

# Waikato River Water Quality Monitoring Programme: Data Report 2006

Prepared by:  
Stuart Beard

For:  
Environment Waikato  
PO Box 4010  
HAMILTON EAST

26 April 2007

ISSN: 1172-4005

Document #: 1185492

Peer reviewed by:  
Bill Vant

Date June 2007

Approved for release by:  
Jim Price

Date June 2007

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# Acknowledgement

Thanks to Matthew Highway, Ralph Ostertag, Kelly Palmer, Rebecca Ireland and Nicholas Holwerda for their commitment and reliability in undertaking field measurements and collecting samples. Ian Buchanan was responsible for co-ordinating the laboratory analyses, and assisted with co-ordination of the field aspects of sample collection. Thanks to Paul Smith for his comments and assistance during preparation of this report.

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, Environment Waikato, Hamilton provided hydrological flow data for the two other sites.

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# 1 Introduction

## 1.1 Background

The year 2006 report follows the format of the previous data report (Smith, 2005), with the addition of the reporting of a microbiological survey conducted in the summer of 2006/2007.

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 Environment Waikato 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 15<sup>th</sup> since the re-design of the Waikato River Monitoring Programme (WARIMP) implemented in 1989. Copies of reports can be obtained via the Environment Waikato Internet site <http://www.ew.govt.nz/publications/index.htm> or by contacting Environment Waikato (the Library) on 0800 800 401, e-mail: [inforeq@ew.govt.nz](mailto:inforeq@ew.govt.nz).

## 1.2 Report Content

The report provides information on:

1. Routine monthly monitoring of water quality at 10 sites:
  - Year 2006 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 2006 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 Year 2006.
2. Microbiological water quality (intensive bathing season monitoring of indicator bacteria in river water):
  - Year 2006/2007 bathing season E. coli summary statistics for each location and reported with the median of the previous 5 summer surveys.
  - A summary table identifying the number of samples meeting the "satisfactory" and "excellent" water quality standards and guidelines for recreation.
  - A graph showing average 2006/2007 bathing season results for E. coli compared to the results from the previous 5 surveys.
  - Raw data (2006/2007 bathing season – December to February).

3. Additional information is provided in the appendices on:
  - Flow (*Appendix I*).
    - The effect of flow is important to assessing water quality and making comparisons between years. Appendix I provides information on annual average flow at some locations for the previous 10 years.
  - Datasonde Deployments
    - Plots of deployments undertaken during 2006 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 2006. 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 IV). The more stringent criteria identify “excellent” water, and reflect expert opinion. Samples gathered in 2006 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 <sup>1</sup>	Satisfactory	Excellent
<b>Ecological Health</b>			
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 <sup>3</sup> )	aquatic life (toxicity)	<0.88	<0.1
Temperature (°C) (May-Sep)	fish (spawning)	<12	<10
		<20	<16
Total phosphorus (g/m <sup>3</sup> )	Nuisance plant growth	<0.04	<0.01
Total nitrogen (g/m <sup>3</sup> )	Nuisance plant growth	<0.5	<0.1
<b>Human Uses—recreation</b>			
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
<b>Human Uses—water supply</b>			
Phytoplankton chlorophyll a (g/m <sup>3</sup> )	filter blockage	<0.02	<0.005
<b>Human Uses—drinking water</b>			
Arsenic (g/m <sup>3</sup> )	human health (toxicity)	<0.01	–
Boron (g/m <sup>3</sup> )	human health (toxicity)	<1.4	–

<sup>1</sup> Refer to Appendix IV for description of Guideline and Standards values used. These guidelines and standards are also defined on the Environment Waikato Internet site; [www.ew.govt.nz](http://www.ew.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 ~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 summarised in *Table 2* and illustrated in *Figure 1*.

**Table 2: Routine Sampling and Bathing Water Monitoring Locations**

Location Number	Distance <sup>1</sup> (km)	Location Name	Map Ref.	Field <sup>T</sup> Measurements
1131.127	0.1	Taupo Gates	U18:772-757	–
1131.119 <sup>*d</sup>	1.2	Taupo – Reids Farm	U18:778:763	true left bank
1131.70 <sup>b</sup>	6.0	Huka Falls	U18:789-792	–
1131.244 <sup>d</sup>	7.8	Downstream Huka Falls	U18:797-809	river boat jetty <sup>2</sup>
1131.105 <sup>d</sup>	36.5	Ohaaki Bridge	U17:981-914	at bridge, true left bank
1131.107	75.8	Ohakuri Tailrace Bridge	U17:796-061	boat ramp <sup>3</sup>
1131.147	105.0	Whakamaru Tailrace	T17:552-056	boat ramp <sup>4</sup>
1131.143	126.1	Waipapa Tailrace	T16:448-200	boat ramp <sup>5</sup>
1131.81 <sup>b</sup>	166.7	Lake Karapiro Boat Ramp	T15:436-570	Horahora domain
1131.101	202.0	Hamilton – Narrows Bridge	S14:168-708	at jetty <sup>6</sup>
1131.145 <sup>*b</sup>	210.8	Hamilton – Wellington St Bch	S14:117-757	at jetty, true right bank
1131.64 <sup>d</sup>	211.5	Hamilton – Traffic Bridge	S14:118-764	true right bank
1131.121 <sup>b</sup>	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 <sup>b</sup>	232.3	Ngaruawahia Bridge	S14:997-912	u/s of confluence <sup>7</sup>
1131.77	246.5	Huntly – Tainui Bridge	S13:003-018	true left bank
1131.117 <sup>*d</sup>	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 <sup>8</sup>
1131.131 <sup>d</sup>	306.5	Tuakau – Elbows Landing	R12:745-352	NZ Steel Ltd pumping station

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

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

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

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

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

<sup>6</sup> jetty at Hamilton Gardens.

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

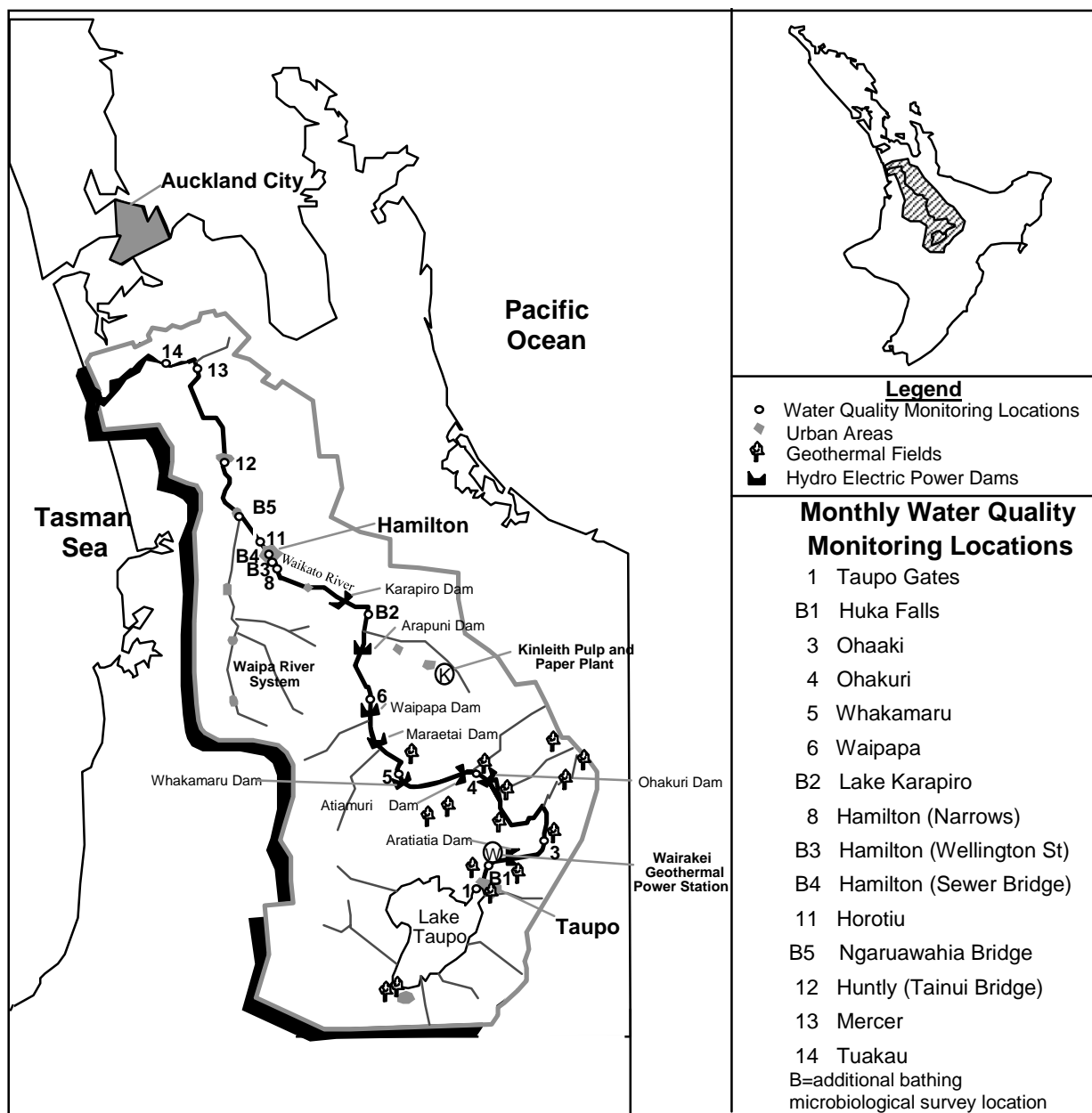
<sup>8</sup> immediately d/s of bridge, at Reserve (true right bank).

<sup>b</sup> bathing season intensive microbiological survey locations only – survey conducted over the 2006/2007 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.

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

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



**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).

## 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 IV).

## 2.4 Quality Control, Data Storage and Analysis

Quality control measures are undertaken in accordance with Environment Waikato's ISO 9001:2000 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 Environment Waikato's water quality archiving database (TimeStudio).

Data analysis was performed using Statistica (version 6.0) 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

Environment Waikato's State of the Environment Report summarises the state of the Waikato River, other rivers in the region, and common pressures (Environment Waikato, 1999).

Environment Waikato Technical Report 2004/02 Trends in river water quality in the Waikato Region, 1987-2002 (Vant & Smith, 2004) 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 Environment Waikato website:

<http://www.ew.govt.nz/publications/index.htm>

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

<http://www.ew.govt.nz/enviroinfo/water/healthyivers/waikato/index.htm>

upon completion of the report. The "Healthy Rivers" page provides a link to 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

The results are divided up into 2 sections. Section 3.1 contains the results and statistical summaries of the routine analysis monitoring of the Waikato River. Section 3.2 reports the results and statistical summaries of the summer intensive microbiological survey. The raw data is included with each section, placed last.

## **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 <sup>-1</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.003	0.000	<u>2.22</u>	0.001
Ohaaki Bridge	12	0.002	0.002	0.001	0.005	0.002	0.67	0.003
Ohakuri Tailrace Bridge	12	0.006	0.006	0.002	0.011	0.004	0.31	0.006
Whakamaru Tailrace	12	0.008	0.007	0.003	0.016	0.003	1.16	0.007
Waipapa Tailrace	12	0.011	0.011	0.004	0.020	0.005	0.55	0.011
Narrows Bridge	12	0.012	0.013	0.009	0.017	0.006	0.25	0.013
Horotiu Bridge	12	0.015	0.014	0.010	0.022	0.006	0.73	0.014
Huntly-Tainui Bridge	12	0.022	0.020	0.012	0.043	0.010	1.04	0.020
Mercer Bridge	12	0.025	0.022	0.014	0.048	0.008	1.33	0.024
Tuakau Bridge	12	0.028	0.028	0.014	0.052	0.017	0.70	0.026

Absorbance of filtered sample at 440 nm (units: cm <sup>-1</sup> )								
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	0.002	0.000	<u>3.02</u>	0.001
Whakamaru Tailrace	12	0.001	0.001	0.001	0.004	0.001	<u>2.21</u>	0.001
Waipapa Tailrace	12	0.002	0.001	0.001	0.005	0.002	1.27	0.002
Narrows Bridge	12	0.002	0.002	0.001	0.005	0.002	1.03	0.003
Horotiu Bridge	12	0.003	0.003	0.001	0.007	0.003	0.99	0.003
Huntly-Tainui Bridge	12	0.004	0.004	0.001	0.008	0.003	0.10	0.004
Mercer Bridge	12	0.004	0.004	0.001	0.008	0.004	0.32	0.005
Tuakau Bridge	12	0.005	0.004	0.002	0.009	0.004	0.46	0.005

Arsenic - Total (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.011	0.011	0.010	0.012	0.001	-0.08	0.010
Ohaaki Bridge	12	0.032	0.027	0.024	0.051	0.016	0.88	0.026
Ohakuri Tailrace Bridge	12	0.037	0.037	0.026	0.058	0.013	0.83	0.032
Whakamaru Tailrace	12	0.034	0.034	0.025	0.052	0.008	1.01	0.032
Waipapa Tailrace	12	0.029	0.029	0.023	0.038	0.008	0.49	0.027
Narrows Bridge	12	0.025	0.025	0.018	0.035	0.008	0.30	0.024
Horotiu Bridge	12	0.025	0.025	0.018	0.032	0.006	0.09	0.024
Huntly-Tainui Bridge	12	0.018	0.018	0.010	0.026	0.008	0.06	0.018
Mercer Bridge	12	0.018	0.016	0.013	0.025	0.011	0.31	0.017
Tuakau Bridge	12	0.017	0.014	0.012	0.026	0.009	0.47	0.015

Boron (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.17	0.17	0.16	0.19	0.02	0.10	0.16
Ohaaki Bridge	12	0.33	0.29	0.27	0.50	0.11	1.09	0.28
Ohakuri Tailrace Bridge	12	0.36	0.34	0.29	0.47	0.11	0.38	0.32
Whakamaru Tailrace	12	0.34	0.32	0.26	0.43	0.08	0.50	0.31
Waipapa Tailrace	12	0.30	0.30	0.25	0.40	0.04	0.95	0.28
Narrows Bridge	12	0.27	0.25	0.21	0.36	0.05	0.78	0.25
Horotiu Bridge	12	0.27	0.26	0.21	0.35	0.04	0.76	0.25
Huntly-Tainui Bridge	12	0.21	0.19	0.12	0.32	0.04	0.80	0.20
Mercer Bridge	12	0.21	0.19	0.16	0.34	0.06	1.27	0.20
Tuakau Bridge	12	0.21	0.18	0.16	0.36	0.07	1.33	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	5.4	5.1	3.5	7.3	1.6	0.24	5.3
Ohakuri Tailrace Bridge	12	3.0	3.0	1.4	4.2	1.0	-0.11	2.8
Whakamaru Tailrace	12	2.5	2.6	1.2	4.2	1.2	0.37	2.2
Waipapa Tailrace	12	2.2	2.2	1.3	3.4	1.0	0.09	2.0
Narrows Bridge	12	1.5	1.5	1.1	2.5	0.5	1.19	1.4
Horotiu Bridge	12	1.4	1.3	1.0	2.0	0.5	0.71	1.2
Huntly-Tainui Bridge	12	0.8	0.8	0.4	1.5	0.4	0.81	0.8
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	0.6	0.6	0.3	0.9	0.3	-0.41	0.6

Biochemical Oxygen Demand - 5 day (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.3	0.2	0.2	0.7	0.3	1.10	0.4
Ohaaki Bridge	12	0.4	0.3	0.2	0.6	0.4	0.36	0.4
Ohakuri Tailrace Bridge	12	0.5	0.6	0.2	0.8	0.3	-0.61	0.6
Whakamaru Tailrace	12	0.7	0.7	0.2	1.5	0.4	0.51	0.7
Waipapa Tailrace	12	0.6	0.6	0.2	1.4	0.4	0.90	0.6
Narrows Bridge	12	0.8	0.7	0.2	1.3	0.6	-0.01	0.8
Horotiu Bridge	12	0.7	0.8	0.2	1.1	0.4	-0.77	0.9
Huntly-Tainui Bridge	12	0.8	0.9	0.2	1.3	0.3	-0.59	1.0
Mercer Bridge	12	1.0	1.1	0.5	1.6	0.5	-0.21	1.1
Tuakau Bridge	12	1.1	1.1	0.5	1.5	0.5	-0.43	1.2

Carbon - Dissolved Organic (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.90	1.00	0.40	1.10	0.35	-0.94	0.70
Ohaaki Bridge	12	0.79	0.80	0.40	1.20	0.20	-0.06	0.70
Ohakuri Tailrace Bridge	12	0.83	0.80	0.50	1.20	0.30	0.42	0.70
Whakamaru Tailrace	12	1.01	1.10	0.70	1.40	0.45	-0.10	0.85
Waipapa Tailrace	12	1.03	1.10	0.60	1.30	0.30	-0.56	0.80
Narrows Bridge	12	1.22	1.30	0.50	1.80	0.50	-0.69	0.90
Horotiu Bridge	12	1.30	1.25	0.80	1.80	0.55	-0.12	0.90
Huntly-Tainui Bridge	12	1.81	1.50	0.80	3.40	1.20	0.59	1.10
Mercer Bridge	12	1.95	1.85	0.70	3.80	0.90	0.75	1.40
Tuakau Bridge	12	2.12	2.15	0.50	3.50	1.60	-0.04	1.45

Carbon - Total Organic (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1.01	1.00	0.80	1.30	0.10	0.42	1.00
Ohaaki Bridge	12	1.03	1.05	0.70	1.40	0.30	0.07	1.00
Ohakuri Tailrace Bridge	12	1.16	1.25	0.90	1.50	0.35	-0.06	1.20
Whakamaru Tailrace	12	1.44	1.45	0.90	2.10	0.55	0.13	1.30
Waipapa Tailrace	12	1.49	1.45	1.20	2.00	0.40	0.56	1.50
Narrows Bridge	12	1.88	1.75	1.30	2.50	0.80	0.23	1.70
Horotiu Bridge	12	1.94	1.90	1.30	2.80	0.85	0.30	1.80
Huntly-Tainui Bridge	12	2.74	2.55	1.70	4.30	1.10	0.65	2.20
Mercer Bridge	12	2.98	2.55	1.90	5.40	1.30	1.13	2.70
Tuakau Bridge	12	3.12	2.95	1.80	4.50	1.25	0.18	3.05

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

Chloride (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	9	9	8	10	0	1.41	9
Ohaaki Bridge	12	19	17	15	30	7	1.16	17
Ohakuri Tailrace Bridge	12	22	21	18	29	5	0.77	21
Whakamaru Tailrace	12	21	20	17	27	4	0.72	20
Waipapa Tailrace	12	20	19	17	25	3	0.88	19
Narrows Bridge	12	18	17	15	23	2	1.26	18
Horotiu Bridge	12	18	17	16	23	2	1.34	18
Huntly-Tainui Bridge	12	16	16	15	21	2	<u>1.76</u>	17
Mercer Bridge	12	17	17	15	21	2	1.42	18
Tuakau Bridge	12	17	17	16	21	2	1.55	18

Chlorophyll a (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.002	0.002	0.002	0.005	0.000	<u>3.02</u>	0.002
Ohaaki Bridge	12	0.002	0.002	0.002	0.002	0.000	1.00	0.002
Ohakuri Tailrace Bridge	12	0.005	0.004	0.002	0.011	0.006	0.66	0.005
Whakamaru Tailrace	12	0.008	0.010	0.002	0.018	0.010	0.13	0.009
Waipapa Tailrace	12	0.006	0.003	0.002	0.015	0.011	0.62	0.008
Narrows Bridge	12	0.009	0.009	0.002	0.019	0.012	0.29	0.011
Horotiu Bridge	12	0.009	0.007	0.002	0.024	0.010	0.75	0.012
Huntly-Tainui Bridge	12	0.007	0.007	0.002	0.016	0.008	0.41	0.010
Mercer Bridge	12	0.013	0.012	0.004	0.032	0.011	0.99	0.017
Tuakau Bridge	12	0.014	0.013	0.004	0.041	0.014	1.27	0.019

Colour (Munsell Colour Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	-	-	-	-	-	-	-	-
Ohaaki Bridge	12	45.8	46.3	37.5	50.0	3.8	-0.88	47.5
Ohakuri Tailrace Bridge	12	39.4	38.8	35.0	47.5	3.8	0.85	40.0
Whakamaru Tailrace	12	37.1	37.5	30.0	42.5	1.3	-0.68	37.5
Waipapa Tailrace	12	35.3	35.0	32.5	40.5	2.5	0.77	35.0
Narrows Bridge	12	34.6	35.0	27.5	47.5	5.0	0.85	35.0
Horotiu Bridge	12	33.3	32.5	27.5	47.5	5.0	<u>1.68</u>	32.5
Huntly-Tainui Bridge	12	32.7	32.5	27.5	45.0	3.8	1.54	30.0
Mercer Bridge	-	-	-	-	-	-	-	-
Tuakau Bridge	12	28.8	28.8	25.0	35.0	3.8	0.44	28.8

Conductivity at 25 °C (ms m <sup>-1</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	11.8	11.8	11.6	12.3	0.4	0.92	12.0
Ohaaki Bridge	12	15.9	15.1	14.0	19.3	2.7	0.83	15.2
Ohakuri Tailrace Bridge	12	17.6	17.4	15.9	21.6	2.0	1.17	17.0
Whakamaru Tailrace	12	17.0	16.6	15.2	20.1	1.1	1.09	16.8
Waipapa Tailrace	12	16.5	16.1	15.5	18.6	1.4	0.99	16.2
Narrows Bridge	12	15.4	15.3	13.9	18.0	1.0	1.04	15.5
Horotiu Bridge	12	15.6	15.4	14.1	18.1	1.0	1.10	15.7
Huntly-Tainui Bridge	12	14.6	14.4	13.5	17.0	1.0	1.38	14.8
Mercer Bridge	12	15.2	15.1	14.1	17.1	0.6	1.16	15.2
Tuakau Bridge	12	15.3	15.1	14.3	17.1	0.5	1.15	15.2

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

Dissolved Oxygen (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	9.7	9.8	8.8	10.8	0.9	0.18	10.0
Ohaaki Bridge	12	9.9	9.7	8.4	11.4	2.3	0.05	10.1
Ohakuri Tailrace Bridge	12	9.6	9.7	7.7	10.9	1.9	-0.38	9.8
Whakamaru Tailrace	12	10.0	9.9	8.5	11.6	1.8	0.04	9.9
Waipapa Tailrace	12	9.9	9.8	8.4	11.5	2.0	0.17	9.8
Narrows Bridge	12	10.0	10.1	8.5	11.8	2.2	0.17	9.9
Horotiu Bridge	12	9.8	9.8	8.1	11.7	2.2	0.08	10.0
Huntly-Tainui Bridge	12	9.6	9.4	7.6	12.5	2.0	0.57	9.8
Mercer Bridge	12	9.5	9.4	7.9	12.7	1.7	1.02	9.7
Tuakau Bridge	12	9.5	9.7	7.7	11.5	1.5	0.01	9.7

Dissolved Oxygen (% Saturation)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	100.6	101.5	95.2	107.1	6.2	0.02	101.6
Ohaaki Bridge	12	104.3	104.9	95.8	111.5	7.7	-0.33	104.9
Ohakuri Tailrace Bridge	12	101.8	104.5	88.5	111.1	10.3	-0.69	102.9
Whakamaru Tailrace	12	104.7	103.4	91.8	120.8	7.8	0.30	105.3
Waipapa Tailrace	12	101.7	98.2	94.0	117.5	9.8	1.06	103.2
Narrows Bridge	12	100.6	98.8	93.5	111.1	11.9	0.39	101.0
Horotiu Bridge	12	99.2	97.6	92.5	110.3	12.1	0.41	99.7
Huntly-Tainui Bridge	12	98.0	97.6	85.6	114.0	10.3	0.32	99.0
Mercer Bridge	12	98.4	96.9	83.6	118.4	9.2	0.67	97.5
Tuakau Bridge	12	99.2	99.7	78.8	120.1	11.3	0.01	99.3

Enterococci (n/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	1	1	1	2	1	1.28	1
Ohaaki Bridge	12	26	4	1	150	16	<u>1.91</u>	8
Ohakuri Tailrace Bridge	12	5	2	1	40	3	<u>2.92</u>	1
Whakamaru Tailrace	12	5	3	1	17	7	1.16	4
Waipapa Tailrace	12	6	3	1	20	9	1.10	4
Narrows Bridge	11	71	25	3	540	32	<u>2.78</u>	21
Horotiu Bridge	11	225	57	13	1000	196	1.56	31
Huntly-Tainui Bridge	11	492	87	1	3500	327	<u>2.49</u>	36
Mercer Bridge	11	97	31	6	330	175	1.07	15
Tuakau Bridge	11	76	20	6	430	41	<u>2.09</u>	21

Escherichia coli (n/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	2	1	1	9	1	<u>2.08</u>	1
Ohaaki Bridge	12	16	10	5	90	5	<u>2.93</u>	12
Ohakuri Tailrace Bridge	12	9	3	1	70	5	<u>2.94</u>	3
Whakamaru Tailrace	12	7	3	1	32	4	<u>1.71</u>	5
Waipapa Tailrace	12	12	8	3	50	6	<u>1.98</u>	8
Narrows Bridge	12	81	33	12	370	84	<u>2.02</u>	36
Horotiu Bridge	12	167	110	18	700	145	<u>1.87</u>	90
Huntly-Tainui Bridge	12	462	125	50	2200	634	<u>1.80</u>	140
Mercer Bridge	12	300	90	13	2100	128	<u>2.68</u>	85
Tuakau Bridge	12	314	60	29	2300	128	<u>2.63</u>	60

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



Faecal Coliforms (n/100 mL)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	2	1	1	9	1	<u>2.08</u>	1
Ohaaki Bridge	12	29	17	5	110	14	<u>1.73</u>	18
Ohakuri Tailrace Bridge	12	10	4	1	80	5	<u>2.95</u>	4
Whakamaru Tailrace	12	9	4	1	41	5	<u>1.82</u>	6
Waipapa Tailrace	12	14	8	3	50	6	<u>1.72</u>	9
Narrows Bridge	12	97	47	20	450	79	<u>2.25</u>	50
Horotiu Bridge	12	200	135	46	700	167	1.54	120
Huntly-Tainui Bridge	12	600	155	74	2200	875	1.25	195
Mercer Bridge	12	364	125	40	2200	170	<u>2.35</u>	120
Tuakau Bridge	12	364	100	29	2500	185	<u>2.66</u>	90

Lithium (g m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.041	0.040	0.037	0.047	0.004	0.64	0.039
Ohaaki Bridge	12	0.107	0.093	0.079	0.175	0.043	1.10	0.088
Ohakuri Tailrace Bridge	12	0.130	0.131	0.098	0.178	0.045	0.35	0.114
Whakamaru Tailrace	12	0.125	0.117	0.096	0.167	0.030	0.72	0.116
Waipapa Tailrace	12	0.109	0.108	0.088	0.150	0.020	1.03	0.099
Narrows Bridge	12	0.092	0.090	0.067	0.133	0.010	1.12	0.087
Horotiu Bridge	12	0.092	0.089	0.069	0.127	0.010	1.00	0.087
Huntly-Tainui Bridge	12	0.068	0.066	0.041	0.104	0.017	0.64	0.066
Mercer Bridge	12	0.069	0.062	0.051	0.102	0.027	0.75	0.065
Tuakau Bridge	12	0.068	0.060	0.052	0.099	0.027	0.71	0.064

Nitrate/Nitrite Nitrogen (g m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.001	0.001	0.001	0.003	0.000	<u>1.79</u>	0.001
Ohaaki Bridge	12	0.037	0.039	0.009	0.061	0.016	-0.33	0.030
Ohakuri Tailrace Bridge	12	0.098	0.104	0.050	0.141	0.066	-0.09	0.065
Whakamaru Tailrace	12	0.116	0.090	0.031	0.216	0.116	0.35	0.072
Waipapa Tailrace	12	0.180	0.155	0.099	0.307	0.104	0.58	0.138
Narrows Bridge	12	0.245	0.204	0.130	0.422	0.181	0.54	0.179
Horotiu Bridge	12	0.273	0.229	0.167	0.443	0.176	0.60	0.200
Huntly-Tainui Bridge	12	0.438	0.371	0.154	0.891	0.290	0.57	0.333
Mercer Bridge	12	0.436	0.390	0.125	0.892	0.370	0.41	0.339
Tuakau Bridge	12	0.417	0.375	0.056	0.854	0.399	0.22	0.297

Nitrogen - Ammoniacal (g m <sup>3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.01	0.01	0.01	0.01	0.00	1.00	0.01
Ohaaki Bridge	12	0.01	0.01	0.01	0.02	0.01	1.28	0.01
Ohakuri Tailrace Bridge	12	0.01	0.01	0.01	0.03	0.01	1.24	0.01
Whakamaru Tailrace	12	0.01	0.01	0.01	0.06	0.02	<u>1.91</u>	0.01
Waipapa Tailrace	12	0.02	0.02	0.01	0.05	0.03	0.58	0.01
Narrows Bridge	12	0.02	0.02	0.01	0.04	0.02	0.59	0.02
Horotiu Bridge	12	0.02	0.02	0.01	0.04	0.02	0.27	0.01
Huntly-Tainui Bridge	12	0.02	0.02	0.01	0.04	0.01	0.82	0.01
Mercer Bridge	12	0.01	0.01	0.01	0.02	0.00	1.59	0.01
Tuakau Bridge	12	0.01	0.01	0.01	0.04	0.01	<u>1.82</u>	0.01

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

Nitrogen - Total Kjeldahl (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.09	0.09	0.03	0.19	0.05	0.62	0.08
Ohaaki Bridge	12	0.11	0.11	0.07	0.16	0.03	0.77	0.09
Ohakuri Tailrace Bridge	12	0.12	0.14	0.03	0.17	0.05	-1.28	0.13
Whakamaru Tailrace	12	0.15	0.16	0.03	0.26	0.08	-0.18	0.16
Waipapa Tailrace	12	0.16	0.17	0.03	0.24	0.05	-1.18	0.16
Narrows Bridge	12	0.21	0.21	0.10	0.32	0.08	0.10	0.22
Horotiu Bridge	12	0.22	0.21	0.12	0.31	0.08	0.15	0.24
Huntly-Tainui Bridge	12	0.27	0.24	0.18	0.48	0.09	1.29	0.28
Mercer Bridge	12	0.32	0.31	0.21	0.53	0.15	0.80	0.33
Tuakau Bridge	12	0.34	0.33	0.23	0.54	0.13	0.79	0.34

Nitrogen - Total (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.09	0.09	0.03	0.19	0.05	0.61	0.08
Ohaaki Bridge	12	0.14	0.14	0.09	0.21	0.05	0.31	0.12
Ohakuri Tailrace Bridge	12	0.22	0.22	0.15	0.29	0.04	-0.04	0.20
Whakamaru Tailrace	12	0.27	0.27	0.12	0.35	0.07	-0.84	0.24
Waipapa Tailrace	12	0.34	0.34	0.26	0.46	0.10	0.26	0.28
Narrows Bridge	12	0.45	0.43	0.32	0.60	0.15	0.17	0.41
Horotiu Bridge	12	0.49	0.48	0.36	0.68	0.15	0.59	0.44
Huntly-Tainui Bridge	12	0.71	0.69	0.36	1.37	0.37	0.85	0.59
Mercer Bridge	12	0.75	0.78	0.37	1.34	0.47	0.35	0.66
Tuakau Bridge	12	0.76	0.74	0.33	1.35	0.48	0.28	0.64

pH (pH Units)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	7.6	7.6	7.4	8.0	0.2	1.15	7.6
Ohaaki Bridge	12	7.2	7.2	7.0	7.5	0.2	0.25	7.3
Ohakuri Tailrace Bridge	12	7.3	7.3	7.1	7.6	0.2	0.35	7.4
Whakamaru Tailrace	12	7.4	7.4	7.2	7.7	0.1	0.25	7.5
Waipapa Tailrace	12	7.4	7.4	7.1	7.7	0.2	0.28	7.5
Narrows Bridge	12	7.5	7.6	7.3	7.7	0.2	-0.55	7.5
Horotiu Bridge	12	7.5	7.5	7.4	7.7	0.1	0.49	7.5
Huntly-Tainui Bridge	12	7.4	7.4	7.3	7.8	0.2	1.38	7.5
Mercer Bridge	12	7.5	7.6	7.3	7.8	0.3	0.11	7.5
Tuakau Bridge	12	7.5	7.4	7.1	8.1	0.4	0.88	7.5

Phosphorus - Dissolved Reactive (g m <sup>-3</sup> )								
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	0.005
Ohaaki Bridge	12	0.006	0.006	0.002	0.010	0.004	0.12	0.009
Ohakuri Tailrace Bridge	12	0.010	0.008	0.002	0.023	0.004	1.28	0.012
Whakamaru Tailrace	12	0.008	0.007	0.002	0.021	0.008	0.77	0.011
Waipapa Tailrace	12	0.014	0.015	0.004	0.025	0.009	-0.01	0.016
Narrows Bridge	12	0.013	0.010	0.006	0.028	0.012	0.80	0.015
Horotiu Bridge	12	0.023	0.024	0.009	0.040	0.006	0.14	0.023
Huntly-Tainui Bridge	12	0.025	0.023	0.013	0.040	0.015	0.33	0.023
Mercer Bridge	12	0.020	0.018	0.009	0.047	0.012	1.35	0.018
Tuakau Bridge	12	0.018	0.016	0.006	0.040	0.013	1.00	0.016

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

Phosphorus - Total (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.005	0.005	0.002	0.007	0.002	-0.42	0.006
Ohaaki Bridge	12	0.016	0.015	0.010	0.025	0.005	0.77	0.014
Ohakuri Tailrace Bridge	12	0.029	0.028	0.018	0.043	0.017	0.40	0.022
Whakamaru Tailrace	12	0.031	0.028	0.021	0.045	0.009	0.88	0.026
Waipapa Tailrace	12	0.035	0.033	0.025	0.049	0.018	0.48	0.031
Narrows Bridge	12	0.040	0.038	0.032	0.056	0.006	1.26	0.038
Horotiu Bridge	12	0.053	0.052	0.038	0.074	0.015	0.56	0.049
Huntly-Tainui Bridge	12	0.066	0.061	0.041	0.109	0.019	1.06	0.065
Mercer Bridge	12	0.069	0.066	0.047	0.117	0.017	1.23	0.070
Tuakau Bridge	12	0.071	0.067	0.044	0.115	0.019	0.98	0.070

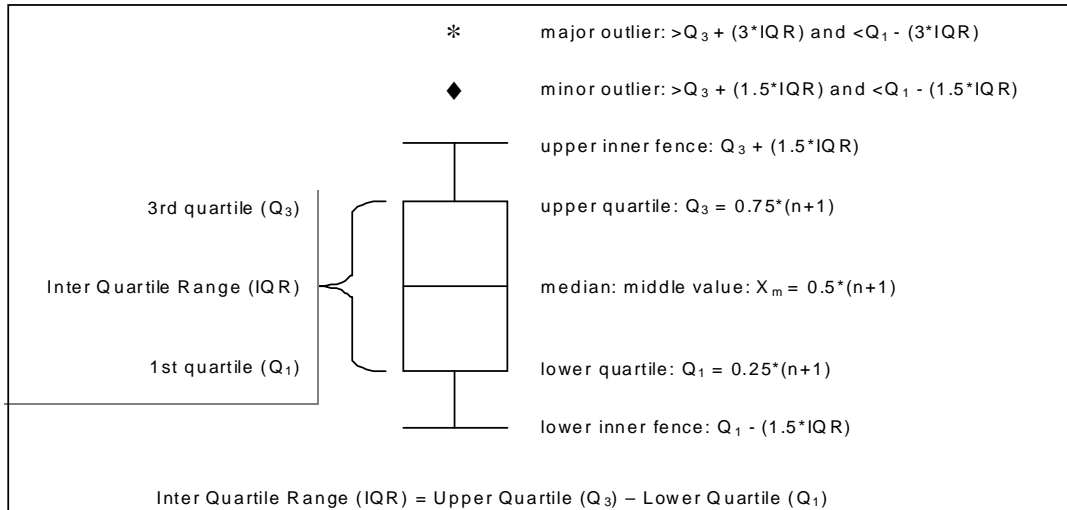
Temperature (°C)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	15.1	15.2	11.3	21.0	5.3	0.35	14.8
Ohaaki Bridge	12	16.5	17.1	12.6	22.2	5.8	0.15	16.4
Ohakuri Tailrace Bridge	12	16.6	16.9	11.6	22.2	5.8	0.04	16.2
Whakamaru Tailrace	12	16.4	16.8	11.0	22.4	5.8	0.00	16.2
Waipapa Tailrace	12	16.0	16.3	10.7	21.2	6.1	-0.08	16.1
Narrows Bridge	12	16.1	16.6	10.6	21.9	8.1	-0.11	16.1
Horotiu Bridge	12	16.3	16.9	10.2	22.1	7.4	-0.16	16.2
Huntly-Tainui Bridge	12	16.5	16.6	9.6	22.4	6.5	-0.19	16.0
Mercer Bridge	12	17.2	17.6	10.8	23.0	8.0	-0.13	16.8
Tuakau Bridge	12	17.4	17.5	10.3	23.9	8.0	-0.10	17.1

Dissolved Solids - Total (g m <sup>-3</sup> )								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	87	87	80	96	8	0.18	87
Ohaaki Bridge	12	113	110	96	139	16	0.69	108
Ohakuri Tailrace Bridge	12	131	135	116	152	22	0.11	123
Whakamaru Tailrace	12	130	123	115	153	27	0.55	123
Waipapa Tailrace	12	129	127	113	147	10	0.56	123
Narrows Bridge	12	124	124	104	147	13	0.10	120
Horotiu Bridge	12	122	123	102	142	14	0.10	119
Huntly-Tainui Bridge	12	115	115	100	133	15	0.40	114
Mercer Bridge	12	119	120	106	130	11	-0.22	117
Tuakau Bridge	12	122	118	107	145	14	0.65	117

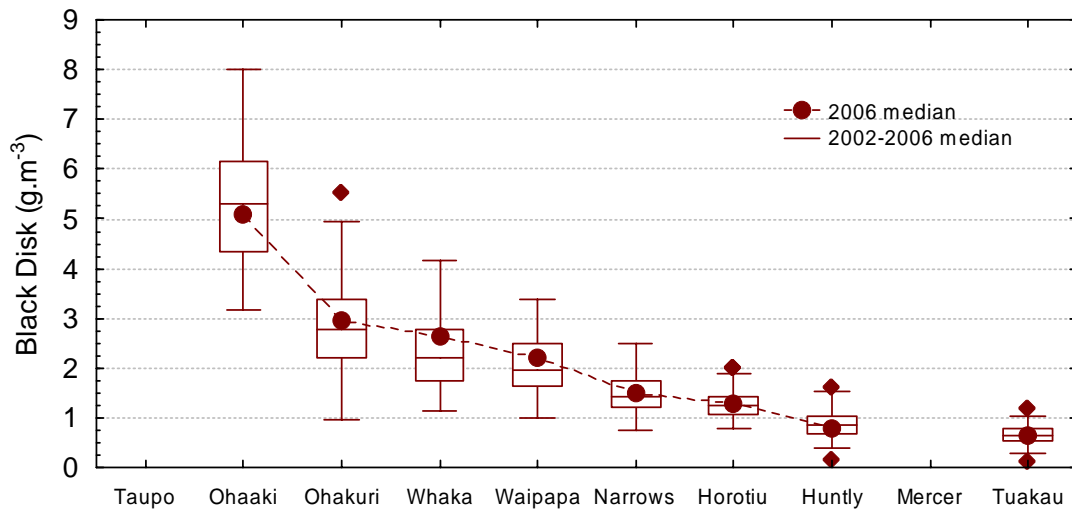
Turbidity (NTU)								
Location	Count	Mean	Median	Min	Max	IQR	Skew	5 Yr Median
Taupo Control Gates	12	0.3	0.3	0.2	0.5	0.1	1.33	0.3
Ohaaki Bridge	12	0.7	0.6	0.5	1.1	0.2	1.36	0.6
Ohakuri Tailrace Bridge	12	1.0	1.0	0.7	1.5	0.4	0.31	1.1
Whakamaru Tailrace	12	1.1	1.0	0.7	1.8	0.5	0.82	1.2
Waipapa Tailrace	12	1.2	1.3	0.9	1.6	0.5	0.04	1.5
Narrows Bridge	12	2.2	2.2	1.4	3.2	0.9	0.11	2.4
Horotiu Bridge	12	2.8	2.7	1.6	4.2	1.1	0.42	2.9
Huntly-Tainui Bridge	12	7.3	6.5	3.0	18	2.8	1.45	5.5
Mercer Bridge	12	9.6	7.3	4.9	22	6.6	1.24	8.5
Tuakau Bridge	12	10.5	8.4	4.7	28.4	4.4	<u>1.92</u>	8.8

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

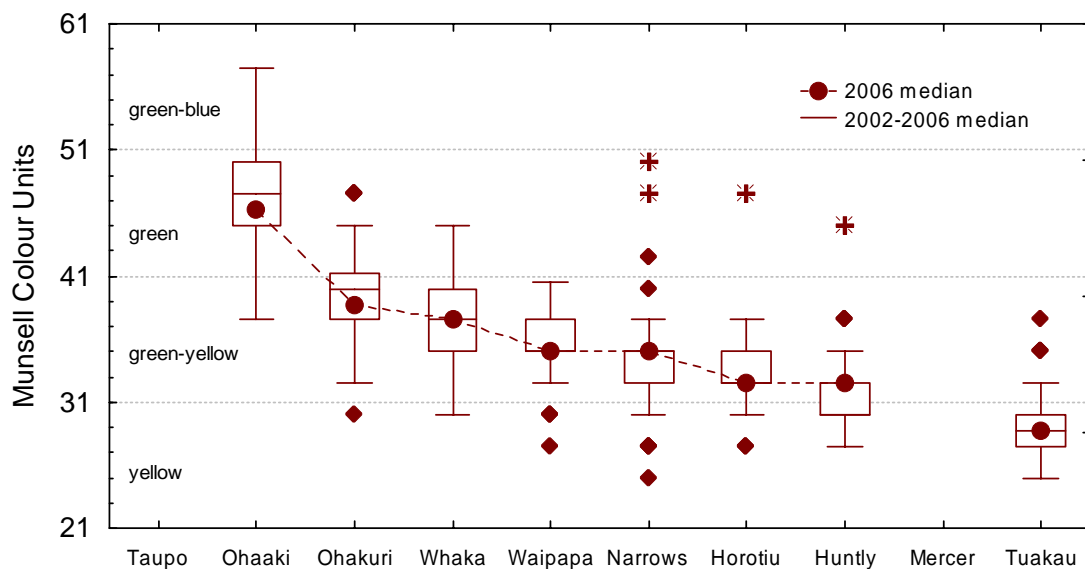
## Boxplots are used to present data



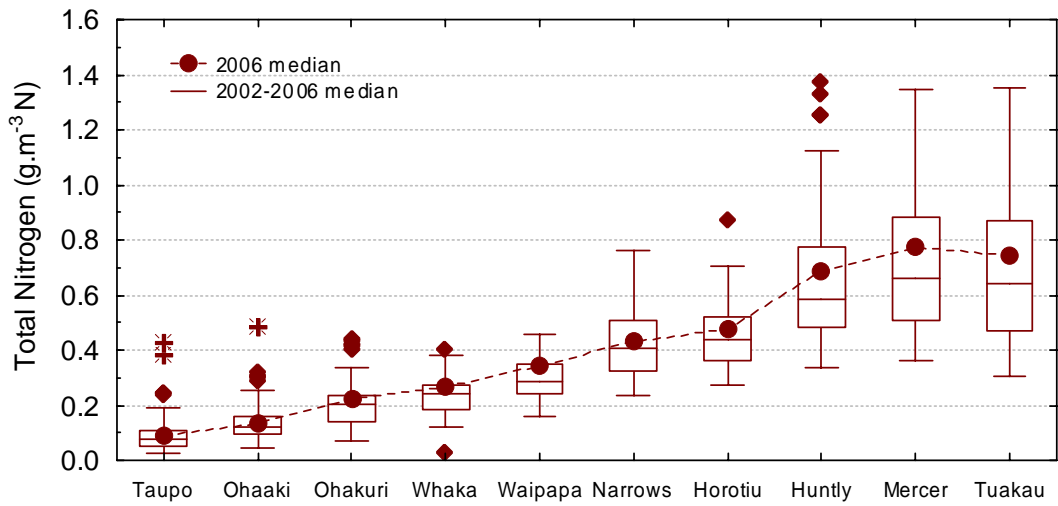
### Black Disk, 2002-2006 Data



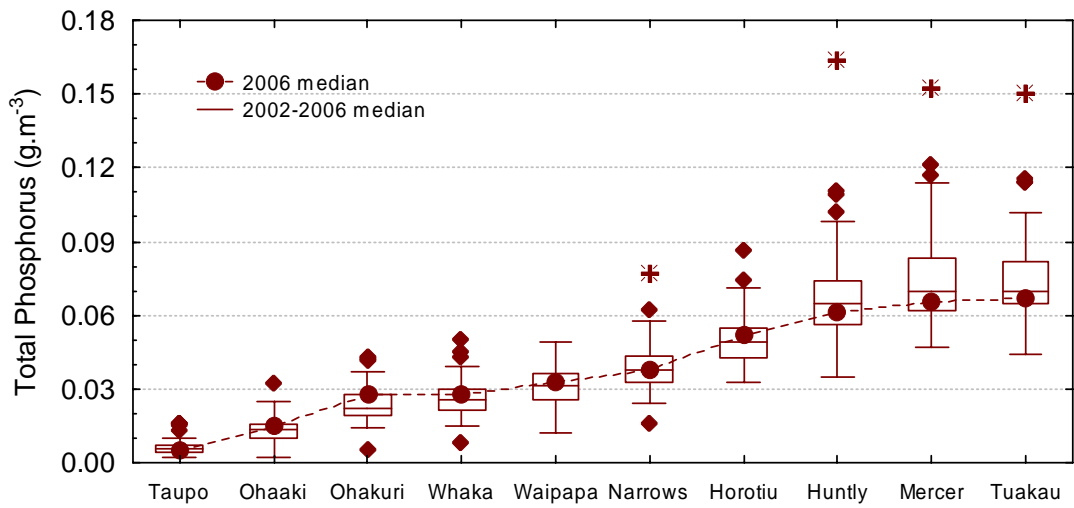
### Colour, 2002-2006 Data



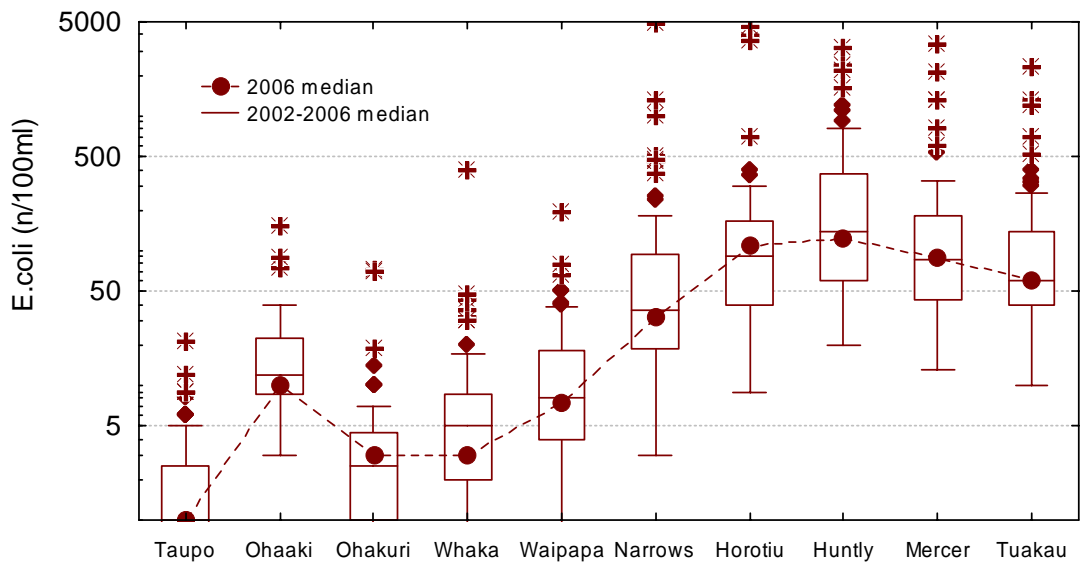
**Total Nitrogen, 2002-2006 Data**



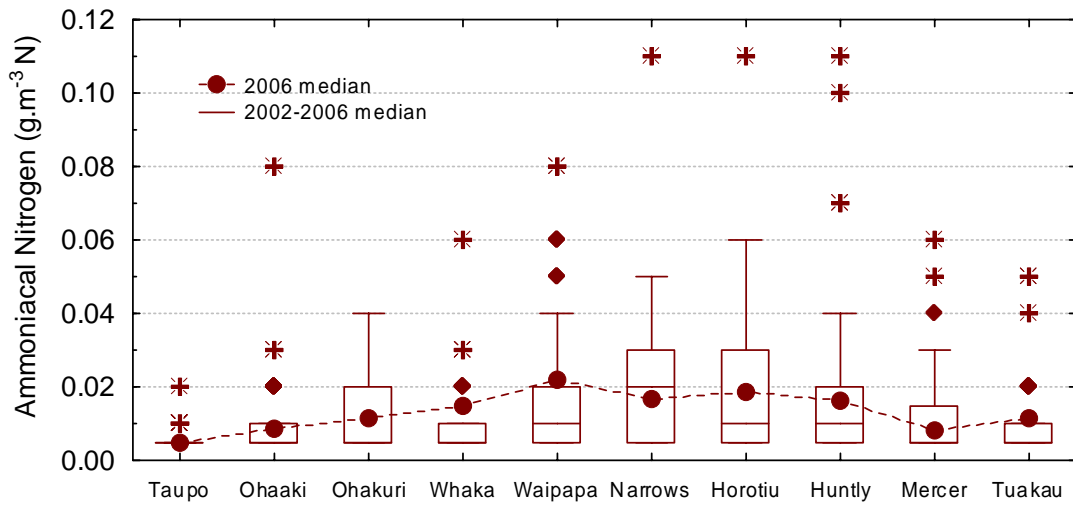
**Total Phosphorus, 2002-2006 Data**



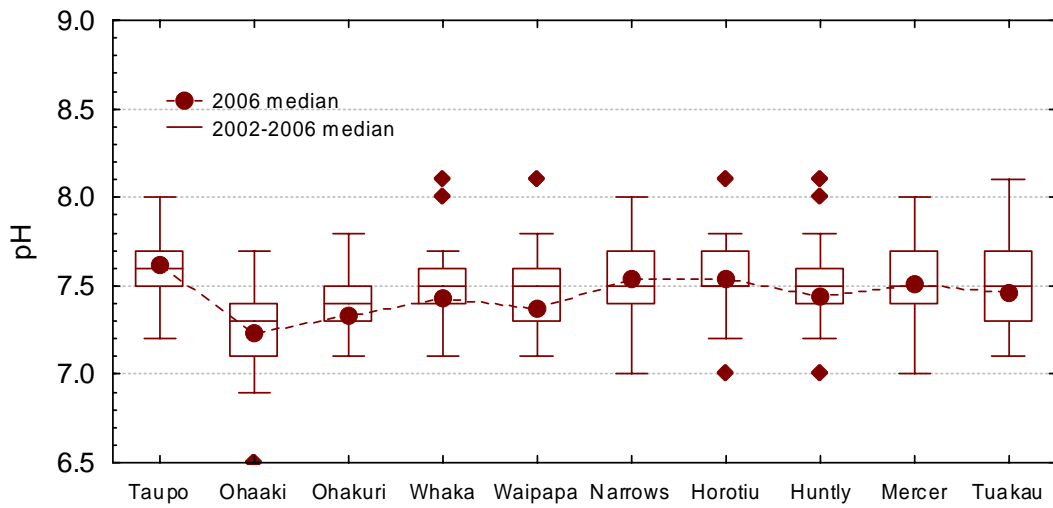
**E.coli, 2002-2006 Data**



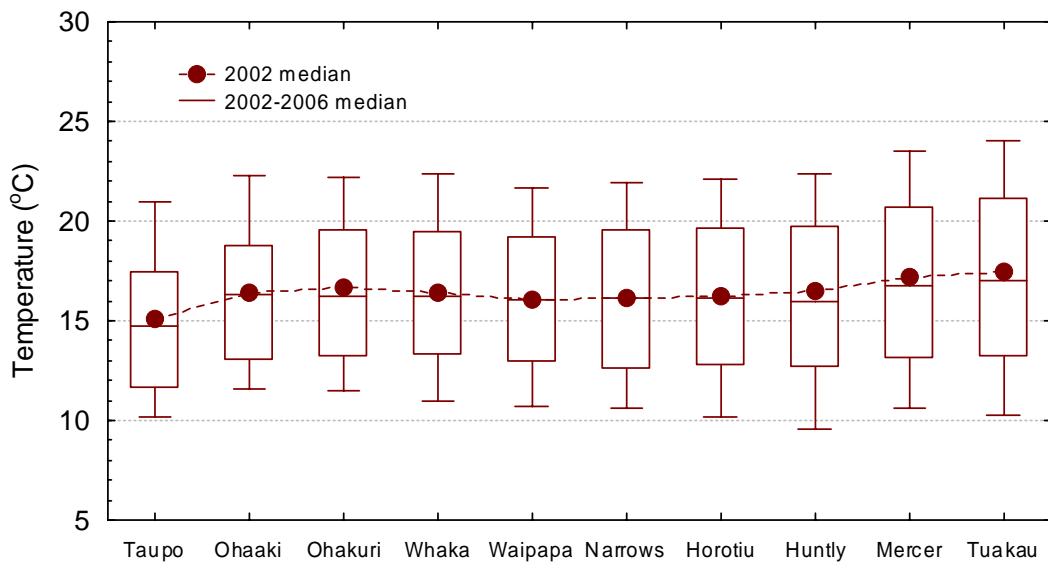
### Ammoniacal Nitrogen, 2002-2006 Data



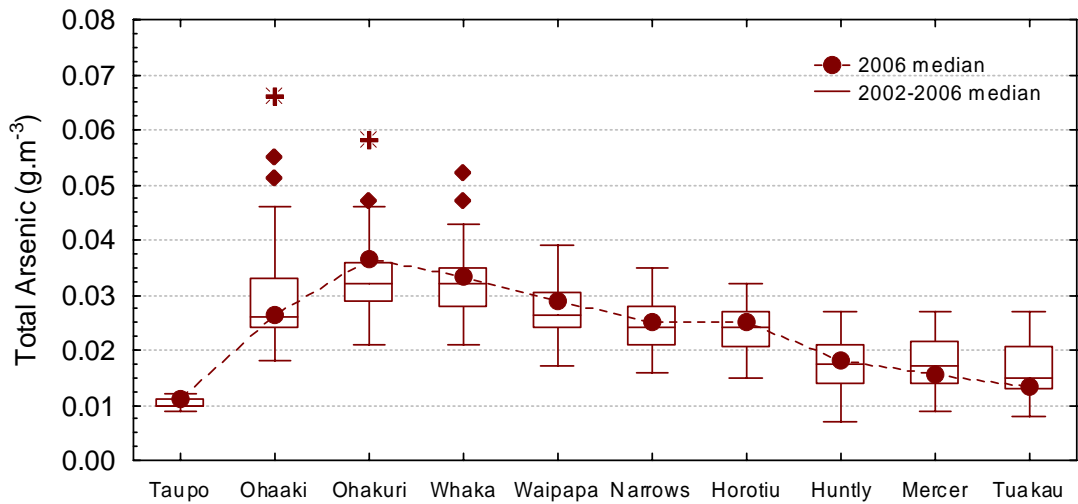
### pH, 2002-2006 Data



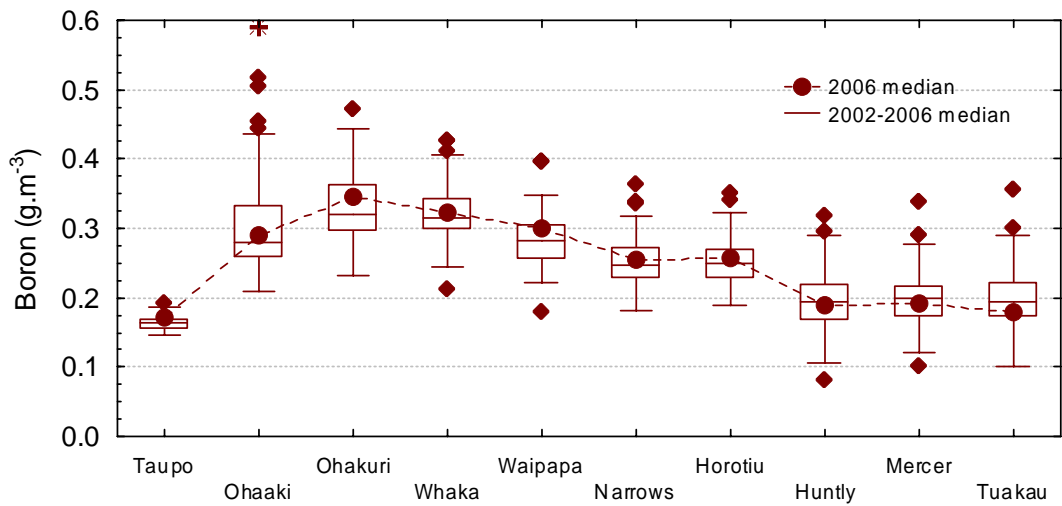
### Temperature, 2002-2006 Data



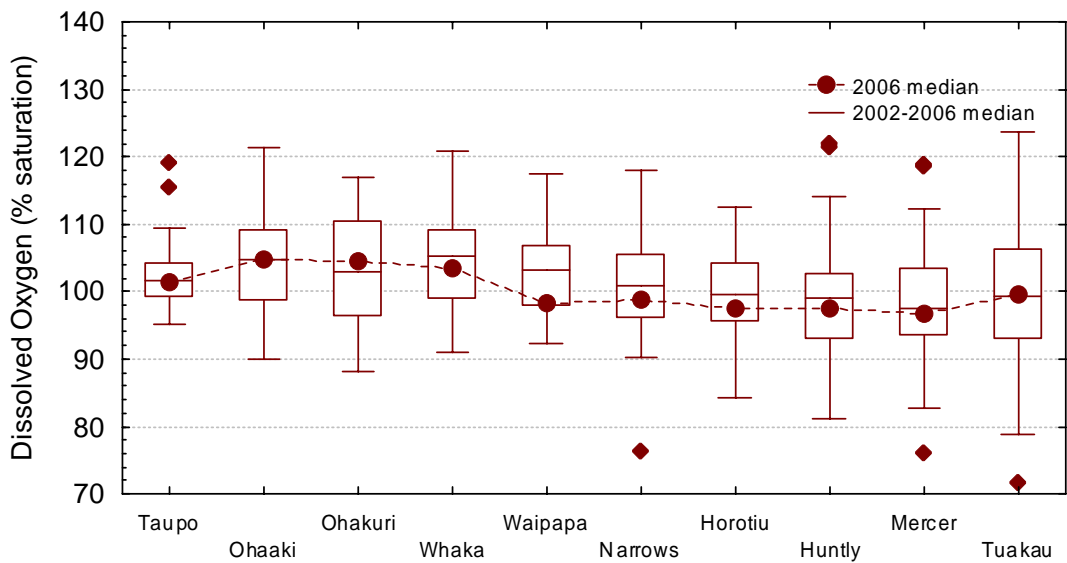
### Total Arsenic, 2002-2006 Data



### Boron, 2002-2006 Data



### Dissolved Oxygen, 2002-2006 Data



**Table 3: Samples (Year 2006) complying with the 'Satisfactory' Water Quality Guidelines and Standards. n = 12**

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

<sup>1</sup> 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 2006) complying with the 'Excellent' Water Quality Guidelines and Standards. n = 12.**

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

<sup>1</sup> 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 dd/mm/yy	TIME* hh:mm	FLOW m <sup>3</sup> /s	BDISK m	COLOR units	COND mS/m	PH units	TEMP °C	DO g/m <sup>3</sup>	PCDO %Sat	BOD5 g/m <sup>3</sup>	TURB NTU	TDS g/m <sup>3</sup>	NNN g/m <sup>3</sup>	NO3-N g/m <sup>3</sup>	NH4-N g/m <sup>3</sup>
Satisfactory Water Quality			>1.6	-	-	6.5-9	<12 (May-Sep)	>80	-	<5	-	-	-	-	<0.88
Guideline/Standard							<20 (Oct-Apr)								

1131-127 UD = 262 m<sup>3</sup>/m (Flows from "Reids Farm")

**Waikato River @ Taupo Control Gates**

10/01/06	8:28 AM	202	-	-	11.9	7.5	18.2	9.1	99.7	< 0.4	0.27	85	< 0.002	< 0.002	< 0.01
01/02/06	8:15 AM	227	-	-	12.0	7.6	<u>21.0</u>	8.8	103.5	< 0.4	0.24	92	< 0.002	< 0.002	< 0.01
06/03/06	8:10 AM	201	-	-	11.8	7.6	17.9	9.1	101.3	0.4	0.30	96	0.003	0.003	< 0.01
04/04/06	9:25 AM	120	-	-	11.6	7.7	17.1	9.3	101.8	< 0.4	0.23	80	< 0.002	< 0.002	< 0.01
01/05/06	9:10 AM	220	-	-	11.6	7.7	<u>15.9</u>	9.5	101.6	< 0.4	0.25	91	< 0.002	< 0.002	< 0.01
06/06/06	9:17 AM	276	-	-	11.6	7.5	<u>12.8</u>	9.7	95.6	< 0.4	0.27	89	0.003	0.003	< 0.01
05/07/06	9:05 AM	212	-	-	11.7	7.5	11.7	10.1	97.3	0.5	0.29	89	< 0.002	< 0.002	< 0.01
01/08/06	9:10 AM	271	-	-	11.8	7.6	11.6	9.9	95.2	< 0.4	0.31	85	< 0.002	< 0.002	< 0.01
06/09/06	9:00 AM	222	-	-	12.3	7.4	11.3	10.3	96.5	0.6	0.35	83	< 0.002	< 0.002	< 0.01
05/10/06	8:45 AM	221	-	-	11.6	7.7	12.7	10.8	107.1	< 0.4	0.51	93	< 0.002	< 0.002	< 0.01
06/11/06	8:30 AM	221	-	-	12.0	8.0	14.4	10.1	102.7	0.7	0.41	84	< 0.002	< 0.002	< 0.01
04/12/06	8:50 AM	282	-	-	11.8	7.6	16.2	9.8	105.4	< 0.4	0.33	82	< 0.002	< 0.002	< 0.01

1131-105 UD = 272 m<sup>3</sup>/s (Flows from Ohaaki Bridge Recorder, +/- 20%)

**Waikato River @ Ohaaki Br**

10/01/06	9:05 AM	82	7.1	47.5	17.0	7.0	<u>20.2</u>	8.5	95.8	< 0.4	0.54	118	0.030	0.028	< 0.01
01/02/06	9:01 AM	166	6.0	45.0	15.0	7.2	<u>22.2</u>	8.4	99.8	< 0.4	1.11	96	0.009	0.007	< 0.01
06/03/06	9:02 AM	153	4.7	47.5	14.3	7.1	18.4	9.5	105.6	0.4	0.50	109	0.030	0.030	< 0.01
04/04/06	10:15 AM	91	7.3	47.5	17.9	7.1	19.0	9.0	101.8	0.4	0.50	125	0.046	0.045	< 0.01
01/05/06	9:56 AM	119	4.4	40.0	19.3	7.2	<u>18.3</u>	8.7	96.1	< 0.4	0.57	139	0.031	0.029	0.02
06/06/06	10:20 AM	265	> 4.8	45.0	14.0	7.3	<u>13.2</u>	11.1	109.0	< 0.4	1.01	107	0.020	0.018	< 0.01
05/07/06	9:45 AM	168	6.2	50.0	15.0	7.2	<u>12.6</u>	11.1	107.9	0.5	0.66	114	0.041	0.041	0.01
01/08/06	9:50 AM	182	6.0	45.0	14.9	7.4	<u>12.9</u>	10.9	107.2	< 0.4	0.50	105	0.047	0.045	0.01
06/09/06	9:35 AM	185	5.1	50.0	15.1	7.2	<u>12.6</u>	11.4	110.4	0.6	0.59	100	0.037	0.037	< 0.01
05/10/06	9:25 AM	175	4.3	37.5	14.6	7.3	13.4	11.2	111.5	< 0.4	0.67	110	0.045	0.044	< 0.01
06/11/06	9:00 AM	126	5.1	50.0	15.2	7.5	15.9	9.9	104.1	0.6	0.70	106	0.042	0.042	0.01
04/12/06	9:50 AM	96	3.5	45.0	18.6	7.3	18.7	9.1	102.5	0.6	0.64	129	0.061	0.060	0.02

1131-107 UD = 310 m<sup>3</sup>/s (Flows from Ohakuri Dam - Total)

**Waikato River @ Ohakuri Tailrace Br**

10/01/06	10:02 AM	195	2.0	35.0	21.6	7.3	<u>21.0</u>	9.3	105.9	0.8	1.25	152	0.050	0.049	0.01
01/02/06	10:10 AM	342	(2.5)	37.5	19.6	7.4	<u>22.2</u>	8.9	102.7	0.5	1.17	143	0.059	0.058	< 0.01
06/03/06	10:05 AM	194	3.0	37.5	17.5	7.3	<u>20.0</u>	7.7	88.5	0.7	1.25	134	0.070	0.068	0.03
04/04/06	11:10 AM	141	4.1	42.5	17.7	7.2	18.3	8.7	96.0	0.6	0.81	145	0.087	0.082	0.01
01/05/06	11:00 AM	309	3.5	37.5	18.0	7.3	<u>17.7</u>	8.3	90.6	< 0.4	0.83	135	0.141	0.138	0.02
06/06/06	11:15 AM	308	4.2	40.0	16.0	7.3	<u>13.3</u>	9.9	96.6	< 0.4	0.84	117	0.124	0.122	< 0.01
05/07/06	10:50 AM	255	3.0	40.0	16.3	7.1	11.6	10.9	103.5	0.6	0.74	123	0.131	0.130	< 0.01
01/08/06	10:40 AM	292	3.4	40.0	15.9	7.6	<u>12.2</u>	10.7	107.8	< 0.4	0.79	121	0.138	0.136	0.01
06/09/06	10:25 AM	282	2.7	47.5	17.2	7.3	<u>13.4</u>	10.7	106.3	0.6	0.93	116	0.121	0.120	< 0.01
05/10/06	10:50 AM	311	<u>(1.4)</u>	35.0	18.4	7.2	15.8	10.6	111.1	0.5	1.09	135	0.126	0.124	< 0.01
06/11/06	10:05 AM	189	2.3	42.5	16.4	7.5	16.0	10.2	106.8	0.6	1.45	117	0.066	0.062	0.02
04/12/06	10:55 AM	271	3.3	37.5	16.2	7.5	18.1	9.5	105.4	0.7	1.18	138	0.057	0.054	0.01

1131-147 UD = 305 m<sup>3</sup>/s (Flows from Whakamaru Dam - Total)

**Waikato River @ Whakamaru Tailrace**

10/01/06	10:48 AM	191	2.8	35.0	20.1	7.4	<u>20.2</u>	9.4	105.4	0.7	1.58	151	0.090	0.089	0.06
01/02/06	11:00 AM	232	2.6	35.0	19.0	7.4	<u>22.4</u>	8.7	103.3	0.7	1.33	147	0.062	0.061	0.02
06/03/06	11:00 AM	249	2.3	37.5	16.7	7.4	19.6	9.0	101.1	0.8	1.15	153	0.031	0.030	0.03
04/04/06	12:10 PM	200	2.7	40.0	16.9	7.4	18.4	9.4	103.5	0.7	1.01	123	0.082	0.080	< 0.01
01/05/06	11:45 AM	267	4.2	37.5	17.9	7.4	<u>17.4</u>	8.5	91.8	< 0.4	0.75	145	0.169	0.166	0.01
06/06/06	12:03 PM	260	3.9	37.5	16.5	7.3	<u>13.5</u>	9.6	93.8	< 0.4	0.77	119	0.214	0.213	< 0.01
05/07/06	11:45 AM	209	3.0	37.5	15.2	7.2	11.0	10.9	101.7	0.7	0.71	123	0.191	0.189	< 0.01
01/08/06	11:20 AM	264	2.6	42.5	15.8	7.5	<u>12.0</u>	10.8	102.7	< 0.4	0.79	115	0.216	0.214	< 0.01
06/09/06	11:15 AM	260	<u>1.5</u>	37.5	16.3	7.5	<u>13.0</u>	11.3	109.0	0.9	1.02	116	0.142	0.141	< 0.01
05/10/06	11:50 AM	289	<u>1.5</u>	30.0	16.9	7.5	15.9	11.6	120.8	1.5	0.82	122	0.067	0.065	< 0.01
06/11/06	10:55 AM	198	<u>1.2</u>	37.5	16.4	7.7	16.2	11.0	114.1	0.8	1.81	120	0.039	0.037	0.02
04/12/06	12:00 PM	216	1.7	37.5	16.3	7.5	17.4	10.1	109.4	0.7	1.20	131	0.089	0.088	< 0.01

Note: < = less than value stated  
UD = upper decile flow (period 1987-2006 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 value – don't assess for compliance

TKN g/m <sup>3</sup>	TN g/m <sup>3</sup>	DRP g/m <sup>3</sup>	TP g/m <sup>3</sup>	CL g/m <sup>3</sup>	AS g/m <sup>3</sup>	B g/m <sup>3</sup>	LI g/m <sup>3</sup>	A340F /cm	A440F /cm	ENT cfu/100ml	FC cfu/100ml	E coli	CHLA g/m <sup>3</sup>	DOC g/m <sup>3</sup>	TOC g/m <sup>3</sup>
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<273	<0.02		

0.07	0.07	<0.004	<0.004	8.0	<u>0.012</u>	0.16	0.037	0.002	<0.002	1	1	1	0.005	1	1
<0.05	<0.05	<0.004	<0.004	8.5	<u>0.011</u>	0.17	0.043	<0.002	<0.002	1	<1	<1	<0.003	1	1
0.05	0.05	<0.004	0.006	10.0	<u>0.011</u>	0.16	0.038	<0.002	<0.002	2	1	1	<0.003	1.1	1.3
0.08	0.08	<0.004	0.004	8.2	<u>0.011</u>	0.18	0.042	<0.002	<0.002	1	2	2	<0.003	0.7	0.8
0.09	0.09	<0.004	0.005	9.0	<u>0.011</u>	0.19	0.045	<0.002	<0.002	<1	<1	<1	<0.003	0.4	1
0.09	0.09	<0.004	0.005	8.8	<u>0.011</u>	0.18	0.039	<0.002	<0.002	<1	1	1	<0.003	1.1	1
0.18	0.18	<0.004	0.004	8.3	0.010	0.16	0.037	<0.002	<0.002	<1	<1	<1	<0.003	1.1	1.1
<0.05	<0.05	<0.004	0.004	8.8	<u>0.012</u>	0.16	0.039	<0.002	<0.002	<1	<1	<1	<0.003	0.7	1
0.12	0.12	<0.004	0.007	8.6	<u>0.011</u>	0.19	0.047	0.003	<0.002	<1	<1	<1	<0.003	1	1
0.09	0.09	<0.004	0.006	8.5	<u>0.011</u>	0.18	0.042	<0.002	<0.002	2	9	9	<0.003	0.8	0.9
0.19	0.19	<0.004	0.005	8.7	0.010	0.17	0.039	<0.002	<0.002	<1	<1	<1	<0.003	1.1	1.2
0.10	0.10	<0.004	0.005	8.7	<u>0.012</u>	0.17	0.041	<0.002	<0.002	<1	<10	<10	<0.003	0.8	0.8

0.07	0.10	0.010	0.016	20.0	<u>0.038</u>	<u>0.34</u>	0.106	0.005	<0.002	12	12	18	<0.003	0.9	1.1
0.08	0.09	<0.004	0.015	16.8	<u>0.030</u>	<u>0.31</u>	0.099	0.003	<0.002	<b>100</b>	7	90	<0.003	0.8	1.2
0.07	0.10	<0.004	0.013	15.2	<u>0.024</u>	0.27	0.079	<0.002	<0.002	<b>150</b>	90	110	<0.003	0.5	1.2
0.16	0.21	0.006	0.021	24.6	<u>0.044</u>	<u>0.44</u>	0.148	0.003	<0.002	10	10	17	<0.003	0.7	0.8
0.10	0.13	0.010	0.025	30.1	<u>0.051</u>	<u>0.50</u>	0.175	0.002	<0.002	22	16	29	<0.003	0.4	1
0.11	0.13	<0.004	0.010	15.2	<u>0.024</u>	0.28	0.080	<0.002	<0.002	2	12	17	<0.003	1.2	1
0.16	0.20	0.005	0.016	16.7	<u>0.027</u>	0.28	0.089	<0.002	<0.002	1	7	9	<0.003	0.8	0.8
0.11	0.16	0.006	0.015	16.2	<u>0.026</u>	0.28	0.085	0.002	<0.002	<1	9	10	<0.003	0.7	0.9
0.09	0.13	0.006	0.015	15.5	<u>0.025</u>	0.30	0.097	0.003	<0.002	1	10	10	<0.003	1	1.4
0.11	0.16	0.005	0.014	15.4	<u>0.025</u>	0.27	0.083	<0.002	<0.002	6	12	17	<0.003	0.9	1.1
0.10	0.14	0.006	0.014	17.1	<u>0.026</u>	0.28	0.088	<0.002	<0.002	2	7	11	<0.003	0.9	1.1
0.11	0.17	0.008	0.023	26.1	<u>0.045</u>	<u>0.45</u>	0.151	0.004	<0.002	<1	<10	<10	<0.003	0.7	0.7

0.17	0.22	0.009	0.036	29.1	<u>0.058</u>	<u>0.47</u>	0.178	0.011	0.002	2	1	1	0.011	1.1	1.3
0.15	0.21	0.008	<u>0.041</u>	25.6	<u>0.047</u>	<u>0.43</u>	0.168	0.009	<0.002	40	6	6	0.010	0.7	1.3
0.15	0.22	0.017	<u>0.043</u>	22.2	<u>0.041</u>	<u>0.34</u>	0.134	0.011	<0.002	<1	<1	<1	0.008	0.7	1.5
0.14	0.23	0.012	<u>0.029</u>	22.3	<u>0.043</u>	<u>0.39</u>	0.139	0.006	<0.002	3	<1	1	<0.003	0.7	0.9
0.15	0.29	0.023	<u>0.042</u>	24.7	<u>0.040</u>	<u>0.42</u>	0.148	0.007	<0.002	5	70	80	<0.003	0.5	1.3
<0.05	0.12	<0.004	0.022	18.9	<u>0.030</u>	<u>0.32</u>	0.100	0.005	<0.002	<1	5	5	0.003	0.8	1.2
0.11	0.24	0.008	0.024	17.8	<u>0.026</u>	0.29	0.104	0.002	<0.002	1	4	5	<0.003	0.8	0.9
0.07	0.21	0.008	0.019	18.1	<u>0.029</u>	0.29	0.098	0.004	<0.002	2	<1	<1	<0.003	0.6	1
0.13	0.25	0.008	0.018	19.9	<u>0.029</u>	<u>0.35</u>	0.128	0.005	<0.002	2	2	2	0.005	1.1	1.3
0.15	0.28	0.005	0.026	23.0	<u>0.038</u>	<u>0.43</u>	0.149	0.005	<0.002	4	7	7	0.007	0.9	1
0.10	0.17	0.007	0.022	18.9	<u>0.030</u>	<u>0.31</u>	0.103	0.002	<0.002	<1	1	1	0.004	1.2	1.3
0.14	0.20	0.007	0.029	19.3	<u>0.035</u>	<u>0.32</u>	0.112	0.007	<0.002	<1	<10	<10	<0.003	0.8	0.9

0.26	0.35	0.015	<u>0.045</u>	26.6	<u>0.052</u>	<u>0.43</u>	0.163	0.016	0.004	2	2	2	0.014	1.1	1.7
0.19	0.25	0.008	<u>0.043</u>	25.7	<u>0.043</u>	<u>0.43</u>	0.167	0.013	0.002	17	4	5	0.011	1.2	2.1
0.09	0.12	<0.004	0.027	21.2	<u>0.035</u>	<u>0.33</u>	0.117	0.006	<0.002	12	6	6	0.011	1.2	1.7
0.17	0.25	0.006	0.026	21.0	<u>0.036</u>	<u>0.36</u>	0.131	0.007	<0.002	2	2	4	<0.003	0.7	1.1
0.16	0.33	0.021	0.038	24.9	<u>0.036</u>	<u>0.41</u>	0.153	0.008	<0.002	17	32	41	<0.003	0.7	1.4
<0.05	0.21	0.013	0.028	20.2	<u>0.030</u>	<u>0.31</u>	0.116	0.009	<0.002	4	4	7	<0.003	1.4	1.8
0.08	0.27	0.010	0.027	17.1	<u>0.025</u>	0.26	0.096	0.003	<0.002	1	1	1	<0.003	1.2	1
0.12	0.34	0.010	0.024	18.4	<u>0.027</u>	0.29	0.100	0.006	<0.002	3	2	2	<0.003	0.7	1.2
0.15	0.29	0.006	0.021	18.3	<u>0.027</u>	<u>0.34</u>	0.121	0.006	<0.002	2	<1	<1	0.011	1.1	1.5
0.24	0.31	<0.004	0.026	20.3	<u>0.032</u>	<u>0.31</u>	0.114	0.005	<0.002	4	4	4	0.018	1.1	1.2
0.15	0.19	<0.004	0.030	19.2	<u>0.031</u>	<u>0.31</u>	0.110	0.004	0.002	<1	1	1	0.011	0.8	1.7
0.18	0.27	0.005	0.031	19.5	<u>0.037</u>	<u>0.32</u>	0.116	0.007	<0.002	<1	30	30	0.009	0.9	0.9

Note: < = less than value stated

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

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

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

1131-143 UD = 352 m<sup>3</sup>/s (Flows from Waipapa Dam - Total)

**Waikato River @ Waipapa Tailrace**

10/01/06	11:40 AM	210	2.0	35.0	17.8	7.2	19.8	8.9	97.2	0.6	1.45	125	0.156	0.152	0.05
01/02/06	11:55 AM	260	2.2	35.0	18.6	7.4	<u>21.2</u>	8.4	96.2	0.4	1.31	147	0.135	0.130	0.04
06/03/06	12:00 PM	277	2.8	35.0	15.8	7.4	19.9	8.8	98.1	0.4	1.02	124	0.106	0.103	0.05
04/04/06	1:00 PM	189	2.6	37.5	16.4	7.3	18.3	9.1	98.2	0.5	1.19	130	0.154	0.151	0.02
01/05/06	12:30 PM	275	3.0	35.0	18.0	7.3	<u>16.8</u>	9.1	96.3	0.4	0.99	147	0.234	0.231	0.02
06/06/06	12:45 PM	294	3.4	35.0	16.2	7.3	<u>13.4</u>	9.7	94.0	< 0.4	0.93	131	0.242	0.238	< 0.01
05/07/06	12:35 PM	298	2.5	37.5	15.5	7.1	10.7	10.9	99.7	0.6	0.93	134	0.249	0.247	< 0.01
01/08/06	12:00 PM	256	2.2	40.5	15.8	7.5	11.7	10.5	97.8	< 0.4	1.09	129	0.307	0.304	0.01
06/09/06	12:00 PM	254	<u>1.3</u>	32.5	15.7	7.4	<u>12.5</u>	11.4	108.6	1.1	1.48	113	0.187	0.185	0.01
05/10/06	12:40 PM	297	<u>1.3</u>	32.5	15.9	7.5	15.3	11.5	117.5	1.0	1.40	122	0.134	0.131	0.01
06/11/06	11:35 AM	253	<u>1.5</u>	32.5	15.6	7.7	15.8	11.0	111.7	1.4	1.62	117	0.099	0.099	< 0.01
04/12/06	1:10 PM	376	(1.95)	35.0	16.5	7.4	17.0	9.8	104.5	0.6	1.50	125	0.151	0.146	0.04

1131-101 UD = 357 m<sup>3</sup>/s (Flows from Karapiro Dam - Total)

**Waikato River @ Narrows Br**

12/01/06	7:55 AM	159	<u>1.5</u>	35.0	14.9	7.6	<u>20.0</u>	9.1	99.0	0.6	2.04	104	0.164	0.160	0.01
02/02/06	7:40 AM	258	<u>1.3</u>	32.5	18.0	7.6	<u>21.9</u>	8.5	97.0	1.3	2.69	147	0.173	0.166	0.04
08/03/06	7:45 AM	153	1.8	35.0	15.0	7.6	19.8	8.5	94.5	0.6	1.88	120	0.130	0.127	0.03
04/04/06	8:45 AM	154	1.8	35.0	16.3	7.3	19.8	8.5	93.8	0.8	1.95	138	0.197	0.193	0.02
01/05/06	8:50 AM	288	<u>1.3</u>	27.5	15.6	7.5	<u>16.5</u>	9.1	93.5	0.5	3.20	134	0.355	0.350	< 0.01
08/06/06	9:10 AM	296	1.8	37.5	13.9	7.6	11.9	10.3	94.9	0.5	1.61	117	0.344	0.343	0.02
04/07/06	8:45 AM	165	2.5	40.0	14.6	7.6	10.6	10.9	98.5	0.5	1.39	127	0.356	0.355	< 0.01
02/08/06	9:30 AM	272	<u>1.4</u>	47.5	15.6	7.4	11.6	11.8	103.4	< 0.4	1.65	129	0.422	0.420	< 0.01
05/09/06	8:50 AM	166	<u>1.1</u>	32.5	14.3	7.4	11.6	11.8	108.5	1.1	2.68	107	0.262	0.259	0.01
04/10/06	8:20 AM	160	<u>1.5</u>	30.0	15.9	7.5	15.0	11.1	111.1	1.1	2.40	125	0.210	0.206	0.02
08/11/06	9:30 AM	327	<u>1.1</u>	27.5	15.5	7.7	16.6	10.0	104.7	1.0	2.68	122	0.154	0.151	0.03
05/12/06	8:20 AM	186	<u>1.3</u>	35.0	15.1	7.7	18.2	10.1	108.4	1.1	2.51	120	0.174	0.170	< 0.01

1131-69 UD = 382 m<sup>3</sup>/s (Flows from Hamilton - Bridge Street Bridge)

**Waikato River @ Horotiu Br**

12/01/06	8:50 AM	190	<u>1.3</u>	32.5	15.2	7.7	<u>20.4</u>	8.9	98.0	0.8	2.69	107	0.174	0.170	< 0.01
02/02/06	8:57 AM	292	<u>1.2</u>	30.0	18.1	7.5	<u>22.1</u>	8.1	92.6	1.1	3.75	140	0.219	0.211	0.04
08/03/06	8:30 AM	194	1.7	35.0	15.2	7.5	19.7	8.3	93.0	0.8	2.41	118	0.167	0.165	< 0.01
04/04/06	9:55 AM	182	1.6	35.0	16.3	7.4	19.7	8.5	93.2	0.8	2.44	142	0.220	0.215	0.01
01/05/06	10:00 AM	345	<u>1.1</u>	30.0	15.8	7.5	<u>16.6</u>	9.0	92.5	0.6	4.18	129	0.426	0.421	< 0.01
08/06/06	10:30 AM	316	<u>1.6</u>	32.5	14.1	7.5	<u>12.9</u>	10.3	94.5	< 0.4	1.99	114	0.359	0.356	0.03
04/07/06	9:45 AM	252	2.0	37.5	14.8	7.6	10.2	10.8	97.1	< 0.4	1.61	128	0.370	0.367	0.01
02/08/06	10:40 AM	270	<u>1.2</u>	47.5	15.7	7.4	11.4	11.2	104.1	0.5	2.20	124	0.443	0.435	0.02
05/09/06	9:50 AM	233	<u>1.1</u>	30.0	14.5	7.5	11.7	11.7	107.3	1.0	3.09	102	0.280	0.274	0.02
04/10/06	9:15 AM	215	<u>1.4</u>	30.0	16.1	7.6	15.1	10.9	110.3	0.9	2.61	124	0.238	0.233	0.03
08/11/06	10:45 AM	243	<u>1.0</u>	27.5	15.3	7.7	17.1	9.6	102.0	0.9	3.87	116	0.183	0.179	0.03
05/12/06	10:00 AM	263	<u>1.2</u>	32.5	15.5	7.5	18.1	10.0	106.3	0.8	2.78	121	0.195	0.188	0.02

1131-77 UD = 578 m<sup>3</sup>/s (Flows from Huntly Power Station Recorder)

**Waikato River @ Huntly-Tainui Br**

12/01/06	9:35 AM	218	<u>0.9</u>	32.5	14.7	7.8	<u>21.5</u>	9.3	105.4	0.9	<u>6.23</u>	105	0.186	0.183	< 0.01
02/02/06	9:50 AM	322	<u>0.8</u>	30.0	17.0	7.4	<u>22.4</u>	7.6	88.2	0.8	<u>6.86</u>	133	0.293	0.286	0.02
08/03/06	9:15 AM	272	<u>1.4</u>	32.5	15.1	7.5	19.8	8.5	93.8	0.8	3.04	117	0.154	0.151	< 0.01
04/04/06	10:45 AM	218	<u>1.0</u>	35.0	15.3	7.4	19.9	8.5	94.2	1.0	<u>5.30</u>	133	0.300	0.296	0.01
01/05/06	10:30 AM	490	<u>0.5</u>	27.5	13.6	7.3	<u>15.6</u>	8.5	85.6	0.8	<u>17.60</u>	109	0.891	0.881	< 0.01
08/06/06	11:15 AM	481	<u>0.8</u>	32.5	13.9	7.3	11.6	10.1	92.1	0.7	4.7	119	0.589	0.585	0.03
04/07/06	10:20 AM	383	<u>1.5</u>	35.0	14.3	7.5	9.6	10.8	95.3	< 0.4	3.50	124	0.584	0.580	0.02
02/08/06	11:40 AM	408	<u>0.7</u>	45.0	14.8	7.4	<u>14.4</u>	12.5	114.0	0.4	4.45	116	0.661	0.656	0.02
05/09/06	10:25 AM	364	<u>0.8</u>	30.0	13.5	7.4	<u>12.3</u>	11.1	103.8	1.0	<u>7.45</u>	103	0.550	0.544	0.01
04/10/06	9:50 AM	386	<u>0.4</u>	27.5	14.1	7.3	15.2	10.0	100.8	1.3	<u>14</u>	113	0.428	0.422	0.04
08/11/06	11:40 AM	324	<u>0.6</u>	32.5	14.4	7.5	17.6	9.3	99.8	0.9	<u>6.85</u>	110	0.308	0.301	0.02
05/12/06	11:10 AM	356	<u>0.6</u>	32.5	14.0	7.5	18.5	9.5	102.6	1.2	<u>7.35</u>	100	0.313	0.308	0.01

Note: < = less than value stated  
UD = upper decile flow (period 1987-2006 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 value – don't assess for compliance

TKN g/m <sup>3</sup>	TN g/m <sup>3</sup>	DRP g/m <sup>3</sup>	TP g/m <sup>3</sup>	CL g/m <sup>3</sup>	AS g/m <sup>3</sup>	B g/m <sup>3</sup>	LI g/m <sup>3</sup>	A340F /cm	A440F /cm	ENT cfu/100ml	FC cfu/100ml	E coli cfu/100ml	CHLA g/m <sup>3</sup>	DOC g/m <sup>3</sup>	TOC g/m <sup>3</sup>
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<273	<0.02		

0.24	0.40	0.022	<u>0.043</u>	21.3	<u>0.038</u>	<u>0.31</u>	0.114	0.020	0.005	5	10	10	0.010	1.3	2
0.20	0.34	0.017	<u>0.049</u>	23.9	<u>0.038</u>	<u>0.40</u>	0.150	0.015	0.003	17	8	8	0.007	1.1	1.6
0.16	0.27	0.016	0.033	19.0	<u>0.030</u>	<u>0.27</u>	0.099	0.008	<0.002	12	11	11	0.005	1	1.6
0.15	0.30	0.014	0.035	19.9	<u>0.030</u>	<u>0.32</u>	0.114	0.011	0.003	3	8	9	<0.003	0.8	1.2
0.18	0.41	0.025	<u>0.046</u>	24.6	<u>0.033</u>	<u>0.40</u>	0.143	0.012	<0.002	20	31	44	<0.003	0.7	1.5
<0.05	0.24	0.009	0.032	19.2	<u>0.025</u>	<u>0.29</u>	0.093	0.014	0.003	7	6	6	<0.003	1.1	1.7
0.10	0.35	0.014	0.031	16.7	<u>0.023</u>	<u>0.25</u>	0.088	0.006	<0.002	<1	6	6	<0.003	1	1.2
0.15	0.46	0.018	0.027	18.4	<u>0.026</u>	<u>0.27</u>	0.096	0.010	<0.002	3	4	4	<0.003	0.6	1.3
0.18	0.37	0.008	0.025	17.1	<u>0.024</u>	<u>0.30</u>	0.109	0.008	<0.002	1	7	7	0.015	1.1	1.2
0.21	0.34	0.004	0.026	18.1	<u>0.025</u>	<u>0.30</u>	0.106	0.008	<0.002	3	3	3	0.015	1.3	1.3
0.16	0.26	0.006	0.027	17.7	<u>0.028</u>	<u>0.26</u>	0.091	0.004	<0.002	<1	3	4	0.015	1.1	1.9
0.19	0.34	0.016	<u>0.049</u>	20.0	<u>0.033</u>	<u>0.31</u>	0.109	0.012	<0.002	<1	50	50	<0.003	1.3	1.4
0.16	0.32	0.006	0.038	16.5	<u>0.025</u>	<u>0.25</u>	0.088	0.013	<0.002	21	31	37	0.018	1.3	2.3
0.25	0.42	0.008	<u>0.050</u>	22.9	<u>0.035</u>	<u>0.34</u>	0.133	0.016	0.002	<u>540</u>	370	<u>450</u>	0.011	1.5	2.3
0.20	0.33	0.010	0.036	17.1	<u>0.027</u>	<u>0.36</u>	0.090	0.014	0.003	27	31	39	0.010	0.6	1.8
0.18	0.38	0.018	0.038	19.6	<u>0.030</u>	<u>0.32</u>	0.112	0.011	0.002	42	48	70	<0.003	0.5	1.3
0.24	<u>0.60</u>	0.028	<u>0.056</u>	19.4	<u>0.025</u>	<u>0.28</u>	0.096	0.017	0.002	62	150	170	0.004	1.3	2.4
0.10	0.44	0.023	<u>0.045</u>	15.6	<u>0.018</u>	<u>0.21</u>	0.067	0.013	0.003	25	33	42	<0.003	1.5	1.7
0.16	<u>0.52</u>	0.021	0.036	15.8	<u>0.019</u>	<u>0.25</u>	0.081	0.009	<0.002	3	12	51	<0.003	1.3	1.5
0.17	<u>0.59</u>	0.013	0.038	17.7	<u>0.022</u>	<u>0.26</u>	0.090	0.009	<0.002	8	18	20	0.004	0.7	1.6
0.24	<u>0.50</u>	0.007	0.037	15.3	<u>0.019</u>	<u>0.22</u>	0.079	0.012	0.003	4	21	21	0.019	1.3	1.5
0.32	<u>0.53</u>	0.006	0.033	17.3	<u>0.024</u>	<u>0.27</u>	0.093	0.009	<0.002	36	160	160	0.012	1.8	1.5
0.21	0.36	0.009	0.032	17.1	<u>0.029</u>	<u>0.24</u>	0.092	0.009	<0.002		70	70	0.008	1.5	2.1
0.25	0.42	0.009	0.036	17.5	<u>0.027</u>	<u>0.24</u>	0.088	0.017	0.005	9	32	35	0.018	1.3	2.5
0.19	0.36	0.009	0.038	16.8	<u>0.027</u>	<u>0.26</u>	0.088	0.014	<0.002	29	41	50	<u>0.024</u>	1.3	2.2
0.28	0.50	0.021	<u>0.061</u>	23.2	<u>0.032</u>	<u>0.34</u>	0.127	0.019	0.003	<u>810</u>	700	<u>700</u>	0.004	1.2	2.1
0.21	0.38	0.025	<u>0.051</u>	17.4	<u>0.027</u>	<u>0.35</u>	0.092	0.014	0.003	<u>80</u>	160	170	0.011	0.9	1.9
0.18	0.40	0.025	<u>0.053</u>	19.6	<u>0.031</u>	<u>0.30</u>	0.111	0.012	0.002	<u>150</u>	190	220	0.004	0.8	1.3
0.25	<u>0.68</u>	0.040	<u>0.074</u>	19.4	<u>0.024</u>	<u>0.27</u>	0.094	0.022	0.003	<u>250</u>	170	220	0.005	1.5	2.8
0.12	0.48	0.033	<u>0.055</u>	15.7	<u>0.018</u>	<u>0.21</u>	0.069	0.015	0.004	16	51	56	<0.003	1.8	1.9
0.16	<u>0.53</u>	0.025	<u>0.044</u>	16.0	<u>0.019</u>	<u>0.25</u>	0.082	0.010	<0.002	30	18	46	<0.003	0.9	1.4
0.22	<u>0.66</u>	0.020	<u>0.050</u>	18.0	<u>0.022</u>	<u>0.26</u>	0.088	0.010	<0.002	<u>1000</u>	40	100	0.005	1.2	1.4
0.19	0.47	0.020	<u>0.044</u>	15.5	<u>0.020</u>	<u>0.22</u>	0.078	0.014	0.005	13	39	47	0.020	1.2	1.6
0.31	<u>0.55</u>	0.011	<u>0.043</u>	17.5	<u>0.024</u>	<u>0.27</u>	0.095	0.012	0.002	44	180	180	0.011	1.6	1.7
0.20	0.38	0.027	<u>0.060</u>	17.0	<u>0.026</u>	<u>0.24</u>	0.089	0.011	<0.002		360	<u>520</u>	0.009	1.6	2.5
0.28	0.48	0.023	<u>0.058</u>	17.7	<u>0.026</u>	<u>0.26</u>	0.087	0.021	0.007	57	60	95	0.017	1.6	2.5
0.19	0.38	0.013	<u>0.049</u>	16.1	<u>0.021</u>	<u>0.20</u>	0.068	0.018	0.002	27	90	90	0.005	1.4	2.2
0.28	<u>0.57</u>	0.033	<u>0.075</u>	21.3	<u>0.025</u>	<u>0.30</u>	0.104	0.024	0.004	<u>990</u>	1100	<u>2100</u>	0.009	1.2	2.5
0.21	0.36	0.019	<u>0.041</u>	17.2	<u>0.026</u>	<u>0.32</u>	0.086	0.016	0.004	<u>120</u>	150	170	0.012	0.8	1.9
0.18	0.48	0.036	<u>0.068</u>	17.9	<u>0.024</u>	<u>0.24</u>	0.083	0.020	0.004	<u>160</u>	200	200	0.003	1.1	1.9
0.48	<u>1.37</u>	0.040	<u>0.109</u>	14.9	0.010	0.12	0.041	0.043	0.007	<u>420</u>	800	<u>1300</u>	0.004	2.9	4.3
0.19	<u>0.78</u>	0.034	<u>0.067</u>	15.4	<u>0.014</u>	<u>0.18</u>	0.055	0.026	0.005	31	100	140	0.003	2.3	2.6
0.22	<u>0.80</u>	0.028	<u>0.052</u>	15.2	<u>0.015</u>	<u>0.20</u>	0.062	0.012	<0.002	60	50	90	<0.003	3.4	3.2
0.25	<u>0.91</u>	0.017	<u>0.054</u>	16.7	<u>0.017</u>	<u>0.21</u>	0.069	0.013	<0.002	<u>87</u>	50	80	0.006	1	1.7
0.29	<u>0.84</u>	0.022	<u>0.059</u>	14.8	<u>0.013</u>	<u>0.17</u>	0.055	0.020	0.005	15	72	74	0.016	1.4	2.5
0.47	<u>0.90</u>	0.019	<u>0.091</u>	15.1	<u>0.015</u>	<u>0.18</u>	0.062	0.032	0.006	<u>3500</u>	2200	<u>2200</u>	0.01	2.4	4.1
0.21	<u>0.52</u>	0.024	<u>0.062</u>	16.1	<u>0.021</u>	<u>0.19</u>	0.068	0.018	0.003		630	<u>630</u>	0.008	2.2	2.9
0.28	<u>0.59</u>	0.018	<u>0.060</u>	15.7	<u>0.019</u>	<u>0.18</u>	0.065	0.027	0.008	<1	100	130	0.012	1.6	3.1

Note: < = less than value stated

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

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

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

1131-91 UD = 642 m<sup>3</sup>/s (Flows from Mercer Bridge Recorder)

**Waikato River @ Mercer Br**

12/01/06	10:20 AM	248	-	-	15.1	7.8	<u>22.6</u>	9.6	106.0	1.2	<u>6.89</u>	107	0.125	0.123	< 0.01
02/02/06	10:40 AM	385	-	-	17.1	7.6	<u>23.0</u>	7.9	92.0	1.0	<u>8.0</u>	106	0.270	0.267	< 0.01
08/03/06	10:20 AM	302	-	-	15.1	7.6	<u>20.6</u>	8.5	96.1	1.0	<u>5.53</u>	117	0.142	0.139	< 0.01
04/04/06	11:30 AM	237	-	-	15.9	7.6	<u>21.2</u>	8.5	95.7	1.2	<u>5.33</u>	130	0.267	0.265	< 0.01
01/05/06	11:15 AM	549	-	-	15.1	7.3	<u>16.4</u>	8.1	83.6	0.9	<u>17.00</u>	126	0.892	0.884	< 0.01
08/06/06	12:10 PM	593	-	-	14.1	7.3	<u>12.1</u>	9.9	91.5	0.6	<u>7.2</u>	117	0.598	0.595	0.02
04/07/06	11:15 AM	448	-	-	14.9	7.5	10.8	10.4	95.0	0.5	4.90	123	0.667	0.664	< 0.01
02/08/06	12:40 PM	518	-	-	15.4	7.4	<u>12.1</u>	12.7	118.4	0.6	<u>7.46</u>	130	0.720	0.715	0.01
05/09/06	11:10 AM	455	-	-	14.7	7.4	<u>13.7</u>	10.7	102.7	1.2	<u>12.00</u>	110	0.510	0.504	< 0.01
04/10/06	11:50 AM	505	-	-	15.0	7.3	16.3	9.4	97.6	1.6	<u>22</u>	120	0.447	0.442	0.02
08/11/06	12:45 PM	433	-	-	15.3	7.7	18.8	9.4	102.7	1.3	<u>6.24</u>	119	0.259	0.257	< 0.01
05/12/06	11:40 AM	431	-	-	14.3	7.6	18.9	9.2	99.9	1.3	<u>13.00</u>	121	0.333	0.329	< 0.01

1131-133

**Waikato River @ Tuakau Br**

12/01/06	11:10 AM	-	<u>0.9</u>	27.5	15.0	8.1	<u>23.6</u>	10.2	120.1	1.4	4.74	107	0.056	0.054	< 0.01
02/02/06	11:14 AM	-	<u>0.8</u>	30.0	17.1	7.6	<u>23.9</u>	8.2	96.6	1.1	<u>8.3</u>	145	0.208	0.205	< 0.01
08/03/06	10:48 AM	-	<u>0.8</u>	32.5	15.1	7.6	<u>20.9</u>	9.0	101.5	1.2	<u>6.15</u>	117	0.101	0.098	< 0.01
04/04/06	12:00 PM	-	<u>0.7</u>	30.0	16.0	7.4	<u>21.3</u>	8.7	98.4	1.1	<u>8.44</u>	137	0.294	0.292	< 0.01
01/05/06	11:40 AM	-	<u>0.4</u>	25.0	15.2	7.2	<u>16.6</u>	7.7	<u>78.8</u>	1.1	<u>17.40</u>	134	0.854	0.847	< 0.01
08/06/06	12:45 PM	-	<u>0.7</u>	30.0	14.3	7.2	<u>12.2</u>	9.7	89.0	0.5	<u>8.2</u>	118	0.596	0.592	0.02
04/07/06	11:50 AM	-	<u>0.8</u>	27.5	15.3	7.4	10.3	10.4	93.1	0.7	<u>6.5</u>	125	0.683	0.680	0.01
02/08/06	1:20 PM	-	<u>0.6</u>	30.0	15.7	7.3	<u>12.0</u>	11.5	106.0	0.7	<u>9.15</u>	123	0.710	0.707	0.01
05/09/06	11:35 AM	-	<u>0.5</u>	25.0	15.1	7.1	<u>14.0</u>	10.5	100.9	1.5	<u>11.8</u>	108	0.494	0.489	< 0.01
04/10/06	11:15 AM	-	<u>0.3</u>	25.0	15.0	7.3	16.6	9.1	94.9	1.3	<u>28.4</u>	118	0.455	0.450	0.02
08/11/06	1:15 PM	-	<u>0.6</u>	35.0	15.1	7.7	18.3	9.7	104.6	1.0	<u>6.9</u>	114	0.274	0.271	0.04
05/12/06	12:20 PM	-	<u>0.4</u>	27.5	14.4	7.6	19.6	9.7	106.4	1.5	<u>10.40</u>	117	0.281	0.278	< 0.01

Note: < = less than value stated  
UD = upper decile flow (period 1987-2006 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 value – don't assess for compliance

TKN g/m <sup>3</sup>	TN g/m <sup>3</sup>	DRP g/m <sup>3</sup>	TP g/m <sup>3</sup>	CL g/m <sup>3</sup>	AS g/m <sup>3</sup>	B g/m <sup>3</sup>	LI g/m <sup>3</sup>	A340F /cm	A440F /cm	ENT cfu/100ml	FC cfu/100ml	E coli cfu/100ml	CHLA g/m <sup>3</sup>	DOC g/m <sup>3</sup>	TOC g/m <sup>3</sup>
-	<0.5	-	<0.04	-	<0.01	<0.3	-	-	-	<77	-	<273	<0.02		

0.26	0.39	0.009	<u>0.048</u>	16.5	<u>0.022</u>	0.21	0.070	0.019	<0.002	6	45	52	<u>0.032</u>	1.4	2.3
0.33	<u>0.60</u>	0.011	<u>0.074</u>	21.4	<u>0.024</u>	0.28	0.102	0.022	0.004	<u>230</u>	80	110	0.010	1.4	2.7
0.23	0.37	0.020	<u>0.047</u>	17.3	<u>0.025</u>	<u>0.34</u>	0.090	0.015	0.004	60	150	170	0.016	0.7	1.9
0.21	0.48	0.027	<u>0.067</u>	18.6	<u>0.024</u>	0.26	0.088	0.021	0.005	53	70	70	0.007	1	2
0.45	<u>1.34</u>	0.047	<u>0.117</u>	17.3	<u>0.014</u>	0.17	0.057	0.048	0.008	<u>330</u>	600	<u>970</u>	0.006	3.2	5.4
0.28	<u>0.88</u>	0.032	<u>0.072</u>	15.3	<u>0.013</u>	0.18	0.053	0.028	0.005	31	130	150	0.004	2.6	2.7
0.22	<u>0.89</u>	0.018	<u>0.057</u>	16.6	<u>0.013</u>	0.19	0.056	0.020	0.003	13	13	60	0.004	1.7	2.4
0.33	<u>1.05</u>	0.017	<u>0.064</u>	17.8	<u>0.015</u>	0.20	0.061	0.022	0.002	10	20	40	0.006	1.9	2.3
0.40	<u>0.91</u>	0.011	<u>0.062</u>	15.7	<u>0.013</u>	0.16	0.051	0.027	0.008	12	100	140	<u>0.023</u>	2	4
0.53	<u>0.98</u>	0.020	<u>0.093</u>	16.2	<u>0.014</u>	0.18	0.064	0.038	0.008	<u>310</u>	2100	<u>2200</u>	0.013	3.8	4.4
0.22	0.48	0.018	<u>0.057</u>	17.2	<u>0.024</u>	0.22	0.078	0.014	<0.002		70	110	0.014	1.9	3.2
0.34	<u>0.67</u>	0.013	<u>0.073</u>	15.6	<u>0.016</u>	0.18	0.058	0.021	0.003	15	220	<u>300</u>	0.017	1.8	2.4

0.27	0.33	0.006	<u>0.044</u>	16.7	<u>0.022</u>	0.22	0.073	0.019	0.002	10	29	29	<u>0.041</u>	1.3	2.5
0.34	<u>0.55</u>	0.009	<u>0.068</u>	21.4	<u>0.022</u>	0.29	0.099	0.025	0.004	38	70	200	0.013	1.3	2.7
0.26	0.36	0.016	<u>0.055</u>	17.7	<u>0.026</u>	<u>0.36</u>	0.091	0.014	0.003	20	50	50	<u>0.021</u>	0.5	1.9
0.24	<u>0.53</u>	0.031	<u>0.075</u>	18.4	<u>0.024</u>	0.26	0.088	0.018	0.003	55	80	110	0.007	0.9	1.8
0.50	<u>1.35</u>	0.040	<u>0.115</u>	17.6	<u>0.013</u>	0.16	0.052	0.052	0.008	<u>210</u>	700	<u>740</u>	0.006	3.2	4.4
0.31	<u>0.91</u>	0.029	<u>0.081</u>	15.8	<u>0.012</u>	0.17	0.052	0.037	0.007	35	270	<u>280</u>	0.004	3.5	3.6
0.31	<u>0.99</u>	0.016	<u>0.067</u>	17.0	<u>0.012</u>	0.18	0.054	0.027	0.004	6	45	48	0.004	1.8	2.7
0.42	<u>1.13</u>	0.013	<u>0.065</u>	17.8	<u>0.013</u>	0.18	0.057	0.029	0.004	10	60	90	0.007	2.1	2.8
0.35	<u>0.84</u>	0.011	<u>0.067</u>	16.1	<u>0.013</u>	0.17	0.054	0.034	0.009	14	59	60	<u>0.022</u>	2.6	4.1
0.54	<u>1.00</u>	0.018	<u>0.096</u>	16.1	<u>0.013</u>	0.18	0.062	0.038	0.007	<u>430</u>	2300	<u>2500</u>	0.013	3.5	4.5
0.23	<u>0.50</u>	0.015	<u>0.054</u>	17.1	<u>0.021</u>	0.20	0.075	0.018	0.002		60	90	0.015	2.2	3.1
0.36	<u>0.64</u>	0.010	<u>0.064</u>	15.8	<u>0.014</u>	0.18	0.055	0.028	0.005	8	40	170	0.020	2.5	3.3

Note: < = less than value stated

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

() black disk measurements taken in flows above upper decile value – 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
	98/99	00/01	02/03	04/05	06/07	Median
Taupo Gates	2	1	1	1	2	1
Huka Falls	7	9	5	4	8	6
Ohaaki Bridge	32	28	18	22	16	22
Ohakuri Tailrace Br	3	1	2	4	2	2
Whakamaru Tailrace	6	5	6	7	6	6
Waipapa Tailrace	5	8	6	9	6	7
Lake Karapiro Boatramp	44	19	25	27	8	20
Narrows Br	60	100	26	28	55	43
Wellington Street Beach	85	100	39	43	84	50
Sewer Br Alandale	135	100	44	75	100	80
Horotiu Br	190	160	44	90	150	100
Ngaruawahia Br	-	-	160	80	140	-
Huntly-Tainui Br	260	140	175	135	150	150
Mercer Br	69	80	70	36	85	70
Tuakau Br	40	60	70	44	50	60
Waipa River (Ngaruawahia Br)	-	-	86	95	90	-

**Table 6: Year 2006/2007 Bathing Season E. coli survey results complying with the “Satisfactory” and “Excellent” Water Quality Guidelines. n = 12 (except Tuakau Br, n=10).**

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	11	Y
Ohaaki Bridge	12	Y	12	Y
Ohakuri Tailrace Br	12	Y	12	Y
Whakamaru Tailrace	12	Y	11	Y
Waipapa Tailrace	12	Y	11	Y
Lake Karapiro Boatramp	12	Y	11	Y
Narrows Br	12	Y	6	N
Wellington Street Beach	12	Y	5	N
Sewer Br Alandale	12	Y	3	N
Horotiu Br	12	N	2	N
Ngaruawahia Br	12	N	3	N
Huntly-Tainui Br	11	N	2	N
Mercer Br	11	Y	4	N
Tuakau Br	9	Y	5	N
Waipa River (Ngaruawahia Br)	11	Y	0	N



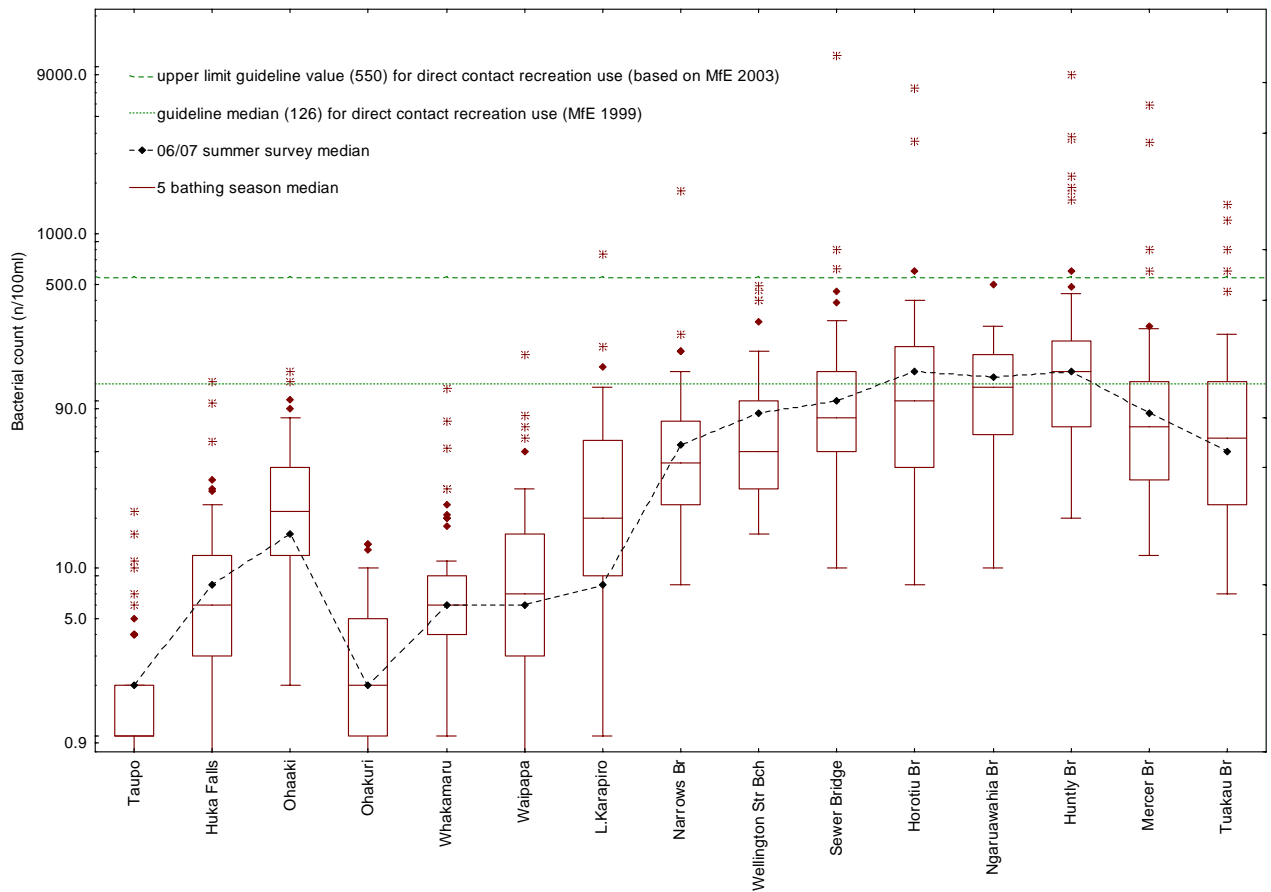


Figure 2: E. coli – 5 Bathing Season Data

DATE	ENT c/100ml	FC c/100ml	EColi c/100ml	DATE	ENT c/100ml	FC c/100ml	EColi c/100ml	DATE	ENT c/100ml	FC c/100ml	EColi c/100ml
<b>Taupo Control Gates</b>				<b>Lake Karapiro Boatramp</b>				<b>Huntly-Tainui Bridge</b>			
4/12/06	< 10	< 1	< 10	6/12/06	20	< 1	20	5/12/06	100	< 1	130
14/12/06	1	< 1	1	14/12/06	12	400	13	13/12/06	20	< 10	60
18/12/06	16	29	16	18/12/06	6	6	10	20/12/06	230	42	230
4/01/07	2	< 1	2	4/01/07	160	54	210	3/01/07	34	5	52
10/01/07	6	6	9	10/01/07	6	2	7	9/01/07	60	34	170
15/01/07	2	< 1	2	15/01/07	50	210	50	17/01/07	420	36	420
23/01/07	< 2	< 2	< 2	24/01/07	5	2	6	24/01/07	480	190	590
30/01/07	11	3	15	30/01/07	3	10	10	31/01/07	100	35	700
8/02/07	< 1	1	< 1	8/02/07	10	10	190	8/02/07	1900	220	2300
15/02/07	< 1	< 1	< 1	15/02/07	5	3	5	12/02/07	220	110	310
20/02/07	1	< 1	1	20/02/07	8	1	8	20/02/07	160	110	280
26/02/07	2	1	2	26/02/07	8	8	8	28/02/07	140	50	250
Median	2	3	2	Median	8	8	10	Median	150	46	265
<b>Huka Falls</b>				<b>Narrows Bridge</b>				<b>Mercer Bridge</b>			
4/12/06	< 10	5	< 10	5/12/06	32	9	35	5/12/06	220	15	300
14/12/06	1	3	1	14/12/06	12	5	12	13/12/06	20	10	20
18/12/06	30	25	35	18/12/06	20	41	30	20/12/06	70	14	80
4/01/07	6	4	16	3/01/07	12	6	12	3/01/07	12	2	12
10/01/07	98	69	110	10/01/07	90	33	110	9/01/07	26	5	31
15/01/07	5	3	10	15/01/07	80	34	80	17/01/07	120	3	120
23/01/07	34	24	38	23/01/07	44	44	44	24/01/07	80	24	80
30/01/07	24	20	45	30/01/07	66	30	66	31/01/07	90	16	170
8/02/07	2	8	3	8/02/07	80	32	80	8/02/07	800	430	800
15/02/07	5	1	6	15/02/07	70	21	70	12/02/07	100	8	370
20/02/07	3	< 1	4	20/02/07	30	25	30	20/02/07	50	4	70
26/02/07	18	8	22	26/02/07	250	80	290	28/02/07	130	38	240
Median	6	8	16	Median	55	31	55	Median	85	12	100
<b>Ohaaki Bridge</b>				<b>Wellington Street Beach</b>				<b>Tuakau Bridge</b>			
4/12/06	< 10	< 1	< 10	5/12/06	42	< 1	60	5/12/06	40	8	170
14/12/06	2	< 1	2	13/12/06	20	30	20	13/12/06	20	10	20
18/12/06	22	11	33	20/12/06	490	550	490	20/12/06	150	33	270
4/01/07	8	< 1	12	3/01/07	24	8	24	3/01/07	21	62	25
10/01/07	38	30	48	9/01/07	140	37	210	9/01/07	23	9	40
15/01/07	28	12	31	17/01/07	87	23	87	17/01/07	30	24	30
23/01/07	7	4	12	24/01/07	100	76	100	24/01/07	90	27	100
30/01/07	22	12	34	31/01/07	80	31	80	31/01/07	600	1200	1100
8/02/07	48	16	56	8/02/07	120	45	150	8/02/07	1200	440	1200
15/02/07	16	10	21	12/02/07	30	34	290	12/02/07	60	10	590
20/02/07	15	17	19	20/02/07	50	48	250				
26/02/07	11	54	16	28/02/07	90	39	90				
Median	16	12	21	Median	84	37	95	Median	50	26	135
<b>Ohakuri Tailrace Bridge</b>				<b>Sewer Bridge Alandale</b>							
4/12/06	< 10	< 1	< 10	5/12/06	10	< 10	40				
14/12/06	1	< 1	1	13/12/06	30	40	50				
18/12/06	10	5	10	20/12/06	150	< 1	170				
4/01/07	3	< 1	4	3/01/07	25	10	25				
10/01/07	2	< 2	6	9/01/07	60	83	120				
15/01/07	7	10	7	17/01/07	80	40	90				
23/01/07	2	6	2	24/01/07	450	110	450				
30/01/07	4	16	5	31/01/07	110	60	250				
8/02/07	1	3	1	8/02/07	150	130	190				
15/02/07	1	7	1	12/02/07	150	80	660				
20/02/07	< 1	8	1	20/02/07	90	130	230				
26/02/07	2	6	3	28/02/07	170	44	340				
Median	2	7	3	Median	100	70	180				
<b>Whakamaru Tailrace</b>				<b>Horotiu Bridge</b>				<b>Waipa River @ Ngaruawahia</b>			
4/12/06	30	< 1	30	5/12/06	60	57	95	5/12/06	110	20	530
14/12/06	1	2	1	13/12/06	30	20	60	13/12/06	70	< 10	70
18/12/06	8	10	9	20/12/06	240	120	310	20/12/06	200	16	240
4/01/07	< 1	3	< 1	3/01/07	30	4	190	3/01/07	63	14	63
10/01/07	4	10	7	9/01/07	150	68	200	9/01/07	70	35	82
15/01/07	120	60	130	17/01/07	60	27	130	17/01/07	140	21	160
23/01/07	5	7	7	24/01/07	180	70	190	24/01/07	60	60	60
30/01/07	24	21	24	31/01/07	100	31	300	31/01/07	230	130	240
8/02/07	3	16	3	8/02/07	220	55	250	8/02/07	2800	2200	3400
15/02/07	5	20	5	12/02/07	240	130	430	12/02/07	270	80	340
20/02/07	6	14	26	20/02/07	150	60	320	20/02/07	70	80	140
26/02/07	8	13	10	28/02/07	150	35	370	28/02/07	70	31	90
Median	6	13	9	Median	150	56	225	Median	90	35	150
<b>Waipapa Tailrace</b>				<b>Ngaruawahia Bridge</b>							
4/12/06	50	< 1	50	5/12/06	50	< 10	70				
14/12/06	5	4	6	13/12/06	30	10	40				
18/12/06	4	20	4	20/12/06	180	200	260				
4/01/07	10	1	11	3/01/07	10	5	280				
10/01/07	2	4	4	9/01/07	240	81	330				
15/01/07	70	15	70	17/01/07	90	39	90				
23/01/07	6	1	7	24/01/07	170	90	190				
30/01/07	19	16	19	31/01/07	70	32	440				
8/02/07	7	5	7	8/02/07	260	35	320				
15/02/07	3	1	3	12/02/07	280	100	840				
20/02/07	4	< 1	4	20/02/07	170	110	230				
26/02/07	3	6	3	28/02/07	110	40	470				
Median	6	5	7	Median	140	40	270				

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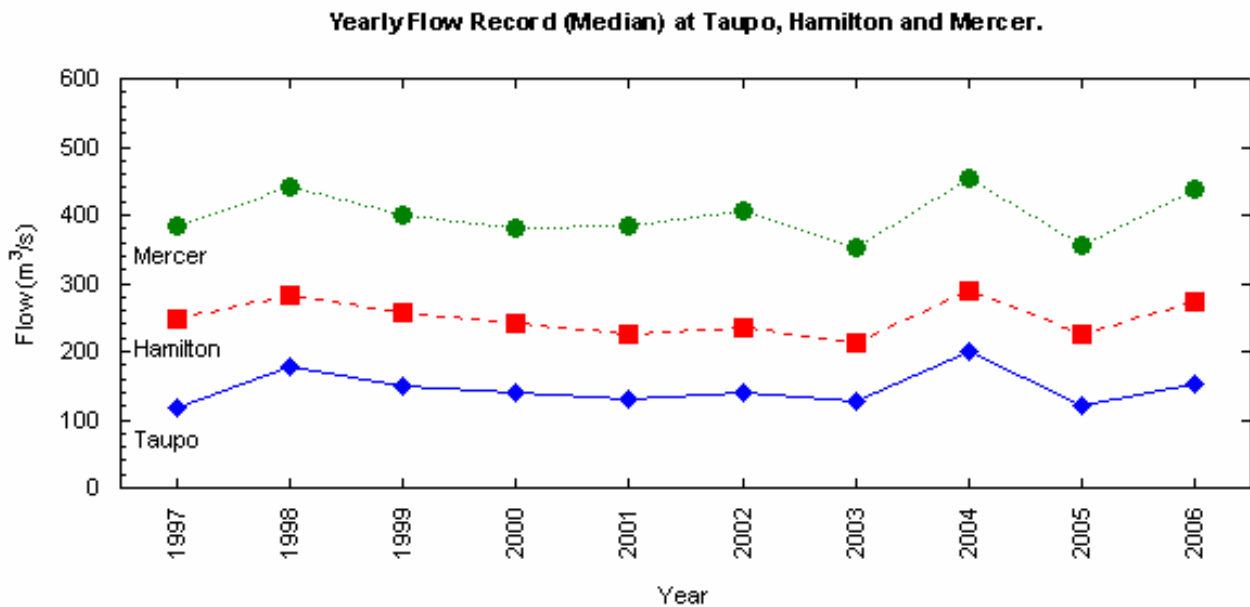
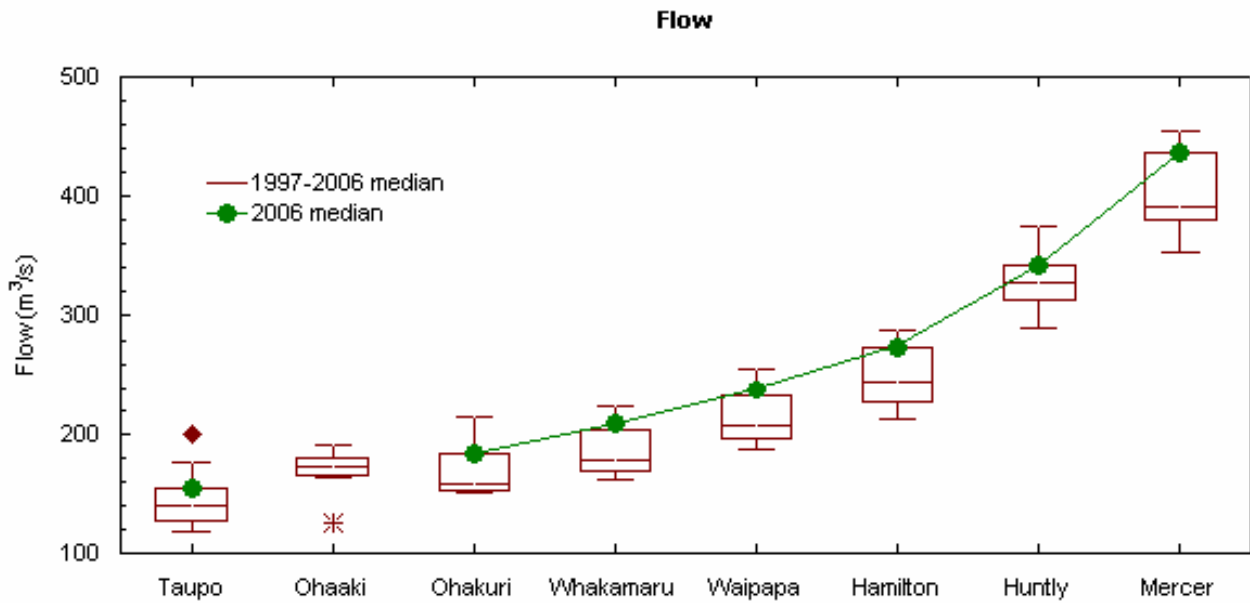
# Appendix I

## Flow Information

**Median Flows of the Waikato River and Main Tributaries**

Location	DISTANCE km	FLOW RATE* (m <sup>3</sup> /s)										10 YEAR Median
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
Taupo	4.2	118	177	148	139	130	141	127	200	121	154	145
Ohakuri	75.8	153	187	157	158	150	164	157	214	152	184	166
Whakamaru	105.0	182	204	174	168	161	183	168	224	175	208	184
Waipapa	126.1	207	232	205	196	186	211	192	256	200	237	210
Hamilton	211.5	249	283	257	241	225	234	213	288	226	273	247
Huntly	246.5	332	364	327	314	299	328	315	376	290	343	324
Mercer	286.3	383	442	400	381	383	408	353	455	355	437	399
Waioatapu Stm	46.6	3.8	3.5	3.4	2.8	3.2	2.8	2.6	3.7	3.6	3.8	3.3
Waipa River	232.7	58	66	55	52	62	73	61	87	56	61	61

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

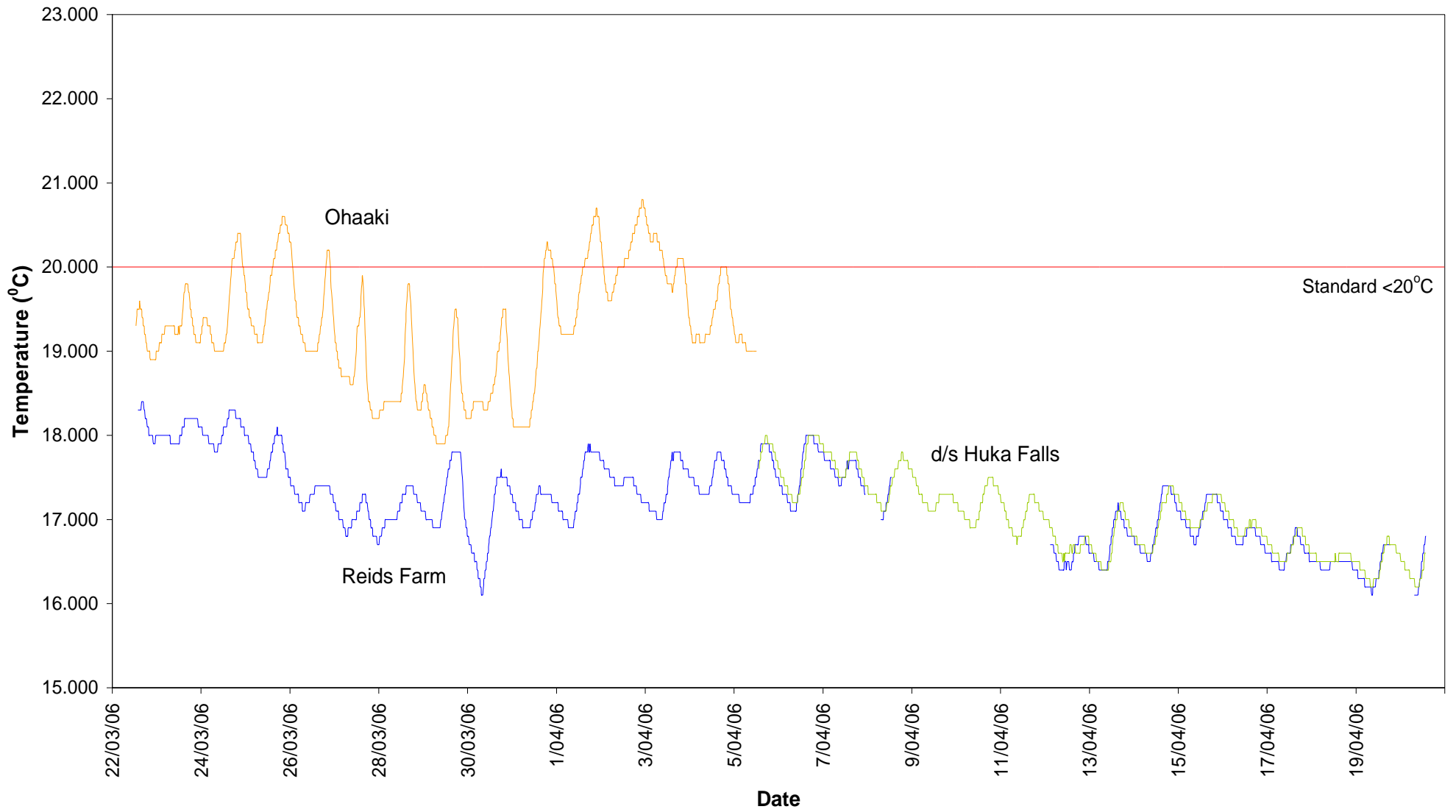


# **Appendix II**

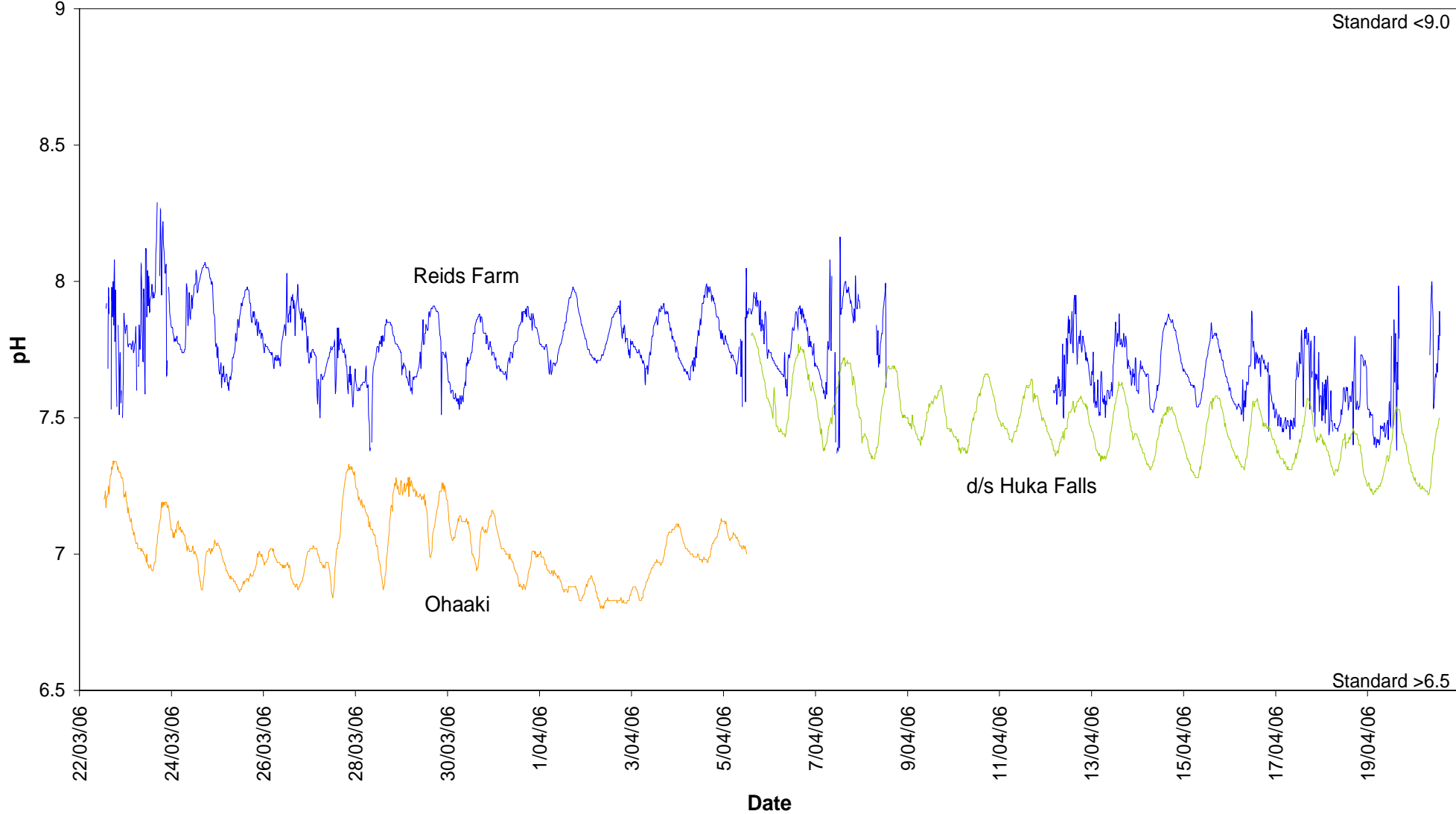
## **Datasonde Deployments**

### **Diurnal variation of Some Water Quality Parameters**

# Temperature: Upper Waikato (March - April)

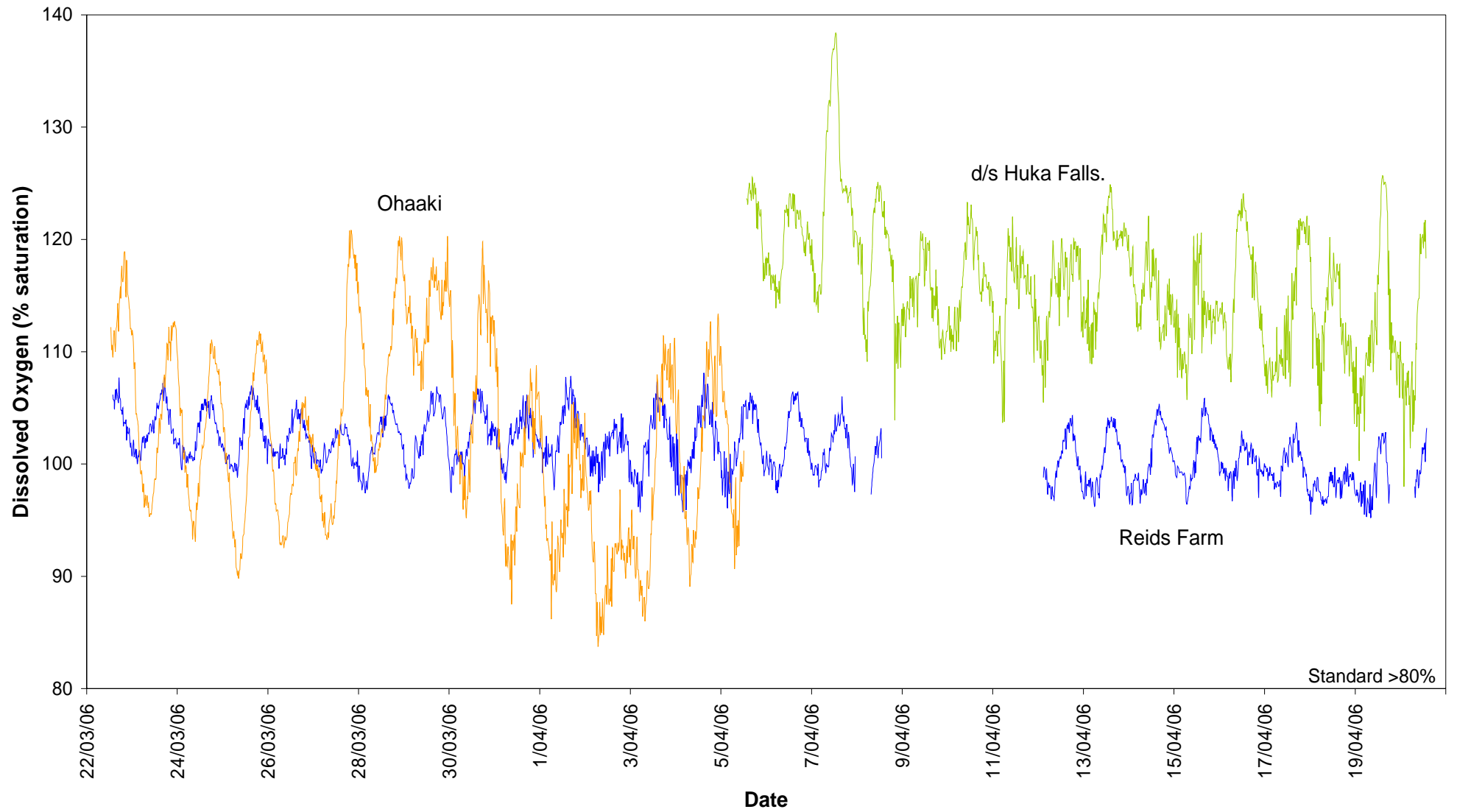


### pH: Upper Waikato (March - April)

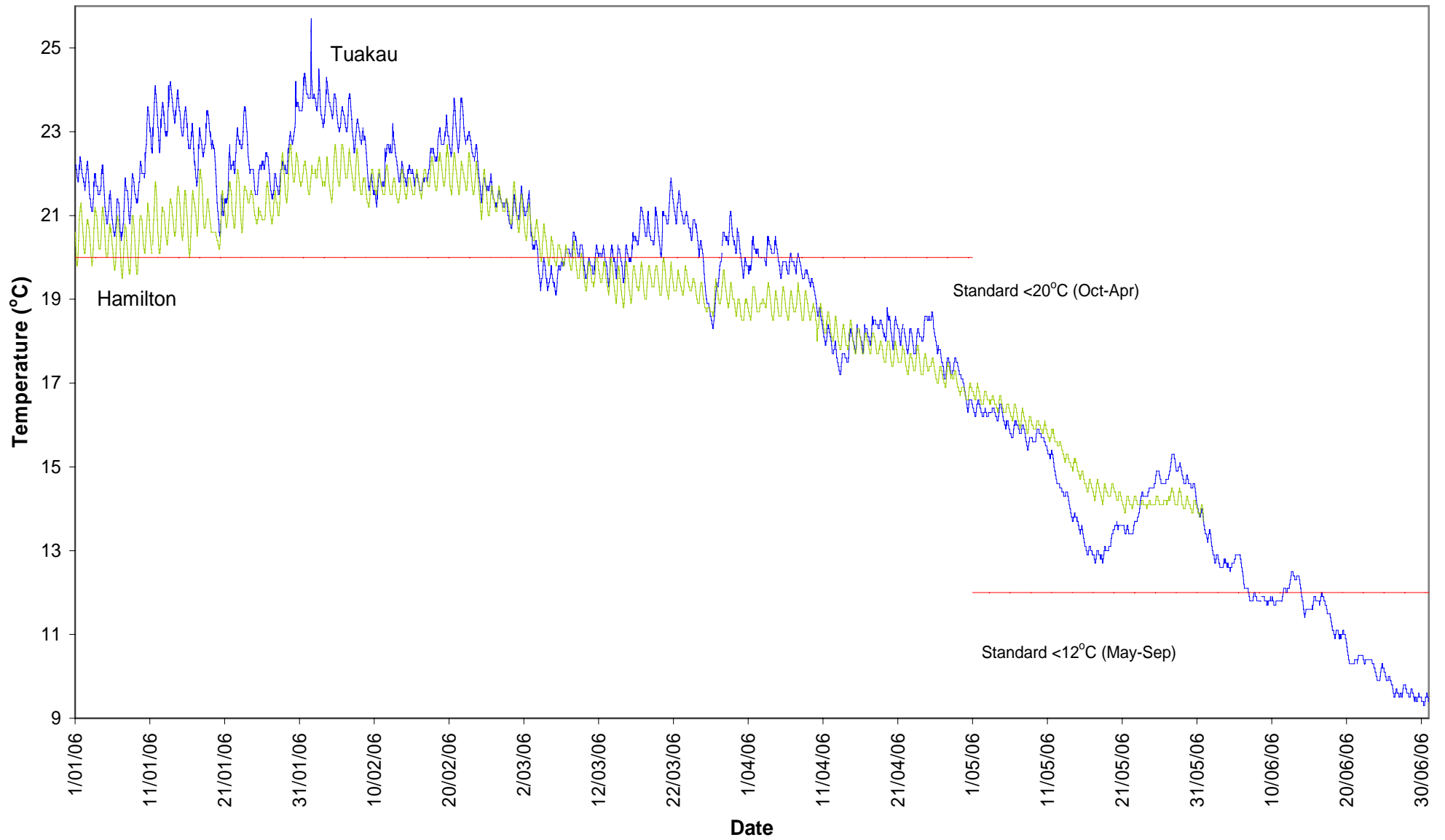




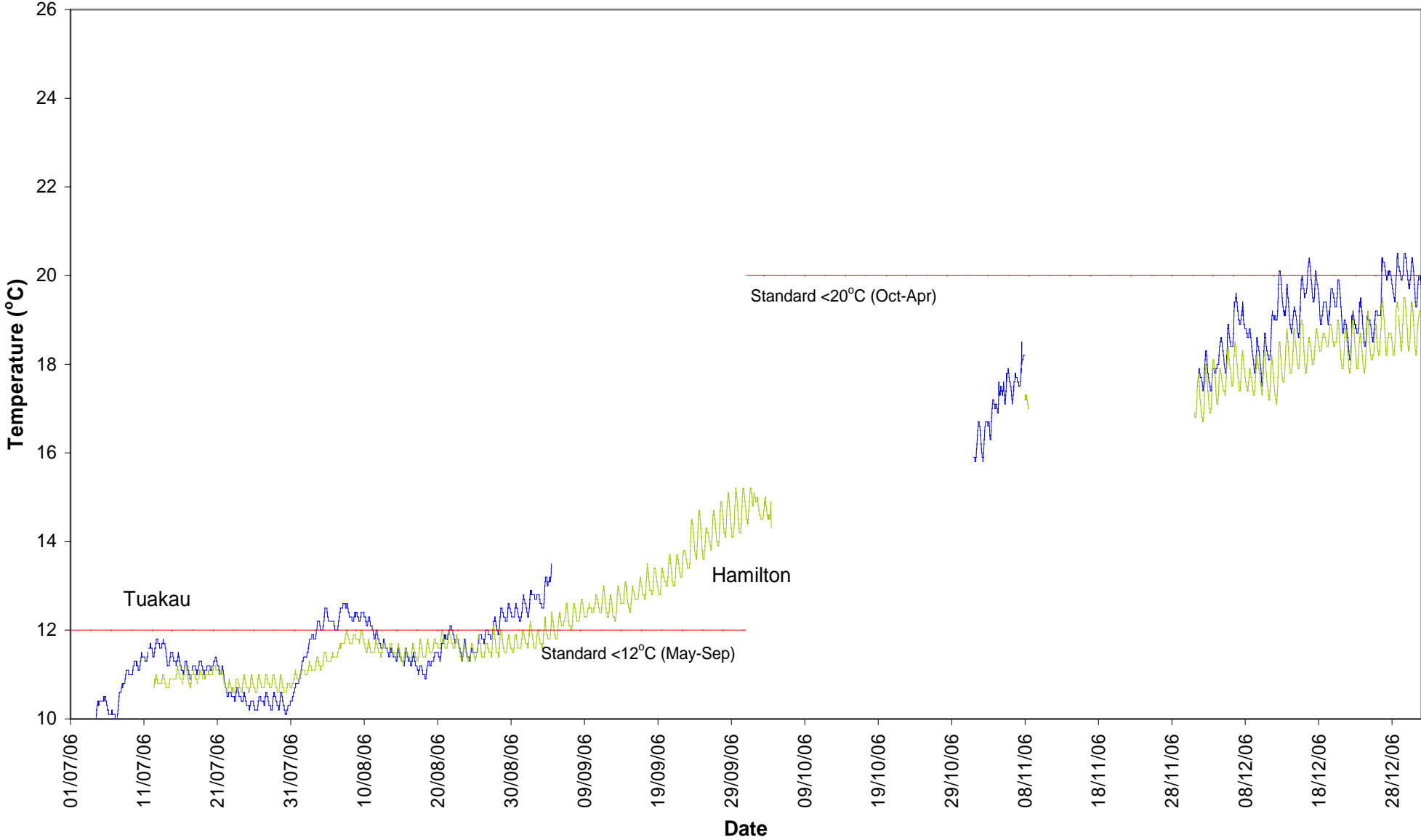
### Dissolved Oxygen, % saturation: Upper Waikato (March - April)



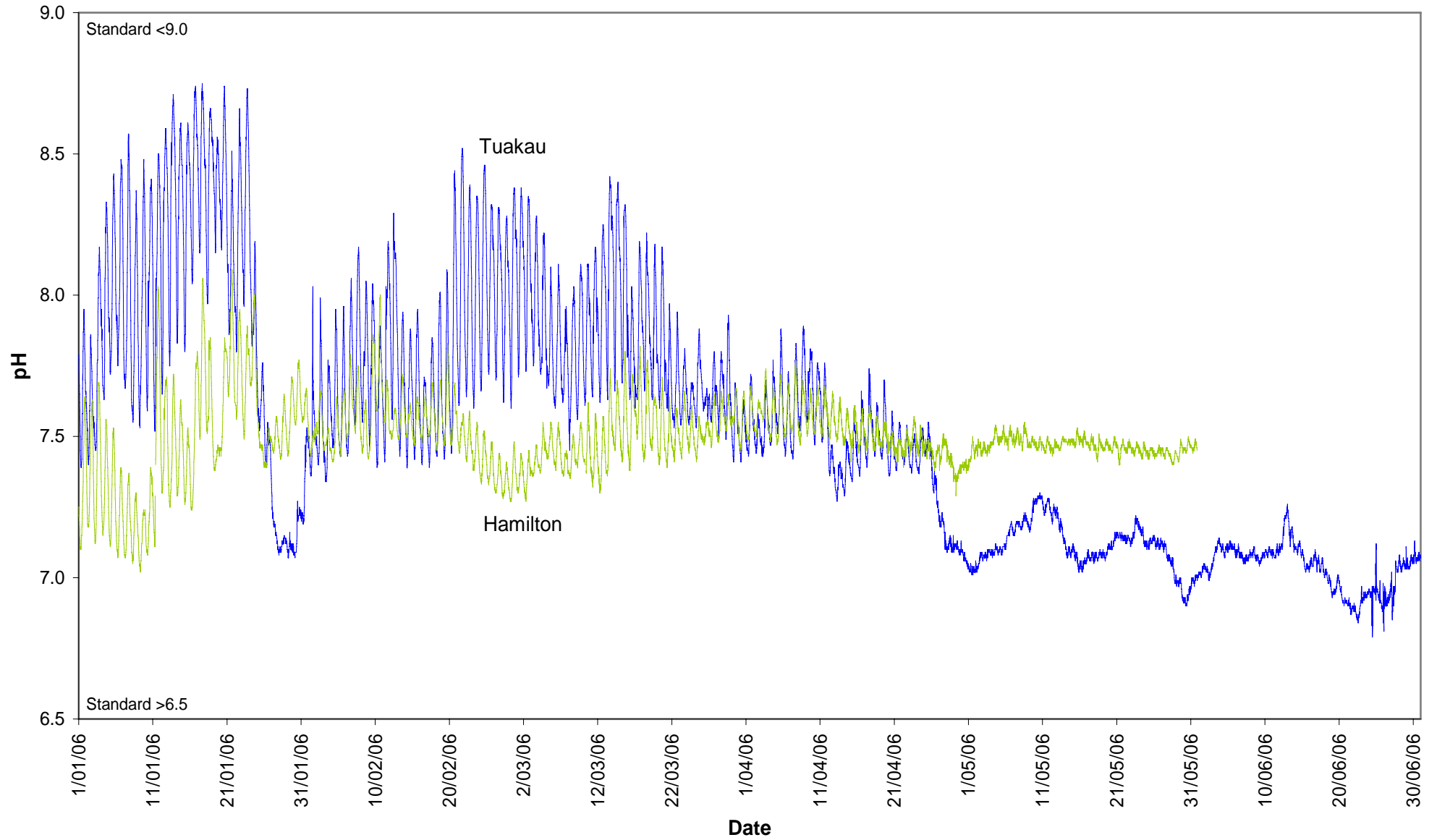
### Temperature: Lower Waikato (January-June)



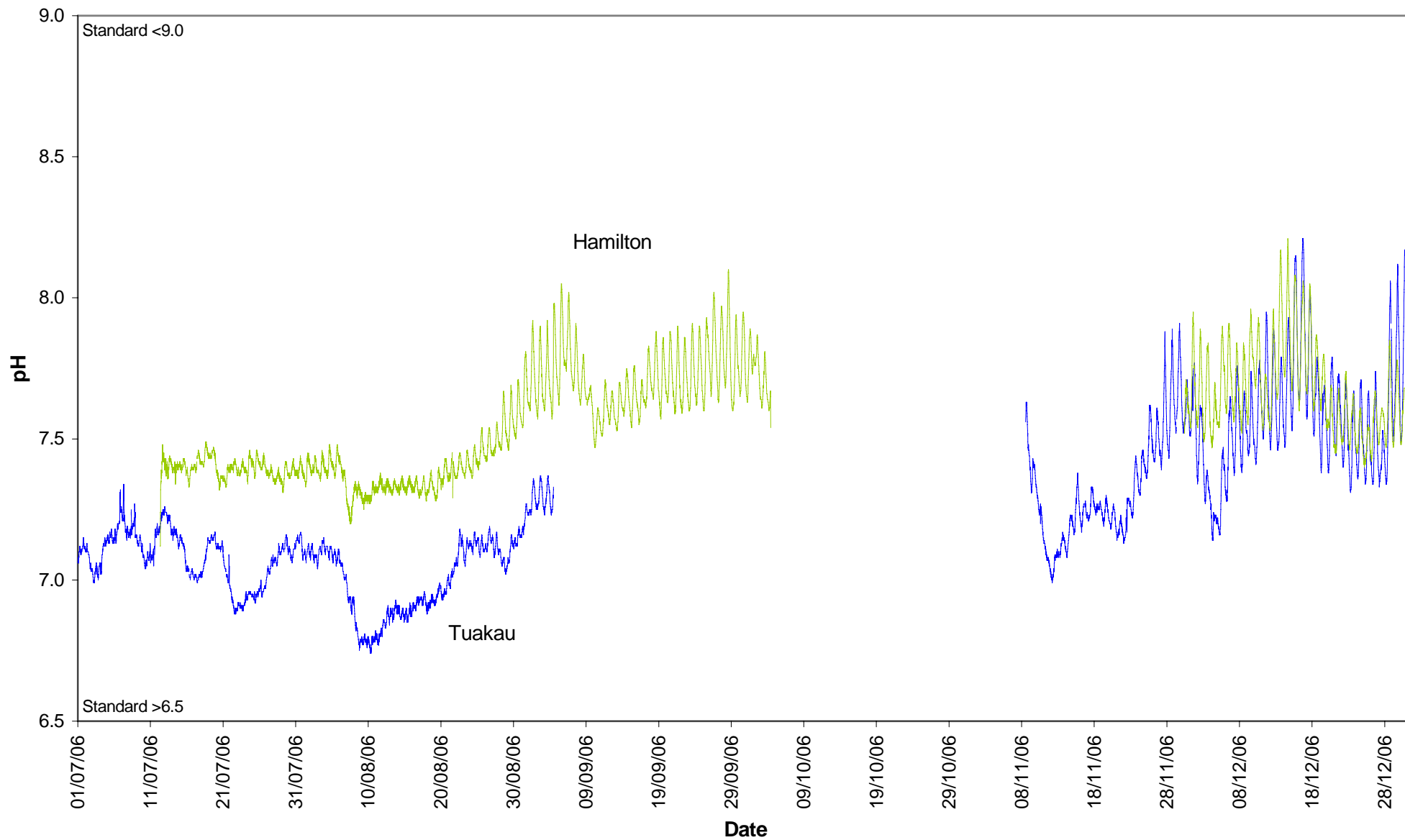
### Temperature: Lower Waikato (July - December)



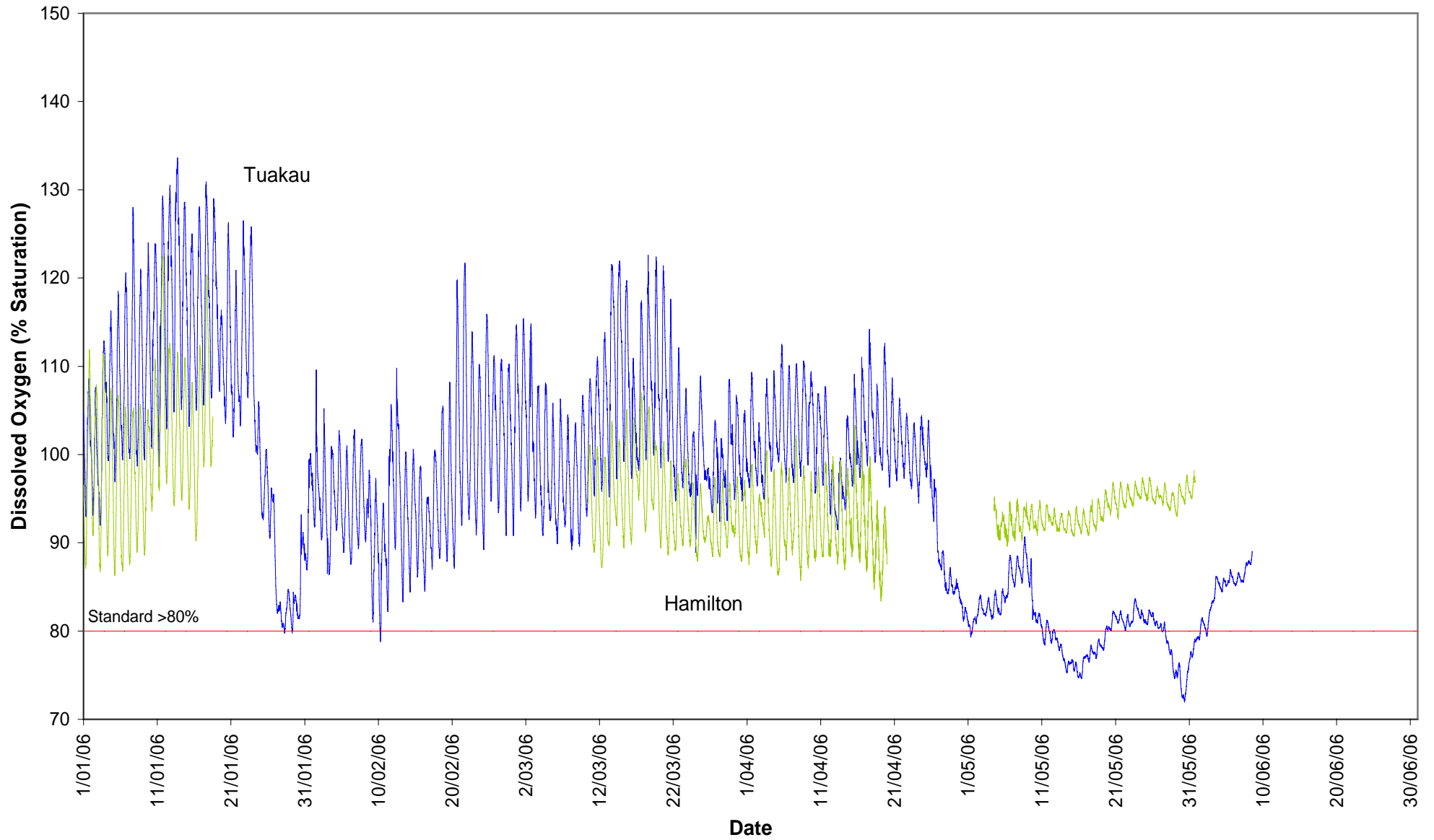
### pH: Lower Waikato (January - June)



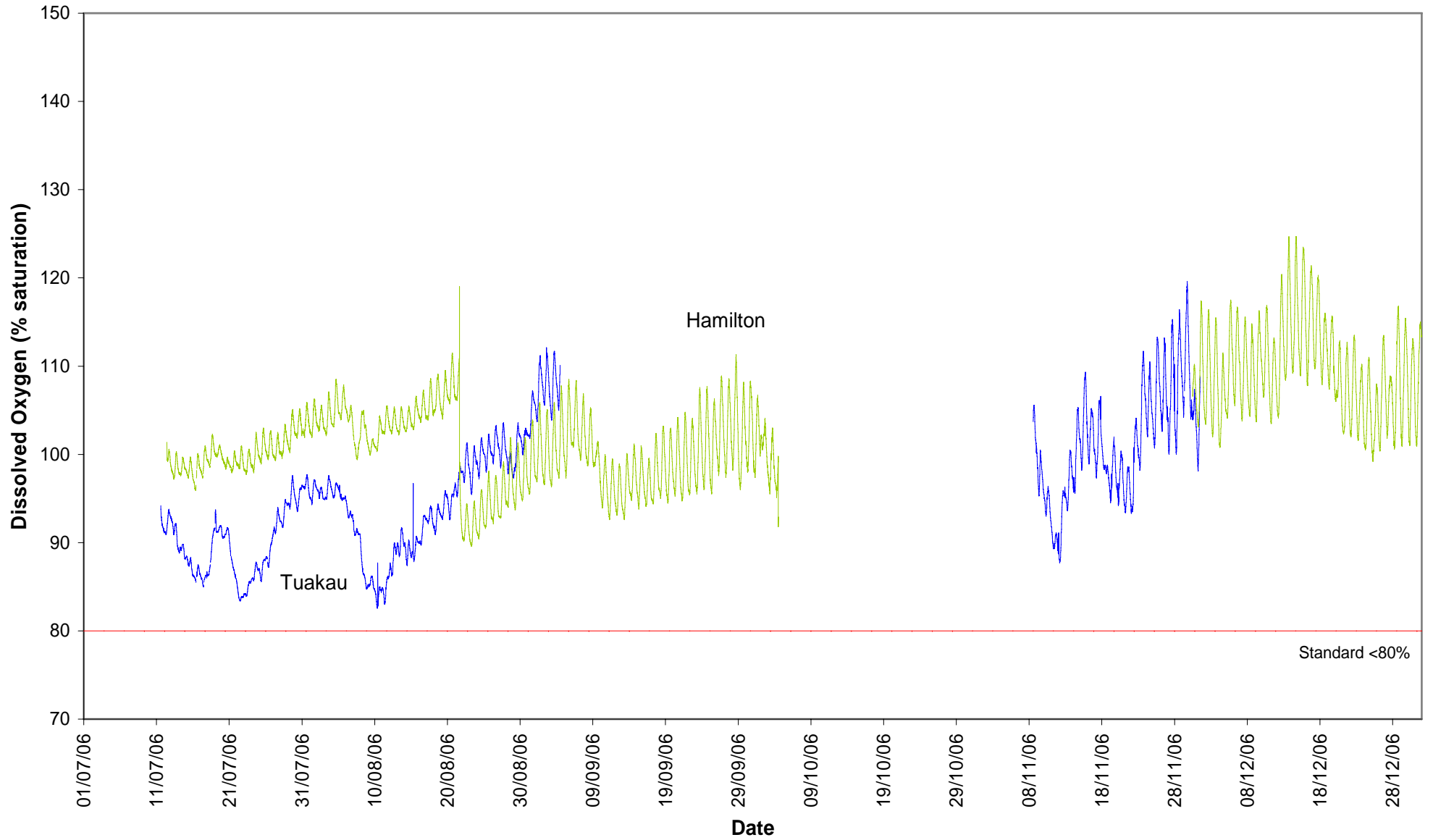
### pH: Lower Waikato (July - December)



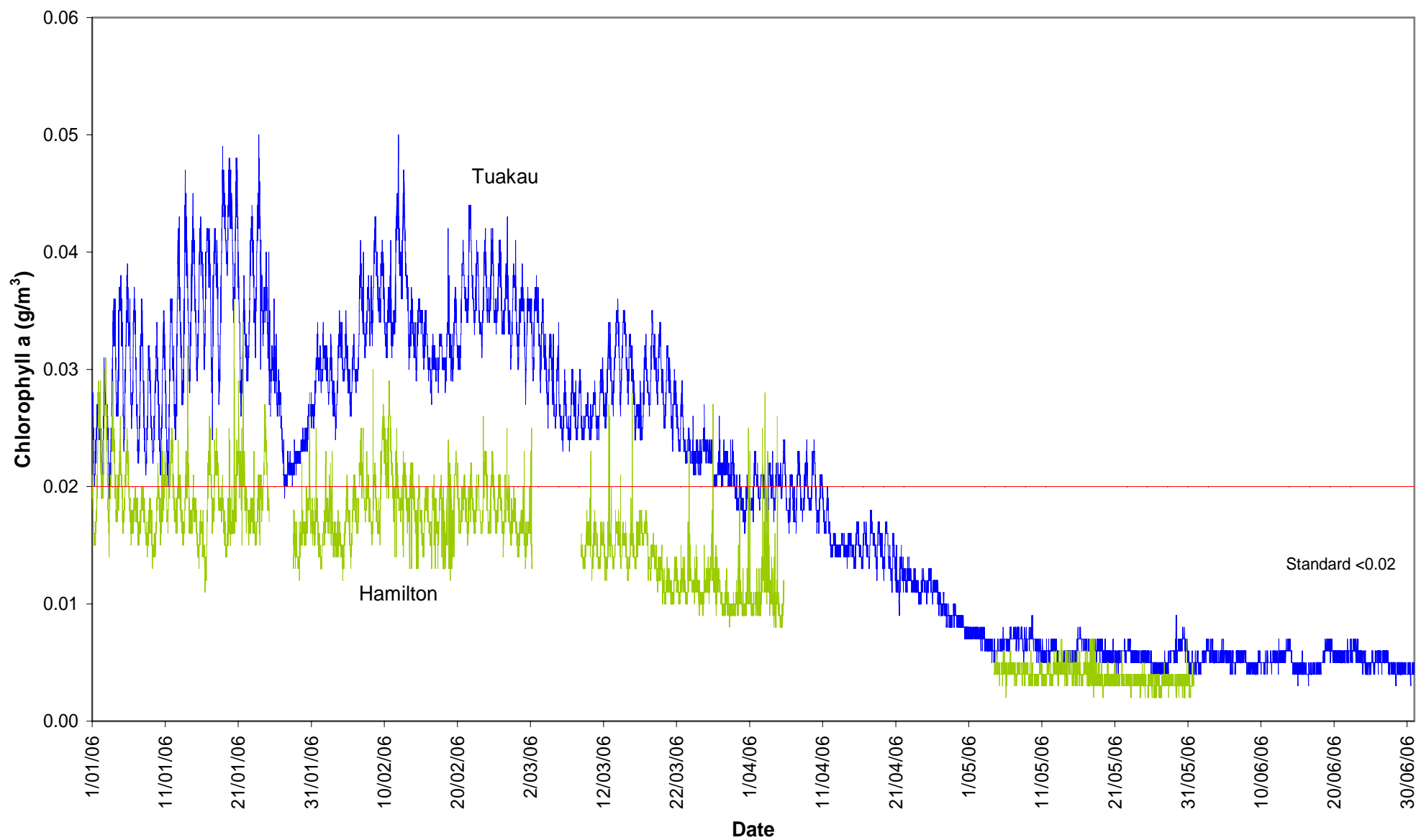
### Dissolved Oxygen (% saturation): Lower Waikato (January - June)



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

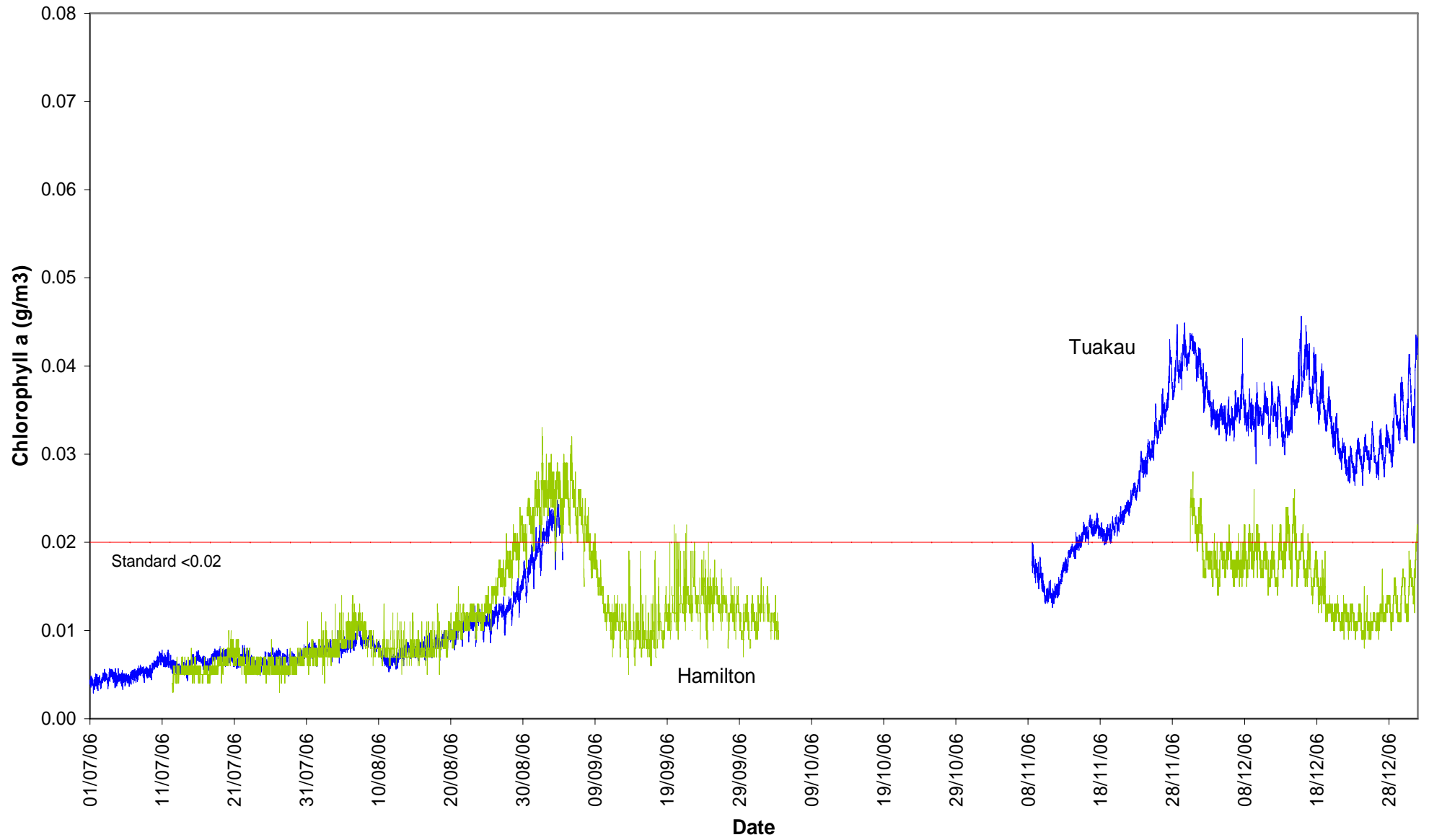


### Chlorophyll a: Lower Waikato (January - June)





### 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 <sup>1</sup>	Comments <sup>2</sup>
<b>Dissolved Oxygen</b>	- requirement for aquatic life	DO (conc.)	routine (field)
	- indicator of organic pollution	DO (%sat.)	routine (field)
	- indicator of photosynthesis (plant growth)		
<b>Temperature</b>	- indicator of biological activity	Temperature	routine (field)
	- requirement for aquatic life		
	- mixing processes		
	- modelling studies (e.g. nutrient uptake)		
<b>Conductivity</b>	- indicator of total salts dissolved in water	Conductivity	routine
	- indicator for geothermal input	TDS	routine
<b>pH</b>	- aquatic life protection	pH	routine
	- indicator of industrial discharges, mining		
<b>Clarity</b> - 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		
<b>Colour</b> - light absorption	- aesthetic appearance	Munsell colour	routine (field)
	- light availability for excessive plant growth	Absorbance at: 340,440,780nm	routine
	- indicator of presence of organic matter		
<b>Nutrients (N and P)</b> <b>Chlorophyll a</b>	- enrichment, excessive plant growth	NO <sub>3</sub> -N+NO <sub>2</sub> -N	routine
	- nutrient limitation for plant/algal growth	NH <sub>4</sub> -N,TKN	
		DRP, TP, Chl a	
<b>Geothermal Contaminants</b>	- indicators of geothermal inflows	Cl, Li, B, As	routine
	- aquatic life protection (ecotoxicity)		
	- drinking water (human health aspects)		
<b>Organic Carbon</b>	- indicator of organic pollution	BOD <sub>5</sub>	routine
	- catchment characteristics	TOC/DOC	routine
<b>Faecal Bacteria</b> - E. coli - enterococci - faecal coliforms	- indicator of pollution with faecal matter	E. Coli	routine
	- disease risk for swimming etc.	ENT	routine
		FC	routine

<sup>1</sup> see the page 54 for the meaning of the abbreviations.

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

## Details of Water Quality Standards and Guidelines for “Satisfactory” Water Quality

Parameter	Critical Value(s)	Source
Dissolved oxygen	>80% of saturation concentration	RMA Third Schedule, Classes AE, F, and FS.
pH	6.5–9	ANZECC (1992) and Canadian guidelines for freshwater aquatic life (1987).
Turbidity	<5 NTU	Studies of adverse effects on underwater light—and thus on plant and invertebrate production—in certain South Island streams (Davies-Colley 1991).
Ammoniacal-nitrogen	<0.88 g/m <sup>3</sup>	USEPA (1998) value for 1-hour exposure at pH 9.
Temperature	<12°C (May – Sep) <20°C (Oct – Apr)	Environment Waikato Proposed Regional Plan standards for trout fisheries and trout spawning (1998).
Total phosphorus	<0.04 g/m <sup>3</sup>	From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdram 1994)—note that the guidelines for “excellent” conditions are the lower quartile concentrations for these rivers.
Total nitrogen	<0.5 g/m <sup>3</sup>	From upper quartile values for 77 New Zealand rivers in NIWA’s National Water Quality Network (after Smith & Maasdram 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 <sup>3</sup>	Ministry for the Environment (1992).
Arsenic	<0.01 g/m <sup>3</sup>	Ministry of Health (2001).
Boron	<1.4 g/m <sup>3</sup>	Ministry of Health (2001).

## Waikato River Monitoring Programme - Water Quality Parameters & Analytical Methods

Id <sup>1</sup>	Parameter	Method
A340F	Absorbance @ 340 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A440F	Absorbance @ 440 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
A780F <sup>†</sup>	Absorbance @ 780 nm Filtered	Spectrophotometer, 1 cm path length, APHA method 5910B
As	Arsenic Total	Nitric acid digestion, ICP-MS, APHA method 3125B
B	Boron	ICP-MS, APHA method 3125B
BDISK	Black Disk	Field measurement, horizontal water transparency (20mm, 60mm, 100mm, 200mm disk) in river or trough (20mm only)
BOD <sub>5</sub>	Biochemical Oxygen Demand (5 day)	Incubation 5 days at 20°C, DO-meter, No nitrification inhibitor added, unseeded, APHA method 5210B
CHLA	Chlorophyll a	Acetone extraction. Spectroscopy. APHA method 10200H
Cl	Chloride	Filtered sample. Ion Chromatography APHA method 4110B
COLOUR	Colour	Field measurement, Munsell Colour Patches
COND	Conductivity	Lab Meter @ 25°C. APHA method 2510B
DO	Dissolved Oxygen	Field measurement (WTW DO meter, model 340A)
DO (% Sat)	Dissolved Oxygen (percent saturation)	Field measurement (WTW DO meter, model 340A)
DOC	Dissolved Organic Carbon	Filtration, acidification, purging to remove inorganic C, catalytic oxidation, IR detection. APHA method 5310B (modified)
DRP	Dissolved Reactive Phosphorus	Molybdenum Blue Colorimetry. Flow injection analyser. APHA 4500 PG (proposed)
E. coli	Escherichia coli	Membrane Filtration (mFC Agar) confirmation by NA-MUG Agar. APHA method 9222G
ENT	Enterococci bacteria	Membrane Filtration (mE Agar) confirmation by EIA Agar. APHA method 9230C
FC	Faecal Coliforms	Membrane Filtration with resuscitation(mFC Agar). APHA method 9222D
Flow	Flow – Instantaneous	Calculated from rating curve ± 8%
Li	Lithium	ICP-MS, method APHA 3125B
NH <sub>4</sub> -N	Ammoniacal Nitrogen (Total)	Phenol/Hypochlorite Colorimetry. Flow injection analyser. APHA method 4500-NH <sub>3</sub> H
NNN	Nitrite/Nitrate Nitrogen	Automated Cadmium reduction. Flow injection analyser. APHA method 4500 – NO <sub>3</sub> I (proposed).
NO <sub>3</sub> -N	Nitrate Nitrogen	Calculation: (Nitrate-N + Nitrite -N) – Nitrite - N
pH	pH	Lab Meter @ 25°C. APHA method 4500-H <sup>+</sup> B
TDS	Total Dissolved Solids	Filtration, gravimetric. APHA 2540C (modified)
TEMP	Temperature	Field measurement (WTW DO meter, model 340A)
TKN	Total Kjeldahl-Nitrogen	Acid digestion. Phenol/Hypochlorite colorimetry. Flow injection analyser. APHA method 4500-N <sub>org</sub> D (modified)
TOC	Total Organic Carbon	Acidification, purging to remove inorganic C, catalytic oxidation, IR detection. APHA method 5310B (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-PE (modified)
TURB	Turbidity	Turbidity Meter Hach 2100N. APHA method 2130B

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

APHA = Standards Methods for the Examination of Water and Wastewater, 20<sup>th</sup> Edition, 1998, APHA, AWWA, WEF

ICP-MS = Inductively Coupled Plasma – Mass Spectroscopy