 24.1 | 64.3 | 111.3 | 56.3 |
| | Mean | 3.0 | 3.0 | 58 | 2.3 | 0.029 | 0.017 | 0.196 | 0.058 | 3 | 0.046 | 0.006 | 11.3 | 114 | 342 | 8.6 | 2.5 | 142.0 | 17.0 | 27.6 | 102.8 | 47.7 |
| | Std. Dev. | 5.2 | 3.1 | 89 | 0.7 | 0.008 | 0.007 | 0.072 | 0.073 | 3 | 0.072 | 0.003 | 1.7 | 20 | 29 | 0.3 | 1.2 | 11.0 | 4.8 | 28.5 | 11.0 | 8.2 |
| | Count | 15 | 16 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 14 | 13 | 16 | 16 | 4 | 5 | 16 | 4 | 4 | 4 |
| Esk Rv at Berry Rd | Minimum | 0.4 | 1.5 | 6 | 0.3 | 0.015 | 0.008 | 0.180 | 0.101 | 6 | 0.088 | 0.005 | 9.8 | 84 | 253 | 7.9 | 1.1 | 130.0 | 8.3 | 35.1 | 107.4 | 42.1 |
| | 5%'ile | 0.4 | 1.5 | 6 | 0.3 | 0.015 | 0.008 | 0.181 | 0.105 | 6 | 0.092 | 0.005 | 9.9 | 85 | 255 | 7.9 | no data | no data | 8.4 | no data | no data | no data |
| | 25%'ile | 0.6 | 1.5 | 13 | 2.3 | 0.018 | 0.015 | 0.215 | 0.143 | 9 | 0.135 | 0.005 | 10.7 | 104 | 287 | 8.3 | 1.2 | 132.3 | 10.4 | 45.3 | 107.8 | 45.5 |
| | Median | 1.7 | 1.5 | 25 | 2.6 | 0.026 | 0.023 | 0.363 | 0.243 | 12 | 0.225 | 0.011 | 11.5 | 109 | 300 | 8.4 | 1.4 | 139.0 | 14.1 | 76.0 | 108.9 | 55.6 |
| | 75%'ile | 1.9 | 3.0 | 48 | 3.2 | 0.034 | 0.028 | 0.445 | 0.328 | 14 | 0.305 | 0.018 | 11.6 | 111 | 308 | 8.7 | 1.6 | 153.3 | 15.3 | 88.0 | 121.5 | 56.7 |
| | 95%'ile | 22.7 | 31.1 | 552 | 4.2 | 0.061 | 0.035 | 0.607 | 0.449 | 17 | 0.420 | 0.024 | 12.7 | 115 | 320 | 9.0 | no data | no data | 16.3 | no data | no data | no data |
| | Maximum | 23.8 | 34.0 | 600 | 4.2 | 0.063 | 0.035 | 0.610 | 0.460 | 18 | 0.430 | 0.024 | 12.8 | 115 | 320 | 9.1 | 1.6 | 158.0 | 16.3 | 92.0 | 125.7 | 57.1 |
| | Mean | 3.4 | 4.9 | 80 | 2.5 | 0.029 | 0.022 | 0.358 | 0.246 | 11 | 0.228 | 0.011 | 11.3 | 106 | 296 | 8.5 | 1.4 | 142.3 | 13.0 | 67.7 | 114.0 | 51.6 |
| | Std. Dev. | 6.8 | 9.2 | 167 | 1.2 | 0.014 | 0.009 | 0.148 | 0.110 | 3 | 0.104 | 0.007 | 0.8 | 9 | 19 | 0.3 | 0.3 | 14.3 | 2.8 | 29.4 | 10.2 | 8.3 |
| | Count | 11 | 12 | 12 | 11 | 12 | 12 | 11 | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 11 | 3 | 3 | 12 | 3 | 3 | 3 |
| Esk Rv at Waipunga Br | Minimum | 0.6 | 1.5 | 9 | 1.3 | 0.011 | 0.010 | 0.078 | 0.014 | 1 | 0.001 | 0.005 | 9.2 | 88 | 292 | 8.0 | 0.6 | 140.0 | 8.1 | 183.0 | 97.8 | 33.3 |
| | 5%'ile | 0.6 | 1.5 | 10 | no data | 0.012 | 0.010 | 0.080 | 0.014 | 1 | 0.001 | 0.005 | 9.3 | 88 | 295 | 8.0 | no data | no data | 8.3 | no data | no data | no data |
| | 25%'ile | 0.9 | 1.5 | 23 | 2.0 | 0.022 | 0.016 | 0.130 | 0.034 | 2 | 0.026 | 0.005 | 10.6 | 100 | 333 | 8.1 | 1.2 | 144.5 | 13.5 | 183.0 | 99.4 | 34.6 |
| | Median | 1.4 | 1.5 | 43 | 2.6 | 0.030 | 0.020 | 0.204 | 0.098 | 4 | 0.100 | 0.005 | 11.2 | 115 | 345 | 8.4 | 1.9 | 150.0 | 17.1 | 208.4 | 104.2 | 38.5 |
| | 75%'ile | 1.7 | 2.4 | 75 | 3.6 | 0.034 | 0.027 | 0.348 | 0.230 | 9 | 0.211 | 0.008 | 11.7 | 126 | 358 | 8.8 | 2.0 | 158.8 | 19.5 | 233.9 | 104.5 | 40.9 |
| | 95%'ile | 1.8 | 10.3 | 127 | no data | 0.053 | 0.038 | 0.406 | 0.322 | 12 | 0.306 | 0.045 | 12.2 | 140 | 368 | 9.5 | no data | no data | 23.6 | no data | no data | no data |
| | Maximum | 1.8 | 11.0 | 130 | 4.4 | 0.054 | 0.039 | 0.410 | 0.328 | 12 | 0.310 | 0.048 | 12.2 | 140 | 369 | 9.5 | 2.0 | 164.0 | 23.7 | 233.9 | 104.6 | 41.7 |
| | Mean | 1.3 | 2.6 | 53 | 2.8 | 0.030 | 0.022 | 0.234 | 0.128 | 5 | 0.118 | 0.010 | 11.1 | 114 | 342 | 8.5 | 1.6 | 151.4 | 16.4 | 208.4 | 102.2 | 37.8 |
| | Std. Dev. | 0.4 | 2.8 | 37 | 1.0 | 0.011 | 0.009 | 0.120 | 0.112 | 4 | 0.107 | 0.012 | 0.8 | 17 | 21 | 0.4 | 0.7 | 9.4 | 4.8 | 36.0 | 3.8 | 4.2 |
| | Count | 11 | 12 | 12 | 9 | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 12 | 11 | 12 | 12 | 4 | 5 | 12 | 2 | 3 | 3 |

## < 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla (mg/m$^2$) | MCI (Unit) | % EPT taxa |
| Mahiaruhe Strm | Minimum | 2.6 | 3.3 | 22 | 0.7 | 0.054 | 0.027 | 0.520 | 0.176 | 2 | 0.100 | 0.005 | 5.6 | 95 | 192 | 7.8 | 3.3 | 75.0 | 9.9 | no data | 72.6 | 22.2 |
| | 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 | 3.0 | 3.7 | 31 | 0.9 | 0.058 | 0.030 | 0.530 | 0.181 | 4 | 0.130 | 0.015 | 5.6 | no data | 197 | 7.9 | 3.5 | 84.5 | 12.8 | no data | 72.6 | 22.2 |
| | Median | 3.5 | 4.1 | 64 | 1.2 | 0.086 | 0.051 | 0.585 | 0.238 | 7 | 0.215 | 0.030 | 7.2 | 95 | 220 | 8.0 | 3.9 | 94.0 | 15.8 | no data | 85.2 | 24.3 |
| | 75%'ile | 4.3 | 4.7 | 179 | 1.4 | 0.135 | 0.081 | 0.680 | 0.352 | 8 | 0.320 | 0.051 | 8.7 | no data | 252 | 8.1 | 4.4 | 107.0 | 18.2 | no data | 97.8 | 26.3 |
| | 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 | 5.0 | 5.3 | 270 | 1.5 | 0.160 | 0.095 | 0.730 | 0.415 | 9 | 0.370 | 0.066 | 8.7 | 95 | 265 | 8.2 | 4.6 | 120.0 | 20.5 | no data | 97.8 | 26.3 |
| | Mean | 3.7 | 4.2 | 105 | 1.1 | 0.097 | 0.056 | 0.605 | 0.267 | 6 | 0.225 | 0.033 | 7.2 | 95 | 224 | 8.0 | 3.9 | 95.8 | 15.5 | no data | 85.2 | 24.3 |
| | Std. Dev. | 1.0 | 0.8 | 114 | 0.3 | 0.049 | 0.031 | 0.096 | 0.111 | 3 | 0.120 | 0.025 | 2.2 | 0 | 34 | 0.2 | 0.6 | 18.5 | 4.3 | no data | 17.8 | 2.9 |
| | Count | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 1 | 4 | 4 | 4 | 4 | 4 | no data | 2 | 2 |
| Sandy Ck | Minimum | 1.9 | 1.5 | 34 | 0.7 | 0.072 | 0.043 | 0.520 | 0.169 | 2 | 0.120 | 0.027 | 9.4 | 96 | 210 | 7.8 | 2.4 | 83.0 | 9.6 | 15.8 | 93.8 | 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 | 2.2 | 1.5 | 62 | 1.0 | 0.077 | 0.045 | 0.525 | 0.252 | 4 | 0.205 | 0.028 | no data | no data | 212 | 7.8 | 2.7 | 87.0 | 11.9 | no data | 93.8 | 33.3 |
| | Median | 2.8 | 2.8 | 205 | 1.4 | 0.096 | 0.056 | 0.560 | 0.377 | 7 | 0.335 | 0.032 | 9.4 | 96 | 223 | 7.9 | 3.2 | 95.5 | 14.5 | 15.8 | 100.3 | 35.6 |
| | 75%'ile | 3.6 | 4.6 | 380 | 1.8 | 0.125 | 0.082 | 0.992 | 0.705 | 15 | 0.670 | 0.037 | no data | no data | 250 | 8.0 | 3.8 | 110.0 | 17.7 | no data | 106.7 | 37.9 |
| | 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 | 4.1 | 5.0 | 440 | 2.1 | 0.140 | 0.100 | 1.394 | 0.991 | 23 | 0.960 | 0.039 | 9.4 | 96 | 267 | 8.0 | 4.0 | 120.0 | 20.6 | 15.8 | 106.7 | 37.9 |
| | Mean | 2.9 | 3.0 | 221 | 1.4 | 0.101 | 0.064 | 0.758 | 0.478 | 10 | 0.438 | 0.032 | 9.4 | 96 | 231 | 7.9 | 3.2 | 98.5 | 14.8 | 15.8 | 100.3 | 35.6 |
| | Std. Dev. | 1.0 | 1.8 | 191 | 0.6 | 0.031 | 0.026 | 0.425 | 0.357 | 9 | 0.365 | 0.006 | 0.0 | 0 | 26 | 0.1 | 0.7 | 15.9 | 4.5 | 0.0 | 9.1 | 3.3 |
| | Count | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 | 1 | 4 | 4 | 4 | 4 | 4 | 1 | 2 | 2 |
| Waikari Rv | Minimum | 0.6 | 1.5 | 1 | 1.9 | 0.018 | 0.002 | 0.242 | 0.022 | 2 | 0.010 | 0.005 | 9.9 | 115 | 345 | 8.4 | 2.2 | 120.0 | 9.9 | 29.2 | 86.9 | 20.7 |
| | 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 | 0.7 | 1.5 | 6 | 2.0 | 0.018 | 0.002 | 0.258 | 0.029 | 6 | 0.016 | 0.005 | 9.9 | no data | 349 | 8.5 | 2.5 | 132.0 | 13.5 | 29.2 | 86.9 | 20.7 |
| | Median | 0.7 | 1.5 | 22 | 2.1 | 0.025 | 0.006 | 0.305 | 0.046 | 19 | 0.030 | 0.009 | 10.3 | 115 | 398 | 8.5 | 3.1 | 147.0 | 17.3 | 67.2 | 91.8 | 33.3 |
| | 75%'ile | 1.3 | 1.5 | 54 | 2.4 | 0.038 | 0.016 | 0.399 | 0.164 | 28 | 0.135 | 0.021 | 10.7 | no data | 453 | 8.6 | 3.5 | 155.0 | 19.6 | 105.2 | 96.7 | 45.8 |
| | 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 | 2.0 | 1.5 | 65 | 2.7 | 0.044 | 0.022 | 0.430 | 0.269 | 29 | 0.230 | 0.029 | 10.7 | 115 | 463 | 8.7 | 3.6 | 160.0 | 21.7 | 105.2 | 96.7 | 45.8 |
| | Mean | 1.0 | 1.5 | 29 | 2.2 | 0.028 | 0.009 | 0.326 | 0.096 | 17 | 0.075 | 0.013 | 10.3 | 115 | 401 | 8.5 | 3.0 | 143.5 | 16.5 | 67.2 | 91.8 | 33.3 |
| | Std. Dev. | 0.6 | 0.0 | 33 | 0.3 | 0.013 | 0.009 | 0.096 | 0.116 | 13 | 0.104 | 0.011 | 0.5 | 0 | 61 | 0.1 | 0.6 | 17.0 | 4.9 | 53.7 | 6.9 | 17.7 |
| | Count | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 2 | 1 | 4 | 4 | 4 | 4 | 4 | 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp (°C) | Chla ($mg/m^2$) | MCI (Unit) | % EPT taxa |
| Anaura Strm | Minimum | 1.0 | 1.5 | 1 | 1.2 | 0.007 | 0.002 | 0.055 | 0.018 | 5 | 0.013 | 0.005 | 8.8 | 90 | 214 | 7.8 | 2.6 | 91.0 | 3.8 | 0.7 | 105.7 | 46.4 |
| | 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 | 1.3 | 1.5 | 6 | 1.5 | 0.007 | 0.002 | 0.088 | 0.025 | 8 | 0.014 | 0.005 | 10.6 | 91 | 214 | 8.0 | 3.1 | 91.0 | 5.0 | 0.7 | 105.7 | 46.4 |
| | Median | 2.7 | 1.5 | 15 | 1.8 | 0.008 | 0.002 | 0.143 | 0.032 | 12 | 0.020 | 0.005 | 11.4 | 91 | 236 | 8.2 | 3.7 | 92.0 | 9.7 | 55.9 | 109.0 | 47.4 |
| | 75%'ile | 4.8 | 1.5 | 17 | 2.2 | 0.012 | 0.007 | 0.213 | 0.051 | 14 | 0.037 | 0.012 | 12.0 | 104 | 265 | 8.2 | 4.4 | 101.5 | 16.8 | 111.1 | 112.3 | 48.4 |
| | 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 | 5.6 | 1.5 | 24 | 2.2 | 0.017 | 0.008 | 0.262 | 0.102 | 17 | 0.079 | 0.016 | 12.3 | 117 | 314 | 8.3 | 5.0 | 110.0 | 17.2 | 111.1 | 112.3 | 48.4 |
| | Mean | 3.0 | 1.5 | 13 | 1.8 | 0.010 | 0.004 | 0.151 | 0.043 | 11 | 0.030 | 0.008 | 11.1 | 97 | 245 | 8.1 | 3.7 | 96.3 | 10.5 | 55.9 | 109.0 | 47.4 |
| | Std. Dev. | 2.0 | 0.0 | 9 | 0.4 | 0.004 | 0.003 | 0.087 | 0.034 | 4 | 0.028 | 0.005 | 1.3 | 13 | 41 | 0.2 | 1.0 | 9.2 | 6.2 | 78.0 | 4.7 | 1.4 |
| | Count | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 4 | 5 | 2 | 2 | 2 |
| Aropaoanui Rv | Minimum | 0.5 | 1.5 | 1 | 2.1 | 0.024 | 0.015 | 0.110 | 0.014 | 1 | 0.001 | 0.005 | 9.5 | 100 | 323 | 7.7 | 1.5 | 140.0 | 7.1 | 36.0 | 86.7 | 37.5 |
| | 5%'ile | no data | 1.5 | no data | 2.1 | 0.024 | 0.015 | 0.110 | 0.014 | 1 | 0.001 | 0.005 | no data | no data | 323 | 7.7 | no data | no data | 7.1 | no data | no data | no data |
| | 25%'ile | 1.4 | 1.5 | 3 | 2.1 | 0.028 | 0.018 | 0.130 | 0.017 | 1 | 0.007 | 0.005 | 10.7 | 103 | 331 | 8.6 | 1.5 | 140.0 | 11.7 | 36.0 | 86.7 | 37.5 |
| | Median | 1.7 | 1.5 | 27 | 2.2 | 0.031 | 0.020 | 0.215 | 0.041 | 2 | 0.026 | 0.005 | 11.2 | 113 | 360 | 8.6 | 1.8 | 150.0 | 18.2 | 50.2 | 96.4 | 41.3 |
| | 75%'ile | 2.5 | 3.0 | 56 | 3.0 | 0.033 | 0.025 | 0.298 | 0.164 | 6 | 0.152 | 0.005 | 12.6 | 127 | 371 | 8.9 | 2.0 | 160.0 | 22.1 | 64.3 | 106.0 | 45.0 |
| | 95%'ile | no data | 5.0 | no data | 3.4 | 0.047 | 0.029 | 0.330 | 0.245 | 12 | 0.230 | 0.016 | no data | no data | 389 | 9.1 | no data | no data | 24.1 | no data | no data | no data |
| | Maximum | 21.6 | 5.0 | 100 | 3.4 | 0.047 | 0.029 | 0.330 | 0.245 | 12 | 0.230 | 0.016 | 14.7 | 172 | 389 | 9.1 | 2.0 | 160.0 | 24.1 | 64.3 | 106.0 | 45.0 |
| | Mean | 3.9 | 2.4 | 35 | 2.5 | 0.032 | 0.021 | 0.218 | 0.080 | 4 | 0.068 | 0.007 | 11.8 | 120 | 356 | 8.6 | 1.8 | 150.0 | 16.8 | 50.2 | 96.4 | 41.3 |
| | Std. Dev. | 6.7 | 1.3 | 33 | 0.5 | 0.007 | 0.005 | 0.083 | 0.085 | 4 | 0.085 | 0.004 | 1.7 | 24 | 23 | 0.4 | 0.4 | 14.1 | 6.0 | 20.0 | 13.6 | 5.3 |
| | Count | 9 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 8 | 10 | 10 | 2 | 2 | 10 | 2 | 2 | 2 |
| Esk Rv at Berry Rd | Minimum | 0.5 | 1.5 | 9 | 1.1 | 0.015 | 0.012 | 0.191 | 0.101 | 6 | 0.088 | 0.005 | 9.8 | 84 | 253 | 7.9 | 1.1 | 130.0 | 8.3 | 76.0 | 107.4 | 42.1 |
| | 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 | 14 | 2.3 | 0.020 | 0.021 | 0.255 | 0.159 | 8 | 0.144 | 0.005 | 10.9 | 102 | 282 | 8.2 | 1.1 | 130.0 | 9.2 | 76.0 | 107.4 | 42.1 |
| | Median | 1.6 | 1.5 | 20 | 2.6 | 0.028 | 0.023 | 0.392 | 0.244 | 11 | 0.230 | 0.011 | 11.6 | 109 | 304 | 8.4 | 1.3 | 144.0 | 14.2 | 84.0 | 108.2 | 48.9 |
| | 75%'ile | 1.8 | 1.9 | 40 | 3.7 | 0.032 | 0.028 | 0.440 | 0.347 | 13 | 0.323 | 0.017 | 11.7 | 113 | 307 | 8.5 | 1.4 | 158.0 | 15.0 | 92.0 | 108.9 | 55.6 |
| | 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 | 1.9 | 5.0 | 120 | 4.2 | 0.046 | 0.035 | 0.550 | 0.460 | 15 | 0.430 | 0.024 | 12.8 | 115 | 316 | 8.9 | 1.4 | 158.0 | 15.8 | 92.0 | 108.9 | 55.6 |
| | Mean | 1.3 | 2.1 | 33 | 2.8 | 0.028 | 0.024 | 0.364 | 0.262 | 11 | 0.244 | 0.012 | 11.4 | 106 | 294 | 8.4 | 1.3 | 144.0 | 12.8 | 84.0 | 108.2 | 48.9 |
| | Std. Dev. | 0.6 | 1.2 | 35 | 1.0 | 0.010 | 0.007 | 0.124 | 0.115 | 3 | 0.109 | 0.007 | 0.9 | 10 | 20 | 0.3 | 0.2 | 19.8 | 3.0 | 11.3 | 1.1 | 9.5 |
| | Count | 8 | 9 | 9 | 8 | 9 | 9 | 8 | 9 | 9 | 9 | 9 | 9 | 8 | 9 | 8 | 2 | 2 | 9 | 2 | 2 | 2 |
| Esk Rv at Waipunga Br | Minimum | 0.6 | 1.5 | 20 | 1.3 | 0.019 | 0.014 | 0.078 | 0.014 | 1 | 0.001 | 0.005 | 10.4 | 88 | 292 | 8.0 | 2.0 | 140.0 | 8.1 | 183.0 | 104.2 | 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 | 0.9 | 1.5 | 26 | 2.1 | 0.027 | 0.017 | 0.125 | 0.026 | 1 | 0.010 | 0.005 | 10.6 | 106 | 337 | 8.1 | 2.0 | 140.0 | 13.8 | 183.0 | 104.2 | 38.5 |
| | Median | 1.3 | 1.5 | 51 | 3.0 | 0.032 | 0.023 | 0.253 | 0.083 | 3 | 0.100 | 0.005 | 11.2 | 120 | 348 | 8.4 | 2.0 | 152.0 | 18.8 | 208.4 | 104.4 | 40.1 |
| | 75%'ile | 1.5 | 1.5 | 90 | 4.0 | 0.037 | 0.030 | 0.350 | 0.235 | 8 | 0.211 | 0.010 | 11.7 | 129 | 358 | 8.6 | 2.0 | 164.0 | 21.2 | 233.9 | 104.6 | 41.7 |
| | 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 | 4.0 | 130 | 4.4 | 0.054 | 0.039 | 0.410 | 0.328 | 12 | 0.310 | 0.048 | 12.2 | 140 | 369 | 9.5 | 2.0 | 164.0 | 23.7 | 233.9 | 104.6 | 41.7 |
| | Mean | 1.3 | 1.8 | 61 | 2.9 | 0.033 | 0.024 | 0.243 | 0.129 | 5 | 0.121 | 0.012 | 11.2 | 117 | 343 | 8.5 | 2.0 | 152.0 | 17.4 | 208.4 | 104.4 | 40.1 |
| | Std. Dev. | 0.4 | 0.9 | 41 | 1.2 | 0.011 | 0.009 | 0.131 | 0.124 | 4 | 0.121 | 0.015 | 0.6 | 17 | 24 | 0.5 | 0.0 | 17.0 | 5.6 | 36.0 | 0.3 | 2.3 |
| | Count | 7 | 8 | 8 | 6 | 8 | 8 | 8 | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 8 | 2 | 2 | 8 | 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 | $NO_3$-N (mg/l) | $NH_4$-N (mg/l) | DO (mg/l) | DO (%) | Elec. Cond. (µS/cm) | pH | TOC (mg/l) | Hardness (mg/l) | Temp ($^oC$) | Chla ($mg/m^2$) | MCI (Unit) | % EPT taxa |
| Mahiaruhe Strm | Minimum | 3.6 | 4.1 | 39 | 0.7 | 0.110 | 0.067 | 0.630 | 0.176 | 2 | 0.100 | 0.035 | 5.6 | no data | 238 | 7.9 | 3.3 | 94.0 | 9.9 | no data | 72.6 | 26.3 |
| | 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 | 4.1 | 39 | 0.7 | 0.110 | 0.067 | 0.630 | 0.176 | 2 | 0.100 | 0.035 | no data | no data | 238 | 7.9 | 3.3 | 94.0 | 9.9 | no data | no data | no data |
| | Median | 4.3 | 4.7 | 155 | 1.0 | 0.135 | 0.081 | 0.680 | 0.295 | 4 | 0.235 | 0.051 | 5.6 | no data | 252 | 8.0 | 3.7 | 107.0 | 15.2 | no data | 72.6 | 26.3 |
| | 75%'ile | 5.0 | 5.3 | 270 | 1.2 | 0.160 | 0.095 | 0.730 | 0.415 | 6 | 0.370 | 0.066 | no data | no data | 265 | 8.0 | 4.1 | 120.0 | 20.5 | 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 | 5.0 | 5.3 | 270 | 1.2 | 0.160 | 0.095 | 0.730 | 0.415 | 6 | 0.370 | 0.066 | 5.6 | no data | 265 | 8.0 | 4.1 | 120.0 | 20.5 | no data | 72.6 | 26.3 |
| | Mean | 4.3 | 4.7 | 155 | 1.0 | 0.135 | 0.081 | 0.680 | 0.295 | 4 | 0.235 | 0.051 | 5.6 | no data | 252 | 8.0 | 3.7 | 107.0 | 15.2 | no data | 72.6 | 26.3 |
| | Std. Dev. | 1.0 | 0.8 | 163 | 0.4 | 0.035 | 0.020 | 0.071 | 0.169 | 3 | 0.191 | 0.022 | 0.0 | no data | 19 | 0.1 | 0.6 | 18.4 | 7.5 | no data | 0.0 | 0.0 |
| | Count | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | no data | 2 | 2 | 2 | 2 | 2 | no data | 1 | 1 |
| Sandy Ck | Minimum | 2.4 | 1.5 | 34 | 0.7 | 0.110 | 0.064 | 0.530 | 0.169 | 2 | 0.120 | 0.028 | no data | no data | 232 | 8.0 | 2.4 | 91.0 | 9.6 | 15.8 | 93.8 | 37.9 |
| | 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 | 2.4 | 1.5 | 34 | 0.7 | 0.110 | 0.064 | 0.530 | 0.169 | 2 | 0.120 | 0.028 | no data | no data | 232 | 8.0 | 2.4 | 91.0 | 9.6 | no data | no data | no data |
| | Median | 2.8 | 1.5 | 177 | 1.1 | 0.125 | 0.082 | 0.560 | 0.293 | 4 | 0.250 | 0.034 | no data | no data | 250 | 8.0 | 3.2 | 105.5 | 15.1 | 15.8 | 93.8 | 37.9 |
| | 75%'ile | 3.1 | 1.5 | 320 | 1.6 | 0.140 | 0.100 | 0.590 | 0.418 | 7 | 0.380 | 0.039 | no data | no data | 267 | 8.0 | 4.0 | 120.0 | 20.6 | 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 | 3.1 | 1.5 | 320 | 1.6 | 0.140 | 0.100 | 0.590 | 0.418 | 7 | 0.380 | 0.039 | no data | no data | 267 | 8.0 | 4.0 | 120.0 | 20.6 | 15.8 | 93.8 | 37.9 |
| | Mean | 2.8 | 1.5 | 177 | 1.1 | 0.125 | 0.082 | 0.560 | 0.293 | 4 | 0.250 | 0.034 | no data | no data | 250 | 8.0 | 3.2 | 105.5 | 15.1 | 15.8 | 93.8 | 37.9 |
| | Std. Dev. | 0.5 | 0.0 | 202 | 0.6 | 0.021 | 0.025 | 0.042 | 0.176 | 3 | 0.184 | 0.008 | no data | no data | 25 | 0.0 | 1.1 | 20.5 | 7.8 | 0.0 | 0.0 | 0.0 |
| | Count | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | no data | no data | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| Waikari Rv | Minimum | 0.6 | 1.5 | 22 | 2.1 | 0.032 | 0.010 | 0.305 | 0.035 | 2 | 0.022 | 0.005 | 9.9 | no data | 443 | 8.4 | 2.2 | 150.0 | 9.9 | 105.2 | 86.9 | 20.7 |
| | 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 | 0.6 | 1.5 | no data | 2.1 | 0.032 | 0.010 | 0.305 | 0.035 | 2 | 0.022 | 0.005 | no data | no data | 443 | 8.4 | 2.2 | 150.0 | 9.9 | no data | no data | no data |
| | Median | 0.7 | 1.5 | 22 | 2.1 | 0.038 | 0.016 | 0.367 | 0.152 | 14 | 0.126 | 0.017 | 9.9 | no data | 453 | 8.5 | 2.5 | 155.0 | 15.8 | 105.2 | 86.9 | 20.7 |
| | 75%'ile | 0.7 | 1.5 | no data | 2.1 | 0.044 | 0.022 | 0.430 | 0.269 | 27 | 0.230 | 0.029 | no data | no data | 463 | 8.5 | 2.7 | 160.0 | 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 | 0.7 | 1.5 | 22 | 2.1 | 0.044 | 0.022 | 0.430 | 0.269 | 27 | 0.230 | 0.029 | 9.9 | no data | 463 | 8.5 | 2.7 | 160.0 | 21.7 | 105.2 | 86.9 | 20.7 |
| | Mean | 0.7 | 1.5 | 22 | 2.1 | 0.038 | 0.016 | 0.367 | 0.152 | 14 | 0.126 | 0.017 | 9.9 | no data | 453 | 8.5 | 2.5 | 155.0 | 15.8 | 105.2 | 86.9 | 20.7 |
| | Std. Dev. | 0.1 | 0.0 | 0 | 0.0 | 0.008 | 0.008 | 0.088 | 0.165 | 18 | 0.147 | 0.017 | 0.0 | no data | 14 | 0.1 | 0.4 | 7.1 | 8.3 | 0.0 | 0.0 | 0.0 |
| | Count | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | no data | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |

## Appendix C Trend analysis results for water quality variables

| Site | Variable | Sample Period | n | Min | Median | Max | Trend p | Trend PAC |
|---|---|---|---|---|---|---|---|---|
| **Anaura Strm** | TN (mg/l) | 18/5/04-16/8/12 | 30 | 0.122 | 0.244 | 1.190 | **0.000** | **-14.73** |
| | TP (mg/l) | 18/5/04-16/8/12 | 32 | 0.004 | 0.011 | 0.045 | **0.016** | **-8.55** |
| | DIN (mg/l) | 18/5/04-16/8/12 | 31 | 0.015 | 0.099 | 0.860 | **0.001** | **-22.80** |
| | DRP (mg/l) | 18/5/04-16/8/12 | 32 | 0.002 | 0.004 | 0.017 | 0.894 | 0.00 |
| | $NO_3$-N (mg/l) | 18/5/04-16/8/12 | 31 | 0.001 | 0.079 | 0.850 | **0.003** | **-27.90** |
| | Black Disc | 18/5/04-16/8/12 | 30 | 0.2 | 1.6 | 4.2 | 0.947 | -0.90 |
| | Turbidity (NTU) | 18/5/04-16/8/12 | 31 | 0.7 | 2.2 | 31.0 | 0.614 | 3.28 |
| | E. Coli (cfu/100ml) | 31/8/04-16/8/12 | 31 | 1 | 12 | 850 | 0.700 | -3.45 |
| | DIN:DRP | 18/5/04-16/8/12 | 31 | 3.0 | 17.0 | 325.0 | 0.058 | -20.05 |
| | $NH_4$-N (mg/l) | 18/5/04-16/8/12 | 32 | 0.005 | 0.005 | 0.070 | 0.417 | 0.00 |
| | SS (mg/l) | 18/5/04-16/8/12 | 32 | 1.5 | 1.5 | 64.0 | 0.567 | 0.00 |
| | TOC (mg/l) | 18/5/04-30/5/12 | 30 | 2.1 | 3.7 | 10.1 | 0.119 | -5.22 |
| | TON (mg/l) | 18/5/04-16/8/12 | 31 | 0.044 | 0.130 | 0.380 | 0.127 | -7.65 |
| | Conductivity (µS/cm) | 18/5/04-16/8/12 | 32 | 117 | 211 | 337 | 0.903 | -0.91 |
| | HDT (mg/l) | 18/5/04-30/5/12 | 31 | 33 | 82 | 121 | 0.437 | -1.22 |
| **Aropaoanui Rv** | TN (mg/l) | 9/2/04-16/11/13 | 39 | 0.116 | 0.298 | 1.360 | 0.164 | -2.66 |
| | TP (mg/l) | 9/2/04-16/11/13 | 39 | 0.018 | 0.032 | 0.330 | **0.033** | **-3.19** |
| | DIN (mg/l) | 9/2/04-16/11/13 | 39 | 0.015 | 0.101 | 0.520 | **0.018** | **-4.64** |
| | DRP (mg/l) | 9/2/04-16/11/13 | 39 | 0.004 | 0.021 | 0.042 | 0.304 | -2.13 |
| | $NO_3$-N (mg/l) | 9/2/04-16/11/13 | 39 | 0.003 | 0.082 | 0.500 | 0.105 | -2.90 |
| | Black Disc | 9/2/04-16/11/13 | 39 | 0.1 | 1.9 | 3.8 | 0.431 | -2.56 |
| | Turbidity (NTU) | 9/2/04-16/11/13 | 38 | 0.5 | 1.8 | 139.0 | **0.034** | **6.10** |
| | E. Coli (cfu/100ml) | 30/8/04-16/11/13 | 37 | 1 | 30 | 3300 | 0.766 | -0.90 |
| | DIN:DRP | 9/2/04-16/11/13 | 39 | 0.8 | 5.1 | 115.6 | 0.610 | -1.47 |
| | $NH_4$-N (mg/l) | 9/2/04-16/11/13 | 38 | 0.005 | 0.005 | 0.040 | 0.059 | 0.00 |
| | SS (mg/l) | 9/2/04-16/11/13 | 39 | 1.5 | 3.4 | 320.0 | 0.883 | 0.00 |
| | TOC (mg/l) | 9/2/04-30/5/12 | 32 | 0.6 | 2.8 | 5.8 | 0.242 | -6.07 |
| | TON (mg/l) | 9/2/04-16/11/13 | 39 | 0.050 | 0.175 | 1.036 | 0.484 | -1.87 |
| | Conductivity (µS/cm) | 9/2/04-16/11/13 | 39 | 236 | 312 | 389 | 1.000 | -0.14 |
| | HDT (mg/l) | 9/2/04-30/5/12 | 33 | 94 | 134 | 160 | 0.722 | 0.25 |

| Site | Variable | Sample Period | n | Min | Median | Max | Trend p | Trend PAC |
|---|---|---|---|---|---|---|---|---|
| **Esk Rv at Berry Rd** | TN (mg/l) | 28/1/04-16/11/13 | 36 | 0.210 | 0.421 | 0.780 | **0.039** | **-2.26** |
| | TP (mg/l) | 28/1/04-16/11/13 | 37 | 0.012 | 0.029 | 0.089 | **0.032** | **-3.46** |
| | DIN (mg/l) | 28/1/04-16/11/13 | 37 | 0.122 | 0.298 | 0.564 | 0.146 | -1.63 |
| | DRP (mg/l) | 28/1/04-16/11/13 | 37 | 0.002 | 0.020 | 0.047 | 0.189 | -1.67 |
| | $NO_3$-N (mg/l) | 28/1/04-5/11/13 | 36 | 0.106 | 0.268 | 0.540 | 0.060 | -2.43 |
| | Black Disc | 28/1/04-16/11/13 | 36 | 0.3 | 1.5 | 4.1 | 0.277 | -3.66 |
| | Turbidity (NTU) | 28/1/04-16/11/13 | 36 | 0.4 | 1.8 | 12.1 | **0.026** | **10.46** |
| | E. Coli (cfu/100ml) | 24/8/04-16/11/13 | 35 | 2 | 20 | 260 | **0.027** | **9.47** |
| | DIN:DRP | 28/1/04-16/11/13 | 37 | 4.5 | 15.0 | 80.0 | 0.764 | 0.43 |
| | $NH_4$-N (mg/l) | 28/1/04-16/11/13 | 37 | 0.005 | 0.010 | 0.063 | 0.192 | 0.00 |
| | SS (mg/l) | 28/1/04-16/11/13 | 37 | 1.5 | 3.4 | 29.0 | 0.535 | 0.00 |
| | TOC (mg/l) | 28/1/04-8/11/11 | 30 | 0.3 | 1.7 | 3.7 | 0.494 | -2.51 |
| | TON (mg/l) | 28/1/04-16/11/13 | 36 | 0.050 | 0.090 | 0.290 | 1.000 | 0.00 |
| | Conductivity (µS/cm) | 28/1/04-16/11/13 | 37 | 261 | 294 | 325 | 0.133 | -0.51 |
| | HDT (mg/l) | 28/1/04-15/5/12 | 32 | 120 | 140 | 158 | 0.803 | -0.30 |
| **Esk Rv at Waipunga Br** | TN (mg/l) | 28/1/04-16/11/13 | 40 | 0.078 | 0.375 | 0.850 | 0.687 | -0.66 |
| | TP (mg/l) | 28/1/04-16/11/13 | 40 | 0.013 | 0.034 | 0.075 | 0.243 | -3.22 |
| | DIN (mg/l) | 28/1/04-16/11/13 | 40 | 0.012 | 0.256 | 0.618 | 0.893 | -0.49 |
| | DRP (mg/l) | 28/1/04-16/11/13 | 40 | 0.002 | 0.025 | 0.037 | 0.207 | -2.01 |
| | $NO_3$-N (mg/l) | 28/1/04-16/11/13 | 39 | 0.001 | 0.240 | 0.590 | 0.677 | -1.64 |
| | Black Disc | 28/1/04-16/11/13 | 38 | 0.4 | 1.7 | 4.2 | 0.564 | 1.69 |
| | Turbidity (NTU) | 28/1/04-16/11/13 | 38 | 0.4 | 1.6 | 16.0 | 0.597 | 1.53 |
| | E. Coli (cfu/100ml) | 24/8/04-16/11/13 | 38 | 1 | 19 | 1900 | **0.001** | **19.88** |
| | DIN:DRP | 28/1/04-16/11/13 | 40 | 1.1 | 10.3 | 36.5 | 0.623 | 1.09 |
| | $NH_4$-N (mg/l) | 28/1/04-16/11/13 | 40 | 0.005 | 0.005 | 0.037 | 0.466 | 0.00 |
| | SS (mg/l) | 28/1/04-16/11/13 | 40 | 1.5 | 1.5 | 37.0 | 0.762 | 0.00 |
| | TOC (mg/l) | 28/1/04-8/11/11 | 32 | 0.3 | 2.1 | 4.4 | 0.950 | 0.47 |
| | TON (mg/l) | 28/1/04-16/11/13 | 40 | 0.050 | 0.096 | 0.232 | 0.583 | 0.00 |
| | Conductivity (µS/cm) | 28/1/04-16/11/13 | 40 | 268 | 332 | 382 | 0.107 | -0.65 |
| | HDT (mg/l) | 28/1/04-15/5/12 | 34 | 110 | 150 | 164 | 0.777 | -0.11 |

| Site | Variable | Sample Period | n | Min | Median | Max | Trend p | Trend PAC |
|---|---|---|---|---|---|---|---|---|
| Mahiaruhe Strm | TN (mg/l) | 9/2/04-18/11/11 | 31 | 0.291 | 0.630 | 3.430 | **0.045** | **3.43** |
| | TP (mg/l) | 9/2/04-18/11/11 | 32 | 0.026 | 0.071 | 0.830 | 0.265 | -2.86 |
| | DIN (mg/l) | 9/2/04-18/11/11 | 31 | 0.072 | 0.292 | 0.600 | 0.071 | 5.39 |
| | DRP (mg/l) | 9/2/04-18/11/11 | 32 | 0.009 | 0.035 | 0.095 | 0.576 | -2.55 |
| | $NO_3$-N (mg/l) | 9/2/04-18/11/11 | 31 | 0.051 | 0.270 | 0.550 | 0.272 | 4.44 |
| | Black Disc | 9/2/04-18/11/11 | 32 | 0.0 | 1.2 | 2.1 | **0.019** | **-7.23** |
| | Turbidity (NTU) | 9/2/04-18/11/11 | 31 | 1.3 | 3.5 | 270.0 | **0.033** | **7.65** |
| | E. Coli (cfu/100ml) | 30/8/04-18/11/11 | 28 | 4 | 87 | 24000 | 1.000 | 0.29 |
| | DIN:DRP | 9/2/04-18/11/11 | 31 | 1.4 | 8.1 | 61.4 | **0.028** | **9.65** |
| | $NH_4$-N (mg/l) | 9/2/04-18/11/11 | 32 | 0.005 | 0.032 | 0.270 | 0.261 | -4.21 |
| | SS (mg/l) | 9/2/04-18/11/11 | 32 | 1.5 | 5.0 | 550.0 | 0.315 | 5.58 |
| | TOC (mg/l) | 9/2/04-18/11/11 | 32 | 3.3 | 4.5 | 12.6 | 0.420 | -1.96 |
| | TON (mg/l) | 9/2/04-18/11/11 | 32 | 0.020 | 0.318 | 2.830 | **0.041** | **4.86** |
| | Conductivity (µS/cm) | 9/2/04-18/11/11 | 32 | 101 | 199 | 265 | 0.173 | -1.42 |
| | HDT (mg/l) | 9/2/04-18/11/11 | 32 | 33 | 77 | 120 | 0.575 | -1.03 |
| Sandy Ck | TN (mg/l) | 9/2/04-16/11/13 | 40 | 0.287 | 0.683 | 2.450 | 0.210 | 1.92 |
| | TP (mg/l) | 9/2/04-16/11/13 | 40 | 0.055 | 0.083 | 0.790 | 0.065 | -2.46 |
| | DIN (mg/l) | 9/2/04-16/11/13 | 40 | 0.120 | 0.421 | 1.210 | 0.089 | 3.53 |
| | DRP (mg/l) | 9/2/04-16/11/13 | 40 | 0.016 | 0.050 | 0.100 | 0.152 | -2.34 |
| | $NO_3$-N (mg/l) | 9/2/04-16/11/13 | 40 | 0.084 | 0.370 | 1.200 | 0.054 | 3.92 |
| | Black Disc | 9/2/04-16/11/13 | 38 | 0.1 | 1.3 | 2.8 | 0.164 | -5.19 |
| | Turbidity (NTU) | 9/2/04-16/11/13 | 40 | 1.7 | 3.2 | 210.0 | 0.195 | 3.49 |
| | E. Coli (cfu/100ml) | 30/8/04-16/11/13 | 36 | 4 | 135 | 13000 | 0.837 | 1.18 |
| | DIN:DRP | 9/2/04-16/11/13 | 40 | 1.6 | 8.6 | 75.6 | 0.166 | 4.34 |
| | $NH_4$-N (mg/l) | 9/2/04-16/11/13 | 40 | 0.005 | 0.034 | 0.117 | **0.033** | **-5.64** |
| | SS (mg/l) | 9/2/04-16/11/13 | 40 | 1.5 | 5.0 | 510.0 | 0.268 | 5.00 |
| | TOC (mg/l) | 9/2/04-30/5/12 | 33 | 2.4 | 3.9 | 11.3 | **0.021** | **-3.70** |
| | TON (mg/l) | 9/2/04-16/11/13 | 40 | 0.118 | 0.258 | 1.983 | 0.501 | -1.44 |
| | Conductivity (µS/cm) | 9/2/04-16/11/13 | 40 | 102 | 213 | 268 | 0.395 | -0.90 |
| | HDT (mg/l) | 9/2/04-14/2/13 | 35 | 33 | 89 | 120 | 0.451 | -0.98 |

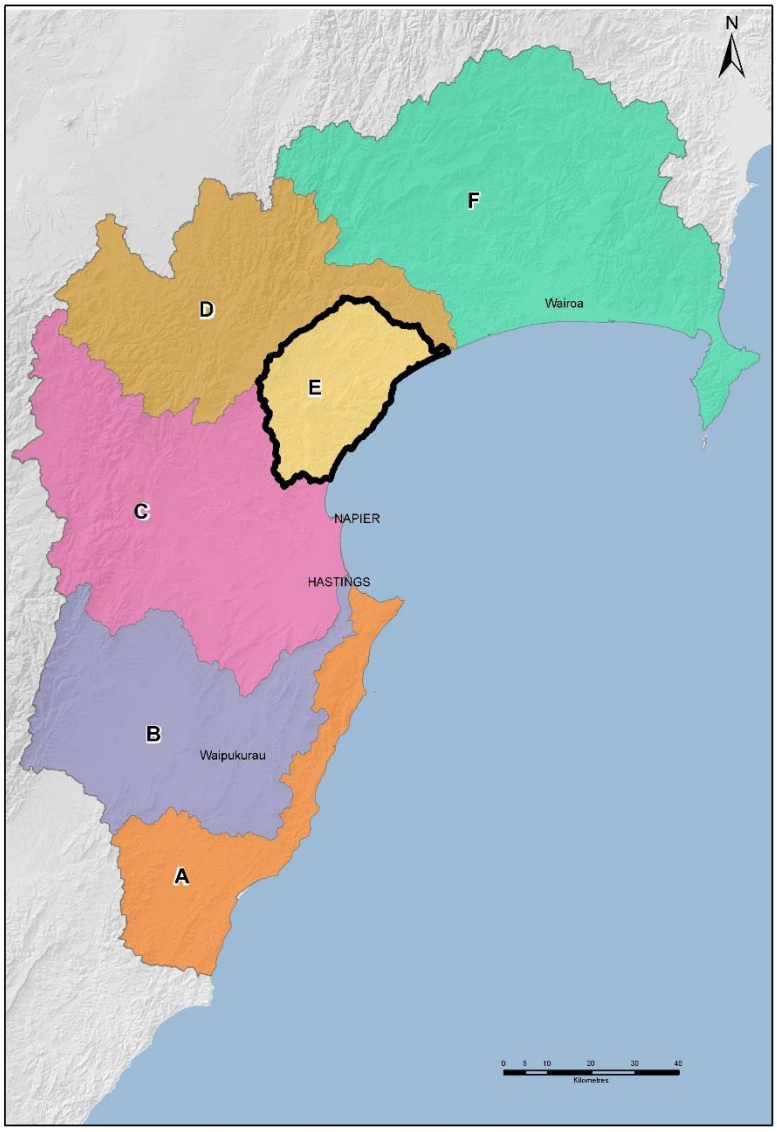
| Site | Variable | Sample Period | n | Min | Median | Max | Trend p | Trend PAC |
|---|---|---|---|---|---|---|---|---|
| Waikari Rv | TN (mg/l) | 9/2004-16/11/13 | 39 | 0.176 | 0.434 | 5.010 | 0.355 | -2.10 |
| | TP (mg/l) | 9/2004-16/11/13 | 40 | 0.014 | 0.030 | 1.610 | 0.058 | -3.55 |
| | DIN (mg/l) | 9/2004-16/11/13 | 40 | 0.014 | 0.232 | 1.185 | **0.039** | **-3.38** |
| | DRP (mg/l) | 9/2004-16/11/13 | 40 | 0.002 | 0.017 | 0.053 | 0.161 | -4.57 |
| | $NO_3$-N (mg/l) | 9/2004-16/11/13 | 40 | 0.003 | 0.216 | 1.160 | **0.036** | **-2.64** |
| | Black Disc | 9/2004-16/11/13 | 40 | 0.0 | 1.8 | 3.6 | 0.964 | 0.54 |
| | Turbidity (NTU) | 9/2004-16/11/13 | 39 | 0.6 | 2.0 | 1890.0 | 0.139 | 10.88 |
| | E. Coli (cfu/100ml) | 30/8/04-16/11/13 | 36 | 1 | 33 | 16000 | 0.329 | 6.62 |
| | DIN:DRP | 9/2004-16/11/13 | 40 | 1.0 | 15.4 | 270.0 | 0.720 | 0.73 |
| | $NH_4$-N (mg/l) | 9/2004-16/11/13 | 40 | 0.005 | 0.011 | 0.090 | 0.259 | 0.00 |
| | SS (mg/l) | 9/2004-16/11/13 | 40 | 1.5 | 1.5 | 3300.0 | 0.720 | 0.00 |
| | TOC (mg/l) | 9/2004-30/5/12 | 33 | 2.2 | 3.8 | 20.0 | 0.059 | -3.19 |
| | TON (mg/l) | 9/2004-16/11/13 | 39 | 0.080 | 0.210 | 4.790 | 1.000 | 0.00 |
| | Conductivity (µS/cm) | 9/2004-16/11/13 | 40 | 137 | 333 | 478 | 0.929 | -0.16 |
| | HDT (mg/l) | 9/2004-30/5/12 | 34 | 49 | 120 | 160 | 0.821 | 0.42 |

The tables presented in Appendix C present the state and trend of water quality variables from sites within the Esk, Aropaoanui and Waikari catchments. The minima, medians and maxima are given for each variable at each site for the sample period indicated. Sample periods in amber indicate the time period covered fewer than 8 out of the 10 years from Jan 2004 to Dec 2013, and caution should be exercised when comparing these results to other sites with longer records. We explored whether any trends over time were evident by using Seasonal Kendall tests with a significance level (α) of 0.05. Sen slope was used to estimate the Percent Annual Change (PAC) and gives an indication of the magnitude of change over time. A statistically significant ($p < 0.05$, in bold) change of 1% or more was considered "meaningful". Cells are coloured blue 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"). Cells are shaded grey when the direction of change in the variable of interest is neither intuitively good nor bad (e.g. conductivity, DIN/DRP).

# 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 |
| Aropaoanui 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 |

| Site | Median TN | Sample size (n) | Rank | Catchment | Reporting Zone |
|---|---|---|---|---|---|
| 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 |
| Aropaoanui 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 |
| Aropaoanui 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 |

| Site | Median $NO_3$-N | Sample size (n) | Rank | Catchment | Reporting Zone |
|---|---|---|---|---|---|
| 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 Disk (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 |
| 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* (counts/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 |
| Aropaoanui 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 |
| Aropaoanui 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 |
| 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-FM 2014 NOF attribute tables

**Periphyton NOF attribute table**

| **Value** | Ecosystem health | | |
|---|---|---|---|
| **Freshwater Body Type** | Rivers | | |
| **Attribute** | Periphyton (Trophic state) | | |
| **Attribute Unit** | mg Chl-a/$m^2$ (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 than17% 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 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 (i.e. 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.<br>No observed effect on any species. |
| **B** | >0.03 and ≤ 0.24 | >0.05 and ≤ 0.40 | 95% species protection level.<br>Starts impacting occasionally on the 5% most sensitive species. |
| **C** | >0.24 and ≤ 1.30 | >0.40 and ≤ 2.020 | 80% species protection level.<br>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 (i.e. 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 mean 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 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** | Ecosystem health | | |
|---|---|---|---|
| **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 (less than 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. 540/100 ml is the **minimum acceptable state** for activities likely to involve full immersion. |
| **C** | >540 and ≤ 1,000 | 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 full immersion. |
| **National Bottom Line** | **1,000** | Annual median | |
| **D** | >1,000 | 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 F1: NPS-FM 2014 NOF bands for the *E. coli* attribute for Esk, Aropaoanui and Waikari catchment monitoring sites.**
Cells are coloured as per the Attribute State gradings shown:

| A | B | C | D |
|---|---|---|---|

| Site | Annual Medians | | | | | 5 Year 95th percentile |
|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | |
| Esk Rv at Waipunga Br | 20 | 27 | 21 | 54 | 70 | 130 |
| Esk Rv at Berry Rd | 23 | 68 | 28 | 30 | 20 | 120 |
| Sandy Ck | 177 | 1,300 | 66 | NA | NA | 440 |
| Mahiaruhe Strm | 31 | 530 | 58 | NA | NA | 270 |
| Aropaoanui Rv | 14 | 115 | 16 | 22 | 41 | 360 |
| Anaura Strm | 6 | 20 | 10 | 8 | NA | 24 |
| Waikari Rv | 22 | 190 | 41 | NA | NA | 65 |

**Table F2: NPS-FM 2014 NOF bands for the nitrate Attribute States for nitrate toxicity for the Esk, Aropaoanui and Waikari catchment monitoring sites.**
Gaps in table appear where no data were available. Cells are coloured as per the Attribute State gradings shown:

| A | B | C | D |
|---|---|---|---|

| Site | Annual Medians | | | | | Annual 95th Percentiles | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Esk Rv at Waipunga Br | 0.235 | 0.167 | 0.330 | 0.305 | 0.168 | 0.590 | 0.400 | 0.520 | 0.610 | 0.439 |
| Esk Rv at Berry Rd | 0.260 | 0.223 | 0.300 | 0.320 | 0.260 | 0.540 | 0.340 | 0.430 | 0.530 | 0.466 |
| Sandy Ck | 0.335 | 0.365 | 0.605 | 0.470 | 0.365 | 0.630 | 0.410 | 0.960 | 0.610 | 1.026 |
| Mahiaruhe Strm | 0.250 | 0.320 | 0.320 | NA | NA | 0.370 | 0.370 | 0.350 | NA | NA |
| Aropaoanui Rv | 0.036 | 0.240 | 0.190 | 0.097 | 0.094 | 0.320 | 0.290 | 0.410 | 0.290 | 0.576 |
| Anaura Strm | 0.098 | 0.051 | 0.087 | 0.014 | NA | 0.850 | 0.186 | 0.148 | 0.073 | NA |
| Waikari Rv | 0.135 | 0.240 | 0.330 | 0.141 | 0.125 | 0.300 | 0.350 | 1.160 | 0.300 | 0.577 |

**Table F3 NPS-FM 2014 NOF bands for the ammonia toxicity attribute for Esk, Aropaoanui and Waikari catchment monitoring sites.**

Gaps in table appear where no data were available. Cells are coloured as per the Attribute State gradings shown:

| A | B | C | D |
|---|---|---|---|

| Site | Medians | | | | | Maxima | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Esk Rv at Waipunga Br | 0.015 | 0.012 | 0.005 | 0.010 | 0.009 | 0.028 | 0.037 | 0.022 | 0.113 | 0.090 |
| Esk Rv at Berry Rd | 0.005 | 0.034 | 0.008 | 0.013 | 0.011 | 0.024 | 0.063 | 0.012 | 0.024 | 0.019 |
| Sandy Ck | 0.037 | 0.027 | 0.036 | 0.023 | 0.023 | 0.050 | 0.117 | 0.041 | 0.044 | 0.063 |
| Mahiaruhe Strm | 0.038 | 0.022 | 0.031 | NA | NA | 0.066 | 0.270 | 0.038 | NA | NA |
| Aropaoanui Rv | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.011 | 0.024 | 0.005 | 0.016 | 0.031 |
| Anaura Strm | 0.005 | 0.015 | 0.005 | 0.011 | NA | 0.005 | 0.056 | 0.020 | 0.016 | NA |
| Waikari Rv | 0.015 | 0.005 | 0.020 | 0.005 | 0.009 | 0.029 | 0.021 | 0.045 | 0.040 | 0.053 |