

Waikato river water quality monitoring programme data report 2021

Prepared by:
Briar Mills

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

Publication Date: March 2023

Document #: 25903255

Peer reviewed by:

Date 07/03/2024

Approved for release by:

Ed Brown

Date 5/05/2023

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 Aroha Salu, Asaeli Tulagi, Chris McKinnon, Debbie Eastwood, Douglas De Brito, John Hughey, Nicole Squires, Noel Bates, Shana Edgcombe, Sophie, Taylor Thomas and the hydrology team for their commitment and reliability in undertaking field measurements and sample collection, as well as Aroha Salu for co-ordination of the field aspects of sample collection. Thanks to Samii Thornborough for assisting with the report formatting.

Hydrological flow data is provided by Mercury Energy (Hydro Lakes, Waiotapu stream and Reid's Farm), Contact Energy (Ohaaki Bridge), and Genesis Power (Huntly) through agents Opus and NIWA.

Table of contents

Acknowledgement	i
1 Introduction	1
1.1 Background	1
1.2 Report Content	1
1.3 Water Quality Guidelines and Standards	2
2 The Waikato River Monitoring Programme Design	3
2.1 Sampling Collection	3
2.2 Sample Locations	3
2.3 Water Quality Parameters	5
3 Quality Control, Data Storage and Analysis	5
3.1 Reports	5
4 Results	6
4.1 Summary Statistics	6
4.2 Key Parameter Boxplots	16
4.3 Comparison with Water Quality Standards	20
4.4 Trace Metal Summary Data	27
References	28
Appendix I	29
Flow Information	29
Appendix II	30
Datasonde Deployments Graphs: Selected Water Quality Parameters	30
Appendix III	35
Waikato River Water Quality Parameters	35
Guidelines and Standards	36
Analytical Methods	37

Tables

Table 1:	Guidelines and standards of water quality for ecological health and for human uses of water	2
Table 2:	Routine water quality monitoring sites	4
Table 3:	Sample summary statistics for 2021 including a 5-year median from 2017-2021	6
Table 4:	Number of monthly samples (2021) complying with the satisfactory water quality guidelines and standards	20
Table 5:	Number of monthly samples (2021) complying with the excellent water quality guidelines and standards	20
Table 6:	Raw data summary: samples collected compared with the "satisfactory" water quality standards in the year 2021	21
Table 7:	Five yearly trace metals raw data summary	27
Table 8:	Median flows fo the Waikato River and main tributaries from 2012 - 2021	29

Figures

Figure 1:	Waikato River water quality monitoring locations	3
Figure 2:	Boxplot graphs for key water quality parameters from 2017-2021	19
Figure 3:	Waikato River flow boxplot from 2012-2021 with 2021 median trend line	29
Figure 4:	Yearly flow record (median) at Taupo, Hamilton and Mercer for 2012-2021	29

1 Introduction

1.1 Background

A range of physical, chemical and microbiological water quality parameters have been monitored at several sites along the Waikato River since 1989 as part of the Waikato River Monitoring Programme (WaRiMP). Currently, the programme includes 12 sites monitored at monthly intervals, see Figure 1. This report is the 31st since the re-design of the programme and covers the calendar year of 2021 and follows the format of the previous data report (Bates, 2020). The previous reports can be located through the following link: [Publications | Waikato Regional Council](#).

The WaRiMP and the technical reports address 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.

1.2 Report Content

The report provides information on:

1. Routine monthly monitoring of water quality at 12 sites:
 - Year 2021 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 2021 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 routine parameters in 2021.
 - Raw data for trace metals tested every five years.
2. Additional information is provided in the appendices on:
 - Flow (*Appendix I*).
 - Annual median flow at nine locations along the Waikato River for the previous 10 years.
 - Continuous monitoring (*Appendix II*).
 - Plots of the Hamilton and Tuakau sites during 2021 showing the level of diurnal and seasonal variation of selected parameters.
 - Water quality criteria (*Appendix III*)
 - Identifying the water quality parameters, guidelines, standards, and analytical methods used in the Waikato River water quality monitoring programme.

1.3 Water Quality Guidelines and Standards

Physical, chemical and biological parameters for water quality standards and guidelines used to assess the condition of the Waikato River are in table 1. The standards relate to the protection of the ecological health of rivers and streams and whether they are suitable for water-based recreation. 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 identify water that is satisfactory for the desired use; these are mostly based on existing national and other guidelines and standards (Appendix III). The more stringent criteria identify excellent water and reflect expert opinion. Samples gathered in 2021 whose results do not comply with the “satisfactory” criteria (Table 1) are underlined in raw data summaries (Table 6).

Adoption of updated water guidelines within council is currently under review, including the National Policy Statement for Freshwater Management 2020 (NPSFM) and updated ANZECC (2018) guidelines.

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

Water quality measure	Relevance ¹	Satisfactory	Excellent
Ecological health			
Dissolved Oxygen (% sat.)	aquatic life (breathing)	>80	>90
Dissolved Oxygen (mg/L)	aquatic life (stress)	>5	>8
pH	aquatic life (acidity)	6.5-9	7-8
Turbidity (NTU)	plant life (clarity)	<5	<2
Ammoniacal Nitrogen (g/m ³)	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 ³)	nuisance plant growth	<0.04	<0.01
Total Nitrogen (g/m ³)	nuisance plant growth	<0.5	<0.1
Human uses - recreation			
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
Human uses - water supply			
Chlorophyll <i>a</i> (g/m ³)	filter blockage	<0.02	<0.005
Human uses - drinking water			
Arsenic (g/m ³)	human health (toxicity)	<0.01	n/a
Boron (g/m ³)	human health (toxicity)	<1.4	n/a

¹Refer to Appendix III for description of guideline and standards values used. These guidelines and standards are also defined on the Waikato Regional Council website: www.waikatoregion.govt.nz/guidelines

2 The Waikato River Monitoring Programme Design

2.1 Sampling Collection

Sample collection occurs over two days each month. 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 Karapiro (at the Karapiro tailrace) to Tuakau are visited on the next. Each location is sampled at a similar time on each occasion (coefficient of variation $\approx 2-6\%$) to minimise the effect of diurnal variation on the measurement of water quality parameters. Sample times are recorded in New Zealand Standard Time (NZST). Ten sites have one month of sampling missed and two sites have two months of sampling missing due to Covid 19 related restrictions and/or issues.

2.2 Sample Locations

Routine water quality monitoring locations of the Waikato River Monitoring Programme illustrated in *Figure 1* and summarised in *Table 2*.

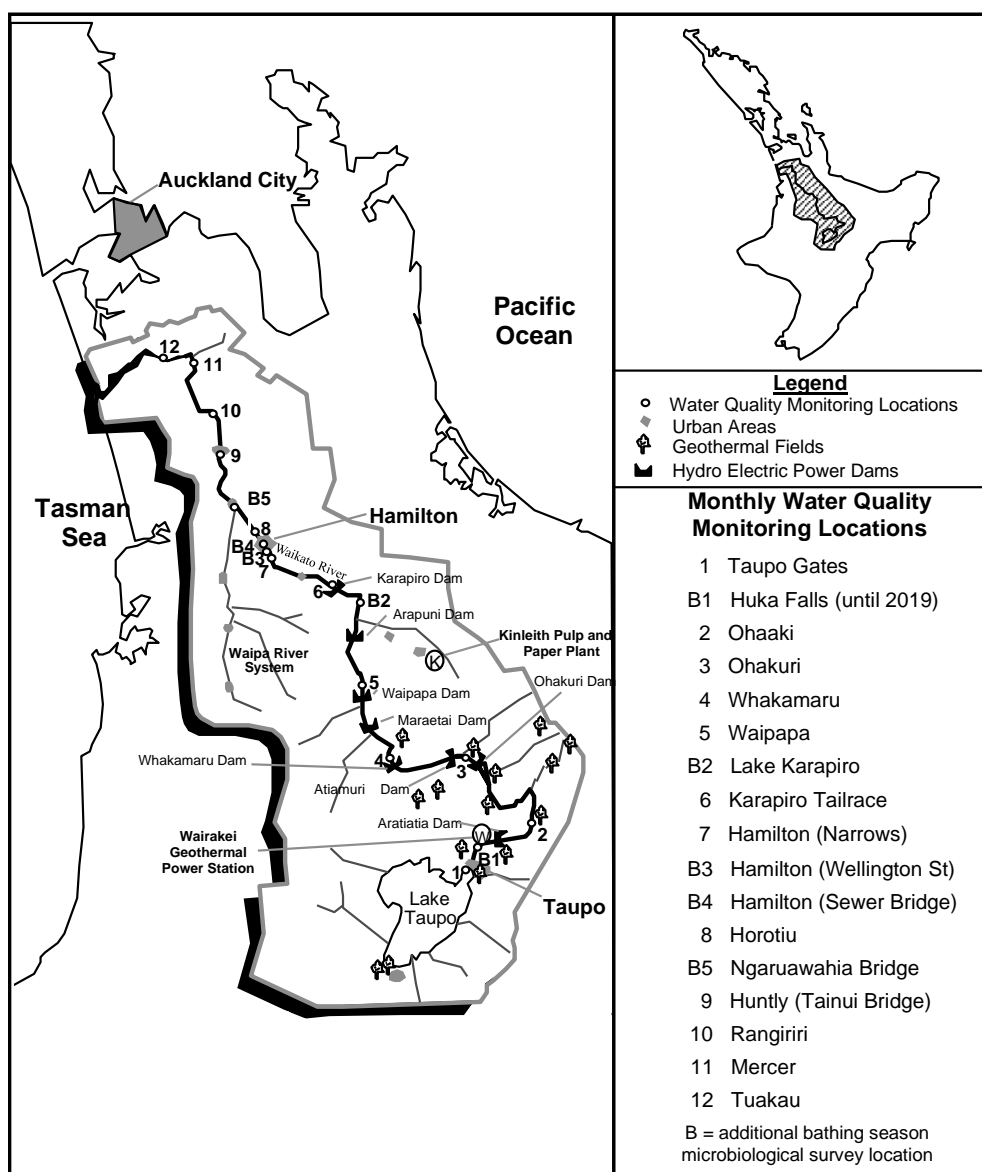


Figure 1: Waikato River water quality monitoring locations

The following twelve locations along the river Taupo, Ohaaki, Ohakuri, Whakamaru, Waipapa, Karapiro, Hamilton-Narrows, Hamilton-Horotiu, Huntly, Rangiriri, Mercer and Tuakau are assessed. Ohakuri Bridge's black disk and Munsell colour parameter values are measured at the Ohakuri boat ramp in the recreation reserve immediately upstream of the dam but for the purpose of this report will be reported as Ohakuri Bridge. There are no black disk measurements at the Taupo site due to lack of safe access to rivers edge. Additional locations are included for the summer intensive microbiological survey (*Figure 1*), the results of which are reported to LAWA for public access. The major tributaries that enter the Waikato River are also monitored monthly as part of the Regional River Monitoring Programme (ReRiMP).

Table 2: Routine water quality monitoring sites

Location number	Distance ¹ (km)	Location	Location coordinate (NZTM)
1131-127	0.1	Taupo Control Gates	1867049, 5714142
1131-105	36.5	Ohaaki Bridge	1887985, 5729892
1131-107	75.8	Ohakuri Tailrace Bridge	1869480, 5744515
1131-147	105	Whakamaru Tailrace	1845004, 5743996
1131-143	126.1	Waipapa Tailrace	1834859, 5759095
1131-79	179.3	Karapiro Tailrace	1823187, 5799700
1131-328	202.2	Hamilton – Narrows	1806588, 5809381
1131-64 ^d	211.5	Hamilton – Traffic Bridge	1801620, 5814821
1131-69	225.6	Horotiu Bridge	1794554, 5825430
1131-77	246.5	Huntly – Tainui Bridge	1790260, 5840128
1131-117	262.3	Rangiriri Bridge	1788389, 5855059
1131-91	286.3	Mercer Bridge	1781445, 5871961
1131-133	296.8	Tuakau Bridge	1772410, 5870516
1131-131 ^d	306.5	Tuakau – Elbows Landing at NZ Steel Ltd pumping station	1764150, 5873515

¹ approximate distance (in kilometres) from Lake Taupo outlet.

^d datasonde deployment sites

2.3 Water Quality Parameters

Water quality of the Waikato River is assessed by measuring more than 40 parameters (30 routinely). A collection of parameters is measured in the field and the remainder are analysed in a laboratory using standard analytical methods. Details of field measurements and analytical methods used are included in *Appendix III*.

3 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 weeks 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 in this report was performed using WQ Stats 2.2 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., $<x = x/2$) except bacteria values, and results greater than the value reported were taken as equal to the value reported (i.e., $>x = x$).

3.1 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 following link:

[Trends in river water quality in the Waikato region, 1993-2017 | Waikato Regional Council](#)

The data contained in these Waikato River reports is updated to the Waikato Regional Council website linked below:

[Waikato River | Waikato Regional Council](#)

This data is also supplied to the LAWA website:

<https://www.lawa.org.nz/explore-data/waikato-region>

4 Results

4.1 Summary Statistics

Table 3: Sample summary statistics for 2021 including a 5-year median from 2017-2021

Absorbance (340nm) (/cm)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.001	0.001	0.001	0.002	0.000	3.32	0.001
Ohaaki Bridge	11	0.003	0.003	0.001	0.006	0.001	0.45	0.004
Ohakuri Tailrace Br	11	0.006	0.005	0.004	0.008	0.001	0.81	0.006
Whakamaru Tailrace	11	0.007	0.007	0.004	0.011	0.003	0.65	0.007
Waipapa Tailrace	11	0.010	0.009	0.006	0.016	0.002	1.26	0.009
Karapiro Tailrace	11	0.010	0.009	0.007	0.015	0.004	0.76	0.010
Narrows Boat Ramp	11	0.012	0.009	0.007	0.027	0.009	1.53	0.012
Horotiu Bridge	11	0.014	0.011	0.009	0.031	0.008	1.76	0.013
Huntly-Tainui Bridge	11	0.019	0.015	0.005	0.043	0.011	1.20	0.019
Rangiriri Bridge	11	0.021	0.016	0.008	0.063	0.011	2.18	0.018
Mercer Bridge	10	0.020	0.019	0.009	0.036	0.014	0.59	0.020
Tuakau Bridge	10	0.024	0.021	0.009	0.050	0.023	0.74	0.024

Absorbance (440nm) (/cm)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.001	0.001	0.001	0.001	0.000	0.00	0.001
Ohaaki Bridge	11	0.001	0.001	0.001	0.001	0.000	0.00	0.001
Ohakuri Tailrace Br	11	0.001	0.001	0.001	0.003	0.000	3.32	0.001
Whakamaru Tailrace	11	0.001	0.001	0.001	0.001	0.000	0.00	0.001
Waipapa Tailrace	11	0.002	0.001	0.001	0.003	0.001	0.85	0.002
Karapiro Tailrace	11	0.002	0.001	0.001	0.003	0.001	1.15	0.002
Narrows Boat Ramp	11	0.002	0.002	0.001	0.005	0.003	0.76	0.002
Horotiu Bridge	11	0.003	0.002	0.001	0.006	0.004	0.69	0.003
Huntly-Tainui Bridge	11	0.004	0.003	0.001	0.008	0.003	1.05	0.004
Rangiriri Bridge	11	0.004	0.003	0.001	0.012	0.004	1.49	0.004
Mercer Bridge	10	0.004	0.004	0.001	0.007	0.003	0.46	0.004
Tuakau Bridge	10	0.004	0.004	0.001	0.009	0.004	0.55	0.005

Arsenic (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.012	0.012	0.011	0.014	0.001	0.96	0.012
Ohaaki Bridge	11	0.025	0.024	0.018	0.043	0.007	1.50	0.020
Ohakuri Tailrace Br	11	0.027	0.027	0.025	0.032	0.003	0.89	0.026
Whakamaru Tailrace	11	0.027	0.026	0.025	0.031	0.002	0.81	0.026
Waipapa Tailrace	11	0.024	0.024	0.019	0.028	0.004	-0.51	0.023
Karapiro Tailrace	11	0.021	0.021	0.015	0.028	0.005	0.13	0.021
Narrows Boat Ramp	11	0.021	0.021	0.015	0.027	0.006	-0.10	0.020
Horotiu Bridge	11	0.021	0.021	0.015	0.026	0.007	-0.15	0.019
Huntly-Tainui Bridge	11	0.016	0.016	0.009	0.024	0.008	0.19	0.016
Rangiriri Bridge	11	0.017	0.017	0.009	0.025	0.005	-0.11	0.017
Mercer Bridge	10	0.017	0.016	0.011	0.024	0.007	0.60	0.015
Tuakau Bridge	10	0.016	0.015	0.011	0.025	0.005	0.83	0.014

Boron (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.17	0.17	0.16	0.18	0.01	-0.17	0.17
Ohaaki Bridge	11	0.29	0.25	0.21	0.46	0.10	1.31	0.25
Ohakuri Tailrace Br	11	0.30	0.30	0.25	0.34	0.02	-0.51	0.28
Whakamaru Tailrace	11	0.29	0.29	0.26	0.33	0.04	0.32	0.28
Waipapa Tailrace	11	0.26	0.27	0.21	0.29	0.03	-0.94	0.25
Karapiro Tailrace	11	0.24	0.23	0.20	0.26	0.03	-0.60	0.24
Narrows Boat Ramp	11	0.24	0.24	0.21	0.28	0.04	0.32	0.23
Horotiu Bridge	11	0.23	0.22	0.21	0.26	0.03	0.38	0.22
Huntly-Tainui Bridge	11	0.19	0.18	0.14	0.25	0.07	-0.05	0.18
Rangiriri Bridge	11	0.21	0.21	0.13	0.27	0.06	-0.50	0.20
Mercer Bridge	10	0.20	0.20	0.16	0.25	0.05	0.23	0.18
Tuakau Bridge	10	0.21	0.21	0.15	0.26	0.06	-0.19	0.18

Black Disk (m)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	11	5.9	5.8	4.9	7.5	1.3	0.75	5.1
Ohakuri Tailrace Br	11	2.8	2.8	1.5	4.5	1.1	0.59	2.5
Whakamaru Tailrace	11	2.9	2.8	1.6	4.2	1.0	0.17	2.7
Waipapa Tailrace	11	2.7	2.9	1.4	3.4	1.0	-1.08	2.2
Karapiro Tailrace	11	2.0	2.0	1.3	2.8	0.4	0.16	1.9
Narrows Boat Ramp	11	2.0	1.9	1.0	2.8	0.7	-0.38	1.8
Horotiu Bridge	11	1.7	1.7	0.8	2.6	0.8	-0.09	1.5
Huntly-Tainui Bridge	11	1.1	0.9	0.6	1.8	0.7	0.39	0.9
Rangiriri Bridge	11	1.1	1.1	0.5	1.7	0.4	-0.27	0.9
Mercer Bridge	10	0.7	0.7	0.3	1.2	0.5	0.10	0.7
Tuakau Bridge	10	0.8	0.8	0.4	1.2	0.5	0.04	0.7

Biochemical Oxygen Demand 5 day (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.3	0.2	0.2	0.6	0.3	0.67	0.4
Ohaaki Bridge	11	0.4	0.4	0.2	0.7	0.4	0.38	0.6
Ohakuri Tailrace Br	11	0.5	0.5	0.2	1.0	0.5	0.30	0.7
Whakamaru Tailrace	11	0.7	0.7	0.4	1.1	0.2	0.54	0.7
Waipapa Tailrace	11	0.5	0.5	0.2	0.9	0.6	0.19	0.7
Karapiro Tailrace	11	0.7	0.7	0.2	1.0	0.3	-0.53	0.8
Narrows Boat Ramp	11	0.6	0.5	0.2	0.9	0.3	-0.15	0.8
Horotiu Bridge	11	0.6	0.7	0.2	1.0	0.5	-0.37	0.8
Huntly-Tainui Bridge	11	0.7	0.6	0.2	0.9	0.2	-0.93	0.8
Rangiriri Bridge	11	0.7	0.6	0.2	1.3	0.4	0.62	0.7
Mercer Bridge	10	0.7	0.8	0.2	1.2	0.5	-0.36	1.0
Tuakau Bridge	10	0.9	1.0	0.2	1.3	0.5	-0.85	1.0

Dissolved Organic Carbon (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.6	0.6	0.2	1.0	0.2	-0.07	0.6
Ohaaki Bridge	11	0.7	0.7	0.2	1.2	0.5	-0.16	0.7
Ohakuri Tailrace Br	11	0.9	0.8	0.4	1.8	0.5	0.86	0.8
Whakamaru Tailrace	11	0.9	1.0	0.4	1.5	0.3	0.23	0.9
Waipapa Tailrace	11	1.1	1.0	0.6	2.0	0.4	1.44	1.1
Karapiro Tailrace	11	1.1	1.1	0.6	1.6	0.3	0.29	1.1
Narrows Boat Ramp	11	1.3	1.1	0.8	2.9	0.7	2.14	1.2
Horotiu Bridge	11	1.4	1.0	0.7	3.5	0.6	2.49	1.3
Huntly-Tainui Bridge	11	1.7	1.3	0.8	3.9	1.0	1.72	1.6
Rangiriri Bridge	11	1.8	1.3	0.9	5.2	0.9	2.51	1.4
Mercer Bridge	10	1.7	1.4	0.9	2.8	1.0	0.44	1.9
Tuakau Bridge	10	2.0	1.6	0.8	3.9	1.4	0.69	2.3

Total Organic Carbon (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.9	0.7	0.5	2.3	0.5	1.78	0.9
Ohaaki Bridge	11	1.0	0.9	0.6	1.9	0.4	1.63	1.0
Ohakuri Tailrace Br	11	1.4	1.1	0.9	2.5	0.6	1.32	1.2
Whakamaru Tailrace	11	1.4	1.3	0.9	2.1	0.5	0.57	1.3
Waipapa Tailrace	11	1.5	1.5	1.0	2.1	0.4	0.62	1.4
Karapiro Tailrace	11	1.5	1.4	1.2	1.8	0.3	0.82	1.6
Narrows Boat Ramp	11	1.7	1.6	1.2	2.8	0.5	1.65	1.6
Horotiu Bridge	11	1.7	1.5	1.3	2.8	0.3	1.69	1.7
Huntly-Tainui Bridge	11	2.4	2.0	1.4	4.3	1.0	1.17	2.3
Rangiriri Bridge	11	2.4	2.0	1.4	5.3	1.1	1.66	2.2
Mercer Bridge	10	2.5	2.3	1.5	4.0	1.0	0.71	2.8
Tuakau Bridge	10	2.9	2.6	1.6	4.8	1.9	0.53	3.0

Chloride Dissolved (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	8.1	8.2	7.6	8.4	0.2	-1.41	8.1
Ohaaki Bridge	11	15.2	13.3	10.8	26.0	4.4	1.51	12.7
Ohakuri Tailrace Br	11	16.2	16.5	13.6	17.5	1.3	-1.45	15.2
Whakamaru Tailrace	11	16.4	16.3	14.5	19.4	2.0	0.71	15.8
Waipapa Tailrace	11	16.0	16.6	13.2	17.4	1.8	-1.02	14.9
Karapiro Tailrace	11	15.2	15.4	13.4	17.1	1.7	-0.11	14.9
Narrows Boat Ramp	11	15.0	15.5	12.5	17.2	1.9	-0.25	14.4
Horotiu Bridge	11	15.1	14.9	13.7	17.5	1.1	1.00	14.8
Huntly-Tainui Bridge	11	14.8	15.0	12.8	17.4	1.9	0.27	14.4
Rangiriri Bridge	11	15.4	15.7	13.8	17.7	1.5	0.46	15.0
Mercer Bridge	10	15.4	15.8	12.8	17.0	1.3	-1.13	14.7
Tuakau Bridge	10	15.7	15.8	13.6	17.9	1.6	0.07	15.0

Chlorophyll <i>a</i> (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.002	0.002	0.002	0.002	0.000	0.00	0.002
Ohaaki Bridge	11	0.002	0.002	0.002	0.002	0.000	0.00	0.002
Ohakuri Tailrace Br	11	0.003	0.002	0.002	0.010	0.003	1.70	0.002
Whakamaru Tailrace	11	0.003	0.002	0.002	0.010	0.003	1.69	0.003
Waipapa Tailrace	11	0.003	0.002	0.002	0.014	0.000	3.24	0.002
Karapiro Tailrace	11	0.005	0.002	0.002	0.015	0.005	1.46	0.005
Narrows Boat Ramp	11	0.004	0.002	0.002	0.012	0.005	1.48	0.004
Horotiu Bridge	11	0.004	0.002	0.002	0.014	0.005	1.58	0.004
Huntly-Tainui Bridge	11	0.004	0.002	0.002	0.010	0.007	0.74	0.003
Rangiriri Bridge	11	0.004	0.002	0.002	0.012	0.007	0.87	0.006
Mercer Bridge	10	0.005	0.002	0.002	0.016	0.006	1.50	0.005
Tuakau Bridge	10	0.007	0.006	0.002	0.022	0.008	1.20	0.007

Colour (Munsell Colour Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	11	53.0	52.5	45.0	57.5	4.4	-0.84	53.0
Ohakuri Tailrace Br	11	39.5	40.0	32.5	50.0	4.4	0.92	37.5
Whakamaru Tailrace	11	39.8	40.0	35.0	52.5	2.5	2.50	37.5
Waipapa Tailrace	11	40.5	40.0	35.0	52.5	5.0	1.34	37.5
Karapiro Tailrace	11	37.5	37.5	32.5	42.5	3.8	0.00	37.5
Narrows Boat Ramp	11	36.4	37.5	30.0	42.5	6.3	-0.43	35.0
Horotiu Bridge	11	34.8	37.5	27.5	40.0	5.0	-0.87	35.0
Huntly-Tainui Bridge	11	33.2	32.5	25.0	37.5	4.4	-0.88	32.5
Rangiriri Bridge	11	32.0	32.5	27.5	37.5	4.4	0.42	32.5
Mercer Bridge	10	31.0	30.0	27.5	35.0	2.5	0.32	30.0
Tuakau Bridge	10	32.3	31.3	30.0	37.5	5.0	0.86	30.0

Conductivity at 25 degrees Celsius (µS/cm)*								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	119.8	120.0	116.0	124.0	1.8	0.41	119.0
Ohaaki Bridge	11	151.2	141.0	133.0	195.0	23.3	1.37	141.0
Ohakuri Tailrace Br	11	162.3	163.0	151.0	171.0	5.5	-0.62	157.0
Whakamaru Tailrace	11	162.3	164.0	153.0	177.0	11.8	0.38	157.0
Waipapa Tailrace	11	159.0	160.0	144.0	168.0	7.3	-1.07	155.0
Karapiro Tailrace	11	152.9	153.0	143.0	163.0	13.5	-0.03	152.0
Narrows Boat Ramp	11	154.4	152.0	144.0	170.0	13.8	0.51	151.0
Horotiu Bridge	11	154.1	153.0	143.0	166.0	11.8	0.06	152.0
Huntly-Tainui Bridge	11	150.0	146.0	139.0	164.0	18.8	0.19	144.0
Rangiriri Bridge	11	156.7	156.0	144.0	165.0	9.8	-0.61	154.0
Mercer Bridge	10	157.8	158.5	144.0	172.0	14.0	0.01	149.0
Tuakau Bridge	10	160.6	159.5	151.0	171.0	15.0	0.11	152.0

*previous technical reports reported conductivity in mS/m.

Dissolved Oxygen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	9.7	9.7	8.8	10.4	0.8	-0.09	9.8
Ohaaki Bridge	11	9.8	9.8	8.1	12.2	1.8	0.57	9.8
Ohakuri Tailrace Br	11	9.7	9.6	8.3	10.6	1.3	-0.38	10.0
Whakamaru Tailrace	11	9.7	9.5	8.8	10.8	1.0	0.22	9.8
Waipapa Tailrace	11	9.5	9.2	8.6	11.6	1.2	1.33	9.8
Karapiro Tailrace	11	9.6	9.3	8.8	11.3	0.8	1.26	9.6
Narrows Boat Ramp	11	9.3	9.3	8.3	10.8	1.4	0.39	9.7
Horotiu Bridge	11	9.3	9.2	8.0	10.8	1.3	0.41	9.6
Huntly-Tainui Bridge	11	9.3	9.2	8.3	10.5	1.3	0.23	9.4
Rangiriri Bridge	11	9.2	9.0	8.3	10.1	1.3	0.11	9.5
Mercer Bridge	10	9.1	8.9	8.4	10.1	1.4	0.49	9.2
Tuakau Bridge	10	9.3	9.2	8.8	9.9	1.0	0.12	9.5

Dissolved Oxygen (% sat.)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	101.4	101.1	97.0	106.8	5.6	0.34	101.0
Ohaaki Bridge	11	103.3	103.1	93.8	111.3	5.5	-0.37	104.0
Ohakuri Tailrace Br	10	103.5	103.7	93.2	114.5	14.8	-0.10	103.0
Whakamaru Tailrace	11	102.6	102.9	94.1	120.3	10.8	1.08	101.0
Waipapa Tailrace	11	98.9	97.8	93.1	112.2	7.6	1.19	101.0
Karapiro Tailrace	11	98.7	98.2	92.7	108.1	5.9	0.84	98.0
Narrows Boat Ramp	11	95.5	93.7	92.3	104.2	4.0	1.72	95.0
Horotiu Bridge	11	95.4	93.8	91.2	103.9	5.3	1.06	96.0
Huntly-Tainui Bridge	11	95.8	94.9	92.4	100.4	4.7	0.54	95.0
Rangiriri Bridge	11	94.8	94.7	91.0	100.0	4.1	0.59	95.0
Mercer Bridge	10	95.5	94.4	86.5	106.0	5.2	0.53	95.0
Tuakau Bridge	10	98.4	97.8	89.5	106.7	14.6	0.06	96.0

Enterococci (cfu/100ml)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	2	2	1	6	3	0.98	4
Ohaaki Bridge	11	13	7	1	67	10	2.82	10
Ohakuri Tailrace Br	11	2	1	1	6	2	1.42	5
Whakamaru Tailrace	11	7	5	1	20	8	1.23	7
Waipapa Tailrace	11	3	2	1	6	4	0.39	5
Karapiro Tailrace	11	10	8	2	32	9	1.84	8
Narrows Boat Ramp	11	79	39	13	230	140	1.12	40
Horotiu Bridge	11	412	50	25	1600	928	1.27	80
Huntly-Tainui Bridge	11	131	40	16	800	90	2.87	58
Rangiriri Bridge	11	59	42	12	190	53	1.85	45
Mercer Bridge	10	48	30	8	110	97	0.84	35
Tuakau Bridge	10	41	37	7	120	48	1.44	37

Escherichia coli (cfu/100ml)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	6	3	1	24	3	2.09	5
Ohaaki Bridge	11	37	23	12	160	21	2.89	26
Ohakuri Tailrace Br	11	17	6	1	140	5	3.30	5
Whakamaru Tailrace	11	17	6	5	100	7	3.16	10
Waipapa Tailrace	11	9	6	2	40	7	2.75	10
Karapiro Tailrace	11	17	10	7	42	18	1.20	10
Narrows Boat Ramp	11	81	27	20	250	120	1.12	50
Horotiu Bridge	11	322	110	40	1100	498	1.28	110
Huntly-Tainui Bridge	11	386	150	50	2300	210	3.12	150
Rangiriri Bridge	11	225	130	70	1200	70	3.23	130
Mercer Bridge	10	135	105	30	350	178	0.94	120
Tuakau Bridge	10	117	90	20	300	144	0.92	140

Faecal Coliforms (cfu/100ml)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	9	5	1	44	5	2.36	5
Ohaaki Bridge	11	45	33	15	160	27	2.67	38
Ohakuri Tailrace Br	11	17	6	2	140	6	3.29	5
Whakamaru Tailrace	11	28	8	5	180	20	3.12	12
Waipapa Tailrace	11	10	7	2	40	7	2.33	10
Karapiro Tailrace	11	19	17	7	45	19	1.08	10
Narrows Boat Ramp	11	141	80	20	450	137	1.48	70
Horotiu Bridge	11	419	120	50	1800	508	1.83	150
Huntly-Tainui Bridge	11	541	190	50	2700	553	2.62	190
Rangiriri Bridge	11	277	180	110	1200	175	2.90	180
Mercer Bridge	10	188	140	30	570	208	1.41	170
Tuakau Bridge	10	138	110	43	320	150	0.81	150

Lithium (g/m³)

Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.040	0.041	0.038	0.042	0.002	-0.71	0.040
Ohaaki Bridge	11	0.083	0.071	0.057	0.145	0.027	1.51	0.067
Ohakuri Tailrace Br	11	0.098	0.100	0.080	0.111	0.012	-0.53	0.090
Whakamaru Tailrace	11	0.097	0.100	0.086	0.114	0.013	0.58	0.092
Waipapa Tailrace	11	0.087	0.086	0.069	0.102	0.013	-0.20	0.082
Karapiro Tailrace	11	0.080	0.081	0.070	0.091	0.012	0.05	0.078
Narrows Boat Ramp	11	0.080	0.079	0.072	0.090	0.015	0.26	0.074
Horotiu Bridge	11	0.077	0.072	0.070	0.088	0.014	0.47	0.071
Huntly-Tainui Bridge	11	0.062	0.058	0.041	0.082	0.027	-0.10	0.056
Rangiriri Bridge	11	0.067	0.068	0.041	0.087	0.020	-0.51	0.066
Mercer Bridge	10	0.064	0.062	0.049	0.080	0.021	0.25	0.057
Tuakau Bridge	10	0.063	0.063	0.043	0.085	0.023	0.09	0.056

Nitrate-Nitrite Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.001	0.001	0.001	0.001	0.000	0.00	0.001
Ohaaki Bridge	11	0.051	0.050	0.023	0.080	0.034	0.06	0.049
Ohakuri Tailrace Br	11	0.096	0.072	0.015	0.220	0.114	0.50	0.120
Whakamaru Tailrace	11	0.152	0.155	0.027	0.340	0.124	0.73	0.180
Waipapa Tailrace	11	0.242	0.230	0.116	0.400	0.098	0.46	0.250
Karapiro Tailrace	11	0.280	0.310	0.086	0.490	0.217	0.08	0.290
Narrows Boat Ramp	11	0.318	0.330	0.130	0.540	0.252	0.13	0.350
Horotiu Bridge	11	0.328	0.350	0.115	0.540	0.247	-0.10	0.370
Huntly-Tainui Bridge	11	0.432	0.370	0.111	0.770	0.350	0.12	0.440
Rangiriri Bridge	11	0.413	0.370	0.118	0.770	0.355	0.24	0.420
Mercer Bridge	10	0.399	0.370	0.039	0.800	0.447	0.33	0.440
Tuakau Bridge	10	0.387	0.375	0.045	0.760	0.425	0.24	0.430

Ammoniacal Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.005	0.005	0.005	0.005	0.000	0.00	0.005
Ohaaki Bridge	11	0.008	0.005	0.005	0.016	0.006	1.29	0.005
Ohakuri Tailrace Br	11	0.011	0.005	0.005	0.033	0.009	2.08	0.005
Whakamaru Tailrace	11	0.008	0.005	0.005	0.020	0.008	1.29	0.005
Waipapa Tailrace	11	0.023	0.021	0.005	0.051	0.017	0.66	0.019
Karapiro Tailrace	11	0.019	0.014	0.005	0.061	0.016	1.88	0.017
Narrows Boat Ramp	11	0.017	0.016	0.005	0.041	0.013	1.10	0.017
Horotiu Bridge	11	0.019	0.005	0.005	0.083	0.016	2.39	0.013
Huntly-Tainui Bridge	11	0.013	0.005	0.005	0.045	0.014	1.72	0.010
Rangiriri Bridge	11	0.013	0.005	0.005	0.044	0.012	1.76	0.005
Mercer Bridge	10	0.007	0.005	0.005	0.020	0.000	2.21	0.005
Tuakau Bridge	10	0.007	0.005	0.005	0.027	0.000	3.16	0.005

Total Kjeldahl Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.04	0.05	0.03	0.07	0.03	-0.02	0.06
Ohaaki Bridge	11	0.05	0.05	0.03	0.09	0.04	0.08	0.09
Ohakuri Tailrace Br	11	0.08	0.08	0.03	0.12	0.02	-1.00	0.12
Whakamaru Tailrace	11	0.12	0.10	0.07	0.17	0.06	0.56	0.14
Waipapa Tailrace	11	0.12	0.12	0.09	0.14	0.03	-0.33	0.14
Karapiro Tailrace	11	0.15	0.15	0.11	0.20	0.04	0.62	0.16
Narrows Boat Ramp	11	0.15	0.14	0.09	0.26	0.03	1.57	0.17
Horotiu Bridge	11	0.16	0.15	0.09	0.25	0.08	0.60	0.18
Huntly-Tainui Bridge	11	0.19	0.18	0.12	0.34	0.08	1.47	0.23
Rangiriri Bridge	11	0.22	0.18	0.11	0.59	0.07	2.72	0.21
Mercer Bridge	10	0.21	0.21	0.13	0.35	0.07	0.90	0.24
Tuakau Bridge	10	0.25	0.24	0.11	0.38	0.20	0.15	0.29

Total Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.05	0.05	0.03	0.07	0.04	-0.02	0.06
Ohaaki Bridge	11	0.10	0.10	0.07	0.15	0.04	0.34	0.14
Ohakuri Tailrace Br	11	0.18	0.16	0.11	0.30	0.09	0.84	0.23
Whakamaru Tailrace	11	0.27	0.24	0.19	0.45	0.08	1.37	0.32
Waipapa Tailrace	11	0.36	0.34	0.26	0.52	0.13	0.62	0.39
Karapiro Tailrace	11	0.43	0.42	0.24	0.61	0.25	0.08	0.47
Narrows Boat Ramp	11	0.47	0.45	0.27	0.70	0.29	0.22	0.53
Horotiu Bridge	11	0.49	0.46	0.28	0.71	0.26	0.14	0.55
Huntly-Tainui Bridge	11	0.62	0.53	0.26	0.99	0.36	0.22	0.66
Rangiriri Bridge	11	0.63	0.51	0.28	1.25	0.36	0.90	0.62
Mercer Bridge	10	0.61	0.58	0.22	1.00	0.36	0.22	0.67
Tuakau Bridge	10	0.63	0.56	0.27	1.12	0.50	0.57	0.70

pH								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	7.5	7.6	7.0	7.9	0.3	-0.88	7.6
Ohaaki Bridge	11	7.3	7.4	7.0	7.5	0.4	-0.77	7.3
Ohakuri Tailrace Br	11	7.4	7.4	6.9	7.7	0.2	-0.95	7.4
Whakamaru Tailrace	11	7.4	7.5	6.9	7.7	0.4	-0.83	7.5
Waipapa Tailrace	11	7.4	7.4	6.9	7.6	0.2	-1.46	7.4
Karapiro Tailrace	11	7.5	7.5	7.2	7.9	0.2	0.33	7.5
Narrows Boat Ramp	11	7.4	7.4	7.2	7.7	0.2	0.11	7.5
Horotiu Bridge	11	7.5	7.5	7.3	7.8	0.2	0.57	7.5
Huntly-Tainui Bridge	11	7.5	7.5	7.2	7.8	0.3	-0.13	7.4
Rangiriri Bridge	11	7.5	7.5	7.1	7.8	0.4	-0.18	7.6
Mercer Bridge	10	7.5	7.5	7.2	7.9	0.3	0.15	7.5
Tuakau Bridge	10	7.5	7.6	7.0	7.8	0.5	-0.78	7.5

Dissolved Reactive Phosphorus (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.002	0.002	0.002	0.002	0.000	0.00	0.002
Ohaaki Bridge	11	0.006	0.006	0.002	0.010	0.002	-0.54	0.006
Ohakuri Tailrace Br	11	0.008	0.008	0.002	0.014	0.009	-0.06	0.008
Whakamaru Tailrace	11	0.009	0.008	0.002	0.021	0.006	0.74	0.010
Waipapa Tailrace	11	0.017	0.017	0.009	0.026	0.007	0.18	0.014
Karapiro Tailrace	11	0.013	0.011	0.002	0.029	0.011	0.58	0.013
Narrows Boat Ramp	11	0.016	0.015	0.006	0.030	0.007	0.41	0.016
Horotiu Bridge	11	0.018	0.020	0.004	0.027	0.009	-0.83	0.019
Huntly-Tainui Bridge	11	0.017	0.019	0.005	0.023	0.006	-1.35	0.020
Rangiriri Bridge	11	0.018	0.020	0.008	0.027	0.009	-0.21	0.018
Mercer Bridge	10	0.014	0.016	0.002	0.022	0.012	-0.67	0.017
Tuakau Bridge	10	0.011	0.011	0.002	0.021	0.008	-0.19	0.015

Total Phosphorus (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.003	0.002	0.002	0.006	0.003	0.50	0.004
Ohaaki Bridge	11	0.013	0.012	0.008	0.019	0.004	0.70	0.012
Ohakuri Tailrace Br	11	0.020	0.020	0.014	0.023	0.005	-0.43	0.020
Whakamaru Tailrace	11	0.022	0.022	0.016	0.033	0.005	1.20	0.022
Waipapa Tailrace	11	0.028	0.028	0.023	0.034	0.003	0.39	0.027
Karapiro Tailrace	11	0.027	0.026	0.018	0.045	0.007	1.20	0.028
Narrows Boat Ramp	11	0.031	0.029	0.017	0.047	0.016	0.36	0.030
Horotiu Bridge	11	0.037	0.035	0.021	0.065	0.011	1.10	0.035
Huntly-Tainui Bridge	11	0.040	0.040	0.024	0.061	0.010	0.59	0.041
Rangiriri Bridge	11	0.044	0.038	0.026	0.089	0.012	1.71	0.044
Mercer Bridge	10	0.043	0.044	0.029	0.057	0.015	-0.11	0.047
Tuakau Bridge	10	0.041	0.035	0.026	0.060	0.022	0.43	0.046

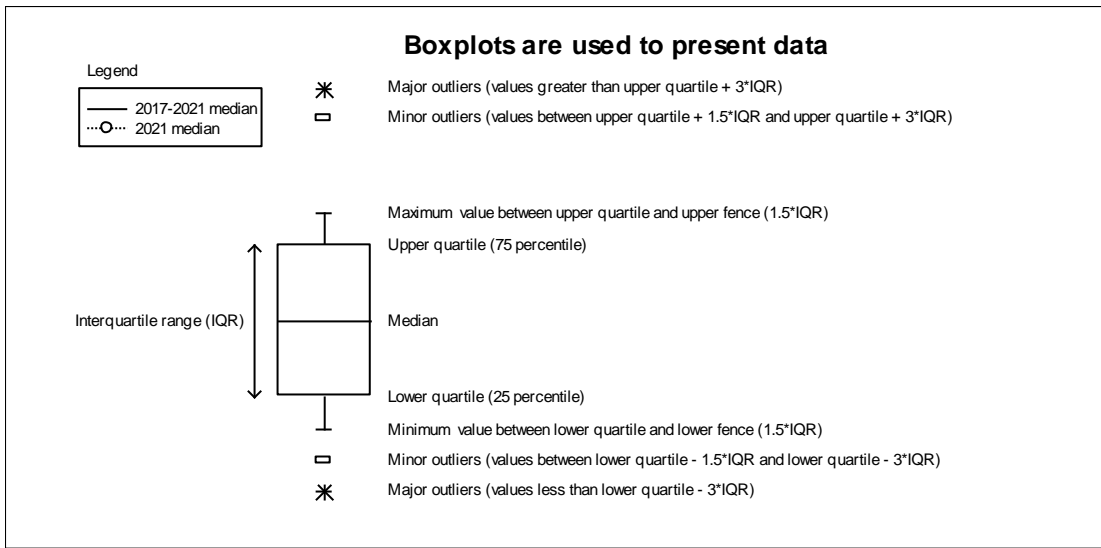
Water Temperature (°C)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	15.7	15.2	11.2	19.9	6.7	-0.12	15.1
Ohaaki Bridge	11	16.5	16.2	10.2	20.7	7.4	-0.34	16.0
Ohakuri Tailrace Br	11	16.7	15.9	11.4	21.9	7.7	-0.03	15.9
Whakamaru Tailrace	11	16.9	16.9	11.6	22.4	8.0	-0.05	16.8
Waipapa Tailrace	11	16.8	16.4	11.7	21.9	7.2	-0.10	16.3
Karapiro Tailrace	11	16.9	16.9	11.5	21.8	8.0	-0.09	16.4
Narrows Boat Ramp	11	16.6	16.7	10.8	21.6	7.8	-0.09	16.1
Horotiu Bridge	11	16.7	16.5	11.2	21.5	8.4	-0.07	16.3
Huntly-Tainui Bridge	11	16.8	15.8	11.2	22.5	9.3	0.03	16.0
Rangiriri Bridge	11	17.1	16.3	11.2	22.6	9.2	-0.07	16.2
Mercer Bridge	10	17.9	18.3	11.5	23.4	9.8	-0.26	17.0
Tuakau Bridge	10	18.3	18.5	11.6	24.6	10.0	-0.13	16.9

Total Dissolved Solids (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	80	82	59	97	13	-0.41	85
Ohaaki Bridge	11	108	103	96	146	11	1.75	102
Ohakuri Tailrace Br	11	119	118	108	132	14	0.26	117
Whakamaru Tailrace	11	122	123	105	138	8	-0.24	122
Waipapa Tailrace	11	122	121	116	130	5	0.63	121
Karapiro Tailrace	11	115	114	95	134	17	0.24	115
Narrows Boat Ramp	11	114	114	87	125	12	-1.50	119
Horotiu Bridge	11	116	119	94	133	13	-0.72	119
Huntly-Tainui Bridge	11	116	115	100	138	11	0.78	113
Rangiriri Bridge	11	118	122	100	126	11	-1.31	121
Mercer Bridge	10	115	117	94	133	9	-0.68	116
Tuakau Bridge	10	122	122	103	136	15	-0.38	118

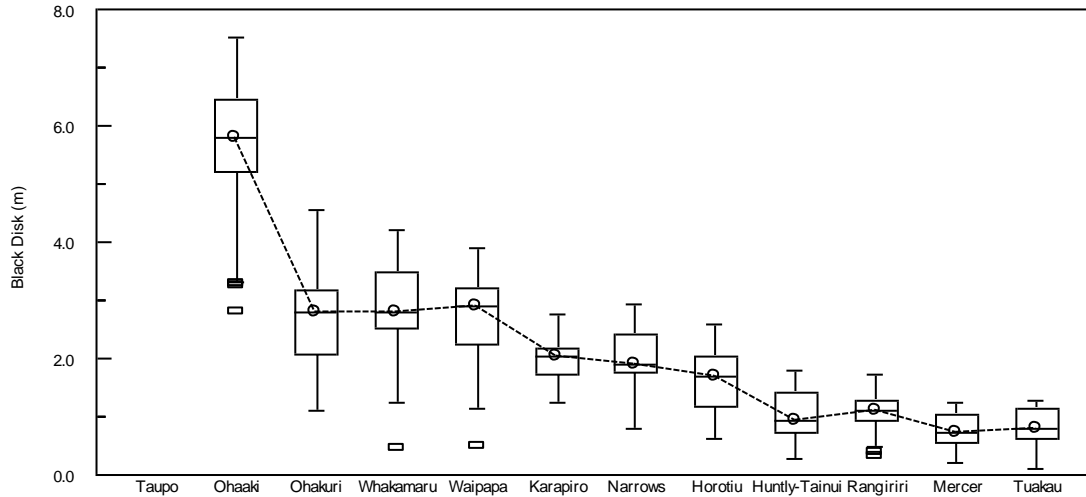
Turbidity (NTU)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5-year median
Taupo Control Gates	11	0.3	0.3	0.2	0.6	0.1	2.15	0.3
Ohaaki Bridge	11	0.5	0.5	0.4	0.9	0.2	1.25	0.7
Ohakuri Tailrace Br	11	0.9	0.7	0.5	1.7	0.7	0.82	1.0
Whakamaru Tailrace	11	1.0	0.8	0.6	2.6	0.3	2.85	1.0
Waipapa Tailrace	11	0.8	0.7	0.4	1.4	0.4	1.12	1.2
Karapiro Tailrace	11	1.5	1.3	0.5	3.3	0.7	1.50	1.5
Narrows Boat Ramp	11	1.8	1.4	0.7	3.9	1.5	1.09	1.9
Horotiu Bridge	11	2.7	1.4	0.9	6.4	3.4	1.06	2.4
Huntly-Tainui Bridge	11	5.4	5.3	1.6	13.4	5.5	1.00	5.4
Rangiriri Bridge	11	6.3	3.5	2.4	18.5	4.0	1.67	5.0
Mercer Bridge	10	6.6	6.1	3.1	13.8	5.8	0.98	7.5
Tuakau Bridge	10	6.2	5.1	2.4	14.1	5.1	1.17	8.2

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

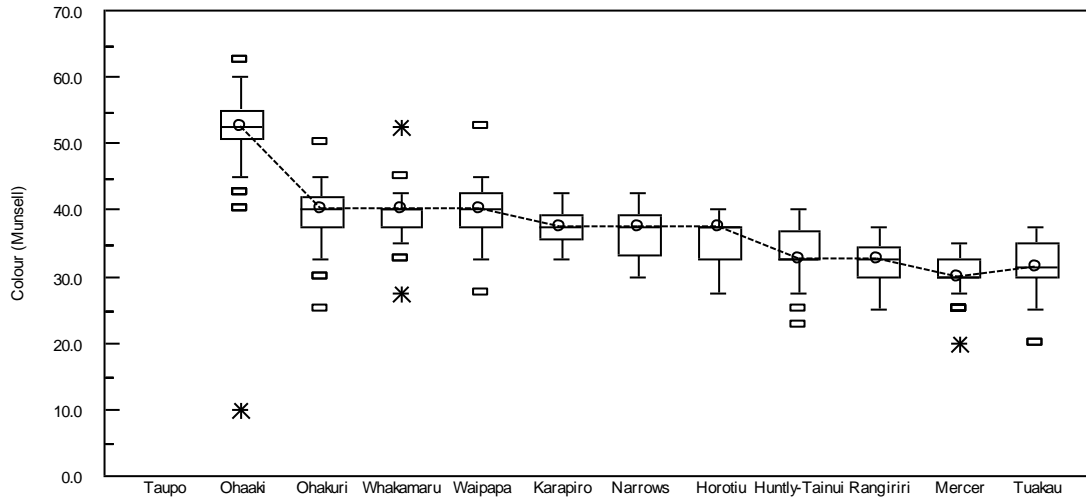
4.2 Key Parameter Boxplots



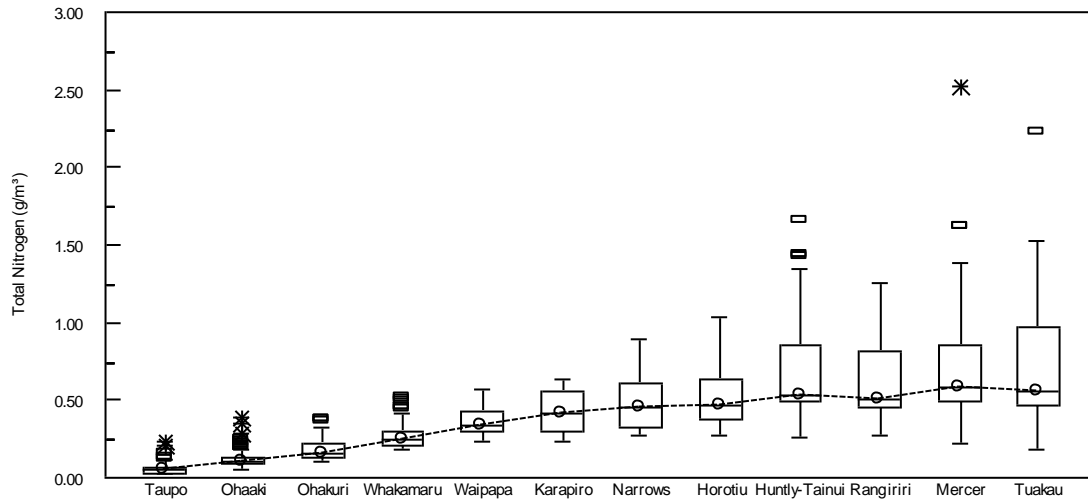
Black Disk, 2017-2021 Data. Dashed line is 2021 median.



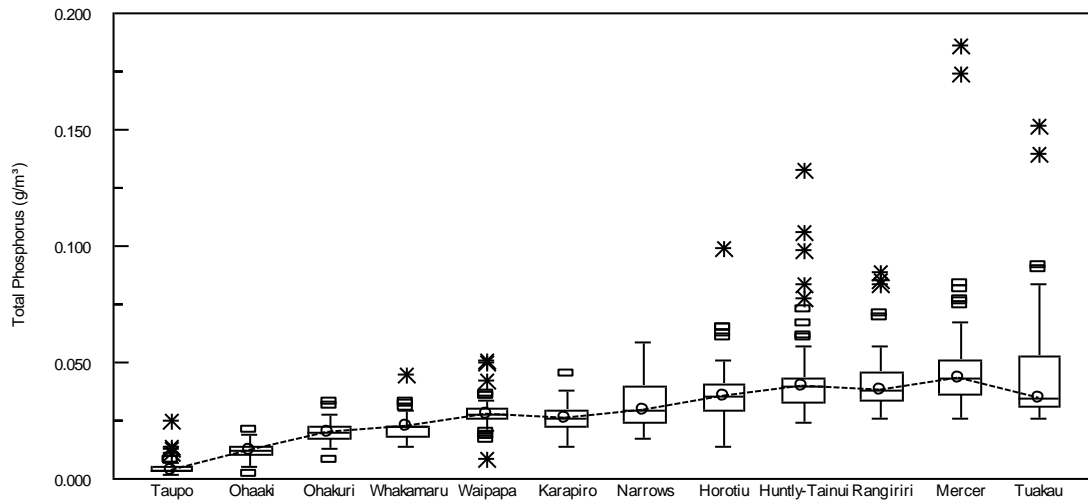
Colour (Munsell), 2017-2021 Data. Dashed line is 2021 median.



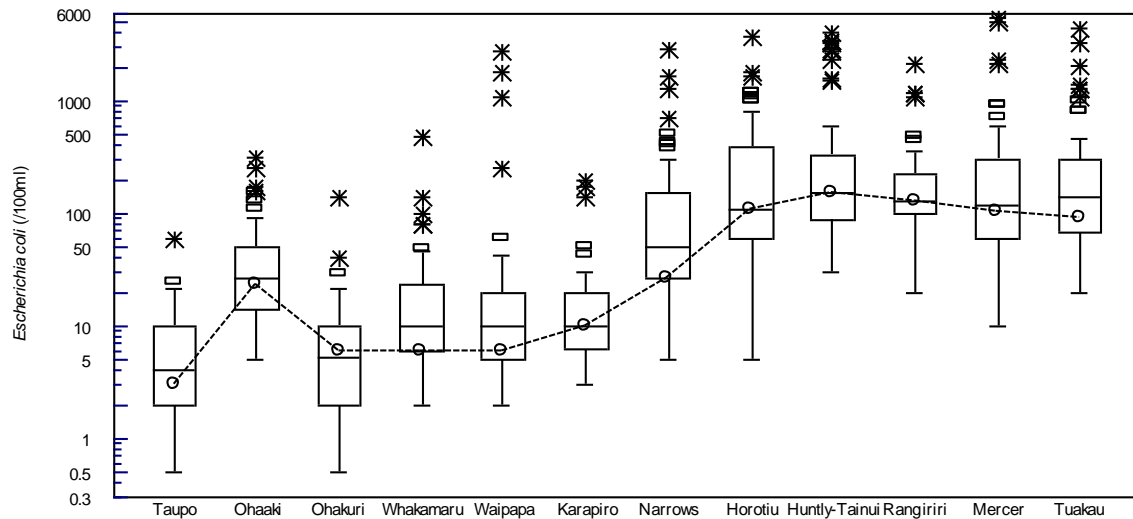
Total Nitrogen, 2017-2021 Data. Dashed line is 2021 median.

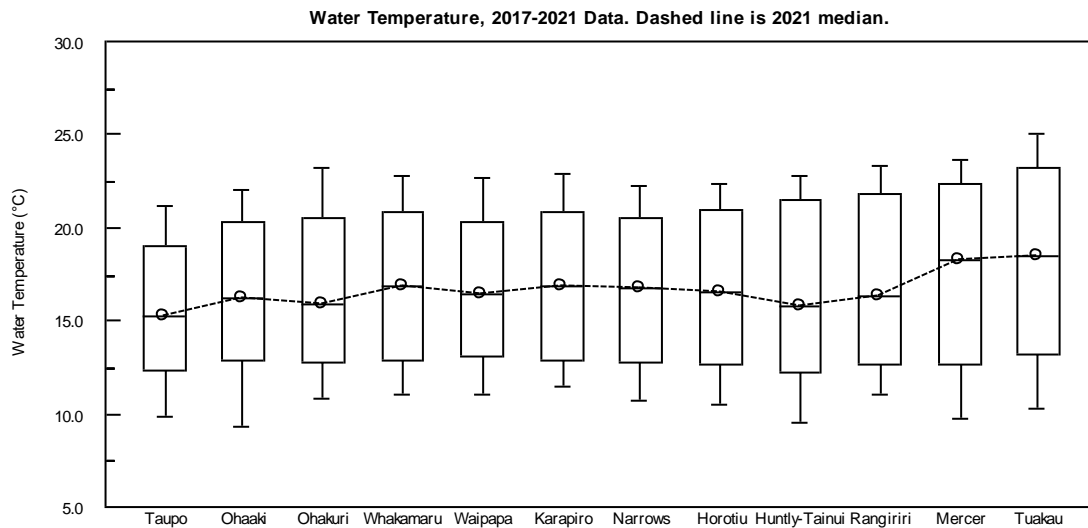
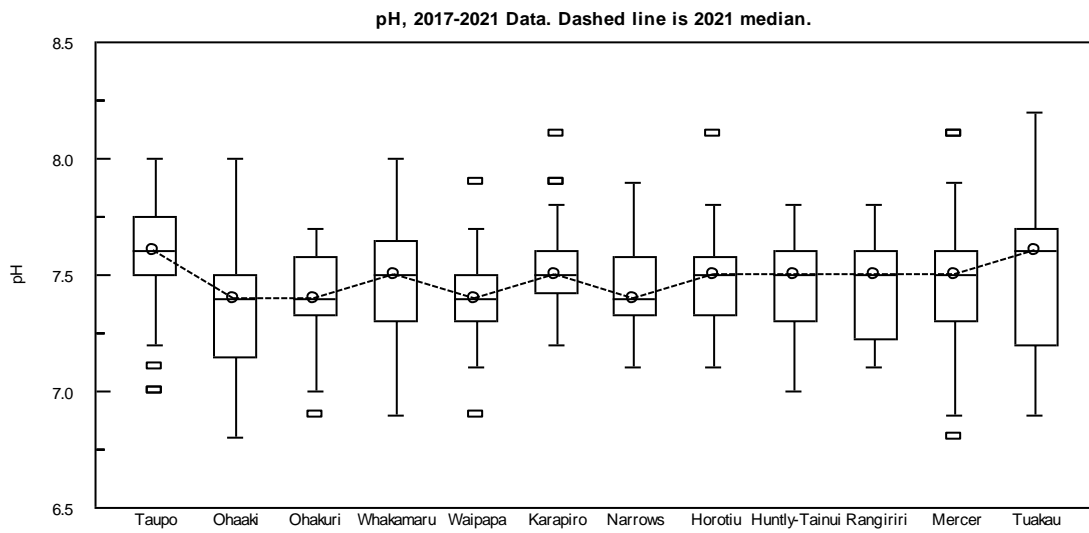
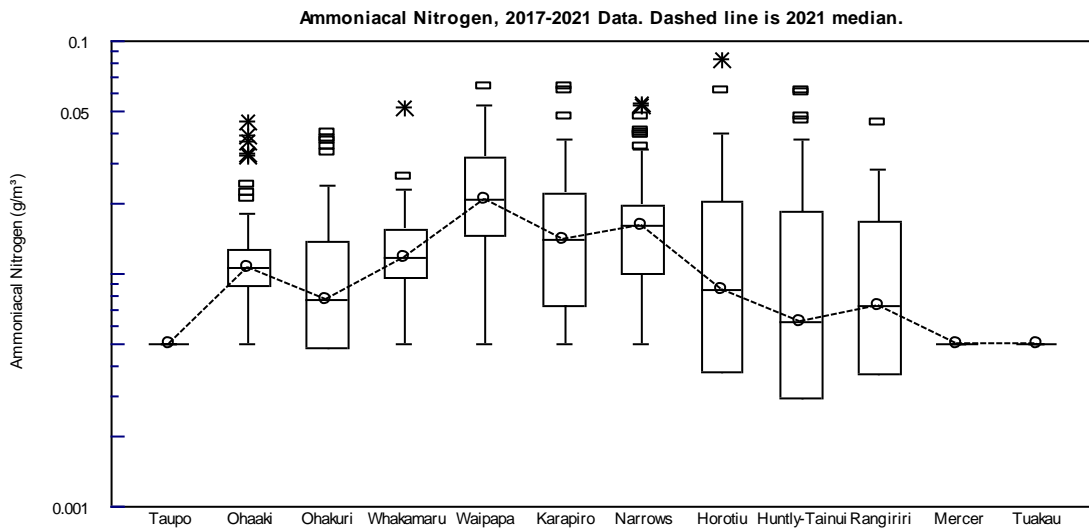


Total Phosphorus, 2017-2021 Data. Dashed line is 2021 median.



Escherichia coli, 2017-2021 Data. Dashed line is 2021 median.





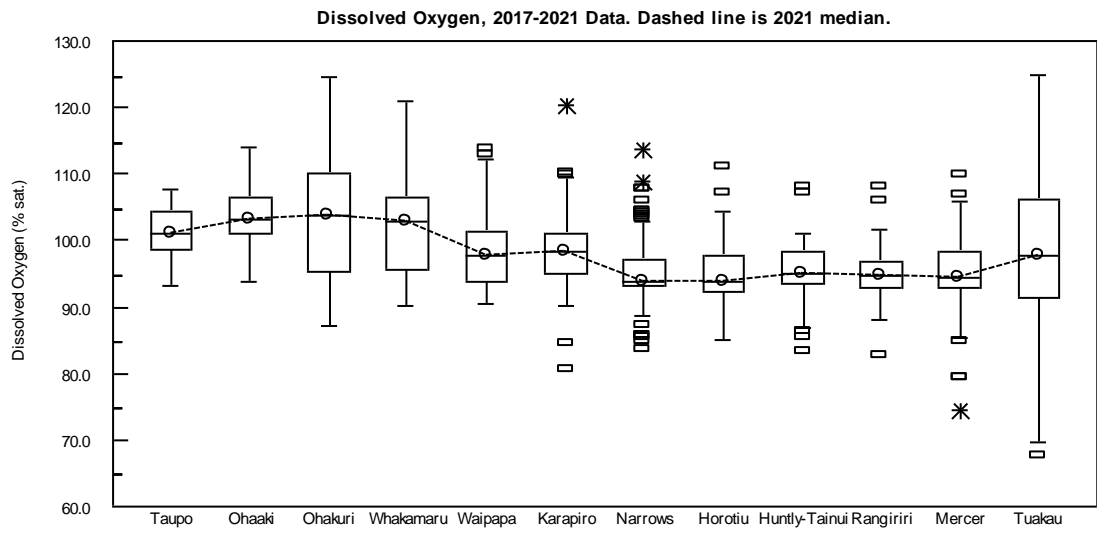
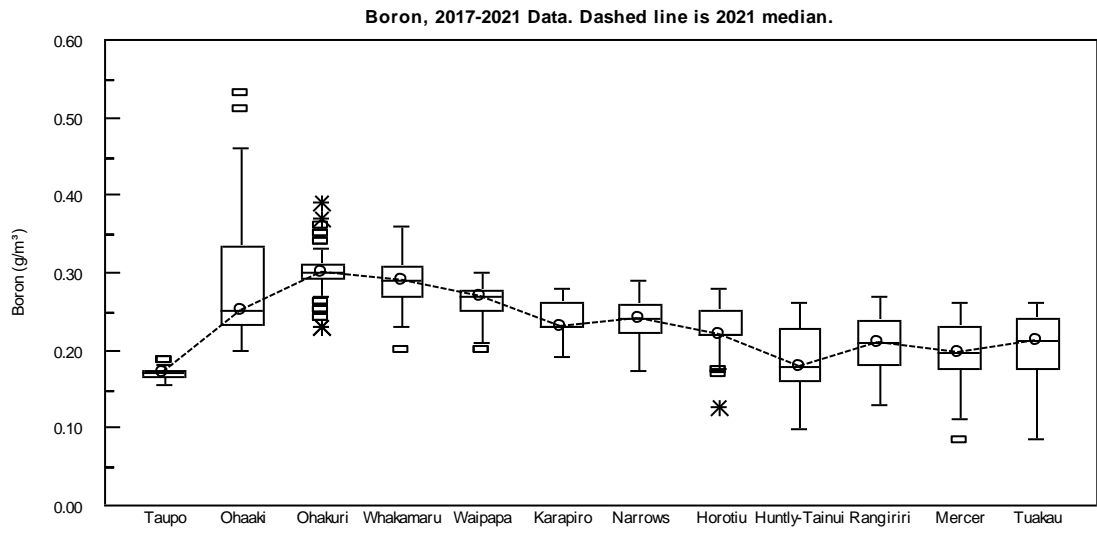
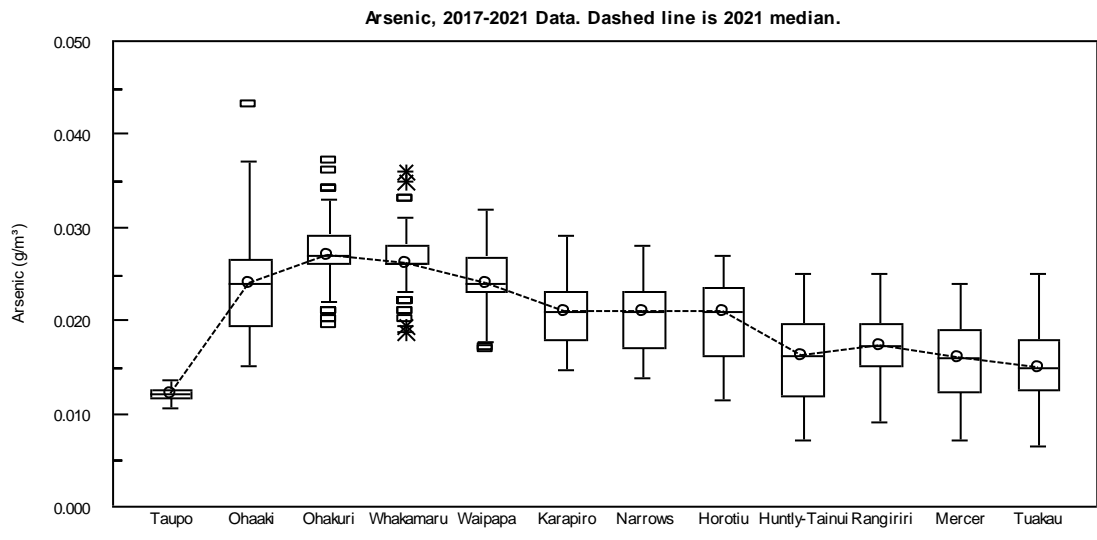


Figure 2: Boxplot graphs for key water quality parameters from 2017-2021

4.3 Comparison with Water Quality Standards

Table 4: Number of monthly samples (2021) complying with the satisfactory water quality guidelines and standards

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

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

Table 5: Number of monthly samples (2021) complying with the excellent water quality guidelines and standards

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

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 standards in the year 2021

Date	Time	Flow	BDisk m	Colour	Cond mS/m	pH	Temp °C	DO g/m ³	DO% sat.	BOD-5d g/m ³	Turb NTU	TDS g/m ³	NNN g/m ³	NH ₄ N* g/m ³	TKN g/m ³
Satisfactory Water Quality			>1.6			6.5-9	<12May-Sep		>80		<5			<0.88	
Guideline/Standard							<20Oct-Apr								
Taupo Control Gates upper decile flow = 264 m ³ /s measured at															
5/1/21	07:48	164	-	-	116.0	7.9	18.3	9.2	101.6	<0.4	0.2	88	0.001	<0.010	0.05
3/2/21	08:18	166	-	-	123.0	7.6	19.9	8.8	101.1	<0.4	0.2	86	0.001	<0.010	0.03
2/3/21	07:46	189	-	-	124.0	7.5	19.3	9.4	106.8	0.6	0.3	75	0.001	<0.010	0.06
6/4/21	09:41	172	-	-	120.0	7.8	18.9	9.2	103.1	0.4	0.6	75	0.001	<0.010	0.06
4/5/21	08:58	177	-	-	120.0	7.6	14.8	9.7	98.7	<0.4	0.2	97	0.001	<0.010	0.07
1/6/21	09:28	65	-	-	119.0	7.8	12.8	9.8	98.7	<0.4	0.3	59	0.001	<0.010	0.06
6/7/21	08:46	176	-	-	118.0	7.5	11.4	10.3	97.0	<0.4	0.2	86	0.001	<0.010	0.03
3/8/21	09:12	239	-	-	118.0	7.0	11.2	10.4	100.4	0.6	0.2	82	0.001	<0.010	0.03
10/9/21	08:58	162	-	-	120.0	7.1	12.2	10.0	98.2	0.4	0.3	73	0.001	<0.010	0.06
2/11/21	08:34	174	-	-	120.0	7.6	15.2	10.1	104.8	0.5	0.3	85	0.001	<0.010	0.03
2/12/21	08:20	179	-	-	120.0	7.5	19.1	9.4	104.7	<0.4	0.3	71	0.001	<0.010	0.03
Ohaaki Br upper decile flow = 264 m ³ /s measured at															
5/1/21	08:38	132	5.1	52.5	188.0	7.0	<u>20.5</u>	8.1	93.8	<0.4	0.9	137	0.080	0.016	0.05
3/2/21	09:02	173	6.0	50.0	133.0	7.5	<u>20.7</u>	8.7	100.9	0.6	0.7	97	0.024	<0.010	0.05
2/3/21	08:38	180	5.6	52.5	133.0	7.4	19.8	9.0	103.1	0.6	0.5	110	0.023	<0.010	0.09
6/4/21	10:23	151	4.9	57.5	144.0	7.5	<u>20.3</u>	8.9	102.2	<0.4	0.6	96	0.049	<0.010	0.08
4/5/21	09:49	112	6.6	50.0	141.0	7.3	15.2	10.2	103.9	<0.4	0.4	103	0.054	<0.010	0.06
1/6/21	10:22	97	6.8	55.0	147.0	7.5	14.6	9.8	100.9	<0.4	0.6	103	0.059	<0.010	0.03
6/7/21	09:36	141	5.5	57.5	140.0	7.4	10.2	12.2	111.3	0.5	0.4	99	0.037	<0.010	0.06
3/8/21	09:54	212	5.8	52.5	138.0	7.0	11.5	11.1	107.1	<0.6	0.5	96	0.036	<0.010	0.05
10/9/21	09:51	78	6.0	55.0	138.0	7.1	12.3	10.9	106.6	0.4	0.4	103	0.050	<0.010	0.03
2/11/21	09:27	162	7.5	55.0	166.0	7.3	16.2	10.1	105.8	0.7	0.6	101	0.074	0.013	0.03
2/12/21	09:13	162	5.1	45.0	195.0	7.5	<u>20.2</u>	8.9	100.6	0.4	0.5	146	0.076	0.016	0.07
Ohakuri Tailrace Br upper decile flow = 347 m ³ /s measured at															
5/1/21	09:29	346	2.0	37.5	168.0	7.5	<u>20.9</u>	9.1	104.9	0.7	1.0	128	0.039	<0.010	0.12
3/2/21	10:02	189	2.9	40.0	155.0	7.6	<u>21.9</u>	9.1	106.8	1.0	0.7	118	0.015	<0.010	0.09
2/3/21	09:26	278	3.3	37.5	151.0	7.4	<u>20.0</u>	9.6	110.0	0.7	0.6	109	0.023	<0.010	0.10
6/4/21	11:37	268	2.8	42.5	160.0	7.4	19.3	8.3	93.2	0.8	0.6	108	0.072	0.014	0.08
4/5/21	10:38	212	3.9	42.5	164.0	7.4	15.4	9.1	-	<0.4	0.5	121	0.118	0.014	0.07
1/6/21	11:11	163	4.5	35.0	171.0	7.6	13.4	9.5	95.2	<0.4	0.5	115	0.155	0.013	0.08
6/7/21	10:23	291	2.9	40.0	166.0	7.3	11.4	10.2	94.9	<0.4	0.8	130	0.220	0.033	0.08
3/8/21	10:50	292	2.6	50.0	164.0	6.9	12.2	10.4	102.2	0.4	0.5	132	0.175	<0.010	0.07
10/9/21	10:38	289	2.3	40.0	163.0	7.1	12.6	10.5	102.5	0.5	1.4	123	0.131	0.012	0.03
2/11/21	10:27	262	1.9	32.5	160.0	7.4	15.9	10.6	110.4	0.6	1.4	114	0.071	<0.010	0.11
2/12/21	09:59	323	<u>1.5</u>	37.5	163.0	7.7	<u>20.7</u>	10.0	114.5	0.4	1.7	112	0.034	<0.010	0.09
Whakamaru Tailrace upper decile flow = 319 m ³ /s measured at															
5/1/21	10:15	184	3.0	40.0	153.0	7.5	<u>21.1</u>	9.1	104.8	0.6	0.8	119	0.073	0.017	0.13
3/2/21	10:52	176	2.7	40.0	156.0	7.7	<u>22.4</u>	10.2	120.3	1.1	0.6	123	0.027	<0.010	0.16
2/3/21	10:04	178	2.8	37.5	156.0	7.5	<u>21.0</u>	9.3	108.3	0.6	0.8	119	0.064	<0.010	0.17
6/4/21	12:38	266	3.8	52.5	155.0	7.3	19.1	8.8	97.3	0.4	0.8	105	0.129	<0.010	0.10
4/5/21	11:34	90	3.7	35.0	167.0	7.5	15.5	9.4	94.9	0.7	0.8	123	0.156	<0.010	0.09
1/6/21	12:00	148	4.2	37.5	171.0	7.7	13.4	9.5	94.1	0.5	0.7	127	0.210	<0.010	0.10
6/7/21	11:08	170	2.9	40.0	177.0	7.3	11.6	10.2	95.1	0.8	0.9	138	0.340	0.016	0.11
3/8/21	11:38	250	2.3	40.0	164.0	6.9	12.3	10.2	99.5	0.8	1.1	125	0.260	<0.010	0.16
10/9/21	11:27	258	1.6	37.5	167.0	7.2	12.7	10.8	104.7	0.8	2.6	127	0.172	<0.010	0.07
2/11/21	11:14	201	2.8	37.5	166.0	7.4	16.9	10.2	107.0	0.8	1.0	122	0.155	<0.010	0.09
2/12/21	11:04	274	2.4	40.0	153.0	7.7	<u>20.3</u>	9.2	102.9	0.6	1.0	114	0.085	0.020	0.10

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance. *value for 1-hour exposure at pH 9

TN g/m ³	DRP g/m ³	TP g/m ³	CL g/m ³	As g/m ³	B g/m ³	Li g/m ³	A340F /cm	A440F /cm	ENT. /100ml	F coli /100ml	E coli /100ml	CHL _a g/m ³	DOC g/m ³	TOC g/m ³
<0.5		<0.04		<0.01	<1.4				<77		<550	<0.02		

Taupo Control Gates

0.05	<0.004	<0.004	7.6	<u>0.011</u>	0.16	0.038	<0.002	<0.002	3	5	4	<0.003	0.6	2.3
0.03	<0.004	0.004	8.3	<u>0.012</u>	0.17	0.041	<0.002	<0.002	1	5	5	<0.003	0.7	0.7
0.06	<0.004	<0.004	7.9	<u>0.012</u>	0.17	0.038	<0.002	<0.002	1	6	4	<0.003	1.0	1.0
0.06	<0.004	<0.004	8.2	<u>0.012</u>	0.17	0.040	<0.002	<0.002	2	3	2	<0.003	0.5	0.8
0.07	<0.004	0.006	8.2	<u>0.012</u>	0.17	0.041	<0.002	<0.002	4	2	2	<0.003	0.4	1.1
0.06	<0.004	0.005	8.0	<u>0.012</u>	0.17	0.040	<0.002	<0.002	4	8	3	<0.003	0.6	1.6
0.03	<0.004	<0.004	8.2	<u>0.013</u>	0.17	0.041	<0.002	<0.002	<1	1	1	<0.003	0.7	0.5
0.03	<0.004	<0.004	8.2	<u>0.012</u>	0.17	0.041	0.002	<0.002	2	3	3	<0.003	0.6	0.7
0.06	<0.004	0.005	8.4	<u>0.014</u>	0.18	0.042	<0.002	<0.002	1	3	3	<0.003	<0.3	0.5
0.03	<0.004	<0.004	8.1	<u>0.012</u>	0.16	0.039	<0.002	<0.002	<1	23	16	<0.003	0.6	0.6
0.03	<0.004	0.006	8.2	<u>0.013</u>	0.17	0.041	<0.002	<0.002	6	44	24	<0.003	0.5	0.6

Ohaaki Br

0.13	0.008	0.017	23.0	<u>0.037</u>	0.46	0.134	0.006	<0.002	14	36	25	<0.003	0.6	1.9
0.07	<0.004	0.009	12.3	<u>0.019</u>	0.22	0.063	0.003	<0.002	20	31	23	<0.003	0.7	1.0
0.11	<0.004	0.012	10.8	<u>0.018</u>	0.21	0.057	<0.002	<0.002	67	160	160	<0.003	1.2	1.1
0.13	0.007	0.012	13.3	<u>0.025</u>	0.25	0.071	0.003	<0.002	2	53	42	<0.003	0.6	0.9
0.11	0.006	0.014	11.1	<u>0.018</u>	0.23	0.061	0.003	<0.002	7	15	12	<0.003	1.0	0.8
0.08	0.006	0.012	14.2	<u>0.024</u>	0.28	0.079	0.003	<0.002	7	38	25	<0.003	0.5	1.0
0.10	0.008	0.010	13.4	<u>0.024</u>	0.26	0.072	0.002	<0.002	2	22	12	<0.003	1.2	1.3
0.09	0.006	0.008	12.7	<u>0.021</u>	0.24	0.069	0.003	<0.002	1	18	16	<0.003	0.9	0.8
0.08	0.005	0.011	12.3	<u>0.020</u>	0.24	0.063	0.004	<0.002	5	24	21	<0.003	<0.3	0.7
0.10	0.007	0.014	17.6	<u>0.027</u>	0.35	0.094	0.004	<0.002	4	60	50	<0.003	0.9	0.6
0.15	0.010	0.019	26.0	<u>0.043</u>	0.44	0.145	0.004	<0.002	9	33	22	<0.003	0.4	0.6

Ohakuri Tailrace Br

0.16	0.005	0.020	16.6	<u>0.032</u>	0.33	0.108	0.006	<0.002	<10	4	2	0.005	1.1	2.1
0.11	<0.004	0.017	15.6	<u>0.029</u>	0.28	0.089	0.004	<0.002	1	2	2	<0.003	0.8	1.1
0.12	<0.004	0.014	13.6	<u>0.025</u>	0.25	0.080	0.004	0.003	<1	3	3	<0.003	1.8	1.6
0.15	0.011	0.019	15.8	<u>0.029</u>	0.30	0.103	0.005	<0.002	2	6	6	<0.003	0.6	1.1
0.19	0.009	0.023	16.4	<u>0.026</u>	0.31	0.103	0.005	<0.002	<1	6	6	<0.003	1.1	1.2
0.24	0.012	0.020	17.5	<u>0.026</u>	0.34	0.111	0.005	<0.002	<1	2	2	<0.003	0.8	2.5
0.30	0.014	0.022	17.2	<u>0.027</u>	0.30	0.100	0.008	<0.002	1	8	8	<0.003	1.5	1.6
0.24	0.012	0.023	16.7	<u>0.025</u>	0.31	0.099	0.006	<0.002	<1	7	7	0.004	0.5	0.9
0.16	0.008	0.018	16.5	<u>0.027</u>	0.30	0.101	0.006	<0.002	1	2	1	0.005	0.4	1.0
0.18	0.006	0.017	15.5	<u>0.027</u>	0.29	0.091	0.008	<0.002	6	140	140	0.004	1.0	1.0
0.12	<0.004	0.023	17.0	<u>0.029</u>	0.30	0.091	0.005	<0.002	3	10	6	0.010	0.7	1.0

Whakamaru Tailrace

0.20	0.008	0.019	14.9	<u>0.028</u>	0.26	0.088	0.006	<0.002	5	7	6	0.004	1.0	1.2
0.19	<0.004	0.016	16.8	<u>0.031</u>	0.27	0.090	0.004	<0.002	20	8	8	<0.003	1.0	1.7
0.23	0.006	0.017	14.5	<u>0.028</u>	0.27	0.088	0.005	<0.002	5	5	5	<0.003	1.5	1.3
0.23	0.015	0.022	15.3	<u>0.026</u>	0.26	0.088	0.007	<0.002	5	8	6	<0.003	1.0	1.3
0.25	0.008	0.022	17.1	<u>0.026</u>	0.29	0.101	0.005	<0.002	5	7	5	<0.003	0.4	1.0
0.31	0.011	0.020	17.0	<u>0.025</u>	0.32	0.114	0.005	<0.002	2	5	5	<0.003	0.7	2.1
0.45	0.021	0.029	19.4	<u>0.030</u>	0.33	0.114	0.011	<0.002	2	19	13	<0.003	1.1	1.7
0.42	0.013	0.033	16.3	<u>0.026</u>	0.30	0.101	0.009	<0.002	1	7	6	0.006	0.8	1.5
0.24	0.008	0.022	17.4	<u>0.025</u>	0.30	0.101	0.007	<0.002	12	30	20	0.010	0.9	1.1
0.24	<0.004	0.018	16.3	<u>0.028</u>	0.31	0.100	0.010	<0.002	1	30	10	0.005	1.0	1.5
0.19	0.008	0.023	15.0	<u>0.026</u>	0.27	0.086	0.007	<0.002	17	180	100	<0.003	0.6	0.9

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

Date	Time	Flow	BDisk m	Colour	Cond mS/m	pH	Temp °C	DO g/m ³	DO% % sat.	BOD-5d g/m ³	Turb NTU	TDS g/m ³	NNN g/m ³	NH ₄ N* g/m ³	TKN g/m ³
Satisfactory Water Quality			>1.6			6.5-9	<12May-Sep		>80		<5			<0.88	
Guideline/Standard							<20Oct-Apr								

Waipapa Tailrace upper decile flow = 371 m³/s measured at

5/1/21	11:04	202	3.1	37.5	144.0	7.4	<u>20.5</u>	8.7	97.8	<0.4	0.6	116	0.197	0.033	0.09
3/2/21	11:28	223	2.9	42.5	160.0	7.5	<u>21.9</u>	9.2	106.3	0.9	0.7	121	0.116	0.019	0.14
2/3/21	11:10	221	3.2	40.0	158.0	7.5	<u>20.9</u>	8.9	101.5	0.6	0.7	119	0.132	0.021	0.13
6/4/21	13:54	139	3.1	45.0	164.0	7.3	19.0	8.8	96.7	<0.4	0.6	121	0.198	0.022	0.14
4/5/21	12:35	162	3.4	42.5	166.0	7.4	16.0	9.2	93.4	<0.4	0.6	125	0.240	0.016	0.10
1/6/21	13:09	316	3.3	52.5	168.0	7.5	13.4	9.5	93.1	0.4	0.7	130	0.300	0.014	0.13
6/7/21	12:08	247	2.7	37.5	162.0	7.3	11.7	10.1	93.3	<0.4	0.8	130	0.400	0.027	0.12
3/8/21	12:30	310	2.7	40.0	148.0	6.9	11.8	10.4	98.7	0.5	0.4	122	0.370	<0.010	0.09
10/9/21	12:31	206	<u>1.4</u>	35.0	163.0	7.2	13.0	11.6	112.2	0.8	1.4	124	0.230	<0.010	0.11
2/11/21	12:11	270	2.1	37.5	160.0	7.4	16.4	9.7	100.7	0.8	1.0	121	0.280	0.040	0.13
2/12/21	12:14	337	2.0	35.0	156.0	7.6	19.7	8.6	94.7	0.6	1.3	118	0.197	0.051	0.11

Karapiro Tailrace upper decile flow = 375 m³/s measured at

6/1/21	07:21	154	2.0	42.5	143.0	7.6	<u>20.9</u>	8.8	98.8	1.0	1.3	115	0.120	0.023	0.17
4/2/21	06:34	176	1.9	37.5	163.0	7.9	<u>21.8</u>	9.1	104.1	0.8	1.1	134	0.086	0.014	0.15
3/3/21	07:05	211	1.7	35.0	160.0	7.5	<u>21.4</u>	8.9	101.5	0.9	1.7	114	0.129	0.012	0.15
7/4/21	07:37	156	2.0	40.0	157.0	7.6	18.6	9.2	98.2	0.7	1.1	107	0.195	0.014	0.15
5/5/21	07:49	155	2.2	37.5	162.0	7.6	15.8	9.5	94.9	0.6	1.0	133	0.310	<0.010	0.11
2/6/21	07:50	151	2.8	40.0	159.0	7.5	13.0	9.8	94.2	0.6	1.0	127	0.340	0.011	0.12
7/7/21	08:32	203	2.7	37.5	153.0	7.4	12.1	9.9	92.7	0.4	1.3	114	0.470	0.019	0.13
4/8/21	07:53	232	2.1	37.5	143.0	7.2	11.5	10.9	97.7	0.5	0.5	95	0.490	<0.010	0.12
17/9/21	09:31	229	<u>1.5</u>	37.5	147.0	7.6	12.8	11.3	108.1	0.8	2.2	109	0.330	<0.010	0.18
3/11/21	07:52	198	<u>1.3</u>	32.5	149.0	7.4	16.9	9.3	95.7	0.7	3.3	115	0.370	0.061	0.20
3/12/21	08:12	242	2.1	35.0	146.0	7.5	<u>20.7</u>	9.0	99.4	<0.4	1.7	103	0.240	0.036	0.13

Narrows Boat Ramp upper decile flow = 375 m³/s measured at

6/1/21	07:49	154	2.4	42.5	145.0	7.6	<u>20.6</u>	8.4	93.1	0.7	1.0	104	0.151	0.019	0.16
4/2/21	07:07	175	2.4	37.5	162.0	7.7	<u>21.6</u>	8.3	93.7	0.7	1.4	125	0.130	0.016	0.14
3/3/21	07:39	210	1.8	35.0	164.0	7.4	<u>21.1</u>	8.3	94.9	0.7	1.6	122	0.158	0.018	0.11
7/4/21	08:22	156	2.5	40.0	158.0	7.6	17.9	8.9	93.6	0.5	1.0	123	0.230	0.015	0.14
5/5/21	08:27	155	2.3	37.5	170.0	7.4	15.5	9.4	93.2	0.5	1.3	121	0.330	0.020	0.13
2/6/21	08:35	151	2.8	40.0	157.0	7.4	12.6	9.9	93.1	<0.4	0.9	119	0.360	0.012	0.09
7/7/21	09:03	206	<u>1.6</u>	30.0	152.0	7.3	12.0	9.9	92.3	0.4	3.2	110	0.500	<0.010	0.12
4/8/21	08:32	232	1.9	37.5	144.0	7.2	10.8	10.6	96.4	0.4	0.7	87	0.540	<0.010	0.13
17/9/21	10:13	227	<u>1.0</u>	30.0	151.0	7.5	13.1	10.8	104.2	0.9	3.9	114	0.440	<0.010	0.26
3/11/21	08:30	196	1.8	37.5	148.0	7.3	16.7	9.3	97.3	0.7	1.9	110	0.390	0.041	0.20
3/12/21	08:55	242	1.8	32.5	147.0	7.5	<u>20.3</u>	9.0	98.6	0.5	2.7	114	0.270	0.026	0.14

Horotiu Br upper decile flow = 364 m³/s measured at

6/1/21	08:30	153	1.8	40.0	146.0	7.6	<u>21.4</u>	8.6	97.0	0.7	1.3	119	0.144	<0.010	0.15
4/2/21	08:01	190	1.7	37.5	163.0	7.8	<u>21.5</u>	8.6	97.8	0.8	1.4	123	0.115	<0.010	0.16
3/3/21	08:33	227	<u>1.1</u>	32.5	153.0	7.5	<u>21.1</u>	8.0	91.2	0.9	<u>6.4</u>	119	0.191	0.021	0.22
7/4/21	09:12	155	2.1	37.5	160.0	7.5	18.2	8.7	92.2	1.0	1.4	116	0.240	<0.010	0.12
5/5/21	09:30	167	2.3	37.5	166.0	7.4	15.8	9.2	92.0	0.4	0.9	133	0.350	0.018	0.11
2/6/21	09:28	158	2.6	37.5	157.0	7.6	12.4	9.9	92.8	<0.4	1.3	124	0.370	<0.010	0.09
7/7/21	09:43	208	<u>0.8</u>	27.5	143.0	7.3	12.0	10.0	93.3	0.5	<u>5.6</u>	105	0.490	0.035	0.15
4/8/21	09:29	222	1.7	37.5	146.0	7.3	11.2	10.6	96.2	0.5	0.9	94	0.540	<0.010	0.12
17/9/21	10:54	218	<u>0.9</u>	27.5	153.0	7.5	13.2	10.8	103.9	0.9	<u>5.5</u>	111	0.460	<0.010	0.25
3/11/21	09:07	227	<u>1.6</u>	35.0	152.0	7.3	16.5	9.2	93.8	0.8	2.2	125	0.420	0.083	0.21
3/12/21	09:37	239	1.7	32.5	156.0	7.5	<u>20.5</u>	9.0	99.6	<0.4	2.4	112	0.290	0.019	0.16

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

*value for 1-hour exposure at pH 9

TN g/m ³	DRP g/m ³	TP g/m ³	CL g/m ³	As g/m ³	B g/m ³	Li g/m ³	A340F /cm	A440F /cm	ENT. /100ml	F coli /100ml	E coli /100ml	CHL _a g/m ³	DOC g/m ³	TOC g/m ³
<0.5		<0.04		<0.01	<1.4				<77		<550	<0.02		

Waipapa Tailrace

0.29	0.017	0.028	13.2	<u>0.024</u>	0.21	0.069	0.009	<0.002	5	8	8	<0.003	1.0	1.5
0.26	0.009	0.026	16.7	<u>0.028</u>	0.25	0.086	0.008	<0.002	1	4	3	<0.003	1.2	1.7
0.26	0.014	0.026	15.2	<u>0.026</u>	0.25	0.083	0.006	<0.002	3	3	3	<0.003	1.3	1.5
0.34	0.020	0.028	16.6	<u>0.026</u>	0.27	0.087	0.009	0.002	<1	4	3	<0.003	0.8	1.5
0.34	0.019	0.030	17.1	<u>0.027</u>	0.29	0.102	0.007	<0.002	5	9	8	<0.003	0.6	1.1
0.43	0.019	0.029	17.0	<u>0.022</u>	0.28	0.098	0.009	0.002	<1	2	2	<0.003	1.2	2.1
<u>0.52</u>	0.026	0.033	17.1	<u>0.023</u>	0.27	0.096	0.016	0.003	2	12	10	<0.003	2.0	2.0
0.46	0.020	0.028	14.2	<u>0.019</u>	0.24	0.080	0.010	0.002	<1	5	5	<0.003	0.8	1.3
0.34	0.010	0.023	17.4	<u>0.023</u>	0.29	0.094	0.009	<0.002	1	7	6	0.014	0.9	1.3
0.41	0.013	0.027	15.7	<u>0.023</u>	0.27	0.083	0.012	0.003	5	40	40	<0.003	1.2	1.2
0.31	0.015	0.034	15.6	<u>0.027</u>	0.26	0.082	0.011	<0.002	6	19	13	0.003	0.8	1.0

Karapiro Tailrace

0.29	0.007	0.022	13.4	<u>0.023</u>	0.23	0.073	0.008	<0.002	11	21	18	0.007	1.2	1.6
0.24	<0.004	0.019	17.1	<u>0.028</u>	0.26	0.086	0.007	<0.002	11	9	8	0.011	0.9	1.8
0.28	0.011	0.018	15.4	<u>0.027</u>	0.23	0.082	0.007	<0.002	5	30	30	<0.003	1.6	1.3
0.35	0.010	0.024	15.9	<u>0.023</u>	0.26	0.087	0.008	<0.002	2	7	7	<0.003	1.0	1.4
0.42	0.015	0.029	15.9	<u>0.021</u>	0.26	0.091	0.009	<0.002	14	21	17	<0.003	0.6	1.4
0.46	0.019	0.026	15.9	<u>0.021</u>	0.26	0.086	0.009	<0.002	4	9	8	<0.003	1.0	1.4
<u>0.60</u>	0.029	0.037	16.0	<u>0.017</u>	0.24	0.081	0.015	0.003	16	30	29	<0.003	0.9	1.8
<u>0.61</u>	0.020	0.029	13.6	<u>0.015</u>	0.20	0.070	0.013	0.003	4	11	10	<0.003	1.2	1.5
<u>0.51</u>	0.006	0.023	14.6	<u>0.017</u>	0.23	0.075	0.010	<0.002	8	17	10	0.015	1.6	1.4
<u>0.57</u>	0.018	<u>0.045</u>	14.8	<u>0.021</u>	0.23	0.077	0.012	0.002	8	45	42	<0.003	1.2	1.3
0.37	0.010	0.028	14.1	<u>0.022</u>	0.23	0.073	0.011	0.002	32	10	10	0.006	1.1	1.2

Narrows Boat Ramp

0.31	0.007	0.017	12.5	<u>0.023</u>	0.23	0.074	0.008	<0.002	39	37	23	0.007	1.1	1.6
0.27	0.006	0.021	17.2	<u>0.026</u>	0.28	0.090	0.008	<0.002	50	27	27	0.007	0.8	1.6
0.27	0.014	0.023	15.5	<u>0.027</u>	0.25	0.082	0.007	<0.002	<u>190</u>	150	150	<0.003	1.2	1.4
0.37	0.014	0.029	16.0	<u>0.023</u>	0.26	0.088	0.009	<0.002	37	120	120	<0.003	1.0	1.6
0.46	0.019	0.028	15.9	<u>0.021</u>	0.25	0.090	0.008	<0.002	13	20	20	<0.003	0.8	1.2
0.45	0.020	0.030	16.0	<u>0.020</u>	0.26	0.086	0.009	0.002	17	32	22	<0.003	0.8	1.6
<u>0.62</u>	0.030	<u>0.043</u>	15.8	<u>0.016</u>	0.24	0.079	0.017	0.004	<u>230</u>	170	160	<0.003	1.6	2.1
<u>0.67</u>	0.023	0.035	13.8	<u>0.015</u>	0.21	0.072	0.015	0.003	16	26	24	<0.003	1.3	2.0
<u>0.70</u>	0.015	<u>0.047</u>	14.0	<u>0.015</u>	0.23	0.072	0.027	0.005	<u>190</u>	440	250	0.012	2.9	2.8
<u>0.59</u>	0.018	<u>0.041</u>	14.1	<u>0.020</u>	0.22	0.074	0.017	0.004	24	450	20	<0.003	1.5	1.5
0.41	0.012	0.027	14.1	<u>0.022</u>	0.22	0.072	0.011	0.002	66	80	80	0.005	0.8	1.4

Horotiu Br

0.29	0.011	0.022	13.7	<u>0.022</u>	0.22	0.070	0.009	<0.002	26	50	40	0.006	1.0	1.4
0.28	0.004	0.021	17.5	<u>0.026</u>	0.26	0.088	0.009	<0.002	32	100	50	0.009	0.9	1.6
0.41	0.016	0.039	14.8	<u>0.026</u>	0.24	0.079	0.011	0.002	<u>1200</u>	1800	<u>1100</u>	<0.003	1.5	1.6
0.36	0.019	0.029	15.9	<u>0.024</u>	0.25	0.084	0.010	0.002	48	80	50	<0.003	1.5	1.4
0.46	0.020	0.034	16.1	<u>0.021</u>	0.25	0.088	0.009	<0.002	60	150	110	<0.003	0.7	1.3
0.46	0.020	0.031	15.3	<u>0.021</u>	0.26	0.085	0.010	<0.002	41	63	42	<0.003	1.0	1.3
<u>0.64</u>	0.024	<u>0.048</u>	14.7	<u>0.015</u>	0.21	0.072	0.018	0.005	<u>1600</u>	600	<u>600</u>	<0.003	1.3	2.8
<u>0.66</u>	0.023	0.038	13.9	<u>0.015</u>	0.22	0.071	0.017	0.005	25	50	50	<0.003	0.9	1.7
<u>0.71</u>	0.027	<u>0.065</u>	14.9	<u>0.015</u>	0.22	0.071	0.031	0.006	<u>250</u>	500	390	0.014	3.5	2.8
<u>0.63</u>	0.020	<u>0.041</u>	14.9	<u>0.019</u>	0.22	0.072	0.019	0.004	50	120	110	<0.003	1.6	1.5
0.45	0.012	0.035	14.6	<u>0.021</u>	0.22	0.070	0.012	0.002	<u>1200</u>	1100	<u>1000</u>	0.006	1.0	1.5

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

Date	Time	Flow	BDisk m	Colour	Cond mS/m	pH	Temp °C	DO g/m ³	DO% % sat.	BOD-5d g/m ³	Turb NTU	TDS g/m ³	NNN g/m ³	NH ₄ N* g/m ³	TKN g/m ³
Satisfactory Water Quality			>1.6			6.5-9	<12May-Sep		>80		<5			<0.88	
Guideline/Standard							<20Oct-Apr								

Huntly-Tainui Br upper decile flow = 536 m³/s measured at

6/1/21	09:09	195	<u>0.8</u>	32.5	140.0	7.6	<u>21.9</u>	8.3	94.9	0.8	<u>13.4</u>	100	0.290	<0.010	0.24
4/2/21	09:29	227	1.6	35.0	163.0	7.8	<u>22.5</u>	8.7	100.4	0.8	2.5	124	0.111	<0.010	0.15
3/3/21	09:06	239	<u>1.4</u>	32.5	157.0	7.7	<u>21.4</u>	8.6	98.3	0.9	2.4	128	0.155	<0.010	0.14
7/4/21	09:47	183	<u>1.3</u>	35.0	159.0	7.6	18.4	8.8	94.0	0.6	2.2	111	0.310	0.014	0.19
5/5/21	10:51	193	1.8	37.5	164.0	7.5	15.5	9.5	94.2	0.5	1.6	138	0.370	0.010	0.12
2/6/21	10:03	180	<u>1.4</u>	37.5	158.0	7.6	11.8	10.0	92.4	0.6	1.8	116	0.430	0.020	0.14
7/7/21	10:27	348	<u>0.7</u>	32.5	145.0	7.3	11.3	10.1	93.3	<0.4	<u>5.5</u>	115	0.670	0.029	0.18
4/8/21	10:04	382	<u>0.9</u>	37.5	140.0	7.2	11.2	10.5	95.5	0.6	<u>5.3</u>	113	0.770	<0.010	0.19
17/9/21	11:27	425	<u>0.7</u>	25.0	139.0	7.3	13.3	10.1	97.8	0.9	<u>8.4</u>	111	0.650	<0.010	0.34
3/11/21	09:50	384	<u>0.6</u>	27.5	139.0	7.2	15.8	9.2	92.8	0.7	<u>10.3</u>	108	0.630	0.045	0.23
3/12/21	10:18	266	<u>0.9</u>	32.5	146.0	7.5	<u>21.5</u>	8.9	99.8	0.6	<u>5.6</u>	115	0.370	<0.010	0.14

Rangiriri Br upper decile flow = 543 m³/s measured at

6/1/21	09:42	216	<u>1.0</u>	32.5	144.0	7.6	<u>22.1</u>	8.3	95.6	1.1	<u>6.3</u>	116	0.220	<0.010	0.22
4/2/21	10:03	243	<u>1.2</u>	30.0	164.0	7.8	<u>22.6</u>	8.5	97.9	0.8	3.5	122	0.118	<0.010	0.16
3/3/21	09:39	253	<u>1.3</u>	32.5	160.0	7.8	<u>22.0</u>	8.4	97.3	0.7	2.7	122	0.150	<0.010	0.15
7/4/21	10:20	198	<u>1.2</u>	32.5	161.0	7.6	19.4	8.6	93.0	0.5	2.6	121	0.330	<0.010	0.16
5/5/21	11:22	213	1.7	35.0	165.0	7.6	16.3	9.4	95.2	0.5	2.4	126	0.370	<0.010	0.11
2/6/21	10:36	197	<u>1.5</u>	37.5	163.0	7.5	12.2	9.9	92.9	0.5	2.7	122	0.430	0.013	0.15
7/7/21	10:53	361	<u>1.1</u>	35.0	156.0	7.3	11.7	10.0	92.7	<0.4	3.0	110	0.620	0.018	0.18
4/8/21	10:35	399	<u>1.0</u>	30.0	152.0	7.2	11.2	10.1	92.6	0.5	<u>5.0</u>	100	0.770	0.013	0.21
17/9/21	12:05	432	<u>0.5</u>	30.0	155.0	7.1	13.8	9.7	94.7	1.3	<u>15.9</u>	124	0.660	0.028	0.59
3/11/21	10:22	402	<u>0.5</u>	27.5	148.0	7.2	16.1	9.0	91.0	0.9	<u>18.5</u>	122	0.550	0.044	0.27
3/12/21	10:49	277	<u>0.9</u>	30.0	156.0	7.5	<u>21.1</u>	9.0	100.0	0.6	<u>6.8</u>	110	0.330	<0.010	0.18

Mercer Br upper decile flow = 626 m³/s measured at

6/1/21	10:09	219	<u>0.6</u>	30.0	144.0	7.7	<u>22.9</u>	8.4	98.2	1.2	<u>13.8</u>	94	0.163	<0.010	0.35
4/2/21	10:28	217	<u>0.8</u>	30.0	165.0	7.9	<u>23.4</u>	9.0	106.0	1.0	3.8	119	0.039	<0.010	0.18
3/3/21	10:10	236	<u>1.2</u>	32.5	157.0	7.6	<u>22.4</u>	8.6	100.1	0.8	3.4	120	0.153	<0.010	0.17
7/4/21	10:42	220	<u>0.7</u>	32.5	172.0	7.5	19.5	8.7	94.6	1.0	<u>6.5</u>	123	0.310	<0.010	0.29
5/5/21	12:03	209	<u>1.0</u>	35.0	167.0	7.6	17.0	9.4	95.8	0.6	3.1	133	0.360	<0.010	0.13
2/6/21	11:03	196	<u>1.1</u>	35.0	161.0	7.5	12.6	9.9	93.6	0.4	3.3	122	0.430	<0.010	0.14
7/7/21	11:19	346	<u>0.3</u>	27.5	160.0	7.3	11.8	10.0	92.7	<0.4	<u>5.7</u>	115	0.740	0.013	0.22
4/8/21	11:01	395	<u>0.6</u>	30.0	153.0	7.2	11.5	10.1	93.0	0.5	<u>7.0</u>	98	0.800	<0.010	0.20
3/11/21	11:09	415	<u>0.4</u>	30.0	148.0	7.2	16.3	8.5	86.5	0.8	<u>9.7</u>	114	0.610	0.020	0.24
3/12/21	11:16	275	<u>0.8</u>	27.5	151.0	7.5	<u>21.2</u>	8.4	94.1	0.9	<u>9.2</u>	113	0.380	<0.010	0.21

Tuakau Br upper decile flow = 626 m³/s measured at

6/1/21	10:38	218	<u>0.5</u>	32.5	152.0	7.8	<u>24.1</u>	8.9	106.7	1.3	<u>9.1</u>	121	0.165	<0.010	0.38
4/2/21	11:02	216	<u>0.8</u>	30.0	171.0	7.8	<u>24.6</u>	8.8	106.1	1.1	2.6	120	0.045	<0.010	0.22
3/3/21	10:40	235	<u>1.1</u>	32.5	159.0	7.6	<u>23.2</u>	8.8	103.9	1.0	4.7	122	0.091	<0.010	0.19
7/4/21	11:12	216	<u>0.8</u>	30.0	169.0	7.6	<u>20.1</u>	8.8	96.5	1.1	<u>5.3</u>	133	0.320	<0.010	0.25
5/5/21	12:30	207	<u>1.1</u>	35.0	168.0	7.7	16.9	9.7	99.0	<0.4	2.4	136	0.360	<0.010	0.11
2/6/21	11:32	195	<u>1.2</u>	35.0	168.0	7.7	13.2	9.8	93.2	0.6	3.3	132	0.410	<0.010	0.16
7/7/21	11:47	348	<u>0.7</u>	37.5	160.0	7.0	11.6	9.9	91.5	0.5	<u>7.2</u>	122	0.740	0.027	0.29
4/8/21	11:30	395	<u>0.6</u>	30.0	155.0	7.1	11.8	9.8	90.7	0.8	<u>8.4</u>	103	0.760	<0.010	0.36
3/11/21	11:27	416	<u>0.4</u>	30.0	151.0	7.2	16.2	8.8	89.5	1.2	<u>14.1</u>	115	0.590	<0.010	0.38
3/12/21	11:36	278	<u>0.8</u>	30.0	153.0	7.5	<u>21.3</u>	9.5	106.5	1.0	4.9	117	0.390	<0.010	0.13

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

*value for 1-hour exposure at pH 9

TN g/m ³	DRP g/m ³	TP g/m ³	CL g/m ³	As g/m ³	B g/m ³	Li g/m ³	A340F /cm	A440F /cm	ENT. /100ml	F coli /100ml	E coli /100ml	CHL _a g/m ³	DOC g/m ³	TOC g/m ³
<0.5		<0.04		<0.01	<1.4				<77		<550	<0.02		

Huntly-Tainui Br

<u>0.53</u>	0.015	<u>0.044</u>	12.8	<u>0.016</u>	0.18	0.056	0.022	0.005	28	160	120	0.008	1.6	2.7
0.26	0.005	0.024	17.4	<u>0.024</u>	0.25	0.082	0.010	0.002	40	900	400	0.010	1.0	1.7
0.30	0.015	0.026	15.6	<u>0.024</u>	0.23	0.076	0.010	0.002	<u>240</u>	800	300	<0.003	1.6	1.4
<u>0.50</u>	0.018	0.036	16.0	<u>0.020</u>	0.23	0.076	0.015	0.003	41	190	150	<0.003	1.2	1.9
0.49	0.021	0.037	15.6	<u>0.019</u>	0.22	0.075	0.012	0.002	34	120	70	<0.003	0.8	1.7
<u>0.57</u>	0.023	0.032	15.6	<u>0.016</u>	0.22	0.071	0.014	0.003	52	50	50	<0.003	1.3	1.7
<u>0.85</u>	0.023	<u>0.040</u>	15.0	<u>0.013</u>	0.17	0.058	0.005	<0.002	<u>140</u>	390	330	<0.003	1.0	4.3
<u>0.96</u>	0.019	<u>0.040</u>	13.7	<u>0.010</u>	0.16	0.046	0.021	0.004	30	140	110	<0.003	2.1	2.7
<u>0.99</u>	0.019	<u>0.061</u>	13.7	0.009	0.14	0.041	0.043	0.008	<u>800</u>	2700	<u>2300</u>	0.009	3.9	3.8
<u>0.86</u>	0.020	<u>0.054</u>	13.4	<u>0.012</u>	0.14	0.044	0.034	0.007	16	310	290	<0.003	2.6	2.4
<u>0.51</u>	0.013	<u>0.041</u>	14.3	<u>0.017</u>	0.18	0.056	0.019	0.003	25	190	130	0.008	1.1	2.0

Rangiriri Br

0.44	0.014	0.038	13.8	<u>0.017</u>	0.20	0.059	0.019	0.006	12	110	90	0.009	1.5	2.1
0.28	0.008	0.026	17.7	<u>0.023</u>	0.27	0.087	0.009	<0.002	30	300	140	0.008	0.9	1.8
0.30	0.013	0.028	15.7	<u>0.025</u>	0.24	0.078	0.008	<0.002	<u>110</u>	110	100	<0.003	1.0	1.4
0.49	0.018	0.038	16.3	<u>0.020</u>	0.25	0.079	0.014	0.003	48	210	130	<0.003	1.2	1.8
0.48	0.021	0.033	15.9	<u>0.019</u>	0.23	0.078	0.012	0.002	47	110	70	<0.003	1.2	1.5
<u>0.58</u>	0.021	0.035	16.0	<u>0.016</u>	0.23	0.073	0.015	0.002	42	120	100	<0.003	1.3	1.7
<u>0.80</u>	0.027	<u>0.044</u>	15.8	<u>0.015</u>	0.21	0.068	0.019	0.004	<u>90</u>	180	170	<0.003	1.4	2.2
<u>0.98</u>	0.020	<u>0.046</u>	14.5	<u>0.012</u>	0.17	0.055	0.025	0.005	31	110	100	<0.003	2.1	3.0
<u>1.25</u>	0.027	<u>0.089</u>	15.0	0.009	0.13	0.041	0.063	0.012	<u>190</u>	1200	<u>1200</u>	0.012	5.2	5.3
<u>0.82</u>	0.023	<u>0.069</u>	14.5	<u>0.017</u>	0.18	0.058	0.034	0.007	26	360	200	<0.003	2.5	4.1
<u>0.51</u>	0.011	<u>0.040</u>	14.0	<u>0.018</u>	0.20	0.065	0.016	0.003	25	240	170	0.009	1.0	2.0

Mercer Br

<u>0.51</u>	0.008	<u>0.051</u>	12.8	<u>0.015</u>	0.19	0.055	0.023	0.004	35	310	240	0.016	2.2	4.0
0.22	<0.004	0.037	17.0	<u>0.024</u>	0.25	0.080	0.011	0.002	8	30	30	0.016	0.9	2.0
0.32	0.014	0.030	15.9	<u>0.024</u>	0.23	0.075	0.009	<0.002	<u>110</u>	240	120	<0.003	0.9	1.5
<u>0.60</u>	<0.004	0.036	15.7	<u>0.019</u>	0.24	0.070	0.015	0.003	<u>110</u>	170	160	<0.003	1.4	2.8
0.49	0.021	0.038	16.1	<u>0.018</u>	0.22	0.078	0.012	0.002	15	52	42	<0.003	1.2	1.6
<u>0.57</u>	0.019	0.029	16.0	<u>0.016</u>	0.21	0.065	0.016	0.003	24	110	70	<0.003	1.4	1.9
<u>0.96</u>	0.022	<u>0.051</u>	15.9	<u>0.012</u>	0.18	0.058	0.026	0.005	<u>110</u>	570	350	<0.003	2.4	2.2
<u>1.00</u>	0.020	<u>0.049</u>	14.7	<u>0.011</u>	0.16	0.049	0.026	0.005	40	110	90	<0.003	2.2	2.9
<u>0.85</u>	0.018	<u>0.057</u>	14.3	<u>0.012</u>	0.16	0.052	0.036	0.007	13	260	220	<0.003	2.8	3.7
<u>0.59</u>	0.012	<u>0.050</u>	15.3	<u>0.016</u>	0.18	0.054	0.022	0.004	11	32	32	0.007	1.4	2.4

Tuakau Br

<u>0.55</u>	0.008	<u>0.053</u>	13.6	<u>0.014</u>	0.18	0.053	0.027	0.005	25	200	140	<u>0.022</u>	2.4	3.8
0.27	<0.004	0.028	17.9	<u>0.023</u>	0.26	0.085	0.010	<0.002	8	50	20	0.017	0.8	1.8
0.28	0.012	0.026	15.7	<u>0.025</u>	0.24	0.076	0.009	0.002	60	120	90	0.008	0.8	1.6
<u>0.57</u>	<0.004	0.032	16.6	<u>0.017</u>	0.25	0.071	0.016	0.003	36	90	90	<0.003	1.8	2.8
0.47	0.016	0.032	15.8	<u>0.018</u>	0.23	0.076	0.012	0.002	7	48	27	<0.003	1.4	1.9
<u>0.57</u>	0.017	0.031	16.2	<u>0.015</u>	0.23	0.067	0.016	0.003	12	43	36	<0.003	1.5	2.0
<u>1.03</u>	0.021	<u>0.058</u>	16.4	<u>0.013</u>	0.19	0.058	0.035	0.006	65	200	180	<0.003	2.8	3.8
<u>1.12</u>	0.016	<u>0.052</u>	14.8	<u>0.011</u>	0.17	0.049	0.035	0.007	37	100	80	0.003	2.8	3.6
<u>0.97</u>	0.009	<u>0.060</u>	14.5	<u>0.011</u>	0.15	0.043	0.050	0.009	38	320	300	0.009	3.9	4.8
<u>0.52</u>	0.010	0.037	15.3	<u>0.014</u>	0.18	0.055	0.027	0.005	<u>120</u>	210	210	0.008	1.5	2.4

Time is New Zealand standard time 24 h clock. < means less than value stated. Underlined bold values do not comply with "satisfactory" water quality standards. Bracketed black disk measurements were carried out at flows above the upper decile and were not assessed for compliance.

4.4 Trace Metal Summary Data

Table 7: Five yearly trace metals raw data summary

Date, Time (dd/mm/yy, hh:mm)	Al TR g/m ³	As T g/m ³	B TR g/m ³	Cd TR g/m ³	Co TR g/m ³	Cr TR g/m ³	Cu TR g/m ³	Fe Diss g/m ³	Fe TR g/m ³	Hg T g/m ³	Li TR g/m ³	Mn Diss g/m ³	Mn TR g/m ³	Mo TR g/m ³	Ni TR g/m ³	Pb TR g/m ³	Sb TR g/m ³	Tl TR g/m ³	UTR g/m ³	Zn TR g/m ³	ZnDiss g/m ³
1131-127																					
Waikato River at Taupo Control Gates																					
2/6/2020 9:05:00	< 0.003	0.0129	0.178	< 0.000011	< 0.00004	< 0.0006	< 0.0002	< 0.005	< 0.006	< 0.00002	0.043	0.0002	0.0009	0.00023	< 0.0004	< 0.00006	0.00021	< 0.000011	< 0.00003	< 0.0005	< 0.0005
10/8/2020 8:53:00	< 0.003	0.0134	0.173	< 0.000011	< 0.00004	< 0.0006	< 0.0002	< 0.005	< 0.006	< 0.00002	0.04	0.0003	0.0008	0.00023	< 0.0004	< 0.00006	0.00021	< 0.000011	< 0.00003	< 0.0005	< 0.0005
3/11/2020 8:41:00	< 0.003	0.0127	0.169	< 0.000011	< 0.00004	< 0.0006	0.0007	< 0.005	< 0.006	< 0.00002	0.039	0.0008	0.0012	0.00023	< 0.0004	< 0.00006	0.0002	< 0.000011	< 0.00003	0.0029	0.002
3/2/2021 8:19:00	< 0.003	0.0125	0.178	< 0.000011	< 0.00004	< 0.0006	< 0.0002	< 0.005	< 0.006	< 0.00002	0.042	< 0.0002	0.0009	0.00023	< 0.0004	< 0.00006	0.00023	< 0.000011	< 0.00003	0.0024	0.0021
1131-107																					
Waikato River at Ohakuri Tailrace Bridge																					
2/6/2020 11:01:00	0.014	0.027	0.32	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.044	0.094	< 0.00002	0.099	0.0043	0.0085	0.0004	< 0.0004	< 0.00006	0.00078	0.000021	< 0.00003	0.0011	0.0008
10/8/2020 10:52:00	0.02	0.024	0.27	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.039	0.097	< 0.00002	0.082	0.0077	0.0109	0.00038	< 0.0004	< 0.00006	0.00067	0.000021	< 0.00003	0.0009	0.0006
3/11/2020 10:46:00	0.015	0.035	0.38	< 0.000011	< 0.00004	< 0.0006	0.0008	0.049	0.127	< 0.00002	0.127	0.0004	0.0121	0.00048	< 0.0004	0.00005	0.00106	0.000033	< 0.00003	0.0028	0.0016
3/2/2021 10:03:00	0.011	0.03	0.29	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.04	0.069	< 0.00002	0.096	0.0003	0.0061	0.00045	< 0.0004	0.00027	0.00085	0.000026	< 0.00003	0.0023	0.0016
1131-328																					
Waikato River at Narrows Boat Ramp																					
19/5/2020 9:15:00	0.036	0.022	0.25	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.035	0.122	< 0.00002	0.085	0.0012	0.02	0.00046	< 0.0004	< 0.00006	0.00065	0.000019	< 0.00003	< 0.0005	< 0.0005
3/8/2020 9:10:00	0.043	0.0176	0.23	< 0.000011	< 0.00004	< 0.0006	0.0004	0.06	0.15	< 0.00002	0.075	0.0044	0.0159	0.00037	< 0.0004	0.00006	0.00059	0.000017	< 0.00003	0.002	0.0015
4/11/2020 7:57:00	0.028	0.021	0.25	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.044	0.125	< 0.00002	0.082	0.0016	0.02	0.00036	< 0.0004	< 0.00006	0.00063	0.000019	< 0.00003	0.0005	< 0.0005
4/2/2021 7:08:00	0.019	0.027	0.28	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.022	0.07	< 0.00002	0.092	0.0003	0.0126	0.00047	< 0.0004	< 0.00006	0.00077	0.000021	< 0.00003	< 0.0005	< 0.0005
1131-69																					
Waikato River at Horoitu Bridge																					
19/5/2020 10:06:00	0.062	0.022	0.26	< 0.000011	0.00006	< 0.0006	< 0.0002	0.04	0.2	< 0.00002	0.087	0.0015	0.032	0.00044	< 0.0004	0.00008	0.00064	0.000017	< 0.00003	0.0007	< 0.0005
3/8/2020 9:50:00	0.048	0.0177	0.23	< 0.000011	0.00004	< 0.0006	< 0.0002	0.062	0.165	< 0.00002	0.075	0.0036	0.0176	0.00039	< 0.0004	< 0.00006	0.00061	0.000017	< 0.00003	0.0011	0.0007
4/11/2020 8:45:00	0.037	0.02	0.25	< 0.000011	0.00004	< 0.0006	< 0.0002	0.05	0.177	< 0.00002	0.084	0.0015	0.023	0.00036	< 0.0004	< 0.00006	0.00061	0.000020	< 0.00003	0.0009	< 0.0005
4/2/2021 8:02:00	0.022	0.027	0.28	< 0.000011	< 0.00004	< 0.0006	< 0.0002	0.025	0.088	< 0.00002	0.094	0.0003	0.0148	0.00044	< 0.0004	< 0.00006	0.00076	0.000023	< 0.00003	< 0.0005	< 0.0005
1131-133																					
Waikato River at Tuakau Bridge																					
19/5/2020 12:24:00	0.07	0.0182	0.24	< 0.000011	0.00008	< 0.0006	0.0002	0.076	0.26	< 0.00002	0.076	0.0032	0.031	0.00043	< 0.0004	0.00008	0.00056	0.000020	< 0.00003	0.0009	< 0.0005
3/8/2020 11:56:00	0.185	0.0118	0.185	< 0.000011	0.00031	< 0.0006	0.0005	0.2	0.55	< 0.00002	0.055	0.044	0.072	0.00029	< 0.0004	0.00016	0.00044	0.000021	0.00002	0.0026	0.0013
4/11/2020 10:59:00	0.117	0.0133	0.197	< 0.000011	0.00013	< 0.0006	0.0005	0.144	0.41	< 0.00002	0.06	0.0158	0.039	0.0003	< 0.0004	0.00018	0.00042	0.000020	0.00002	0.003	0.0013
4/2/2021 11:03:00	0.104	0.024	0.27	< 0.000011	0.00011	< 0.0006	0.0003	0.041	0.25	< 0.00002	0.086	0.0006	0.037	0.00045	< 0.0004	0.00015	0.00068	0.000026	< 0.00003	0.0016	< 0.0005

References

Bates N 2021. Waikato River water quality monitoring programme: Data report 2020. Waikato Regional Council Technical Report 2021/23. Hamilton, Waikato Regional Council.

Ministry of Health 2018. Drinking water standards. Rev. ed. Wellington, Ministry of Health. [Drinking-water Standards for New Zealand 2005 \(Revised 2018\) | Ministry of Health NZ](#) [Accessed 01 September 2021].

Tulagi A 2018. Waikato River water quality monitoring programme: data report 2017. Waikato Regional Council Technical Report 2018/24. Hamilton, Waikato Regional Council.

Vant B 2018. Trends in River Water Quality in the Waikato Region, 1993–2017. Waikato Regional Council Technical Report 2018/30, Hamilton, Waikato Regional Council.

Tulagi A 2016. Waikato River water Quality Monitoring Programme: Data report 2015. Waikato Regional Council Technical Report 2016/33. Hamilton, Waikato Regional Council.

Appendix I

Flow Information

Table 8: Median flows for the Waikato River and main tributaries from 2012 - 2021

Location	DISTANCE km	FLOW RATE+ (m ³ /s)										10 YEAR Median
		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	
Taupo	4.2	194	93	99	104	117	204	190	97	93	89	119
Ohakuri	75.8	229	163	164	184	191	282	232	170	163	163	178
Whakamaru	105.0	236	168	167	189	212	258	242	170	168	169	178
Waipapa	126.1	245	175	171	186	207	280	240	186	178	178	194
Karapiro	166.7	-	-	-	-	-	-	250	186	163	175	205
Hamilton	211.5	261	177	194	201	223	319	270	202	185	191	215
Huntly	246.5	346	263	259	298	285	439	341	254	231	244	292
Rangiriri	262.3	-	-	-	-	-	-	353	268	241	261	290
Mercer	286.3	358	286	280	303	314	504	359	275	257	268	308
Waiotapu Stream	46.6	3	2	2	3	3	5	4	3	3	3	3
Waipa River	232.7	62	47	55	53	60	85	58	37	44	35	53

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

+Historical flow data updated due to rating changes from updated data received.

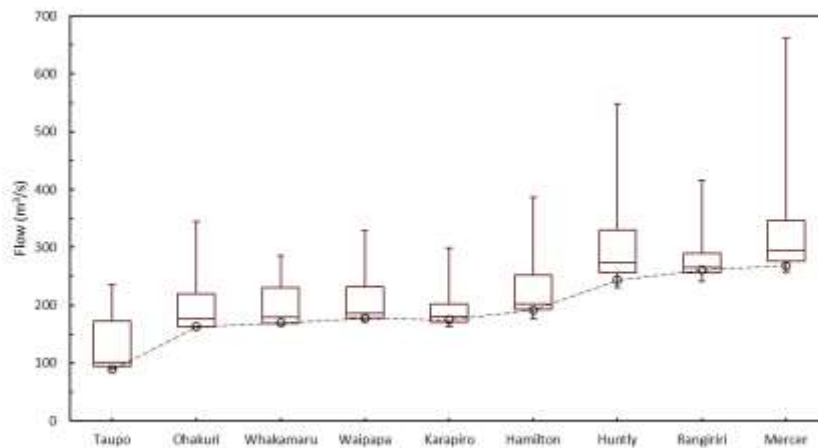


Figure 3: Waikato River flow boxplot from 2012-2021 with 2021 median trend line

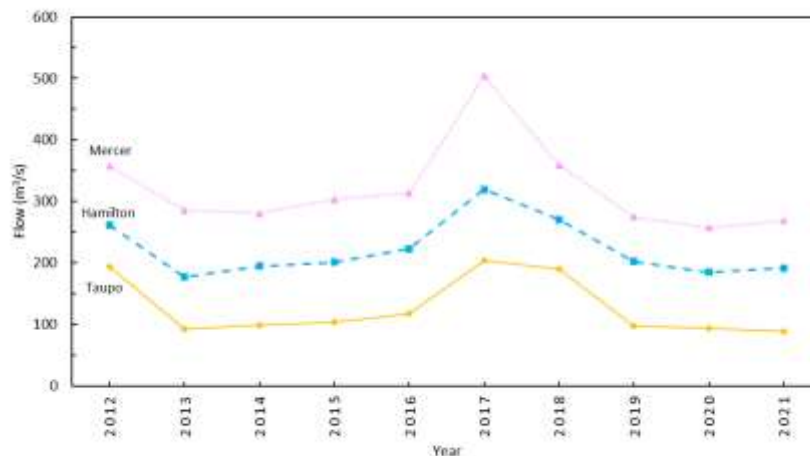
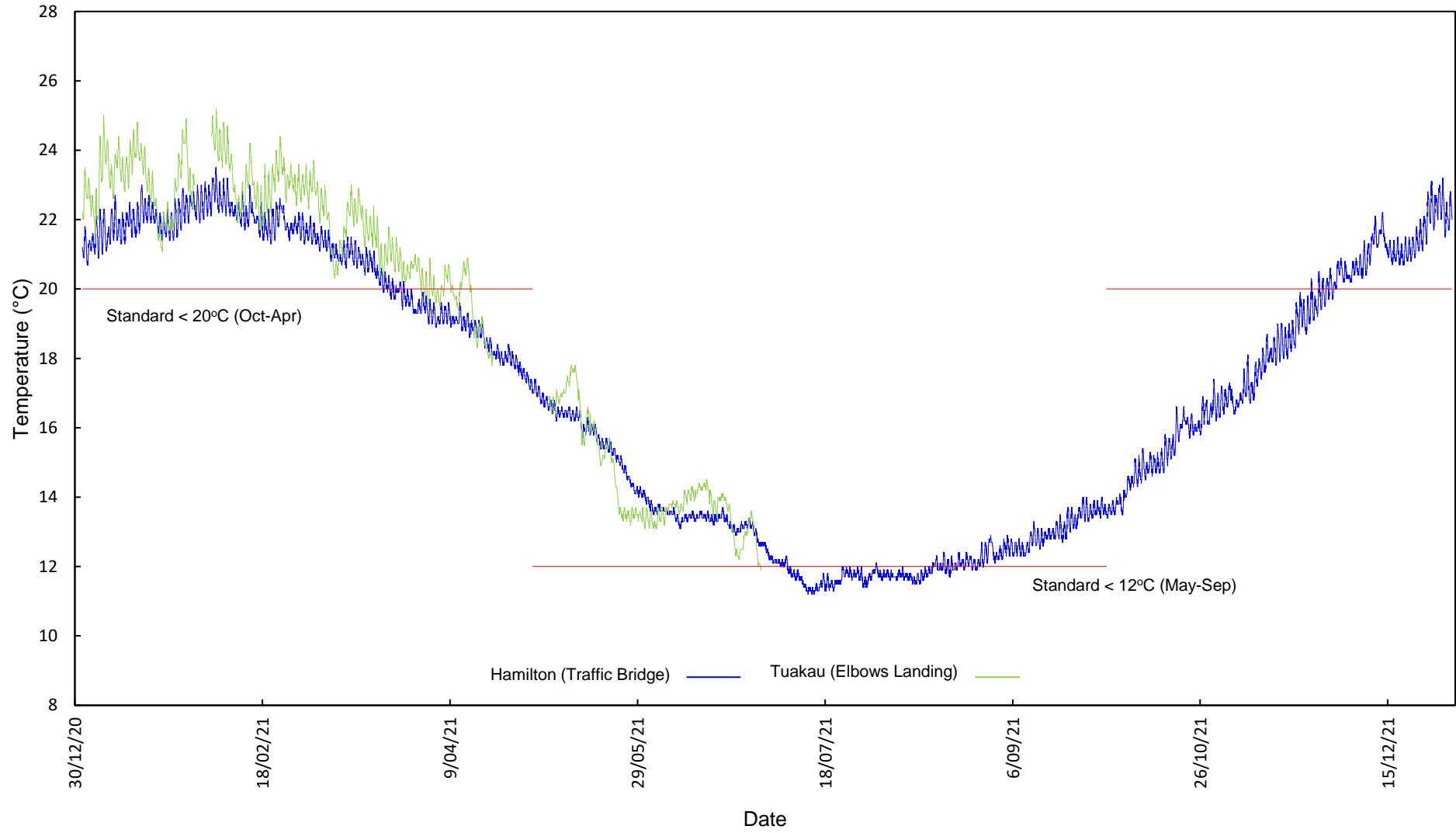


Figure 4: Yearly flow record (median) at Taupo, Hamilton and Mercer for 2012-2021

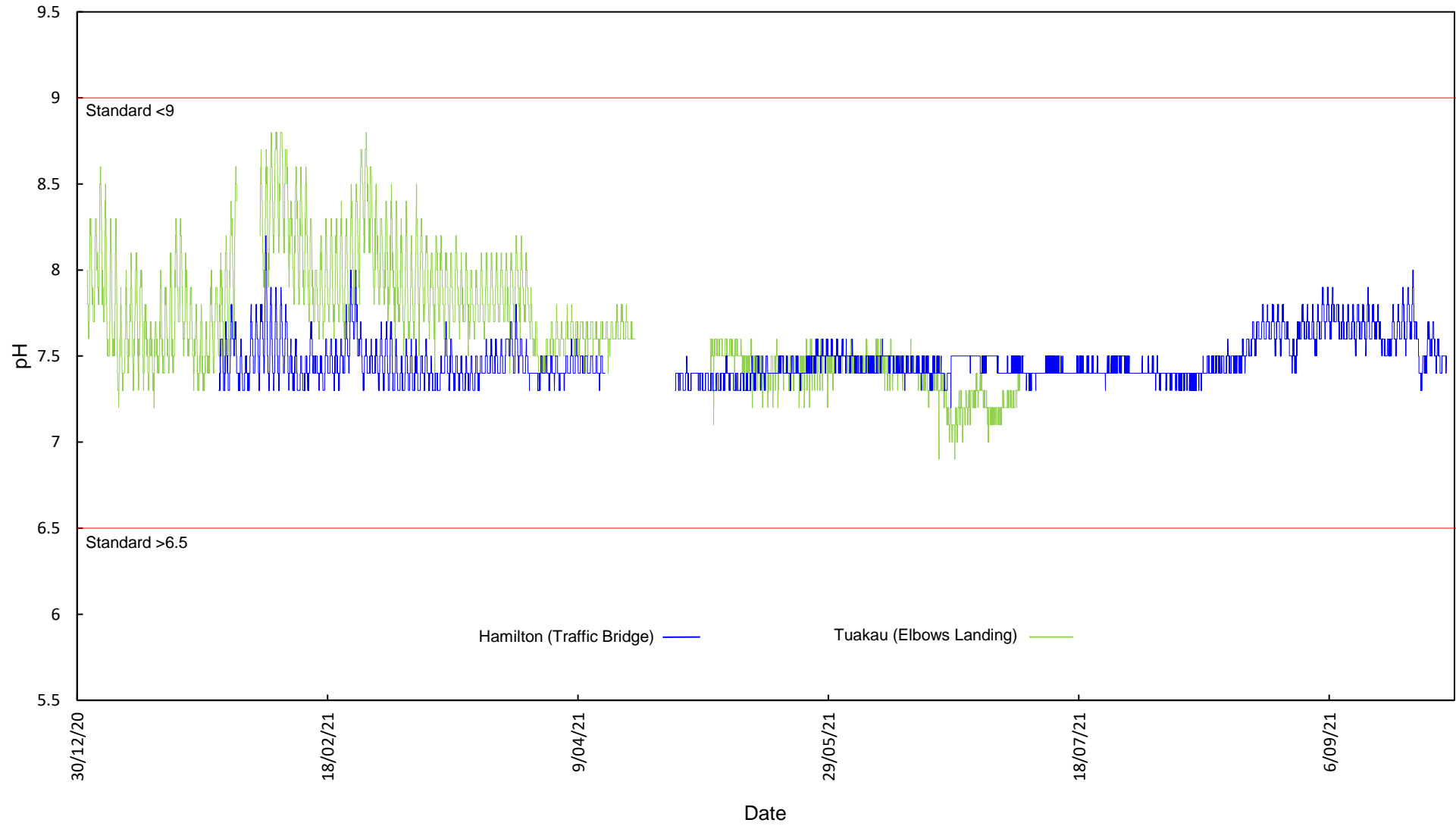
Appendix II

Datasonde Deployments Graphs: Selected Water Quality Parameters

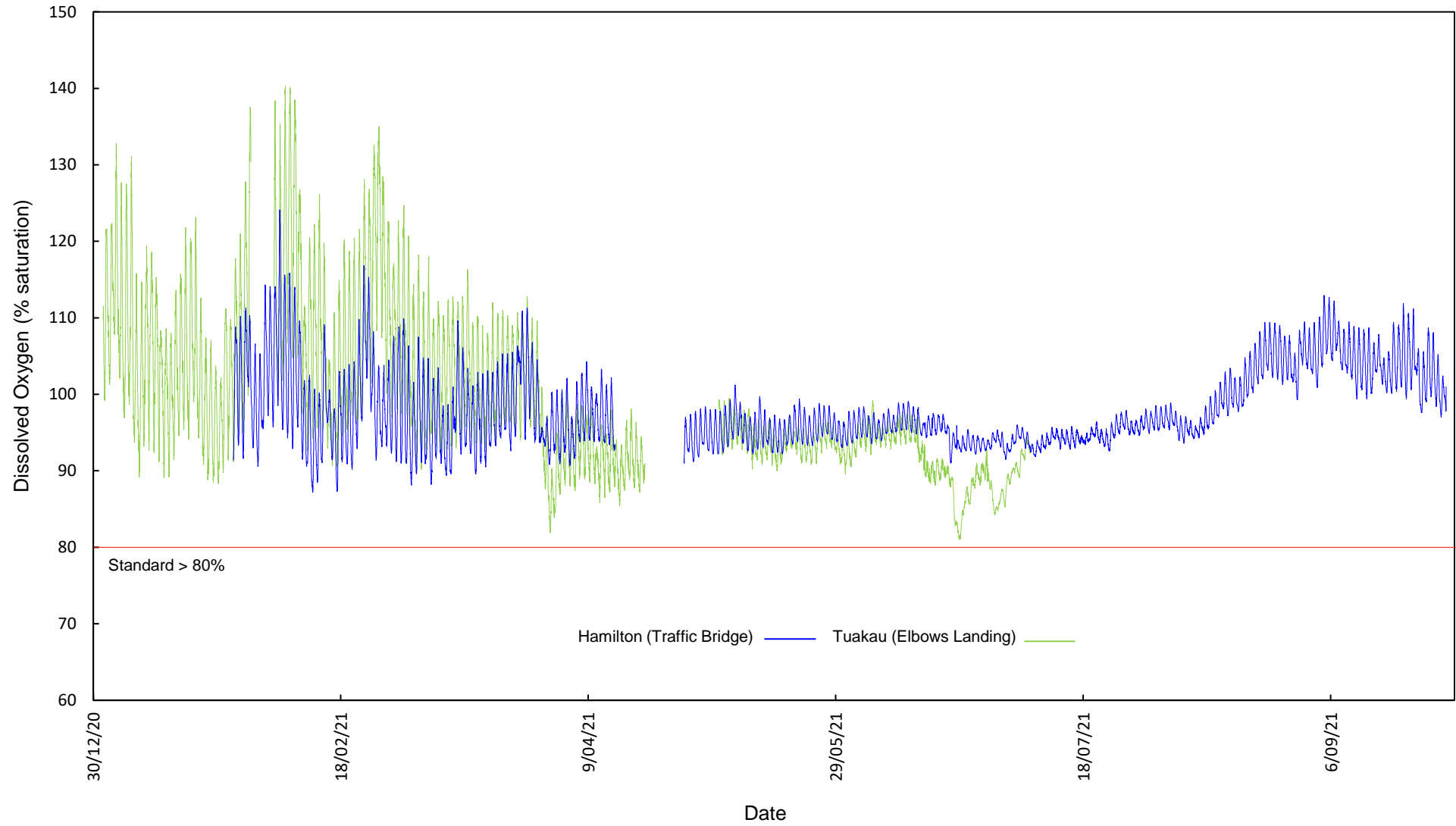
Water Temperature: Lower Waikato (2021)



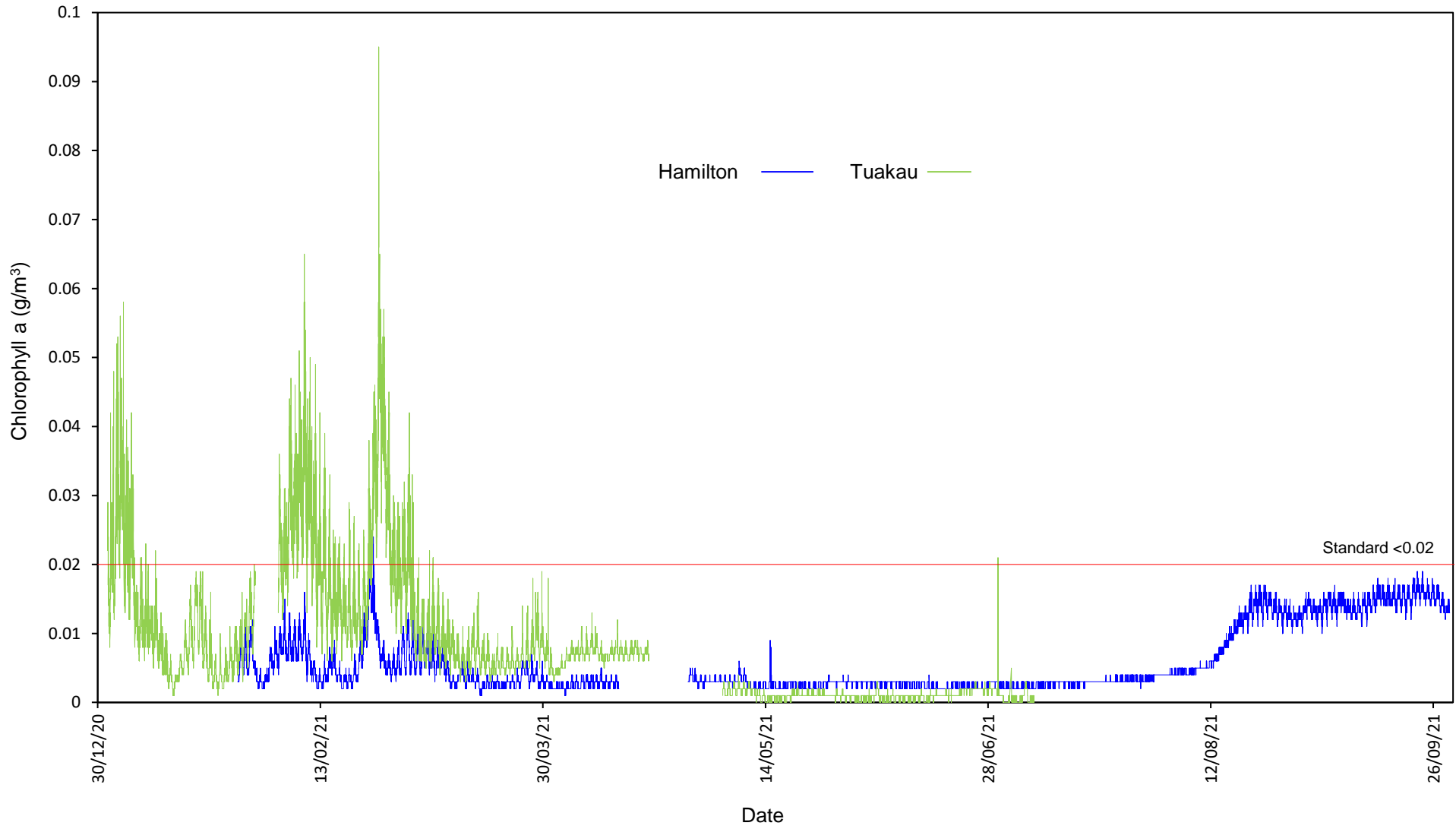
pH: Lower Waikato (2021)



Dissolved Oxygen (% saturation): Lower Waikato (2021)



Chlorophyll a: Lower Waikato (2021)



Appendix III

Waikato River Water Quality Parameters

Water quality parameter	Reason for monitoring	Parameter monitored ¹	Comments ²
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 - turbidity - black disk (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 - 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) chlorophyll α	- enrichment, excessive plant growth	NO ₃ -N+NO ₂ -N	routine
	- nutrient limitation for plant/algal growth	NH ₄ -N,TKN	
		DRP, TP, Chl α	
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 ₅	routine
	- catchment characteristics	TOC/DOC	routine
Faecal bacteria - E. coli - enterococci - faecal coliforms	- indicator of pollution with faecal matter	E. Coli	routine
	- disease risk for swimming etc.	ENT	routine
		FC	routine

¹ see last page of Appendix III for the meaning of the abbreviations.

² routine means sampled monthly.

Guidelines and Standards

Parameter	Critical value(s)	Source
Dissolved oxygen	>80% of saturation concentration	RMA Third Schedule, Classes AE, F, and FS.
Dissolved oxygen	>4.0 mg/L 1-day minimum*	National Policy Statement for Freshwater Management 2020, Appendix 2B, Table 17.
Dissolved oxygen	>5.0 mg/L 7-day mean minimum*	National Policy Statement for Freshwater Management 2020, Appendix 2B, Table 17.
pH	6.5–9	ANZECC. (2000). Australia and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council. Agriculture and Resource Management Council of Australia and New Zealand. ISBN 09578245 0 5.
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 ³	USEPA (1998) value for 1-hour exposure at pH 9.
Temperature	<12°C (May – Sep) <20°C (Oct – Apr)	Waikato Regional Council Proposed Regional Plan standards for trout fisheries and trout spawning (1998).
Total phosphorus	<0.04 g/m ³	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 ³	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 ³	Ministry for the Environment (1992).
Arsenic	<0.01 g/m ³	Ministry of Health (2018).
Boron	<1.4 g/m ³	Ministry of Health (2018).

*critical values are based on continuous data

Analytical Methods

Id ¹	Parameter	Short name ²	Method
A340F	Absorbance (340nm)	A340F	Spectrophotometer, 1 cm path length, APHA method 5910B
A440F	Absorbance (440nm)	A440F	Spectrophotometer, 1 cm path length, APHA method 5910B
A780F	Absorbance (780nm)	A440F	Spectrophotometer, 1 cm path length, APHA method 5910B
Arsenic	Arsenic	As	Nitric acid digestion, ICP-MS, APHA method 3125 B / USEPA 200B, uses Tt or TR if Tr not available or average if both available
BDisk	Black Disk	BDisk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river or trough (20mm only)
BOD5Dil	Biochemical Oxygen Demand 5 day	BOD-5d	Incubation 5 days at 20°C, DO-meter, No nitrification inhibitor added, unseeded, APHA method 5210 B
Boron	Boron	B	ICP-MS, APHA method 3125 B. Uses either TR or Tt or average if both available
CHLA	Chlorophyll <i>a</i>	CHLa	Acetone extraction. Spectroscopy. APHA method 10200 H (modified)
Cl Diss	Chloride Dissolved	CL	Filtered sample. Ferric thiocyanate colorimetry, Discrete analyser. APHA method 4500 Cl ⁻ E (modified)
Colour Munsell	Colour (Munsell)	Colour	Field measurement, Munsell colour patches
DO	Dissolved Oxygen	DO	Field measurement (Hach DO meter, model HQ 30d)
DO_Percent	Dissolved Oxygen	DO%	Field measurement (Hach DO meter, model HQ 30d)
DOC	Dissolved Organic Carbon	DOC	Filtration, acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (modified)
DRP	Dissolved Reactive Phosphorus	DRP	Filtration, Molybdenum Blue Colorimetry. Discrete analyser. APHA 4500 PE (modified)
EC25	Conductivity at 25°C	Cond	ab Meter @ 25°C. APHA method 2510B
EColi	<i>Escherichia coli</i>	<i>E coli</i>	Membrane Filtration (mFC Agar) confirmation by MUG Agar. APHA method 9222 G
ENT	Enterococci	ENT.	Membrane Filtration (mE Agar) confirmation by EIA Agar. APHA method 9230 C
FColi	Faecal Coliforms	F coli	Membrane Filtration (mFC Agar). APHA method 9222 D
Li	Lithium	Li	ICP-MS, method APHA 3125 B
NH4	Ammoniacal Nitrogen	NH ₄ N	Filtration, Phenol/Hypochlorite Colorimetry. Discrete analyser. APHA method 4500-NH ₃ F (modified).
NitriteNitrogen	Nitrite Nitrogen	NO ₂ -N	Automated azo dye colorimetry.Flow injection analyser. APHA 4500-NO ₂ I.
NNN	Nitrate/Nitrite Nitrogen	NNN	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 - NO ₃ -I (modified).
pH	pH	pH	Lab Meter @ 25°C. APHA method 4500-H ⁺ B
TDSMisc	Total Dissolved Solids	TDS	Filtration, gravimetric. APHA 2540 C (modified)
TKN	Total Kjeldahl Nitrogen	TKN	Acid digestion. Phenol/Hypochlorite colorimetry. Discrete analyser. APHA method 4500-Norg D
TN	Total Nitrogen	TN	Calculated from NNN + TKN (Nitrite/Nitrate Nitrogen + Total Kjeldahl-Nitrogen)
TOC	Total Organic Carbon	TOC	Acidification, purging to remove inorganic C, persulphate oxidation, IR detection. APHA method 5310 C (modified)
TP	Total Phosphorus	TP	Acid persulphate digestion, Colorimetry. Discrete Analyser. APHA method 4500-P B E (modified). Also modified to include the use of reductant to eliminate interference from arsenic present in the sample. NAWASCA Pub 38, 1982
Turb_NTU	Turbidity	Turb	Turbidity Meter Hach 2100N. APHA method 2130 B
WT	Water Temperature	Temp	Field measurement (Hach DO meter, model HQ 30d)

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

²Water quality parameter short name used in this report.

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

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy