

Waikato River water quality monitoring programme: data report 2012

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Hydrological flow data were provided by Mighty River Power (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 the two other sites.

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1 Introduction

1.1 Background

The year 2012 report follows the format of the previous data report (Tulagi, 2012).

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 22nd 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, e-mail: inforeq@waikatoregion.govt.nz.

1.2 Report content

The report provides information on:

1. Routine monthly monitoring of water quality at 10 sites:
 - Year 2012 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 2012 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 2012.
 - Raw data for the 2-yearly bathing season microbiological survey (15 sites, weekly sampling).
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 provide information on annual median flow at some locations for the previous 10 years.
 - Datasonde deployments
 - Plots of deployments undertaken during 2012 showing the level of diurnal and seasonal variation at five Waikato River sites (*Appendix II*).

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 2012. The standards mainly relate to either the protection of the 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 III). The more stringent criteria identify “excellent” water, and reflect expert opinion. Samples gathered in 2012 whose results do not comply with the “satisfactory” criteria (Table 1) are underlined in raw data summaries.

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

Water Quality Measure	Relevance ¹	Satisfactory	Excellent
Ecological health			
Dissolved oxygen (% saturation)	aquatic life (breathing)	>80	>90
pH	aquatic life (acidity)	6.5–9	7–8
Turbidity (NTU)	plant growth (clarity)	<5	<2
Ammoniacal-N (g/m ³)	aquatic life (toxicity)	<0.88	<0.1
Temperature (°C)	fish (spawning)	<12	<10
	(May-Sep)	<20	<16
	(Oct-Apr)		
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			
Baseflow water clarity (m)	visibility	>1.6	>4
Escherichia coli (no./100 mL)	human health	<550	<55
Median Escherichia coli (no./100 mL)	human health	<126	<23
Human uses - water supply			
Phytoplankton chlorophyll a (g/m ³)	filter blockage	<0.02	<0.005
Human uses - drinking water			
Arsenic (g/m ³)	human health (toxicity)	<0.01	–
Boron (g/m ³)	human health (toxicity)	<1.4	–

¹ 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

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 $\approx 2-6\%$) 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*.

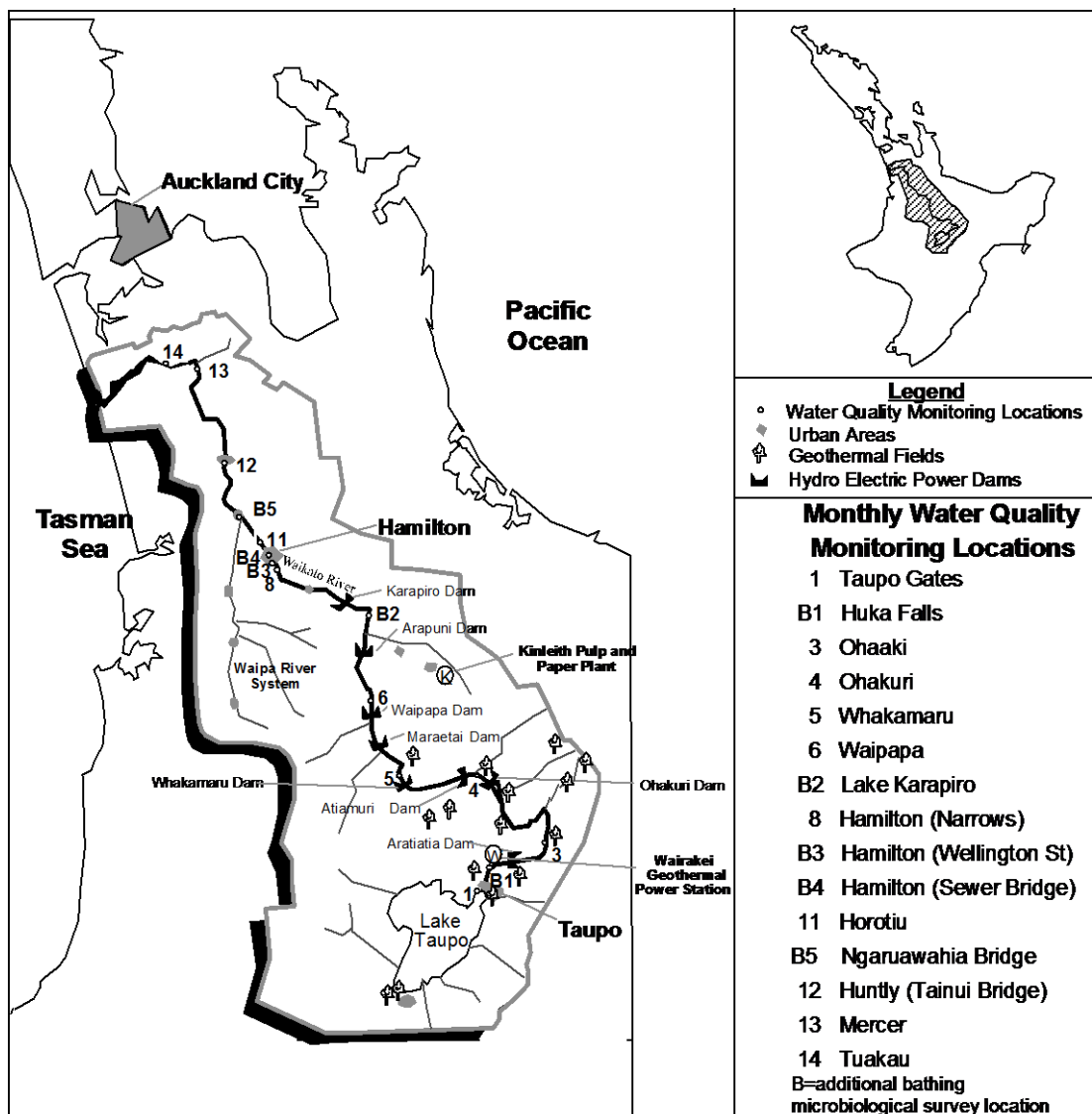


Figure 1: Waikato River water quality monitoring locations

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). Three locations (Taupo at Reids Farm, Hamilton at Wellington Street, and Rangiriri) are sampled by NIWA as part of the 'National River Water Quality Network' (Table 2).

Table 2: Routine sampling and bathing water monitoring locations

Location Number	Distance ¹ (km)	Location name	Map Ref.	Field ^Y Measurements
1131.127	0.1	Taupo Gates	U18:772-757	–
1131.119 ^{*d}	1.2	Taupo – Reids Farm	U18:778:763	true left bank
1131.70 ^b	6.0	Huka Falls	U18:789-792	–
1131.244 ^d	7.8	Downstream Huka Falls	U18:797-809	river boat jetty ²
1131.105 ^d	36.5	Ohaaki Bridge	U17:981-914	at bridge, true right bank
1131.107	75.8	Ohakuri Tailrace Bridge	U17:796-061	boat ramp ³
1131.147	105.0	Whakamaru Tailrace	T17:552-056	boat ramp ⁴
1131.143	126.1	Waipapa Tailrace	T16:448-200	boat ramp ⁵
1131.81 ^b	166.7	Lake Karapiro Boat Ramp	T15:436-570	Horahora domain
1131.328	202.2	Hamilton – Narrows	S14:168-710	boat ramp ⁶
1131.145 ^{*b}	210.8	Hamilton – Wellington St Bch	S14:117-757	at jetty, true right bank
1131.64 ^d	211.5	Hamilton – Traffic Bridge	S14:118-764	true right bank
1131.121 ^b	219.8	Hamilton – Sewer Bridge	S14:082-823	true left bank
1131.69	225.6	Horotiu Bridge	S14:048-871	d/s of bridge
1131.102 ^b	232.3	Ngaruawahia Bridge	S14:997-912	u/s of confluence ⁷
1131.77	246.5	Huntly – Tainui Bridge	S13:003-018	true left bank
1131.117 ^{*d}	262.3	Rangiriri Bridge	S13:989-167	true right bank
1131.91	286.3	Mercer Bridge	S12:919-336	–
1131.133	296.8	Tuakau Bridge	R12:828-320	boat ramp ⁸
1131.131 ^d	306.5	Tuakau – Elbows Landing	R12:745-352	NZ Steel Ltd pumping station

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

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

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

⁴ boat ramp at Whakamaru Power Station.

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

⁶ boat ramp accessed via Narrows Lane (true right bank)

⁷ road bridge upstream of Waipa River confluence.

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

^b bathing season intensive microbiological survey locations only – survey conducted over the 2012/13 summer.

^{*} Locations at **Taupo (Reids Farm)**, 1.1 km d/s from Taupo Gates), at **Hamilton** (Wellington Street jetty) and at **Rangiriri** (Rangiriri Bridge) are sampled and reported as part of the National River Water Quality Network undertaken by NIWA. Contact person: Graham Bryers, NIWA, Hamilton.

^Y Logistic considerations mean field measurements are often made at slightly different locations from sample collection (e.g. sampling from bridges).

^d 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 III*).

2.4 Quality control, data storage and analysis

Quality control measures are undertaken in accordance with Waikato Regional Council's ISO 9001:2008 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 water quality archiving database (TimeStudio).

Data analysis was performed using Statistica (version 11.0) and DataDesk (version 6.0.1). 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's State of the Environment Report summarises the state of the Waikato River, other rivers in the region, and common pressures (Environment Waikato, 1999).

Waikato Regional Council Technical Report 2013/20, Trends in River Water Quality in the Waikato Region, 1993–2012 (Vant, 2013) 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/Environmental-information/Rivers-lakes-and-wetlands/>

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.

3 Results

Section 3.1 contains the results and statistical summaries of the routine and 5 yearly trace metal monitoring of the Waikato River. The raw data is also included.

3.1 Waikato River Monitoring Programme

Routine Water Quality Monitoring

Summary Statistics

Key Parameter Graphs

Comparison with Water Quality Standards

Raw Data

Absorbance of filtered sample at 340 nm (units: /cm)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohaaki Bridge	12	0.002	0.002	0.001	0.004	0.002	0.41	0.003
Ohakuri Tailrace Bridge	12	0.006	0.006	0.004	0.010	0.002	0.94	0.005
Whakamaru Tailrace	12	0.007	0.006	0.005	0.015	0.002	<u>2.17</u>	0.007
Waipapa Tailrace	12	0.009	0.008	0.007	0.013	0.003	0.70	0.009
Narrow s	12	0.012	0.011	0.006	0.018	0.006	0.43	0.011
Horotiu Bridge	12	0.012	0.011	0.008	0.018	0.006	0.30	0.012
Huntly-Tainui Bridge	12	0.019	0.017	0.011	0.038	0.009	1.33	0.018
Mercer Bridge	12	0.025	0.020	0.013	0.050	0.015	1.12	0.021
Tuakau Bridge	12	0.027	0.023	0.013	0.051	0.014	1.03	0.024

Absorbance of filtered sample at 440 nm (units: /cm)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohaaki Bridge	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Ohakuri Tailrace Bridge	12	0.001	0.001	0.001	0.001	0.000	-1.00	0.001
Whakamaru Tailrace	12	0.001	0.001	0.001	0.004	0.000	<u>2.56</u>	0.001
Waipapa Tailrace	12	0.001	0.001	0.001	0.003	0.000	<u>2.22</u>	0.001
Narrow s	12	0.002	0.001	0.001	0.004	0.002	0.75	0.002
Horotiu Bridge	12	0.002	0.002	0.001	0.003	0.002	0.16	0.002
Huntly-Tainui Bridge	12	0.003	0.003	0.001	0.008	0.002	1.01	0.003
Mercer Bridge	12	0.005	0.004	0.002	0.011	0.003	1.32	0.004
Tuakau Bridge	12	0.005	0.004	0.002	0.009	0.003	1.03	0.004

Arsenic - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.011	0.012	0.009	0.012	0.001	-1.15	0.011
Ohaaki Bridge	12	0.027	0.025	0.021	0.040	0.007	1.13	0.027
Ohakuri Tailrace Bridge	12	0.030	0.030	0.026	0.035	0.005	0.36	0.032
Whakamaru Tailrace	12	0.028	0.026	0.023	0.032	0.005	0.34	0.031
Waipapa Tailrace	12	0.025	0.025	0.021	0.028	0.004	0.03	0.026
Narrow s	12	0.021	0.022	0.017	0.026	0.005	-0.08	0.023
Horotiu Bridge	12	0.021	0.022	0.017	0.024	0.006	-0.33	0.023
Huntly-Tainui Bridge	12	0.016	0.016	0.011	0.023	0.007	0.08	0.017
Mercer Bridge	12	0.015	0.016	0.009	0.020	0.006	-0.32	0.017
Tuakau Bridge	12	0.016	0.016	0.009	0.023	0.006	0.07	0.017

Boron (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.17	0.17	0.15	0.18	0.01	-0.91	0.17
Ohaaki Bridge	12	0.29	0.25	0.23	0.52	0.09	1.61	0.28
Ohakuri Tailrace Bridge	12	0.31	0.31	0.26	0.40	0.05	0.92	0.33
Whakamaru Tailrace	12	0.29	0.29	0.25	0.35	0.07	0.21	0.32
Waipapa Tailrace	12	0.27	0.27	0.22	0.32	0.06	0.29	0.28
Narrow s	12	0.23	0.24	0.19	0.26	0.05	-0.58	0.25
Horotiu Bridge	12	0.24	0.25	0.20	0.28	0.05	-0.10	0.26
Huntly-Tainui Bridge	12	0.19	0.19	0.15	0.23	0.03	0.39	0.19
Mercer Bridge	12	0.18	0.19	0.14	0.23	0.06	0.07	0.20
Tuakau Bridge	12	0.18	0.18	0.14	0.23	0.05	0.20	0.19

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Black Disk (m)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	12	4.2	4.5	2.6	6.6	1.2	0.64	3.6
Ohakuri Tailrace Bridge	11	2.4	2.3	1.1	4.0	1.6	0.18	2.0
Whakamaru Tailrace	12	1.9	1.7	1.0	3.4	1.0	0.84	1.8
Waipapa Tailrace	12	2.0	2.0	1.2	3.5	1.2	0.67	1.7
Narrow s	12	1.6	1.6	0.9	2.5	0.6	0.39	1.4
Horotiu Bridge	12	1.4	1.4	1.0	2.0	0.5	0.17	1.1
Huntly-Tainui Bridge	12	0.8	0.8	0.5	1.1	0.4	-0.02	0.8
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	0.6	0.6	0.3	1.1	0.3	0.31	0.6

Biochemical Oxygen Demand - 5 day (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.9	0.6	0.2	3.6	0.3	<u>2.77</u>	0.6
Ohaaki Bridge	12	0.7	0.6	0.2	1.3	0.3	0.47	0.6
Ohakuri Tailrace Bridge	12	0.9	0.7	0.2	2.5	0.8	1.13	0.8
Whakamaru Tailrace	12	1.2	1.0	0.2	2.4	1.1	0.48	1.0
Waipapa Tailrace	12	0.9	0.8	0.2	2.7	0.4	<u>1.85</u>	0.8
Narrow s	12	1.0	0.9	0.6	2.2	0.3	1.56	0.9
Horotiu Bridge	12	0.9	0.7	0.2	1.7	0.5	0.52	0.8
Huntly-Tainui Bridge	12	0.9	0.8	0.2	1.9	0.5	0.96	0.9
Mercer Bridge	12	1.5	1.2	0.6	2.5	1.2	0.29	1.2
Tuakau Bridge	12	1.4	1.2	0.7	3.0	0.8	1.25	1.2

Carbon - Dissolved Organic (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.96	0.90	0.50	1.80	0.45	0.94	0.85
Ohaaki Bridge	12	1.12	1.05	0.60	2.20	0.55	1.01	0.90
Ohakuri Tailrace Bridge	12	1.08	1.15	0.60	1.50	0.35	-0.48	1.00
Whakamaru Tailrace	12	1.10	1.15	0.70	1.50	0.40	-0.12	1.10
Waipapa Tailrace	12	1.36	1.25	0.70	2.50	0.65	0.79	1.30
Narrow s	12	1.54	1.55	1.10	2.10	0.25	0.51	1.40
Horotiu Bridge	12	1.58	1.55	1.30	2.10	0.30	0.83	1.50
Huntly-Tainui Bridge	12	1.88	1.80	1.20	2.70	0.35	0.55	1.90
Mercer Bridge	12	2.58	2.10	1.70	5.20	1.45	1.37	2.15
Tuakau Bridge	12	2.50	2.25	1.60	4.10	1.15	0.77	2.30

Carbon - Total Organic (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.31	1.10	0.90	2.30	0.55	1.17	1.10
Ohaaki Bridge	12	1.32	1.15	1.00	2.40	0.35	<u>1.80</u>	1.10
Ohakuri Tailrace Bridge	12	1.31	1.30	1.00	1.50	0.20	-0.53	1.30
Whakamaru Tailrace	12	1.47	1.40	1.30	1.80	0.20	0.84	1.40
Waipapa Tailrace	12	1.69	1.60	1.30	2.30	0.55	0.58	1.70
Narrow s	12	1.94	1.90	1.60	2.70	0.25	1.58	1.85
Horotiu Bridge	12	2.29	2.10	1.60	4.90	0.40	<u>2.40</u>	2.10
Huntly-Tainui Bridge	12	2.70	2.45	1.90	5.50	0.60	<u>2.06</u>	2.70
Mercer Bridge	12	3.67	3.10	2.20	8.20	1.25	<u>1.99</u>	3.50
Tuakau Bridge	12	3.58	3.25	2.10	5.80	1.50	0.83	3.40

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Chloride (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	9	9	8	9	0	0.51	9
Ohaaki Bridge	12	17	15	13	24	6	0.90	17
Ohakuri Tailrace Bridge	12	19	19	16	25	3	0.96	20
Whakamaru Tailrace	12	18	19	15	20	4	-0.47	20
Waipapa Tailrace	12	18	18	15	21	3	0.07	19
Narrow s	12	17	17	14	19	4	-0.21	18
Horotiu Bridge	12	17	17	14	20	4	-0.05	18
Huntly-Tainui Bridge	12	15	15	8	18	2	-1.62	16
Mercer Bridge	12	16	16	14	18	3	0.13	17
Tuakau Bridge	12	16	16	14	19	3	0.10	17

Chlorophyll a (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.002	0.002	0.002	0.000	1.00	0.002
Ohaaki Bridge	12	0.002	0.002	0.002	0.013	0.000	<u>3.02</u>	0.002
Ohakuri Tailrace Bridge	12	0.003	0.002	0.002	0.011	0.002	<u>2.20</u>	0.003
Whakamaru Tailrace	12	0.012	0.005	0.002	0.045	0.015	1.49	0.006
Waipapa Tailrace	12	0.005	0.005	0.002	0.011	0.007	0.59	0.004
Narrow s	12	0.007	0.004	0.002	0.023	0.006	1.64	0.007
Horotiu Bridge	12	0.007	0.006	0.002	0.020	0.007	1.37	0.008
Huntly-Tainui Bridge	12	0.007	0.007	0.002	0.019	0.007	0.88	0.006
Mercer Bridge	12	0.010	0.008	0.002	0.023	0.009	0.70	0.011
Tuakau Bridge	12	0.012	0.008	0.005	0.030	0.010	1.15	0.012

Colour (Munsell Colour Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	10	47.5	48.8	25.0	62.5	15.0	-0.74	50.0
Ohakuri Tailrace Bridge	9	42.2	40.0	25.0	57.5	15.6	0.13	37.5
Whakamaru Tailrace	10	40.3	41.3	25.0	50.0	10.0	-0.63	37.5
Waipapa Tailrace	10	38.5	38.8	25.0	50.0	5.0	-0.42	37.5
Narrow s	12	37.7	37.5	25.0	55.0	7.5	0.72	35.0
Horotiu Bridge	12	36.3	35.0	30.0	47.5	5.0	1.07	35.0
Huntly-Tainui Bridge	12	35.6	35.0	27.5	50.0	7.5	0.96	32.5
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	31.0	28.8	25.0	42.5	6.3	1.06	30.0

Conductivity at 25 °C (ms/m)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	11.7	11.8	11.5	12.0	0.3	-0.06	11.9
Ohaaki Bridge	12	15.1	14.3	13.6	18.4	2.2	1.04	15.3
Ohakuri Tailrace Bridge	12	16.5	16.1	15.1	19.0	0.8	1.26	17.1
Whakamaru Tailrace	12	15.8	15.8	14.6	16.9	1.3	0.04	17.0
Waipapa Tailrace	12	15.8	15.8	14.5	17.3	1.2	0.24	16.2
Narrow s	12	15.2	15.0	14.1	16.3	1.3	0.25	15.7
Horotiu Bridge	12	15.3	15.2	14.2	16.5	1.2	0.15	15.9
Huntly-Tainui Bridge	12	14.5	14.3	13.0	16.1	1.1	0.33	15.0
Mercer Bridge	12	15.0	15.1	13.6	16.1	1.6	-0.29	15.7
Tuakau Bridge	12	14.9	15.1	13.7	16.2	1.5	-0.13	15.6

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Dissolved Oxygen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	10.1	10.1	8.9	11.5	1.5	0.10	9.6
Ohaaki Bridge	12	10.4	9.8	9.0	13.0	2.4	0.67	9.6
Ohakuri Tailrace Bridge	12	10.1	10.1	8.2	12.0	1.5	0.05	9.7
Whakamaru Tailrace	12	10.6	10.6	9.2	12.7	1.7	0.45	10.1
Waipapa Tailrace	12	10.3	10.1	9.2	11.6	1.7	0.24	9.9
Narrow s	12	10.2	10.4	8.0	11.8	1.7	-0.43	9.9
Horotiu Bridge	12	10.1	10.1	8.1	11.6	1.8	-0.29	9.8
Huntly-Tainui Bridge	12	9.8	10.0	8.1	11.1	1.3	-0.58	9.4
Mercer Bridge	12	9.6	9.6	7.5	10.8	1.3	-0.71	9.4
Tuakau Bridge	12	9.6	9.8	7.6	11.1	1.1	-0.59	9.5

Dissolved Oxygen (% Saturation)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	103.1	103.7	97.8	108.0	7.4	-0.21	100.2
Ohaaki Bridge	12	106.7	103.4	98.7	126.1	7.9	1.35	102.6
Ohakuri Tailrace Bridge	12	104.4	104.8	89.9	117.0	12.0	-0.08	101.5
Whakamaru Tailrace	12	108.8	107.9	100.2	126.0	9.5	0.94	103.8
Waipapa Tailrace	12	104.3	105.1	98.9	112.9	5.9	0.42	101.4
Narrow s	12	101.8	101.0	88.5	120.5	8.5	0.69	97.9
Horotiu Bridge	12	100.5	99.0	89.2	115.9	8.4	0.60	96.9
Huntly-Tainui Bridge	12	97.7	96.5	89.9	113.3	4.1	1.15	96.5
Mercer Bridge	12	96.5	95.2	86.0	115.6	10.7	0.86	95.5
Tuakau Bridge	12	97.9	96.4	84.5	120.3	9.4	0.77	97.3

Enterococci (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1	1	1	4	0	<u>2.6</u>	1
Ohaaki Bridge	12	11	6	1	37	17	1.1	8
Ohakuri Tailrace Bridge	12	2	1	1	14	1	<u>2.9</u>	2
Whakamaru Tailrace	12	53	3	1	600	5	<u>3.0</u>	6
Waipapa Tailrace	12	8	4	1	32	5	1.7	4
Narrow s	11	34	30	5	110	24	1.5	27
Horotiu Bridge	11	165	34	10	1400	38	<u>2.8</u>	52
Huntly-Tainui Bridge	11	134	40	12	900	34	<u>2.5</u>	48
Mercer Bridge	11	715	29	5	4700	518	<u>2.0</u>	30
Tuakau Bridge	11	103	20	1	700	94	<u>2.6</u>	28

Escherichia coli (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	2	2	1	4	1	0.9	2
Ohaaki Bridge	12	14	9	4	40	14	1.2	12
Ohakuri Tailrace Bridge	12	4	3	1	17	3	<u>2.4</u>	3
Whakamaru Tailrace	12	13	7	1	90	8	<u>2.9</u>	8
Waipapa Tailrace	12	11	5	2	60	10	<u>2.6</u>	8
Narrow s	11	51	34	13	190	15	<u>1.8</u>	40
Horotiu Bridge	11	216	90	10	1600	93	<u>2.8</u>	110
Huntly-Tainui Bridge	11	298	100	50	2200	103	<u>2.8</u>	115
Mercer Bridge	11	508	90	45	2400	650	1.6	120
Tuakau Bridge	11	222	100	29	1600	73	<u>2.8</u>	100

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Faecal Coliforms (cfu/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	2	2	1	4	2	0.4	2
Ohaaki Bridge	12	17	12	4	40	19	0.7	14
Ohakuri Tailrace Bridge	12	4	3	1	23	4	<u>2.7</u>	3
Whakamaru Tailrace	12	14	8	1	90	10	<u>2.8</u>	9
Waipapa Tailrace	12	13	9	3	60	10	<u>2.6</u>	9
Narrow s	11	59	40	18	220	23	<u>2.0</u>	50
Horotiu Bridge	11	326	100	10	2600	118	<u>2.8</u>	140
Huntly-Tainui Bridge	11	477	100	50	4100	100	<u>2.8</u>	125
Mercer Bridge	11	563	130	45	2400	1021	1.3	150
Tuakau Bridge	11	261	100	29	1900	75	<u>2.8</u>	105

Lithium (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.040	0.040	0.035	0.044	0.002	-0.797	0.040
Ohaaki Bridge	12	0.087	0.076	0.068	0.135	0.022	1.286	0.089
Ohakuri Tailrace Bridge	12	0.108	0.105	0.091	0.138	0.020	0.819	0.115
Whakamaru Tailrace	12	0.104	0.102	0.086	0.125	0.027	0.134	0.118
Waipapa Tailrace	12	0.095	0.091	0.080	0.122	0.022	0.623	0.098
Narrow s	12	0.084	0.088	0.067	0.103	0.017	-0.114	0.090
Horotiu Bridge	12	0.086	0.091	0.067	0.113	0.021	0.183	0.091
Huntly-Tainui Bridge	12	0.064	0.063	0.050	0.079	0.018	0.249	0.066
Mercer Bridge	12	0.061	0.062	0.044	0.080	0.025	0.064	0.064
Tuakau Bridge	12	0.061	0.060	0.043	0.079	0.023	0.121	0.064

Nitrate/Nitrite Nitrogen (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.004	0.002	0.001	0.029	0.002	<u>2.85</u>	0.002
Ohaaki Bridge	12	0.043	0.038	0.021	0.077	0.023	0.86	0.039
Ohakuri Tailrace Bridge	12	0.097	0.082	0.003	0.200	0.115	0.20	0.086
Whakamaru Tailrace	12	0.119	0.094	0.029	0.220	0.140	0.28	0.101
Waipapa Tailrace	12	0.197	0.175	0.107	0.320	0.133	0.33	0.162
Narrow s	12	0.289	0.250	0.096	0.500	0.160	0.31	0.230
Horotiu Bridge	12	0.310	0.265	0.116	0.550	0.200	0.41	0.260
Huntly-Tainui Bridge	12	0.464	0.400	0.148	0.900	0.320	0.52	0.360
Mercer Bridge	12	0.442	0.400	0.154	0.870	0.245	0.65	0.355
Tuakau Bridge	12	0.419	0.395	0.108	0.800	0.295	0.35	0.330

Nitrogen - Ammoniacal (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.008	0.005	0.005	0.031	0.003	<u>2.50</u>	0.005
Ohaaki Bridge	12	0.008	0.005	0.005	0.028	0.003	<u>2.39</u>	0.005
Ohakuri Tailrace Bridge	12	0.019	0.008	0.005	0.104	0.016	<u>2.61</u>	0.005
Whakamaru Tailrace	12	0.010	0.005	0.005	0.029	0.010	1.26	0.005
Waipapa Tailrace	12	0.016	0.019	0.005	0.030	0.019	-0.09	0.015
Narrow s	12	0.016	0.014	0.005	0.043	0.020	0.81	0.016
Horotiu Bridge	12	0.013	0.011	0.005	0.035	0.013	1.09	0.012
Huntly-Tainui Bridge	12	0.011	0.008	0.005	0.022	0.011	0.55	0.012
Mercer Bridge	12	0.009	0.005	0.005	0.029	0.005	<u>1.86</u>	0.005
Tuakau Bridge	12	0.007	0.005	0.005	0.024	0.000	<u>3.02</u>	0.005

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Nitrogen - Total Kjeldahl (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.063	0.060	0.025	0.150	0.055	0.88	0.070
Ohaaki Bridge	12	0.133	0.095	0.025	0.270	0.130	0.44	0.085
Ohakuri Tailrace Bridge	12	0.131	0.100	0.080	0.480	0.020	<u>2.90</u>	0.120
Whakamaru Tailrace	12	0.147	0.115	0.080	0.350	0.080	1.65	0.150
Waipapa Tailrace	12	0.132	0.120	0.090	0.180	0.050	0.32	0.150
Narrow s	12	0.173	0.150	0.090	0.310	0.055	1.14	0.185
Horotiu Bridge	12	0.169	0.175	0.120	0.220	0.050	0.03	0.190
Huntly-Tainui Bridge	12	0.238	0.205	0.120	0.430	0.120	0.86	0.235
Mercer Bridge	12	0.292	0.265	0.150	0.590	0.160	1.21	0.315
Tuakau Bridge	12	0.290	0.260	0.200	0.420	0.110	0.73	0.315

Nitrogen - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.068	0.065	0.026	0.151	0.069	0.63	0.072
Ohaaki Bridge	12	0.175	0.158	0.054	0.316	0.140	0.33	0.118
Ohakuri Tailrace Bridge	12	0.228	0.206	0.103	0.566	0.123	1.65	0.218
Whakamaru Tailrace	12	0.266	0.277	0.138	0.431	0.074	0.39	0.274
Waipapa Tailrace	12	0.328	0.324	0.251	0.430	0.078	0.34	0.330
Narrow s	12	0.462	0.415	0.339	0.810	0.132	<u>1.79</u>	0.430
Horotiu Bridge	12	0.479	0.435	0.306	0.690	0.170	0.44	0.441
Huntly-Tainui Bridge	12	0.702	0.615	0.460	1.110	0.415	0.60	0.620
Mercer Bridge	12	0.734	0.680	0.444	1.150	0.445	0.36	0.730
Tuakau Bridge	12	0.709	0.655	0.368	1.190	0.345	0.54	0.695

pH (pH Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	7.7	7.8	7.3	8.0	0.3	-0.40	7.7
Ohaaki Bridge	12	7.3	7.4	7.0	7.5	0.1	-1.18	7.3
Ohakuri Tailrace Bridge	12	7.4	7.3	7.1	7.6	0.2	-0.08	7.3
Whakamaru Tailrace	12	7.6	7.5	7.4	7.9	0.3	0.65	7.5
Waipapa Tailrace	12	7.4	7.4	7.2	7.6	0.2	-0.17	7.4
Narrow s	12	7.5	7.5	7.3	7.7	0.2	0.04	7.5
Horotiu Bridge	12	7.5	7.6	7.3	7.8	0.2	0.21	7.5
Huntly-Tainui Bridge	12	7.4	7.5	7.2	7.6	0.2	-0.75	7.5
Mercer Bridge	12	7.5	7.6	7.0	7.7	0.3	-1.06	7.5
Tuakau Bridge	12	7.4	7.5	7.0	7.7	0.5	-0.26	7.4

Phosphorus - Dissolved Reactive (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.002	0.002	0.006	0.000	<u>3.02</u>	0.002
Ohaaki Bridge	12	0.005	0.005	0.002	0.013	0.003	1.38	0.006
Ohakuri Tailrace Bridge	12	0.010	0.010	0.002	0.024	0.010	0.43	0.009
Whakamaru Tailrace	12	0.009	0.008	0.002	0.016	0.008	0.03	0.008
Waipapa Tailrace	12	0.014	0.016	0.002	0.022	0.008	-0.77	0.015
Narrow s	12	0.015	0.015	0.002	0.024	0.012	-0.45	0.018
Horotiu Bridge	12	0.019	0.020	0.007	0.030	0.013	-0.22	0.022
Huntly-Tainui Bridge	12	0.020	0.021	0.002	0.031	0.011	-0.76	0.023
Mercer Bridge	12	0.016	0.016	0.007	0.027	0.012	0.17	0.019
Tuakau Bridge	12	0.016	0.015	0.005	0.027	0.009	0.19	0.017

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

Phosphorus - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.006	0.003	0.002	0.027	0.006	<u>2.18</u>	0.003
Ohaaki Bridge	12	0.011	0.008	0.002	0.035	0.009	1.56	0.011
Ohakuri Tailrace Bridge	12	0.019	0.019	0.012	0.028	0.006	0.27	0.020
Whakamaru Tailrace	12	0.022	0.022	0.010	0.034	0.009	0.19	0.022
Waipapa Tailrace	12	0.025	0.025	0.006	0.036	0.007	-1.15	0.028
Narrow s	12	0.035	0.030	0.019	0.102	0.008	<u>2.54</u>	0.031
Horotiu Bridge	12	0.042	0.038	0.024	0.121	0.011	<u>2.67</u>	0.041
Huntly-Tainui Bridge	12	0.051	0.045	0.035	0.096	0.018	1.66	0.055
Mercer Bridge	12	0.062	0.053	0.041	0.156	0.013	<u>2.63</u>	0.060
Tuakau Bridge	12	0.054	0.051	0.036	0.081	0.012	0.79	0.059

TP results corrected for arsenic interference

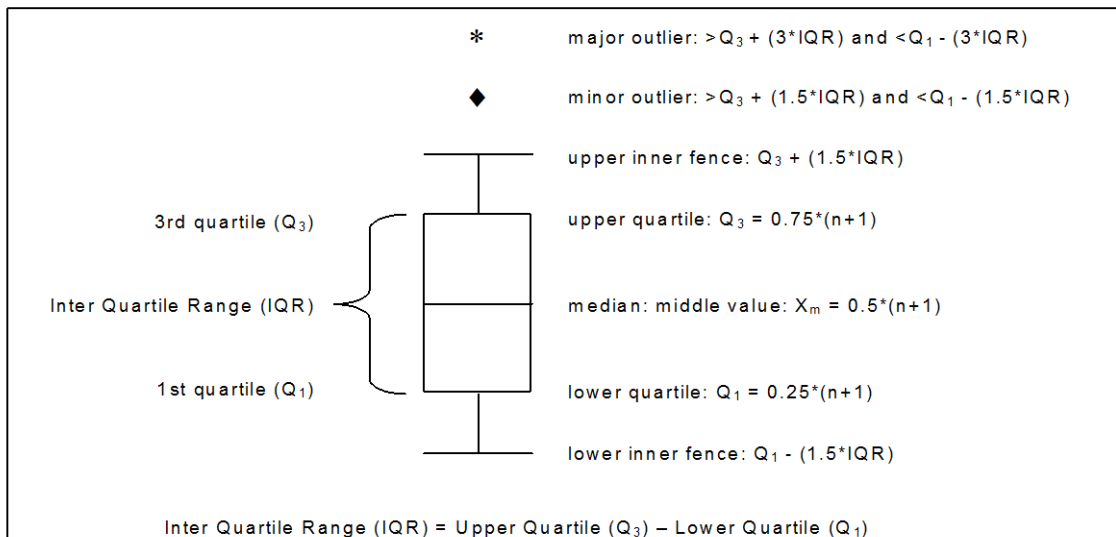
Temperature (°C)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	14.6	14.2	10.7	19.3	5.9	0.10	14.7
Ohaaki Bridge	12	15.4	15.4	10.2	20.2	6.0	-0.11	15.7
Ohakuri Tailrace Bridge	12	16.1	16.1	12.0	20.4	6.3	0.01	16.2
Whakamaru Tailrace	12	16.0	16.2	11.2	20.3	6.7	-0.09	16.3
Waipapa Tailrace	12	15.8	16.2	11.0	20.2	6.6	-0.08	16.0
Narrow s	12	15.7	15.0	11.4	20.2	5.7	0.13	16.0
Horotiu Bridge	12	15.7	15.3	10.7	20.1	6.0	-0.02	15.6
Huntly-Tainui Bridge	12	15.7	15.2	9.8	20	5.7	-0.10	15.5
Mercer Bridge	12	16.2	15.7	10.4	22	6.0	0.13	16.5
Tuakau Bridge	12	16.5	16.0	10.5	21.4	6.1	-0.13	16.6

Dissolved Solids - Total (g/m ³)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	91.1	88.0	81.0	109.0	12.5	0.80	87.0
Ohaaki Bridge	12	112.3	109.5	98.0	137.0	23.0	0.65	110.0
Ohakuri Tailrace Bridge	12	123.5	120.0	114.0	142.0	14.0	0.83	125.5
Whakamaru Tailrace	12	125.4	126.0	111.0	138.0	12.5	-0.17	127.0
Waipapa Tailrace	12	123.3	122.0	107.0	139.0	10.5	0.21	121.5
Narrow s	12	118.9	116.5	108.0	134.0	14.5	0.52	120.0
Horotiu Bridge	12	119.0	118.0	108.0	135.0	7.0	0.78	120.0
Huntly-Tainui Bridge	12	110.8	110.0	99.0	127	9.5	0.48	115.0
Mercer Bridge	12	114.3	114.5	99.0	128	3.5	-0.31	118.0
Tuakau Bridge	12	115.0	113.5	106.0	130.0	9.0	0.88	118.5

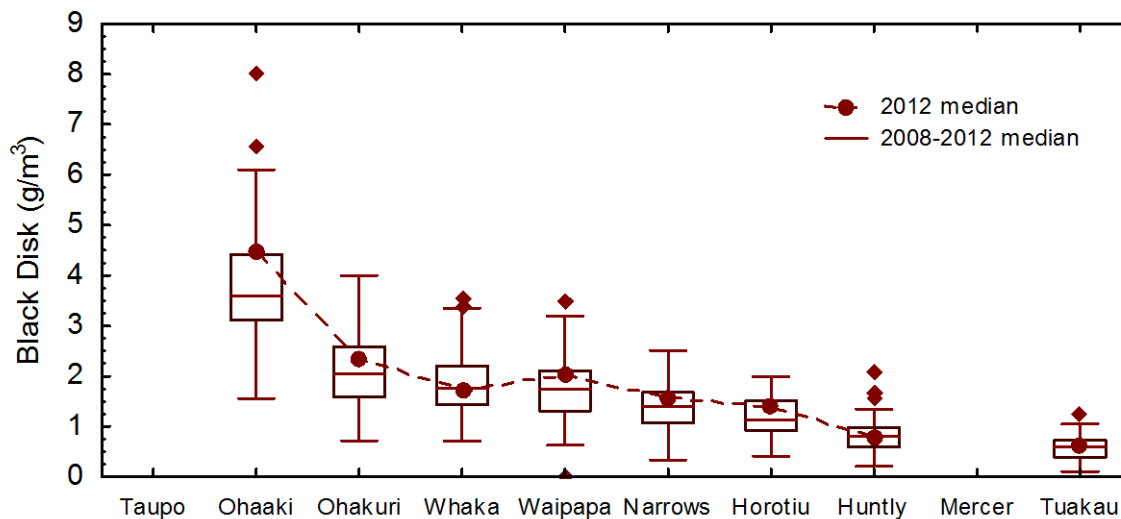
Turbidity (NTU)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.7	0.5	0.3	1.8	0.3	<u>1.79</u>	0.5
Ohaaki Bridge	12	1.7	1.0	0.5	10.2	0.6	<u>2.94</u>	0.7
Ohakuri Tailrace Bridge	12	1.6	1.2	0.8	5.1	0.8	<u>2.34</u>	1.1
Whakamaru Tailrace	12	1.4	1.4	0.8	2.4	0.7	0.61	1.3
Waipapa Tailrace	12	1.4	1.3	1.1	2.1	0.5	0.73	1.3
Narrow s	12	2.2	2.1	1.3	3.9	1.1	0.88	2.1
Horotiu Bridge	12	2.8	2.7	1.6	4.0	0.7	0.32	2.6
Huntly-Tainui Bridge	12	7.4	5.9	2.9	23	4.1	<u>2.17</u>	6.2
Mercer Bridge	12	12.3	9.4	4.2	36	4.7	<u>2.12</u>	10.0
Tuakau Bridge	12	11.1	9.9	4.6	32.0	7.2	<u>1.87</u>	9.3

Skew = skewness. Underlined values = non-normal distribution. IQR = Inter Quartile Range

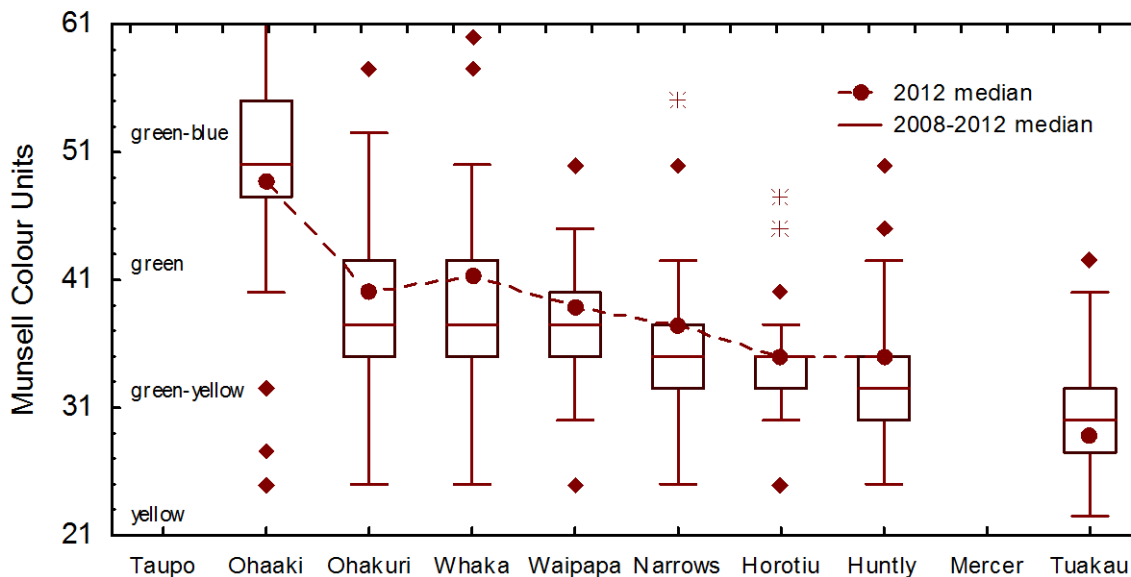
Boxplots are used to present data



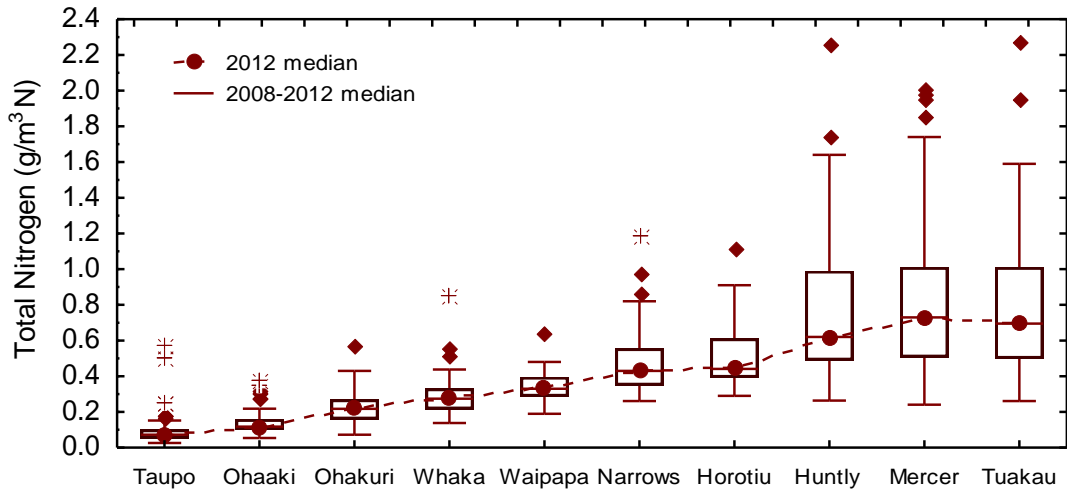
Black Disk, 2008-2012 Data



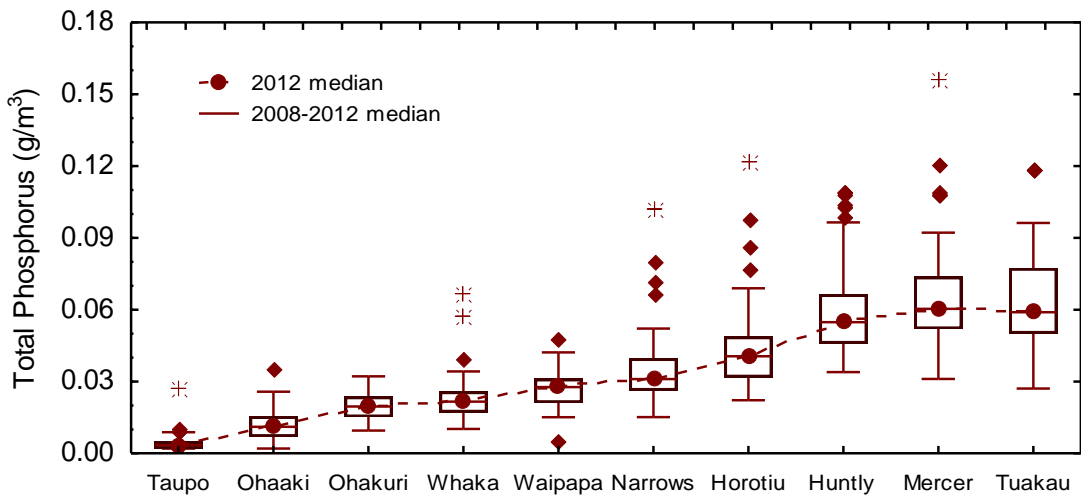
Colour, 2008-2012 Data



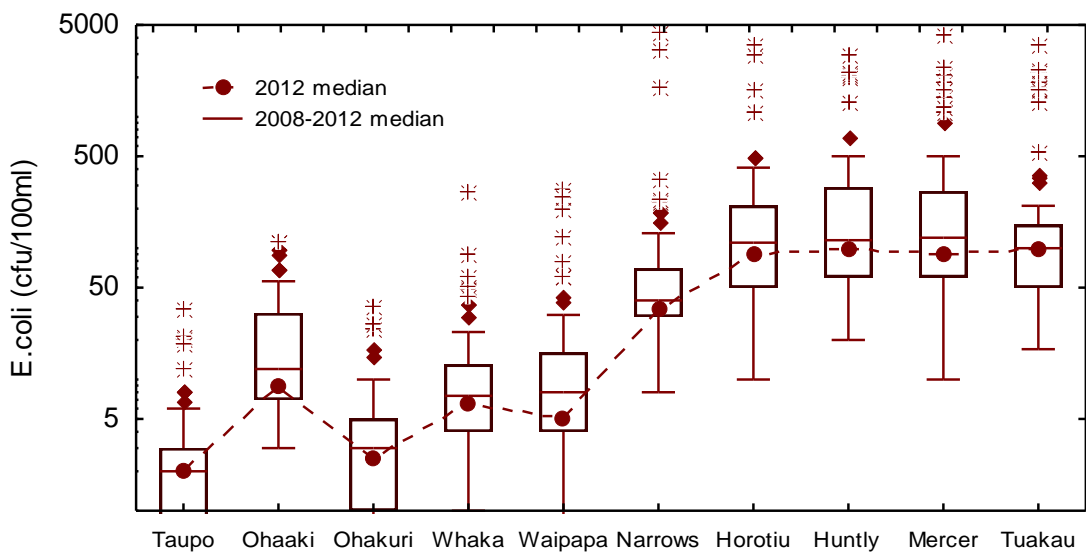
Total Nitrogen, 2008-2012 Data



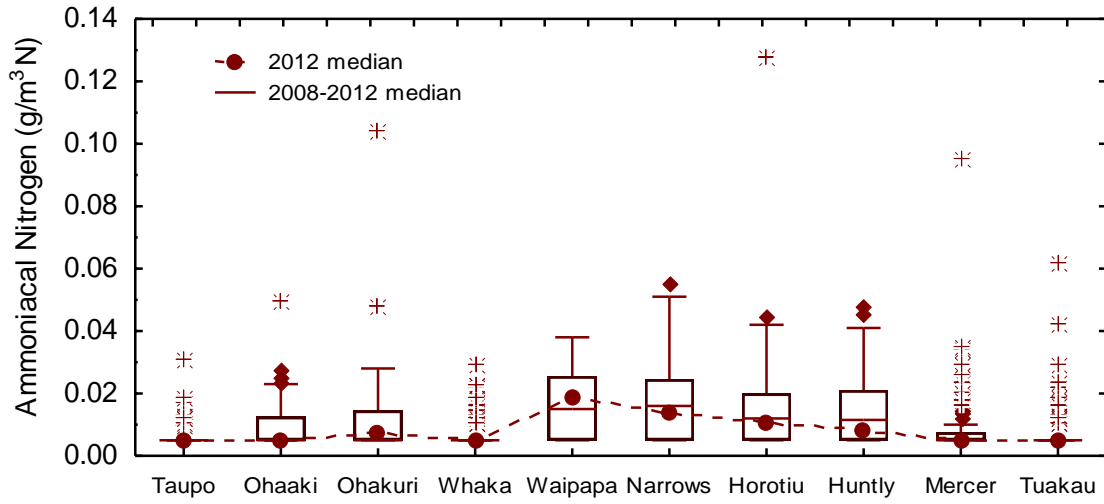
Total Phosphorus, 2008-2012 Data



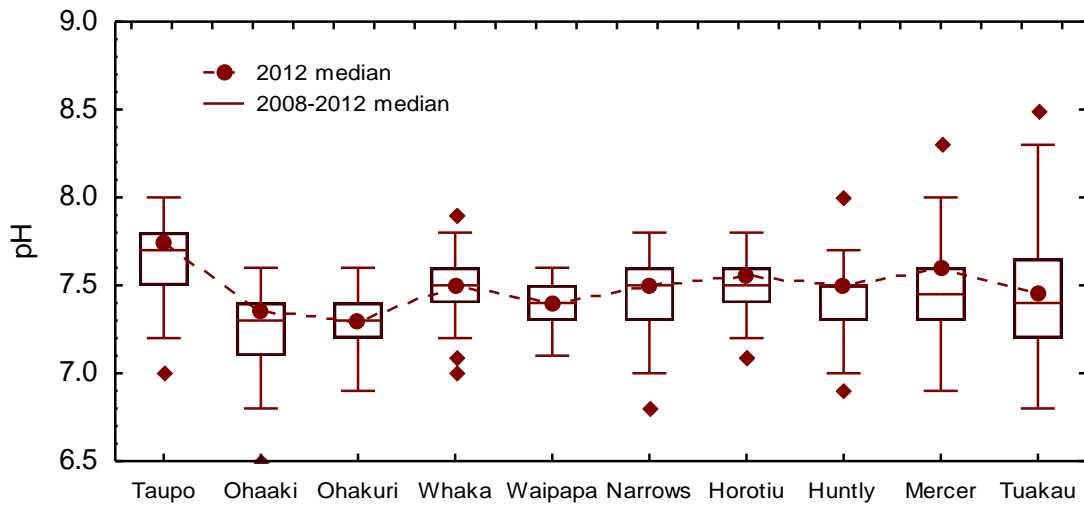
E.coli, 2008-2012 Data



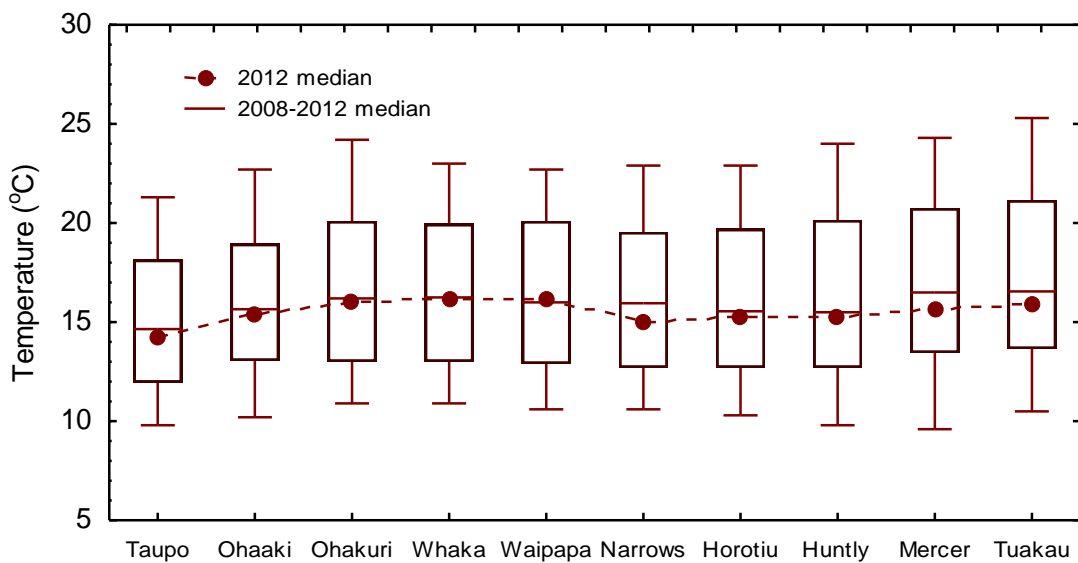
Ammoniacal Nitrogen, 2008-2012 Data



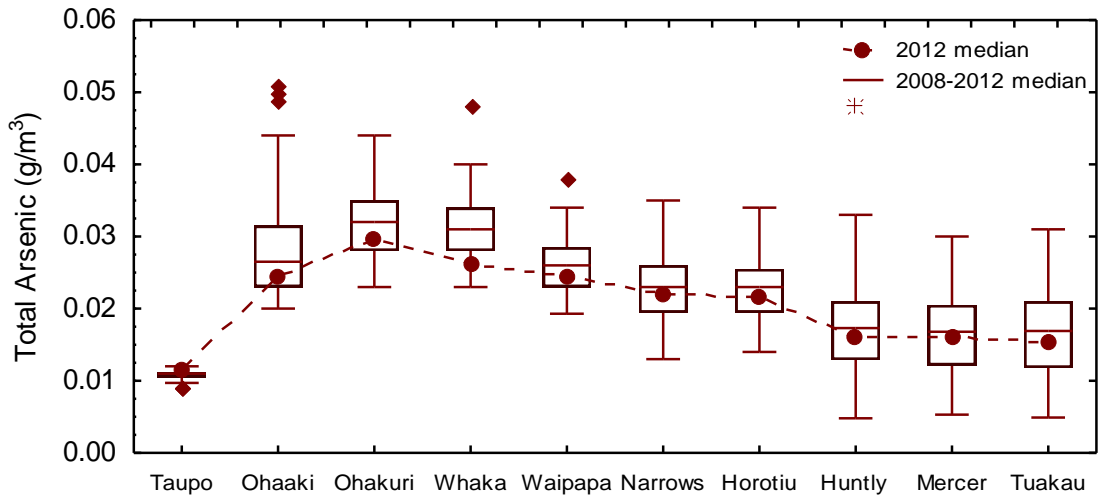
pH, 2008-2012 Data



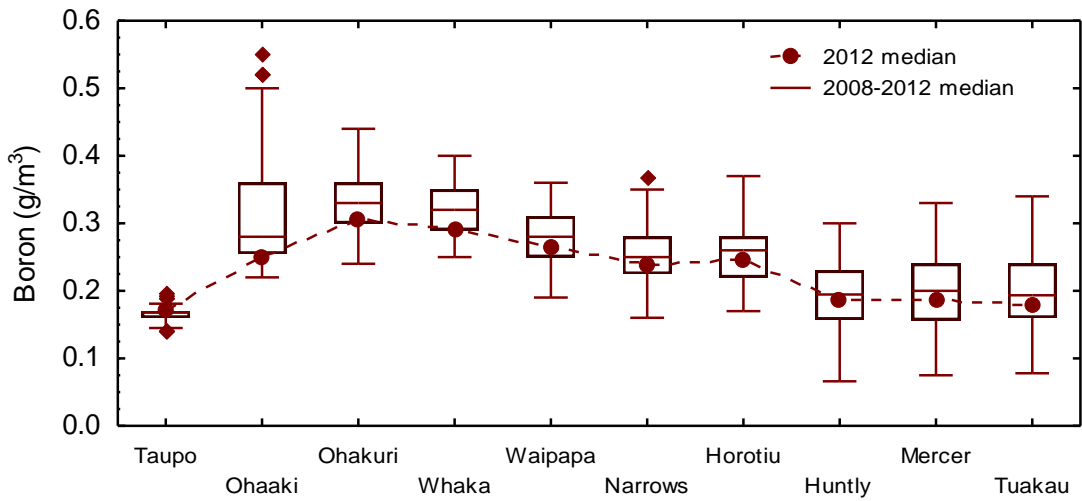
Temperature, 2008-2012 Data



Total Arsenic, 2008-2012 Data



Boron, 2008-2012 Data



Dissolved Oxygen, 2008-2012 Data

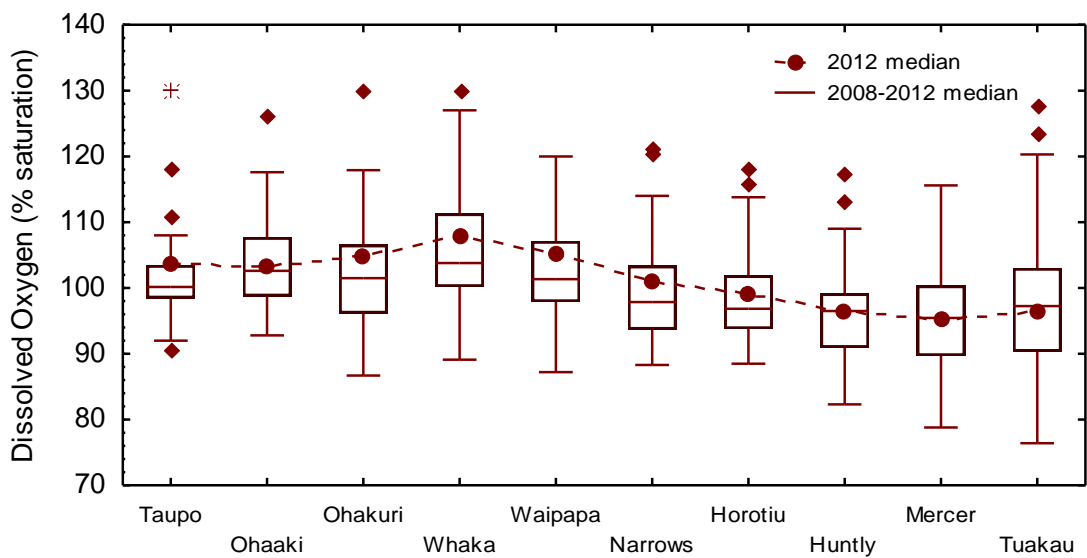


Table 3: Samples (year 2012) complying with the ‘satisfactory’ water quality guidelines and standards. n = 12 (except * where n = 11).

Location	ECOLOGICAL HEALTH							HUMAN USES					
								Recreation			water supply	drinking water	
	DO	pH	Turb	NH ₄ N	Temp	TP	TN	Bk ¹ Disk	E coli	Median E coli	CHLa	As	B
Taupo Gates	12	12	12	12	10	12	12	-	12	Y	12	1	12
Ohaaki Bridge	12	12	11	12	9	12	12	10/10	12	Y	12	0	3
Ohakuri Tailrace Br	12	12	11	12	6	12	11	7/10	12	Y	12	0	6
Whakamaru Tailrace	12	12	12	12	7	12	12	6/10	12	Y	9	0	7
Waipapa Tailrace	12	12	12	12	8	11	12	6/10	12	Y	12	0	9
Hamilton – Narrows	12	12	12	12	7	10	9	4/10	11*	Y*	11	0	12
Horotiu Bridge	12	12	12	12	8	5	8	2/12	10*	Y*	11	0	12
Huntly – Tainui Br	12	12	4	12	6	0	3	0/12	10*	Y*	12	0	12
Mercer Bridge	12	12	1	12	7	0	4	-	8*	Y*	10	2	12
Tuakau Bridge	12	12	2	12	6	0	3	0/12	10*	Y*	10	1	12

¹ samples complying with the baseflow water clarity guideline from the number of samples measured when flow was below the upper decile of all flows

Table 4: Samples (year 2012) complying with the ‘excellent’ water quality guidelines and standards. n = 12 (except * where n = 11).

Location	ECOLOGICAL HEALTH							HUMAN USES					
								Recreation			water supply	Drinking water	
	DO	pH	Turb	NH ₄ N	Temp	TP	TN	Bk ¹ Disk	E coli	Median E coli	CHLa	As	B
Taupo Gates	12	12	12	12	2	10	9	-	12	Y	12	n/a	n/a
Ohaaki Bridge	12	12	11	12	2	2	2	7/10	12	Y	11	n/a	n/a
Ohakuri Tailrace Br	11	12	10	11	2	0	0	1/10	12	Y	10	n/a	n/a
Whakamaru Tailrace	12	12	11	12	2	0	0	0/10	11	Y	6	n/a	n/a
Waipapa Tailrace	12	12	11	12	1	0	0	0/10	11	Y	6	n/a	n/a
Hamilton – Narrows	11	12	5	12	2	0	0	0/10	9*	N*	7	n/a	n/a
Horotiu Bridge	11	12	2	12	2	0	0	0/10	4*	N*	5	n/a	n/a
Huntly – Tainui Br	10	12	0	12	3	0	0	0/12	0*	N*	5	n/a	n/a
Mercer Bridge	9	12	0	12	1	0	0	-	1*	N*	2	n/a	n/a
Tuakau Bridge	10	12	0	12	1	0	0	0/12	3*	N*	0	n/a	n/a

¹ samples complying with the baseflow water clarity guideline from the number of samples measured when flow was below the upper decile of all flows

DATE	TIME*	FLOW	BDISK	COLOR	COND	pH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/mm/yy	hh:mm	m ³ /s	m	units	mS/m	units	°C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water Quality Guideline/Standard			>1.6	-	-	6.5-9	<12 (May-Sep) <20 (Oct-Apr)	>80	-	<5	-	-	-	-	<0.88

1131-127 UD = 270 m³/s (Flows from "Reids Farm")

Waikato River at Taupo Control Gates

05/01/12	8:15 a.m.	290	-	-	11.9	7.5	18.3	9.5	104.6	3.6	0.49	87	0.002	<0.002	0.01
01/02/12	8:15 a.m.	211	-	-	11.8	8.0	19.3	9.3	106.1	<0.4	0.69	102	0.003	<0.002	<0.01
06/03/12	8:30 a.m.	260	-	-	11.5	7.8	17.2	9.2	99.0	0.5	0.50	82	<0.002	<0.002	<0.01
03/04/12	9:20 a.m.	193	-	-	11.5	7.8	17.6	8.9	97.9	0.6	0.47	103	0.002	0.002	<0.01
01/05/12	9:40 a.m.	152	-	-	11.5	8.0	<u>15.0</u>	10.3	106.7	0.8	0.88	86	<0.002	<0.002	<0.01
05/06/12	9:13 a.m.	103	-	-	12.0	7.6	<u>12.7</u>	10.5	103.6	0.6	1.75	81	0.006	0.004	0.03
03/07/12	9:15 a.m.	258	-	-	11.8	7.8	11.1	10.9	99.0	0.6	0.36	83	<0.002	<0.002	<0.01
07/08/12	9:00 a.m.	264	-	-	11.7	7.3	10.7	10.8	102.8	0.9	0.52	92	<0.002	<0.002	<0.01
04/09/12	9:25 a.m.	206	-	-	11.8	7.5	11.0	11.5	108.0	0.7	1.00	88	0.029	0.029	<0.01
02/10/12	9:15 a.m.	228	-	-	11.6	7.7	11.9	11.1	107.8	0.4	0.42	92	0.002	0.002	<0.01
06/11/12	8:13 a.m.	277	-	-	11.9	7.7	13.4	9.9	97.8	0.8	0.56	109	<0.002	<0.002	0.01
11/12/12	8:40 a.m.	245	-	-	11.7	7.9	17.1	9.7	103.7	0.6	0.26	88	<0.002	<0.002	<0.01

1131-105 UD = 276 m³/s (Flows from Ohaaki Bridge Recorder, +/- 20%)

Waikato River at Ohaaki Br

05/01/12	9:30 a.m.	309	(3.3)	-	13.7	7.4	18.4	9.8	107.9	0.4	1.18	99	0.021	0.019	<0.01
01/02/12	8:50 a.m.	174	3.2	27.5	17.6	7.0	<u>20.2</u>	9.0	103.6	<0.4	<u>10.20</u>	137	0.076	0.075	<0.01
06/03/12	10:00 a.m.	214	5.0	62.5	13.6	7.3	18.1	9.5	102.7	0.6	0.52	99	0.028	0.027	<0.01
03/04/12	10:15 a.m.	155	4.5	50.0	14.9	7.4	18.0	9.0	98.7	0.8	0.60	118	0.043	0.043	0.01
01/05/12	10:35 a.m.	116	4.5	-	17.2	7.3	<u>16.3</u>	9.8	103.2	0.7	0.54	133	0.055	0.054	<0.01
05/06/12	10:01 a.m.	101	6.6	57.5	18.4	7.0	<u>14.4</u>	9.8	99.1	0.8	1.23	127	0.077	0.076	0.03
03/07/12	10:10 a.m.	276	4.5	57.5	14.2	7.5	10.2	12.3	106.9	<0.4	1.19	105	0.029	0.029	<0.01
07/08/12	10:40 a.m.	278	(2.6)	47.5	14.1	7.4	11.8	11.9	114.2	0.6	1.36	100	0.032	0.023	<0.01
04/09/12	10:10 a.m.	272	3.4	25.0	13.8	7.3	11.7	13.0	126.1	1.3	1.08	108	0.035	0.035	<0.01
02/10/12	10:15 a.m.	193	4.5	57.5	14.3	7.3	12.7	11.6	113.1	0.6	0.59	98	0.048	0.048	<0.01
06/11/12	9:04 a.m.	253	3.5	42.5	14.2	7.4	14.1	10.3	102.6	1.2	0.85	111	0.026	0.026	<0.01
11/12/12	9:40 a.m.	195	4.5	47.5	15.0	7.4	18.6	9.3	102.7	0.6	0.54	112	0.041	0.041	0.01

1131-107 UD = 358 m³/s (Flows from Ohakuri Dam - Total)

Waikato River at Ohakuri Tailrace Br

05/01/12	10:15 a.m.	301	1.7	-	15.9	7.3	19.1	9.1	101.2	2.5	1.75	114	0.086	0.085	0.02
01/02/12	9:39 a.m.	286	2.6	32.5	15.1	7.5	<u>20.4</u>	9.4	108.4	<0.4	1.17	123	0.030	0.029	0.01
06/03/12	10:54 a.m.	285	2.3	50.0	16.3	7.5	19.0	8.2	89.9	<0.4	1.04	116	0.057	0.057	0.02
03/04/12	11:08 a.m.	296	<u>1.5</u>	42.5	16.5	7.2	18.6	8.9	98.1	0.6	<u>5.10</u>	137	0.063	0.062	0.10
01/05/12	11:25 a.m.	291	3.4	-	16.6	7.5	<u>16.5</u>	9.8	103.2	0.7	1.51	117	0.078	0.077	<0.01
05/06/12	10:56 a.m.	292	2.7	37.5	18.6	7.3	<u>13.0</u>	10.0	98.2	0.8	2.20	133	0.172	0.171	0.02
03/07/12	10:55 a.m.	319	4.0	57.5	19.0	7.3	<u>12.0</u>	10.5	96.3	0.6	0.85	142	0.200	0.200	0.02
07/08/12	11:35 a.m.	351	-	-	16.5	7.1	<u>12.5</u>	11.0	107.6	<0.4	0.92	119	0.145	0.144	<0.01
04/09/12	11:00 a.m.	393	(3.3)	25.0	15.7	7.3	<u>12.4</u>	12.0	117.0	0.7	0.82	121	0.175	0.172	<0.01
02/10/12	11:04 a.m.	319	2.3	57.5	15.8	7.3	13.8	11.2	111.8	0.8	0.80	117	0.125	0.122	<0.01
06/11/12	10:12 a.m.	314	<u>1.1</u>	40.0	15.5	7.6	15.6	10.4	106.4	1.7	1.30	128	0.029	0.028	<0.01
11/12/12	10:40 a.m.	313	<u>1.3</u>	37.5	15.9	7.5	19.8	10.2	114.9	1.6	1.68	115	0.003	0.002	<0.01

1131-147 UD = 325 m³/s (Flows from Whakamaru Dam - Total)

Waikato River at Whakamaru Tailrace

05/01/12	10:50 a.m.	265	<u>1.4</u>	-	16.8	7.4	19.6	9.5	105.8	0.9	1.5	122	0.106	0.104	<0.01
01/02/12	10:10 a.m.	237	2	32.5	14.6	7.8	20.3	9.7	110.4	2.3	2.4	131	0.029	0.027	0.03
06/03/12	11:43 a.m.	265	<u>1.1</u>	50.0	16.0	7.7	19.1	9.2	100.2	1.2	1.3	120	0.072	0.071	<0.01
03/04/12	12:00 p.m.	220	1.7	42.5	16.0	7.5	18.7	9.5	103.8	0.6	1.0	133	0.072	0.072	0.02
01/05/12	12:10 p.m.	252	3.4	-	16.5	7.5	<u>16.5</u>	10.3	107.3	1.1	1.7	138	0.149	0.147	<0.01
05/06/12	11:42 a.m.	229	2.2	47.5	16.9	7.4	<u>12.6</u>	10.5	101.4	0.9	0.9	119	0.210	0.210	<0.01
03/07/12	11:43 a.m.	312	3.4	42.5	16.7	7.5	11.2	11.3	101.1	0.6	1.0	129	0.220	0.220	0.02
07/08/12	12:50 p.m.	335	(1.8)	47.5	15.5	7.4	<u>12.3</u>	11.2	108.5	<0.4	1.4	125	0.220	0.220	<0.01
04/09/12	11:45 a.m.	298	2.4	25.0	15.4	7.4	<u>12.7</u>	11.3	110.0	0.8	0.8	127	0.185	0.184	<0.01
02/10/12	11:45 a.m.	347	(1.6)	40.0	15.1	7.9	14.1	12.7	126.0	2.4	1.4	114	0.081	0.078	<0.01
06/11/12	11:03 a.m.	304	<u>1.0</u>	37.5	15.2	7.7	15.8	11.1	113.8	2.0	1.6	136	0.044	0.043	0.01
11/12/12	11:35 a.m.	334	<u>1.2</u>	37.5	15.4	7.6	19.6	10.6	117.2	1.6	1.8	111	0.038	0.038	<0.01

Note: < = less than the value stated
UD = upper decile flow (long-term record 1993-2012 inclusive)

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

*New Zealand Standard Time

() black disk measurements taken in flows above upper decile values –don't assess for compliance

TKN g/m ³	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 cfu/100mL	FC cfu/100mL	E coli cfu/100mL	CHLA g/m ³	DOC g/m ³	TOC g/m ³
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		
0.09	0.09	<0.004	0.003	8.5	<u>0.011</u>	0.17	0.038	<0.002	<0.002	<1	4	2	<0.003	0.8	1.1
0.06	0.06	<0.004	0.005	8.7	<u>0.011</u>	0.17	0.042	<0.002	<0.002	4	2	2	<0.003	0.7	1.0
0.11	0.11	<0.004	0.004	8.4	<u>0.010</u>	0.17	0.040	<0.002	<0.002	2	2	2	<0.003	0.9	1.1
0.07	0.07	<0.004	0.002	8.3	<u>0.012</u>	0.18	0.044	<0.002	<0.002	<1	4	3	<0.003	0.6	1.0
0.05	0.05	0.006	0.010	8.4	<u>0.011</u>	0.17	0.040	<0.002	<0.002	<1	4	4	<0.003	1.1	1.2
0.06	0.07	<0.004	0.010	8.9	0.009	0.17	0.040	<0.002	<0.002	<1	2	2	<0.003	1.5	1.9
<0.05	0.05	<0.004	0.002	8.6	<u>0.012</u>	0.15	0.035	<0.002	<0.002	<1	<1	<1	<0.003	0.5	0.9
0.15	0.15	<0.004	0.007	8.6	<u>0.011</u>	0.17	0.041	<0.002	<0.002	<1	<1	<1	<0.003	0.6	1.0
0.07	0.10	<0.004	0.027	8.2	<u>0.012</u>	0.17	0.041	<0.002	<0.002	<1	<1	<1	<0.003	1.0	1.2
<0.05	0.05	<0.004	<0.004	8.5	<u>0.012</u>	0.16	0.040	<0.002	<0.002	1	2	2	<0.003	1.1	2.0
<0.05	0.05	<0.004	<0.004	8.1	<u>0.012</u>	0.17	0.042	<0.002	<0.002	1	2	<1	<0.003	1.8	2.3
<0.05	0.05	<0.004	<0.004	9.1	<u>0.012</u>	0.16	0.040	<0.002	<0.002	2	1	3	<0.003	0.9	1.0
0.26	0.28	<0.004	0.003	13.1	<u>0.022</u>	0.24	0.068	0.004	<0.002	28	32	26	<0.003	2.2	2.4
0.24	0.32	0.004	0.035	23.0	<u>0.040</u>	<u>0.52</u>	0.099	0.003	<0.002	30	40	40	<0.003	1.4	1.5
0.09	0.12	<0.004	0.008	14.1	<u>0.021</u>	0.24	0.074	<0.002	<0.002	37	30	23	<0.003	1.1	1.1
0.15	0.19	0.005	0.008	16.6	<u>0.028</u>	0.29	0.093	0.002	<0.002	11	12	9	<0.003	0.6	1.0
0.09	0.15	0.008	0.006	23.0	<u>0.038</u>	<u>0.36</u>	0.124	0.003	<0.002	7	12	9	<0.003	0.9	1.0
0.09	0.17	0.013	0.018	24.0	<u>0.031</u>	<u>0.40</u>	0.135	0.002	<0.002	3	4	4	<0.003	0.9	1.1
<0.05	0.08	0.005	0.007	15.4	<u>0.024</u>	0.25	0.076	<0.002	<0.002	1	7	4	<0.003	0.6	1.4
0.18	0.21	0.005	0.013	14.6	<u>0.021</u>	0.24	0.074	<0.002	<0.002	2	6	6	<0.003	0.7	1.1
0.27	0.31	<0.004	0.019	13.1	<u>0.023</u>	0.23	0.072	0.002	<0.002	5	7	7	<0.003	1.6	1.7
0.10	0.15	0.005	0.009	15.0	<u>0.025</u>	0.24	0.074	0.003	<0.002	<1	21	17	<0.003	1.1	1.2
0.07	0.10	0.006	0.006	14.1	<u>0.023</u>	0.25	0.076	<0.002	<0.002	5	7	7	0.013	1.3	1.2
<0.05	0.09	0.005	<0.004	16.9	<u>0.026</u>	0.27	0.082	0.002	<0.002	17	6	20	<0.003	1.0	1.1
0.48	<u>0.57</u>	0.009	0.015	18.0	<u>0.032</u>	<u>0.31</u>	0.103	0.010	<0.002	14	23	17	<0.003	1.2	1.4
0.08	0.11	0.004	0.017	16.6	<u>0.029</u>	0.26	0.092	0.005	<0.002	<1	1	1	0.004	1.3	1.4
0.14	0.20	0.014	0.022	19.3	<u>0.032</u>	0.30	0.114	0.006	<0.002	1	5	4	<0.003	1.3	1.5
0.10	0.16	<0.004	0.023	19.5	<u>0.032</u>	<u>0.33</u>	0.113	0.008	<0.002	<1	4	4	<0.003	0.7	1.0
0.09	0.17	0.010	0.020	19.8	<u>0.031</u>	<u>0.33</u>	0.115	0.006	<0.002	1	1	1	<0.003	1.1	1.2
0.10	0.27	0.015	0.028	23.0	<u>0.028</u>	<u>0.40</u>	0.138	0.007	<0.002	<1	1	1	0.003	1.0	1.3
0.12	0.32	0.017	0.020	25.0	<u>0.035</u>	<u>0.38</u>	0.137	0.005	<0.002	<1	<1	<1	<0.003	0.6	1.2
0.08	0.23	0.013	0.019	18.9	<u>0.026</u>	0.30	0.106	0.004	<0.002	3	5	5	<0.003	0.8	1.3
0.09	0.27	0.024	0.019	16.4	<u>0.027</u>	0.28	0.096	0.007	<0.002	2	<1	<1	<0.003	1.2	1.5
0.09	0.22	0.010	0.015	17.1	<u>0.027</u>	0.28	0.093	0.005	<0.002	<1	2	2	0.005	1.1	1.2
0.10	0.13	0.005	0.012	15.8	<u>0.028</u>	0.29	0.091	0.004	<0.002	<1	3	3	<0.003	1.5	1.4
0.10	0.10	<0.004	0.012	19.1	<u>0.030</u>	<u>0.31</u>	0.098	0.005	<0.002	4	1	4	0.011	1.2	1.3
0.18	0.29	0.007	0.023	20.0	<u>0.032</u>	<u>0.34</u>	0.123	0.015	0.004	1	15	12	0.005	1.1	1.6
0.19	0.22	0.006	0.034	15.5	<u>0.026</u>	0.25	0.086	0.005	<0.002	3	1	1	<u>0.028</u>	1.0	1.4
0.17	0.24	0.009	0.026	19.5	<u>0.032</u>	<u>0.31</u>	0.115	0.009	0.002	3	10	10	<u>0.021</u>	1.3	1.5
0.10	0.17	0.005	0.021	19.4	<u>0.031</u>	<u>0.32</u>	0.118	0.006	<0.002	5	1	1	0.005	0.8	1.3
0.12	0.27	0.013	0.020	20.0	<u>0.029</u>	<u>0.32</u>	0.117	0.006	<0.002	3	6	6	<0.003	1.3	1.4
0.08	0.29	0.013	0.022	20.0	<u>0.023</u>	<u>0.35</u>	0.125	0.005	<0.002	4	4	4	0.004	0.9	1.3
0.08	0.30	0.016	0.032	19.9	<u>0.025</u>	0.29	0.103	0.007	<0.002	<1	2	2	0.004	0.7	1.3
0.11	0.33	0.014	0.025	18.0	<u>0.025</u>	0.29	0.101	0.006	<0.002	9	11	10	0.003	0.9	1.4
0.10	0.29	0.012	0.010	16.3	<u>0.026</u>	0.25	0.093	0.007	<0.002	<1	3	3	<0.003	1.3	1.7
0.35	0.43	0.005	0.018	16.6	<u>0.026</u>	0.25	0.088	0.007	<0.002	>600	90	90	<u>0.045</u>	1.2	1.5
0.18	0.22	<.004	0.015	15.4	<u>0.026</u>	0.26	0.088	0.005	<0.002	1	10	7	0.005	1.5	1.8
0.10	0.14	<.004	0.013	18.3	<u>0.029</u>	0.27	0.093	0.005	<0.002	11	6	14	0.015	1.2	1.4

Note: < = less than the value stated

UD = upper decile flow (long-term record 1993-2012 inclusive)

*New Zealand Standard Time

TP results corrected for arsenic interference

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

() black disk measurements taken in flows above upper decile values –don't assess for compliance

DATE	TIME*	FLOW	BDISK	COLOR	COND	PH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/m/yy	hh:mm	m ³ /s	m	units	mS/m	units	'C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water Quality Guideline/Standard			>1.6	-	-	6.5-9	<12 (May-Sep)	>80	-	<5	-	-	-	-	<0.88
							<20 (Oct-Apr)								

1131-143 UD = 395 m³/s (Flows from Waipapa Dam - Total)

Waikato River at Waipapa Tailrace

05/01/12	11:38 a.m.	376	<u>1.2</u>	-	16.3	7.4	19.6	9.6	105.9	0.7	1.76	122	0.132	0.132	0.03
01/02/12	10:50 a.m.	231	2.1	32.5	14.5	7.5	<u>20.2</u>	9.4	105.5	<0.4	1.19	137	0.137	0.134	0.02
06/03/12	12:40 p.m.	305	3.5	50.0	16.0	7.4	19.5	9.2	101.4	0.7	1.59	122	0.133	0.132	0.02
03/04/12	12:41 p.m.	246	<u>1.5</u>	42.5	15.5	7.5	18.3	9.3	100.1	0.6	1.05	124	0.131	0.127	0.03
01/05/12	12:55 p.m.	261	2.3	-	17.0	7.5	<u>16.2</u>	9.9	101.8	0.8	1.16	139	0.210	0.210	0.02
05/06/12	12:25 p.m.	235	2.6	37.5	17.3	7.2	<u>12.9</u>	10.3	98.9	0.8	1.27	131	0.320	0.320	<0.01
03/07/12	12:14 p.m.	409	(2.6)	42.5	15.2	7.4	11.0	11.2	99.1	0.4	1.09	115	0.270	0.270	0.01
07/08/12	1:20 p.m.	329	<u>1.3</u>	40.0	15.3	7.3	11.8	11.2	105.8	1.0	1.37	119	0.290	0.290	<0.01
04/09/12	12:15 p.m.	336	2.1	25.0	15.0	7.3	<u>12.4</u>	11.2	107.3	0.7	1.19	122	0.260	0.260	<0.01
02/10/12	12:20 p.m.	346	1.9	40.0	15.2	7.4	13.1	11.6	112.9	1.1	1.48	116	0.230	0.230	<0.01
06/11/12	11:50 a.m.	421	<u>(1.2)</u>	37.5	16.2	7.6	16.1	10.6	107.9	2.7	1.95	107	0.140	0.137	0.02
11/12/12	12:26 p.m.	263	<u>1.2</u>	37.5	16.5	7.4	18.9	9.6	104.7	1.4	2.10	125	0.107	0.103	0.02

1131-328 UD = 382 m³/s (Flows from Karapiro Dam - Total)

Waikato River at Narrows Boat Ramp

06/01/12	7:53 a.m.	392	(1.8)	37.5	15.1	7.4	19.4	9.3	100.2	0.8	2.10	112	0.230	0.220	0.04
02/02/12	8:04 a.m.	218	1.7	37.5	14.6	7.6	<u>20.2</u>	8.0	88.5	0.8	1.48	110	0.189	0.185	0.03
07/03/12	8:21 a.m.	269	1.9	42.5	15.6	7.5	18.8	9.5	101.8	0.9	1.85	134	0.220	0.220	<0.01
04/04/12	8:50 a.m.	224	2.0	25.0	15.6	7.5	18.5	8.9	93.6	0.8	1.37	124	0.230	0.220	0.02
02/05/12	8:40 a.m.	220	2.5	50.0	16.2	7.6	<u>15.2</u>	9.8	96.7	0.6	1.27	134	0.270	0.260	0.02
06/06/12	9:15 a.m.	212	<u>0.9</u>	32.5	16.3	7.6	<u>13.1</u>	10.3	99.8	0.6	1.55	119	0.400	0.400	<0.01
04/07/12	9:20 a.m.	391	<u>(1.4)</u>	32.5	16.1	7.3	11.4	10.4	96.2	0.9	3.90	127	0.440	0.440	0.03
08/08/12	8:57 a.m.	377	<u>1.6</u>	55.0	14.6	7.4	<u>12.1</u>	11.1	104.5	0.9	3.10	114	0.500	0.500	<0.01
05/09/12	8:55 a.m.	345	<u>1.4</u>	37.5	14.6	7.4	<u>12.9</u>	11.1	105.3	1.0	2.50	121	0.350	0.350	<0.01
03/10/12	8:02 a.m.	344	<u>1.1</u>	35.0	14.3	7.7	13.2	11.8	111.9	1.8	2.10	110	0.330	0.330	<0.01
07/11/12	7:50 a.m.	351	<u>1.5</u>	37.5	14.1	7.5	14.7	10.6	102.9	1.1	2.10	114	0.210	0.210	0.01
05/12/12	7:40 a.m.	209	<u>1.0</u>	30.0	14.8	7.3	18.6	11.2	120.5	2.2	2.70	108	0.096	0.094	0.02

1131-69 UD = 374 m³/s (Flows from Hamilton - Bridge Street Bridge)

Waikato River at Horotiu Br

06/01/12	8:47 a.m.	333	1.7	32.5	15.3	7.4	19.8	9.0	97.9	0.7	2.80	110	0.250	0.250	0.04
02/02/12	8:50 a.m.	189	<u>1.3</u>	35.0	14.7	7.6	<u>20.1</u>	8.1	89.2	0.5	2.40	114	0.210	0.210	0.03
07/03/12	9:16 a.m.	198	<u>1.5</u>	30.0	15.8	7.6	19.2	9.3	100.8	0.7	1.99	121	0.210	0.210	<0.01
04/04/12	9:30 a.m.	200	2.0	40.0	15.8	7.6	18.5	8.9	92.8	1.2	2.80	118	0.220	0.220	0.01
02/05/12	9:24 a.m.	154	<u>1.6</u>	47.5	16.5	7.6	<u>15.2</u>	9.9	97.5	0.7	1.55	135	0.280	0.270	0.01
06/06/12	9:50 a.m.	204	<u>1.0</u>	32.5	16.2	7.5	<u>13.4</u>	10.1	98.2	0.7	2.30	118	0.430	0.420	<0.01
04/07/12	10:05 a.m.	246	<u>1.5</u>	35.0	16.0	7.4	10.7	10.5	94.6	0.7	2.90	132	0.460	0.460	0.03
08/08/12	9:35 a.m.	334	<u>1.5</u>	47.5	14.7	7.4	11.6	11.2	103.5	<0.4	3.90	117	0.550	0.550	0.01
05/09/12	9:37 a.m.	367	<u>1.3</u>	35.0	14.8	7.5	<u>12.4</u>	11.1	105.4	0.8	3.20	118	0.400	0.400	<0.01
03/10/12	8:35 a.m.	247	<u>1.0</u>	35.0	14.5	7.8	13.6	11.6	110.8	1.5	2.60	115	0.360	0.360	<0.01
07/11/12	8:35 a.m.	321	<u>1.2</u>	35.0	14.2	7.6	15.4	10.1	99.7	1.2	2.60	122	0.230	0.230	<0.01
05/12/12	8:35 a.m.	311	<u>1.0</u>	30.0	15.1	7.3	18.2	10.8	115.9	1.7	4.00	108	0.116	0.113	0.01

1131-77 UD = 578 m³/s (Flows from Huntly Power Station Recorder)

Waikato River at Huntly-Tainui Br

06/01/12	9:51 a.m.	564	<u>0.7</u>	27.5	13.6	7.2	<u>20.2</u>	8.2	89.9	0.9	<u>10.20</u>	99	0.440	0.440	0.02
02/02/12	9:20 a.m.	308	<u>0.8</u>	35.0	14.4	7.5	<u>20.1</u>	8.1	89.9	0.7	3.90	108	0.290	0.290	0.01
07/03/12	10:00 a.m.	278	<u>1.0</u>	30.0	14.8	7.5	18.6	9.3	99.2	0.7	4.60	117	0.310	0.300	<0.01
04/04/12	10:00 a.m.	263	<u>1.0</u>	40.0	16.1	7.5	18.3	9.0	95.7	0.8	4.10	115	0.300	0.300	<0.01
02/05/12	9:50 a.m.	225	<u>0.5</u>	50.0	15.7	7.5	<u>14.9</u>	10.0	97.6	0.5	2.90	127	0.360	0.350	0.01
06/06/12	10:20 a.m.	272	<u>0.7</u>	37.5	14.9	7.5	<u>13.2</u>	9.9	95.8	0.8	<u>5.30</u>	105	0.560	0.560	<0.01
04/07/12	10:40 a.m.	458	<u>1.1</u>	35.0	14.2	7.4	9.8	10.5	92.9	0.5	<u>6.80</u>	116	0.680	0.680	0.02
08/08/12	10:31 a.m.	525	<u>1.0</u>	42.5	13.8	7.2	<u>12.3</u>	10.2	96.3	<0.4	<u>10.10</u>	107	0.900	0.900	0.02
05/09/12	10:35 a.m.	557	<u>0.5</u>	32.5	13.0	7.4	<u>12.6</u>	10.3	97.4	0.9	<u>23.00</u>	113	0.650	0.640	0.02
03/10/12	9:11 a.m.	388	<u>0.6</u>	35.0	14.2	7.3	14.0	11.1	107.6	1.2	<u>5.40</u>	108	0.600	0.600	<0.01
07/11/12	9:10 a.m.	383	<u>0.8</u>	32.5	13.8	7.6	15.5	9.8	96.6	1.2	<u>6.60</u>	112	0.330	0.320	<0.01
05/12/12	9:18 a.m.	335	<u>0.6</u>	30.0	14.9	7.5	18.5	10.6	113.3	1.9	<u>6.40</u>	102	0.148	0.145	<0.01

Note: < = less than the value stated

UD = upper decile flow (long-term record 1993-2012 inclusive)

*New Zealand Standard Time

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

() black disk measurements taken in flows above upper decile values –don't assess for compliance

TKN g/m ³	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 cfu/100mL	FC cfu/100mL	E coli	CHLA g/m ³	DOC g/m ³	TOC g/m ³
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		
0.14	0.27	0.009	0.021	19.3	<u>0.028</u>	<u>0.32</u>	0.111	0.012	0.003	<1	15	15	0.005	1.0	1.5
0.18	0.32	0.016	0.025	15.1	<u>0.024</u>	0.22	0.080	0.008	<0.002	3	5	5	0.005	1.0	1.4
0.16	0.29	0.018	0.036	19.7	<u>0.025</u>	0.27	0.099	0.011	<0.002	5	9	4	0.006	1.8	2.1
0.12	0.25	0.012	0.025	18.3	<u>0.028</u>	0.30	0.104	0.007	<0.002	6	5	5	<0.003	1.0	1.4
0.12	0.33	0.020	0.028	21.0	<u>0.028</u>	0.29	0.108	0.010	<0.002	4	4	3	<0.003	1.5	1.7
0.11	0.43	0.022	0.030	21.0	<u>0.023</u>	<u>0.32</u>	0.122	0.013	0.002	6	8	4	<0.003	1.5	1.8
0.09	0.36	0.018	0.025	17.1	<u>0.021</u>	0.24	0.086	0.008	<0.002	1	4	2	<0.003	0.7	1.3
0.11	0.40	0.017	0.028	17.3	<u>0.021</u>	0.26	0.094	0.008	<0.002	32	13	12	0.003	0.8	1.4
0.10	0.36	0.013	0.005	15.7	<u>0.024</u>	0.23	0.085	0.007	<0.002	29	60	60	0.004	1.3	1.8
0.12	0.35	0.016	0.019	16.6	<u>0.023</u>	0.23	0.084	0.008	<0.002	<1	15	15	0.011	1.2	1.4
0.17	0.31	<0.004	0.021	17.2	<u>0.025</u>	0.27	0.087	0.008	<0.002	<1	9	8	0.010	2.5	2.2
0.16	0.27	0.009	0.022	19.3	<u>0.026</u>	0.25	0.081	0.010	<0.002	2	1	3	0.010	2.0	2.3
0.17	0.40	0.019	0.030	17.7	<u>0.024</u>	0.26	0.091	0.018	0.004	37	53	37	<0.003	1.5	1.9
0.15	0.34	0.013	0.029	15.3	<u>0.022</u>	0.20	0.074	0.008	<0.002	34	30	30	0.003	1.3	1.8
0.21	0.43	0.013	0.029	18.9	<u>0.024</u>	0.24	0.087	0.011	<0.002	31	27	21	0.009	1.4	1.7
0.15	0.38	0.015	0.029	17.1	<u>0.023</u>	0.24	0.088	0.009	<0.002	30	42	36	0.003	1.6	2.0
0.13	0.40	0.021	0.032	19.0	<u>0.023</u>	0.25	0.088	0.011	0.002	11	18	13	<0.003	1.6	1.6
0.14	<u>0.54</u>	0.022	0.032	18.7	<u>0.020</u>	0.26	0.103	0.016	0.003	<u>110</u>	31	29	0.004	1.6	1.9
0.09	<u>0.53</u>	0.024	<u>0.043</u>	18.9	<u>0.017</u>	0.25	0.093	0.017	0.003	70	220	190	0.004	1.1	2.0
0.31	<u>0.81</u>	0.022	0.033	16.9	<u>0.019</u>	0.24	0.081	0.014	0.003	15	45	38	0.004	1.3	2.1
0.15	0.50	0.015	<u>0.102</u>	16.1	<u>0.019</u>	0.25	0.091	0.011	<0.002	16	120	120	0.011	2.1	2.7
0.13	0.46	0.006	0.019	15.1	<u>0.018</u>	0.19	0.068	0.009	<0.002	11	40	34	<u>0.023</u>	1.5	1.7
0.16	0.37	<0.004	0.020	13.8	<u>0.022</u>	0.20	0.067	0.009	<0.002	5	20	14	0.009	1.9	2.0
0.29	0.39	0.004	0.019	15.1	<u>0.026</u>	0.21	0.074	0.006	<0.002	-	-	-	0.009	1.6	1.9
0.19	0.44	0.023	0.037	17.6	<u>0.024</u>	0.25	0.091	0.018	0.003	57	110	100	<0.003	1.5	2.1
0.18	0.39	0.018	0.038	15.6	<u>0.022</u>	0.21	0.074	0.009	<0.002	<u>130</u>	250	170	0.006	1.4	1.7
0.22	0.43	0.018	0.038	19.5	<u>0.024</u>	0.25	0.090	0.011	<0.002	10	100	90	0.009	1.7	1.8
0.19	0.41	0.016	0.033	16.9	<u>0.023</u>	0.26	0.097	0.010	0.002	38	80	50	0.003	2.1	4.9
0.14	0.42	0.023	0.033	19.1	<u>0.023</u>	0.27	0.093	0.011	0.002	30	60	40	<0.003	1.6	1.6
0.14	<u>0.57</u>	0.028	0.040	18.9	<u>0.021</u>	0.28	0.113	0.015	0.003	<u>1400</u>	2600	<u>1600</u>	0.006	1.6	2.0
0.12	<u>0.58</u>	0.029	<u>0.045</u>	19.1	<u>0.018</u>	0.26	0.097	0.015	0.003	60	140	140	0.003	1.3	2.2
0.14	<u>0.69</u>	0.030	<u>0.044</u>	16.8	<u>0.017</u>	0.22	0.080	0.016	0.003	15	30	30	0.004	1.3	2.3
0.21	<u>0.61</u>	0.022	<u>0.121</u>	16.1	<u>0.018</u>	0.24	0.091	0.015	<0.002	34	170	110	0.010	1.8	2.8
0.14	0.50	0.010	0.027	15.4	<u>0.018</u>	0.20	0.068	0.011	0.002	24	40	40	0.020	1.4	1.9
0.17	0.40	0.009	0.029	13.9	<u>0.021</u>	0.21	0.067	0.009	<0.002	20	10	10	0.005	1.7	2.1
0.19	0.31	0.007	0.024	15.1	<u>0.024</u>	0.23	0.075	0.008	<0.002	-	-	-	0.011	1.5	2.1
0.26	<u>0.70</u>	0.028	<u>0.064</u>	14.8	<u>0.015</u>	0.17	0.054	0.038	0.008	40	200	180	<0.003	2.7	3.6
0.20	0.49	0.021	<u>0.046</u>	15.2	<u>0.019</u>	0.19	0.063	0.012	<0.002	30	100	100	0.007	1.3	2.0
0.22	<u>0.53</u>	0.021	<u>0.043</u>	18.1	<u>0.019</u>	0.19	0.070	0.019	0.003	40	110	110	0.008	2.0	2.6
0.16	0.46	0.019	<u>0.051</u>	16.6	<u>0.019</u>	0.22	0.079	0.014	<0.002	24	50	50	0.006	2.1	2.3
0.15	<u>0.51</u>	0.025	0.039	17.9	<u>0.018</u>	0.23	0.075	0.017	0.004	12	50	50	<0.003	1.8	1.9
0.19	<u>0.75</u>	0.031	<u>0.054</u>	16.9	<u>0.015</u>	0.20	0.076	0.020	0.004	<u>290</u>	240	240	0.004	1.8	2.2
0.12	<u>0.80</u>	0.024	<u>0.044</u>	16.1	<u>0.011</u>	0.17	0.062	0.017	0.003	45	90	80	<0.003	1.2	2.0
0.21	<u>1.11</u>	0.029	<u>0.060</u>	15.4	<u>0.011</u>	0.15	0.050	0.024	0.004	22	80	80	0.003	1.7	2.8
0.39	<u>1.04</u>	0.020	<u>0.096</u>	13.9	<u>0.011</u>	0.17	0.057	0.027	0.004	<u>900</u>	4100	<u>2200</u>	0.008	2.7	5.5
0.43	<u>1.03</u>	<0.004	0.035	15.0	<u>0.014</u>	0.16	0.055	0.016	0.003	60	130	130	0.019	1.7	2.5
0.20	<u>0.53</u>	0.012	0.039	13.6	<u>0.017</u>	0.18	0.055	0.013	0.003	13	100	60	0.011	1.9	2.6
0.33	0.48	0.009	0.036	7.8	<u>0.023</u>	0.20	0.067	0.011	<0.002	-	-	-	0.017	1.7	2.4

Note: < = less than the value stated

UD = upper decile flow (long-term record 1993-2012 inclusive)

*New Zealand Standard Time

TP results corrected for arsenic interference

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

() black disk measurements taken in flows above upper decile values –don't assess for compliance

DATE	TIME*	FLOW	BDISK	COLOR	COND	PH	TEMP	DO	PCDO	BOD5	TURB	TDS	NNN	NO3-N	NH4-N
dd/m/yy	hh:mm	m ³ /s	m	units	mS/m	units	'C	g/m ³	%Sat	g/m ³	NTU	g/m ³	g/m ³	g/m ³	g/m ³
Satisfactory Water Quality Guideline/Standard			>1.6	-	-	6.5-9	<12 (May-Sep) <20 (Oct-Apr)	>80	-	<5	-	-	-	-	<0.88

1131-91 UD = 659 m³/s (Flows from Mercer Bridge Recorder)

Waikato River at Mercer Br

06/01/12	11:10 a.m.	602	-	-	13.9	7.2	<u>22.3</u>	7.5	86.0	0.9	<u>12.30</u>	99	0.460	0.450	<0.01
02/02/12	10:30 a.m.	289	-	-	15.0	7.6	<u>20.7</u>	8.0	89.6	0.7	<u>8.00</u>	112	0.310	0.310	<0.01
07/03/12	11:08 a.m.	315	-	-	15.4	7.7	19.7	9.5	103.7	1.0	<u>8.10</u>	116	0.270	0.270	<0.01
04/04/12	10:45 a.m.	305	-	-	15.8	7.5	19.3	8.7	93.6	1.0	<u>18.30</u>	114	0.290	0.290	<0.01
02/05/12	10:35 a.m.	262	-	-	16.1	7.7	<u>14.7</u>	10.3	99.6	0.6	4.20	128	0.340	0.340	<0.01
06/06/12	11:20 a.m.	261	-	-	15.9	7.6	<u>15.0</u>	9.4	95.2	2.2	<u>7.00</u>	117	0.550	0.540	<0.01
04/07/12	11:33 a.m.	488	-	-	15.6	7.4	10.4	10.3	92.4	2.5	<u>9.20</u>	122	0.650	0.640	0.02
08/08/12	11:18 a.m.	649	-	-	14.9	7.3	11.8	10.2	95.2	1.1	<u>13.00</u>	114	0.870	0.860	0.02
05/09/12	11:12 a.m.	580	-	-	13.6	7.0	<u>12.7</u>	9.7	86.8	2.4	<u>36.00</u>	115	0.540	0.540	0.03
03/10/12	10:00 a.m.	373	-	-	14.3	7.6	14.4	10.8	105.1	1.9	<u>12.50</u>	114	0.540	0.540	<0.01
07/11/12	10:00 a.m.	371	-	-	13.9	7.6	16.3	9.5	95.7	1.3	<u>9.50</u>	115	0.330	0.330	<0.01
05/12/12	10:15 a.m.	283	-	-	15.1	7.6	16.7	10.7	115.6	2.0	<u>9.20</u>	105	0.154	0.152	<0.01

1131-133 UD = 659 m³/s (Flows from Mercer Bridge Recorder)

Waikato River at Tuakau Br

06/01/12	11:45 a.m.	603	<u>0.7</u>	27.5	13.8	7.2	<u>20.9</u>	7.6	84.9	1.1	<u>13.10</u>	109	0.460	0.460	<0.01
02/02/12	11:00 a.m.	289	<u>0.7</u>	32.5	14.9	7.6	<u>21.4</u>	8.2	93.0	0.9	<u>6.50</u>	114	0.270	0.270	<0.01
07/03/12	12:02 p.m.	323	<u>0.8</u>	25.0	15.3	7.7	<u>20.6</u>	9.8	108.8	1.2	<u>6.60</u>	114	0.230	0.230	<0.01
04/04/12	11:05 a.m.	305	<u>1.1</u>	40.0	15.8	7.6	19.3	9.1	97.5	1.5	4.90	122	0.260	0.250	<0.01
02/05/12	11:00 a.m.	258	<u>0.6</u>	42.5	16.2	7.7	<u>15.5</u>	10.1	100.1	0.7	4.60	130	0.330	0.330	<0.01
06/06/12	11:50 a.m.	270	<u>0.9</u>	30.0	15.9	7.4	<u>15.0</u>	9.8	99.4	0.8	<u>5.80</u>	110	0.500	0.500	<0.01
04/07/12	12:05 p.m.	492	<u>0.5</u>	35.0	15.4	7.3	10.5	10.2	91.9	0.9	<u>9.80</u>	120	0.620	0.610	<0.01
08/08/12	11:47 a.m.	646	<u>0.6</u>	27.5	14.3	7.0	11.9	9.1	84.5	1.1	<u>15.30</u>	119	0.800	0.790	0.02
05/09/12	11:38 a.m.	581	<u>0.4</u>	27.5	13.7	7.2	<u>12.9</u>	10.0	95.0	3.0	<u>32.00</u>	113	0.660	0.650	<0.01
03/10/12	10:25 a.m.	374	<u>0.4</u>	30.0	14.8	7.2	14.9	10.5	103.6	1.8	<u>13.50</u>	112	0.500	0.500	<0.01
07/11/12	10:30 a.m.	371	<u>0.6</u>	27.5	14.0	7.5	16.4	9.4	95.2	1.3	<u>9.90</u>	111	0.290	0.290	<0.01
05/12/12	10:40 a.m.	284	<u>0.3</u>	27.5	15.2	7.7	19.0	11.1	120.3	2.4	<u>11.60</u>	106	0.108	0.106	<0.01

Note: < = less than the value stated
UD = upper decile flow (long-term record 1993-2012 inclusive)

*New Zealand Standard Time

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

() black disk measurements taken in flows above upper decile values –don't assess for compliance

TKN g/m ³	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 cfu/100mL	FC	E coli	CHLA g/m ³	DOC g/m ³	TOC g/m ³
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<550	<0.02		
0.34	0.80	0.019	0.070	14.6	0.013	0.15	0.046	0.048	0.011	32	160	160	0.006	3.4	4.8
0.25	0.56	0.014	0.056	15.3	0.017	0.19	0.060	0.018	0.003	5	45	45	0.013	1.8	2.8
0.21	0.48	0.015	0.054	18.2	0.018	0.21	0.071	0.019	0.003	29	130	80	0.011	2.0	2.8
0.20	0.49	0.016	0.156	17.0	0.020	0.23	0.080	0.015	0.002	20	90	90	0.005	3.5	3.7
0.15	0.49	0.022	0.041	18.4	0.018	0.22	0.074	0.016	0.003	11	62	53	0.006	1.7	2.2
0.39	0.94	0.027	0.051	17.8	0.015	0.21	0.076	0.022	0.004	4700	1600	1600	<0.003	2.1	2.9
0.21	0.86	0.022	0.052	17.7	0.013	0.18	0.065	0.021	0.004	2300	1400	900	0.004	1.7	2.5
0.28	1.15	0.021	0.068	15.9	0.009	0.15	0.044	0.040	0.007	30	150	120	0.007	3.2	4.4
0.59	1.13	0.010	0.049	15.3	0.009	0.14	0.045	0.050	0.008	700	2400	2400	0.016	5.2	8.2
0.39	0.93	0.010	0.055	14.9	0.012	0.15	0.049	0.020	0.004	25	100	80	0.023	2.4	3.5
0.20	0.53	0.010	0.048	13.7	0.017	0.17	0.052	0.017	0.003	13	60	60	0.009	2.1	3.1
0.29	0.44	0.007	0.044	15.0	0.020	0.19	0.064	0.013	0.002	-	-	-	0.021	1.9	3.1
0.40	0.86	0.023	0.075	14.7	0.014	0.16	0.052	0.046	0.008	120	120	100	0.006	3.4	5.1
0.30	0.57	0.012	0.057	15.7	0.017	0.17	0.056	0.021	0.003	4	29	29	0.016	2.0	3.0
0.25	0.48	0.015	0.050	18.4	0.020	0.21	0.076	0.017	0.003	19	190	180	0.015	1.6	2.8
0.23	0.49	0.014	0.043	17.3	0.018	0.23	0.079	0.022	0.003	16	70	50	0.005	2.7	3.4
0.20	0.53	0.021	0.039	18.7	0.018	0.23	0.075	0.017	0.003	10	60	43	0.007	1.8	2.1
0.24	0.74	0.027	0.052	17.5	0.014	0.20	0.073	0.026	0.006	20	90	80	0.005	2.1	2.7
0.23	0.85	0.014	0.054	18.1	0.013	0.18	0.064	0.025	0.004	90	130	110	0.005	1.9	2.8
0.39	1.19	0.022	0.081	16.1	0.009	0.14	0.043	0.051	0.009	48	140	120	0.007	3.4	5.1
0.42	1.08	0.015	0.036	15.0	0.010	0.15	0.051	0.037	0.005	700	1900	1600	0.012	4.1	5.8
0.30	0.80	0.010	0.059	15.3	0.012	0.15	0.049	0.024	0.004	1	100	100	0.025	2.7	3.5
0.26	0.55	0.013	0.050	13.7	0.018	0.18	0.052	0.019	0.004	110	40	30	0.009	2.4	3.1
0.26	0.37	0.005	0.049	15.1	0.023	0.20	0.065	0.013	0.002	-	-	-	0.030	1.9	3.5

Note: < = less than the value stated

UD = upper decile flow (long-term record 1993-2012 inclusive)

*New Zealand Standard Time

Underlined values don't comply with the "satisfactory" water quality Guidelines and Standards - Table 1

() black disk measurements taken in flows above upper decile values –don't assess for compliance

3.2 Waikato River Monitoring Programme

Bathing Season Microbiological Survey

Summary Statistics

Comparison with Water Quality Standards

Parameter Graph

Raw Data

Table 5: Bathing Season Statistics of E. coli Bacteria.

Location Name	BATHING SEASON MEDIAN					5 Season
	04/05	06/07	08/09	10/11	12/13	Median
Taupo Gates	1	2	3	8	6	3
Huka Falls	4	8	13	15	9	9
Ohaaki Bridge	22	16	41	19	18	19
Ohakuri Tailrace Br	4	2	3	3	3	3
Whakamaru Tailrace	7	6	10	18	8	8
Waipapa Tailrace	9	6	6	7	6	6
Lake Karapiro Boatramp	27	8	25	45	30	27
Narrows Br	28	55	83	60	34	55
Wellington Street Beach	43	84	80	80	43	80
Sewer Br Alandale	75	100	120	130	70	100
Horotiu Br	90	150	120	110	64	110
Ngaruawahia Br	80	140	120	240	65	120
Huntly-Tainui Br	135	150	160	160	75	150
Mercer Br	36	85	115	160	48	85
Tuakau Br	44	50	105	80	41	50
Waipa River (Ngaruawahia Br)	95	90	130	100	52	95

Table 6: Year 2012/13 Bathing Season E. coli survey results complying with the “Satisfactory” and “Excellent” Water Quality Guidelines. n = 12 (except * where n = 13).

Location Name	HUMAN USES - RECREATION			
	SATISFACTORY		EXCELLENT	
	<i>E. coli</i> Samples < 550	<i>E. coli</i> Median <126	<i>E. coli</i> Samples < 55	<i>E. coli</i> Median <23
Taupo Gates	12	Y	12	Y
Huka Falls	12	Y	12	Y
Ohaaki Bridge	12	Y	12	Y
Ohakuri Tailrace Br	12	Y	12	Y
Whakamaru Tailrace	12	Y	11	Y
Waipapa Tailrace	12	Y	12	Y
Lake Karapiro Boatramp	12	Y	8	Y
Narrows Br	12	Y	8	Y
Wellington Street Beach	13*	Y*	8*	Y*
Sewer Br Alandale	12*	Y*	4*	Y*
Horotiu Br	12	Y	4	Y
Ngaruawahia Br	13*	Y*	3*	Y*
Huntly-Tainui Br	10	Y	2	Y
Mercer Br	12	Y	9	Y
Tuakau Br	12	Y	8	Y
Waipa River (Ngaruawahia Br)	11*	Y*	2*	Y*

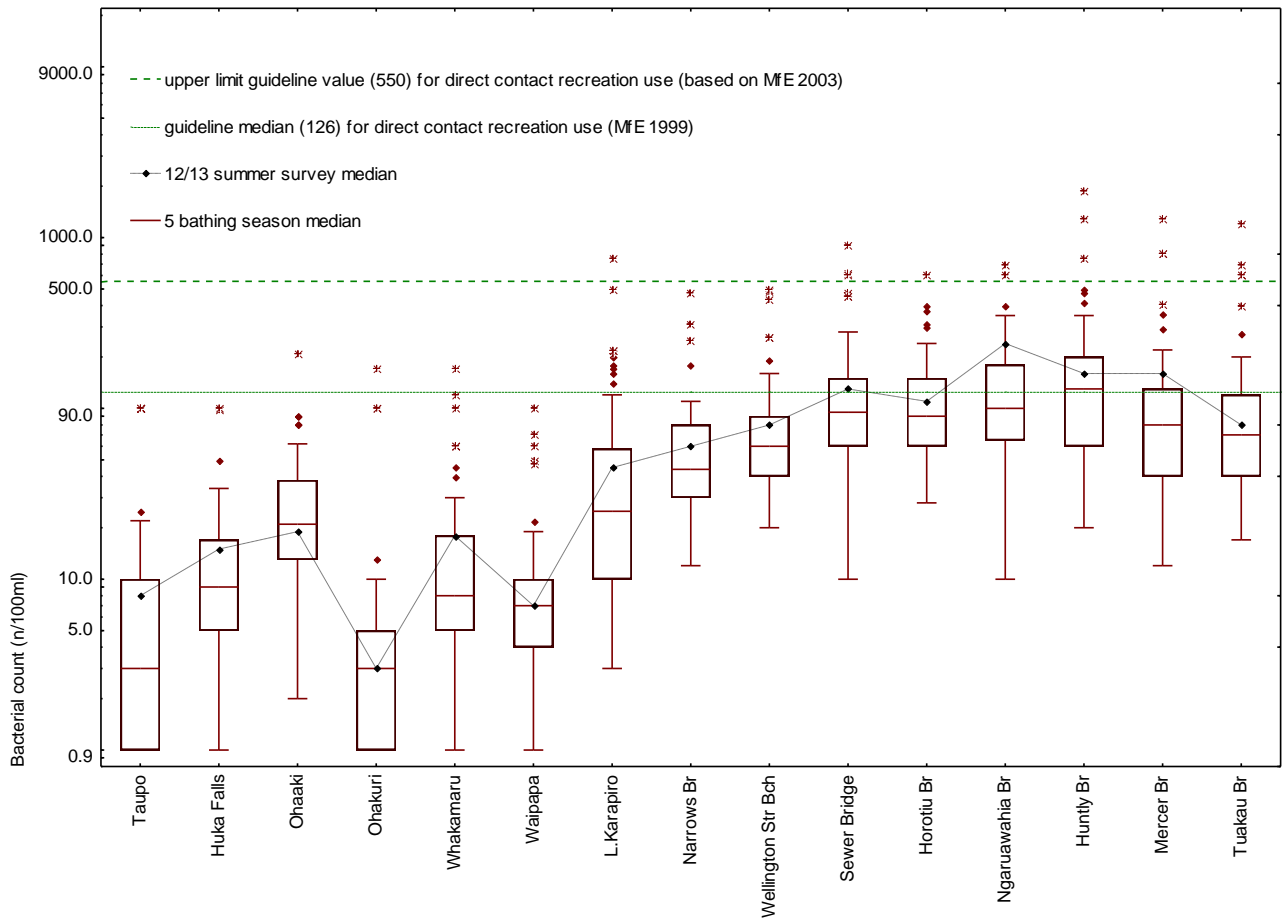


Figure 2: E. coli - five years of bathing season data

DATE	EColi c/100ml	ENT c/100ml	FC c/100ml	DATE	EColi c/100ml	ENT c/100ml	FC c/100ml	DATE	EColi c/100ml	ENT c/100ml	FC c/100ml
Taupo Control Gates				Lake Karapiro Boatramp				Huntly-Tainui Bridge			
11/12/12	2	< 1	3	11/12/12	12	7	13	12/12/12	90	23	100
20/12/12	< 1	< 1	< 1	20/12/12	220	1100	410	19/12/12	110	47	120
3/01/13	14	16	16	3/01/13	100	250	150	4/01/13	60	34	60
8/01/13	22	15	22	8/01/13	7	8	9	9/01/13	36	16	45
11/01/13	< 1	1	< 1	11/01/13	20	24	20	16/01/13	310	190	310
15/01/13	6	< 1	6	15/01/13	120	60	170	20/01/13	59	21	65
29/01/13	2	< 1	2	29/01/13	30	7	38	23/01/13	40	24	50
5/02/13	7	24	7	5/02/13	40	50	180	30/01/13	340	180	340
12/02/13	3	2	3	12/02/13	6	1	6	7/02/13	80	30	90
19/02/13	3	< 1	3	19/02/13	25	3	25	13/02/13	70	40	80
26/02/13	< 1	< 1	1	26/02/13	170	140	170	27/02/13	50	15	50
5/03/13	10	3	20	5/03/13	29	31	29	6/03/13	80	18	100
<i>Median</i>	<i>6</i>	<i>9</i>	<i>5</i>	<i>Median</i>	<i>30</i>	<i>28</i>	<i>34</i>	<i>Median</i>	<i>75</i>	<i>27</i>	<i>85</i>
Huka Falls				Narrows Boat Ramp				Mercer Bridge			
11/12/12	7	4	7	11/12/12	60	12	70	12/12/12	60	9	60
20/12/12	12	4	12	20/12/12	19	17	23	19/12/12	47	4	52
3/01/13	26	21	29	3/01/13	36	24	39	4/01/13	40	15	40
8/01/13	29	16	29	9/01/13	60	44	80	9/01/13	39	10	62
11/01/13	3	7	6	11/01/13	31	20	31	16/01/13	90	36	90
15/01/13	6	10	8	15/01/13	80	46	80	20/01/13	23	12	32
29/01/13	7	2	10	29/01/13	49	43	52	23/01/13	80	110	110
5/02/13	23	38	23	7/02/13	32	26	38	30/01/13	50	80	50
12/02/13	13	19	17	12/02/13	18	17	21	7/02/13	70	11	80
19/02/13	9	5	13	19/02/13	28	18	32	13/02/13	48	17	48
26/02/13	4	7	4	26/02/13	24	14	24	27/02/13	40	7	40
5/03/13	9	24	20	6/03/13	80	45	80	6/03/13	20	10	40
<i>Median</i>	<i>9</i>	<i>9</i>	<i>13</i>	<i>Median</i>	<i>34</i>	<i>22</i>	<i>39</i>	<i>Median</i>	<i>48</i>	<i>12</i>	<i>51</i>
Ohaaki Bridge				Wellington Street Beach				Tuakau Bridge			
11/12/12	17	6	20	5/12/12	60	40	120	12/12/12	30	9	30
20/12/12	13	5	15	12/12/12	70	12	80	19/12/12	40	11	50
3/01/13	15	8	15	19/12/12	37	28	45	4/01/13	40	12	50
8/01/13	34	7	57	4/01/13	60	21	70	9/01/13	400	510	3300
11/01/13	18	24	18	9/01/13	29	37	41	16/01/13	110	34	120
15/01/13	34	12	47	16/01/13	140	170	140	20/01/13	35	10	44
29/01/13	27	18	39	20/01/13	90	27	90	23/01/13	60	10	80
5/02/13	46	110	46	23/01/13	31	44	31	30/01/13	25	14	25
12/02/13	10	17	11	30/01/13	30	100	210	7/02/13	70	13	80
19/02/13	10	9	13	7/02/13	49	56	55	13/02/13	41	33	41
26/02/13	9	9	9	13/02/13	43	34	47	27/02/13	40	9	40
5/03/13	40	80	40	27/02/13	27	45	31	6/03/13	50	10	60
<i>Median</i>	<i>18</i>	<i>11</i>	<i>19</i>	<i>Median</i>	<i>43</i>	<i>37</i>	<i>55</i>	<i>Median</i>	<i>41</i>	<i>12</i>	<i>50</i>
Ohakuri Tailrace Bridge				Sewer Bridge Alandale							
11/12/12	4	< 1	4	5/12/12	100	50	120				
20/12/12	2	2	2	12/12/12	50	6	50				
3/01/13	3	< 1	4	19/12/12	70	22	100				
8/01/13	4	< 1	4	4/01/13	63	37	69				
11/01/13	< 1	1	< 1	9/01/13	45	51	59				
15/01/13	5	1	11	16/01/13	160	140	160				
29/01/13	1	2	1	20/01/13	70	46	110				
5/02/13	6	2	6	23/01/13	69	41	69				
12/02/13	3	3	3	30/01/13	110	100	110				
19/02/13	< 1	3	< 1	7/02/13	90	33	110				
26/02/13	2	3	2	13/02/13	50	40	50				
5/03/13	2	4	2	27/02/13	110	25	140				
<i>Median</i>	<i>3</i>	<i>2</i>	<i>4</i>	<i>Median</i>	<i>70</i>	<i>40</i>	<i>100</i>				
Whakamaru Tailrace				Horotiu Bridge				Waipa River @ Ngaruawahia			
11/12/12	11	6	14	12/12/12	60	19	60	5/12/12	110	30	110
20/12/12	3	4	3	19/12/12	70	25	70	12/12/12	32	7	43
3/01/13	12	6	12	4/01/13	50	36	70	19/12/12	40	22	40
8/01/13	11	10	13	9/01/13	70	67	80	4/01/13	120	26	160
11/01/13	8	26	8	16/01/13	150	150	150	9/01/13	52	18	52
15/01/13	18	26	42	20/01/13	60	37	60	16/01/13	130	120	150
29/01/13	2	19	2	23/01/13	90	38	90	20/01/13	90	30	90
41310.5	60	270	60	30/01/13	67	95	85	23/01/13	40	28	50
41317.5	7	25	10	7/02/13	130	80	150	30/01/13	140	70	170
19/02/13	3	2	3	13/02/13	50	42	70	7/02/13	220	60	290
26/02/13	6	3	6	27/02/13	30	30	30	13/02/13	40	110	40
5/03/13	7	10	7	6/03/13	30	12	40	27/02/13	50	24	70
<i>Median</i>	<i>8</i>	<i>10</i>	<i>9</i>	<i>Median</i>	<i>64</i>	<i>38</i>	<i>70</i>	6/03/13	49	43	56
Waipapa Tailrace				Ngaruawahia Bridge				<i>Median</i>			
11/12/12	2	1	3	5/12/12	50	70	70	<i>Median</i>	<i>52</i>	<i>30</i>	<i>70</i>
20/12/12	7	< 1	7	12/12/12	65	9	70				
3/01/13	5	1	6	19/12/12	50	32	60				
8/01/13	3	3	3	4/01/13	60	33	80				
11/01/13	7	8	10	9/01/13	60	29	60				
15/01/13	7	7	14	16/01/13	220	180	220				
29/01/13	9	2	9	20/01/13	250	360	320				
5/02/13	47	100	47	23/01/13	70	37	70				
12/02/13	1	3	2	30/01/13	120	90	120				
19/02/13	3	< 1	4	7/02/13	40	160	50				
26/02/13	4	1	4	13/02/13	65	36	65				
5/03/13	12	25	12	27/02/13	80	40	80				
<i>Median</i>	<i>6</i>	<i>3</i>	<i>7</i>	6/03/13	60	29	70				
				<i>Median</i>	<i>65</i>	<i>37</i>	<i>70</i>				

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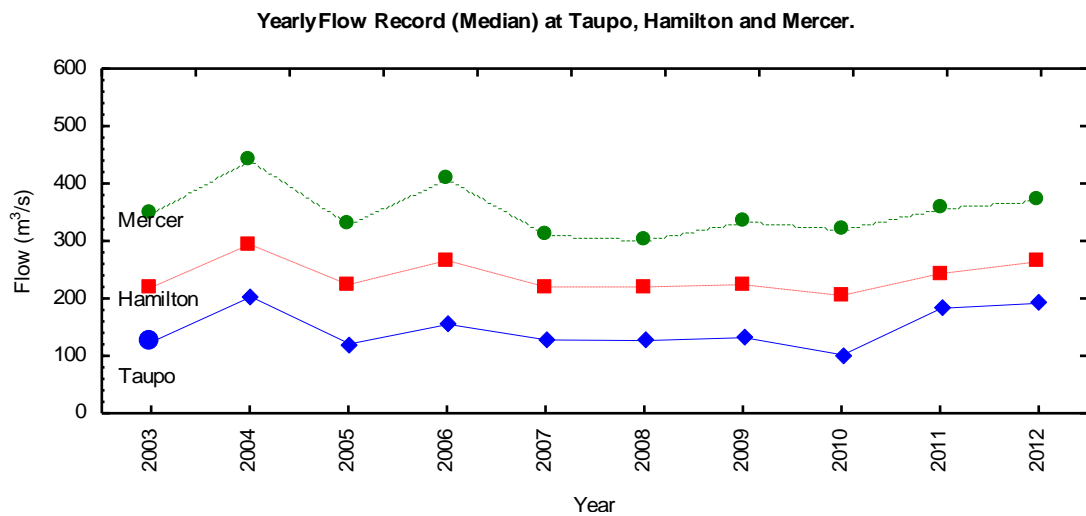
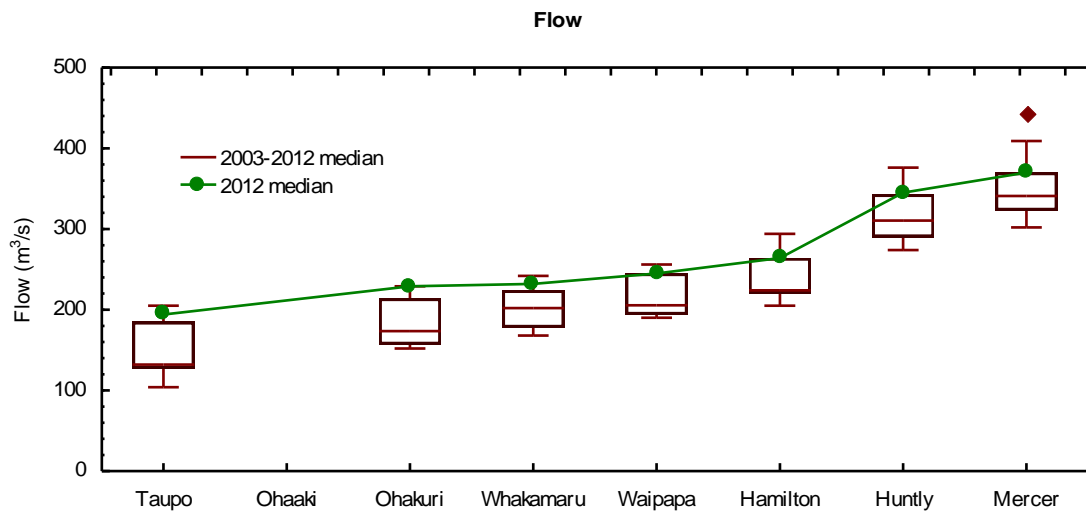
Appendix I:

Flow Information

Location	DISTANCE		FLOW RATE (m ³ /s)									10 YEAR	
	km		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Median
Taupo	4.2		127	205	123	157	130	129	134	104	185	194	149
Ohakuri	75.8		157	214	152	184	157	163	162	192	225	229	184
Whakamaru	105.0		168	224	175	208	178	186	196	209	242	232	202
Waipapa	126.1		192	256	200	237	190	211	194	198	250	245	217
Hamilton	211.5		219	294	224	266	220	220	224	205	243	264	238
Huntly	246.5		315	376	290	343	280	274	306	296	339	345	316
Mercer	286.3		348	444	332	409	313	302	334	323	356	370	353
Waiotapu Stn	46.6		2.6	3.7	3.6	3.8	2.8	3.0	2.7	3.3	3.8	3.5	3.3
Waipa River	232.7		57	87	48	62	34	43	53	41	61	62	54

*Rating curve errors mean estimates of flow are $\pm 8\%$

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

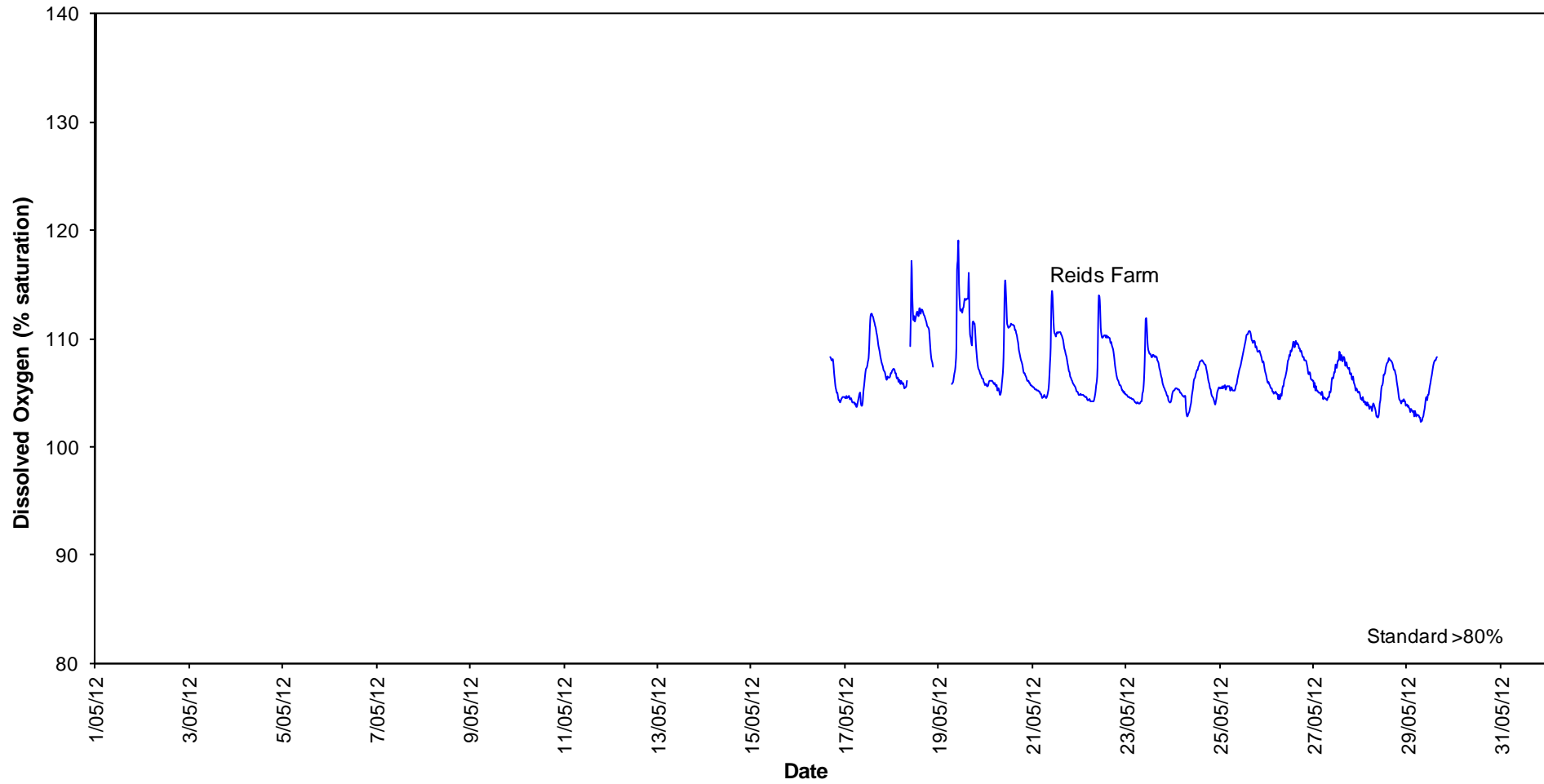


Appendix II

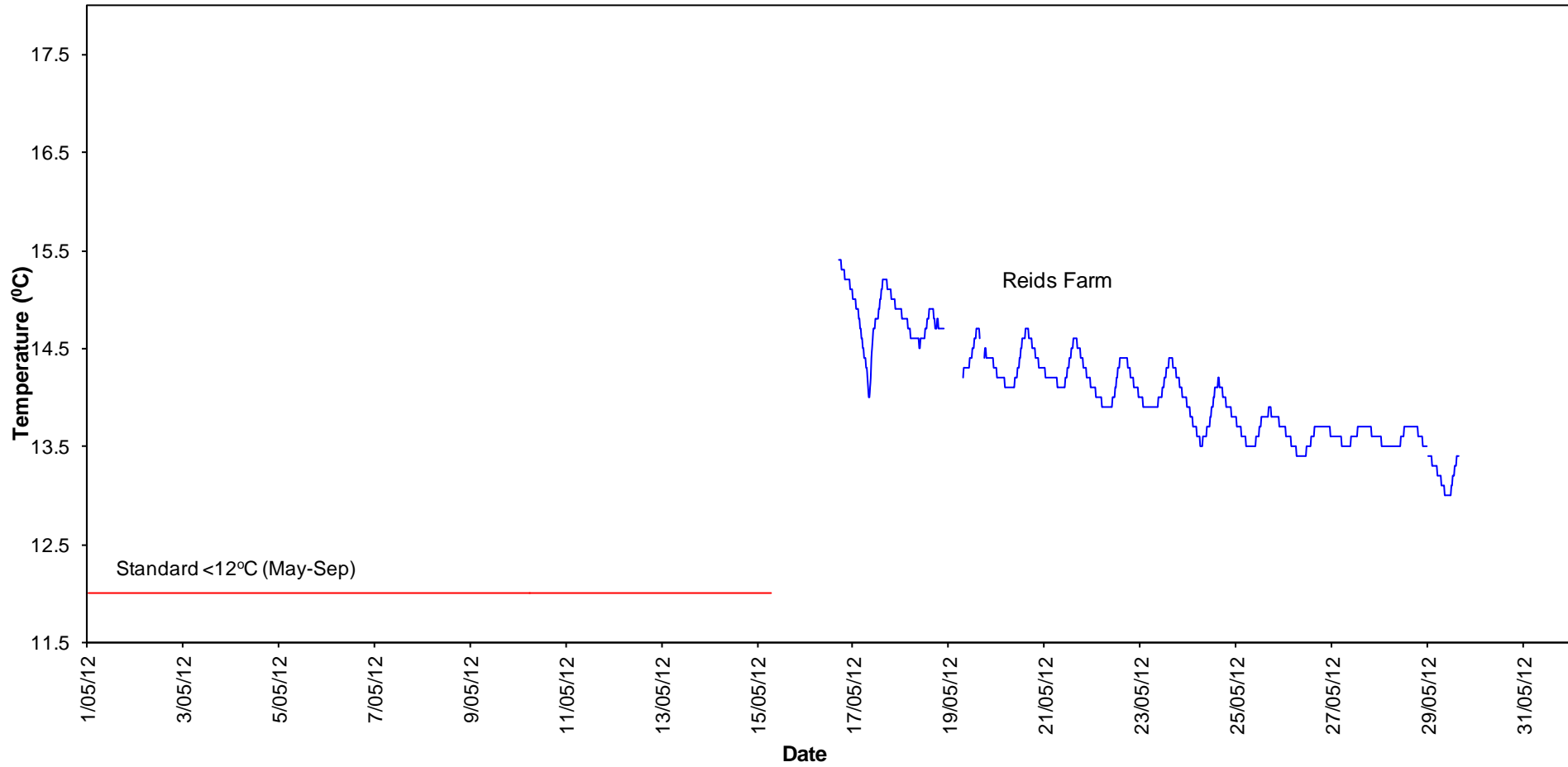
Datasonde deployments

Diurnal variation of selected water quality parameters

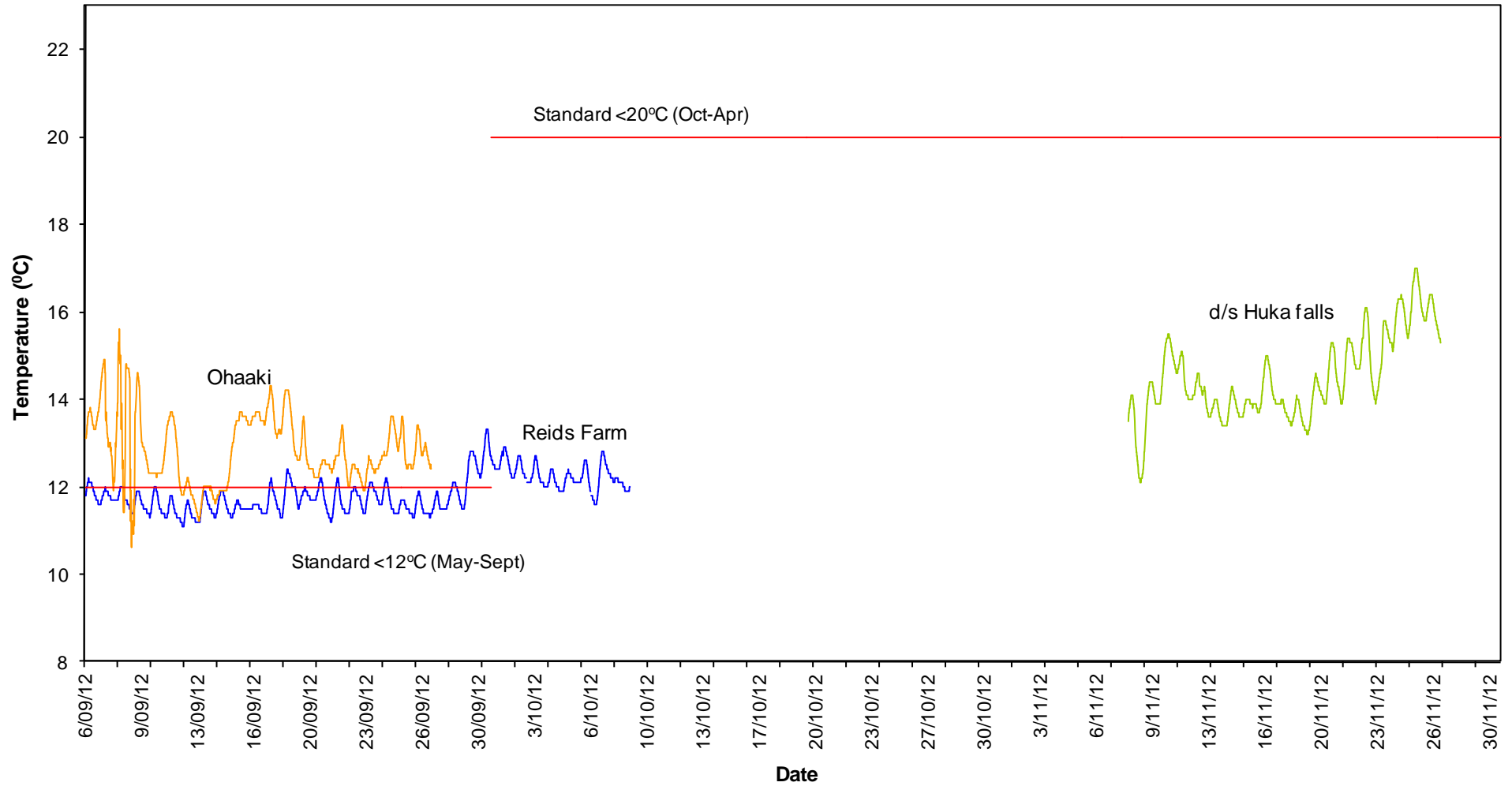
Dissolved Oxygen, % saturation: Upper Waikato (May)



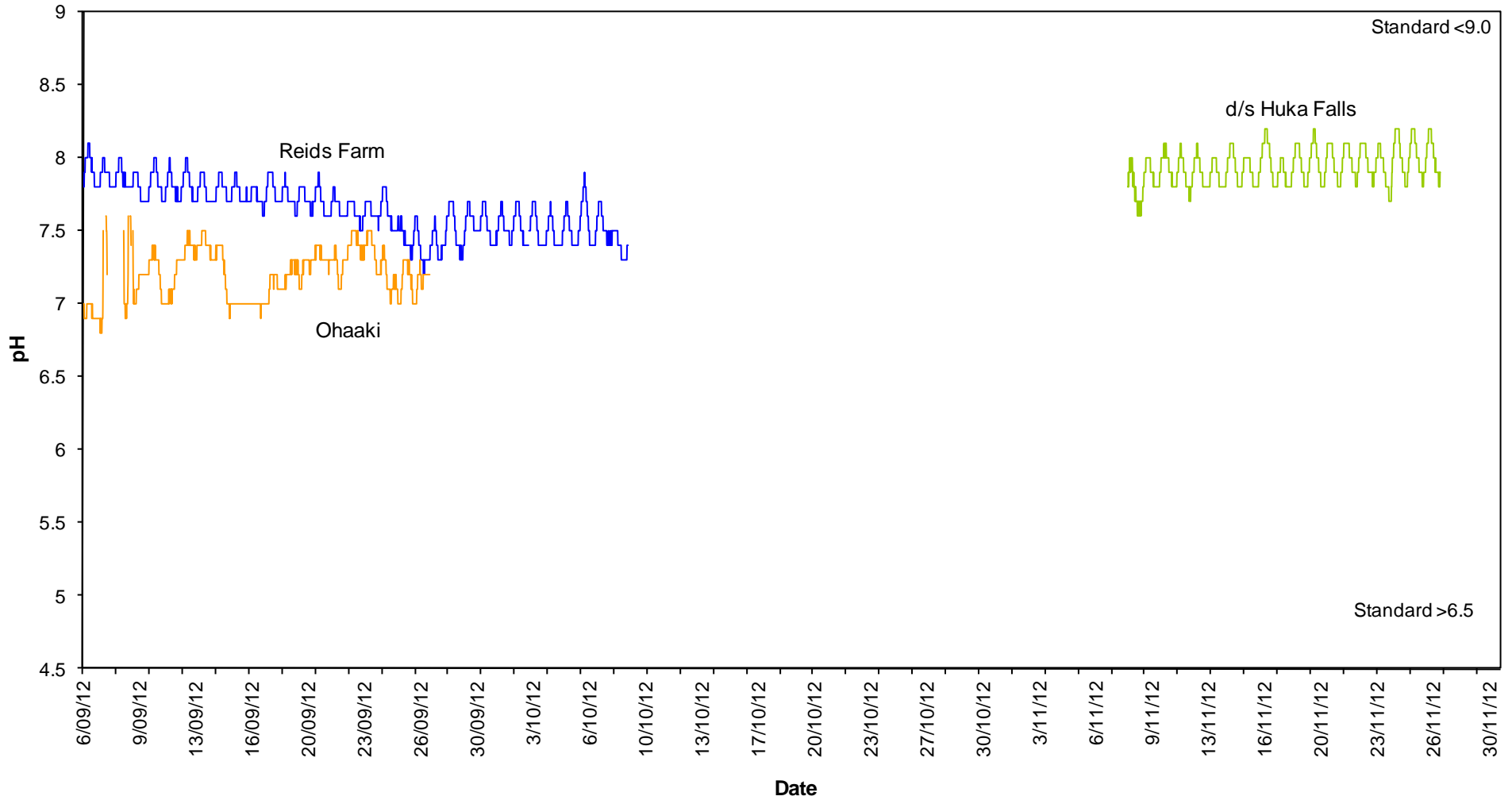
Temperature: Upper Waikato (May)



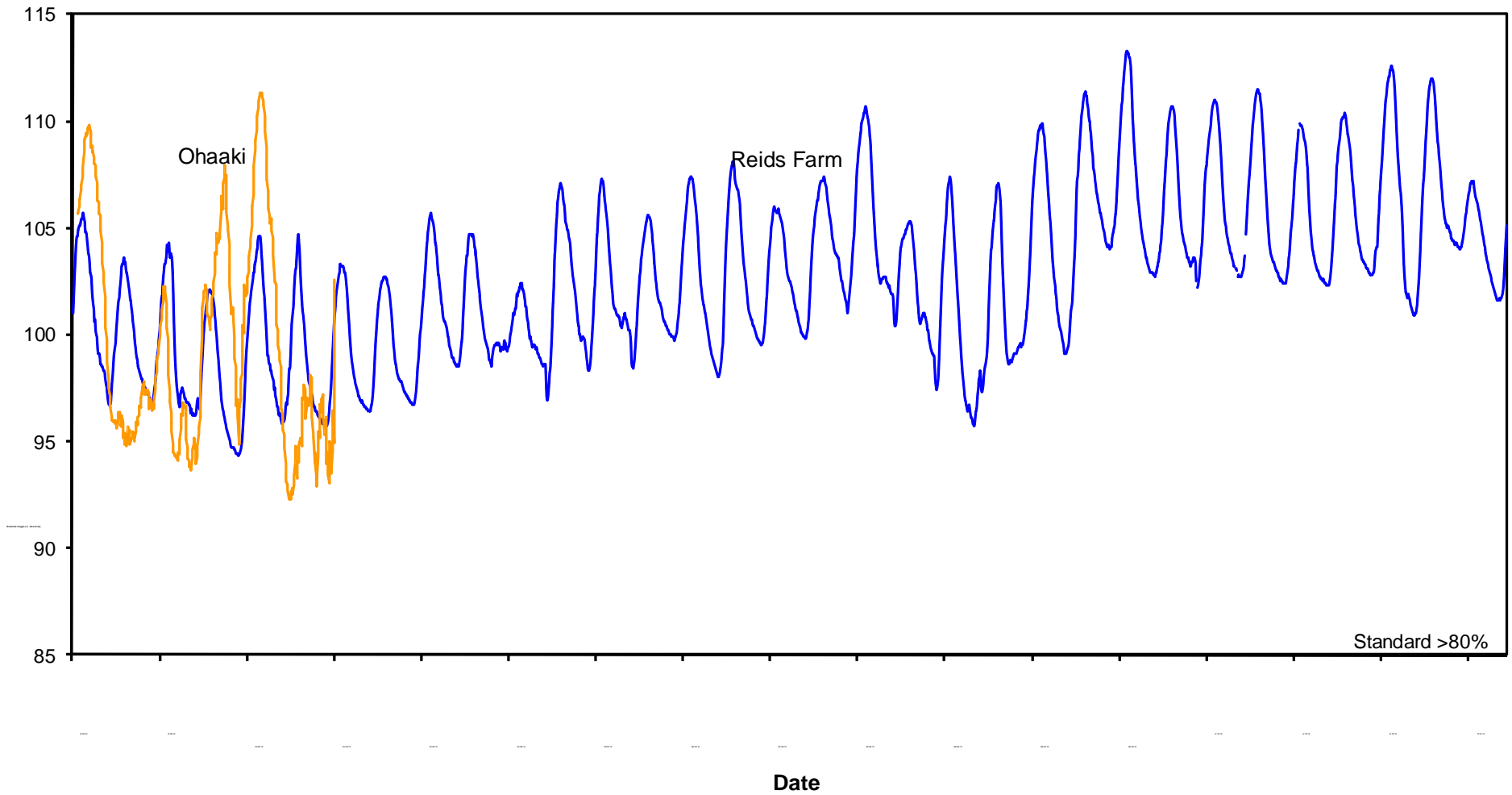
Temperature: Upper Waikato (September - November)



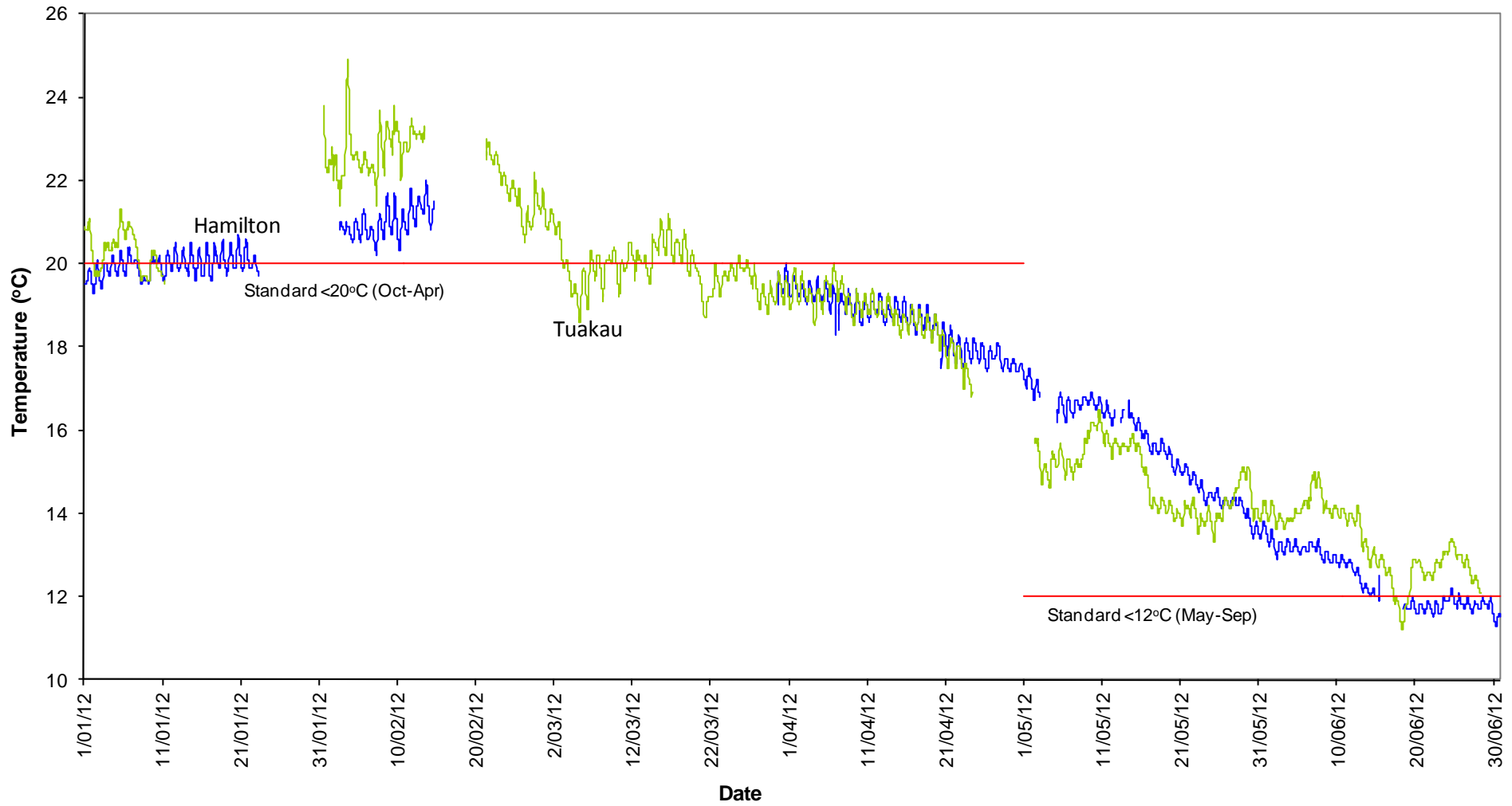
pH: Upper Waikato (September-November)



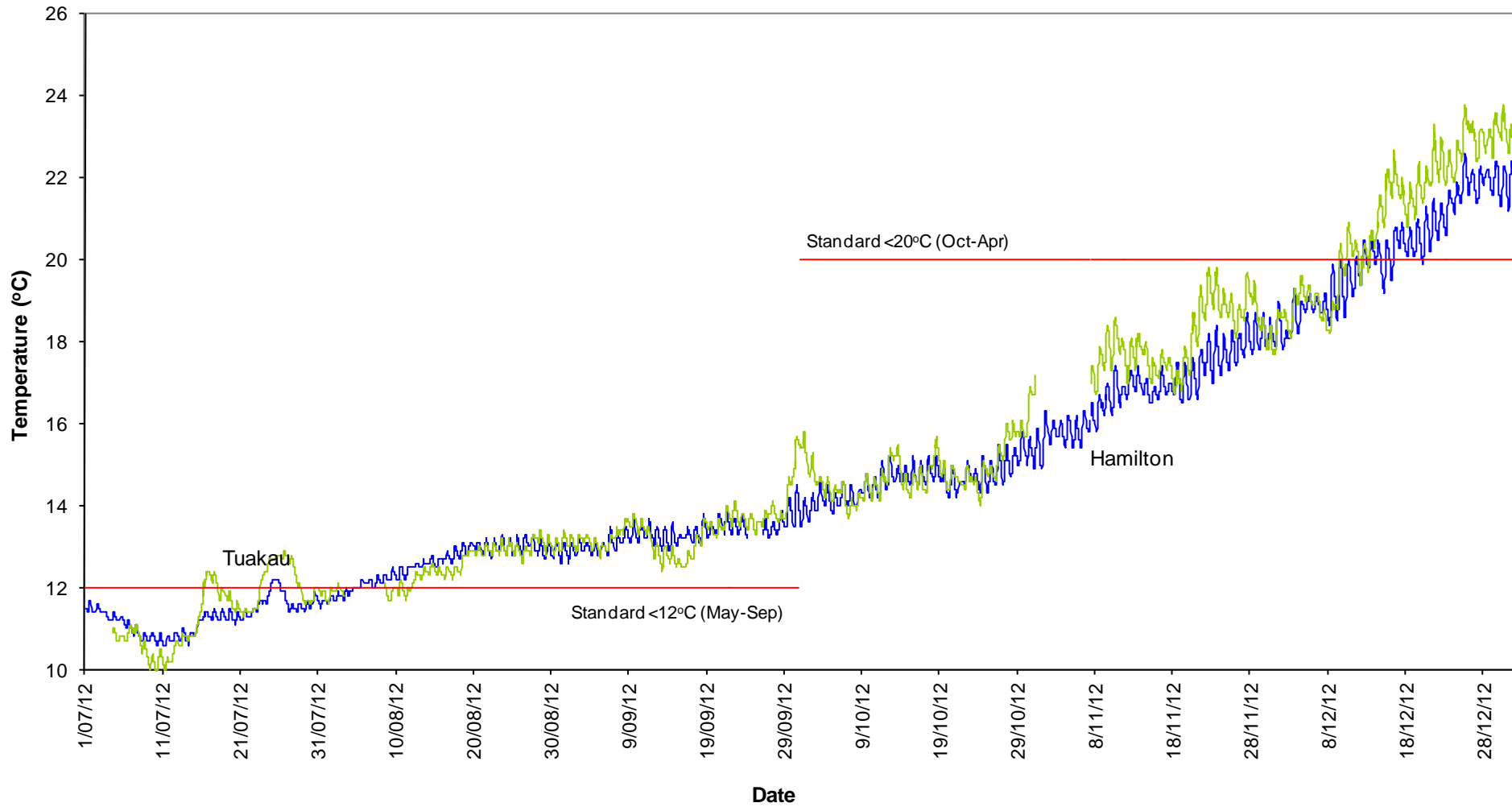
Dissolved Oxygen, % saturation: Upper Waikato (September-October)



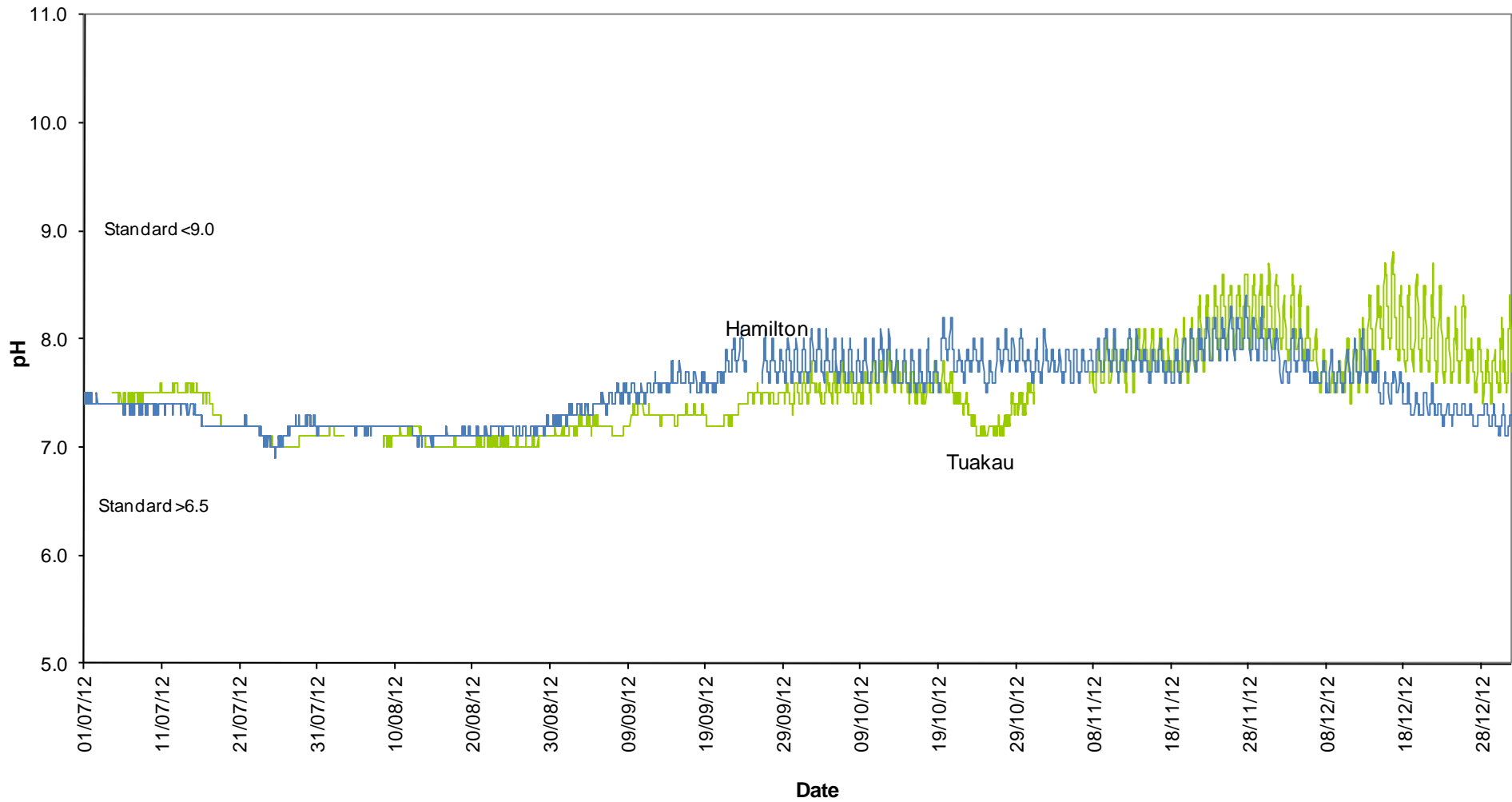
Temperature: Lower Waikato (January-June)



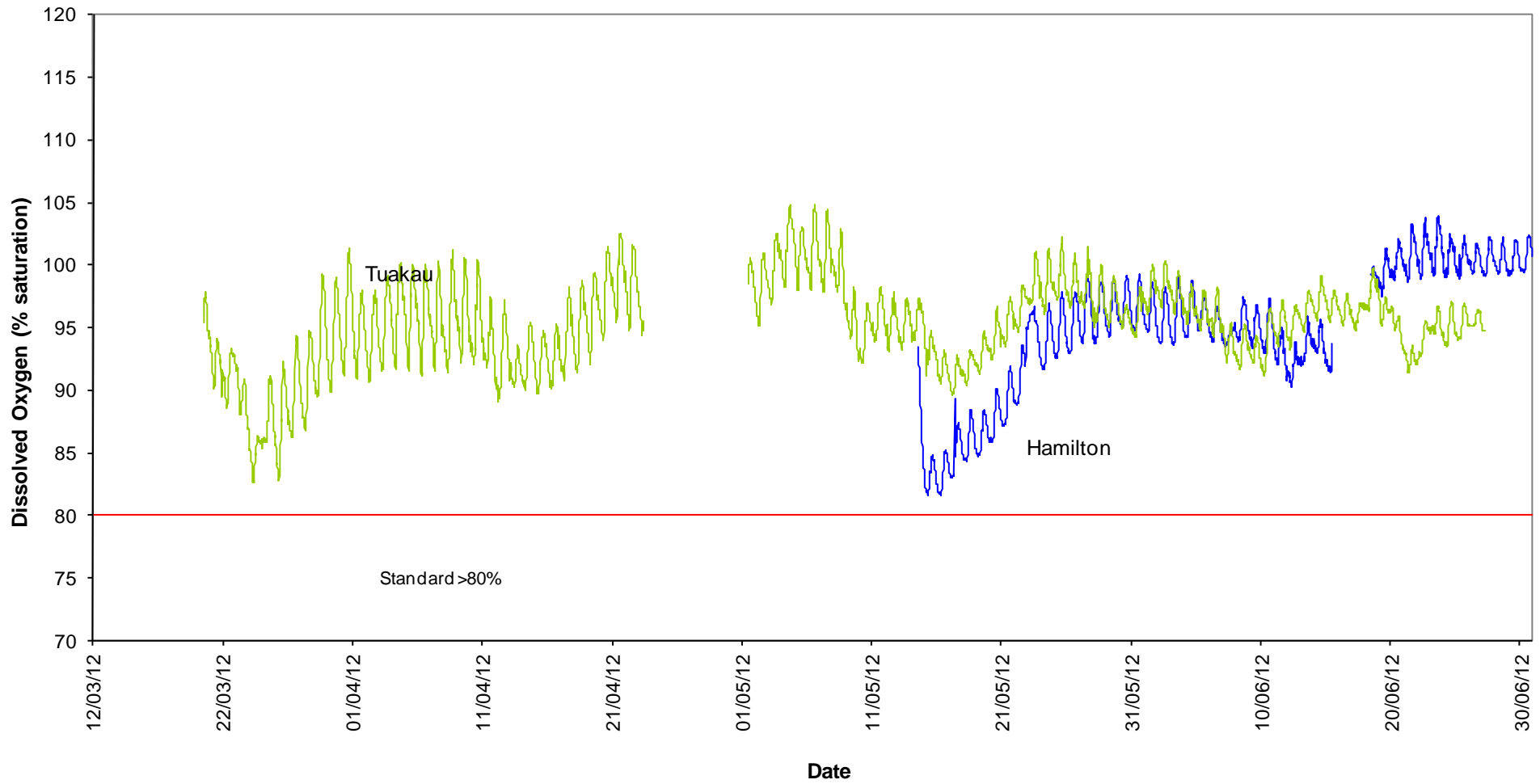
Temperature: Lower Waikato (July-December)



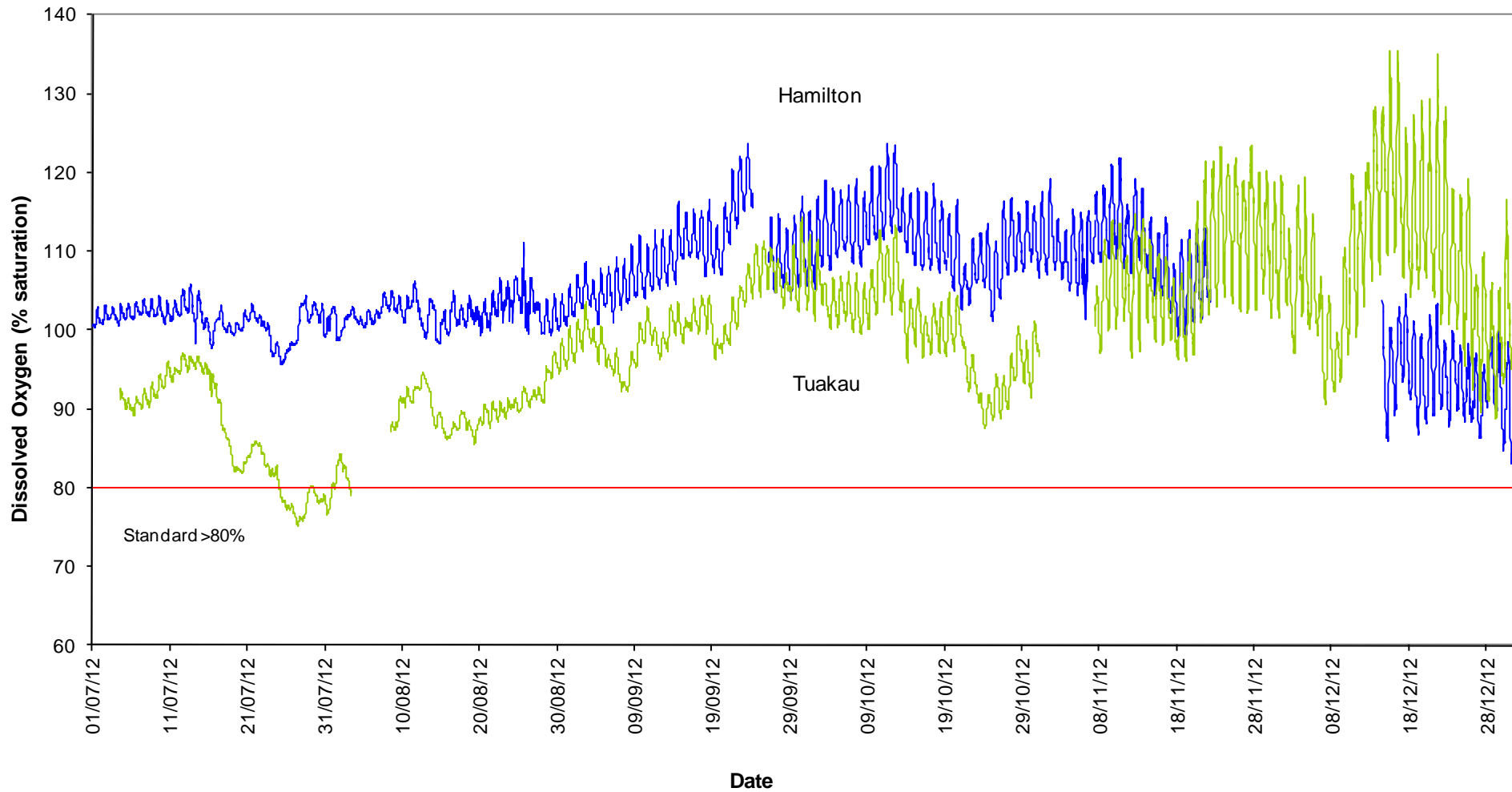
pH: Lower Waikato (July - December)



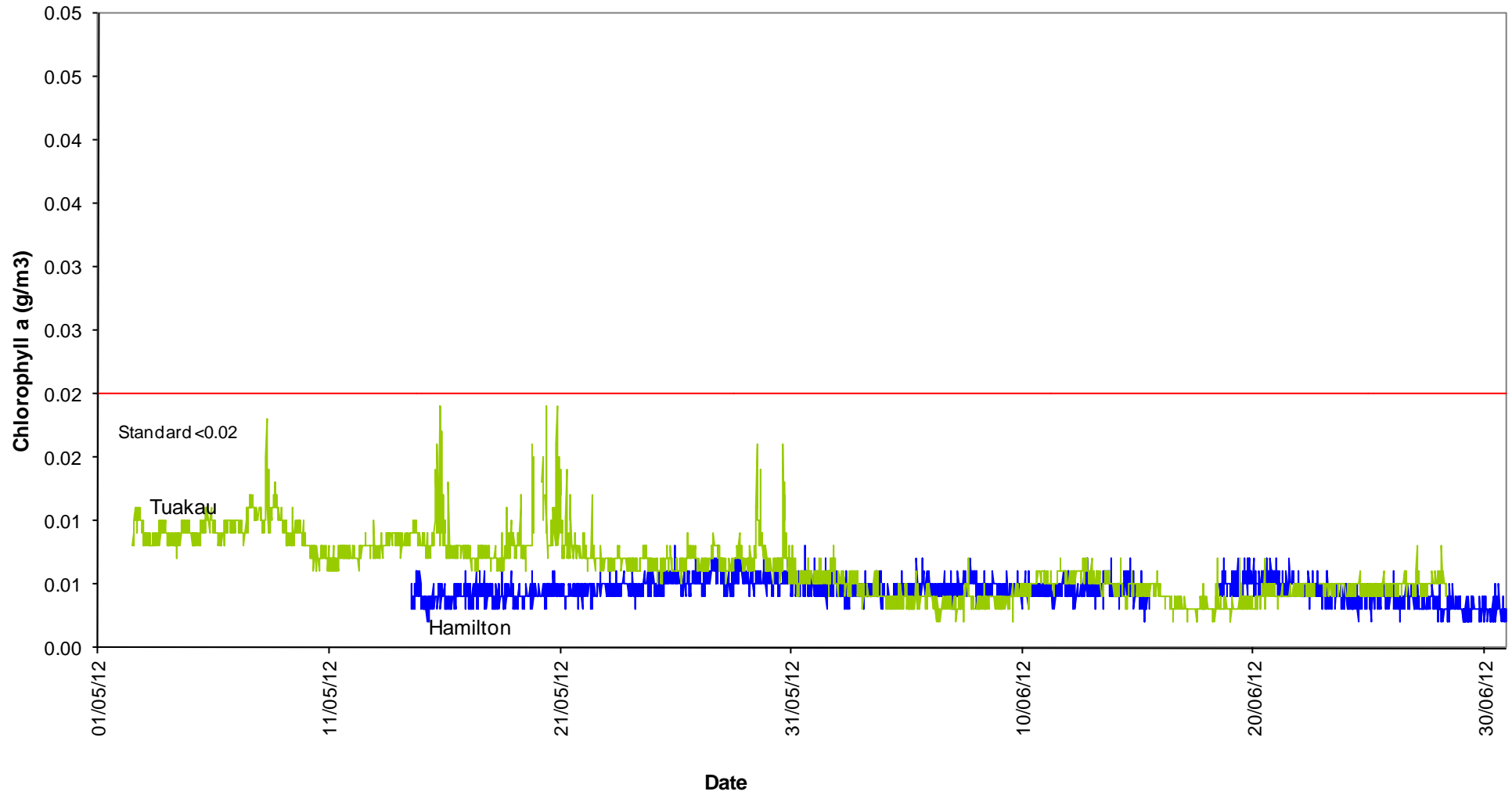
Dissolved Oxygen (% saturation): Lower Waikato (March - June)



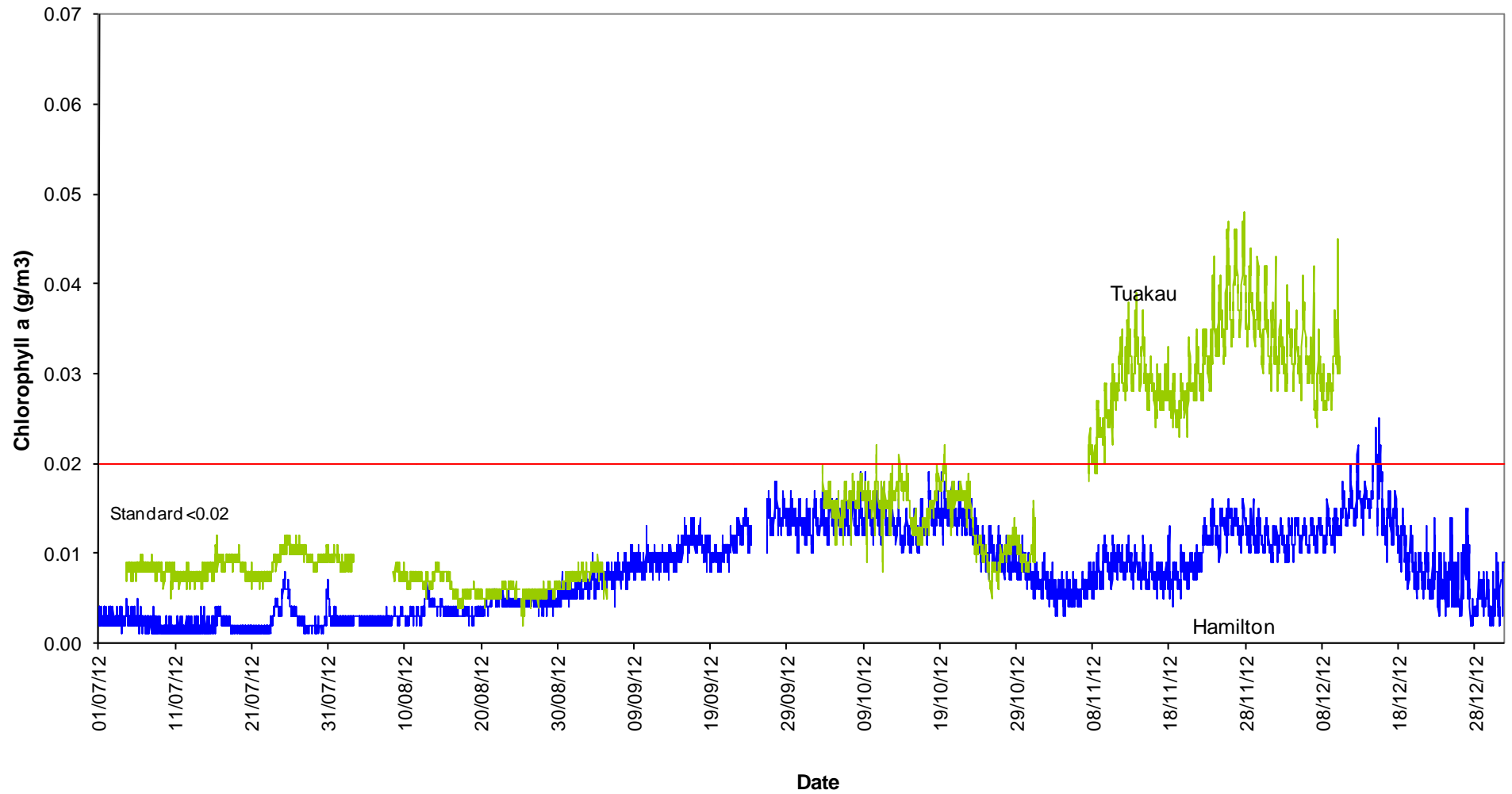
Dissolved Oxygen (% saturation): Lower Waikato (July - December)



Chlorophyll a: Lower Waikato (May - June)



Chlorophyll a: Lower Waikato (July - December)



Appendix III:
Water quality parameters
Guidelines and standards
Analytical methods

Waikato River water quality monitoring programme 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 a	- enrichment, excessive plant growth	NO ₃ -N+NO ₂ -N	routine
	- nutrient limitation for plant/algal growth	NH ₄ -N,TKN DRP, TP, Chl a	
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 the page 49 for the meaning of the abbreviations.

² 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 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).
Escherichia coli	<550/100 mL	Ministry for the Environment (2003) guidelines for the management of recreational and marine shellfish-gathering waters.
Median Escherichia coli	<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 a	<0.02 g/m ³	Ministry for the Environment (1992).
Arsenic	<0.01 g/m ³	Ministry of Health (2001).
Boron	<1.4 g/m ³	Ministry of Health (2001).

Waikato River monitoring programme - water quality parameters and analytical methods

Id ¹	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
A780	Absorbance @ 780 nm filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
As	Arsenic total	Nitric acid digestion, ICP-MS, APHA method 3125 B
B	Boron	ICP-MS, APHA method 3125 B
BDISK	Black disk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river
BOD ₅	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 ClE (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, catalytic oxidation, IR detection. APHA method 5310 B (modified)
DRP	Dissolved reactive Phosphorus	Filtration, Molybdenum Blue Colorimetry. Discrete analyser. APHA 4500 PG (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 ₄ -N	Ammoniacal Nitrogen (Total)	Phenol/Hypochlorite Colorimetry. Discrete analyser. APHA method 4500-NH ₃ F (modified).
NNN	Nitrite/Nitrate Nitrogen	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO ₃ -I (modified)
NO ₃ -N	Nitrate nitrogen	Calculation: (Nitrate-N + Nitrite –N) – Nitrite - N
pH	pH	Lab Meter @ 25°C. APHA method 4500-H ⁺ 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 _{org} B (modified)
TOC	Total Organic Carbon	Acidification, purging to remove inorganic C, catalytic oxidation, IR detection. APHA method 5310 B (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 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

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

APHA = Standards Methods for the Examination of Water and Wastewater, 21st Edition, 2005, APHA, AWWA, WEF

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy