

# Waikato River water quality monitoring programme: Data report 2017

Prepared by:  
Asaeli Tulagi

For:  
Waikato Regional Council  
Private Bag 3038  
Waikato Mail Centre  
HAMILTON 3240

August 2019

Document #: 12603454

Peer reviewed by:  
Eloise Ryan

Date May 2019

Approved for release by:  
Edmund Brown

Date August 2019

### **Disclaimer**

This technical report has been prepared for the use of Waikato Regional Council as a reference document and as such does not constitute Council's policy.

Council requests that if excerpts or inferences are drawn from this document for further use by individuals or organisations, due care should be taken to ensure that the appropriate context has been preserved, and is accurately reflected and referenced in any subsequent spoken or written communication.

While Waikato Regional Council has exercised all reasonable skill and care in controlling the contents of this report, Council accepts no liability in contract, tort or otherwise, for any loss, damage, injury or expense (whether direct, indirect or consequential) arising out of the provision of this information or its use by you or any other party.



# Acknowledgement

Thanks to Chris McKinnon, Alicia Catlin, Julia Simpson, Claire Kotze, Jacoro Lati, Aroha Salu, Bayley Kelepamu, Ian Weir, Kane Lynn, Mark Hamer, Aaron Pedraza, Sameer Sankhyadhar and Debbie Eastwood for their commitment and reliability in undertaking field measurements and sample collection; Chris McKinnon for co-ordination of the field aspects of sample collection. Thanks to Meagan Reid for assisting with the report formatting.

Hydrological flow data were provided by Mercury Energy (Hydro Lakes, Waiotapu stream and Waikato River at Reids Farm), Contact Energy (Ohaaki Bridge) and Genesis Power (Huntly) through agents Opus and NIWA. The Environmental Monitoring Programme, Waikato Regional Council, Hamilton provided hydrological flow data for two sites.



# Table of contents

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Introduction</b>                                  | <b>1</b>  |
| 1.1      | Background   | 1         |
| 1.2      | Report content                                       | 1         |
| 1.3      | Water quality guidelines and standards               | 2         |
| <b>2</b> | <b>The Waikato River monitoring programme design</b> | <b>3</b>  |
| 2.1      | Sampling collection                                  | 3         |
| 2.2      | Sample locations                                     | 3         |
| 2.3      | Water quality parameters                             | 5         |
| 2.4      | Quality control, data storage and analysis           | 5         |
| 2.5      | Reports  | 5         |
| <b>3</b> | <b>Results</b>                                       | <b>6</b>  |
| 3.1      | Waikato River monitoring programme                   | 6         |
|          | Routine water quality monitoring                     | 6         |
|          | Summary statistics                                   | 6         |
|          | Key parameter graphs                                 | 6         |
|          | Comparison with water quality standards              | 6         |
|          | Raw data   | 6         |
|          | <b>References</b>                                    | <b>23</b> |
|          | <b>Appendix I:</b>                                   | <b>24</b> |
|          | Flow information                                     | 24        |
|          | <b>Appendix II:</b>                                  | <b>25</b> |
|          | Water quality parameters                             | 25        |
|          | Guidelines and standards                             | 25        |
|          | Analytical methods                                   | 25        |

## Tables

|          |   |    |
|----------|---|----|
| Table 1: | Guidelines and standards for physiochemical water quality for ecological health and for human uses of water                   | 2  |
| Table 2: | Routine sampling and bathing water monitoring sites   | 4  |
| Table 3: | Sample statistics for 2017  | 7  |
| Table 4: | Number of monthly samples (2017) complying with the "satisfactory" water quality guidelines and standards.                    | 16 |
| Table 5: | Number of monthly samples (2017) complying with the "excellent" water quality guidelines and standards.                       | 16 |
| Table 6: | Raw data summary: Samples collected compared with the "satisfactory" water quality guidelines and standards in the year 2017. | 17 |

## Figures

|           |  |   |
|-----------|--|---|
| Figure 1: | Waikato River water quality monitoring locations | 3 |
|-----------|--|---|





# 1 Introduction

## 1.1 Background

This report covers the calendar year of 2017 and follows the format of the previous data report (Tulagi, 2016).

To effectively manage water quality, the Waikato River monitoring programme addresses the following questions:

1. What is the quality of the water now?
2. Why is the water of the observed level of quality?
3. Is water quality getting better or worse? If so - what makes it change?
4. How can we improve the quality, ecological health and integrity of the Waikato River?

The monitoring information allows the Council to:

- determine compliance with classification standards
- define the suitability of the resource for various beneficial uses and values of the water
- monitor the impact of major discrete point source discharges on water quality
- monitor the impacts of diffuse discharges on water quality
- provide a basis for evaluating the effectiveness of resource management measures.

This dataset is invaluable for the evaluation of the Waikato River: its state, the pressures on it and its response to these pressures. We need to continue to gather comprehensive, reliable, and good quality data on the Waikato River to protect and enhance its values into the future.

This report is the 27<sup>th</sup> since the re-design of the Waikato River Monitoring Programme (WARIMP) implemented in 1989. Copies of reports can be obtained via the Waikato Regional Council Internet site <http://www.waikatoregion.govt.nz/Publications/> or by contacting Waikato Regional Council (the Library) on 0800 800 401 and filling out the request for service form at: [www.waikatoregion.govt.nz/request](http://www.waikatoregion.govt.nz/request).

## 1.2 Report content

The report provides information on:

1. Routine monthly monitoring of water quality at 10 sites:
  - Year 2017 summary data tabulated by parameter for each location and reported with the median of the previous 5 years.
  - Key parameter graphs showing the average water quality for 2017 at each location, compared to results of the previous 5 years.
  - Summary tables identifying the number of samples meeting 'satisfactory' and 'excellent' water quality standards and guidelines.
  - Raw data for 2017.
2. Additional information is provided in the appendices on:
  - Flow (*Appendix I*).
    - The effect of flow is important to assessing water quality and making comparisons between years. Appendix I provides information on annual median flow at some locations for the previous 10 years.

## 1.3 Water quality guidelines and standards

Table 1 lists the physical and chemical water quality standards and guidelines used to assess the condition of the Waikato River in 2017. The standards mainly relate to either the protection of ecological health of rivers and streams or to whether they are suitable for water-based recreation, especially swimming.

Some water quality guidelines and standards are relevant to the use of the Waikato River for both general water supply (industrial/cooling water, irrigation, stock water etc.) and as a source of municipal drinking water. In most cases two criteria are shown. The less stringent criteria define water that is “satisfactory” for the desired use; these are mostly based on existing national and other guidelines and standards (Appendix II). The more stringent criteria identify “excellent” water, and reflect expert opinion. Samples gathered in 2017 whose results do not comply with the “satisfactory” criteria (Table 1) are underlined in raw data summaries.

Adoption of updated water guidelines within council is currently under review. Including the National Policy Statement for Freshwater Management 2017 (NPSFM) and updated ANZECC (2018) guidelines.

**Table 1: Guidelines and standards for physiochemical water quality for ecological health and for human uses of water**

| Water quality measure                    | Relevance <sup>1</sup>   | Satisfactory | Excellent |
|--|--------------------------|--------------|-----------|
| <b>Ecological health</b>                 |                          |              |           |
| Dissolved Oxygen (% sat.)                | aquatic life (breathing) | >80          | >90       |
| pH                                       | aquatic life (acidity)   | 6.5-9        | 7-8       |
| Turbidity (NTU)                          | plant life (clarity)     | <5           | <2        |
| Ammoniacal Nitrogen (g/m <sup>3</sup> )  | aquatic life (toxicity)  | <0.88        | <0.1      |
| Water Temperature (°C)(May-Sep)          | fish (spawning)          | <12          | <10       |
| (Oct-Apr)                                | fish health              | <20          | <16       |
| Total Phosphorus (g/m <sup>3</sup> )     | nuisance plant growth    | <0.04        | <0.01     |
| Total Nitrogen (g/m <sup>3</sup> )       | nuisance plant growth    | <0.5         | <0.1      |
| <b>Human uses - recreation</b>           |                          |              |           |
| Black Disk (m)                           | visibility               | >1.6         | >4        |
| <i>Escherichia coli</i> (✓100ml)         | human health             | <550         | <55       |
| Median <i>Escherichia coli</i> (✓100ml)  | human health             | <126         | <23       |
| <b>Human uses - water supply</b>         |                          |              |           |
| Chlorophyll <i>a</i> (g/m <sup>3</sup> ) | filter blockage          | <0.02        | <0.005    |
| <b>Human uses - drinking water</b>       |                          |              |           |
| Arsenic (g/m <sup>3</sup> )              | human health (toxicity)  | <0.01        | -         |
| Boron (g/m <sup>3</sup> )                | human health (toxicity)  | <1.4         | -         |

<sup>1</sup>Refer to Appendix III for description of guideline and standards values used. These guidelines and standards are also defined on the Waikato Regional Council Internet site; [www.waikatoregion.govt.nz/guidelines](http://www.waikatoregion.govt.nz/guidelines)

## 2 The Waikato River monitoring programme design

### 2.1 Sampling collection

Sample collection occurs monthly, as two sampling runs. Locations in the upper catchment from Taupo to Waipapa are visited as part of the first run, and locations in the middle and lower catchments from Hamilton (at the Narrows) to Tuakau are visited on the next. Each location is sampled at a similar time on each occasion (coefficient of variation  $\approx 2\text{--}6\%$ ) to minimise the effect of diurnal variation on the measurement of water quality parameters. Sample times are recorded in New Zealand Standard Time (NZST). Because of the controlled nature of the river, our daytime samples are generally collected at higher than median flows.

### 2.2 Sample locations

Routine water quality monitoring locations of the Waikato River Monitoring Programme and additional locations used during the summer microbiological surveys are illustrated in *Figure 1* and summarised in *Table 2*. The 2016-2017 summer microbiological survey was reported in the council's technical report 2017/14. Copies can be downloaded from the council's web page [www.waikatoregion.govt.nz\\_tr2017/14](http://www.waikatoregion.govt.nz_tr2017/14)

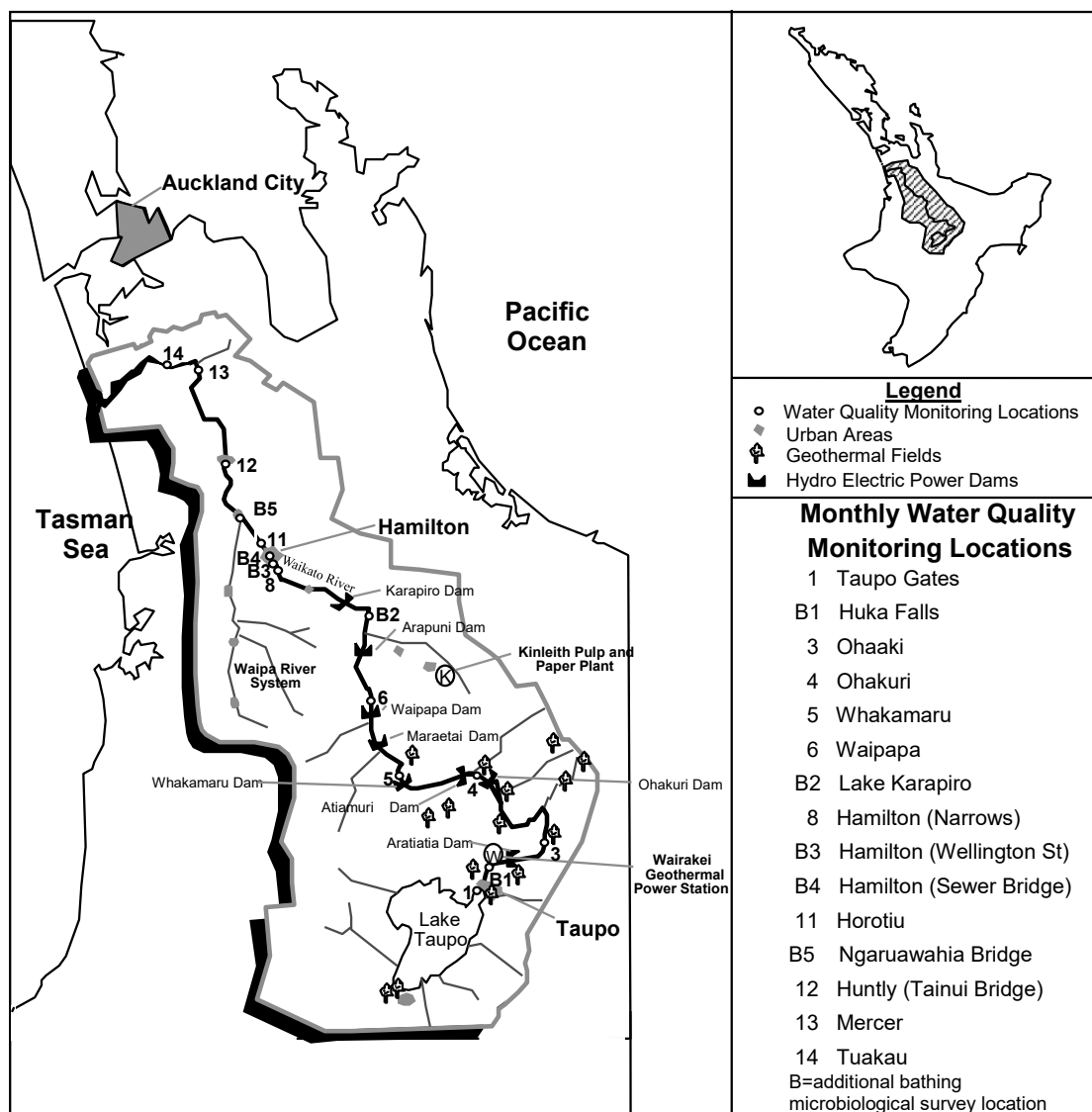


Figure 1: Waikato River water quality monitoring locations

Ten locations along the river are visited monthly (Taupo, Ohaaki, Ohakuri, Whakamaru, Waipapa, Hamilton-Narrows, Hamilton-Horotiu, Huntly, Mercer and Tuakau), and an additional four locations are included for the summer intensive microbiological survey (see Table 2, Figure 1). The major tributaries that enter the Waikato River are also monitored monthly as part of the Regional River Monitoring Programme (RERIMP) initiated in 1993 (Huser and Wilson, 1996b).

**Table 2: Routine sampling and bathing water monitoring sites**

| Location number        | Distance <sup>1</sup> (km) | Location name   | Map Ref.    |
|------------------------|----------------------------|---|-------------|
| 1131-127               | 0.1                        | Taupo Gates   | U18:772-757 |
| 1131-649 <sup>*d</sup> | 2                          | Taupo Bungy at jetty, true right bank                   | U18:785:758 |
| 1131-70 <sup>b</sup>   | 6                          | Huka Falls  | U18:789-792 |
| 1131-219 <sup>d</sup>  | 8.4                        | Downstream Huka Falls at river boat jetty <sup>2</sup>  | U17:802-813 |
| 1131-105 <sup>d</sup>  | 36.5                       | Ohaaki Bridge at bridge, true right bank                | U17:981-914 |
| 1131-107               | 75.8                       | Ohakuri Tailrace Bridge at boat ramp <sup>3</sup>       | U17:796-061 |
| 1131-147               | 105                        | Whakamaru Tailrace at boat ramp <sup>4</sup>            | T17:552-056 |
| 1131-143               | 126.1                      | Waipapa Tailrace at boat ramp <sup>5</sup>              | T16:448-200 |
| 1131-81 <sup>b</sup>   | 166.7                      | Lake Karapiro Boat Ramp at Horahora domain              | T15:436-570 |
| 1131-328               | 202.2                      | Hamilton – Narrows at boat ramp <sup>6</sup>            | S14:168-710 |
| 1131-64 <sup>d</sup>   | 211.5                      | Hamilton – Traffic Bridge true right bank               | S14:118-764 |
| 1131-121 <sup>b</sup>  | 219.8                      | Hamilton – Sewer Bridge true left bank                  | S14:082-823 |
| 1131-69                | 225.6                      | Horotiu Bridge d/s of bridge                            | S14:048-871 |
| 1131-102 <sup>b</sup>  | 232.3                      | Ngaruawahia Bridge u/s of confluence <sup>7</sup>       | S14:997-912 |
| 1131-77                | 246.5                      | Huntly – Tainui Bridge true left bank                   | S13:003-018 |
| 1131-91                | 286.3                      | Mercer Bridge   | S12:919-336 |
| 1131-133               | 296.8                      | Tuakau Bridge at boat ramp <sup>8</sup>                 | R12:828-320 |
| 1131-131 <sup>d</sup>  | 306.5                      | Tuakau – Elbows Landing at NZ Steel Ltd pumping station | R12:745-352 |
| 792-1 <sup>b</sup>     | 337                        | Port Waikato – Maraetai Bay at dune beach               | R13:630-223 |

<sup>1</sup> approximate distance (in kilometres) from Lake Taupo's outlet.

<sup>2</sup> river boat jetty and boat ramp, true left bank, about 1.8 km downstream of Huka Falls

<sup>3</sup> boat ramp in recreation reserve immediately upstream from dam (true left bank).

<sup>4</sup> boat ramp at Whakamaru Power Station.

<sup>5</sup> river access d/s of Lake Waipapa, about 500 m off S.H. 32 along a gravel road (true left bank).

<sup>6</sup> boat ramp accessed via Narrows Lane (true right bank)

<sup>7</sup> road bridge upstream of Waipa River confluence.

<sup>8</sup> immediately d/s of bridge, at Reserve (true right bank).

<sup>b</sup> bathing season intensive microbiological survey locations only – survey conducted over the 2014/15 summer.

<sup>\*</sup> locations at Taupo (Taupo Bungy, 2 km d/s from Taupo Gates)

<sup>\*</sup> logistic considerations mean field measurements are often made at slightly different locations from sample collection (e.g. sampling from bridges).

<sup>d</sup> datasonde deployment sites.

## 2.3 Water quality parameters

Water quality of the Waikato River is assessed by measuring up to 40 parameters (27 routinely). Some parameters are measured in the field, but the majority of parameters are analysed in a laboratory using standard analytical methods. Details of field measurements and analytical methods used are appended (*Appendix II*).

## 2.4 Quality control, data storage and analysis

Quality control measures are undertaken in accordance with Waikato Regional Council's standards including procedures for the collection, transport, storage of samples, and methods for data verification and quality assurance to ensure the consistency of data across the programme. Samples are sent to IANZ registered laboratories for analysis. Back-up samples are held for two months until results have been verified by routine quality assurance procedures. All data from field measurements and laboratory analyses are stored in Waikato Regional Council's database called WISKI.

Data analysis was performed using WQStats program. For the purpose of data analysis, non-detect results (i.e. results with "less than" values) were assumed to be equal to half the corresponding limit of detection (i.e.  $<x = x/2$ ), and results greater than the value reported were taken as equal to the value reported (i.e.  $>x = x$ ).

## 2.5 Reports

Waikato Regional Council Technical Report 2018/30, Trends in River Water Quality in the Waikato Region, 1993–2017 (Vant, 2018) outlines the trends in the Waikato River and other rivers in the region. Copies are available in electronic format from the publications page of the Waikato Regional Council website:

<http://www.waikatoregion.govt.nz/Publications/Technical-Reports>

The data contained in these Waikato River reports is updated to the Waikato Regional Council "Waikato River" Internet page:

<http://www.waikatoregion.govt.nz/Fresh-water-quality>

The "How healthy are our rivers?" link provides details of the guidelines and standards used to assess the condition of the Waikato River and other rivers in the region. A link to water quality at other regional river monitoring sites is also available from this page.

This data is also supplied to the LAWA website <https://www.lawa.org.nz/explore-data/waikato-region>

## **3 Results**

### **3.1 Waikato River monitoring programme**

**Routine water quality monitoring**

**Summary statistics**

**Key parameter graphs**

**Comparison with water quality standards**

**Raw data**

**Table 3: Sample statistics for 2017**

| Absorbance (340nm) (1/cm) |       |       |        |       |       |       |       |               |
|---------------------------|-------|-------|--------|-------|-------|-------|-------|---------------|
| Location                  | Count | Mean  | Median | Min   | Max   | IQR   | Skew  | 5 year median |
| Taupo Gates               | 12    | 0.001 | 0.001  | 0.001 | 0.003 | 0.001 | 1.46  | 0.001         |
| Ohaaki Br                 | 12    | 0.003 | 0.004  | 0.001 | 0.005 | 0.002 | -0.54 | 0.003         |
| Ohakuri Tailrace Br       | 12    | 0.008 | 0.008  | 0.005 | 0.011 | 0.003 | 0.46  | 0.006         |
| Whakamaru Tailrace        | 6     | 0.008 | 0.008  | 0.006 | 0.009 | 0.000 | -1.44 | 0.007         |
| Waipapa Tailrace          | 12    | 0.010 | 0.010  | 0.006 | 0.016 | 0.003 | 0.89  | 0.010         |
| Narrows Boat Ramp         | 12    | 0.016 | 0.015  | 0.009 | 0.038 | 0.007 | 2.25  | 0.012         |
| Horotiu Br                | 12    | 0.019 | 0.017  | 0.010 | 0.055 | 0.008 | 2.81  | 0.012         |
| Huntly-Tainui Br          | 12    | 0.028 | 0.024  | 0.014 | 0.065 | 0.018 | 1.59  | 0.020         |
| Mercer Bridge             | 12    | 0.036 | 0.029  | 0.012 | 0.086 | 0.031 | 1.22  | 0.022         |
| Tuakau Br                 | 12    | 0.042 | 0.041  | 0.012 | 0.082 | 0.033 | 0.56  | 0.026         |

| Absorbance (440nm) (1/cm) |       |       |        |       |       |       |      |               |
|---------------------------|-------|-------|--------|-------|-------|-------|------|---------------|
| Location                  | Count | Mean  | Median | Min   | Max   | IQR   | Skew | 5 year median |
| Taupo Gates               | 12    | 0.001 | 0.001  | 0.001 | 0.001 | 0.000 | 0.00 | 0.001         |
| Ohaaki Br                 | 12    | 0.001 | 0.001  | 0.001 | 0.001 | 0.000 | 0.00 | 0.001         |
| Ohakuri Tailrace Br       | 12    | 0.001 | 0.001  | 0.001 | 0.003 | 0.000 | 3.46 | 0.001         |
| Whakamaru Tailrace        | 6     | 0.001 | 0.001  | 0.001 | 0.002 | 0.000 | 2.45 | 0.001         |
| Waipapa Tailrace          | 12    | 0.002 | 0.002  | 0.001 | 0.004 | 0.001 | 1.08 | 0.002         |
| Narrows Boat Ramp         | 12    | 0.003 | 0.004  | 0.001 | 0.007 | 0.003 | 0.44 | 0.002         |
| Horotiu Br                | 12    | 0.004 | 0.004  | 0.001 | 0.011 | 0.002 | 2.24 | 0.002         |
| Huntly-Tainui Br          | 12    | 0.005 | 0.005  | 0.002 | 0.013 | 0.003 | 1.65 | 0.004         |
| Mercer Bridge             | 12    | 0.007 | 0.006  | 0.002 | 0.016 | 0.005 | 1.33 | 0.004         |
| Tuakau Br                 | 12    | 0.008 | 0.008  | 0.002 | 0.015 | 0.006 | 0.55 | 0.004         |

| Arsenic (g/m <sup>3</sup> ) |       |       |        |       |       |       |      |               |
|-----------------------------|-------|-------|--------|-------|-------|-------|------|---------------|
| Location                    | Count | Mean  | Median | Min   | Max   | IQR   | Skew | 5 year median |
| Taupo Gates                 | 12    | 0.011 | 0.011  | 0.011 | 0.013 | 0.001 | 0.41 | 0.012         |
| Ohaaki Br                   | 12    | 0.018 | 0.018  | 0.015 | 0.024 | 0.002 | 1.14 | 0.024         |
| Ohakuri Tailrace Br         | 12    | 0.024 | 0.024  | 0.020 | 0.033 | 0.006 | 1.02 | 0.029         |
| Whakamaru Tailrace          | 6     | 0.025 | 0.024  | 0.020 | 0.033 | 0.009 | 0.70 | 0.030         |
| Waipapa Tailrace            | 12    | 0.022 | 0.020  | 0.017 | 0.029 | 0.007 | 0.68 | 0.025         |
| Narrows Boat Ramp           | 12    | 0.019 | 0.017  | 0.014 | 0.027 | 0.007 | 0.71 | 0.022         |
| Horotiu Br                  | 12    | 0.018 | 0.016  | 0.013 | 0.027 | 0.006 | 1.00 | 0.022         |
| Huntly-Tainui Br            | 12    | 0.014 | 0.012  | 0.009 | 0.022 | 0.008 | 0.85 | 0.016         |
| Mercer Bridge               | 12    | 0.014 | 0.011  | 0.009 | 0.023 | 0.007 | 1.10 | 0.016         |
| Tuakau Br                   | 12    | 0.013 | 0.011  | 0.009 | 0.023 | 0.006 | 1.41 | 0.016         |

| Black Disk (m)      |       |      |        |     |     |     |       |               |
|---------------------|-------|------|--------|-----|-----|-----|-------|---------------|
| Location            | Count | Mean | Median | Min | Max | IQR | Skew  | 5 year median |
| Taupo Gates         | -     | -    | -      | -   | -   | -   | -     | -             |
| Ohaaki Br           | 12    | 5.2  | 5.7    | 2.8 | 6.6 | 2.1 | -0.75 | 4.8           |
| Ohakuri Tailrace Br | 12    | 2.5  | 2.5    | 1.5 | 3.6 | 0.6 | 0.17  | 2.5           |
| Whakamaru Tailrace  | 6     | 2.3  | 2.4    | 1.5 | 2.7 | 0.6 | -1.12 | 2.4           |
| Waipapa Tailrace    | 12    | 2.0  | 2.1    | 0.5 | 3.3 | 0.7 | -0.61 | 2.1           |
| Narrows Boat Ramp   | 10    | 1.5  | 1.4    | 0.8 | 2.2 | 1.0 | 0.26  | 1.9           |
| Horotiu Br          | 10    | 1.2  | 1.2    | 0.6 | 1.9 | 0.9 | 0.14  | 1.6           |
| Huntly-Tainui Br    | 8     | 0.8  | 0.8    | 0.3 | 1.3 | 0.6 | -0.12 | 1.0           |
| Mercer Bridge       | -     | -    | -      | -   | -   | -   | -     | -             |
| Tuakau Br           | 10    | 0.6  | 0.6    | 0.1 | 1.0 | 0.4 | -0.17 | 0.7           |

Skew = skewness (> 1 is lightly skewed, >2 is highly skewed; IQR = inter-quartile range)

| Conductivity at 25 DegC (mS/m) |       |      |        |      |      |     |       |               |
|--------------------------------|-------|------|--------|------|------|-----|-------|---------------|
| Location                       | Count | Mean | Median | Min  | Max  | IQR | Skew  | 5 year median |
| Taupo Gates                    | 12    | 11.9 | 11.9   | 11.7 | 12.1 | 0.3 | -0.04 | 12.0          |
| Ohaaki Br                      | 12    | 13.7 | 13.6   | 12.7 | 15.1 | 0.3 | 0.97  | 14.7          |
| Ohakuri Tailrace Br            | 12    | 15.4 | 15.3   | 14.5 | 17.6 | 1.1 | 1.33  | 16.6          |
| Whakamaru Tailrace             | 6     | 15.6 | 15.3   | 14.8 | 17.5 | 1.1 | 1.61  | 16.7          |
| Waipapa Tailrace               | 12    | 15.1 | 14.8   | 13.8 | 17.0 | 1.7 | 0.63  | 16.0          |
| Narrows Boat Ramp              | 12    | 14.6 | 14.4   | 13.3 | 16.5 | 1.6 | 0.40  | 15.9          |
| Horotiu Br                     | 12    | 14.6 | 14.3   | 13.5 | 16.9 | 1.3 | 0.97  | 15.9          |
| Huntly-Tainui Br               | 12    | 13.9 | 13.6   | 12.2 | 16.0 | 1.4 | 0.73  | 14.8          |
| Mercer Bridge                  | 12    | 14.4 | 14.3   | 12.8 | 16.3 | 1.4 | 0.49  | 15.6          |
| Tuakau Br                      | 12    | 14.4 | 14.2   | 12.3 | 16.7 | 1.5 | 0.35  | 15.7          |

| Dissolved Oxygen (g/m <sup>3</sup> ) |       |      |        |     |      |     |       |               |
|--------------------------------------|-------|------|--------|-----|------|-----|-------|---------------|
| Location                             | Count | Mean | Median | Min | Max  | IQR | Skew  | 5 year median |
| Taupo Gates                          | 12    | 9.9  | 10     | 8.9 | 10.9 | 1.1 | -0.08 | 9.9           |
| Ohaaki Br                            | 12    | 10.3 | 10.3   | 9.0 | 12.0 | 1.7 | 0.30  | 9.8           |
| Ohakuri Tailrace Br                  | 12    | 10.0 | 10.3   | 8.4 | 10.9 | 1.5 | -0.69 | 9.7           |
| Whakamaru Tailrace                   | 6     | 10.0 | 10.0   | 9.2 | 10.9 | 0.7 | 0.25  | 9.9           |
| Waipapa Tailrace                     | 12    | 10.2 | 10.2   | 8.9 | 11.4 | 0.8 | -0.55 | 10.1          |
| Narrows Boat Ramp                    | 12    | 9.7  | 10.1   | 7.8 | 11.4 | 1.5 | -0.39 | 9.9           |
| Horotiu Br                           | 12    | 9.5  | 9.7    | 7.7 | 10.9 | 1.6 | -0.54 | 9.7           |
| Huntly-Tainui Br                     | 12    | 9.2  | 9.3    | 7.9 | 10.6 | 1.7 | -0.13 | 9.4           |
| Mercer Bridge                        | 12    | 8.9  | 9.0    | 7.0 | 10.2 | 1.7 | -0.39 | 9.3           |
| Tuakau Br                            | 12    | 8.7  | 9.1    | 6.4 | 9.9  | 1.5 | -1.06 | 9.4           |

| Dissolved Oxygen (% sat.) |       |      |        |     |     |     |       |               |
|---------------------------|-------|------|--------|-----|-----|-----|-------|---------------|
| Location                  | Count | Mean | Median | Min | Max | IQR | Skew  | 5 year median |
| Taupo Gates               | 12    | 101  | 102    | 93  | 108 | 4   | -0.3  | 102           |
| Ohaaki Br                 | 12    | 106  | 105    | 101 | 114 | 5   | 1.01  | 103           |
| Ohakuri Tailrace Br       | 12    | 103  | 101    | 92  | 125 | 9   | 1.38  | 101           |
| Whakamaru Tailrace        | 6     | 105  | 107    | 96  | 114 | 14  | -0.43 | 103           |
| Waipapa Tailrace          | 12    | 104  | 105    | 92  | 114 | 12  | -0.24 | 100           |
| Narrows Boat Ramp         | 12    | 97   | 98     | 85  | 109 | 10  | -0.19 | 97            |
| Horotiu Br                | 12    | 95   | 97     | 85  | 103 | 7   | -0.68 | 96            |
| Huntly-Tainui Br          | 12    | 92   | 94     | 83  | 98  | 8   | -0.56 | 95            |
| Mercer Bridge             | 12    | 90   | 93     | 74  | 99  | 8   | -1.23 | 96            |
| Tuakau Br                 | 12    | 89   | 90     | 68  | 102 | 12  | -0.9  | 97            |

| Enterococci (/100ml) |       |      |        |     |      |     |      |               |
|----------------------|-------|------|--------|-----|------|-----|------|---------------|
| Location             | Count | Mean | Median | Min | Max  | IQR | Skew | 5 year median |
| Taupo Gates          | 12    | 7    | 3      | 1   | 48   | 9   | 2.95 | 2             |
| Ohaaki Br            | 12    | 58   | 14     | 1   | 370  | 53  | 2.64 | 8             |
| Ohakuri Tailrace Br  | 12    | 10   | 6      | 1   | 35   | 11  | 1.55 | 3             |
| Whakamaru Tailrace   | 6     | 34   | 12     | 1   | 130  | 47  | 1.84 | 6             |
| Waipapa Tailrace     | 12    | 74   | 8      | 3   | 500  | 41  | 2.62 | 5             |
| Narrows Boat Ramp    | 12    | 372  | 48     | 15  | 1900 | 553 | 1.74 | 45            |
| Horotiu Br           | 12    | 628  | 85     | 21  | 3100 | 974 | 1.69 | 48            |
| Huntly-Tainui Br     | 12    | 904  | 63     | 18  | 5900 | 745 | 2.39 | 53            |
| Mercer Bridge        | 12    | 737  | 42     | 13  | 5800 | 698 | 3.06 | 24            |
| Tuakau Br            | 12    | 869  | 33     | 9   | 5100 | 555 | 2.05 | 23            |

Skew = skewness (> 1 is lightly skewed, >2 is highly skewed); IQR = inter-quartile range



| <b>Escherichia coli (/100ml)</b> |       |      |        |     |      |      |      |               |
|----------------------------------|-------|------|--------|-----|------|------|------|---------------|
| Location                         | Count | Mean | Median | Min | Max  | IQR  | Skew | 5 year median |
| Taupo Gates                      | 12    | 10   | 4      | 1   | 60   | 12   | 2.81 | 3             |
| Ohaaki Br                        | 12    | 49   | 18     | 7   | 310  | 37   | 3.06 | 14            |
| Ohakuri Tailrace Br              | 12    | 12   | 9      | 1   | 29   | 15   | 0.51 | 3             |
| Whakamaru Tailrace               | 6     | 37   | 18     | 2   | 140  | 26   | 2.18 | 9             |
| Waipapa Tailrace                 | 12    | 339  | 15     | 5   | 2800 | 31   | 2.81 | 7             |
| Narrows Boat Ramp                | 12    | 463  | 145    | 34  | 2900 | 240  | 2.66 | 53            |
| Horotiu Br                       | 12    | 707  | 150    | 30  | 3700 | 1025 | 2.19 | 90            |
| Huntly-Tainui Br                 | 11    | 1317 | 190    | 70  | 4000 | 2733 | 0.76 | 150           |
| Mercer Bridge                    | 12    | 957  | 340    | 60  | 5400 | 811  | 2.57 | 80            |
| Tuakau Br                        | 12    | 881  | 260    | 60  | 4500 | 1259 | 2.17 | 70            |

| <b>Faecal Coliforms (/100ml)</b> |       |      |        |     |      |      |      |               |
|----------------------------------|-------|------|--------|-----|------|------|------|---------------|
| Location                         | Count | Mean | Median | Min | Max  | IQR  | Skew | 5 year median |
| Taupo Gates                      | 12    | 12   | 3      | 1   | 70   | 15   | 2.69 | 3             |
| Ohaaki Br                        | 12    | 69   | 28     | 9   | 380  | 75   | 2.8  | 17            |
| Ohakuri Tailrace Br              | 12    | 14   | 12     | 2   | 32   | 17   | 0.5  | 4             |
| Whakamaru Tailrace               | 6     | 37   | 19     | 2   | 140  | 26   | 2.18 | 10            |
| Waipapa Tailrace                 | 12    | 393  | 19     | 6   | 3300 | 38   | 2.88 | 8             |
| Narrows Boat Ramp                | 12    | 645  | 160    | 47  | 3700 | 450  | 2.41 | 67            |
| Horotiu Br                       | 12    | 978  | 250    | 40  | 5500 | 1315 | 2.53 | 115           |
| Huntly-Tainui Br                 | 12    | 1604 | 385    | 110 | 6000 | 2935 | 1.24 | 175           |
| Mercer Bridge                    | 12    | 1073 | 400    | 80  | 5600 | 1004 | 2.36 | 96            |
| Tuakau Br                        | 12    | 1169 | 350    | 63  | 4600 | 1985 | 1.39 | 85            |

| <b>Nitrate/Nitrite Nitrogen (g/m<sup>3</sup>)</b> |       |      |        |      |      |      |       |               |
|---|-------|------|--------|------|------|------|-------|---------------|
| Location  | Count | Mean | Median | Min  | Max  | IQR  | Skew  | 5 year median |
| Taupo Gates                                       | 12    | 0.00 | 0.00   | 0.00 | 0.01 | 0.00 | 2.32  | 0.00          |
| Ohaaki Br   | 12    | 0.05 | 0.05   | 0.02 | 0.08 | 0.03 | 0.20  | 0.04          |
| Ohakuri Tailrace Br                               | 12    | 0.14 | 0.15   | 0.01 | 0.30 | 0.16 | 0.05  | 0.10          |
| Whakamaru Tailrace                                | 6     | 0.18 | 0.14   | 0.03 | 0.36 | 0.23 | 0.57  | 0.11          |
| Waipapa Tailrace                                  | 12    | 0.24 | 0.25   | 0.02 | 0.42 | 0.20 | -0.21 | 0.19          |
| Narrows Boat Ramp                                 | 12    | 0.40 | 0.46   | 0.20 | 0.60 | 0.27 | -0.46 | 0.29          |
| Horotiu Br  | 12    | 0.44 | 0.50   | 0.22 | 0.65 | 0.29 | -0.45 | 0.30          |
| Huntly-Tainui Br                                  | 12    | 0.58 | 0.67   | 0.27 | 0.94 | 0.38 | -0.20 | 0.43          |
| Mercer Bridge                                     | 12    | 0.59 | 0.66   | 0.25 | 0.95 | 0.37 | -0.25 | 0.42          |
| Tuakau Br   | 12    | 0.57 | 0.61   | 0.24 | 0.91 | 0.29 | -0.14 | 0.42          |

| <b>Ammoniacal Nitrogen (g/m<sup>3</sup>)</b> |       |       |        |       |       |       |      |               |
|--|-------|-------|--------|-------|-------|-------|------|---------------|
| Location                                     | Count | Mean  | Median | Min   | Max   | IQR   | Skew | 5 year median |
| Taupo Gates                                  | 12    | 0.005 | 0.005  | 0.005 | 0.005 | 0.000 | 0.00 | 0.005         |
| Ohaaki Br                                    | 12    | 0.006 | 0.005  | 0.005 | 0.012 | 0.000 | 2.09 | 0.005         |
| Ohakuri Tailrace Br                          | 12    | 0.011 | 0.008  | 0.005 | 0.024 | 0.010 | 0.86 | 0.005         |
| Whakamaru Tailrace                           | 6     | 0.010 | 0.005  | 0.005 | 0.023 | 0.013 | 1.13 | 0.005         |
| Waipapa Tailrace                             | 12    | 0.014 | 0.005  | 0.005 | 0.034 | 0.024 | 0.83 | 0.012         |
| Narrows Boat Ramp                            | 12    | 0.024 | 0.025  | 0.005 | 0.053 | 0.032 | 0.23 | 0.016         |
| Horotiu Br                                   | 12    | 0.025 | 0.025  | 0.005 | 0.061 | 0.028 | 0.62 | 0.011         |
| Huntly-Tainui Br                             | 12    | 0.020 | 0.017  | 0.005 | 0.061 | 0.020 | 1.54 | 0.012         |
| Mercer Bridge                                | 12    | 0.013 | 0.009  | 0.005 | 0.043 | 0.012 | 2.06 | 0.005         |
| Tuakau Br                                    | 12    | 0.015 | 0.011  | 0.005 | 0.038 | 0.017 | 0.91 | 0.005         |

Skew = skewness (> 1 is lightly skewed, >2 is highly skewed; IQR = inter-quartile range)

| Total Kjeldahl Nitrogen (g/m <sup>3</sup> ) |       |      |        |      |      |      |      |               |
|---|-------|------|--------|------|------|------|------|---------------|
| Location                                    | Count | Mean | Median | Min  | Max  | IQR  | Skew | 5 year median |
| Taupo Gates                                 | 12    | 0.12 | 0.10   | 0.05 | 0.23 | 0.07 | 0.98 | 0.07          |
| Ohaaki Br                                   | 12    | 0.14 | 0.11   | 0.07 | 0.30 | 0.10 | 1.34 | 0.09          |
| Ohakuri Tailrace Br                         | 12    | 0.16 | 0.15   | 0.11 | 0.24 | 0.04 | 1.28 | 0.12          |
| Whakamaru Tailrace                          | 6     | 0.20 | 0.18   | 0.12 | 0.37 | 0.08 | 1.69 | 0.14          |
| Waipapa Tailrace                            | 12    | 0.18 | 0.16   | 0.08 | 0.41 | 0.06 | 2.19 | 0.14          |
| Narrows Boat Ramp                           | 12    | 0.24 | 0.22   | 0.16 | 0.38 | 0.10 | 1.05 | 0.17          |
| Horotiu Br                                  | 12    | 0.24 | 0.22   | 0.14 | 0.47 | 0.08 | 1.97 | 0.18          |
| Huntly-Tainui Br                            | 12    | 0.33 | 0.28   | 0.22 | 0.7  | 0.11 | 1.99 | 0.24          |
| Mercer Bridge                               | 12    | 0.36 | 0.33   | 0.23 | 0.86 | 0.18 | 2.34 | 0.29          |
| Tuakau Br                                   | 12    | 0.39 | 0.36   | 0.24 | 0.71 | 0.15 | 1.36 | 0.31          |

| Total Nitrogen (g/m <sup>3</sup> ) |       |      |        |      |      |      |       |               |
|------------------------------------|-------|------|--------|------|------|------|-------|---------------|
| Location                           | Count | Mean | Median | Min  | Max  | IQR  | Skew  | 5 year median |
| Taupo Gates                        | 12    | 0.12 | 0.10   | 0.05 | 0.23 | 0.06 | 1.00  | 0.07          |
| Ohaaki Br                          | 12    | 0.19 | 0.15   | 0.11 | 0.36 | 0.10 | 1.20  | 0.13          |
| Ohakuri Tailrace Br                | 12    | 0.30 | 0.31   | 0.15 | 0.50 | 0.17 | 0.25  | 0.20          |
| Whakamaru Tailrace                 | 6     | 0.38 | 0.38   | 0.26 | 0.49 | 0.12 | -0.01 | 0.26          |
| Waipapa Tailrace                   | 12    | 0.42 | 0.46   | 0.23 | 0.57 | 0.21 | -0.24 | 0.33          |
| Narrows Boat Ramp                  | 12    | 0.64 | 0.68   | 0.41 | 0.87 | 0.35 | -0.22 | 0.46          |
| Horotiu Br                         | 12    | 0.68 | 0.69   | 0.43 | 1.03 | 0.28 | 0.45  | 0.49          |
| Huntly-Tainui Br                   | 12    | 0.91 | 0.90   | 0.53 | 1.43 | 0.45 | 0.43  | 0.67          |
| Mercer Bridge                      | 12    | 0.95 | 0.96   | 0.49 | 1.61 | 0.50 | 0.44  | 0.71          |
| Tuakau Br                          | 12    | 0.95 | 1.02   | 0.52 | 1.36 | 0.47 | -0.24 | 0.70          |

| pH                  |       |      |        |     |     |     |       |               |
|---------------------|-------|------|--------|-----|-----|-----|-------|---------------|
| Location            | Count | Mean | Median | Min | Max | IQR | Skew  | 5 year median |
| Taupo Gates         | 12    | 7.6  | 7.7    | 7.4 | 7.8 | 0.1 | -0.59 | 7.7           |
| Ohaaki Br           | 12    | 7.3  | 7.3    | 7.1 | 7.6 | 0.2 | 0.29  | 7.3           |
| Ohakuri Tailrace Br | 12    | 7.4  | 7.4    | 7.3 | 7.6 | 0.2 | 0.99  | 7.4           |
| Whakamaru Tailrace  | 6     | 7.4  | 7.4    | 7.2 | 7.6 | 0.1 | 0.44  | 7.4           |
| Waipapa Tailrace    | 12    | 7.4  | 7.4    | 7.1 | 7.6 | 0.3 | -0.38 | 7.4           |
| Narrows Boat Ramp   | 12    | 7.5  | 7.5    | 7.2 | 7.6 | 0.2 | -0.91 | 7.4           |
| Horotiu Br          | 12    | 7.4  | 7.4    | 7.2 | 7.7 | 0.2 | 0.68  | 7.4           |
| Huntly-Tainui Br    | 12    | 7.3  | 7.4    | 7.2 | 7.6 | 0.2 | 0.66  | 7.4           |
| Mercer Bridge       | 12    | 7.3  | 7.4    | 6.9 | 7.6 | 0.3 | -1.02 | 7.5           |
| Tuakau Br           | 12    | 7.3  | 7.4    | 6.9 | 7.8 | 0.3 | 0.17  | 7.4           |

| Dissolved Reactive Phosphorus (g/m <sup>3</sup> ) |       |       |        |       |       |       |       |               |
|---|-------|-------|--------|-------|-------|-------|-------|---------------|
| Location  | Count | Mean  | Median | Min   | Max   | IQR   | Skew  | 5 year median |
| Taupo Gates                                       | 12    | 0.002 | 0.002  | 0.002 | 0.002 | 0.000 | 0.00  | 0.002         |
| Ohaaki Br   | 12    | 0.005 | 0.006  | 0.002 | 0.008 | 0.004 | -0.23 | 0.007         |
| Ohakuri Tailrace Br                               | 12    | 0.009 | 0.010  | 0.002 | 0.014 | 0.009 | -0.22 | 0.009         |
| Whakamaru Tailrace                                | 6     | 0.011 | 0.014  | 0.002 | 0.015 | 0.011 | -0.95 | 0.008         |
| Waipapa Tailrace                                  | 12    | 0.014 | 0.016  | 0.002 | 0.022 | 0.008 | -0.54 | 0.016         |
| Narrows Boat Ramp                                 | 12    | 0.021 | 0.020  | 0.007 | 0.042 | 0.005 | 1.12  | 0.018         |
| Horotiu Br  | 12    | 0.024 | 0.022  | 0.013 | 0.062 | 0.011 | 2.09  | 0.020         |
| Huntly-Tainui Br                                  | 12    | 0.024 | 0.022  | 0.015 | 0.048 | 0.012 | 1.54  | 0.021         |
| Mercer Bridge                                     | 12    | 0.023 | 0.021  | 0.013 | 0.052 | 0.006 | 2.45  | 0.018         |
| Tuakau Br   | 12    | 0.020 | 0.018  | 0.014 | 0.036 | 0.008 | 1.54  | 0.015         |

Skew = skewness (> 1 is lightly skewed, >2 is highly skewed); IQR = inter-quartile range

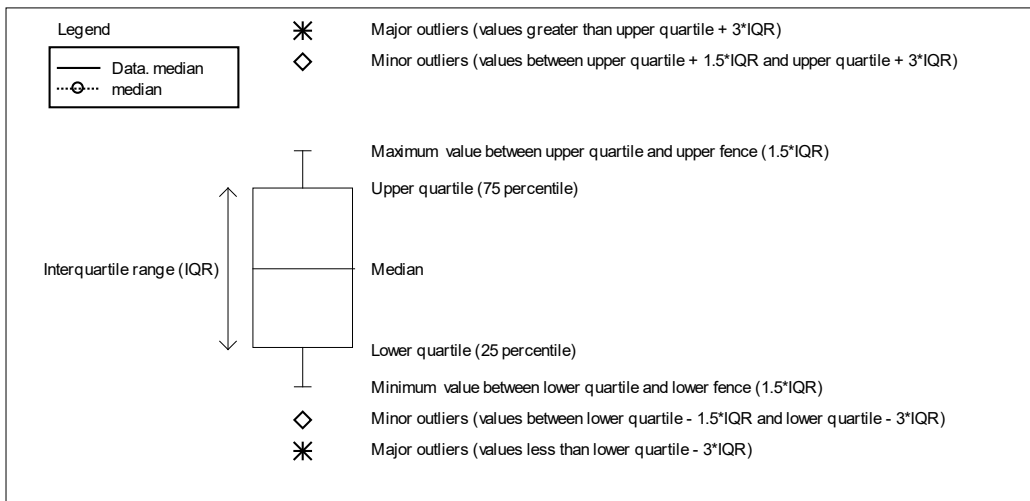
| Total Phosphorus (g/m <sup>3</sup> ) |       |       |        |       |       |       |      |               |
|--------------------------------------|-------|-------|--------|-------|-------|-------|------|---------------|
| Location                             | Count | Mean  | Median | Min   | Max   | IQR   | Skew | 5 year median |
| Taupo Gates                          | 12    | 0.004 | 0.003  | 0.002 | 0.014 | 0.003 | 2.16 | 0.004         |
| Ohaaki Br                            | 12    | 0.011 | 0.010  | 0.002 | 0.021 | 0.007 | 0.34 | 0.010         |
| Ohakuri Tailrace Br                  | 12    | 0.017 | 0.017  | 0.013 | 0.024 | 0.007 | 0.35 | 0.018         |
| Whakamaru Tailrace                   | 6     | 0.022 | 0.021  | 0.015 | 0.028 | 0.004 | 0.04 | 0.021         |
| Waipapa Tailrace                     | 12    | 0.025 | 0.022  | 0.009 | 0.051 | 0.006 | 1.40 | 0.026         |
| Narrows Boat Ramp                    | 12    | 0.034 | 0.030  | 0.023 | 0.059 | 0.007 | 1.71 | 0.029         |
| Horotiu Br                           | 12    | 0.041 | 0.034  | 0.016 | 0.099 | 0.013 | 1.97 | 0.033         |
| Huntly-Tainui Br                     | 12    | 0.053 | 0.042  | 0.031 | 0.133 | 0.019 | 2.26 | 0.041         |
| Mercer Bridge                        | 12    | 0.060 | 0.053  | 0.029 | 0.174 | 0.040 | 2.25 | 0.045         |
| Tuakau Br                            | 12    | 0.057 | 0.050  | 0.029 | 0.140 | 0.029 | 2.04 | 0.048         |

| Water Temperature (°C) |       |      |        |      |      |     |       |               |
|------------------------|-------|------|--------|------|------|-----|-------|---------------|
| Location               | Count | Mean | Median | Min  | Max  | IQR | Skew  | 5 year median |
| Taupo Gates            | 12    | 15.1 | 14.0   | 10.9 | 20.0 | 6.9 | 0.30  | 14.4          |
| Ohaaki Br              | 12    | 15.7 | 15.7   | 10.8 | 20.5 | 6.2 | 0.12  | 16.0          |
| Ohakuri Tailrace Br    | 12    | 16.1 | 16.0   | 11.0 | 20.8 | 6.6 | -0.01 | 16.4          |
| Whakamaru Tailrace     | 6     | 16.8 | 18.1   | 11.4 | 20.9 | 7.6 | -0.49 | 16.7          |
| Waipapa Tailrace       | 12    | 16.3 | 16.0   | 11.5 | 21.3 | 6.5 | 0.04  | 16.3          |
| Narrows Boat Ramp      | 12    | 15.9 | 15.6   | 11.0 | 20.4 | 6.6 | -0.03 | 16.2          |
| Horotiu Br             | 12    | 16.0 | 16.1   | 11.1 | 20.6 | 6.4 | -0.07 | 16.5          |
| Huntly-Tainui Br       | 12    | 16.0 | 15.9   | 10.8 | 21.1 | 6.4 | 0.02  | 16.4          |
| Mercer Bridge          | 12    | 16.3 | 16.1   | 11.3 | 21.4 | 6.0 | 0.08  | 16.9          |
| Tuakau Br              | 12    | 16.7 | 16.4   | 11.4 | 22.7 | 6.7 | 0.21  | 17.4          |

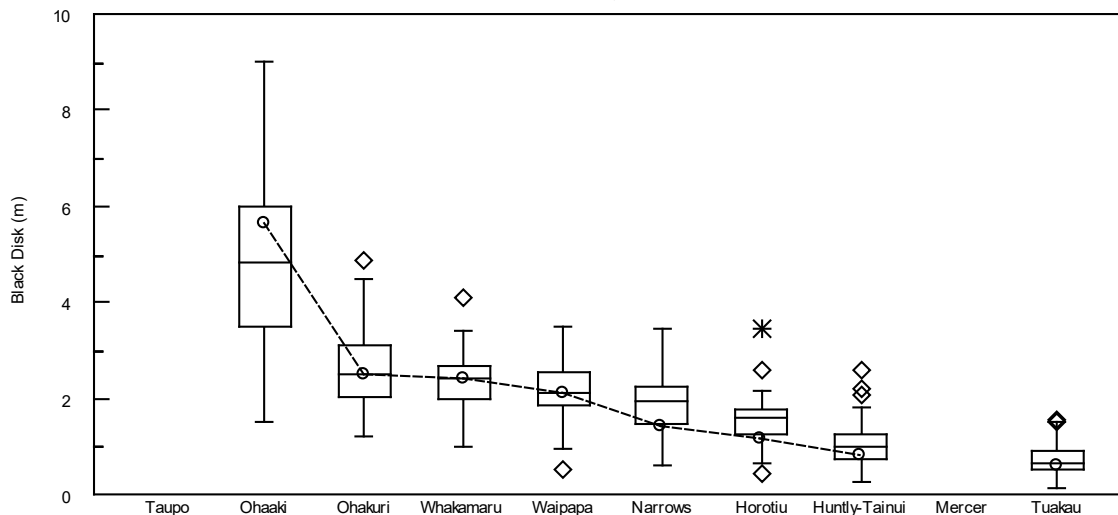
| Turbidity (NTU)     |       |      |        |     |      |     |      |               |
|---------------------|-------|------|--------|-----|------|-----|------|---------------|
| Location            | Count | Mean | Median | Min | Max  | IQR | Skew | 5 year median |
| Taupo Gates         | 12    | 0.4  | 0.4    | 0.3 | 0.7  | 0.2 | 1.01 | 0.4           |
| Ohaaki Br           | 12    | 0.9  | 0.8    | 0.5 | 1.8  | 0.2 | 1.45 | 0.8           |
| Ohakuri Tailrace Br | 12    | 1.3  | 1.3    | 0.7 | 2.0  | 0.5 | 0.08 | 1.0           |
| Whakamaru Tailrace  | 6     | 1.3  | 1.2    | 1.0 | 1.6  | 0.2 | 0.89 | 1.1           |
| Waipapa Tailrace    | 12    | 2.1  | 1.6    | 0.8 | 10.0 | 0.5 | 3.36 | 1.3           |
| Narrows Boat Ramp   | 12    | 2.8  | 2.1    | 1.5 | 6.4  | 1.4 | 1.59 | 1.8           |
| Horotiu Br          | 12    | 4.0  | 3.4    | 1.9 | 11.0 | 1.6 | 2.21 | 2.4           |
| Huntly-Tainui Br    | 12    | 11.8 | 7.0    | 3.1 | 44.0 | 9.4 | 2.32 | 5.5           |
| Mercer Bridge       | 12    | 15.9 | 9.0    | 4.0 | 74.0 | 9.8 | 2.95 | 7.6           |
| Tuakau Br           | 12    | 18.0 | 10.5   | 3.4 | 84.0 | 9.4 | 3.02 | 9.0           |

Skew = skewness (> 1 is lightly skewed, >2 is highly skewed; IQR = inter-quartile range)

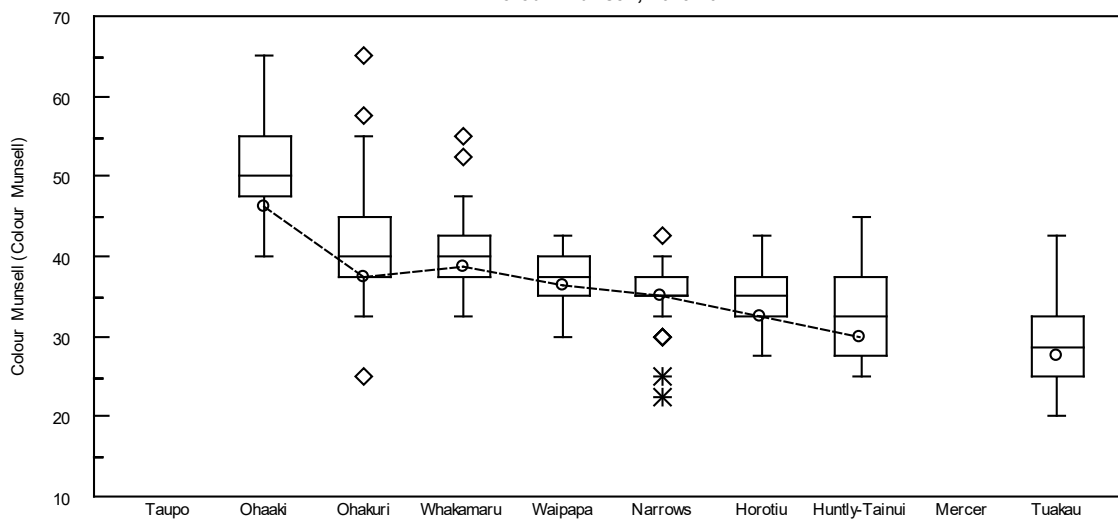
### Boxplots are used to present data



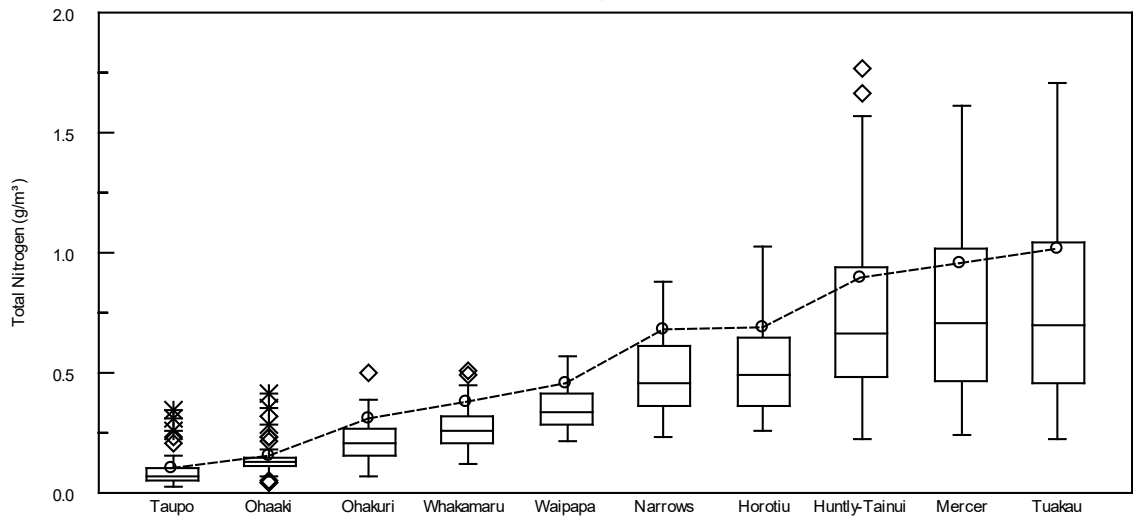
**Black Disk, 2013-2017**



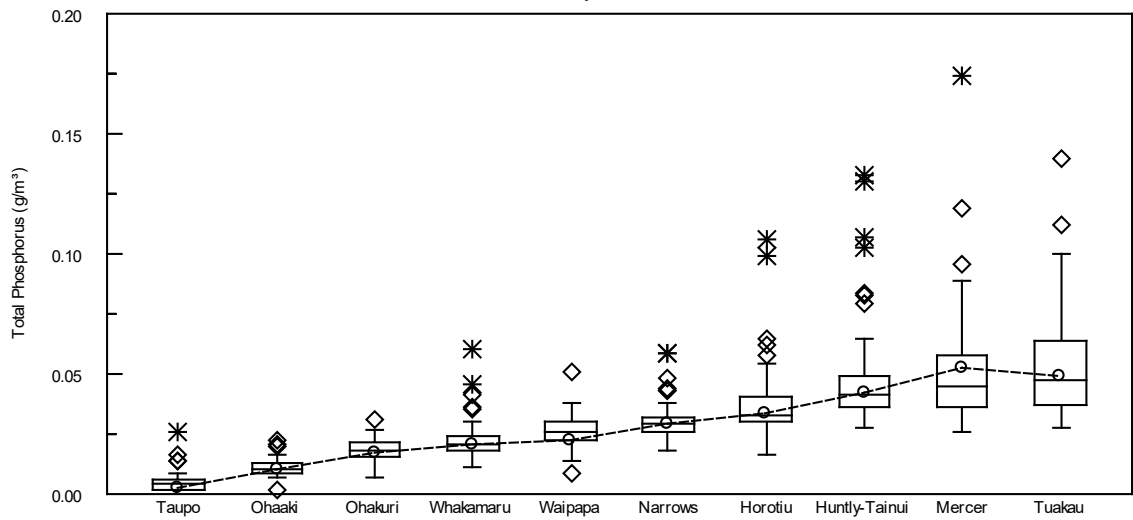
**Colour Munsell, 2013-2017**



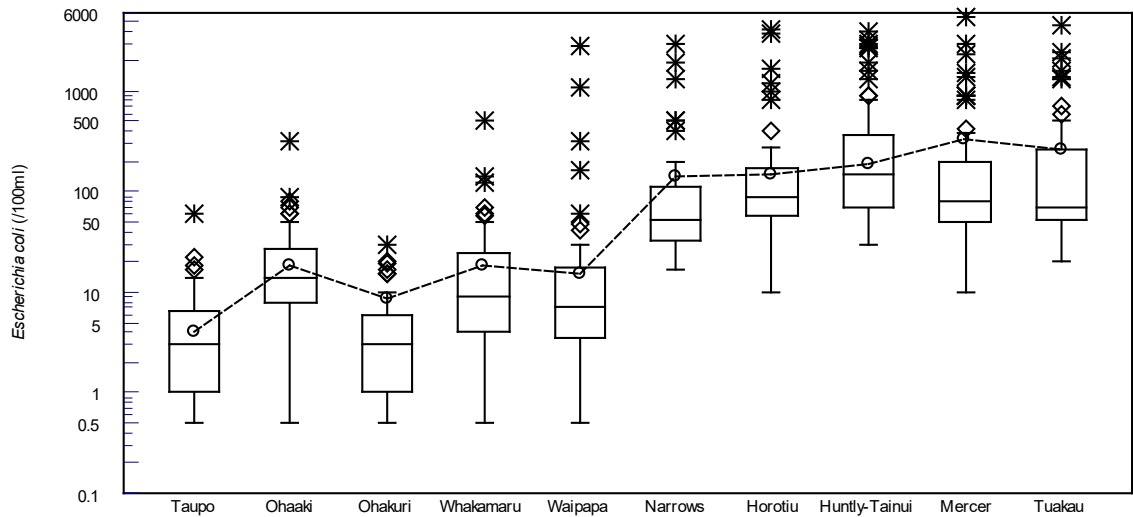
Total Nitrogen, 2013-2017



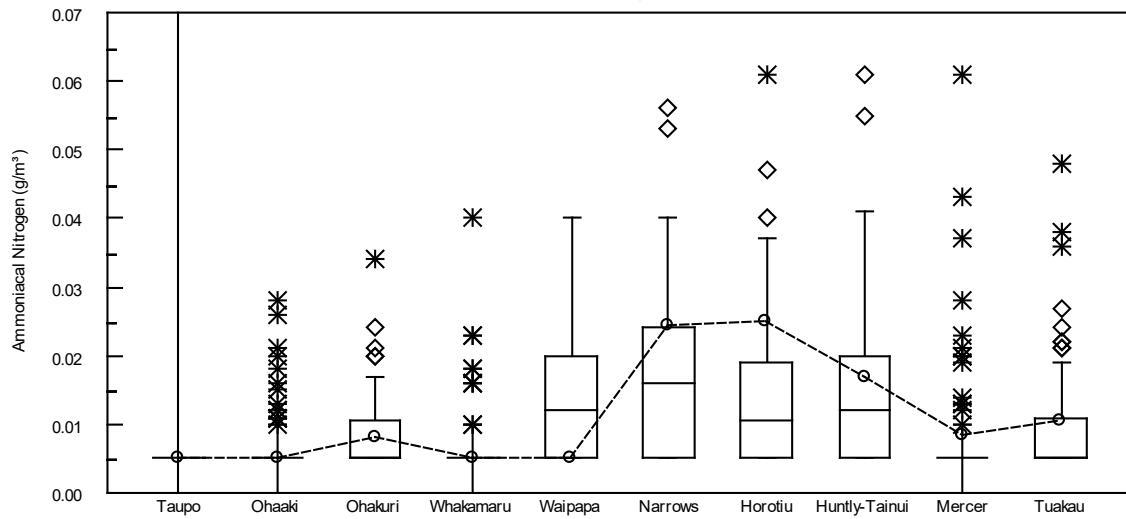
Total Phosphorus, 2013-2017



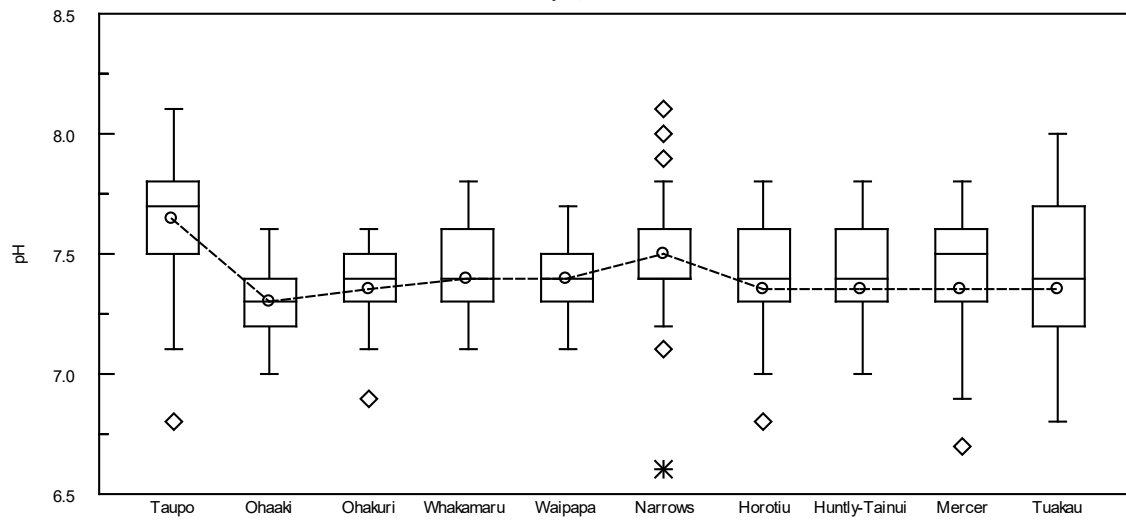
Escherichia coli, 2013-2017



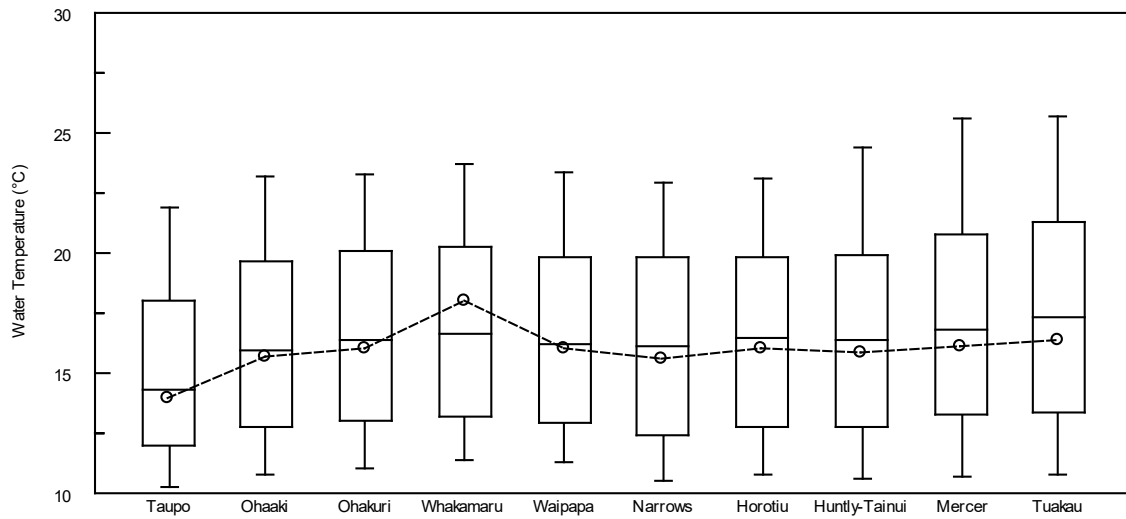
Ammoniacal Nitrogen, 2013-2017



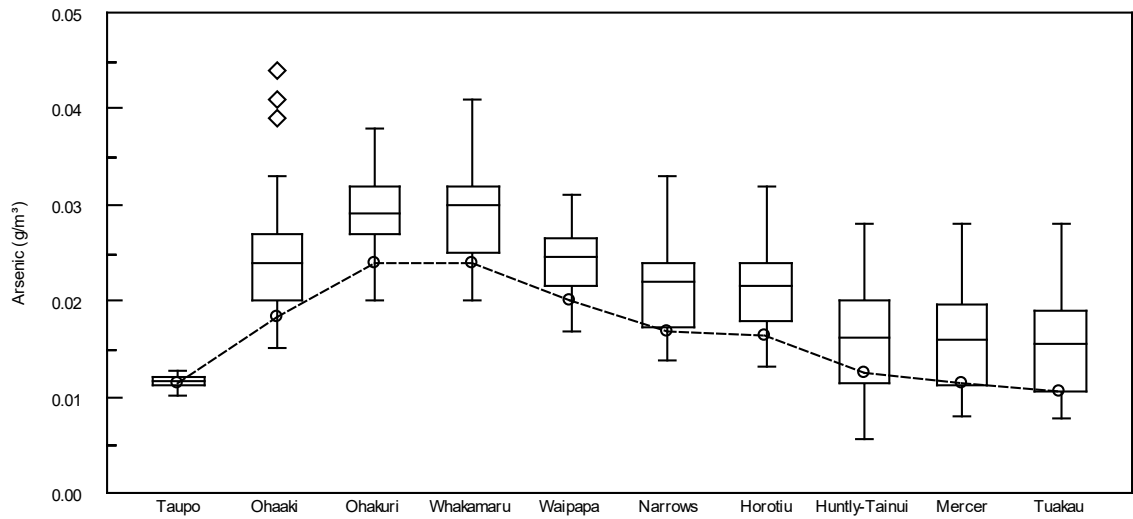
pH, 2013-2017



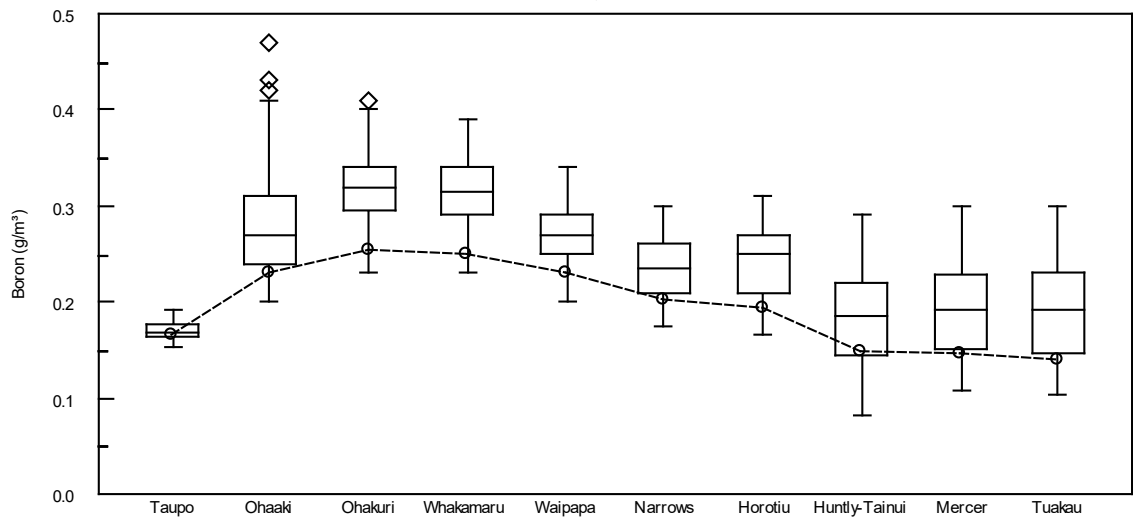
Water Temperature, 2013-2017



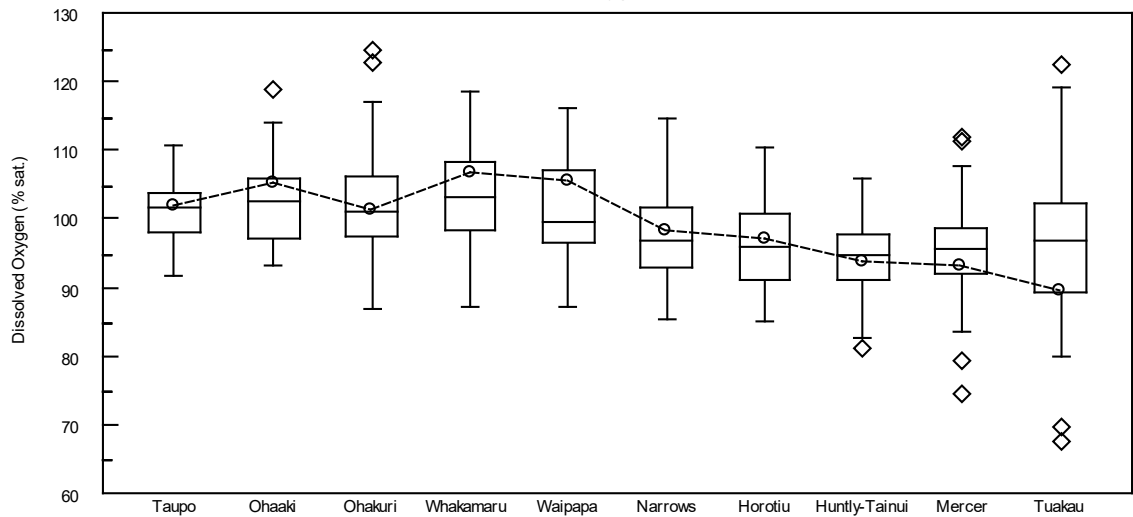
Arsenic, 2013-2017



Boron, 2013-2017



Dissolved Oxygen, 2013-2017



## Comparison with water quality standards

**Table 4: Number of monthly samples (2017) complying with the "satisfactory" water quality guidelines and standards.**

| Location            | ECOLOGICAL HEALTH |                |                |                   |                |                |                | HUMAN USES       |                |                      |                |                |                |
|---------------------|-------------------|----------------|----------------|-------------------|----------------|----------------|----------------|------------------|----------------|----------------------|----------------|----------------|----------------|
|                     | DO                | pH             | Turb           | NH <sub>4</sub> N | Temp           | TP             | TN             | Recreation       |                |                      | Water supply   | Drinking water |                |
|                     |                   |                |                |                   |                |                |                | BDisk            | <i>E coli</i>  | Median <i>E coli</i> | CHLa           | As             | B              |
| Taupo Gates         | 12                | 12             | 12             | 12                | 9              | 12             | 12             | -                | 12             | Y                    | 12             | 0              | 12             |
| Ohaaki Br           | 12                | 12             | 12             | 12                | 6              | 12             | 12             | 9/9              | 12             | Y                    | 12             | 0              | 12             |
| Ohakuri Tailrace Br | 12                | 12             | 12             | 12                | 6              | 12             | 11             | 2/3              | 12             | Y                    | 12             | 0              | 12             |
| Whakamaru Tailrace  | 6 <sup>6</sup>    | 6 <sup>6</sup> | 6 <sup>6</sup> | 6 <sup>6</sup>    | 3 <sup>6</sup> | 6 <sup>6</sup> | 6 <sup>6</sup> | 3/4 <sup>6</sup> | 6 <sup>6</sup> | Y                    | 6 <sup>6</sup> | 0 <sup>6</sup> | 6 <sup>6</sup> |
| Waipapa Tailrace    | 12                | 12             | 11             | 12                | 7              | 11             | 8              | 5/5              | 10             | Y                    | 12             | 0              | 12             |
| Narrows Boat Ramp   | 12                | 12             | 10             | 12                | 8              | 10             | 4              | 3/6 <sup>2</sup> | 10             | N                    | 12             | 0              | 12             |
| Horotiu Br          | 12                | 12             | 10             | 12                | 7              | 8              | 4              | 3/6 <sup>2</sup> | 8              | N                    | 12             | 0              | 12             |
| Huntly-Tainui Br    | 12                | 12             | 2              | 12                | 7              | 5              | 0              | 0/6 <sup>4</sup> | 6 <sup>1</sup> | N                    | 12             | 1              | 12             |
| Mercer Bridge       | 10                | 12             | 1              | 12                | 6              | 5              | 1              | -                | 7              | N                    | 12             | 2              | 12             |
| Tuakau Br           | 10                | 12             | 1              | 12                | 5              | 3              | 0              | 0/8 <sup>2</sup> | 8              | N                    | 12             | 3              | 12             |

Clarity samples excluded because flow exceeded the upper decile flow.

Superscripts denote the number of missing samples when there were fewer than 12 in the year.

**Table 5: Number of monthly samples (2017) complying with the "excellent" water quality guidelines and standards.**

| Location            | ECOLOGICAL HEALTH |                |                |                   |                |                |                | HUMAN USES       |                |                      |                |                |     |
|---------------------|-------------------|----------------|----------------|-------------------|----------------|----------------|----------------|------------------|----------------|----------------------|----------------|----------------|-----|
|                     | DO                | pH             | Turb           | NH <sub>4</sub> N | Temp           | TP             | TN             | Recreation       |                |                      | Water supply   | Drinking water |     |
|                     |                   |                |                |                   |                |                |                | BDisk            | <i>E coli</i>  | Median <i>E coli</i> | CHLa           | As             | B   |
| Taupo Gates         | 12                | 12             | 12             | 12                | 2              | 11             | 4              | -                | 11             | Y                    | 12             | n/a            | n/a |
| Ohaaki Br           | 12                | 12             | 12             | 12                | 2              | 4              | 0              | 8/9              | 9              | Y                    | 12             | n/a            | n/a |
| Ohakuri Tailrace Br | 12                | 12             | 11             | 12                | 2              | 0              | 0              | 0/3              | 12             | Y                    | 8              | n/a            | n/a |
| Whakamaru Tailrace  | 6 <sup>6</sup>    | 6 <sup>6</sup> | 6 <sup>6</sup> | 6 <sup>6</sup>    | 0 <sup>6</sup> | 0 <sup>6</sup> | 0 <sup>6</sup> | 0/4 <sup>6</sup> | 5 <sup>6</sup> | Y                    | 4 <sup>6</sup> | n/a            | n/a |
| Waipapa Tailrace    | 12                | 12             | 10             | 12                | 1              | 1              | 0              | 0/5              | 9              | Y                    | 6              | n/a            | n/a |
| Narrows Boat Ramp   | 10                | 12             | 5              | 12                | 1              | 0              | 0              | 0/6 <sup>2</sup> | 2              | N                    | 8              | n/a            | n/a |
| Horotiu Br          | 10                | 12             | 1              | 12                | 1              | 0              | 0              | 0/6 <sup>2</sup> | 1              | N                    | 9              | n/a            | n/a |
| Huntly-Tainui Br    | 8                 | 12             | 0              | 12                | 1              | 0              | 0              | 0/6 <sup>4</sup> | 0 <sup>1</sup> | N                    | 8              | n/a            | n/a |
| Mercer Bridge       | 8                 | 11             | 0              | 12                | 1              | 0              | 0              | -                | 0              | N                    | 8              | n/a            | n/a |
| Tuakau Br           | 5                 | 11             | 0              | 12                | 1              | 0              | 0              | 0/8 <sup>2</sup> | 0              | N                    | 8              | n/a            | n/a |

Clarity samples excluded because flow exceeded the upper decile flow.

Superscripts denote the number of missing samples when there were fewer than 12 in the year.



**Table 6: Raw data summary: Samples collected compared with the "satisfactory" water quality guidelines and standards in the year 2017.**

| Date   | Time  | Flow m <sup>3</sup> /s | BDisk m    | Colour | Cond mS/m | pH      | Temp °C      | DO g/m <sup>3</sup> | DO% % sat. | BOD-5d g/m <sup>3</sup> | Turb NTU | TDS g/m <sup>3</sup> | NNN g/m <sup>3</sup> | NO <sub>3</sub> -N g/m <sup>3</sup> | NH <sub>4</sub> -N g/m <sup>3</sup> |
|--|-------|------------------------|------------|--------|-----------|---------|--------------|---------------------|------------|-------------------------|----------|----------------------|----------------------|-------------------------------------|-------------------------------------|
| <b>Satisfactory Water Quality</b>                                  |       |                        | >1.6       | -      | -         | 6.5-9.0 | <12(May-Sep) | >80.0               | -          | <5.0                    | -        | -                    | -                    | -                                   | <0.88                               |
| <b>Guideline/Standard</b>  |       |                        |            |        |           |         | <20(Oct-Apr) |                     |            |                         |          |                      |                      |                                     |                                     |
| <b>Taupo Gates upper decile flow = 259 m<sup>3</sup>/s</b>         |       |                        |            |        |           |         |              |                     |            |                         |          |                      |                      |                                     |                                     |
| 4/1/17   | 08:15 | 159                    | -          | -      | 12.1      | 7.7     | 17.1         | 9.6                 | 103.9      | 0.2                     | 0.64     | 87                   | 0.009                | 0.009                               | 0.01                                |
| 31/1/17  | 08:20 | 220                    | -          | -      | 12.1      | 7.7     | 19.7         | 9.0                 | 102.0      | 0.9                     | 0.40     | 89                   | 0.001                | 0.001                               | 0.01                                |
| 7/3/17   | 08:46 | 211                    | -          | -      | 11.9      | 7.4     | 19.8         | 8.9                 | 102.2      | 0.2                     | 0.27     | 93                   | 0.001                | 0.001                               | 0.01                                |
| 5/4/17   | 09:10 | 204                    | -          | -      | 11.9      | 7.8     | 17.7         | 9.0                 | 98.6       | 0.2                     | 0.31     | 80                   | 0.001                | 0.001                               | 0.01                                |
| 2/5/17   | 09:30 | 292                    | -          | -      | 11.9      | 7.7     | <b>13.4</b>  | 10.4                | 102.3      | 0.4                     | 0.27     | 99                   | 0.001                | 0.001                               | 0.01                                |
| 6/6/17   | 09:43 | 285                    | -          | -      | 11.8      | 7.6     | <b>13.1</b>  | 9.9                 | 97.5       | 0.8                     | 0.34     | 83                   | 0.001                | 0.001                               | 0.01                                |
| 4/7/17   | 09:33 | 198                    | -          | -      | 11.7      | 7.6     | 11.3         | 10.3                | 98.2       | 0.6                     | 0.41     | 98                   | 0.001                | 0.001                               | 0.01                                |
| 1/8/17   | 10:04 | 266                    | -          | -      | 11.8      | 7.5     | 11.0         | 10.1                | 93.2       | 0.3                     | 0.40     | 76                   | 0.006                | 0.006                               | 0.01                                |
| 5/9/17   | 09:07 | 283                    | -          | -      | 12.0      | 7.6     | 10.9         | 10.9                | 101.9      | 1.6                     | 0.36     | 77                   | 0.001                | 0.001                               | 0.01                                |
| 3/10/17  | 09:13 | 292                    | -          | -      | 12.1      | 7.6     | 12.3         | 10.8                | 99.4       | 0.2                     | 0.69     | 81                   | 0.001                | 0.001                               | 0.01                                |
| 7/11/17  | 08:45 | 214                    | -          | -      | 11.8      | 7.8     | 14.5         | 10.1                | 102.5      | 0.8                     | 0.33     | 82                   | 0.001                | 0.001                               | 0.01                                |
| 4/12/17  | 08:39 | 184                    | -          | -      | 12.1      | 7.7     | <b>20.0</b>  | 9.5                 | 107.6      | 1.3                     | 0.59     | 89                   | 0.001                | 0.001                               | 0.01                                |
| <b>Ohaaki Br upper decile flow = 248 m<sup>3</sup>/s</b>           |       |                        |            |        |           |         |              |                     |            |                         |          |                      |                      |                                     |                                     |
| 4/1/17   | 08:56 | 119                    | 6.1        | 45.0   | 15.1      | 7.1     | 17.9         | 9.3                 | 101.1      | 0.6                     | 1.25     | 108                  | 0.049                | 0.048                               | 0.01                                |
| 31/1/17  | 09:05 | 139                    | 6.2        | 47.5   | 13.9      | 7.5     | <b>20.5</b>  | 9.0                 | 102.4      | 0.7                     | 0.50     | 110                  | 0.025                | 0.025                               | 0.01                                |
| 7/3/17   | 09:34 | 177                    | 6.0        | 55.0   | 13.8      | 7.2     | 19.7         | 9.0                 | 101.5      | 0.9                     | 0.78     | 100                  | 0.077                | 0.076                               | 0.01                                |
| 5/4/17   | 09:55 | 284                    | (2.8)      | 47.5   | 12.7      | 7.6     | 17.8         | 9.4                 | 102.7      | 0.5                     | 0.76     | 89                   | 0.021                | 0.021                               | 0.01                                |
| 2/5/17   | 10:10 | 237                    | 6.5        | 42.5   | 13.6      | 7.4     | <b>15.5</b>  | 10.2                | 103.8      | 0.7                     | 0.50     | 94                   | 0.029                | 0.028                               | 0.01                                |
| 6/6/17   | 10:22 | 234                    | 6.6        | 45.0   | 13.7      | 7.3     | <b>13.0</b>  | 11.1                | 108.6      | 0.2                     | 0.87     | 103                  | 0.055                | 0.054                               | 0.01                                |
| 4/7/17   | 10:28 | 174                    | 6.4        | 42.5   | 13.5      | 7.2     | <b>12.4</b>  | 10.9                | 105.0      | 1.0                     | 1.76     | 102                  | 0.067                | 0.067                               | 0.01                                |
| 1/8/17   | 10:49 | 260                    | (5.3)      | 60.0   | 13.0      | 7.3     | 10.8         | 11.8                | 108.6      | 0.3                     | 0.86     | 93                   | 0.036                | 0.036                               | 0.01                                |
| 5/9/17   | 10:03 | 242                    | 3.7        | 45.0   | 13.6      | 7.4     | <b>12.0</b>  | 12.0                | 114.0      | 1.7                     | 0.85     | 92                   | 0.040                | 0.040                               | 0.01                                |
| 3/10/17  | 09:48 | 286                    | (3.7)      | 50.0   | 13.6      | 7.3     | 12.8         | 10.9                | 105.8      | 1.1                     | 0.82     | 92                   | 0.043                | 0.043                               | 0.01                                |
| 7/11/17  | 09:35 | 210                    | 5.0        | 40.0   | 13.6      | 7.4     | 15.8         | 10.3                | 107.0      | 1.0                     | 1.11     | 85                   | 0.052                | 0.042                               | 0.01                                |
| 4/12/17  | 09:38 | 145                    | 4.6        | 55.0   | 14.0      | 7.3     | <b>20.5</b>  | 9.3                 | 105.7      | 1.2                     | 0.84     | 107                  | 0.066                | 0.065                               | 0.01                                |
| <b>Ohakuri Tailrace Br upper decile flow = 319 m<sup>3</sup>/s</b> |       |                        |            |        |           |         |              |                     |            |                         |          |                      |                      |                                     |                                     |
| 4/1/17   | 09:40 | 224                    | 3.3        | 40.0   | 17.6      | 7.3     | 19.1         | 8.9                 | 99.4       | 0.5                     | 1.11     | 132                  | 0.052                | 0.051                               | 0.01                                |
| 31/1/17  | 09:53 | 314                    | 2.0        | 35.0   | 16.0      | 7.5     | 19.9         | 9.8                 | 110.0      | 1.2                     | 1.07     | 116                  | 0.008                | 0.008                               | 0.01                                |
| 7/3/17   | 10:30 | 323                    | (2.7)      | 35.0   | 15.3      | 7.3     | <b>20.2</b>  | 9.1                 | 103.6      | 1.4                     | 0.68     | 115                  | 0.009                | 0.009                               | 0.01                                |
| 5/4/17   | 10:45 | 480                    | (2.2)      | 37.5   | 16.6      | 7.4     | 18.6         | 8.4                 | 92.3       | 0.5                     | 1.67     | 118                  | 0.137                | 0.134                               | 0.02                                |
| 2/5/17   | 11:25 | 354                    | (2.5)      | 35.0   | 14.9      | 7.5     | <b>16.3</b>  | 9.4                 | 97.1       | 0.2                     | 0.73     | 107                  | 0.172                | 0.170                               | 0.01                                |
| 6/6/17   | 11:23 | 367                    | (2.6)      | 40.0   | 15.0      | 7.3     | <b>13.1</b>  | 10.2                | 99.7       | 0.8                     | 1.36     | 105                  | 0.240                | 0.240                               | 0.02                                |
| 4/7/17   | 11:18 | 379                    | (3.6)      | 42.5   | 14.7      | 7.3     | <b>12.5</b>  | 10.3                | 99.8       | 1.0                     | 1.19     | 113                  | 0.186                | 0.184                               | 0.01                                |
| 1/8/17   | 11:04 | 419                    | (2.6)      | 37.5   | 14.5      | 7.3     | 11.0         | 10.4                | 95.9       | 0.4                     | 1.24     | 109                  | 0.270                | 0.260                               | 0.01                                |
| 5/9/17   | 10:48 | 377                    | (2.4)      | 37.5   | 15.2      | 7.3     | <b>12.7</b>  | 10.7                | 103.0      | 1.7                     | 1.58     | 120                  | 0.300                | 0.300                               | 0.02                                |
| 3/10/17  | 10:39 | 337                    | (2.5)      | 37.5   | 14.5      | 7.4     | 13.7         | 10.7                | 105.2      | 1.0                     | 1.32     | 99                   | 0.172                | 0.170                               | 0.01                                |
| 7/11/17  | 10:29 | 319                    | (1.6)      | 40.0   | 15.3      | 7.6     | 15.7         | 10.7                | 110.2      | 1.3                     | 2.00     | 109                  | 0.124                | 0.121                               | 0.01                                |
| 4/12/17  | 10:43 | 319                    | <b>1.5</b> | 25.0   | 15.7      | 7.4     | <b>20.8</b>  | 10.9                | 124.6      | 2.0                     | 1.50     | 117                  | 0.047                | 0.046                               | 0.01                                |
| <b>Whakamaru Tailrace upper decile flow = 298 m<sup>3</sup>/s</b>  |       |                        |            |        |           |         |              |                     |            |                         |          |                      |                      |                                     |                                     |
| 4/1/17   | 10:18 | 189                    | 2.6        | 40.0   | 17.5      | 7.3     | 19.8         | 9.7                 | 108.3      | 0.7                     | 1.30     | 126                  | 0.093                | 0.092                               | 0.02                                |
| 31/1/17  | 10:30 | 254                    | 2.0        | 35.0   | 15.1      | 7.4     | <b>20.0</b>  | 9.9                 | 110.3      | 1.2                     | 1.20     | 119                  | 0.110                | 0.108                               | 0.02                                |
| 7/3/17   | 11:15 | 242                    | 2.4        | 35.0   | 16.0      | 7.4     | <b>20.9</b>  | 9.2                 | 105.5      | 1.5                     | 1.04     | 123                  | 0.029                | 0.028                               | 0.01                                |
| 4/7/17   | 12:12 | 318                    | (2.7)      | 37.5   | 14.9      | 7.2     | <b>12.4</b>  | 10.0                | 95.8       | 0.7                     | 1.28     | 115                  | 0.320                | 0.320                               | 0.01                                |
| 1/8/17   | 11:54 | 348                    | (2.4)      | 45.0   | 14.8      | 7.4     | 11.4         | 10.4                | 96.0       | 0.4                     | 1.14     | 108                  | 0.360                | 0.360                               | 0.01                                |
| 7/11/17  | 11:15 | 253                    | <b>1.5</b> | 40.0   | 15.4      | 7.6     | 16.3         | 10.9                | 113.7      | 0.9                     | 1.55     | 112                  | 0.162                | 0.158                               | 0.01                                |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

| TKN<br>g/m <sup>3</sup> | TN g/m <sup>3</sup> | DRP<br>g/m <sup>3</sup> | TP g/m <sup>3</sup> | CL g/m <sup>3</sup> | As g/m <sup>3</sup> | B g/m <sup>3</sup> | Li g/m <sup>3</sup> | A340F<br>/cm | A440F<br>/cm | ENT.<br>/100ml | F coli<br>/100ml | E coli<br>/100ml | CHLa<br>g/m <sup>3</sup> | DOC<br>g/m <sup>3</sup> | TOC g/m <sup>3</sup> |
|-------------------------|---------------------|-------------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------|--------------|----------------|------------------|------------------|--------------------------|-------------------------|----------------------|
| -                       | <0.5                | -                       | <0.04               | -                   | <0.01               | <1.4               | -                   | -            | -            | <77            | -                | <550             | <0.02                    | -                       | -                    |

#### Taupo Gates

|      |      |       |       |     |              |      |       |       |       |    |    |    |       |     |     |
|------|------|-------|-------|-----|--------------|------|-------|-------|-------|----|----|----|-------|-----|-----|
| 0.08 | 0.09 | 0.002 | 0.004 | 8.0 | <u>0.012</u> | 0.16 | 0.039 | 0.001 | 0.001 | 12 | 17 | 12 | 0.002 | 1.2 | 1.3 |
| 0.15 | 0.15 | 0.002 | 0.002 | 8.4 | <u>0.011</u> | 0.16 | 0.043 | 0.001 | 0.001 | 9  | 3  | 3  | 0.002 | 1.4 | 1.0 |
| 0.23 | 0.23 | 0.002 | 0.002 | 8.1 | <u>0.011</u> | 0.17 | 0.042 | 0.001 | 0.001 | 9  | 22 | 17 | 0.002 | 1.1 | 1.5 |
| 0.13 | 0.13 | 0.002 | 0.014 | 7.8 | <u>0.011</u> | 0.17 | 0.041 | 0.002 | 0.001 | 48 | 70 | 60 | 0.002 | 1.6 | 1.2 |
| 0.06 | 0.06 | 0.002 | 0.002 | 7.8 | <u>0.011</u> | 0.17 | 0.039 | 0.002 | 0.001 | 1  | 1  | 1  | 0.002 | 0.8 | 0.9 |
| 0.21 | 0.21 | 0.002 | 0.005 | 7.8 | <u>0.011</u> | 0.16 | 0.040 | 0.003 | 0.001 | 1  | 2  | 2  | 0.002 | 1.4 | 2.6 |
| 0.10 | 0.10 | 0.002 | 0.007 | 7.3 | <u>0.012</u> | 0.17 | 0.039 | 0.001 | 0.001 | 2  | 1  | 1  | 0.002 | 0.8 | 1.1 |
| 0.06 | 0.07 | 0.002 | 0.005 | 7.9 | <u>0.012</u> | 0.16 | 0.037 | 0.001 | 0.001 | 1  | 1  | 1  | 0.002 | 0.4 | 0.7 |
| 0.10 | 0.10 | 0.002 | 0.002 | 8.0 | <u>0.013</u> | 0.18 | 0.040 | 0.002 | 0.001 | 1  | 2  | 2  | 0.002 | 0.2 | 0.8 |
| 0.10 | 0.10 | 0.002 | 0.002 | 8.5 | <u>0.012</u> | 0.18 | 0.040 | 0.001 | 0.001 | 1  | 2  | 5  | 0.002 | 0.7 | 1.2 |
| 0.12 | 0.12 | 0.002 | 0.005 | 8.3 | <u>0.011</u> | 0.16 | 0.036 | 0.001 | 0.001 | 3  | 15 | 14 | 0.002 | 0.6 | 0.9 |
| 0.05 | 0.05 | 0.002 | 0.002 | 7.7 | <u>0.011</u> | 0.18 | 0.040 | 0.001 | 0.001 | 3  | 7  | 7  | 0.002 | 1.6 | 0.8 |

#### Ohaaki Br

|      |      |       |       |      |              |      |       |       |       |            |     |     |       |     |     |
|------|------|-------|-------|------|--------------|------|-------|-------|-------|------------|-----|-----|-------|-----|-----|
| 0.11 | 0.16 | 0.008 | 0.016 | 15.0 | <u>0.024</u> | 0.27 | 0.074 | 0.005 | 0.001 | 34         | 80  | 60  | 0.002 | 1.4 | 1.2 |
| 0.10 | 0.13 | 0.006 | 0.010 | 12.6 | <u>0.019</u> | 0.24 | 0.070 | 0.003 | 0.001 | <b>80</b>  | 100 | 80  | 0.002 | 1.1 | 1.1 |
| 0.21 | 0.29 | 0.004 | 0.010 | 12.2 | <u>0.019</u> | 0.22 | 0.066 | 0.003 | 0.001 | <b>150</b> | 37  | 32  | 0.002 | 1.3 | 1.3 |
| 0.21 | 0.23 | 0.005 | 0.010 | 10.0 | <u>0.015</u> | 0.20 | 0.054 | 0.005 | 0.001 | <b>370</b> | 380 | 310 | 0.002 | 1.9 | 1.4 |
| 0.09 | 0.12 | 0.004 | 0.008 | 11.4 | <u>0.017</u> | 0.24 | 0.059 | 0.004 | 0.001 | 17         | 33  | 27  | 0.002 | 1.1 | 1.2 |
| 0.30 | 0.36 | 0.007 | 0.012 | 11.4 | <u>0.018</u> | 0.23 | 0.063 | 0.004 | 0.001 | 5          | 22  | 9   | 0.002 | 0.9 | 1.0 |
| 0.17 | 0.24 | 0.008 | 0.013 | 10.5 | <u>0.016</u> | 0.23 | 0.059 | 0.003 | 0.001 | 3          | 16  | 16  | 0.002 | 0.8 | 1.4 |
| 0.07 | 0.11 | 0.002 | 0.007 | 10.6 | <u>0.017</u> | 0.21 | 0.053 | 0.001 | 0.001 | 4          | 9   | 7   | 0.002 | 0.4 | 0.7 |
| 0.11 | 0.15 | 0.002 | 0.002 | 11.8 | <u>0.020</u> | 0.23 | 0.062 | 0.002 | 0.001 | 21         | 15  | 14  | 0.002 | 0.5 | 0.8 |
| 0.10 | 0.14 | 0.002 | 0.007 | 11.3 | <u>0.018</u> | 0.23 | 0.059 | 0.001 | 0.001 | 1          | 11  | 9   | 0.002 | 0.6 | 1.0 |
| 0.12 | 0.17 | 0.006 | 0.021 | 12.4 | <u>0.019</u> | 0.22 | 0.059 | 0.004 | 0.001 | 10         | 15  | 8   | 0.002 | 1.2 | 0.8 |
| 0.08 | 0.15 | 0.007 | 0.015 | 11.2 | <u>0.020</u> | 0.24 | 0.063 | 0.004 | 0.001 | 6          | 110 | 20  | 0.002 | 0.2 | 0.7 |

#### Ohakuri Tailrace Br

|      |            |       |       |      |              |      |       |       |       |    |    |    |       |     |     |
|------|------------|-------|-------|------|--------------|------|-------|-------|-------|----|----|----|-------|-----|-----|
| 0.13 | 0.18       | 0.011 | 0.022 | 20.0 | <u>0.033</u> | 0.34 | 0.111 | 0.006 | 0.001 | 1  | 3  | 3  | 0.004 | 1.4 | 1.4 |
| 0.14 | 0.15       | 0.004 | 0.013 | 17.1 | <u>0.026</u> | 0.29 | 0.102 | 0.005 | 0.001 | 1  | 2  | 2  | 0.006 | 1.3 | 1.1 |
| 0.17 | 0.18       | 0.002 | 0.014 | 15.2 | <u>0.027</u> | 0.26 | 0.085 | 0.006 | 0.001 | 3  | 3  | 1  | 0.004 | 1.4 | 1.2 |
| 0.15 | 0.29       | 0.013 | 0.024 | 16.7 | <u>0.027</u> | 0.30 | 0.098 | 0.011 | 0.001 | 15 | 31 | 29 | 0.002 | 1.8 | 1.8 |
| 0.14 | 0.31       | 0.013 | 0.014 | 13.5 | <u>0.022</u> | 0.25 | 0.074 | 0.009 | 0.001 | 7  | 23 | 21 | 0.002 | 1.2 | 1.7 |
| 0.14 | 0.38       | 0.013 | 0.016 | 13.4 | <u>0.021</u> | 0.26 | 0.075 | 0.009 | 0.003 | 25 | 7  | 7  | 0.002 | 1.1 | 1.0 |
| 0.12 | 0.31       | 0.010 | 0.021 | 13.1 | <u>0.020</u> | 0.25 | 0.075 | 0.006 | 0.001 | 12 | 21 | 19 | 0.002 | 0.7 | 1.0 |
| 0.11 | 0.38       | 0.014 | 0.018 | 13.4 | <u>0.021</u> | 0.23 | 0.069 | 0.008 | 0.001 | 2  | 7  | 7  | 0.002 | 0.7 | 1.0 |
| 0.20 | <b>0.5</b> | 0.009 | 0.020 | 14.1 | <u>0.023</u> | 0.24 | 0.075 | 0.009 | 0.001 | 35 | 12 | 7  | 0.002 | 1.0 | 1.1 |
| 0.15 | 0.32       | 0.006 | 0.013 | 12.6 | <u>0.021</u> | 0.23 | 0.066 | 0.006 | 0.001 | 3  | 19 | 17 | 0.006 | 1.0 | 1.4 |
| 0.24 | 0.36       | 0.005 | 0.013 | 15.7 | <u>0.025</u> | 0.25 | 0.081 | 0.008 | 0.001 | 9  | 32 | 20 | 0.011 | 1.4 | 1.1 |
| 0.17 | 0.22       | 0.004 | 0.019 | 14.3 | <u>0.026</u> | 0.28 | 0.079 | 0.007 | 0.001 | 5  | 12 | 10 | 0.014 | 0.8 | 1.4 |

#### Whakamaru Tailrace

|      |      |       |       |      |              |      |       |       |       |            |     |     |       |     |     |
|------|------|-------|-------|------|--------------|------|-------|-------|-------|------------|-----|-----|-------|-----|-----|
| 0.17 | 0.26 | 0.015 | 0.024 | 20.0 | <u>0.033</u> | 0.32 | 0.115 | 0.008 | 0.001 | 48         | 35  | 35  | 0.002 | 1.7 | 1.7 |
| 0.21 | 0.32 | 0.014 | 0.021 | 15.8 | <u>0.024</u> | 0.25 | 0.092 | 0.008 | 0.002 | 4          | 2   | 2   | 0.003 | 1.4 | 1.2 |
| 0.37 | 0.40 | 0.002 | 0.021 | 16.9 | <u>0.030</u> | 0.29 | 0.099 | 0.008 | 0.001 | 20         | 13  | 12  | 0.007 | 1.6 | 1.3 |
| 0.12 | 0.44 | 0.015 | 0.028 | 13.4 | <u>0.020</u> | 0.25 | 0.080 | 0.008 | 0.001 | <b>130</b> | 140 | 140 | 0.002 | 0.8 | 1.2 |
| 0.13 | 0.49 | 0.013 | 0.020 | 14.3 | <u>0.021</u> | 0.23 | 0.075 | 0.009 | 0.001 | 1          | 9   | 9   | 0.002 | 0.8 | 1.1 |
| 0.19 | 0.35 | 0.004 | 0.015 | 16.0 | <u>0.024</u> | 0.24 | 0.084 | 0.006 | 0.001 | 1          | 24  | 24  | 0.019 | 1.7 | 1.3 |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

| Date   | Time  | Flow m <sup>3</sup> /s | BDisk m    | Colour | Cond mS/m | pH      | Temp °C      | DO g/m <sup>3</sup> | DO% sat. | BOD-5d g/m <sup>3</sup> | Turb NTU     | TDS g/m <sup>3</sup> | NNN g/m <sup>3</sup> | NO <sub>3</sub> -N g/m <sup>3</sup> | NH <sub>4</sub> N g/m <sup>3</sup> |
|--|-------|------------------------|------------|--------|-----------|---------|--------------|---------------------|----------|-------------------------|--------------|----------------------|----------------------|-------------------------------------|------------------------------------|
| <b>Satisfactory Water Quality</b>                                  |       |                        | >1.6       | -      | -         | 6.5-9.0 | <12(May-Sep) | >80.0               | -        | <5.0                    | -            | -                    | -                    | -                                   | <0.88                              |
| <b>Guideline/Standard</b>  |       |                        |            |        |           |         | <20(Oct-Apr) |                     |          |                         |              |                      |                      |                                     |                                    |
| <b>Waipapa Tailrace</b> upper decile flow = 361 m <sup>3</sup> /s  |       |                        |            |        |           |         |              |                     |          |                         |              |                      |                      |                                     |                                    |
| 4/1/17   | 10:53 | 232                    | 3.3        | 35.0   | 17.0      | 7.1     | 19.6         | 9.0                 | 99.0     | 0.8                     | 1.72         | 122                  | 0.109                | 0.107                               | 0.03                               |
| 31/1/17  | 11:18 | 264                    | 2.1        | 35.0   | 15.6      | 7.6     | 19.9         | 8.9                 | 98.1     | 1.0                     | 2.00         | 126                  | 0.021                | 0.021                               | 0.01                               |
| 7/3/17   | 12:12 | 300                    | 2.3        | 35.0   | 16.3      | 7.1     | <u>21.3</u>  | 9.9                 | 113.8    | 0.6                     | 1.11         | 121                  | 0.141                | 0.137                               | 0.03                               |
| 5/4/17   | 11:50 | 674                    | (0.5)      | 27.5   | 14.5      | 7.5     | 18.7         | 10.1                | 109.6    | 1.1                     | <u>10.00</u> | 121                  | 0.163                | 0.161                               | 0.03                               |
| 2/5/17   | 12:40 | 325                    | 2.1        | 40.0   | 13.8      | 7.4     | <u>15.8</u>  | 10.7                | 108.2    | 0.7                     | 0.83         | 117                  | 0.250                | 0.250                               | 0.01                               |
| 6/6/17   | 13:09 | 483                    | (2.5)      | 40.0   | 13.9      | 7.4     | <u>13.4</u>  | 10.2                | 98.5     | 0.8                     | 1.30         | 93                   | 0.340                | 0.330                               | 0.01                               |
| 4/7/17   | 12:46 | 407                    | (2.5)      | 37.5   | 15.1      | 7.2     | <u>12.3</u>  | 10.1                | 95.1     | 0.8                     | 1.20         | 122                  | 0.380                | 0.380                               | 0.01                               |
| 1/8/17   | 12:56 | 435                    | (2.1)      | 40.0   | 14.6      | 7.2     | 11.5         | 10.7                | 92.2     | 0.4                     | 1.55         | 112                  | 0.420                | 0.420                               | 0.01                               |
| 5/9/17   | 12:18 | 315                    | 2.1        | 32.5   | 14.6      | 7.4     | <u>12.7</u>  | 10.8                | 102.7    | 1.7                     | 1.56         | 126                  | 0.370                | 0.370                               | 0.01                               |
| 3/10/17  | 12:04 | 361                    | (1.8)      | 40.0   | 14.1      | 7.4     | 14.2         | 11.4                | 111.1    | 0.2                     | 1.71         | 107                  | 0.300                | 0.300                               | 0.01                               |
| 7/11/17  | 11:55 | 372                    | (1.5)      | 40.0   | 15.0      | 7.5     | 16.2         | 10.8                | 108.4    | 0.6                     | 1.61         | 116                  | 0.250                | 0.250                               | 0.01                               |
| 4/12/17  | 12:27 | 363                    | (1.7)      | 32.5   | 16.6      | 7.4     | 19.4         | 10.1                | 110.6    | 1.6                     | 1.19         | 118                  | 0.161                | 0.157                               | 0.03                               |
| <b>Narrows Boat Ramp</b> upper decile flow = 358 m <sup>3</sup> /s |       |                        |            |        |           |         |              |                     |          |                         |              |                      |                      |                                     |                                    |
| 5/1/17   | 07:35 | 265                    | 2.1        | 30.0   | 15.8      | 7.4     | 18.7         | 8.7                 | 92.0     | 0.8                     | 1.93         | 117                  | 0.197                | 0.192                               | 0.04                               |
| 1/2/17   | 07:47 | 269                    | 2.2        | 37.5   | 16.5      | 7.4     | <u>20.4</u>  | 7.8                 | 85.3     | 0.8                     | 1.45         | 120                  | 0.196                | 0.191                               | 0.03                               |
| 8/3/17   | 07:55 | 242                    | <u>1.1</u> | 35.0   | 15.3      | 7.2     | <u>20.3</u>  | 7.9                 | 87.1     | 0.6                     | 1.55         | 130                  | 0.197                | 0.193                               | 0.03                               |
| 6/4/17   | 08:20 | 611                    | (0.8)      | 32.5   | 15.5      | 7.6     | 18.8         | 9.7                 | 104.5    | 1.0                     | <u>6.40</u>  | 126                  | 0.480                | 0.470                               | 0.05                               |
| 3/5/17   | 08:35 | 321                    | <u>1.6</u> | 37.5   | 13.8      | 7.5     | <u>14.8</u>  | 10.2                | 99.5     | 0.8                     | 1.81         | 115                  | 0.480                | 0.480                               | 0.01                               |
| 7/6/17   | 09:16 | 377                    | (1.4)      | 40.0   | 13.3      | 7.5     | 11.7         | 11.3                | 103.4    | 0.2                     | 2.20         | 113                  | 0.490                | 0.490                               | 0.01                               |
| 5/7/17   | 09:35 | 366                    | (0.9)      | 35.0   | 14.0      | 7.4     | 11.8         | 10.1                | 93.0     | 1.2                     | <u>5.20</u>  | 102                  | 0.600                | 0.600                               | 0.04                               |
| 2/8/17   | 09:15 | 385                    | -          | 32.5   | 13.3      | 7.5     | 11.0         | 10.5                | 94.4     | 1.1                     | 2.00         | 107                  | 0.520                | 0.520                               | 0.01                               |
| 6/9/17   | 09:15 | 385                    | (1.3)      | 37.5   | 14.8      | 7.4     | <u>13.7</u>  | 10.1                | 97.5     | 1.9                     | 2.70         | 118                  | 0.560                | 0.550                               | 0.01                               |
| 4/10/17  | 09:03 | 399                    | -          | 32.5   | 13.9      | 7.5     | 13.8         | 11.4                | 109.0    | 1.1                     | 3.50         | 118                  | 0.440                | 0.440                               | 0.01                               |
| 8/11/17  | 08:57 | 318                    | <u>1.4</u> | 35.0   | 14.0      | 7.6     | 16.4         | 10.0                | 102.0    | 1.5                     | 2.90         | 114                  | 0.400                | 0.390                               | 0.02                               |
| 5/12/17  | 07:11 | 251                    | 2.2        | 37.5   | 15.0      | 7.6     | 19.8         | 9.1                 | 99.2     | 1.2                     | 1.75         | 128                  | 0.280                | 0.280                               | 0.03                               |
| <b>Horotiu Br</b> upper decile flow = 357 m <sup>3</sup> /s        |       |                        |            |        |           |         |              |                     |          |                         |              |                      |                      |                                     |                                    |
| 5/1/17   | 08:30 | 222                    | 1.8        | 32.5   | 15.9      | 7.3     | 18.8         | 8.5                 | 90.7     | 0.8                     | 2.90         | 121                  | 0.230                | 0.230                               | 0.03                               |
| 1/2/17   | 08:40 | 186                    | 1.9        | 32.5   | 16.9      | 7.3     | <u>20.6</u>  | 7.8                 | 86.2     | 1.0                     | 1.87         | 123                  | 0.220                | 0.210                               | 0.03                               |
| 8/3/17   | 09:00 | 247                    | <u>0.9</u> | 30.0   | 14.0      | 7.2     | <u>20.1</u>  | 7.7                 | 84.9     | 0.9                     | 3.80         | 116                  | 0.240                | 0.230                               | 0.01                               |
| 6/4/17   | 09:05 | 639                    | (0.6)      | 30.0   | 15.3      | 7.2     | 19.1         | 9.1                 | 97.9     | 1.1                     | <u>11.00</u> | 122                  | 0.560                | 0.550                               | 0.06                               |
| 3/5/17   | 09:25 | 337                    | <u>1.2</u> | 32.5   | 13.9      | 7.6     | <u>15.5</u>  | 9.8                 | 96.5     | 0.7                     | 2.30         | 117                  | 0.510                | 0.500                               | 0.01                               |
| 7/6/17   | 10:06 | 400                    | (1.1)      | 40.0   | 13.5      | 7.5     | <u>12.4</u>  | 10.9                | 101.4    | 0.8                     | 3.00         | 110                  | 0.510                | 0.510                               | 0.01                               |
| 5/7/17   | 10:17 | 369                    | (0.8)      | 30.0   | 14.2      | 7.3     | 11.9         | 10.1                | 92.9     | 1.2                     | <u>6.70</u>  | 113                  | 0.650                | 0.650                               | 0.04                               |
| 2/8/17   | 09:56 | 400                    | -          | 35.0   | 13.5      | 7.3     | 11.1         | 10.5                | 94.9     | 1.0                     | 2.60         | 125                  | 0.550                | 0.540                               | 0.01                               |
| 6/9/17   | 10:06 | 408                    | (1.1)      | 37.5   | 15.0      | 7.4     | <u>13.2</u>  | 10.3                | 97.7     | 1.8                     | 3.90         | 137                  | 0.590                | 0.590                               | 0.02                               |
| 4/10/17  | 09:45 | 367                    | -          | 32.5   | 14.3      | 7.7     | 13.9         | 10.8                | 103.3    | 0.2                     | 3.80         | 119                  | 0.490                | 0.480                               | 0.01                               |
| 8/11/17  | 09:37 | 351                    | <u>1.4</u> | 32.5   | 14.0      | 7.5     | 16.6         | 9.6                 | 98.1     | 1.3                     | 4.10         | 100                  | 0.440                | 0.430                               | 0.04                               |
| 5/12/17  | 08:40 | 281                    | 1.8        | 37.5   | 15.2      | 7.4     | 19.3         | 9.3                 | 99.9     | 1.5                     | 2.20         | 115                  | 0.300                | 0.300                               | 0.04                               |
| <b>Huntly-Tainui Br</b> upper decile flow = 533 m <sup>3</sup> /s  |       |                        |            |        |           |         |              |                     |          |                         |              |                      |                      |                                     |                                    |
| 5/1/17   | 09:14 | 230                    | <u>1.2</u> | 37.5   | 15.8      | 7.6     | 19.2         | 8.8                 | 94.4     | 0.9                     | <u>6.00</u>  | 121                  | 0.330                | 0.330                               | 0.01                               |
| 1/2/17   | 10:00 | 238                    | <u>1.3</u> | 35.0   | 16.0      | 7.2     | <u>21.1</u>  | 7.9                 | 88.0     | 0.9                     | 3.10         | 119                  | 0.270                | 0.270                               | 0.01                               |
| 8/3/17   | 09:40 | 323                    | <u>0.5</u> | 30.0   | 14.0      | 7.2     | 19.1         | 8.0                 | 86.9     | 0.8                     | <u>13.10</u> | 116                  | 0.280                | 0.280                               | 0.01                               |
| 6/4/17   | 09:33 | 1152                   | (0.3)      | 27.5   | 12.2      | 7.4     | 18.0         | 7.9                 | 83.2     | 1.8                     | <u>44.00</u> | 97                   | 0.720                | 0.710                               | 0.06                               |
| 3/5/17   | 10:04 | 487                    | <u>0.9</u> | 27.5   | 13.7      | 7.4     | <u>14.9</u>  | 9.2                 | 90.1     | 0.9                     | <u>6.30</u>  | 118                  | 0.670                | 0.660                               | 0.01                               |
| 7/6/17   | 10:52 | 497                    | -          | -      | 13.4      | 7.4     | 11.9         | 10.6                | 97.5     | 0.8                     | <u>6.20</u>  | 97                   | 0.680                | 0.680                               | 0.02                               |
| 5/7/17   | 11:13 | 575                    | (0.5)      | 30.0   | 13.2      | 7.2     | <u>12.1</u>  | 9.6                 | 89.3     | 1.8                     | <u>16.80</u> | 100                  | 0.940                | 0.940                               | 0.04                               |
| 2/8/17   | 10:36 | 531                    | -          | -      | 13.2      | 7.3     | 10.8         | 10.4                | 93.0     | 1.0                     | <u>5.20</u>  | 106                  | 0.730                | 0.730                               | 0.02                               |
| 6/9/17   | 10:48 | 554                    | -          | -      | 14.1      | 7.3     | <u>13.5</u>  | 9.9                 | 94.9     | 1.8                     | <u>7.60</u>  | 111                  | 0.780                | 0.780                               | 0.03                               |
| 4/10/17  | 10:15 | 628                    | -          | -      | 13.2      | 7.4     | 13.8         | 10.2                | 97.4     | 2.3                     | <u>21.00</u> | 115                  | 0.670                | 0.660                               | 0.02                               |
| 8/11/17  | 10:23 | 474                    | <u>0.7</u> | -      | 13.4      | 7.3     | 16.8         | 9.3                 | 95.2     | 1.3                     | <u>7.80</u>  | 107                  | 0.530                | 0.530                               | 0.02                               |
| 5/12/17  | 09:15 | 333                    | <u>1.1</u> | -      | 15.0      | 7.4     | <u>20.4</u>  | 8.9                 | 97.7     | 1.5                     | 4.10         | 118                  | 0.370                | 0.360                               | 0.01                               |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

| TKN<br>g/m <sup>3</sup> | TN g/m <sup>3</sup> | DRP<br>g/m <sup>3</sup> | TP g/m <sup>3</sup> | CL g/m <sup>3</sup> | As g/m <sup>3</sup> | B g/m <sup>3</sup> | Li g/m <sup>3</sup> | A340F<br>/cm | A440F<br>/cm | ENT.<br>/100ml | F coli<br>/100ml | E coli<br>/100ml | CHLa<br>g/m <sup>3</sup> | DOC<br>g/m <sup>3</sup> | TOC g/m <sup>3</sup> |
|-------------------------|---------------------|-------------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------|--------------|----------------|------------------|------------------|--------------------------|-------------------------|----------------------|
| -                       | <0.5                | -                       | <0.04               | -                   | <0.01               | <1.4               | -                   | -            | -            | <77            | -                | <550             | <0.02                    | -                       | -                    |

#### Waipapa Tailrace

|      |            |       |              |      |              |      |       |       |       |            |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|------------|------|-------------|-------|-----|-----|
| 0.19 | 0.30       | 0.017 | 0.026        | 19.7 | <u>0.029</u> | 0.29 | 0.102 | 0.009 | 0.002 | 6          | 20   | 15          | 0.006 | 1.5 | 2.1 |
| 0.21 | 0.23       | 0.002 | 0.009        | 16.7 | <u>0.026</u> | 0.27 | 0.102 | 0.006 | 0.001 | 43         | 6    | 5           | 0.009 | 1.3 | 1.3 |
| 0.18 | 0.32       | 0.016 | 0.027        | 17.7 | <u>0.026</u> | 0.26 | 0.095 | 0.010 | 0.002 | 9          | 10   | 7           | 0.002 | 1.9 | 2.1 |
| 0.41 | <u>0.6</u> | 0.016 | <u>0.051</u> | 15.0 | <u>0.022</u> | 0.24 | 0.083 | 0.016 | 0.004 | <u>230</u> | 1200 | <u>1100</u> | 0.005 | 2.5 | 3.4 |
| 0.08 | 0.33       | 0.015 | 0.016        | 11.8 | <u>0.018</u> | 0.20 | 0.059 | 0.010 | 0.002 | <u>500</u> | 3300 | <u>2800</u> | 0.002 | 1.5 | 1.5 |
| 0.15 | 0.49       | 0.018 | 0.022        | 11.6 | <u>0.017</u> | 0.20 | 0.062 | 0.010 | 0.001 | 5          | 16   | 16          | 0.002 | 1.0 | 1.4 |
| 0.14 | <u>0.5</u> | 0.022 | 0.035        | 13.8 | <u>0.018</u> | 0.23 | 0.071 | 0.011 | 0.002 | 32         | 77   | 60          | 0.002 | 1.0 | 1.4 |
| 0.14 | <u>0.6</u> | 0.019 | 0.026        | 14.3 | <u>0.019</u> | 0.23 | 0.069 | 0.012 | 0.002 | 4          | 7    | 7           | 0.002 | 1.0 | 1.2 |
| 0.17 | <u>0.5</u> | 0.010 | 0.021        | 13.7 | <u>0.019</u> | 0.23 | 0.070 | 0.012 | 0.003 | 47         | 16   | 14          | 0.004 | 1.1 | 1.2 |
| 0.14 | 0.44       | 0.009 | 0.022        | 12.6 | <u>0.019</u> | 0.21 | 0.061 | 0.009 | 0.001 | 3          | 25   | 21          | 0.008 | 0.5 | 1.5 |
| 0.22 | 0.47       | 0.008 | 0.020        | 14.9 | <u>0.021</u> | 0.21 | 0.069 | 0.008 | 0.002 | 4          | 18   | 15          | 0.013 | 1.6 | 1.4 |
| 0.15 | 0.31       | 0.010 | 0.022        | 15.2 | <u>0.024</u> | 0.27 | 0.075 | 0.008 | 0.001 | 3          | 19   | 13          | 0.005 | 0.6 | 1.1 |

#### Narrows Boat Ramp

|      |            |       |              |      |              |      |       |       |       |             |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|-------------|------|-------------|-------|-----|-----|
| 0.23 | 0.43       | 0.019 | 0.026        | 16.8 | <u>0.025</u> | 0.25 | 0.083 | 0.010 | 0.001 | 47          | 75   | 40          | 0.006 | 1.6 | 1.7 |
| 0.22 | 0.42       | 0.020 | 0.028        | 17.1 | <u>0.027</u> | 0.26 | 0.083 | 0.010 | 0.001 | 39          | 80   | 60          | 0.002 | 1.6 | 1.5 |
| 0.21 | 0.41       | 0.020 | 0.031        | 15.9 | <u>0.022</u> | 0.23 | 0.083 | 0.017 | 0.004 | <u>1100</u> | 610  | 400         | 0.003 | 2.0 | 2.0 |
| 0.34 | <u>0.8</u> | 0.042 | <u>0.059</u> | 16.9 | <u>0.019</u> | 0.22 | 0.079 | 0.038 | 0.007 | <u>1900</u> | 2000 | <u>1300</u> | 0.002 | 4.1 | 4.3 |
| 0.18 | <u>0.7</u> | 0.022 | 0.034        | 11.4 | <u>0.017</u> | 0.17 | 0.054 | 0.018 | 0.004 | 53          | 170  | 140         | 0.002 | 1.8 | 2.3 |
| 0.38 | <u>0.9</u> | 0.022 | 0.027        | 11.6 | <u>0.016</u> | 0.19 | 0.056 | 0.012 | 0.002 | 40          | 90   | 70          | 0.002 | 1.2 | 1.4 |
| 0.24 | <u>0.8</u> | 0.036 | <u>0.059</u> | 12.4 | <u>0.014</u> | 0.20 | 0.058 | 0.020 | 0.004 | <u>1100</u> | 3700 | <u>2900</u> | 0.002 | 1.3 | 2.1 |
| 0.18 | <u>0.7</u> | 0.020 | 0.027        | 12.0 | <u>0.014</u> | 0.18 | 0.052 | 0.015 | 0.006 | 15          | 47   | 34          | 0.002 | 1.0 | 1.4 |
| 0.19 | <u>0.8</u> | 0.019 | 0.032        | 14.4 | <u>0.016</u> | 0.21 | 0.069 | 0.015 | 0.004 | 22          | 150  | 150         | 0.007 | 1.8 | 1.8 |
| 0.16 | <u>0.6</u> | 0.007 | 0.024        | 12.5 | <u>0.016</u> | 0.19 | 0.057 | 0.015 | 0.003 | 48          | 290  | 200         | 0.015 | 1.8 | 1.9 |
| 0.32 | <u>0.7</u> | 0.015 | 0.033        | 12.9 | <u>0.017</u> | 0.18 | 0.056 | 0.017 | 0.003 | 70          | 450  | 200         | 0.010 | 1.5 | 1.7 |
| 0.17 | 0.45       | 0.014 | 0.023        | 14.6 | <u>0.024</u> | 0.22 | 0.068 | 0.009 | 0.001 | 25          | 80   | 60          | 0.002 | 1.1 | 2.0 |

#### Horotiu Br

|      |            |       |              |      |              |      |       |       |       |             |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|-------------|------|-------------|-------|-----|-----|
| 0.25 | 0.48       | 0.024 | 0.032        | 16.8 | <u>0.024</u> | 0.24 | 0.082 | 0.010 | 0.002 | <u>230</u>  | 150  | 80          | 0.004 | 1.6 | 2.0 |
| 0.21 | 0.43       | 0.025 | 0.031        | 17.9 | <u>0.027</u> | 0.26 | 0.084 | 0.010 | 0.001 | 43          | 110  | 60          | 0.002 | 1.8 | 2.0 |
| 0.24 | 0.48       | 0.014 | 0.035        | 14.9 | <u>0.020</u> | 0.20 | 0.071 | 0.016 | 0.004 | <u>1800</u> | 1700 | <u>1200</u> | 0.002 | 2.1 | 2.4 |
| 0.47 | <u>1.0</u> | 0.062 | <u>0.099</u> | 15.6 | <u>0.018</u> | 0.21 | 0.072 | 0.055 | 0.011 | <u>3100</u> | 1900 | <u>1700</u> | 0.002 | 5.3 | 5.4 |
| 0.18 | <u>0.7</u> | 0.023 | 0.033        | 11.7 | <u>0.017</u> | 0.17 | 0.053 | 0.019 | 0.004 | 32          | 310  | 130         | 0.002 | 1.9 | 2.3 |
| 0.17 | <u>0.7</u> | 0.020 | 0.035        | 11.5 | <u>0.015</u> | 0.19 | 0.054 | 0.012 | 0.002 | 42          | 40   | 30          | 0.002 | 1.3 | 1.6 |
| 0.30 | <u>1.0</u> | 0.040 | <u>0.065</u> | 12.4 | <u>0.014</u> | 0.19 | 0.057 | 0.022 | 0.004 | <u>1900</u> | 5500 | <u>3700</u> | 0.002 | 1.4 | 2.4 |
| 0.14 | <u>0.7</u> | 0.023 | 0.031        | 12.2 | <u>0.013</u> | 0.18 | 0.052 | 0.014 | 0.003 | 21          | 120  | 70          | 0.002 | 1.1 | 1.4 |
| 0.23 | <u>0.8</u> | 0.014 | <u>0.045</u> | 14.0 | <u>0.016</u> | 0.21 | 0.066 | 0.018 | 0.003 | <u>90</u>   | 190  | 160         | 0.006 | 2.3 | 2.0 |
| 0.21 | <u>0.7</u> | 0.013 | 0.016        | 12.9 | <u>0.015</u> | 0.18 | 0.053 | 0.018 | 0.004 | 41          | 170  | 140         | 0.013 | 1.7 | 2.2 |
| 0.26 | <u>0.7</u> | 0.019 | <u>0.042</u> | 12.8 | <u>0.016</u> | 0.17 | 0.054 | 0.018 | 0.004 | <u>160</u>  | 1200 | <u>1000</u> | 0.008 | 1.3 | 2.0 |
| 0.18 | 0.48       | 0.014 | 0.024        | 14.5 | <u>0.022</u> | 0.22 | 0.067 | 0.010 | 0.001 | <u>80</u>   | 340  | 210         | 0.002 | 1.1 | 1.7 |

#### Huntly-Tainui Br

|      |            |       |              |      |              |      |       |       |       |             |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|-------------|------|-------------|-------|-----|-----|
| 0.25 | <u>0.6</u> | 0.028 | 0.039        | 16.7 | <u>0.019</u> | 0.20 | 0.065 | 0.015 | 0.003 | 40          | 140  | 140         | 0.009 | 2.2 | 2.9 |
| 0.26 | <u>0.5</u> | 0.028 | 0.037        | 17.3 | <u>0.022</u> | 0.23 | 0.073 | 0.014 | 0.003 | 32          | 110  | 70          | 0.002 | 2.0 | 2.4 |
| 0.29 | <u>0.6</u> | 0.015 | <u>0.049</u> | 15.0 | <u>0.017</u> | 0.18 | 0.062 | 0.023 | 0.005 | <u>3000</u> | 4500 | <u>3300</u> | 0.002 | 2.2 | 2.7 |
| 0.70 | <u>1.4</u> | 0.048 | <u>0.133</u> | 12.7 | <u>0.010</u> | 0.12 | 0.037 | 0.065 | 0.013 | <u>5900</u> | 6000 | <u>4000</u> | 0.002 | 6.3 | 6.6 |
| 0.22 | <u>0.9</u> | 0.026 | <u>0.057</u> | 12.4 | <u>0.013</u> | 0.13 | 0.041 | 0.034 | 0.006 | 71          | 370  | -           | 0.002 | 2.8 | 3.4 |
| 0.22 | <u>0.9</u> | 0.022 | 0.037        | 11.9 | <u>0.012</u> | 0.16 | 0.045 | 0.020 | 0.004 | 41          | 120  | 90          | 0.002 | 1.5 | 2.0 |
| 0.49 | <u>1.4</u> | 0.033 | <u>0.084</u> | 11.7 | 0.009        | 0.13 | 0.038 | 0.040 | 0.008 | <u>1300</u> | 3300 | <u>2800</u> | 0.002 | 2.6 | 4.0 |
| 0.32 | <u>1.1</u> | 0.022 | 0.034        | 12.4 | <u>0.010</u> | 0.14 | 0.040 | 0.020 | 0.004 | 18          | 190  | 150         | 0.002 | 1.3 | 1.8 |
| 0.27 | <u>1.1</u> | 0.017 | <u>0.041</u> | 13.4 | <u>0.011</u> | 0.15 | 0.049 | 0.029 | 0.005 | 40          | 220  | 150         | 0.005 | 2.7 | 2.9 |
| 0.38 | <u>1.1</u> | 0.016 | <u>0.043</u> | 12.0 | <u>0.010</u> | 0.13 | 0.037 | 0.036 | 0.007 | <u>270</u>  | 2900 | <u>2900</u> | 0.013 | 2.8 | 3.7 |
| 0.34 | <u>0.9</u> | 0.020 | <u>0.055</u> | 12.4 | <u>0.013</u> | 0.14 | 0.043 | 0.024 | 0.005 | <u>80</u>   | 1000 | <u>700</u>  | 0.007 | 2.2 | 2.9 |
| 0.25 | <u>0.6</u> | 0.016 | 0.031        | 14.5 | <u>0.020</u> | 0.20 | 0.059 | 0.014 | 0.002 | 55          | 400  | 190         | 0.002 | 1.4 | 2.0 |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

| Date   | Time  | Flow m <sup>3</sup> /s | BDisk m    | Colour | Cond mS/m | pH           | Temp °C      | DO g/m <sup>3</sup> | DO% sat.    | BOD-5d g/m <sup>3</sup> | Turb NTU     | TDS g/m <sup>3</sup> | NNN g/m <sup>3</sup> | NO <sub>3</sub> -N g/m <sup>3</sup> | NH <sub>4</sub> N g/m <sup>3</sup> |
|--|-------|------------------------|------------|--------|-----------|--------------|--------------|---------------------|-------------|-------------------------|--------------|----------------------|----------------------|-------------------------------------|------------------------------------|
| <b>Satisfactory Water Quality</b>                            |       |                        | >1.6       | -      | -         | 6.5-9.0      | <12(May-Sep) | >80.0               | -           | <5.0                    | -            | -                    | -                    | <0.88                               |                                    |
| <b>Guideline/Standard</b>                                    |       |                        |            |        |           | <20(Oct-Apr) |              |                     |             |                         |              |                      |                      |                                     |                                    |
| <b>Mercer Bridge upper decile flow = 621 m<sup>3</sup>/s</b> |       |                        |            |        |           |              |              |                     |             |                         |              |                      |                      |                                     |                                    |
| 5/1/17   | 10:02 | 251                    | -          | -      | 16.0      | 7.6          | 19.1         | 8.9                 | 95.7        | 1.0                     | <u>7.10</u>  | 118                  | 0.300                | 0.300                               | 0.01                               |
| 1/2/17   | 10:40 | 240                    | -          | -      | 16.3      | 7.5          | <u>21.1</u>  | 8.3                 | 92.8        | 1.0                     | 4.00         | 116                  | 0.250                | 0.250                               | 0.01                               |
| 8/3/17   | 10:35 | 325                    | -          | -      | 14.9      | 7.3          | 19.2         | 7.9                 | 85.8        | 0.6                     | <u>7.10</u>  | 125                  | 0.310                | 0.300                               | 0.01                               |
| 6/4/17   | 10:50 | 1032                   | -          | -      | 12.8      | 6.9          | 18.2         | 7.0                 | <u>74.4</u> | 1.8                     | <u>74.00</u> | 112                  | 0.750                | 0.740                               | 0.04                               |
| 3/5/17   | 10:58 | 576                    | -          | -      | 14.7      | 7.2          | <u>14.9</u>  | 8.1                 | <u>79.2</u> | 1.0                     | <u>10.50</u> | 121                  | 0.690                | 0.680                               | 0.01                               |
| 7/6/17   | 12:09 | 525                    | -          | -      | 14.1      | 7.4          | <u>12.8</u>  | 10.0                | 93.5        | 0.9                     | <u>7.00</u>  | 111                  | 0.710                | 0.710                               | 0.01                               |
| 5/7/17   | 12:08 | 641                    | -          | -      | 13.7      | 7.2          | <u>12.3</u>  | 9.4                 | 87.9        | 1.2                     | <u>22.00</u> | 114                  | 0.950                | 0.940                               | 0.02                               |
| 2/8/17   | 11:51 | 600                    | -          | -      | 13.7      | 7.3          | 11.3         | 10.2                | 92.1        | 1.0                     | <u>7.50</u>  | 110                  | 0.730                | 0.730                               | 0.01                               |
| 6/9/17   | 11:52 | 622                    | -          | -      | 14.5      | 7.3          | <u>13.5</u>  | 9.7                 | 93.4        | 2.0                     | <u>11.00</u> | 109                  | 0.810                | 0.800                               | 0.02                               |
| 4/10/17  | 11:56 | 665                    | -          | -      | 13.6      | 7.5          | 14.7         | 10.2                | 99.3        | 2.2                     | <u>22.00</u> | 118                  | 0.620                | 0.610                               | 0.01                               |
| 8/11/17  | 11:24 | 503                    | -          | -      | 13.6      | 7.5          | 17.3         | 9.1                 | 94.8        | 1.5                     | <u>11.60</u> | 106                  | 0.550                | 0.540                               | 0.01                               |
| 5/12/17  | 10:12 | 316                    | -          | -      | 15.1      | 7.4          | <u>21.4</u>  | 8.5                 | 95.2        | 1.3                     | <u>6.60</u>  | 114                  | 0.430                | 0.430                               | 0.01                               |
| <b>Tuakau Br upper decile flow = 621 m<sup>3</sup>/s</b>     |       |                        |            |        |           |              |              |                     |             |                         |              |                      |                      |                                     |                                    |
| 5/1/17   | 11:19 | 246                    | <u>0.7</u> | 25.0   | 15.9      | 7.8          | 19.9         | 9.4                 | 102.3       | 1.6                     | <u>8.10</u>  | 119                  | 0.240                | 0.240                               | 0.01                               |
| 1/2/17   | 11:50 | 239                    | <u>1.0</u> | 35.0   | 16.7      | 7.6          | <u>22.3</u>  | 8.8                 | 100.4       | 1.0                     | 3.40         | 118                  | 0.290                | 0.290                               | 0.01                               |
| 8/3/17   | 11:10 | 326                    | <u>0.3</u> | 27.5   | 14.7      | 7.4          | <u>20.0</u>  | 7.6                 | 83.9        | 0.7                     | <u>16.00</u> | 121                  | 0.380                | 0.380                               | 0.02                               |
| 6/4/17   | 11:10 | 1036                   | (0.1)      | 20.0   | 12.3      | 6.9          | 18.4         | 6.4                 | <u>67.6</u> | 1.5                     | <u>84.00</u> | 111                  | 0.610                | 0.610                               | 0.04                               |
| 3/5/17   | 11:20 | 575                    | <u>0.6</u> | 22.5   | 14.9      | 7.0          | <u>15.2</u>  | 7.1                 | <u>69.7</u> | 1.5                     | <u>10.70</u> | 131                  | 0.640                | 0.630                               | 0.04                               |
| 7/6/17   | 12:30 | 526                    | <u>0.7</u> | 27.5   | 14.1      | 7.2          | <u>12.9</u>  | 9.5                 | 89.5        | 0.9                     | <u>9.10</u>  | 115                  | 0.680                | 0.680                               | 0.02                               |
| 5/7/17   | 12:32 | 640                    | (0.3)      | 27.5   | 13.6      | 7.1          | <u>12.3</u>  | 9.2                 | 85.2        | 1.4                     | <u>25.00</u> | 102                  | 0.910                | 0.910                               | 0.02                               |
| 2/8/17   | 12:20 | 601                    | -          | 27.5   | 13.8      | 7.2          | 11.4         | 9.7                 | 88.0        | 1.0                     | <u>9.50</u>  | 105                  | 0.710                | 0.700                               | 0.01                               |
| 6/9/17   | 12:20 | 621                    | <u>0.5</u> | 27.5   | 14.3      | 7.5          | <u>13.6</u>  | 9.4                 | 89.8        | 1.8                     | <u>10.30</u> | 117                  | 0.760                | 0.750                               | 0.02                               |
| 4/10/17  | 12:23 | 665                    | -          | 25.0   | 13.6      | 7.4          | 14.7         | 9.9                 | 96.2        | 2.0                     | <u>19.90</u> | 118                  | 0.600                | 0.590                               | 0.01                               |
| 8/11/17  | 12:01 | 502                    | <u>0.7</u> | 25.0   | 13.6      | 7.4          | 17.5         | 8.9                 | 93.2        | 1.3                     | <u>13.80</u> | 124                  | 0.530                | 0.520                               | 0.01                               |
| 5/12/17  | 10:43 | 317                    | <u>0.9</u> | 32.5   | 15.3      | 7.3          | <u>22.7</u>  | 8.4                 | 96.8        | 1.7                     | <u>6.20</u>  | 121                  | 0.430                | 0.420                               | 0.01                               |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

| TKN<br>g/m <sup>3</sup> | TN g/m <sup>3</sup> | DRP<br>g/m <sup>3</sup> | TP g/m <sup>3</sup> | CL g/m <sup>3</sup> | As g/m <sup>3</sup> | B g/m <sup>3</sup> | Li g/m <sup>3</sup> | A340F<br>/cm | A440F<br>/cm | ENT.<br>/100ml | F coli<br>/100ml | E coli<br>/100ml | CHLa<br>g/m <sup>3</sup> | DOC<br>g/m <sup>3</sup> | TOC g/m <sup>3</sup> |
|-------------------------|---------------------|-------------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------|--------------|----------------|------------------|------------------|--------------------------|-------------------------|----------------------|
| -                       | <0.5                | -                       | <0.04               | -                   | <0.01               | <1.4               | -                   | -            | -            | <77            | -                | <550             | <0.02                    | -                       | -                    |

#### Mercer Bridge

|      |            |       |              |      |              |      |       |       |       |             |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|-------------|------|-------------|-------|-----|-----|
| 0.31 | <u>0.6</u> | 0.018 | 0.029        | 16.9 | <u>0.018</u> | 0.21 | 0.067 | 0.016 | 0.003 | 15          | 80   | 70          | 0.008 | 2.0 | 2.9 |
| 0.24 | 0.49       | 0.022 | 0.030        | 17.6 | <u>0.023</u> | 0.24 | 0.077 | 0.012 | 0.002 | 39          | 90   | 90          | 0.003 | 2.1 | 2.2 |
| 0.24 | <u>0.6</u> | 0.016 | 0.035        | 15.5 | <u>0.018</u> | 0.20 | 0.068 | 0.019 | 0.004 | <u>1300</u> | 1100 | <u>900</u>  | 0.002 | 2.3 | 2.8 |
| 0.86 | <u>1.6</u> | 0.052 | <u>0.174</u> | 13.5 | 0.009        | 0.11 | 0.035 | 0.086 | 0.016 | <u>5800</u> | 5600 | <u>5400</u> | 0.003 | 8.6 | 9.5 |
| 0.35 | <u>1.0</u> | 0.024 | <u>0.058</u> | 13.1 | <u>0.011</u> | 0.13 | 0.037 | 0.056 | 0.010 | <u>140</u>  | 480  | 390         | 0.002 | 4.4 | 5.6 |
| 0.23 | <u>0.9</u> | 0.024 | <u>0.047</u> | 12.5 | <u>0.012</u> | 0.15 | 0.041 | 0.026 | 0.005 | 45          | 100  | 90          | 0.002 | 2.0 | 2.4 |
| 0.44 | <u>1.4</u> | 0.029 | <u>0.077</u> | 12.1 | 0.010        | 0.13 | 0.040 | 0.052 | 0.009 | <u>1100</u> | 1100 | <u>900</u>  | 0.002 | 3.6 | 4.9 |
| 0.25 | <u>1.0</u> | 0.022 | 0.037        | 12.7 | <u>0.010</u> | 0.14 | 0.040 | 0.030 | 0.006 | 14          | 92   | 88          | 0.002 | 1.9 | 2.8 |
| 0.42 | <u>1.2</u> | 0.020 | <u>0.061</u> | 13.7 | <u>0.011</u> | 0.16 | 0.046 | 0.046 | 0.008 | 26          | 320  | 290         | 0.009 | 4.1 | 4.3 |
| 0.41 | <u>1.0</u> | 0.013 | <u>0.081</u> | 12.6 | <u>0.011</u> | 0.14 | 0.041 | 0.038 | 0.007 | <u>330</u>  | 2800 | <u>2300</u> | 0.017 | 3.0 | 4.7 |
| 0.34 | <u>0.9</u> | 0.019 | <u>0.067</u> | 13.2 | <u>0.012</u> | 0.14 | 0.042 | 0.028 | 0.005 | 20          | 900  | <u>900</u>  | 0.011 | 2.5 | 3.7 |
| 0.23 | <u>0.7</u> | 0.018 | 0.029        | 14.7 | <u>0.017</u> | 0.19 | 0.058 | 0.018 | 0.003 | 13          | 210  | 60          | 0.004 | 1.7 | 1.9 |

#### Tuakau Br

|      |            |       |              |      |              |      |       |       |       |             |      |             |       |     |     |
|------|------------|-------|--------------|------|--------------|------|-------|-------|-------|-------------|------|-------------|-------|-----|-----|
| 0.28 | <u>0.5</u> | 0.015 | 0.034        | 16.9 | <u>0.019</u> | 0.22 | 0.071 | 0.014 | 0.003 | 17          | 120  | 120         | 0.013 | 2.4 | 3.0 |
| 0.24 | <u>0.5</u> | 0.024 | 0.029        | 17.9 | <u>0.023</u> | 0.25 | 0.078 | 0.012 | 0.002 | 9           | 80   | 60          | 0.004 | 1.9 | 2.0 |
| 0.32 | <u>0.7</u> | 0.016 | <u>0.042</u> | 15.6 | <u>0.014</u> | 0.19 | 0.065 | 0.024 | 0.005 | <u>4000</u> | 2600 | <u>2100</u> | 0.002 | 2.8 | 3.1 |
| 0.71 | <u>1.3</u> | 0.036 | <u>0.140</u> | 12.8 | 0.009        | 0.10 | 0.033 | 0.082 | 0.015 | <u>5100</u> | 4600 | <u>4500</u> | 0.003 | 9.0 | 9.4 |
| 0.51 | <u>1.1</u> | 0.028 | <u>0.077</u> | 13.8 | <u>0.011</u> | 0.12 | 0.032 | 0.082 | 0.015 | 48          | 500  | 330         | 0.002 | 5.4 | 7.5 |
| 0.31 | <u>1.0</u> | 0.018 | <u>0.047</u> | 13.1 | <u>0.011</u> | 0.15 | 0.038 | 0.042 | 0.008 | 46          | 150  | 120         | 0.004 | 2.9 | 3.4 |
| 0.45 | <u>1.4</u> | 0.023 | <u>0.073</u> | 12.5 | 0.009        | 0.13 | 0.037 | 0.052 | 0.009 | <u>900</u>  | 1600 | <u>1400</u> | 0.004 | 3.6 | 5.1 |
| 0.33 | <u>1.0</u> | 0.018 | <u>0.052</u> | 13.3 | 0.009        | 0.13 | 0.035 | 0.039 | 0.008 | 13          | 63   | 62          | 0.003 | 2.4 | 3.6 |
| 0.41 | <u>1.2</u> | 0.016 | <u>0.058</u> | 13.7 | <u>0.010</u> | 0.15 | 0.042 | 0.057 | 0.010 | 18          | 280  | 250         | 0.010 | 4.5 | 4.7 |
| 0.44 | <u>1.0</u> | 0.015 | <u>0.045</u> | 12.7 | <u>0.010</u> | 0.13 | 0.037 | 0.046 | 0.008 | <u>240</u>  | 3500 | <u>1300</u> | 0.018 | 3.1 | 4.5 |
| 0.38 | <u>0.9</u> | 0.017 | <u>0.060</u> | 12.7 | <u>0.012</u> | 0.13 | 0.041 | 0.033 | 0.006 | 19          | 420  | 270         | 0.012 | 3.3 | 3.6 |
| 0.25 | <u>0.7</u> | 0.014 | 0.031        | 14.7 | <u>0.016</u> | 0.19 | 0.056 | 0.019 | 0.003 | 12          | 110  | 60          | 0.004 | 1.7 | 2.2 |

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality guidelines and standards.

Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

# References

Tulagi A 2017. Waikato River water quality monitoring programme data report 2015. Waikato Regional Council Technical Report 2017/14. Hamilton, Waikato Regional Council

Tulagi A 2013. Waikato River water quality monitoring programme data report 2012. Waikato Regional Council Technical Report 2013/12. Hamilton, Waikato Regional Council

Vant B 2013. Trends in river water quality in the Waikato region, 1993-2012. Waikato Regional Council Technical Report 2013/20, Hamilton, Waikato Regional Council

# Appendix I:

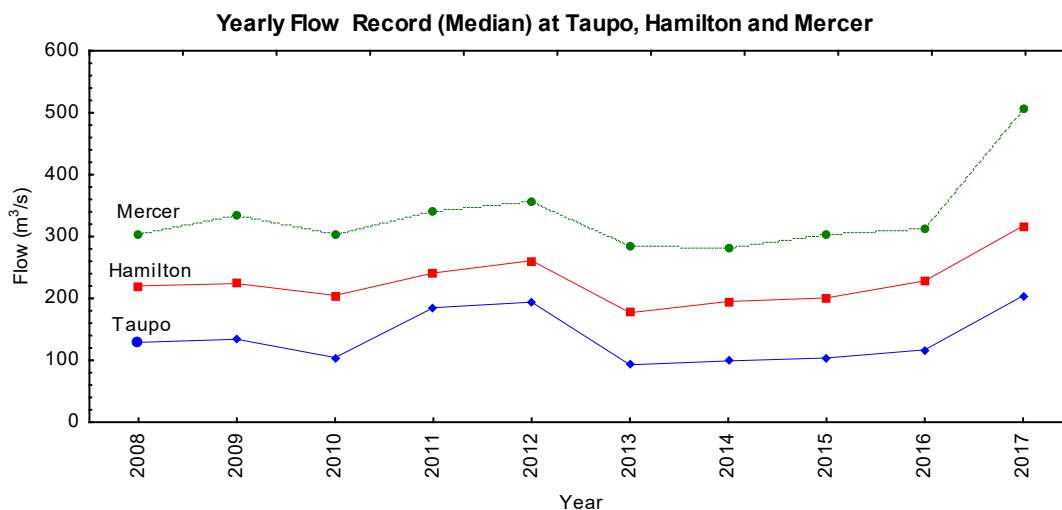
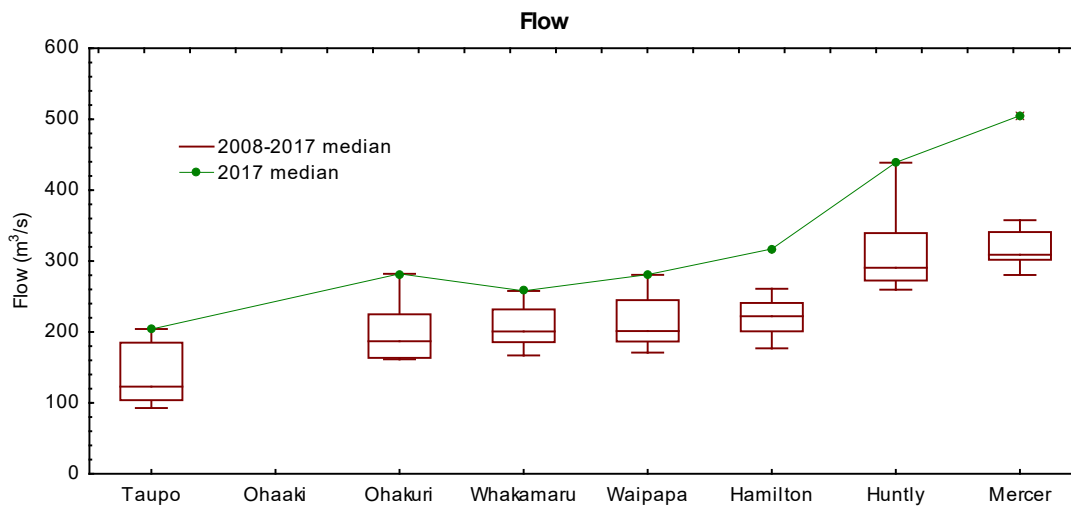
## Flow information

Median Flows of the Waikato River and Main Tributaries

| Location      | DISTANCE |  | FLOW RATE+ (m <sup>3</sup> /s) |      |      |      |      |      |      |      |      |      | 10 YEAR |
|---------------|----------|--|--------------------------------|------|------|------|------|------|------|------|------|------|---------|
|               | km       |  | 2008                           | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Median  |
| Taupo         | 4.2      |  | 129                            | 134  | 104  | 185  | 194  | 93   | 99   | 104  | 117  | 204  | 139     |
| Ohakuri       | 75.8     |  | 163                            | 162  | 192  | 225  | 229  | 163  | 163  | 184  | 190  | 282  | 196     |
| Whakamaru     | 105.0    |  | 186                            | 196  | 209  | 242  | 232  | 168  | 167  | 189  | 206  | 258  | 207     |
| Waipapa       | 126.1    |  | 211                            | 194  | 198  | 250  | 245  | 175  | 171  | 186  | 205  | 281  | 212     |
| Hamilton      | 211.5    |  | 220                            | 224  | 205  | 241  | 261  | 177  | 195  | 201  | 228  | 317  | 226     |
| Huntly        | 246.5    |  | 273                            | 301  | 296  | 339  | 346  | 263  | 260  | 281  | 285  | 439  | 310     |
| Mercer        | 286.3    |  | 302                            | 334  | 304  | 341  | 358  | 286  | 280  | 302  | 314  | 505  | 333     |
| Waioatapu Stm | 46.6     |  | 3.0                            | 2.7  | 3.3  | 3.8  | 3.5  | 2.5  | 2.4  | 2.6  | 2.8  | 4.8  | 3       |
| Waipa River   | 232.7    |  | 43                             | 53   | 41   | 61   | 62   | 47   | 55   | 53   | 59   | 86   | 56      |

+Rating curve errors mean estimates of flow are ± 8%

\*Historical flow data updated due to rating changes from updated data received





# Appendix II:

## Water quality parameters

### Guidelines and standards

### Analytical methods

#### Waikato River water quality monitoring programme parameters

| Water quality parameter   | Reason for monitoring                           | Parameter monitored <sup>1</sup>      | Comments <sup>2</sup> |
|---|---|---------------------------------------|-----------------------|
| Dissolved oxygen  | - requirement for aquatic life                  | DO (conc.)                            | routine (field)       |
|   | - indicator of organic pollution                | DO (%sat.)                            | routine (field)       |
|   | - indicator of photosynthesis (plant growth)    |                                       |                       |
| Temperature   | - indicator of biological activity              | Temperature                           | routine (field)       |
|   | - requirement for aquatic life                  |                                       |                       |
|   | - mixing processes                              |                                       |                       |
|   | - modelling studies (e.g. nutrient uptake)      |                                       |                       |
| Conductivity  | - indicator of total salts dissolved in water   | Conductivity                          | routine               |
|   | - indicator for geothermal input                | TDS                                   | routine               |
| pH  | - aquatic life protection                       | pH                                    | routine               |
|   | - indicator of industrial discharges, mining    |                                       |                       |
| Clarity<br>- turbidity<br>- black disk<br>(visual clarity)          | - aesthetic appearance                          | Turbidity                             | routine               |
|   | - light availability for excessive plant growth | Black disk                            | routine (field)       |
|   | - aquatic life protection                       |                                       |                       |
|   | - indicator of catchment condition, land use    |                                       |                       |
| Colour<br>- light absorption  | - aesthetic appearance                          | Munsell colour                        | routine (field)       |
|   | - light availability for excessive plant growth | Absorbance at:                        | routine               |
|   | - indicator of presence of organic matter       | 340,440,780nm                         |                       |
| Nutrients (N and P)<br>chlorophyll $\alpha$                         | - enrichment, excessive plant growth            | NO <sub>3</sub> -N+NO <sub>2</sub> -N | routine               |
|   | - nutrient limitation for plant/algal growth    | NH <sub>4</sub> -N,TKN                |                       |
|   |   | DRP, TP, Chl $\alpha$                 |                       |
| Geothermal contaminants   | - indicators of geothermal inflows              | Cl, Li, B, As                         | routine               |
|   | - aquatic life protection (ecotoxicity)         |                                       |                       |
|   | - drinking water (human health aspects)         |                                       |                       |
| Organic carbon  | - indicator of organic pollution                | BOD <sub>5</sub>                      | routine               |
|   | - catchment characteristics                     | TOC/DOC                               | routine               |
| Faecal bacteria<br>- E. coli<br>- enterococci<br>- faecal coliforms | - indicator of pollution with faecal matter     | E. Coli                               | routine               |
|   | - disease risk for swimming etc.                | ENT                                   | routine               |
|   |   | FC                                    | routine               |
|   |   |                                       |                       |

<sup>1</sup> see page 33 for the meaning of the abbreviations.

<sup>2</sup> routine means sampled monthly.

## Details of water quality standards and guidelines for “satisfactory” water quality

| Parameter                      | Critical value(s)                      | Source   |
|--------------------------------|--|--|
| Dissolved oxygen               | >80% of saturation concentration       | RMA Third Schedule, Classes AE, F, and FS.   |
| pH                             | 6.5–9                                  | ANZECC (1992) and Canadian guidelines for freshwater aquatic life (1987).  |
| Turbidity                      | <5 NTU                                 | Studies of adverse effects on underwater light—and thus on plant and invertebrate production—in certain South Island streams (Davies-Colley 1991).   |
| Ammoniacal-nitrogen            | <0.88 g/m <sup>3</sup>                 | USEPA (1998) value for 1-hour exposure at pH 9.  |
| Temperature                    | <12°C (May – Sep)<br><20°C (Oct – Apr) | Waikato Regional Council Proposed Regional Plan standards for trout fisheries and trout spawning (1998).   |
| Total phosphorus               | <0.04 g/m <sup>3</sup>                 | From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdam 1994)—note that the guidelines for “excellent” conditions are the lower quartile concentrations for these rivers. |
| Total nitrogen                 | <0.5 g/m <sup>3</sup>                  | From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdam 1994)—note that the guidelines for “excellent” conditions are the lower quartile concentrations for these rivers. |
| Water clarity at baseflow      | >1.6 m                                 | “Baseflow” defined as flows less than the upper decile flow. Guideline from Ministry for the Environment (1994).   |
| <i>Escherichia coli</i>        | <550/100 mL                            | Ministry for the Environment (2003) guidelines for the management of recreational and marine shellfish-gathering waters.   |
| Median <i>Escherichia coli</i> | <126/100 mL                            | Ministry for the Environment (1999) guidelines for the management of recreational and marine shellfish-gathering waters.   |
| Enterococci                    | <77/100 mL                             | Department of Health (1992) guidelines for “moderate” level of recreational use.   |
| Chlorophyll <i>a</i>           | <0.02 g/m <sup>3</sup>                 | Ministry for the Environment (1992).   |
| Arsenic                        | <0.01 g/m <sup>3</sup>                 | Ministry of Health (2001).   |
| Boron                          | <1.4 g/m <sup>3</sup>                  | Ministry of Health (2001).   |

## Waikato River monitoring programme - water quality parameters and analytical methods

| Id <sup>1</sup>    | Parameter                             | Method   |
|--------------------|---------------------------------------|--|
| A340F              | Absorbance @ 340 nm filtered          | Spectrophotometer, 1 cm path length, APHA method 5910B   |
| A440F              | Absorbance @ 440 nm filtered          | Spectrophotometer, 1 cm path length, APHA method 5910B   |
| A780F              | Absorbance @ 780 nm filtered          | Spectrophotometer, 1 cm path length, APHA method 5910B   |
| As                 | Arsenic total                         | Nitric acid digestion, ICP-MS, APHA method 3125 B / USEPA 200B   |
| B                  | Boron                                 | ICP-MS, APHA method 3125 B   |
| BDISK              | Black disk                            | Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river  |
| BOD <sub>5</sub>   | Biochemical oxygen Demand (5 day)     | Incubation 5 days at 20°C, DO-meter, No nitrification inhibitor added, unseeded, APHA method 5210 B  |
| CHLA               | Chlorophyll a                         | Acetone extraction. Spectroscopy. APHA method 10200 H (modified)   |
| Cl                 | Chloride                              | Filtered sample. Ferric thiocyanate colorimetry, Discrete analyser. APHA method 4500 Cl <sup>-</sup> E (modified)  |
| COLOUR             | Colour                                | Field measurement, Munsell colour patches  |
| COND               | Conductivity                          | Lab Meter @ 25°C. APHA method 2510B  |
| DO                 | Dissolved oxygen                      | Field measurement (Hach DO meter, model HQ 30d)  |
| DO (% Sat)         | Dissolved oxygen (percent saturation) | Field measurement (Hach DO meter, model HQ 30d)  |
| DOC                | Dissolved organic Carbon              | Filtration, acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (modified)   |
| DRP                | Dissolved reactive Phosphorus         | Filtration, Molybdenum Blue Colorimetry. Discrete analyser. APHA 4500 PE (modified)  |
| E. coli            | Escherichia coli                      | Membrane Filtration (mFC Agar) confirmation by MUG Agar. APHA method 9222 G  |
| ENT                | Enterococci bacteria                  | Membrane Filtration (mE Agar) confirmation by EIA Agar. APHA method 9230 C   |
| FC                 | Faecal coliforms                      | Membrane Filtration (mFC Agar). APHA method 9222 D   |
| Flow               | Flow – instantaneous                  | Calculated from rating curve ± 8%  |
| Li                 | Lithium                               | ICP-MS, method APHA 3125 B   |
| NH <sub>4</sub> -N | Ammoniacal Nitrogen (Total)           | Filtration, Phenol/Hypochlorite Colorimetry. Discrete analyser. APHA method 4500-NH <sub>3</sub> F (modified).   |
| NNN                | Nitrite/Nitrate Nitrogen              | Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO <sub>3</sub> -I (modified)   |
| NO <sub>3</sub> -N | Nitrate nitrogen                      | Calculation: (Nitrate-N + Nitrite -N) – Nitrite - N  |
| pH                 | pH                                    | Lab Meter @ 25°C. APHA method 4500-H <sup>+</sup> B  |
| TDS                | Total dissolved solids                | Filtration, gravimetric. APHA 2540 C (modified)  |
| TEMP               | Temperature                           | Field measurement (Hach DO meter, model HQ 30d)  |
| TKN                | Total Kjeldahl-Nitrogen               | Acid digestion. Phenol/Hypochlorite colorimetry. Discrete analyser. APHA method 4500-N <sub>org</sub> D (modified), 4500 NH <sub>3</sub> F (modified)  |
| TOC                | Total Organic Carbon                  | Acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (modified)   |
| TN                 | Total Nitrogen                        | Calculated from NNN + TKN (Nitrite/Nitrate Nitrogen + Total Kjeldahl-Nitrogen)   |
| TP                 | Total Phosphorus                      | Acid persulphate digestion, Colorimetry. Discrete Analyser. APHA method 4500-P B & E (modified), corrected values to take into account possible interference from arsenic present in the sample. |
| TURB               | Turbidity                             | Turbidity Meter Hach 2100N. APHA method 2130 B   |

<sup>1</sup> Water quality parameter identification code refers to Waikato Regional Council's water quality database (WISKI) parameter short name.

APHA = Standards Methods for the Examination of Water and Wastewater, 22<sup>nd</sup> Edition, 2012, APHA, AWWA, WEF

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy