



Annual freshwater quality monitoring report for the Wellington region, 2008/09

Quality for Life



greater WELLINGTON
REGIONAL COUNCIL

Environment





Annual freshwater quality monitoring report for the Wellington region, 2008/09

Alton Perrie

Environmental Monitoring and Investigations Department

For more information, contact:

Greater Wellington
142 Wakefield Street
PO Box 11646
Manners Street
Wellington 6142
T 04 384 5708
F 04 385 6960
www.gw.govt.nz

Greater Wellington
34 Chapel Street
PO Box 41
Masterton 5840
T 06 378 2484
F 06 378 2146
www.gw.govt.nz

GW/EMI-G-09/235

October 2009

Contents

1.	Introduction	1
2.	Overview of RSoE monitoring programme	2
2.1	Background	2
2.2	Monitoring objectives	2
2.3	Monitoring sites	2
2.4	Water quality variables	4
2.5	Biological monitoring	4
3.	Physico-chemical and microbiological water quality	5
3.1	Introduction	5
3.2	Water quality index	5
3.3	Results	6
4.	Periphyton	9
4.1	Introduction	9
4.2	Results	9
5.	Macroinvertebrates	13
5.1	Introduction	13
5.2	Results	13
6.	Summary	16
7.	References	17
	Appendix 1: RSoE monitoring sites	19
	Appendix 2: Water quality variables and analytical methods	20
	Appendix 3: Biological monitoring methods	21
	Appendix 4: Physico-chemical and bacteriological data	22
	Appendix 5: Macroinvertebrate indices (2008/09)	38

1. Introduction

Greater Wellington Regional Council (Greater Wellington) manages water quality in lakes, rivers and streams of the Wellington region for natural state, public water supply, recreation and amenity, fish spawning, and aquatic ecosystem health. Regular monitoring of physico-chemical and microbiological water quality, together with assessments of ecosystem health, are integral in managing water for these purposes.

Greater Wellington conducts a range of freshwater quality monitoring, including routine state of the environment monitoring in rivers and streams (56 sites), lake monitoring¹ (four sites on Lake Wairarapa), recreational water quality monitoring (21 sites) and monitoring associated with a riparian rehabilitation programme (see Perrie 2008). In addition, where warranted, targeted water quality investigations are carried out (e.g., Milne & Watts 2008).

This report summarises routine monitoring results from the Rivers State of the Environment (RSoE) programme for July 2008 to June 2009 inclusive. Additional physico-chemical water quality data (suspended solids, major ions and heavy metals) collected from RSoE sites during 2008 have been reported separately (Perrie 2009). A report containing a detailed analysis of long-term trends is produced every six years (see Milne & Perrie 2005). Recreational water quality monitoring results are reported on separately (for the 2008/09 results, see Warr 2009).

¹ Water quality monitoring of lakes Onoke and Waitawa is scheduled to begin in late 2009.

2. Overview of RSoE monitoring programme

2.1 Background

Surface water quality has been routinely monitored in the western half of the Wellington region since 1987 and in the Wairarapa since 1991. The monitoring programme has continued to evolve since this time with changes made to the location and number of monitoring sites, the range of variables monitored, and the methods of analysis. These changes have been made to improve the representativeness and quality of the information collected (Milne & Perrie 2005).

2.2 Monitoring objectives

The aims of Greater Wellington's Rivers State of the Environment (RSoE) water quality monitoring programme are to:

1. Assist in the detection of spatial and temporal changes in fresh waters;
2. Contribute to our understanding of freshwater biodiversity in the region;
3. Determine the suitability of fresh waters for designated uses;
4. Provide information to assist in targeted investigations where remediation or mitigation of poor water quality is desired; and
5. Provide a mechanism to determine the effectiveness of policies and plans.

*Note: the suitability of fresh waters for contact recreation purposes is assessed separately under Greater Wellington's recreational water quality monitoring programme (see Warr 2009).

2.3 Monitoring sites

There are 56 river and stream sites currently monitored under the RSoE programme (Figure 2.1, Appendix 1). These sites were chosen to represent the natural diversity of rivers and streams, and the major land uses and human activities in the region.

2.4 Water quality variables

River and stream water quality is assessed at monthly intervals by measuring a range of physico-chemical and microbiological variables: dissolved oxygen, temperature, pH, conductivity, visual clarity, turbidity, faecal indicator bacteria, total organic carbon, and dissolved and total nutrients. Periphyton cover is also assessed at monthly intervals at sites with hard substrates such as cobbles and large gravel (46 in total, see Appendix 1 for RSoE site substrate types). The full list of variables monitored, together with details of field and analytical methods is provided in Appendix 2.

2.5 Biological monitoring

Water quality in the region's rivers and streams is also assessed through annual biological monitoring, incorporating semi-quantitative assessments of the instream periphyton and macroinvertebrate communities during stable/low flows in summer/autumn. The record and scope of monitoring differs between sites (refer Milne & Perrie 2005); those sites with substrates comprised of soft sediment have only had macroinvertebrates assessed since 2003. The assessment of periphyton communities at sites with hard substrates was also extended at this time to include quantitative assessments of chlorophyll *a* concentrations and ash free dry mass, and a semi-quantitative assessment of taxonomic richness. Details of current biological monitoring methods are summarised in Appendix 3.

3. Physico-chemical and microbiological water quality

3.1 Introduction

A water quality index (WQI) is used as a comparative measure to summarise water quality across the region. The assessment in this section, and the data summaries presented in Appendix 4, are based on physico-chemical and microbiological data collected monthly from July 2008 to June 2009 (inclusive).

The WQI and data summaries are typically based on 12 sampling events for all 56 sites. However, access to five sites (Waitohu Stream at Forest Park, Motuwaireka Stream at Headwaters, Parkvale tributary at Lowes Reserve, Tauanui River at Whakatomotomo Road and Coles Creek tributary at Lagoon Hill Road) was not always permitted by the landowner (e.g., during lambing or calving) or possible during winter. Furthermore, due to unreliable instrument readings on some occasions and/or environmental conditions, not all sites have 12 data points for all variables assessed in the field (e.g., periphyton cover, pH, etc.).

During data processing, any water quality variables reported as less than or greater than detection limits were replaced by values one half of the detection limit or the detection limit respectively (e.g., a value of <2 became 1, a value of >400 became 400).

3.2 Water quality index

A water quality index (WQI), as described in Perrie (2007), is used to facilitate inter-site comparisons of the state of water quality in the region's rivers and streams. The WQI is derived from the *median* values for the following six variables: visual clarity (black disc), dissolved oxygen (% saturation), dissolved reactive phosphorus, ammoniacal nitrogen, nitrite-nitrate nitrogen and *Escherichia coli* (*E. coli*).

The application of the WQI enables water quality at each site to be classified into one of four categories as follows:

- Excellent: median values for all 6 variables comply with guideline values
- Good: median values for 5 of the 6 variables comply with guideline values, of which dissolved oxygen is one variable that must comply²
- Fair: median values for 3 or 4 of the 6 variables comply with guideline values, of which dissolved oxygen is one variable that must comply²
- Poor: median values for <3 of the 6 variables comply with guideline values.

The guidelines used to compare the median values against for the six key water quality variables in WQI are listed in Table 3.1. Refer to Perrie (2007) for further discussion on these guidelines.

² If the median dissolved oxygen concentration does not comply with the guideline value, then the WQI grade automatically drops to "poor".

Table 3.1: Physico-chemical and microbiological variables and guideline values

Variable	Guideline Value	Reference
Dissolved Oxygen (% saturation)	≥ 80	RMA 1991 Third Schedule
Visual Clarity (m)	≥ 1.6	MFE (1994)
Nitrite-Nitrate Nitrogen (mg/L)	≤ 0.444	ANZECC & ARMCANZ (2000)
Ammoniacal Nitrogen (mg/L)	≤ 0.021	ANZECC & ARMCANZ (2000)
Dissolved Reactive Phosphorus (mg/L)	≤ 0.010	ANZECC & ARMCANZ (2000)
<i>E. coli</i> (cfu/100 mL)	≤ 100	ANZECC & ARMCANZ (2000)

3.3 Results

Application of the WQI resulted in the following overall water quality grades for the 56 RSoE sites monitored in the Wellington region over the July 2008 to June 2009 reporting period (Figure 3.1):

- Excellent: 20 sites (35.7 %)
- Good: 8 sites (14.2 %)
- Fair: 16 sites (28.6 %)
- Poor 12 sites (21.4 %)

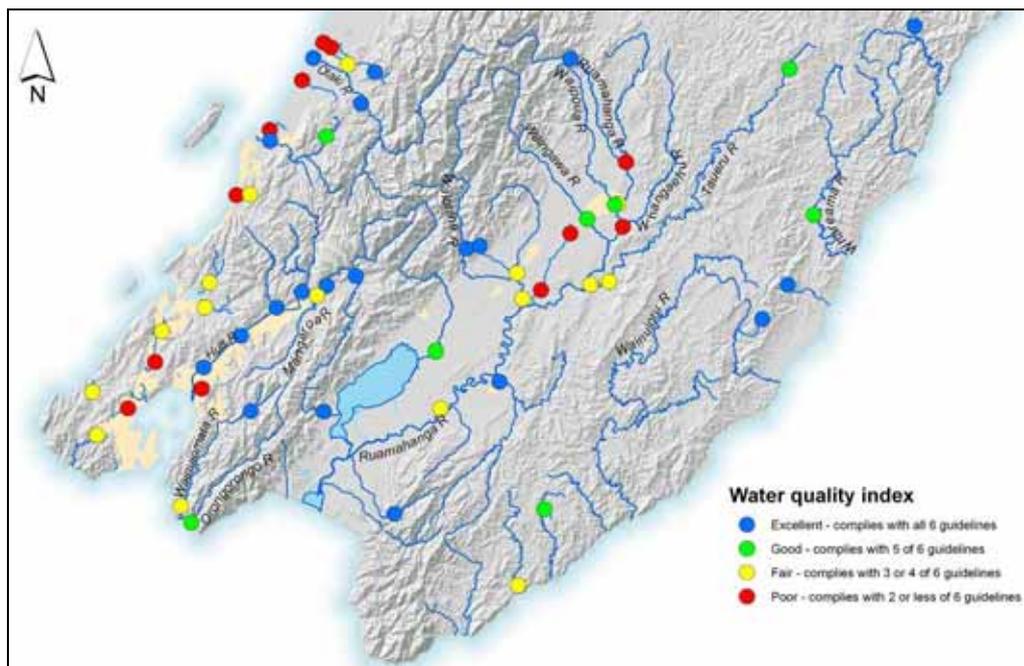


Figure 3.1: Water Quality Index grades for RSoE sites sampled at monthly intervals over June 2008 to July 2009, based on compliance of median dissolved oxygen, visual clarity, nitrite-nitrate nitrogen, ammoniacal nitrogen, dissolved reactive phosphorus and *E. coli* values with guideline values

The majority of RSoE sites graded “excellent” (17 of 20 sites) are located on river and stream reaches in catchments with predominantly unmodified indigenous forest cover (refer Appendix 1 for dominant land cover). These tend to be sites on rivers flowing out of the Aorangi, Tararua and Rimutaka ranges and include the Akatarawa, Hutt, Otaki, and Waingawa rivers, and the upper reaches of the Waitohu, Wainuiomata, Waiohine and Ruamahanga rivers. In contrast, RSoE sites graded “poor” were typically small rivers or streams draining pastoral (7 sites) or urban (5 sites) catchments. Sites with the poorest water quality include the Mangaone, Mangapouri, Ngarara and Waiwhetu streams, and the Whangaehu and Kopuaranga rivers.

As outlined in Section 3.2, the WQI is for comparative purposes rather than an absolute measure of water quality; sites with a grade of “good”, “fair”, or “poor” are all considered degraded because the median value of at least one of the six physico-chemical or microbiological variables in the WQI exceeded a guideline value. In addition, as the WQI is based on median values (i.e., 50 % compliance), sites awarded the same water quality grade may exhibit varying degrees of compliance (from 51 to 100 %) with the guideline value, and so while two sites may fall within the same WQI class they may differ in actual water quality. Therefore to differentiate between “better” and “poorer” sites within a water quality grade, in Table 3.2 the sites within each WQI grade have been ranked based on the number of guideline exceedances for each of the six key variables (i.e., a site that exceeded a guideline on 40% of sampling occasions will be ranked lower than a site with the same WQI grade that exceeded the guideline on 10% of sampling occasions).

The water quality variables that most commonly exceeded guideline values (based on median values) were visual clarity (31 sites), followed by dissolved reactive phosphorus (24 sites), *E. coli* (19 sites) and nitrite-nitrate nitrogen (17 sites). Guidelines for ammoniacal nitrogen and dissolved oxygen were not met at six and four sites respectively.

Table 3.2: Water Quality Index grades for RSoE sites sampled at monthly intervals over June 2008 to July 2009 inclusive, based on compliance of median dissolved oxygen, visual clarity, nitrite-nitrate nitrogen, ammoniacal nitrogen, dissolved reactive phosphorus and *E. coli* values with guideline values

Rank	Site No.	Site Name	Guideline Compliance (median values)					
			DO	Clarity	<i>E. coli</i>	NNN	Amm. N	DRP
<i>Excellent water quality</i>								
1	RS20	Hutt River at Te Marua Intake Site	✓	✓	✓	✓	✓	✓
2	RS23	Pakuratahi River 50m Below Farm Creek	✓	✓	✓	✓	✓	✓
3	RS25	Akatarawa River at Hutt Confluence	✓	✓	✓	✓	✓	✓
4	RS43	Motuwaireka Stream at headwaters	✓	✓	✓	✓	✓	✓
5	RS26	Whakatikei River at Riverstone	✓	✓	✓	✓	✓	✓
6	RS28	Wainuiomata River at Manuka Track	✓	✓	✓	✓	✓	✓
7	RS06	Otaki River at Mouth	✓	✓	✓	✓	✓	✓
8	RS05	Otaki River at Pukehinau	✓	✓	✓	✓	✓	✓
9	RS52	Tauanui River at Whakatomotomo Rd	✓	✓	✓	✓	✓	✓
10	RS56	Waiorongomai River at Forest Park	✓	✓	✓	✓	✓	✓
11	RS49	Beef Creek at headwaters	✓	✓	✓	✓	✓	✓
12	RS35	Mataikona tributary at Sugar Loaf Rd	✓	✓	✓	✓	✓	✓
13	RS47	Waiohine River at Gorge	✓	✓	✓	✓	✓	✓
14	RS44	Totara Stream at Stronvar	✓	✓	✓	✓	✓	✓
15	RS03	Waitohu Stream at Forest Park	✓	✓	✓	✓	✓	✓
16	RS22	Hutt River at Boulcott	✓	✓	✓	✓	✓	✓
17	RS10	Waikanae River at Greenaway Rd	✓	✓	✓	✓	✓	✓
18	RS31	Ruamahanga River at McLays	✓	✓	✓	✓	✓	✓
19	RS51	Huangerua River at Ponatahi Bridge	✓	✓	✓	✓	✓	✓
20	RS21	Hutt River Opposite Manor Park Golf Club	✓	✓	✓	✓	✓	✓
<i>Good water quality</i>								
21	RS55	Tauherenikau River at Websters	✓	x	✓	✓	✓	✓
22	RS09	Waikanae River at Mangaone Walkway	✓	✓	✓	✓	✓	x
23	RS41	Waingawa River at South Rd	✓	x	✓	✓	✓	✓
24	RS30	Orongorongo River at Orongorongo Stn.	✓	x	✓	✓	✓	✓
25	RS54	Coles Creek tributary at Lagoon Hill Rd	✓	x	✓	✓	✓	✓
26	RS40	Waipoua River at Colombo Rd Bridge	✓	✓	✓	x	✓	✓
27	RS36	Taueru River at Castlehill	✓	x	✓	✓	✓	✓
28	RS42	Whareama River at Gauge	✓	x	✓	✓	✓	✓
<i>Fair water quality</i>								
29	RS53	Awhea River at Tora Rd	✓	x	x	✓	✓	✓
30	RS32	Ruamahanga River at Te Ore Ore	✓	x	x	✓	✓	✓
31	RS13	Horokiri Stream at Snodgrass	✓	x	x	✓	✓	✓
32	RS48	Waiohine River at Bicknells	✓	x	✓	✓	✓	x
33	RS29	Wainuiomata River Upstr of White Bridge	✓	x	✓	✓	✓	x
34	RS11	Whareroa Stream at Waterfall Rd	✓	x	✓	✓	✓	x
35	RS33	Ruamahanga River at Gladstone Bridge	✓	x	✓	✓	✓	x
36	RS37	Taueru River at Gladstone	✓	x	✓	x	✓	✓
37	RS24	Mangaroa River at Te Marua	✓	x	x	x	✓	✓
38	RS14	Pauatahanui Stream at Elmwood Bridge	✓	x	x	✓	✓	x
39	RS34	Ruamahanga River at Pukio	✓	x	x	✓	✓	x
40	RS01	Mangapouri Stream at Rahui Rd	✓	x	✓	x	✓	x
41	RS17	Makara Stream at Kennels	✓	x	x	✓	✓	x
42	RS16	Porirua Stream at Wall Park (Milk Depot)	✓	✓	x	x	✓	x
43	RS18	Karori Stream at Makara Peak Mountain	✓	✓	x	x	✓	x
44	RS50	Mangatarere River at State Highway 2	✓	✓	✓	x	x	x
<i>Poor water quality</i>								
45	RS08	Ngarara Stream at Field Way	x	x	✓	✓	✓	x
46	RS15	Porirua Stream at Glenside Overhead Ca.	✓	x	x	x	✓	x
47	RS45	Parkvale tributary at Lowes Reserve	x	x	✓	x	✓	x
48	RS19	Kaiwharawhara Stream at Ngaio Gorge	✓	x	x	x	✓	x
49	RS38	Kopuaranga River at Stewarts	✓	x	x	x	✓	x
50	RS39	Whangaehu River at 250m from Confl.	✓	x	x	x	✓	x
51	RS46	Parkvale Stream at Weir	✓	x	x	x	✓	x
52	RS04	Waitohu Stream at Norfolk Crescent	✓	x	x	x	x	x
53	RS12	Whareroa Stream at QE Park	x	x	x	✓	x	x
54	RS27	Waiwhetu Stream at Wainui Hill Bridge	✓	x	x	x	x	x
55	RS07	Mangaone Stream at Sims Road Bridge	✓	x	x	x	x	x
56	RS02	Mangapouri Stream at Bennetts Rd	x	x	x	x	x	x

4. Periphyton

4.1 Introduction

Assessment of periphyton data is limited to RSoE sites with hard substrates (46 of the 56 sites). Monthly observations of percent streambed periphyton cover, from July 2008 to June 2009 inclusive, and an assessment of periphyton biomass (chlorophyll *a* and Ash Free Dry Mass (AFDM)) undertaken in late summer/early autumn 2009 are compared against various MfE (2000) guidelines (Table 4.1).

Table 4.1: Guidelines used to assess periphyton streambed cover and biomass (MfE 2000)

Instream value/variable	Mat periphyton	Filamentous periphyton
<i>Aesthetics/recreation</i>		
Maximum cover of visible streambed	60% >0.3 cm thick	30% >2 cm long
<i>Benthic biodiversity</i>		
Maximum chlorophyll <i>a</i>	50 mg/m ²	50 mg/m ²
<i>Trout habitat and angling</i>		
Maximum AFDM (mg/m ²)	35 mg/m ²	35 mg/m ²
Maximum cover of visible streambed	N/A	30% >2 cm long

4.2 Results

The number of observations of streambed periphyton cover made during the reporting period varied among the 46 RSoE sites due to either site access being restricted or because turbid water or high flows made assessment of cover impossible.

Of the 46 RSoE sites, 22 exceeded the MfE (2000) guideline for filamentous periphyton streambed cover on at least one sampling occasion (Table 4.2). The sites that most often exceeded the guideline were the Kopuaranga River at Stewarts, the Taueru River at Gladstone (seven times each), and the Huangarua River at Ponatahi Bridge (six times); these sites are all located in catchments dominated by pastoral landuse and experience limited flushing flows to remove algal growth. Three sites located within urban catchments exceeded the guideline on five occasions: the Kaiwharawhara Stream at Ngaio Gorge, Karori Stream at Makara Peak Mountain Bike Park and the Porirua Stream at Glenside Overhead Cable.

Exceedance of the MfE (2000) guideline for mat-forming periphyton cover occurred at four RSoE sites during the reporting period: Waipoua River at Colombo Road (on 3 occasions) Huangarua River at Ponatahi Bridge (once), Hutt River opposite Manor Park Golf Club (once) and the Otaki River at Mouth (once). It is important to note that observations of periphyton cover are typically undertaken in run habitat³, whereas some mat-forming periphyton (particularly cyanobacteria) tend to proliferate initially in riffle habitat⁴ and

³ A run has a character in between that of a riffle and pool, it is moderate in depth and typically has a uniform current and an unbroken surface.

⁴ A riffle is an area of shallow depth, moderate to fast water velocity, with mixed currents and an unbroken but rippled surface.

then in runs (MfE in prep.). Thus the results presented here may not accurately represent the presence of mat-forming periphyton, or exceedance of mat-forming periphyton guidelines. Periphyton cover assessment methods are currently being reviewed to address this issue.

Nine RSoE sites exceeded the MfE (2000) chlorophyll *a* guideline for benthic biodiversity (Table 4.3). The highest chlorophyll *a* biomass recorded was in the Kopuaranga River at Stewarts (690 mg/m², Figure 4.1). Three sites exceeded the MfE (2000) AFDM guideline for trout habitat and angling with the highest biomass recorded in the Taueru River at Gladstone (110 g/m²).

There was a reasonable correlation between exceedance of periphyton guidelines and WQI grades. Sites with excellent water quality were more likely to comply with guidelines for both periphyton cover and biomass than sites with poor or fair WQI grades. At some sites it was clear that variables other than water quality, such as accrual periods and streamside shade, are more strongly influencing the periphyton community and hence compliance with guidelines.



Figure 4.1: The Kopuaranga River (tributary of the Ruamahanga River) recorded the highest periphyton biomass (chlorophyll *a* concentration) during one-off sampling in March 2009

Table 4.2: Summary of monthly observations at RSoE sites, over July 2008 to June 2009 inclusive, of visible streambed cover for filamentous and mat-forming periphyton in relation to exceedances of the MfE (2000) guidelines

Site No.	Site Name	Streambed cover (%)					
		Filamentous (>2 cm long)			Mats (>0.3 cm thick)		
		Max	n >30 % cover	n	Max	n >60 % cover	n
RS03	Waitohu S at Forest Pk	7	0	10	10	0	10
RS05	Otaki R at Pukehinau	0	0	11	0	0	11
RS06	Otaki R at Mouth	32	1	12	61	1	12
RS09	Waikanae R at Mangaone Walkway	0	0	12	0	0	12
RS10	Waikanae R at Greenaway Rd	7	0	10	48	0	10
RS11	Whareroa S at Waterfall Rd	0	0	11	0	0	11
RS13	Horokiri S at Snodgrass	74	2	11	0	0	11
RS14	Pauatahanui S at Elmwood Br	84	1	8	0	0	8
RS15	Porirua S at Glenside	91	5	10	5	0	10
RS16	Porirua S at Wall Park (Milk Depot)	76	3	10	29	0	10
RS17	Makara S at Kennels	9	0	9	0	0	9
RS18	Karori S at Makara Peak	93	5	10	38	0	10
RS19	Kaiwharawhara S at Ngaio Gorge	98	5	11	43	0	11
RS20	Hutt R at Te Marua Intake Site	0	0	11	0	0	11
RS21	Hutt R opp. Manor Park G.C.	20	0	10	70	1	10
RS22	Hutt R at Boulcott	31	1	10	43	0	10
RS23	Pakuratahi R 50m d/s Farm Ck	6	0	11	31	0	11
RS24	Mangaroa R at Te Marua	79	2	11	54	0	11
RS25	Akatarawa R at Hutt confl.	0	0	11	0	0	11
RS26	Whakatikei R at Riverstone	46	1	11	30	0	11
RS28	Wainuiomata R at Manuka Track	0	0	12	0	0	12
RS29	Wainuiomata R u/s of White Br	13	0	6	20	0	6
RS30	Orongorongo R at Orongorongo Stn	100	2	6	3	0	6
RS31	Ruamahanga R at McLays	3	0	8	17	0	8
RS32	Ruamahanga R at Te Ore Ore	20	0	7	0	0	7
RS33	Ruamahanga R at Gladstone Br	21	0	7	60	0	7
RS34	Ruamahanga R at Pukio	100	1	5	0	0	5
RS35	Mataikona Trib at Sugar Loaf Rd	5	0	12	0	0	12
RS37	Taueru R at Gladstone	100	7	7	30	0	7
RS38	Kopuaranga R at Stewarts	100	7	8	26	0	8
RS40	Waipoua R at Colombo Rd Br	53	1	11	100	3	11
RS41	Waingawa R at South Rd	6	0	9	0	0	9
RS43	Motuwaireka S at Headwaters	0	0	11	0	0	11
RS44	Totara S at Stronvar	82	4	11	37	0	11
RS45	Parkvale Trib at Lowes Res.	0	0	10	0	0	10
RS46	Parkvale S at Weir	97	3	7	5	0	7
RS47	Waiohine R at Gorge	3	0	8	20	0	8
RS48	Waiohine R at Bicknells	0	0	7	0	0	7
RS49	Beef Ck at Headwaters	0	0	12	0	0	12
RS50	Mangatarere S at SH 2	93	4	10	1	0	10
RS51	Huangaaru R at Ponatahi Br	84	4	8	71	1	8
RS52	Tauanui R at Whakatomotomo Rd	21	0	7	0	0	7
RS53	Awhea R at Tora Rd	100	6	8	0	0	8
RS54	Coles Ck Trib at Lagoon Hill Rd	80	3	9	0	0	9
RS55	Tauherenikau R at Websters	40	2	9	0	0	9
RS56	Waiorongomai R at Forest Pk	0	0	11	0	0	11

Table 4.3: Periphyton biomass (chlorophyll *a* and AFDM) from one-off sampling during late summer/ autumn of 2009. Non-compliance with MfE (2000) guidelines is highlighted in bold type.

Site No.	Site Name	AFDM (g/m ²)	Chlorophyll <i>a</i> (mg/m ²)
RS03	Waitohu S at Forest Pk	0.75	1.1
RS05	Otaki R at Pukehinau	0.36	0.7
RS06	Otaki R at Mouth	1.25	2.5
RS09	Waikanae R at Mangaone Walkway	0.54	0.2
RS10	Waikanae R at Greenaway Rd	3.99	19.8
RS11	Whareroa S at Waterfall Rd	4.75	29.7
RS13	Horokiri S at Snodgrass	3.84	34.4
RS14	Pauatahanui S at Elmwood Br	15.5	141.4
RS15	Porirua S at Glenside	4.32	43.3
RS16	Porirua S at Wall Park (Milk Depot)	8.53	38.5
RS17	Makara S at Kennels	1.71	5.7
RS18	Karori S at Makara Peak	7.63	71.1
RS19	Kaiwharawhara S at Ngaio Gorge	11.0	61.5
RS20	Hutt R at Te Marua Intake Site	0.27	0.8
RS21	Hutt R opp. Manor Park G.C.	4.00	18.1
RS22	Hutt R at Boulcott	2.62	17.1
RS23	Pakuratahi R 50m d/s Farm Ck	1.04	4.4
RS24	Mangaroa R at Te Marua	9.96	59.8
RS25	Akatarawa R at Hutt confl.	0.59	2.3
RS26	Whakatikei R at Riverstone	2.49	13.6
RS28	Wainuiomata R at Manuka Track	2.50	6.8
RS29	Wainuiomata R u/s of White Br	11.8	40.2
RS30	Orongorongo R at Orongorongo Stn	6.37	19.9
RS31	Ruamahanga R at McLays	0.17	0.3
RS32	Ruamahanga R at Te Ore Ore	4.66	27.7
RS33	Ruamahanga R at Gladstone Br	9.18	47.0
RS34	Ruamahanga R at Pukio	2.86	22.0
RS35	Mataikona Trib at Sugar Loaf Rd	4.54	7.3
RS37	Taueru R at Gladstone	110.9	477.2
RS38	Kopuaranga R at Stewarts	109.5	690.0
RS40	Waipoua R at Colombo Rd Br	13.5	34.6
RS41	Waingawa R at South Rd	5.27	51.3
RS43	Motuwaireka S at Headwaters	2.87	2.9
RS44	Totara S at Stronvar	7.90	14.7
RS45	Parkvale Trib at Lowes Res.	3.35	18.2
RS46	Parkvale S at Weir	52.1	304.4
RS47	Waiohine R at Gorge	0.21	0.3
RS48	Waiohine R at Bicknells	6.69	48.0
RS49	Beef Ck at Headwaters	1.81	7.0
RS50	Mangatarere S at SH 2	22.6	2.3
RS51	Huangarua R at Ponatahi Br	23.0	122.9
RS52	Tauanui R at Whakatomotomo Rd	0.61	0.8
RS53	Awhea R at Tora Rd	21.9	35.8
RS54	Coles Ck Trib at Lagoon Hill Rd	15.5	41.6
RS55	Tauherenikau R at Websters	3.77	12.1
RS56	Waiorongomai R at Forest Pk	1.28	1.7

5. Macroinvertebrates

5.1 Introduction

This section presents the results of macroinvertebrate sampling undertaken at the 56 RSoE sites during late summer/early autumn 2009. The Macroinvertebrate Community Index (MCI) – an index of sensitivity to a complex of environmental variables (Stark & Maxted 2007) – is used to summarise macroinvertebrate health. Additional macroinvertebrate indices (QMCI, % EPT taxa, and taxa richness) are presented in Appendix 5. Refer to Perrie (2007) for further explanation on these indices.

The quality classification, as recommended by Stark & Maxted (2007), for interpretation of the MCI scores is outlined in Table 5.1. Soft bottomed MCI scores (MCI-sb) were calculated for the ten RSoE sites with soft substrates (see Appendix 1).

Table 5.1: Interpretation of MCI-type scores (from Stark & Maxted 2007)

Quality Class	MCI and MCI-sb
Excellent	>119
Good	100-119
Fair	80-99
Poor	<80

5.2 Results

The MCI scores for three replicate samples collected at each monitoring site are summarised in Table 5.2 along with the mean score and standard deviation. Based on mean MCI scores, the 56 RSoE sites fell into the following MCI quality classes (Figure 5.1):

- Excellent: 20 sites (35.7 %)
- Good: 15 sites (26.8 %)
- Fair: 14 sites (25 %)
- Poor: 7 sites (12.5 %)

The majority (17 of 20) of the RSoE sites in the “excellent” MCI quality class are located in catchments dominated by indigenous forest cover (e.g., Waitohu Stream at Forest Park). The seven RSoE sites in the “poor” quality class were typically located in catchments dominated by pastoral landcover (e.g., Parkvale Stream at Weir), except in the case of the Mangapouri Stream at Bennetts Road and the Ngarara Stream at Field Way (urban). Sites with soft-sediment substrate were also over represented in this poor category (six of seven).

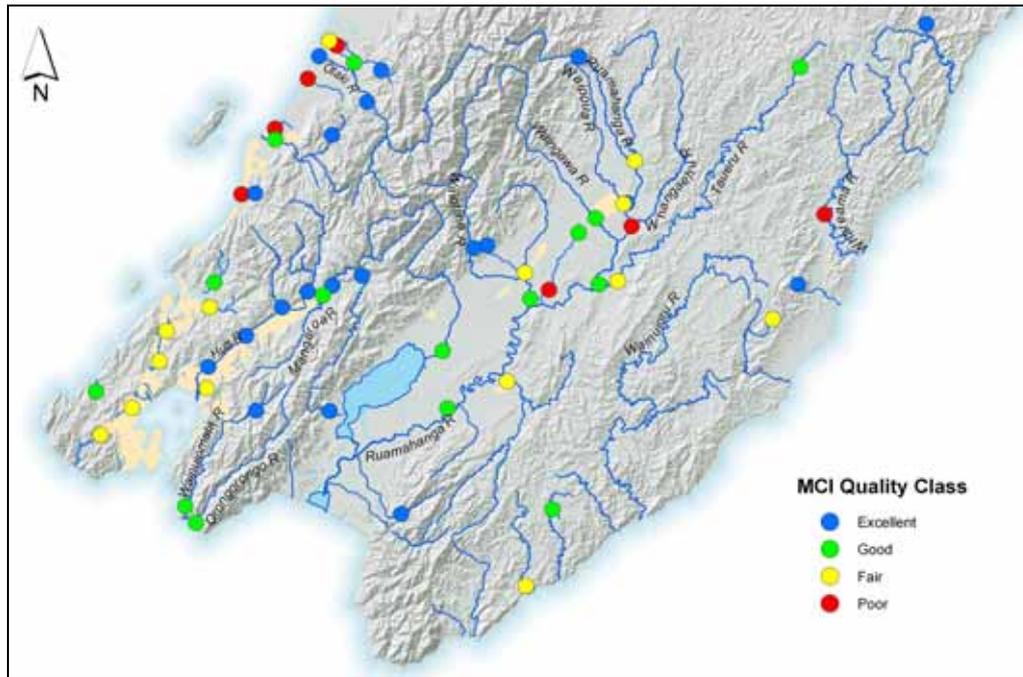


Figure 5.1: MCI quality classes for the 56 RSoE sites, determined from one sampling event over summer/autumn 2009

There was a reasonable correlation between the MCI quality classes and WQI grades. For example, of the 20 RSoE sites with an “excellent” MCI quality class, 17 had a WQI grade of “excellent”, one a WQI grade of “good”, and two had a WQI grade of “fair” (refer Section 3.3). Similarly, five of the seven RSoE sites with an MCI quality class of “poor” also had a WQI grade of “poor” and the other two a WQI grade of “good” and “fair”. The correlation between water quality and macroinvertebrate health based on WQI grades and MCI quality grades was less clear in the “good” and “fair” classes.

Sites that exceeded the MFE (2000) periphyton biomass (chlorophyll *a*) guideline for benthic biodiversity also tended to have low MCI scores. Out of the nine sites that exceeded this guideline seven were in either the “fair” or “poor” MCI classes.

Table 5.2: MCI scores for RSoE sites sampled in 2009 (three replicate samples per site) and the overall MCI quality class based on the mean MCI score from the replicate samples

Site No.	Site Name	Rep. 1	Rep. 2	Rep. 3	Mean	Std Dev.	MCI Quality Class
RS01	Mangapouri S at Rahui Rd	108.7	102.5	105.4	105.5	3.07	Good
RS02	Mangapouri S at Bennetts Rd	74.7	82.9	44.3	67.3	20.3	Poor
RS03	Waitohu S at Forest Park	145.8	144.8	148.4	146.3	1.88	Excellent
RS04	Waitohu S at Norfolk Cres.	92.2	98.4	73.4	88.0	13.0	Fair
RS05	Otaki R at Pukehinau	146.2	132.9	138.6	139.2	6.71	Excellent
RS06	Otaki R at Mouth	110.0	125.3	130.8	122.0	10.8	Excellent
RS07	Mangaone S at Sims Rd Br	63.5	71.0	94.7	76.4	16.3	Poor
RS08	Ngarara S at Field Way	86.7	75.7	57.6	73.3	14.7	Poor
RS09	Waikanae R at Mangaone Walkway	143.4	137.3	140.0	140.2	3.09	Excellent
RS10	Waikanae R at Greenaway Rd	123.0	117.1	115.8	118.6	3.81	Good
RS11	Whareroa S at Waterfall Rd	121.5	122.4	126.1	123.3	2.44	Excellent
RS12	Whareroa S at QE Park	58.3	71.6	52.7	60.8	9.73	Poor
RS13	Horokiri S at Snodgrass	115.0	109.5	116.5	113.7	3.66	Good
RS14	Pauatahanui S at Elmwood Br	98.1	93.0	97.3	96.1	2.74	Fair
RS15	Porirua S at Glenside	102.2	77.3	99.6	93.1	13.7	Fair
RS16	Porirua S at Wall Park (Milk Depot)	85.3	83.2	87.8	85.4	2.31	Fair
RS17	Makara S at Kennels	116.0	108.9	116.0	113.6	4.11	Good
RS18	Karori S at Makara Peak	92.6	93.0	99.2	95.0	3.71	Fair
RS19	Kaiwharawhara S at Ngaio Gorge	94.0	77.9	85.6	85.8	8.06	Fair
RS20	Hutt R at Te Marua Intake Site	143.2	141.9	145.3	143.4	1.70	Excellent
RS21	Hutt R opp. Manor Park G.C.	118.6	120.0	133.7	124.1	8.34	Excellent
RS22	Hutt R at Boulcott	120.0	127.3	123.3	123.5	3.64	Excellent
RS23	Pakuratahi R 50m d/s Farm Ck	137.0	139.0	135.8	137.3	1.62	Excellent
RS24	Mangaroa R at Te Marua	123.2	111.0	116.0	116.7	6.11	Good
RS25	Akatarawa R at Hutt Confl.	138.2	133.9	128.2	133.4	5.02	Excellent
RS26	Whakatikei R at Riverstone	120.0	129.6	121.7	123.8	5.10	Excellent
RS27	Waiwhetu S at Wainui Hill Br	67.2	88.6	84.3	80.0	11.3	Fair
RS28	Wainuiomata R at Manuka Track	137.1	139.2	140.7	139.0	1.79	Excellent
RS29	Wainuiomata R u/s White Br	97.9	101.1	110.8	103.3	6.74	Good
RS30	Orongorongo R at Orongorongo Stn	104.3	86.3	110.0	100.2	12.4	Good
RS31	Ruamahanga R at McLays	144.7	143.1	154.7	147.5	6.31	Excellent
RS32	Ruamahanga R at Te Ore Ore	111.7	125.3	126.3	121.1	8.19	Excellent
RS33	Ruamahanga R at Gladstone Br	120.0	106.2	103.3	109.8	8.92	Good
RS34	Ruamahanga R at Pukio	103.6	104.3	93.3	100.4	6.14	Good
RS35	Mataikona Trib. at Sugar Loaf Rd	131.4	133.6	131.2	132.1	1.31	Excellent
RS36	Taueru R at Castlehill	121.5	111.4	113.7	115.5	5.29	Good
RS37	Taueru R at Gladstone	81.8	84.0	76.4	80.7	3.93	Fair
RS38	Kopuaranga R at Stewarts	88.4	87.6	93.8	90.0	3.39	Fair
RS39	Whangaehu R 250m from Confl.	51.1	48.4	52.2	50.6	1.98	Poor
RS40	Waipoua R at Colombo Rd Br	96.8	101.0	97.1	98.3	2.33	Fair
RS41	Waingawa R at South Rd	115.3	110.7	118.8	114.9	4.06	Good
RS42	Whareama R at Gauge	52.5	45.2	75.4	57.7	15.8	Poor
RS43	Motuwaireka R at Headwaters	134.6	139.3	133.8	135.9	2.99	Excellent
RS44	Totara S at Stronvar	99.2	92.8	99.7	97.2	3.83	Fair
RS45	Parkvale Trib. at Lowes Res.	106.3	113.6	108.0	109.3	3.84	Good
RS46	Parkvale S at Weir	66.0	73.3	75.8	71.7	5.09	Poor
RS47	Waiohine R at Gorge	135.0	135.0	136.2	135.4	0.69	Excellent
RS48	Waiohine R at Bicknells	114.7	110.7	107.1	110.8	3.84	Good
RS49	Beef S at Headwaters	138.0	136.1	142.7	138.9	3.37	Excellent
RS50	Mangatarere S at SH 2	93.7	96.8	96.5	95.7	1.73	Fair
RS51	Huangarua R at Ponatahi Br	91.0	91.8	90.0	90.9	0.88	Fair
RS52	Tauanui S at Whakatomotomo Rd	135.5	124.7	137.0	132.4	6.73	Excellent
RS53	Awhea R at Tora Rd	82.2	83.0	82.5	82.6	0.39	Fair
RS54	Coles Trib. at Lagoon Hill Rd	110.0	110.7	112.9	111.2	1.49	Good
RS55	Tauherenikau R at Websters	116.0	129.5	101.1	115.5	14.2	Good
RS56	Waiorongomai R at Forest Pk	124.9	128.1	124.1	125.7	2.13	Excellent

6. Summary

Using the WQI, 20 of the 56 RSoE sites were allocated water quality grades of “excellent” for the 2008/09 reporting period. Eight sites scored grades of “good”, 16 sites “fair” and 12 sites “poor”.

Of the 46 RSoE sites monitored for periphyton, 22 sites exceeded the MfE (2000) streambed cover guidelines for filamentous growths at least once and four sites exceeded the guideline for mat growths on one or more occasions. The chlorophyll *a* guideline for benthic biodiversity was exceeded at nine sites while the AFDM guideline for trout habitat and angling was exceeded at three sites.

Based on MCI scores, the majority of the 56 RSoE sites received quality classifications of “excellent” (20 sites) or “good” (15 sites). Fourteen sites were classed as “fair” and seven sites were classed as “poor”.

Water quality and aquatic ecosystem health are strongly influenced by land cover; WQI and MCI scores are highest at RSoE sites located on hill-fed river and stream reaches with upstream catchments dominated by unmodified indigenous forest cover. Approximately one third of the rivers and streams within the Wellington region have upstream catchments dominated by indigenous forest. These rivers and streams can generally be expected to have excellent water quality and aquatic ecosystem health. In contrast, RSoE sites with poor WQI and MCI scores are typically located on smaller, low elevation streams draining predominantly pastoral or urban catchments. These sites were also more likely to exceed guidelines for periphyton cover and biomass. Approximately two thirds of rivers and streams in the region are located in pastoral (~60 %) or urban catchments (~3 %). Water quality and aquatic ecosystem health in these rivers and streams are likely to be impacted to some degree, and in a few cases, may be severely degraded.

7. References

ANZECC. 2000. *Australia and New Zealand guidelines for fresh and marine water quality, Volume 1, The guidelines*. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Biggs, B; Kilroy, C. 2000. *Stream periphyton monitoring manual*. National Institute for Water and Atmosphere, Christchurch.

Milne, J.; Perrie, A. 2005. *Freshwater quality monitoring technical report*. Greater Wellington Regional Council, Publication No. GW/RINV-T-05/87.

Milne, J.; Watts, L. 2008. *Stormwater contaminants in urban streams in the Wellington region*. Greater Wellington Regional Council, Publication No. GW/EMI-T-08/82.

Ministry for the Environment. 1994. *Water quality guidelines No. 2: Guidelines for the management of water colour and clarity*. Ministry for the Environment, Wellington.

Ministry for the Environment. 2000. *New Zealand periphyton guideline: detecting, monitoring and managing enrichment of streams*. Ministry for the Environment, Wellington.

Ministry for the Environment and Ministry of Health. In Press. *New Zealand Guidelines for Cyanobacteria in Recreational Waters*. Ministry for the Environment, Wellington.

Perrie, A. 2007. *The state of water quality in selected rivers and streams in the Wellington region, 2003-2006*. Greater Wellington Regional Council, Publication No. GW/EMI-T-07/218. Ministry for the Environment, Wellington.

Perrie, A. 2008. *Riparian rehabilitation to improve aquatic environments in the Wellington region. Results from the riparian management pilot programme, 2002-07*. Greater Wellington Regional Council, Publication No. GW/EMI-T-08/80

Perrie, A. 2009. *Rivers state of environment monitoring programme. Results of additional physico-chemical water quality variables monitored during 2008*. Greater Wellington Regional Council, Internal Report.

Stark, J.D.; Boothroyd, I.K.G.; Harding, J.S.; Maxted, J.R.; Scarsbrook, M.R. 2001. Protocols for sampling macroinvertebrates in wadeable streams. *New Zealand Macroinvertebrate Working Group Report No. 1*. Prepared for the Ministry for the Environment, Sustainable Management Fund Project No. 5103.

Stark, J.D.; Maxted, J.R. 2007. *A user guide for the Macroinvertebrate Community Index*. Prepared for the Ministry for the Environment, Cawthron Institute Report No. 1166.

Warr, S. 2009. *On the Beaches 2008/09: Annual recreational water quality monitoring report for the Wellington region*. Greater Wellington Regional Council, Publication No. GW/EMI-T-09/130.

Appendix 1: RSoE monitoring sites

Site No.	Site Name	Site Coordinates		Substrate (hard or soft bottomed)	REC	Dominant land cover
		Easting	Northing			
RS01	Mangapouri S at Rahui Rd	2693390	6046615	Soft	WD/L/A/U	Pasture
RS02	Mangapouri S at Bennetts Rd	2690920	6049359	Soft	WD/L/A/P	Urban
RS03	Waitohu S at Forest Pk	2697610	6045404	Hard	CW/H/HS/IF	Indigenous forest
RS04	Waitohu S at Norfolk Cres	2689554	6050018	Soft	CW/L/HS/P	Pasture
RS05	Otaki R at Pukehinau	2695443	6040464	Hard	CW/H/HS/IF	Indigenous forest
RS06	Otaki R at Mouth	2688000	6047600	Hard	CW/H/HS/IF	Indigenous forest
RS07	Mangaone S at Sims Rd Br	2686260	6044122	Soft	WW/L/AL/P	Pasture
RS08	Ngarara S at Field Way	2681198	6036335	Soft	WW/L/AL/P	Urban
RS09	Waikanae R at Mangaone Walkway	2689992	6035353	Hard	CW/L/HS/IF	Indigenous forest
RS10	Waikanae R at Greenaway Rd	2681241	6034630	Hard	CW/L/HS/P	Indigenous forest
RS11	Whareroa S at Waterfall Rd	2678093	6026247	Hard	WW/L/HS/P	Pasture
RS12	Whareroa S at QE Park	2675995	6026115	Soft	WW/L/HS/P	Pasture
RS13	Horokiri S at Snodgrass	2671824	6012367	Hard	CW/L/HS/P	Pasture
RS14	Pauatahanui S at Elmwood Br	2671117	6008497	Hard	CW/L/HS/P	Pasture
RS15	Porirua S at Glenside	2663310	6000077	Hard	CW/L/HS/U	Urban
RS16	Porirua S at Wall Park (Milk Depot)	2664386	6004745	Hard	WW/L/HS/U	Urban
RS17	Makara S at Kennels	2653551	5995347	Hard	CW/L/HS/P	Pasture
RS18	Karori S at Makara Peak	2654234	5988585	Hard	CW/L/HS/U	Urban
RS19	Kaiwharawhara S at Ngaio Gorge	2659090	5992789	Hard	CW/L/HS/U	Urban
RS20	Hutt R at Te Marua Intake Site	2690091	6011874	Hard	CX/H/HS/IF	Indigenous forest
RS21	Hutt R opp. Manor Park G.C.	2676700	6004000	Hard	CW/H/HS/IF	Indigenous forest
RS22	Hutt R at Boulcott	2670879	5999200	Hard	CW/L/HS/IF	Indigenous forest
RS23	Pakuratahi R 50m d/s Farm Ck	2694627	6013394	Hard	CX/H/HS/IF	Indigenous forest
RS24	Mangaroa R at Te Marua	2688563	6010359	Hard	CW/L/HS/P	Pasture
RS25	Akatarawa R at Hutt confl.	2686203	6010900	Hard	CW/L/HS/IF	Indigenous forest
RS26	Whakatikei R at Riverstone	2682276	6008463	Hard	CW/L/HS/S	Indigenous forest
RS27	Waiwhetu S at Wainui Hill Br	2670587	5995855	Soft	WW/L/HS/U	Urban
RS28	Wainuiomata R at Manuka Track	2678265	5992349	Hard	CW/L/HS/IF	Indigenous forest
RS29	Wainuiomata R u/s of White Br	2667340	5977436	Hard	CW/L/HS/IF	Indigenous forest
RS30	Orongorongo R at Orongorongo	2668955	5974807	Hard	CW/H/HS/IF	Indigenous forest
RS31	Ruamahanga R at McLays	2728161	6047524	Hard	CX/H/HS/S	Indigenous forest
RS32	Ruamahanga R at Te Ore Ore	2735588	6024740	Hard	CW/L/SS/P	Pasture
RS33	Ruamahanga R at Gladstone Br	2731225	6012049	Hard	CW/L/SS/P	Pasture
RS34	Ruamahanga R at Pukio	2707855	5992730	Hard	CW/L/SS/P	Pasture
RS35	Mataikona Trib at Sugar Loaf Rd	2781839	6052625	Hard	CW/L/SS/P	Pasture
RS36	Taueru R at Castlehill	2762304	6045917	Soft	CW/L/SS/P	Pasture
RS37	Taueru R at Gladstone	2734164	6012538	Hard	CD/L/SS/P	Pasture
RS38	Kopuaranga R at Stewarts	2736773	6031289	Hard	CW/L/SS/P	Pasture
RS39	Whangaehu R 250m u/s confl.	2736281	6021129	Soft	CD/L/SS/P	Pasture
RS40	Waipoua R at Colombo Rd Br	2735032	6024611	Hard	CW/L/HS/P	Pasture
RS41	Waingawa R at South Rd	2730731	6022370	Hard	CX/H/HS/IF	Indigenous forest
RS42	Whareama R at Gauge	2766097	6022956	Soft	WW/L/SS/P	Pasture
RS43	Motuwaireka S at Headwaters	2762028	6012031	Hard	CW/L/HS/S	Indigenous forest
RS44	Totara S at Stronvar	2758038	6006645	Hard	CW/L/HS/EF	Exotic forest
RS45	Parkvale Trib at Lowes Res.	2728110	6020073	Hard	WD/L/A/P	Pasture
RS46	Parkvale S at Weir	2723533	6011190	Hard	WD/L/A/P	Pasture
RS47	Waiohine R at Gorge	2711907	6017714	Hard	CX/H/HS/IF	Indigenous forest
RS48	Waiohine R at Bicknells	2720633	6009820	Hard	CW/H/HS/P	Pasture
RS49	Beef Ck at Headwaters	2713981	6018117	Hard	CW/L/HS/S	Indigenous forest
RS50	Mangatarere S at SH 2	2719786	6013880	Hard	CW/L/HS/P	Pasture
RS51	Huangarua R at Ponatahi Br	2717030	5996934	Hard	CD/L/SS/P	Pasture
RS52	Tauanui R at Whakatomotomo Rd	2700674	5976234	Hard	CW/H/HS/IF	Indigenous forest
RS53	Awhea R at Tora Rd	2719980	5965013	Hard	WW/L/SS/P	Pasture
RS54	Coles Ck Trib at Lagoon Hill Rd	2724046	5976941	Hard	WW/L/SS/S	Indigenous forest
RS55	Tauherenikau R at Websters	2707103	6001661	Hard	CW/H/HS/IF	Indigenous forest
RS56	Waiorongomai R at Forest Pk	2689627	5992276	Hard	CW/H/HS/IF	Indigenous forest

Appendix 2: Water quality variables and analytical methods

Variable	Method	Detection Limit
Temperature	Field Meter - YSI 550A and YSI 556 Meters	0.01 °C
Dissolved Oxygen	Field Meter - YSI 550A and YSI 556 Meters	0.01 mg/L
Visual Clarity	Black disc	0.01 m
pH	Field Meter - YSI 550A and YSI 556 Meters	0.01 units
Conductivity	Field Meter - YSI 550A and YSI 556 Meters	0.1 uS/cm
Turbidity	Analysis using a Hach 2100N, Turbidity meter. APHA 2130 B 21 st ed. 2005	0.05 NTU
Total Organic Carbon	Catalytic oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC - TIC. APHA5310 B 21 st ed. 2005	0.5 mg/L
Ammoniacal Nitrogen	Filtered sample. Phenol/hyperchlorite colorimetry. Discrete Analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N) APHA 4500-NH ₃ F (modified from manual analysis) 21 st ed. 2005	0.001 mg/L
Nitrite	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₂ ⁻ I (proposed) 21 st ed. 2005	0.002 mg/L
Nitrate	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N	0.002 mg/L
Nitrate + Nitrite Nitrogen	Total oxidised nitrogen. Automated cadmium reduction, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (Proposed) 21 st ed. 2005	0.002 mg/L
Total Kjeldahl Nitrogen	Kjeldahl digestion, phenol/hyperchlorite colorimetry (Discrete Analysis). APHA 4500-Norg C. (modified) 4500-NH ₃ F (modified) 21 st ed. 2005	0.1 mg/L
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N	0.1 mg/L
Total Phosphorus	Total Phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 21 st ed. 2005	0.004 mg/L
Dissolved Reactive Phosphorus	Filtered Sample. Molybdenum blue colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 21 st ed. 2005	0.004 mg/L
Faecal Coliforms	APHA 21st Ed. Method 9222 D	1 cfu/100 mL
<i>E. coli</i>	APHA 21st Ed. Method 9222 G	1 cfu/100 mL

Appendix 3: Biological monitoring methods

Periphyton

Periphyton assessments were limited to the 46 RSoE sites with hard bottomed substrates.

Monthly assessment of visible streambed cover

Over the reporting period, periphyton cover was determined by estimating the percentage of visible mats (>0.3 cm thick) and filaments (>2 cm long) present on the stream or river bed within a 20 cm diameter metal ring. Ten observations were made across the width of the stream or river, along a transect. If the stream or river was not wide enough for 10 observations, five observations were made across the width of the waterway in two locations at the site. Two transects of five observations (usually to 0.6 m depth) were also used where it was not possible to wade across more than half of the river's width.

Visible streambed assessments were typically carried out in a run, as opposed to riffle or pool-type habitats.

Annual assessment of biomass

Periphyton samples for quantitative biomass assessments (chlorophyll *a* and AFDM) were collected over January to March 2007 at the time of macroinvertebrate sample collection. Sampling protocols followed quantitative method 1a (QM-1a), as outlined in the stream periphyton monitoring manual (Biggs and Kilroy 2000).

Biomass assessments were carried out on periphyton samples collected in riffle-type habitats in close proximity to macroinvertebrate sampling sites.

Macroinvertebrates

Three macroinvertebrate samples were collected from cobbly riffle areas at or adjacent to each RSoE water sampling site over January to March 2007. The timing of sampling was determined at random, although no macroinvertebrate sampling was undertaken within two weeks of any flood event. Flood events were defined as flows greater than three times the median river flow.

Samples were collected with the use of a kick-net (250 um mesh size) following Protocol C1 of the national macroinvertebrate sampling protocols (Stark et al. 2001) for the 46 RSoE sites with hard bottom substrate and Protocol C2 for the ten RSoE sites with a soft bottom substrate. All samples were processed in accordance with protocol P2 (Stark et al. 2001).

Appendix 4: Physico-chemical and bacteriological data

Table A4.1: Temperature (°C)

Site No.	Site Name	Median	Minimum	5 th percentile	95 th percentile	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	13.1	8.6	9.4	15.8	16.8	12
RS02	Mangapouri S at Bennetts Rd	14.8	8.3	9.2	17.7	19.2	12
RS03	Waitohu S at Forest Pk	10.7	5.3	6.3	15.5	16.2	11
RS04	Waitohu S at Norfolk Cres	14.4	7.4	8.2	19.2	19.4	12
RS05	Otaki R at Pukehinau	10.2	4.7	5.5	16.1	17.8	12
RS06	Otaki R at Mouth	11.4	6.5	7.0	18.1	19.0	12
RS07	Mangaone S at Sims Rd Br	13.6	8.2	8.5	17.2	18.2	12
RS08	Ngarara S at Field Way	15.1	7.1	7.2	18.8	18.9	12
RS09	Waikanae R at Mangaone Walkway	11.6	5.4	6.3	14.8	15.3	12
RS10	Waikanae R at Greenaway Rd	14.3	7.9	8.1	20.0	20.5	12
RS11	Whareroa S at Waterfall Rd	10.9	5.6	6.4	15.5	16.7	12
RS12	Whareroa S at QE Park	13.1	6.9	7.4	17.9	19.5	12
RS13	Horokiri S at Snodgrass	12.6	6.2	6.8	17.4	18.8	12
RS14	Pauatahanui S at Elmwood Br	11.9	5.4	5.8	18.1	20.1	12
RS15	Porirua S at Glenside	11.8	9.2	9.7	16.3	16.3	12
RS16	Porirua S at Wall Park (Milk Depot)	11.4	8.9	9.7	16.6	16.9	12
RS17	Makara S at Kennels	12.2	8.7	9.7	18.9	19.3	12
RS18	Karori S at Makara Peak	12.2	10.7	10.8	16.1	16.7	12
RS19	Kaiwharawhara S at Ngaio Gorge	12.9	10.2	10.7	17.6	18.7	12
RS20	Hutt R at Te Marua Intake Site	9.9	5.8	7.0	16.2	16.9	12
RS21	Hutt R opp. Manor Park G.C.	13.4	8.7	8.9	19.5	19.8	12
RS22	Hutt R at Boulcott	13.0	8.2	8.5	20.0	20.4	12
RS23	Pakuratahi R 50m d/s Farm Ck	10.8	5.8	6.9	16.8	16.9	12
RS24	Mangaroa R at Te Marua	11.5	6.8	7.7	16.4	16.7	12
RS25	Akatarawa R at Hutt confl.	10.4	5.8	7.2	16.4	16.8	12
RS26	Whakatikei R at Riverstone	10.9	5.7	7.1	16.2	16.5	12
RS27	Waiwhetu S at Wainui Hill Br	14.3	10.4	10.9	19.7	19.8	12
RS28	Wainuiomata R at Manuka Track	9.1	7.3	7.3	14.2	15.1	12
RS29	Wainuiomata R u/s of White Br	11.5	8.4	8.4	19.0	19.6	12
RS30	Orongorongo R at Orongorongo Stn	15.0	9.3	9.5	20.8	21.9	12
RS31	Ruamahanga R at McLays	9.1	3.4	5.2	13.0	13.8	12
RS32	Ruamahanga R at Te Ore Ore	12.5	7.6	8.2	20.1	21.7	12
RS33	Ruamahanga R at Gladstone Br	12.7	8.3	8.6	20.4	22.1	12
RS34	Ruamahanga R at Pukio	11.9	8.4	8.6	20.8	23.3	12
RS35	Mataikona Trib at Sugar Loaf Rd	10.3	6.2	7.6	16.3	16.5	12
RS36	Taueru R at Castlehill	10.1	5.6	7.2	15.4	15.6	12
RS37	Taueru R at Gladstone	14.1	7.8	8.7	17.5	17.9	12
RS38	Kopuaranga R at Stewarts	13.1	6.3	7.8	17.0	17.9	12
RS39	Whangaehu R 250m u/s confl.	14.4	6.6	8.0	18.6	19.2	12
RS40	Waipoua R at Colombo Rd Br	15.1	8.5	8.7	19.6	20.6	12
RS41	Waingawa R at South Rd	14.4	7.1	7.8	20.4	21.4	12
RS42	Whareama R at Gauge	13.4	7.9	8.1	21.8	22.9	12
RS43	Motuwaireka S at Headwaters	10.5	6.9	7.4	16.4	17.4	11
RS44	Totara S at Stronvar	15.2	6.6	6.6	22.9	23.6	12
RS45	Parkvale Trib at Lowes Res.	13.6	10.5	11.0	14.8	14.9	10
RS46	Parkvale S at Weir	16.9	8.7	9.6	20.8	22.1	12
RS47	Waiohine R at Gorge	9.9	5.0	5.6	14.2	15.2	12
RS48	Waiohine R at Bicknells	12.4	7.0	7.6	15.6	16.4	12
RS49	Beef Ck at Headwaters	10.6	7.0	7.0	13.4	14.2	12
RS50	Mangatarere S at SH 2	14.0	7.1	7.9	20.0	20.1	12
RS51	Huangaaru R at Ponatahi Br	15.2	8.7	8.9	21.6	21.9	12
RS52	Tauanui R at Whakatomotomo Rd	11.2	7.2	7.9	16.5	17.0	11
RS53	Awhea R at Tora Rd	16.2	8.2	8.5	24.1	24.3	12
RS54	Coles Ck Trib at Lagoon Hill Rd	12.6	7.9	8.5	17.3	18.1	9
RS55	Tauherenikau R at Websters	11.2	5.3	6.3	16.7	17.3	12
RS56	Waiorongomai R at Forest Pk	12.4	7.9	8.5	16.4	16.5	12

Table A4.2: Dissolved Oxygen (% saturation)

Site No.	Site Name	Median	Minimum	5 th percentile	95 th percentile	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	83.2	74.5	75.2	90.7	93.0	12
RS02	Mangapouri S at Bennetts Rd	66.2	47.3	49.7	82.5	86.0	12
RS03	Waitohu S at Forest Pk	98.2	86.3	87.4	110.0	112.0	11
RS04	Waitohu S at Norfolk Cres	83.1	66.6	71.0	99.2	101.0	12
RS05	Otaki R at Pukehinau	97.7	89.0	90.3	110.4	112.0	12
RS06	Otaki R at Mouth	103.0	87.7	88.3	113.6	118.0	12
RS07	Mangaone S at Sims Rd Br	80.5	51.6	54.3	88.4	92.6	12
RS08	Ngarara S at Field Way	56.5	13.3	14.8	66.0	66.9	12
RS09	Waikanae R at Mangaone Walkway	101.0	83.0	87.8	109.5	110.0	12
RS10	Waikanae R at Greenaway Rd	102.5	93.5	93.7	113.5	114.0	12
RS11	Whareroa S at Waterfall Rd	96.2	88.4	88.7	106.2	110.0	12
RS12	Whareroa S at QE Park	69.8	36.5	43.3	82.5	82.6	12
RS13	Horokiri S at Snodgrass	104.0	95.5	96.4	116.9	118.0	12
RS14	Pauatahanui S at Elmwood Br	94.1	78.2	84.4	112.1	117.0	12
RS15	Porirua S at Glenside	108.5	78.8	84.9	130.5	131.0	12
RS16	Porirua S at Wall Park (Milk Depot)	103.0	79.3	85.8	126.9	128.0	12
RS17	Makara S at Kennels	96.4	77.5	83.9	122.9	130.0	12
RS18	Karori S at Makara Peak	98.2	78.3	84.7	121.5	127.0	12
RS19	Kaiwharawhara S at Ngaio Gorge	100.7	78.8	85.9	123.8	132.0	12
RS20	Hutt R at Te Marua Intake Site	102.0	89.0	90.0	109.5	110.0	12
RS21	Hutt R opp. Manor Park G.C.	99.2	85.1	88.2	122.0	122.0	12
RS22	Hutt R at Boulcott	99.9	87.0	88.4	121.3	124.0	12
RS23	Pakuratahi R 50m d/s Farm Ck	97.3	89.1	91.0	109.4	111.0	12
RS24	Mangaroa R at Te Marua	99.4	88.7	88.8	115.5	116.0	11
RS25	Akatarawa R at Hutt confl.	99.7	90.8	92.1	107.4	109.0	12
RS26	Whakatihei R at Riverstone	101.0	89.9	92.5	110.5	111.0	12
RS27	Waiwhetu S at Wainui Hill Br	90.7	52.0	56.5	114.0	114.0	12
RS28	Wainuiomata R at Manuka Track	96.4	91.5	92.9	108.4	110.0	12
RS29	Wainuiomata R u/s of White Br	94.6	85.0	85.6	105.9	107.0	12
RS30	Orongorongo R at Orongorongo Stn	98.1	72.9	82.6	107.1	112.0	12
RS31	Ruamahanga R at McLays	95.3	79.0	79.1	107.1	112.0	12
RS32	Ruamahanga R at Te Ore Ore	94.3	74.2	77.9	114.5	115.0	12
RS33	Ruamahanga R at Gladstone Br	94.1	72.9	76.2	137.9	156.0	12
RS34	Ruamahanga R at Pukio	92.1	67.5	69.6	112.5	113.0	12
RS35	Mataikona Trib at Sugar Loaf Rd	97.0	82.4	82.5	113.5	114.0	12
RS36	Taueru R at Castlehill	95.7	82.1	83.9	114.8	117.0	12
RS37	Taueru R at Gladstone	97.3	78.7	79.0	142.1	163.0	12
RS38	Kopuaranga R at Stewarts	85.4	62.9	69.4	126.6	148.0	12
RS39	Whangaehu R 250m u/s confl.	81.2	55.8	61.0	107.5	108.0	12
RS40	Waipoua R at Colombo Rd Br	105.0	72.6	77.2	122.3	130.0	12
RS41	Waingawa R at South Rd	96.1	79.0	81.3	114.8	123.0	12
RS42	Whareama R at Gauge	89.3	68.5	71.6	101.5	104.0	12
RS43	Motuwaireka S at Headwaters	92.4	68.2	75.4	110.5	111.0	11
RS44	Totara S at Stronvar	94.6	61.2	70.9	123.8	137.0	12
RS45	Parkvale Trib at Lowes Res.	70.1	61.4	63.5	76.7	78.5	10
RS46	Parkvale S at Weir	104.0	76.1	80.2	112.6	117.0	12
RS47	Waiohine R at Gorge	100.5	76.4	80.7	105.5	106.0	12
RS48	Waiohine R at Bicknells	95.1	73.3	79.7	103.9	105.0	12
RS49	Beef Ck at Headwaters	96.8	76.5	77.1	103.9	105.0	12
RS50	Mangatarere S at SH 2	100.0	73.3	76.8	137.5	143.0	12
RS51	Huangaia R at Ponatahi Br	114.0	83.0	83.4	142.8	162.0	12
RS52	Tauanui R at Whakatomotomo Rd	96.1	77.8	80.5	105.0	109.0	11
RS53	Awhea R at Tora Rd	107.5	80.7	82.3	146.0	146.0	12
RS54	Coles Ck Trib at Lagoon Hill Rd	95.2	66.8	73.7	107.2	112.0	9
RS55	Tauherenikau R at Websters	92.5	70.8	76.8	104.0	104.0	12
RS56	Waiorongomai R at Forest Pk	94.6	70.4	77.6	105.4	107.0	12

Table A4.3: Dissolved Oxygen (mg/L)

Site No.	Site Name	Median	Minimum	5 th percentile	95 th percentile	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	8.7	7.7	7.8	9.9	10.1	12
RS02	Mangapouri S at Bennetts Rd	7.0	4.3	4.8	9.4	9.4	12
RS03	Waitohu S at Forest Pk	10.6	9.9	9.9	12.1	12.5	11
RS04	Waitohu S at Norfolk Cres	9.0	6.8	7.2	10.2	10.4	12
RS05	Otaki R at Pukehinau	10.8	9.2	9.6	12.9	14.1	12
RS06	Otaki R at Mouth	10.9	9.6	9.8	12.5	13.2	12
RS07	Mangaone S at Sims Rd Br	8.3	5.3	5.4	10.1	10.9	12
RS08	Ngarara S at Field Way	5.8	1.2	1.4	7.8	8.1	12
RS09	Waikanae R at Mangaone Walkway	11.3	9.6	9.9	11.8	11.9	12
RS10	Waikanae R at Greenaway Rd	10.7	9.2	9.3	11.5	11.7	12
RS11	Whareroa S at Waterfall Rd	11.0	8.6	9.0	12.0	12.2	12
RS12	Whareroa S at QE Park	7.8	3.3	4.1	9.2	9.5	12
RS13	Horokiri S at Snodgrass	11.6	9.1	9.5	13.0	13.3	12
RS14	Pauatahanui S at Elmwood Br	10.8	7.1	8.0	11.8	11.9	12
RS15	Porirua S at Glenside	11.6	9.1	9.6	13.1	13.4	12
RS16	Porirua S at Wall Park (Milk Depot)	11.0	9.2	9.7	13.1	13.4	12
RS17	Makara S at Kennels	10.2	8.5	8.8	12.5	13.9	12
RS18	Karori S at Makara Peak	10.5	8.6	9.1	12.1	12.3	12
RS19	Kaiwharawhara S at Ngaio Gorge	10.6	8.9	9.2	12.1	12.4	12
RS20	Hutt R at Te Marua Intake Site	11.4	9.6	9.9	12.5	12.9	12
RS21	Hutt R opp. Manor Park G.C.	10.4	8.9	9.3	11.6	11.8	12
RS22	Hutt R at Boulcott	10.4	9.2	9.4	11.6	11.6	12
RS23	Pakuratahi R 50m d/s Farm Ck	10.8	9.4	9.6	12.2	12.3	12
RS24	Mangaroa R at Te Marua	11.1	9.8	9.9	12.2	12.3	11
RS25	Akatarawa R at Hutt confl.	10.7	9.6	9.7	12.5	13.0	12
RS26	Whakatihei R at Riverstone	11.1	9.8	9.9	12.2	12.3	12
RS27	Waiwhetu S at Wainui Hill Br	9.4	4.8	5.3	11.5	11.7	12
RS28	Wainuiomata R at Manuka Track	11.2	9.5	9.6	12.5	12.6	12
RS29	Wainuiomata R u/s of White Br	10.5	7.9	7.9	11.8	11.9	12
RS30	Orongorongo R at Orongorongo Stn	9.8	6.4	7.7	11.7	12.4	12
RS31	Ruamahanga R at McLays	10.6	9.2	9.2	54.5	105.0	12
RS32	Ruamahanga R at Te Ore Ore	9.8	8.3	8.6	11.5	12.1	12
RS33	Ruamahanga R at Gladstone Br	9.6	8.2	8.2	13.0	14.5	12
RS34	Ruamahanga R at Pukio	9.3	7.3	7.7	10.9	11.0	12
RS35	Mataikona Trib at Sugar Loaf Rd	10.7	9.0	9.0	12.4	12.6	12
RS36	Taueru R at Castlehill	10.9	9.3	9.5	12.0	12.2	12
RS37	Taueru R at Gladstone	9.8	8.9	9.0	14.0	16.4	12
RS38	Kopuaranga R at Stewarts	8.6	6.7	7.3	12.9	14.1	12
RS39	Whangaehu R 250m u/s confl.	8.4	5.8	6.3	10.8	10.9	12
RS40	Waipoua R at Colombo Rd Br	10.8	7.2	8.2	12.1	12.1	12
RS41	Waingawa R at South Rd	10.0	7.9	8.1	11.7	12.2	12
RS42	Whareama R at Gauge	8.8	7.5	7.6	10.9	11.0	12
RS43	Motuwaireka S at Headwaters	11.2	6.6	7.4	12.3	12.8	11
RS44	Totara S at Stronvar	11.0	5.6	6.3	53.6	104.0	12
RS45	Parkvale Trib at Lowes Res.	7.3	6.5	6.6	8.4	8.7	10
RS46	Parkvale S at Weir	9.6	7.3	8.2	11.9	12.4	12
RS47	Waiohine R at Gorge	10.6	9.5	9.6	12.6	12.9	12
RS48	Waiohine R at Bicknells	10.0	8.9	9.1	11.9	12.3	12
RS49	Beef Ck at Headwaters	10.8	8.5	8.9	12.2	12.4	12
RS50	Mangatarere S at SH 2	10.4	8.3	8.4	12.9	13.0	12
RS51	Huangarua R at Ponatahi Br	11.0	9.2	9.3	13.7	15.5	12
RS52	Tauanui R at Whakatomotomo Rd	9.9	8.6	8.9	12.1	12.1	11
RS53	Awhea R at Tora Rd	10.2	9.1	9.1	13.3	13.6	12
RS54	Coles Ck Trib at Lagoon Hill Rd	9.5	6.6	7.1	12.4	12.8	9
RS55	Tauherenikau R at Websters	9.7	8.0	8.5	12.2	12.6	12
RS56	Waiorongomai R at Forest Pk	10.2	7.6	8.2	11.9	12.0	12

Table A4.4: pH

Site No.	Site Name	Median	Minimum	5 th percentile	95 th percentile	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	6.8	6.4	6.4	7.5	8.0	12
RS02	Mangapouri S at Bennetts Rd	6.6	6.1	6.3	7.3	7.7	12
RS03	Waitohu S at Forest Pk	6.9	6.4	6.4	7.8	8.3	11
RS04	Waitohu S at Norfolk Cres	6.7	6.0	6.2	8.2	9.2	12
RS05	Otaki R at Pukehinau	7.1	5.8	5.9	7.5	7.6	12
RS06	Otaki R at Mouth	7.1	6.4	6.5	7.7	8.1	12
RS07	Mangaone S at Sims Rd Br	6.7	5.7	5.9	7.3	7.7	12
RS08	Ngarara S at Field Way	6.7	6.4	6.4	7.3	7.7	12
RS09	Waikanae R at Mangaone Walkway	7.0	6.6	6.8	7.7	7.9	12
RS10	Waikanae R at Greenaway Rd	7.0	6.2	6.5	7.5	7.7	12
RS11	Whareroa S at Waterfall Rd	7.3	6.5	6.8	8.0	8.4	12
RS12	Whareroa S at QE Park	6.5	6.0	6.1	7.1	7.5	12
RS13	Horokiri S at Snodgrass	7.2	6.0	6.4	8.2	8.3	12
RS14	Pauatahanui S at Elmwood Br	7.3	6.0	6.4	8.4	8.4	12
RS15	Porirua S at Glenside	7.8	6.6	6.8	8.8	8.9	11
RS16	Porirua S at Wall Park (Milk Depot)	7.5	6.9	6.9	8.5	8.6	11
RS17	Makara S at Kennels	7.3	5.9	6.4	8.2	8.7	11
RS18	Karori S at Makara Peak	7.3	6.6	6.7	8.5	8.6	11
RS19	Kaiwharawhara S at Ngaio Gorge	7.6	7.0	7.0	9.1	9.1	11
RS20	Hutt R at Te Marua Intake Site	7.0	6.4	6.5	7.5	7.6	11
RS21	Hutt R opp. Manor Park G.C.	7.5	6.4	6.5	8.2	8.5	11
RS22	Hutt R at Boulcott	7.0	6.4	6.6	7.5	7.6	11
RS23	Pakuratahi R 50m d/s Farm Ck	6.5	6.3	6.3	7.2	7.4	11
RS24	Mangaroa R at Te Marua	6.8	6.1	6.3	7.3	7.4	11
RS25	Akatarawa R at Hutt confl.	7.1	6.6	6.6	7.8	8.2	11
RS26	Whakatiwai R at Riverstone	7.5	6.8	6.9	7.9	7.9	11
RS27	Waiwhetu S at Wainui Hill Br	6.8	6.5	6.5	7.1	7.3	11
RS28	Wainuiomata R at Manuka Track	6.9	6.3	6.5	7.1	7.2	11
RS29	Wainuiomata R u/s of White Br	7.0	6.6	6.6	7.5	7.7	11
RS30	Orongorongo R at Orongorongo Stn	7.5	7.1	7.1	7.9	8.1	11
RS31	Ruamahanga R at McLays	6.6	5.8	6.0	7.2	7.3	12
RS32	Ruamahanga R at Te Ore Ore	7.5	6.9	7.1	8.3	8.3	12
RS33	Ruamahanga R at Gladstone Br	7.4	6.8	6.9	8.8	9.1	12
RS34	Ruamahanga R at Pukio	7.3	6.8	6.9	8.0	8.2	12
RS35	Mataikona Trib at Sugar Loaf Rd	7.9	7.3	7.5	8.5	8.7	12
RS36	Taueru R at Castlehill	7.6	7.1	7.2	8.1	8.5	12
RS37	Taueru R at Gladstone	8.0	7.2	7.3	8.6	8.9	12
RS38	Kopuaranga R at Stewarts	7.4	7.0	7.0	7.9	8.1	12
RS39	Whangaehu R 250m u/s confl.	7.3	6.9	7.0	7.6	7.7	12
RS40	Waipoua R at Colombo Rd Br	7.4	6.3	6.5	8.1	8.3	12
RS41	Waingawa R at South Rd	7.2	6.4	6.6	7.7	7.9	12
RS42	Whareama R at Gauge	7.8	6.6	6.6	8.0	8.0	12
RS43	Motuwaireka S at Headwaters	7.4	7.1	7.1	8.0	8.1	11
RS44	Totara S at Stronvar	7.5	6.5	6.6	8.0	8.3	12
RS45	Parkvale Trib at Lowes Res.	6.4	6.1	6.1	6.8	6.9	10
RS46	Parkvale S at Weir	7.4	6.7	6.8	8.7	8.7	12
RS47	Waiohine R at Gorge	6.9	6.0	6.2	7.4	7.5	12
RS48	Waiohine R at Bicknells	6.5	6.1	6.1	7.6	8.2	12
RS49	Beef Ck at Headwaters	7.2	6.4	6.7	7.6	7.8	12
RS50	Mangatarere S at SH 2	6.8	6.3	6.3	7.9	9.0	12
RS51	Huangaaru R at Ponatahi Br	8.0	6.0	6.9	8.4	8.6	11
RS52	Tauanui R at Whakatomotomo Rd	7.1	5.6	6.1	7.5	7.7	10
RS53	Awhea R at Tora Rd	8.2	6.0	6.8	8.4	8.4	11
RS54	Coles Ck Trib at Lagoon Hill Rd	7.6	7.3	7.3	8.1	8.2	9
RS55	Tauherenikau R at Websters	6.8	6.4	6.5	7.4	7.5	12
RS56	Waiorongomai R at Forest Pk	6.7	5.7	6.1	7.5	7.5	11

Table A4.5: Visual Clarity (m)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	0.31	0.05	0.50	12
RS02	Mangapouri S at Bennetts Rd	0.38	0.15	0.63	12
RS03	Waitohu S at Forest Pk	2.44	0.26	3.70	11
RS04	Waitohu S at Norfolk Cres	0.48	0.17	0.61	12
RS05	Otaki R at Pukehinau	2.54	0.34	6.38	12
RS06	Otaki R at Mouth	2.31	0.26	4.56	12
RS07	Mangaone S at Sims Rd Br	0.38	0.21	1.42	11
RS08	Ngarara S at Field Way	0.39	0.06	0.42	12
RS09	Waikanae R at Mangaone Walkway	2.51	1.40	4.85	12
RS10	Waikanae R at Greenaway Rd	2.01	0.34	4.92	12
RS11	Whareroa S at Waterfall Rd	0.52	0.09	0.62	12
RS12	Whareroa S at QE Park	0.38	0.21	0.50	12
RS13	Horokiri S at Snodgrass	1.58	0.26	2.10	12
RS14	Pauatahanui S at Elmwood Br	1.48	0.05	2.15	12
RS15	Porirua S at Glenside	1.53	0.13	3.09	12
RS16	Porirua S at Wall Park (Milk Depot)	1.68	0.10	4.35	12
RS17	Makara S at Kennels	1.02	0.22	1.78	12
RS18	Karori S at Makara Peak	2.45	0.13	4.35	12
RS19	Kaiwharawhara S at Ngaio Gorge	1.58	0.20	3.31	12
RS20	Hutt R at Te Marua Intake Site	3.27	0.55	4.71	12
RS21	Hutt R opp. Manor Park G.C.	1.72	0.11	4.06	12
RS22	Hutt R at Boulcott	1.72	0.11	3.75	12
RS23	Pakuratahi R 50m d/s Farm Ck	3.48	0.21	4.51	12
RS24	Mangaroa R at Te Marua	1.08	0.13	1.97	12
RS25	Akatarawa R at Hutt confl.	3.23	0.42	4.90	12
RS26	Whakatikei R at Riverstone	2.52	0.34	4.28	12
RS27	Waiwhetu S at Wainui Hill Br	0.69	0.15	1.57	12
RS28	Wainuiomata R at Manuka Track	2.58	1.70	4.09	12
RS29	Wainuiomata R u/s of White Br	1.30	0.13	1.75	12
RS30	Orongorongo R at Orongorongo Stn	0.32	0.06	3.98	12
RS31	Ruamahanga R at McLays	1.67	0.25	6.57	12
RS32	Ruamahanga R at Te Ore Ore	0.66	0.05	4.81	12
RS33	Ruamahanga R at Gladstone Br	0.69	0.05	3.06	12
RS34	Ruamahanga R at Pukio	0.19	0.04	3.59	12
RS35	Mataikona Trib at Sugar Loaf Rd	1.74	0.16	2.70	12
RS36	Taueru R at Castlehill	0.71	0.20	1.99	12
RS37	Taueru R at Gladstone	0.31	0.05	1.56	12
RS38	Kopuaranga R at Stewarts	1.30	0.05	2.62	12
RS39	Whangaehu R 250m u/s confl.	1.19	0.04	2.91	12
RS40	Waipoua R at Colombo Rd Br	2.94	0.15	4.62	12
RS41	Waingawa R at South Rd	1.24	0.07	5.80	12
RS42	Whareama R at Gauge	0.51	0.05	1.70	9
RS43	Motuwaireka S at Headwaters	2.50	0.52	3.32	11
RS44	Totara S at Stronvar	2.31	0.04	4.20	12
RS45	Parkvale Trib at Lowes Res.	1.58	1.51	3.70	9
RS46	Parkvale S at Weir	0.44	0.24	1.90	12
RS47	Waiohine R at Gorge	2.08	0.05	8.72	12
RS48	Waiohine R at Bicknells	1.05	0.03	3.08	12
RS49	Beef Ck at Headwaters	2.10	0.51	3.92	12
RS50	Mangatarere S at SH 2	2.05	0.18	4.32	11
RS51	Huangaaru R at Ponatahi Br	1.76	0.04	2.60	12
RS52	Tauanui R at Whakatomotomo Rd	2.82	0.06	4.65	11
RS53	Awhea R at Tora Rd	1.01	0.02	1.84	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.73	0.26	1.74	9
RS55	Tauherenikau R at Websters	1.55	0.15	4.60	12
RS56	Waiorongomai R at Forest Pk	1.76	0.22	5.10	12

Table A4.6: Turbidity (NTU)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	5.5	3.3	170	12
RS02	Mangapouri S at Bennetts Rd	3.9	2.0	18.0	12
RS03	Waitohu S at Forest Pk	0.7	0.4	15.0	11
RS04	Waitohu S at Norfolk Cres	4.4	2.0	12.0	12
RS05	Otaki R at Pukehinau	1.2	0.3	9.1	12
RS06	Otaki R at Mouth	0.7	0.6	12.0	12
RS07	Mangaone S at Sims Rd Br	4.9	2.7	20.0	12
RS08	Ngarara S at Field Way	9.4	0.3	54.0	12
RS09	Waikanae R at Mangaone Walkway	0.6	0.2	1.1	12
RS10	Waikanae R at Greenaway Rd	1.2	0.4	12.0	12
RS11	Whareroa S at Waterfall Rd	6.7	2.9	41.0	12
RS12	Whareroa S at QE Park	7.1	5.0	16.0	12
RS13	Horokiri S at Snodgrass	1.4	0.5	18.0	12
RS14	Pauatahanui S at Elmwood Br	2.4	1.1	46.0	12
RS15	Porirua S at Glenside	2.6	0.7	37.0	12
RS16	Porirua S at Wall Park (Milk Depot)	2.8	1.1	69.0	12
RS17	Makara S at Kennels	3.5	2.0	13.0	12
RS18	Karori S at Makara Peak	1.3	0.8	36.0	12
RS19	Kaiwharawhara S at Ngaio Gorge	1.4	0.7	28.0	12
RS20	Hutt R at Te Marua Intake Site	0.9	0.3	18.0	12
RS21	Hutt R opp. Manor Park G.C.	2.2	0.6	48.0	12
RS22	Hutt R at Boulcott	1.6	0.4	57.0	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.7	0.3	5.9	12
RS24	Mangaroa R at Te Marua	1.6	0.4	44.0	12
RS25	Akatarawa R at Hutt confl.	0.5	0.2	5.4	12
RS26	Whakatiwai R at Riverstone	1.2	0.3	12.0	12
RS27	Waiwhetu S at Wainui Hill Br	4.2	2.2	36.0	12
RS28	Wainuiomata R at Manuka Track	0.8	0.7	1.8	12
RS29	Wainuiomata R u/s of White Br	2.5	1.5	38.0	12
RS30	Orongorongo R at Orongorongo Stn	17.0	0.6	150	12
RS31	Ruamahanga R at McLays	1.9	0.2	30.0	12
RS32	Ruamahanga R at Te Ore Ore	6.4	0.4	210	12
RS33	Ruamahanga R at Gladstone Br	6.4	0.4	180	12
RS34	Ruamahanga R at Pukio	17.5	0.7	420	12
RS35	Mataikona Trib at Sugar Loaf Rd	1.3	0.4	21.0	12
RS36	Taueru R at Castlehill	3.8	1.6	15.0	12
RS37	Taueru R at Gladstone	9.6	0.8	92.0	12
RS38	Kopuaranga R at Stewarts	2.0	0.6	210	12
RS39	Whangaehu R 250m u/s confl.	4.4	1.0	470	12
RS40	Waipoua R at Colombo Rd Br	0.6	0.2	41.0	12
RS41	Waingawa R at South Rd	2.5	0.4	65.0	12
RS42	Whareama R at Gauge	5.1	0.9	1,100	12
RS43	Motuwaireka S at Headwaters	0.4	0.2	7.2	11
RS44	Totara S at Stronvar	0.9	0.2	320	12
RS45	Parkvale Trib at Lowes Res.	0.6	0.4	1.1	10
RS46	Parkvale S at Weir	4.4	1.3	36.0	12
RS47	Waiohine R at Gorge	1.3	0.2	58.0	12
RS48	Waiohine R at Bicknells	2.6	0.9	65.0	12
RS49	Beef Ck at Headwaters	1.2	0.3	3.0	12
RS50	Mangatarere S at SH 2	1.6	0.5	260	12
RS51	Huangarua R at Ponatahi Br	1.6	0.6	170	12
RS52	Tauanui R at Whakatomotomo Rd	1.3	0.2	51.0	11
RS53	Awhea R at Tora Rd	4.6	0.6	610	12
RS54	Coles Ck Trib at Lagoon Hill Rd	3.0	0.8	12.0	9
RS55	Tauherenikau R at Websters	3.1	0.5	29.0	12
RS56	Waiorongomai R at Forest Pk	3.2	0.2	11.0	12

Table A4.7: Conductivity ($\mu\text{S}/\text{cm}$)

Site No.	Site Name	Median	Minimum	5 th percentile	95 th percentile	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	206	163	181	218	220	12
RS02	Mangapouri S at Bennetts Rd	212	193	200	238	246	12
RS03	Waitohu S at Forest Pk	85	74	76	94	98	11
RS04	Waitohu S at Norfolk Cres	149	130	133	204	205	12
RS05	Otaki R at Pukehinau	66	51	53	77	80	12
RS06	Otaki R at Mouth	69	53	55	75	76	12
RS07	Mangaone S at Sims Rd Br	203	177	187	221	230	12
RS08	Ngarara S at Field Way	294	226	249	446	458	12
RS09	Waikanae R at Mangaone Walkway	84	59	62	90	92	12
RS10	Waikanae R at Greenaway Rd	101	75	85	109	110	12
RS11	Whareroa S at Waterfall Rd	232	146	174	259	262	12
RS12	Whareroa S at QE Park	261	189	203	292	299	12
RS13	Horokiri S at Snodgrass	183	133	143	196	201	12
RS14	Pauatahanui S at Elmwood Br	171	134	142	186	190	12
RS15	Porirua S at Glenside	250	77	139	266	273	11
RS16	Porirua S at Wall Park (Milk Depot)	257	160	172	267	270	11
RS17	Makara S at Kennels	268	240	247	291	299	11
RS18	Karori S at Makara Peak	222	98	116	231	232	11
RS19	Kaiwharawhara S at Ngaio Gorge	290	157	191	309	317	11
RS20	Hutt R at Te Marua Intake Site	67	56	57	79	82	11
RS21	Hutt R opp. Manor Park G.C.	104	88	89	123	127	11
RS22	Hutt R at Boulcott	87	77	78	103	105	11
RS23	Pakuratahi R 50m d/s Farm Ck	79	56	63	87	89	11
RS24	Mangaroa R at Te Marua	104	92	93	109	112	11
RS25	Akatarawa R at Hutt confl.	80	67	72	88	89	11
RS26	Whakatikei R at Riverstone	108	90	98	117	120	11
RS27	Waiwhetu S at Wainui Hill Br	234	201	213	1,493	2,713	11
RS28	Wainuiomata R at Manuka Track	103	76	85	114	117	11
RS29	Wainuiomata R u/s of White Br	138	111	118	152	155	11
RS30	Orongorongo R at Orongorongo	126	112	115	159	164	11
RS31	Ruamahanga R at McLays	42	28	31	59	61	12
RS32	Ruamahanga R at Te Ore Ore	101	51	61	163	167	11
RS33	Ruamahanga R at Gladstone Br	104	59	68	134	144	11
RS34	Ruamahanga R at Pukio	118	65	68	173	203	11
RS35	Mataikona Trib at Sugar Loaf Rd	398	292	293	506	530	12
RS36	Taueru R at Castlehill	234	130	148	282	292	12
RS37	Taueru R at Gladstone	417	281	281	454	467	12
RS38	Kopuaranga R at Stewarts	286	150	151	357	367	12
RS39	Whangaehu R 250m u/s confl.	267	195	199	360	369	11
RS40	Waipoua R at Colombo Rd Br	108	73	84	129	130	12
RS41	Waingawa R at South Rd	60	45	46	68	68	12
RS42	Whareama R at Gauge	541	278	321	633	669	12
RS43	Motuwaireka S at Headwaters	327	194	208	392	394	11
RS44	Totara S at Stronvar	347	144	181	444	450	12
RS45	Parkvale Trib at Lowes Res.	191	154	161	207	210	10
RS46	Parkvale S at Weir	165	127	137	206	219	12
RS47	Waiohine R at Gorge	46	31	34	63	64	12
RS48	Waiohine R at Bicknells	60	45	45	87	91	12
RS49	Beef Ck at Headwaters	84	62	68	111	115	12
RS50	Mangatarere S at SH 2	127	86	90	159	175	12
RS51	Huangarua R at Ponatahi Br	407	221	229	447	456	11
RS52	Tauanui R at Whakatomotomo Rd	147	111	112	177	180	10
RS53	Awhea R at Tora Rd	439	274	288	473	474	11
RS54	Coles Ck Trib at Lagoon Hill Rd	859	291	323	1,140	1,196	9
RS55	Tauherenikau R at Websters	62	47	48	80	81	12
RS56	Waiorongomai R at Forest Pk	110	96	96	136	140	11

Table A4.8: Total Organic Carbon (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	n
RS01	Mangapouri S at Rahui Rd	4.8	2.4	38.0	12
RS02	Mangapouri S at Bennetts Rd	5.3	3.9	11.0	12
RS03	Waitohu S at Forest Pk	1.8	1.0	4.5	11
RS04	Waitohu S at Norfolk Cres	4.0	2.7	5.8	12
RS05	Otaki R at Pukehinau	0.9	<0.5	2.7	12
RS06	Otaki R at Mouth	0.8	0.6	2.9	12
RS07	Mangaone S at Sims Rd Br	4.6	2.0	7.7	12
RS08	Ngarara S at Field Way	19.0	0.7	30.0	12
RS09	Waikanae R at Mangaone Walkway	1.1	0.5	1.7	12
RS10	Waikanae R at Greenaway Rd	1.2	0.5	12.0	12
RS11	Whareroa S at Waterfall Rd	3.3	2.5	5.3	12
RS12	Whareroa S at QE Park	14.0	7.5	21.0	12
RS13	Horokiri S at Snodgrass	1.7	1.2	5.2	12
RS14	Pauatahanui S at Elmwood Br	3.3	1.9	9.1	12
RS15	Porirua S at Glenside	2.9	1.0	4.6	12
RS16	Porirua S at Wall Park (Milk Depot)	2.8	0.8	7.2	12
RS17	Makara S at Kennels	4.1	3.5	4.8	12
RS18	Karori S at Makara Peak	1.9	1.4	5.0	12
RS19	Kaiwharawhara S at Ngaio Gorge	2.4	0.5	6.5	12
RS20	Hutt R at Te Marua Intake Site	2.0	1.1	5.7	12
RS21	Hutt R opp. Manor Park G.C.	2.7	1.4	7.4	12
RS22	Hutt R at Boulcott	2.1	1.2	5.6	12
RS23	Pakuratahi R 50m d/s Farm Ck	2.0	0.8	5.8	12
RS24	Mangaroa R at Te Marua	4.8	2.0	9.2	12
RS25	Akatarawa R at Hutt confl.	1.6	1.1	4.9	12
RS26	Whakatikei R at Riverstone	1.7	1.1	4.0	12
RS27	Waiwhetu S at Wainui Hill Br	3.6	2.1	9.8	12
RS28	Wainuiomata R at Manuka Track	1.8	1.2	2.1	12
RS29	Wainuiomata R u/s of White Br	1.8	1.3	2.8	12
RS30	Orongorongo R at Orongorongo Stn	1.5	<0.5	3.4	12
RS31	Ruamahanga R at McLays	1.8	0.6	4.1	12
RS32	Ruamahanga R at Te Ore Ore	3.1	<0.5	6.0	12
RS33	Ruamahanga R at Gladstone Br	2.8	1.2	6.9	12
RS34	Ruamahanga R at Pukio	3.6	<0.5	9.3	12
RS35	Mataikona Trib at Sugar Loaf Rd	3.3	1.8	4.3	12
RS36	Taueru R at Castlehill	5.6	3.2	7.4	12
RS37	Taueru R at Gladstone	4.6	2.1	13.0	12
RS38	Kopuaranga R at Stewarts	4.0	1.7	11.0	12
RS39	Whangaehu R 250m u/s confl.	5.8	2.8	18.0	12
RS40	Waipoua R at Colombo Rd Br	1.7	<0.5	7.2	12
RS41	Waingawa R at South Rd	1.2	<0.5	3.9	12
RS42	Whareama R at Gauge	7.1	3.9	19.0	12
RS43	Motuwaireka S at Headwaters	2.1	<0.5	5.5	11
RS44	Totara S at Stronvar	3.1	<0.5	13.0	12
RS45	Parkvale Trib at Lowes Res.	3.7	1.2	6.4	10
RS46	Parkvale S at Weir	6.4	3.7	11.0	12
RS47	Waiohine R at Gorge	1.5	0.5	5.1	12
RS48	Waiohine R at Bicknells	1.5	0.8	3.1	12
RS49	Beef Ck at Headwaters	1.6	1.0	3.1	12
RS50	Mangatarere S at SH 2	1.9	1.5	4.0	12
RS51	Huangarua R at Ponatahi Br	4.1	1.7	7.7	12
RS52	Tauanui R at Whakatomotomo Rd	2.7	0.9	4.4	11
RS53	Awhea R at Tora Rd	5.3	1.6	8.6	12
RS54	Coles Ck Trib at Lagoon Hill Rd	5.9	3.6	8.3	9
RS55	Tauherenikau R at Websters	1.7	0.7	4.9	12
RS56	Waiorongomai R at Forest Pk	2.2	1.3	3.9	12

Table A4.9: Ammoniacal Nitrogen (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	0.015	<0.010	0.021	12
RS02	Mangapouri S at Bennetts Rd	0.028	<0.010	0.062	12
RS03	Waitohu S at Forest Pk	0.005	<0.010	0.012	11
RS04	Waitohu S at Norfolk Cres	0.053	0.011	0.078	12
RS05	Otaki R at Pukehinau	0.005	<0.010	0.028	12
RS06	Otaki R at Mouth	0.005	<0.010	0.013	12
RS07	Mangaone S at Sims Rd Br	0.076	<0.010	0.140	12
RS08	Ngarara S at Field Way	0.018	<0.010	0.080	12
RS09	Waikanae R at Mangaone Walkway	0.005	<0.010	0.012	12
RS10	Waikanae R at Greenaway Rd	0.005	<0.010	0.050	12
RS11	Whareroa S at Waterfall Rd	0.005	<0.010	0.021	12
RS12	Whareroa S at QE Park	0.103	<0.010	0.220	12
RS13	Horokiri S at Snodgrass	0.005	<0.010	0.018	12
RS14	Pauatahanui S at Elmwood Br	0.014	<0.010	0.060	12
RS15	Porirua S at Glenside	0.005	<0.010	0.057	12
RS16	Porirua S at Wall Park (Milk Depot)	0.018	<0.010	0.160	12
RS17	Makara S at Kennels	0.016	<0.010	0.023	12
RS18	Karori S at Makara Peak	0.015	<0.010	0.047	12
RS19	Kaiwharawhara S at Ngaio Gorge	0.008	<0.010	0.075	12
RS20	Hutt R at Te Marua Intake Site	0.005	<0.010	0.014	12
RS21	Hutt R opp. Manor Park G.C.	0.005	<0.010	0.034	12
RS22	Hutt R at Boulcott	0.005	<0.010	0.011	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.005	<0.010	0.016	12
RS24	Mangaroa R at Te Marua	0.005	<0.010	0.029	12
RS25	Akatarawa R at Hutt confl.	0.005	<0.010	0.087	12
RS26	Whakatiwai R at Riverstone	0.005	<0.010	0.098	12
RS27	Waiwhetu S at Wainui Hill Br	0.078	<0.010	0.500	12
RS28	Wainuiomata R at Manuka Track	0.005	<0.010	0.014	12
RS29	Wainuiomata R u/s of White Br	0.014	<0.010	0.046	12
RS30	Orongorongo R at Orongorongo Stn	0.005	<0.010	0.014	12
RS31	Ruamahanga R at McLays	0.005	<0.010	0.024	12
RS32	Ruamahanga R at Te Ore Ore	0.005	<0.010	0.024	12
RS33	Ruamahanga R at Gladstone Br	0.018	<0.010	0.043	12
RS34	Ruamahanga R at Pukio	0.005	<0.010	0.038	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.005	<0.010	0.022	12
RS36	Taueru R at Castlehill	0.005	<0.010	0.026	12
RS37	Taueru R at Gladstone	0.015	<0.010	0.100	12
RS38	Kopuaranga R at Stewarts	0.005	<0.010	0.034	12
RS39	Whangaehu R 250m u/s confl.	0.005	<0.010	0.019	12
RS40	Waipoua R at Colombo Rd Br	0.005	<0.010	0.023	12
RS41	Waingawa R at South Rd	0.005	<0.010	0.016	12
RS42	Whareama R at Gauge	0.005	<0.010	0.110	12
RS43	Motuwaireka S at Headwaters	0.005	<0.010	0.015	11
RS44	Totara S at Stronvar	0.005	<0.010	0.037	12
RS45	Parkvale Trib at Lowes Res.	0.005	<0.010	0.034	10
RS46	Parkvale S at Weir	0.013	<0.010	0.067	12
RS47	Waiohine R at Gorge	0.005	<0.010	0.024	12
RS48	Waiohine R at Bicknells	0.005	<0.010	0.042	12
RS49	Beef Ck at Headwaters	0.005	<0.010	0.010	12
RS50	Mangatarere S at SH 2	0.094	0.018	0.220	12
RS51	Huangaaru R at Ponatahi Br	0.005	<0.010	0.030	12
RS52	Tauanui R at Whakatomotomo Rd	0.005	<0.010	0.005	11
RS53	Awhea R at Tora Rd	0.005	<0.010	0.018	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.005	<0.010	0.018	9
RS55	Tauherenikau R at Websters	0.005	<0.010	0.010	12
RS56	Waiorongomai R at Forest Pk	0.005	<0.010	0.005	12

Table A4.10: Nitrite-Nitrate Nitrogen (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	7.050	1.600	8.300	12
RS02	Mangapouri S at Bennetts Rd	2.300	1.200	3.900	12
RS03	Waitohu S at Forest Pk	0.031	0.017	0.068	11
RS04	Waitohu S at Norfolk Cres	0.550	0.290	1.300	12
RS05	Otaki R at Pukehinau	0.040	<0.002	2.800	12
RS06	Otaki R at Mouth	0.057	<0.002	0.140	12
RS07	Mangaone S at Sims Rd Br	2.050	1.500	3.900	12
RS08	Ngarara S at Field Way	0.175	0.002	8.800	12
RS09	Waikanae R at Mangaone Walkway	0.089	0.043	0.160	12
RS10	Waikanae R at Greenaway Rd	0.210	0.037	0.860	12
RS11	Whareroa S at Waterfall Rd	0.365	0.130	0.850	12
RS12	Whareroa S at QE Park	0.325	0.087	1.600	12
RS13	Horokiri S at Snodgrass	0.400	0.047	1.100	12
RS14	Pauatahanui S at Elmwood Br	0.255	<0.002	0.900	12
RS15	Porirua S at Glenside	0.880	0.300	2.200	12
RS16	Porirua S at Wall Park (Milk Depot)	0.875	0.330	2.000	12
RS17	Makara S at Kennels	0.274	0.014	1.400	12
RS18	Karori S at Makara Peak	1.200	0.350	1.500	12
RS19	Kaiwharawhara S at Ngaio Gorge	1.150	<0.002	1.400	12
RS20	Hutt R at Te Marua Intake Site	0.088	0.040	0.150	12
RS21	Hutt R opp. Manor Park G.C.	0.270	0.140	0.460	12
RS22	Hutt R at Boulcott	0.185	0.120	1.500	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.255	0.100	0.410	12
RS24	Mangaroa R at Te Marua	0.540	0.270	0.800	12
RS25	Akatarawa R at Hutt confl.	0.083	0.003	0.220	12
RS26	Whakatiwai R at Riverstone	0.076	0.017	0.310	12
RS27	Waiwhetu S at Wainui Hill Br	0.525	0.170	1.100	12
RS28	Wainuiomata R at Manuka Track	0.066	0.008	0.230	12
RS29	Wainuiomata R u/s of White Br	0.245	0.003	0.610	12
RS30	Orongorongo R at Orongorongo Stn	0.042	0.008	0.075	12
RS31	Ruamahanga R at McLays	0.021	0.002	0.041	12
RS32	Ruamahanga R at Te Ore Ore	0.250	0.014	0.750	12
RS33	Ruamahanga R at Gladstone Br	0.340	0.046	0.830	12
RS34	Ruamahanga R at Pukio	0.255	0.081	0.780	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.005	<0.002	0.140	12
RS36	Taueru R at Castlehill	0.077	0.005	0.420	12
RS37	Taueru R at Gladstone	1.060	0.440	1.900	12
RS38	Kopuaranga R at Stewarts	0.965	0.660	1.100	12
RS39	Whangaehu R 250m u/s confl.	0.850	0.380	2.900	12
RS40	Waipoua R at Colombo Rd Br	1.300	0.210	2.600	12
RS41	Waingawa R at South Rd	0.063	0.016	0.400	12
RS42	Whareama R at Gauge	0.005	<0.002	0.690	12
RS43	Motuwaireka S at Headwaters	0.092	0.020	0.420	11
RS44	Totara S at Stronvar	0.010	<0.002	0.200	12
RS45	Parkvale Trib at Lowes Res.	4.600	3.400	5.800	10
RS46	Parkvale S at Weir	1.700	0.027	4.300	12
RS47	Waiohine R at Gorge	0.027	<0.002	0.038	12
RS48	Waiohine R at Bicknells	0.225	0.018	1.100	12
RS49	Beef Ck at Headwaters	0.023	<0.002	0.046	12
RS50	Mangatarere S at SH 2	1.550	0.850	2.200	12
RS51	Huangarua R at Ponatahi Br	0.325	0.002	0.600	12
RS52	Tauanui R at Whakatomotomo Rd	0.012	0.004	0.042	11
RS53	Awhea R at Tora Rd	0.021	<0.002	0.260	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.006	<0.002	0.018	9
RS55	Tauherenikau R at Websters	0.034	0.003	0.330	12
RS56	Waiorongomai R at Forest Pk	0.017	<0.002	0.035	12

Table A4.11: Total Kjeldahl Nitrogen (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	0.51	0.39	2.80	12
RS02	Mangapouri S at Bennetts Rd	0.55	0.26	0.97	12
RS03	Waitohu S at Forest Pk	0.05	<0.10	0.44	11
RS04	Waitohu S at Norfolk Cres	0.38	0.27	0.44	12
RS05	Otaki R at Pukehinau	0.05	<0.10	0.23	12
RS06	Otaki R at Mouth	0.05	<0.10	0.11	12
RS07	Mangaone S at Sims Rd Br	0.51	0.37	0.78	12
RS08	Ngarara S at Field Way	0.92	0.14	1.40	12
RS09	Waikanae R at Mangaone Walkway	0.05	<0.10	0.05	12
RS10	Waikanae R at Greenaway Rd	0.05	<0.10	0.75	12
RS11	Whareroa S at Waterfall Rd	0.19	0.10	0.39	12
RS12	Whareroa S at QE Park	0.67	0.46	0.93	12
RS13	Horokiri S at Snodgrass	0.16	<0.10	0.39	12
RS14	Pauatahanui S at Elmwood Br	0.22	<0.10	0.81	12
RS15	Porirua S at Glenside	0.24	0.11	0.51	12
RS16	Porirua S at Wall Park (Milk Depot)	0.27	0.19	1.10	12
RS17	Makara S at Kennels	0.30	0.21	0.55	12
RS18	Karori S at Makara Peak	0.22	0.16	0.44	12
RS19	Kaiwharawhara S at Ngaio Gorge	0.26	0.17	0.52	12
RS20	Hutt R at Te Marua Intake Site	0.05	<0.10	0.15	12
RS21	Hutt R opp. Manor Park G.C.	0.11	<0.10	0.37	12
RS22	Hutt R at Boulcott	0.05	<0.10	0.25	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.05	<0.10	0.28	12
RS24	Mangaroa R at Te Marua	0.18	0.12	0.54	12
RS25	Akatarawa R at Hutt confl.	0.05	<0.10	0.12	12
RS26	Whakatiwai R at Riverstone	0.05	<0.10	0.17	12
RS27	Waiwhetu S at Wainui Hill Br	0.29	0.14	0.83	12
RS28	Wainuiomata R at Manuka Track	0.05	<0.10	0.05	12
RS29	Wainuiomata R u/s of White Br	0.14	<0.10	0.74	12
RS30	Orongorongo R at Orongorongo Stn	0.05	<0.10	0.18	12
RS31	Ruamahanga R at McLays	0.05	<0.10	0.14	12
RS32	Ruamahanga R at Te Ore Ore	0.15	<0.10	0.72	12
RS33	Ruamahanga R at Gladstone Br	0.19	<0.10	0.78	12
RS34	Ruamahanga R at Pukio	0.19	<0.10	1.60	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.12	<0.10	0.22	12
RS36	Taueru R at Castlehill	0.29	<0.10	0.44	12
RS37	Taueru R at Gladstone	0.39	0.25	0.74	12
RS38	Kopuaranga R at Stewarts	0.31	0.17	1.60	12
RS39	Whangaehu R 250m u/s confl.	0.46	0.18	2.20	12
RS40	Waipoua R at Colombo Rd Br	0.20	<0.10	0.62	12
RS41	Waingawa R at South Rd	0.05	<0.10	0.24	12
RS42	Whareama R at Gauge	0.40	0.32	2.00	12
RS43	Motuwaireka S at Headwaters	0.05	<0.10	0.05	11
RS44	Totara S at Stronvar	0.10	<0.10	0.91	12
RS45	Parkvale Trib at Lowes Res.	0.42	0.26	0.61	10
RS46	Parkvale S at Weir	0.59	0.32	1.70	12
RS47	Waiohine R at Gorge	0.05	<0.10	0.19	12
RS48	Waiohine R at Bicknells	0.17	<0.10	0.33	12
RS49	Beef Ck at Headwaters	0.05	<0.10	0.13	12
RS50	Mangatarere S at SH 2	0.40	0.23	0.67	12
RS51	Huangarua R at Ponatahi Br	0.23	<0.10	0.69	12
RS52	Tauanui R at Whakatomotomo Rd	0.05	<0.10	0.15	11
RS53	Awhea R at Tora Rd	0.22	0.12	0.74	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.20	0.14	0.24	9
RS55	Tauherenikau R at Websters	0.05	<0.10	0.16	12
RS56	Waiorongomai R at Forest Pk	0.05	<0.10	0.15	12

Table A4.12: Total Nitrogen (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	7.55	4.40	9.60	12
RS02	Mangapouri S at Bennetts Rd	2.95	1.70	4.70	12
RS03	Waitohu S at Forest Pk	0.06	<0.11	0.46	11
RS04	Waitohu S at Norfolk Cres	0.87	0.58	1.70	12
RS05	Otaki R at Pukehinau	0.06	<0.11	2.80	12
RS06	Otaki R at Mouth	0.08	<0.11	0.20	12
RS07	Mangaone S at Sims Rd Br	2.45	2.20	4.50	12
RS08	Ngarara S at Field Way	1.09	0.45	9.90	12
RS09	Waikanae R at Mangaone Walkway	0.14	0.10	0.24	12
RS10	Waikanae R at Greenaway Rd	0.24	0.12	1.20	12
RS11	Whareroa S at Waterfall Rd	0.49	0.29	1.10	12
RS12	Whareroa S at QE Park	1.01	0.56	2.40	12
RS13	Horokiri S at Snodgrass	0.56	0.20	1.30	12
RS14	Pauatahanui S at Elmwood Br	0.59	0.20	1.10	12
RS15	Porirua S at Glenside	1.09	0.60	2.40	12
RS16	Porirua S at Wall Park (Milk Depot)	1.35	0.56	2.40	12
RS17	Makara S at Kennels	0.57	0.24	1.80	12
RS18	Karori S at Makara Peak	1.45	0.73	1.70	12
RS19	Kaiwharawhara S at Ngaio Gorge	1.40	0.26	1.60	12
RS20	Hutt R at Te Marua Intake Site	0.14	0.11	0.26	12
RS21	Hutt R opp. Manor Park G.C.	0.36	0.21	0.83	12
RS22	Hutt R at Boulcott	0.26	0.20	1.50	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.35	0.21	0.58	12
RS24	Mangaroa R at Te Marua	0.72	0.45	1.30	12
RS25	Akatarawa R at Hutt confl.	0.14	<0.11	0.34	12
RS26	Whakatikei R at Riverstone	0.18	<0.11	0.48	12
RS27	Waiwhetu S at Wainui Hill Br	0.90	0.34	1.50	12
RS28	Wainuiomata R at Manuka Track	0.12	<0.11	0.27	12
RS29	Wainuiomata R u/s of White Br	0.39	<0.11	1.40	12
RS30	Orongorongo R at Orongorongo Stn	0.06	<0.11	0.25	12
RS31	Ruamahanga R at McLays	0.06	<0.11	0.16	12
RS32	Ruamahanga R at Te Ore Ore	0.39	0.21	1.20	12
RS33	Ruamahanga R at Gladstone Br	0.63	0.15	1.30	12
RS34	Ruamahanga R at Pukio	0.51	0.16	2.10	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.17	<0.11	0.34	12
RS36	Taueru R at Castlehill	0.38	0.13	0.85	12
RS37	Taueru R at Gladstone	1.45	1.00	2.20	12
RS38	Kopuaranga R at Stewarts	1.35	0.89	2.30	12
RS39	Whangaehu R 250m u/s confl.	1.65	0.67	3.40	12
RS40	Waipoua R at Colombo Rd Br	1.70	0.46	3.00	12
RS41	Waingawa R at South Rd	0.13	<0.11	0.44	12
RS42	Whareama R at Gauge	0.41	0.34	2.30	12
RS43	Motuwaireka S at Headwaters	0.17	<0.11	0.48	11
RS44	Totara S at Stronvar	0.15	<0.11	1.00	12
RS45	Parkvale Trib at Lowes Res.	4.90	4.00	6.10	10
RS46	Parkvale S at Weir	2.45	0.45	5.40	12
RS47	Waiohine R at Gorge	0.06	<0.11	0.22	12
RS48	Waiohine R at Bicknells	0.43	0.16	1.20	12
RS49	Beef Ck at Headwaters	0.08	<0.11	0.18	12
RS50	Mangatarere S at SH 2	2.05	1.40	2.80	12
RS51	Huangarua R at Ponatahi Br	0.64	0.11	1.30	12
RS52	Tauanui R at Whakatomotomo Rd	0.06	<0.11	0.16	11
RS53	Awhea R at Tora Rd	0.24	0.13	0.92	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.21	<0.11	0.25	9
RS55	Tauherenikau R at Websters	0.13	<0.11	0.44	12
RS56	Waiorongomai R at Forest Pk	0.06	<0.11	0.17	12

Table A4.13: Dissolved Reactive Phosphorus (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	0.012	<0.004	0.088	12
RS02	Mangapouri S at Bennetts Rd	0.031	0.020	0.053	12
RS03	Waitohu S at Forest Pk	0.007	<0.004	0.014	11
RS04	Waitohu S at Norfolk Cres	0.019	0.008	0.035	12
RS05	Otaki R at Pukehinau	0.004	<0.004	0.009	12
RS06	Otaki R at Mouth	0.003	<0.004	0.008	12
RS07	Mangaone S at Sims Rd Br	0.025	0.015	0.030	12
RS08	Ngarara S at Field Way	0.034	0.008	0.095	12
RS09	Waikanae R at Mangaone Walkway	0.012	0.010	0.015	12
RS10	Waikanae R at Greenaway Rd	0.007	<0.004	0.043	12
RS11	Whareroa S at Waterfall Rd	0.029	0.014	0.048	12
RS12	Whareroa S at QE Park	0.040	0.021	0.061	12
RS13	Horokiri S at Snodgrass	0.009	<0.004	0.021	12
RS14	Pauatahanui S at Elmwood Br	0.017	0.007	0.024	12
RS15	Porirua S at Glenside	0.014	0.007	0.031	12
RS16	Porirua S at Wall Park (Milk Depot)	0.015	0.005	0.034	12
RS17	Makara S at Kennels	0.029	0.012	0.043	12
RS18	Karori S at Makara Peak	0.038	0.008	0.060	12
RS19	Kaiwharawhara S at Ngaio Gorge	0.030	<0.004	0.085	12
RS20	Hutt R at Te Marua Intake Site	0.003	<0.004	0.008	12
RS21	Hutt R opp. Manor Park G.C.	0.003	<0.004	0.014	12
RS22	Hutt R at Boulcott	0.003	<0.004	0.008	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.006	<0.004	0.009	12
RS24	Mangaroa R at Te Marua	0.009	0.005	0.017	12
RS25	Akatarawa R at Hutt confl.	0.002	<0.004	0.008	12
RS26	Whakatikei R at Riverstone	0.006	<0.004	0.010	12
RS27	Waiwhetu S at Wainui Hill Br	0.026	0.013	0.086	12
RS28	Wainuiomata R at Manuka Track	0.010	0.005	0.018	12
RS29	Wainuiomata R u/s of White Br	0.011	0.004	0.017	12
RS30	Orongorongo R at Orongorongo Stn	0.004	<0.004	0.009	12
RS31	Ruamahanga R at McLays	0.002	<0.004	0.006	12
RS32	Ruamahanga R at Te Ore Ore	0.008	<0.004	0.016	12
RS33	Ruamahanga R at Gladstone Br	0.022	0.007	0.029	12
RS34	Ruamahanga R at Pukio	0.015	<0.004	0.026	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.003	<0.004	0.007	12
RS36	Taueru R at Castlehill	0.008	<0.004	0.014	12
RS37	Taueru R at Gladstone	0.009	<0.004	0.040	12
RS38	Kopuaranga R at Stewarts	0.016	0.005	0.035	12
RS39	Whangaehu R 250m u/s confl.	0.027	0.018	0.076	12
RS40	Waipoua R at Colombo Rd Br	0.003	<0.004	0.008	12
RS41	Waingawa R at South Rd	0.004	<0.004	0.008	12
RS42	Whareama R at Gauge	0.002	<0.004	0.026	12
RS43	Motuwaiereka S at Headwaters	0.002	<0.004	0.008	11
RS44	Totara S at Stronvar	0.002	<0.004	0.006	12
RS45	Parkvale Trib at Lowes Res.	0.018	0.009	0.024	10
RS46	Parkvale S at Weir	0.043	0.018	0.140	12
RS47	Waiohine R at Gorge	0.002	<0.004	0.007	12
RS48	Waiohine R at Bicknells	0.012	0.004	0.020	12
RS49	Beef Ck at Headwaters	0.007	<0.004	0.012	12
RS50	Mangatarere S at SH 2	0.097	0.024	0.370	12
RS51	Huangaaru R at Ponatahi Br	0.005	<0.004	0.026	12
RS52	Tauanui R at Whakatomotomo Rd	0.008	<0.004	0.010	11
RS53	Awhea R at Tora Rd	0.005	<0.004	0.020	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.007	<0.004	0.013	9
RS55	Tauherenikau R at Websters	0.002	<0.004	0.007	12
RS56	Waiorongomai R at Forest Pk	0.005	<0.004	0.009	12

Table A4.14: Total Phosphorus (mg/L)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	0.028	0.022	0.480	12
RS02	Mangapouri S at Bennetts Rd	0.058	0.042	0.120	12
RS03	Waitohu S at Forest Pk	0.011	0.004	0.056	11
RS04	Waitohu S at Norfolk Cres	0.050	0.033	0.086	12
RS05	Otaki R at Pukehinau	0.007	<0.004	0.040	12
RS06	Otaki R at Mouth	0.006	<0.004	0.022	12
RS07	Mangaone S at Sims Rd Br	0.055	0.040	0.088	12
RS08	Ngarara S at Field Way	0.110	0.007	0.610	12
RS09	Waikanae R at Mangaone Walkway	0.014	0.009	0.018	12
RS10	Waikanae R at Greenaway Rd	0.010	0.005	0.140	12
RS11	Whareroa S at Waterfall Rd	0.053	0.034	0.070	12
RS12	Whareroa S at QE Park	0.082	0.063	0.100	12
RS13	Horokiri S at Snodgrass	0.018	0.011	0.056	12
RS14	Pauatahanui S at Elmwood Br	0.031	0.018	0.110	12
RS15	Porirua S at Glenside	0.025	0.009	0.098	12
RS16	Porirua S at Wall Park (Milk Depot)	0.035	0.019	0.220	12
RS17	Makara S at Kennels	0.053	0.031	0.072	12
RS18	Karori S at Makara Peak	0.056	0.026	0.120	12
RS19	Kaiwharawhara S at Ngaio Gorge	0.051	0.027	0.120	12
RS20	Hutt R at Te Marua Intake Site	0.007	<0.004	0.026	12
RS21	Hutt R opp. Manor Park G.C.	0.012	<0.004	0.048	12
RS22	Hutt R at Boulcott	0.008	<0.004	0.076	12
RS23	Pakuratahi R 50m d/s Farm Ck	0.007	<0.004	0.021	12
RS24	Mangaroa R at Te Marua	0.020	0.011	0.096	12
RS25	Akatarawa R at Hutt confl.	0.005	<0.004	0.012	12
RS26	Whakatihei R at Riverstone	0.012	<0.004	0.016	12
RS27	Waiwhetu S at Wainui Hill Br	0.053	0.038	0.370	12
RS28	Wainuiomata R at Manuka Track	0.015	0.012	0.024	12
RS29	Wainuiomata R u/s of White Br	0.023	0.015	0.110	12
RS30	Orongorongo R at Orongorongo Stn	0.020	<0.004	0.170	12
RS31	Ruamahanga R at McLays	0.007	<0.004	0.085	12
RS32	Ruamahanga R at Te Ore Ore	0.031	0.007	0.230	12
RS33	Ruamahanga R at Gladstone Br	0.051	0.022	0.260	12
RS34	Ruamahanga R at Pukio	0.052	0.007	0.420	12
RS35	Mataikona Trib at Sugar Loaf Rd	0.008	0.004	0.066	12
RS36	Taueru R at Castlehill	0.025	0.010	0.038	12
RS37	Taueru R at Gladstone	0.038	0.011	0.140	12
RS38	Kopuaranga R at Stewarts	0.029	0.013	0.330	12
RS39	Whangaehu R 250m u/s confl.	0.051	0.030	0.630	12
RS40	Waipoua R at Colombo Rd Br	0.006	<0.004	0.110	12
RS41	Waingawa R at South Rd	0.008	<0.004	0.100	12
RS42	Whareama R at Gauge	0.021	0.007	0.940	12
RS43	Motuwaireka S at Headwaters	0.004	<0.004	0.014	11
RS44	Totara S at Stronvar	0.005	<0.004	0.340	12
RS45	Parkvale Trib at Lowes Res.	0.024	0.014	0.032	10
RS46	Parkvale S at Weir	0.076	0.041	0.270	12
RS47	Waiohine R at Gorge	0.006	<0.004	0.120	12
RS48	Waiohine R at Bicknells	0.021	0.016	0.110	12
RS49	Beef Ck at Headwaters	0.010	0.006	0.020	12
RS50	Mangatarere S at SH 2	0.125	0.048	0.390	12
RS51	Huangaaru R at Ponatahi Br	0.011	0.005	0.260	12
RS52	Tauanui R at Whakatomotomo Rd	0.009	0.006	0.073	11
RS53	Awhea R at Tora Rd	0.019	0.006	0.470	12
RS54	Coles Ck Trib at Lagoon Hill Rd	0.015	0.006	0.025	9
RS55	Tauherenikau R at Websters	0.007	<0.004	0.048	12
RS56	Waiorongomai R at Forest Pk	0.008	<0.004	0.012	12

Table A4.15: *E. coli* (cfu/100mL)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	81	16	14,000	12
RS02	Mangapouri S at Bennetts Rd	420	130	5,100	12
RS03	Waitohu S at Forest Pk	5	2	2,200	11
RS04	Waitohu S at Norfolk Cres	200	97	4,200	12
RS05	Otaki R at Pukehinau	6	<1	22	12
RS06	Otaki R at Mouth	35	8	230	12
RS07	Mangaone S at Sims Rd Br	210	130	600	12
RS08	Ngarara S at Field Way	70	32	2,200	12
RS09	Waikanae R at Mangaone Walkway	7	<1	79	12
RS10	Waikanae R at Greenaway Rd	22	4	48	12
RS11	Whareroa S at Waterfall Rd	67	8	330	12
RS12	Whareroa S at QE Park	155	44	1,000	12
RS13	Horokiri S at Snodgrass	170	10	1,200	12
RS14	Pauatahanui S at Elmwood Br	245	21	600	12
RS15	Porirua S at Glenside	160	96	2,800	12
RS16	Porirua S at Wall Park (Milk Depot)	670	160	7,000	12
RS17	Makara S at Kennels	195	83	2,600	12
RS18	Karori S at Makara Peak	835	150	4,500	12
RS19	Kaiwharawhara S at Ngaio Gorge	250	74	5,700	12
RS20	Hutt R at Te Marua Intake Site	22	8	80	12
RS21	Hutt R opp. Manor Park G.C.	94	30	200	12
RS22	Hutt R at Boulcott	58	24	1,200	12
RS23	Pakuratahi R 50m d/s Farm Ck	56	12	500	12
RS24	Mangaroa R at Te Marua	130	72	400	12
RS25	Akatarawa R at Hutt confl.	48	13	91	12
RS26	Whakatiwai R at Riverstone	20	5	58	12
RS27	Waiwhetu S at Wainui Hill Br	195	120	3,600	12
RS28	Wainuiomata R at Manuka Track	3	<1	20	12
RS29	Wainuiomata R u/s of White Br	88	27	200	12
RS30	Orongorongo R at Orongorongo Stn	25	2	450	12
RS31	Ruamahanga R at McLays	9	<1	140	12
RS32	Ruamahanga R at Te Ore Ore	106	12	2,500	12
RS33	Ruamahanga R at Gladstone Br	53	9	9,300	12
RS34	Ruamahanga R at Pukio	135	32	2,900	12
RS35	Mataikona Trib at Sugar Loaf Rd	31	6	130	12
RS36	Taueru R at Castlehill	50	24	600	12
RS37	Taueru R at Gladstone	66	29	1,700	12
RS38	Kopuaranga R at Stewarts	170	96	11,000	12
RS39	Whangaehu R 250m u/s confl.	245	90	9,800	12
RS40	Waipoua R at Colombo Rd Br	38	14	3,100	12
RS41	Waingawa R at South Rd	33	3	210	11
RS42	Whareama R at Gauge	100	12	2,800	12
RS43	Motuwaireka S at Headwaters	5	<1	38	10
RS44	Totara S at Stronvar	7	<1	50	11
RS45	Parkvale Trib at Lowes Res.	33	6	86	10
RS46	Parkvale S at Weir	550	110	6,100	12
RS47	Waiohine R at Gorge	6	<1	56	12
RS48	Waiohine R at Bicknells	51	28	1,900	12
RS49	Beef Ck at Headwaters	3	<1	37	12
RS50	Mangatarere S at SH 2	90	15	1,000	12
RS51	Huangarua R at Ponatahi Br	45	9	480	12
RS52	Tauanui R at Whakatomotomo Rd	4	<4	69	11
RS53	Awhea R at Tora Rd	105	10	380	12
RS54	Coles Ck Trib at Lagoon Hill Rd	35	9	230	9
RS55	Tauherenikau R at Websters	19	10	120	12
RS56	Waiorongomai R at Forest Pk	9	<4	32	12

Table A4.16: Faecal coliforms (cfu/100mL)

Site No.	Site Name	Median	Minimum	Maximum	<i>n</i>
RS01	Mangapouri S at Rahui Rd	81	22	14,000	12
RS02	Mangapouri S at Bennetts Rd	470	160	5,100	12
RS03	Waitohu S at Forest Pk	5	2	2,200	11
RS04	Waitohu S at Norfolk Cres	210	97	4,200	12
RS05	Otaki R at Pukehinau	8	1	22	12
RS06	Otaki R at Mouth	44	8	240	12
RS07	Mangaone S at Sims Rd Br	215	130	700	12
RS08	Ngarara S at Field Way	86	32	2,300	12
RS09	Waikanae R at Mangaone Walkway	9	<1	79	12
RS10	Waikanae R at Greenaway Rd	27	6	54	12
RS11	Whareroa S at Waterfall Rd	96	8	330	12
RS12	Whareroa S at QE Park	155	48	1,200	12
RS13	Horokiri S at Snodgrass	195	14	1,200	12
RS14	Pauatahanui S at Elmwood Br	245	24	2,000	12
RS15	Porirua S at Glenside	160	96	3,000	12
RS16	Porirua S at Wall Park (Milk Depot)	825	160	7,200	12
RS17	Makara S at Kennels	195	83	2,600	12
RS18	Karori S at Makara Peak	885	160	5,100	12
RS19	Kaiwharawhara S at Ngaio Gorge	255	76	5,700	12
RS20	Hutt R at Te Marua Intake Site	23	8	80	12
RS21	Hutt R opp. Manor Park G.C.	130	42	400	12
RS22	Hutt R at Boulcott	62	26	1,500	12
RS23	Pakuratahi R 50m d/s Farm Ck	56	16	500	12
RS24	Mangaroa R at Te Marua	135	72	900	12
RS25	Akatarawa R at Hutt confl.	61	13	100	12
RS26	Whakatikei R at Riverstone	24	6	58	12
RS27	Waiwhetu S at Wainui Hill Br	195	120	3,800	12
RS28	Wainuiomata R at Manuka Track	5	<1	23	12
RS29	Wainuiomata R u/s of White Br	88	27	200	12
RS30	Orongorongo R at Orongorongo Stn	31	2	500	12
RS31	Ruamahanga R at McLays	12	<1	140	12
RS32	Ruamahanga R at Te Ore Ore	110	12	2,500	12
RS33	Ruamahanga R at Gladstone Br	58	9	9,300	12
RS34	Ruamahanga R at Pukio	140	34	3,400	12
RS35	Mataikona Trib at Sugar Loaf Rd	39	6	340	12
RS36	Taueru R at Castlehill	50	24	600	12
RS37	Taueru R at Gladstone	67	29	1,800	12
RS38	Kopuaranga R at Stewarts	175	110	11,000	12
RS39	Whangaehu R 250m u/s confl.	265	90	9,800	12
RS40	Waipoua R at Colombo Rd Br	50	18	3,500	12
RS41	Waingawa R at South Rd	33	3	210	11
RS42	Whareama R at Gauge	100	14	2,800	12
RS43	Motuwaireka S at Headwaters	5	<1	38	10
RS44	Totara S at Stronvar	8	<1	50	11
RS45	Parkvale Trib at Lowes Res.	37	9	88	10
RS46	Parkvale S at Weir	600	110	6,100	12
RS47	Waiohine R at Gorge	7	<1	56	12
RS48	Waiohine R at Bicknells	70	36	2,100	12
RS49	Beef Ck at Headwaters	3	<1	59	12
RS50	Mangatarere S at SH 2	90	15	1,200	12
RS51	Huangarua R at Ponatahi Br	50	13	480	12
RS52	Tauanui R at Whakatomotomo Rd	4	<4	69	11
RS53	Awhea R at Tora Rd	115	10	380	12
RS54	Coles Ck Trib at Lagoon Hill Rd	37	12	230	9
RS55	Tauherenikau R at Websters	22	12	130	12
RS56	Waiorongomai R at Forest Pk	9	<4	51	12

Appendix 5: Macroinvertebrate indices (2008/09)

Table A5.1: QMCI 2008/09

Site No.	Site Name	Rep. 1	Rep. 2	Rep. 3	Mean	Std Dev.
RS01	Mangapouri S at Rahui Rd	4.82	4.84	4.43	4.70	0.23
RS02	Mangapouri S at Bennetts Rd	4.51	4.67	4.64	4.61	0.08
RS03	Waitohu S at Forest Pk	8.25	8.04	8.22	8.17	0.12
RS04	Waitohu S at Norfolk Cres	4.69	4.84	4.51	4.68	0.16
RS05	Otaki R at Pukehinau	6.67	7.58	7.71	7.32	0.56
RS06	Otaki R at Mouth	7.32	7.59	7.85	7.58	0.26
RS07	Mangaone S at Sims Rd Br	4.54	4.12	4.47	4.38	0.23
RS08	Ngarara S at Field Way	4.28	4.23	4.40	4.30	0.09
RS09	Waikanae R at Mangaone Walkway	8.18	8.00	7.79	7.99	0.20
RS10	Waikanae R at Greenaway Rd	6.09	6.51	6.98	6.53	0.44
RS11	Whareroa S at Waterfall Rd	6.96	7.19	7.26	7.14	0.16
RS12	Whareroa S at QE Park	4.30	4.39	4.39	4.36	0.05
RS13	Horokiri S at Snodgrass	6.07	6.12	6.00	6.06	0.06
RS14	Pauatahanui S at Elmwood Br	4.90	4.44	5.47	4.94	0.52
RS15	Porirua S at Glenside	4.27	3.95	4.62	4.28	0.33
RS16	Porirua S at Wall Park (Milk Depot)	3.57	3.56	3.95	3.70	0.22
RS17	Makara S at Kennels	5.90	5.49	5.90	5.77	0.24
RS18	Karori S at Makara Peak	3.73	4.92	4.78	4.48	0.65
RS19	Kaiwharawhara S at Ngaio Gorge	3.06	3.03	3.52	3.20	0.28
RS20	Hutt R at Te Marua Intake Site	8.12	8.04	8.41	8.19	0.20
RS21	Hutt R opp. Manor Park G.C.	7.27	6.68	7.64	7.20	0.48
RS22	Hutt R at Boulcott	7.87	7.89	7.88	7.88	0.01
RS23	Pakuratahi R 50m d/s Farm Ck	7.94	7.77	7.75	7.82	0.10
RS24	Mangaroa R at Te Marua	7.19	5.75	6.73	6.56	0.74
RS25	Akatarawa R at Hutt confl.	7.73	7.99	7.40	7.71	0.29
RS26	Whakatikei R at Riverstone	6.15	6.72	7.06	6.65	0.46
RS27	Waiwhetu S at Wainui Hill Br	4.02	4.06	3.98	4.02	0.04
RS28	Wainuiomata R at Manuka Track	7.48	7.24	7.22	7.31	0.15
RS29	Wainuiomata R u/s of White Br	3.64	4.44	3.74	3.94	0.43
RS30	Orongorongo R at Orongorongo Stn	6.08	5.17	6.26	5.84	0.58
RS31	Ruamahanga R at McLays	7.93	7.91	8.06	7.97	0.08
RS32	Ruamahanga R at Te Ore Ore	7.27	7.48	7.61	7.45	0.17
RS33	Ruamahanga R at Gladstone Br	6.85	7.42	6.84	7.04	0.33
RS34	Ruamahanga R at Pukio	7.47	7.77	7.64	7.63	0.15
RS35	Mataikona Trib at Sugar Loaf Rd	6.62	6.70	7.10	6.81	0.26
RS36	Taueru R at Castlehill	5.02	4.48	5.48	4.99	0.50
RS37	Taueru R at Gladstone	4.77	4.93	4.42	4.71	0.26
RS38	Kopuaranga R at Stewarts	4.10	4.27	4.29	4.22	0.10
RS39	Whangaehu R 250m u/s confl.	3.99	3.97	3.92	3.96	0.04
RS40	Waipoua R at Colombo Rd Br	3.28	4.03	4.07	3.79	0.44
RS41	Waingawa R at South Rd	6.31	5.51	4.77	5.53	0.77
RS42	Whareama R at Gauge	4.03	4.01	3.89	3.98	0.08
RS43	Motuwaireka S at Headwaters	7.05	7.06	7.02	7.04	0.02
RS44	Totara S at Stronvar	4.55	4.64	4.52	4.57	0.06
RS45	Parkvale Trib at Lowes Res.	5.36	5.35	5.10	5.27	0.15
RS46	Parkvale S at Weir	3.10	2.92	3.51	3.17	0.30
RS47	Waiohine R at Gorge	7.94	7.86	7.92	7.91	0.04
RS48	Waiohine R at Bicknells	4.57	6.30	6.22	5.70	0.98
RS49	Beef Ck at Headwaters	7.36	7.57	7.05	7.33	0.26
RS50	Mangatarere S at SH 2	4.60	4.75	4.32	4.55	0.22
RS51	Huangarua R at Ponatahi Br	3.71	3.74	3.72	3.72	0.02
RS52	Tauanui R at Whakatomotomo Rd	6.91	6.92	7.21	7.02	0.17
RS53	Awhea R at Tora Rd	4.91	5.56	3.95	4.80	0.81
RS54	Coles Ck Trib at Lagoon Hill Rd	5.07	5.23	5.23	5.18	0.09
RS55	Tauherenikau R at Websters	6.04	6.37	6.76	6.39	0.36
RS56	Waiorongomai R at Forest Pk	7.27	7.30	7.24	7.27	0.03

Table A5.2: %EPT taxa 2008/09

Site No.	Site Name	Rep. 1	Rep. 2	Rep. 3	Mean	Std Dev.
RS01	Mangapouri S at Rahui Rd	5.9	8.6	0.1	4.9	4.4
RS02	Mangapouri S at Bennetts Rd	0.0	0.4	0.0	0.1	0.2
RS03	Waitohu S at Forest Pk	91.9	89.3	90.9	90.7	1.3
RS04	Waitohu S at Norfolk Cres	0.1	0.1	0.0	0.1	0.0
RS05	Otaki R at Pukehinau	66.6	82.1	91.5	80.1	12.6
RS06	Otaki R at Mouth	84.4	92.0	89.7	88.7	3.9
RS07	Mangaone S at Sims Rd Br	0.0	0.0	0.0	0.0	0.0
RS08	Ngarara S at Field Way	0.0	0.0	0.0	0.0	0.0
RS09	Waikanae R at Mangaone Walkway	82.0	77.4	77.2	78.9	2.7
RS10	Waikanae R at Greenaway Rd	54.1	54.7	63.0	57.3	5.0
RS11	Whareroa S at Waterfall Rd	68.1	70.4	78.7	72.4	5.6
RS12	Whareroa S at QE Park	0.0	0.4	0.0	0.1	0.2
RS13	Horokiri S at Snodgrass	68.4	71.1	79.0	72.8	5.5
RS14	Pauatahanui S at Elmwood Br	43.8	44.8	50.3	46.3	3.5
RS15	Porirua S at Glenside	28.2	24.4	37.0	29.9	6.5
RS16	Porirua S at Wall Park (Milk Depot)	20.6	11.7	20.3	17.5	5.1
RS17	Makara S at Kennels	41.8	34.3	27.6	34.5	7.1
RS18	Karori S at Makara Peak	24.3	47.1	40.3	37.2	11.7
RS19	Kaiwharawhara S at Ngaio Gorge	11.2	15.9	18.5	15.2	3.7
RS20	Hutt R at Te Marua Intake Site	87.7	91.8	93.2	90.9	2.8
RS21	Hutt R opp. Manor Park G.C.	81.6	71.6	88.9	80.7	8.7
RS22	Hutt R at Boulcott	96.4	96.8	96.2	96.4	0.3
RS23	Pakuratahi R 50m d/s Farm Ck	92.4	80.6	84.3	85.8	6.0
RS24	Mangaroa R at Te Marua	83.8	57.6	72.3	71.2	13.1
RS25	Akatarawa R at Hutt confl.	86.2	89.1	89.9	88.4	2.0
RS26	Whakatikei R at Riverstone	58.7	75.2	73.9	69.3	9.1
RS27	Waiwhetu S at Wainui Hill Br	0.0	0.0	0.0	0.0	0.0
RS28	Wainuiomata R at Manuka Track	79.2	78.0	69.2	75.5	5.4
RS29	Wainuiomata R u/s of White Br	36.2	49.5	38.5	41.4	7.1
RS30	Orongorongo R at Orongorongo Stn	71.6	52.1	71.6	65.1	11.3
RS31	Ruamahanga R at McLays	93.3	91.7	90.3	91.8	1.5
RS32	Ruamahanga R at Te Ore Ore	71.3	84.5	82.9	79.6	7.2
RS33	Ruamahanga R at Gladstone Br	60.9	76.4	63.1	66.8	8.4
RS34	Ruamahanga R at Pukio	85.0	94.7	89.9	89.9	4.9
RS35	Mataikona Trib at Sugar Loaf Rd	77.1	71.2	87.6	78.6	8.3
RS36	Taueru R at Castlehill	44.8	17.4	66.1	42.7	24.4
RS37	Taueru R at Gladstone	3.9	13.4	2.7	6.7	5.8
RS38	Kopuaranga R at Stewarts	7.7	12.7	24.9	15.1	8.8
RS39	Whangaehu R 250m u/s confl.	0.2	0.0	0.0	0.1	0.1
RS40	Waipoua R at Colombo Rd Br	32.2	37.7	49.0	39.6	8.6
RS41	Waingawa R at South Rd	69.8	46.7	37.1	51.2	16.8
RS42	Whareama R at Gauge	0.0	0.0	0.0	0.0	0.0
RS43	Motuwaireka S at Headwaters	63.1	62.9	67.9	64.6	2.8
RS44	Totara S at Stronvar	61.3	14.7	38.4	38.1	23.3
RS45	Parkvale Trib at Lowes Res.	24.7	27.5	29.5	27.2	2.4
RS46	Parkvale S at Weir	1.5	1.4	2.0	1.6	0.3
RS47	Waiohine R at Gorge	92.6	91.4	91.9	91.9	0.6
RS48	Waiohine R at Bicknells	31.7	60.1	59.9	50.6	16.3
RS49	Beef Ck at Headwaters	79.0	84.8	72.8	78.8	6.0
RS50	Mangatarere S at SH 2	46.1	26.5	9.7	27.4	18.2
RS51	Huangarua R at Ponatahi Br	64.7	63.9	63.6	64.1	0.5
RS52	Tauanui R at Whakatomotomo Rd	79.0	73.5	73.3	75.3	3.2
RS53	Awhea R at Tora Rd	0.0	29.5	0.0	9.8	17.0
RS54	Coles Ck Trib at Lagoon Hill Rd	22.9	33.4	34.1	30.2	6.3
RS55	Tauherenikau R at Websters	70.2	81.9	83.5	78.5	7.2
RS56	Waiorongomai R at Forest Pk	86.8	93.2	86.8	88.9	3.7

Table A5.3: Taxa richness 2008/09

Site No.	Site Name	Rep. 1	Rep. 2	Rep. 3	Mean	Std Dev.
RS01	Mangapouri S at Rahui Rd	18	19	18	18.3	0.6
RS02	Mangapouri S at Bennetts Rd	11	15	6	10.7	4.5
RS03	Waitohu S at Forest Pk	24	21	19	21.3	2.5
RS04	Waitohu S at Norfolk Cres	9	5	10	8.0	2.6
RS05	Otaki R at Pukehinau	18	14	14	15.3	2.3
RS06	Otaki R at Mouth	14	15	13	14.0	1.0
RS07	Mangaone S at Sims Rd Br	16	12	11	13.0	2.6
RS08	Ngarara S at Field Way	11	14	15	13.3	2.1
RS09	Waikanae R at Mangaone Walkway	29	22	26	25.7	3.5
RS10	Waikanae R at Greenaway Rd	27	14	19	20.0	6.6
RS11	Whareroa S at Waterfall Rd	27	25	23	25.0	2.0
RS12	Whareroa S at QE Park	8	15	15	12.7	4.0
RS13	Horokiri S at Snodgrass	16	21	17	18.0	2.6
RS14	Pauatahanui S at Elmwood Br	21	20	22	21.0	1.0
RS15	Porirua S at Glenside	18	15	22	18.3	3.5
RS16	Porirua S at Wall Park (Milk Depot)	15	19	18	17.3	2.1
RS17	Makara S at Kennels	17	18	10	15.0	4.4
RS18	Karori S at Makara Peak	19	20	26	21.7	3.8
RS19	Kaiwharawhara S at Ngaio Gorge	18	19	18	18.3	0.6
RS20	Hutt R at Te Marua Intake Site	19	21	19	19.7	1.2
RS21	Hutt R opp. Manor Park G.C.	14	16	19	16.3	2.5
RS22	Hutt R at Boulcott	10	11	12	11.0	1.0
RS23	Pakuratahi R 50m d/s Farm Ck	20	20	19	19.7	0.6
RS24	Mangaroa R at Te Marua	19	20	20	19.7	0.6
RS25	Akatarawa R at Hutt confl.	22	23	22	22.3	0.6
RS26	Whakatikei R at Riverstone	20	23	23	22.0	1.7
RS27	Waiwhetu S at Wainui Hill Br	10	10	7	9.0	1.7
RS28	Wainuiomata R at Manuka Track	28	25	28	27.0	1.7
RS29	Wainuiomata R u/s of White Br	19	18	24	20.3	3.2
RS30	Orongorongo R at Orongorongo Stn	14	16	14	14.7	1.2
RS31	Ruamahanga R at McLays	17	13	19	16.3	3.1
RS32	Ruamahanga R at Te Ore Ore	12	15	19	15.3	3.5
RS33	Ruamahanga R at Gladstone Br	12	13	12	12.3	0.6
RS34	Ruamahanga R at Pukio	11	14	12	12.3	1.5
RS35	Mataikona Trib at Sugar Loaf Rd	28	28	25	27.0	1.7
RS36	Taueru R at Castlehill	16	21	19	18.7	2.5
RS37	Taueru R at Gladstone	22	20	22	21.3	1.2
RS38	Kopuaranga R at Stewarts	19	21	26	22.0	3.6
RS39	Whangaehu R 250m u/s confl.	16	17	21	18.0	2.6
RS40	Waipoua R at Colombo Rd Br	25	20	21	22.0	2.6
RS41	Waingawa R at South Rd	17	18	16	17.0	1.0
RS42	Whareama R at Gauge	11	12	10	11.0	1.0
RS43	Motuwaireka S at Headwaters	26	29	32	29.0	3.0
RS44	Totara S at Stronvar	25	25	23	24.3	1.2
RS45	Parkvale Trib at Lowes Res.	19	17	20	18.7	1.5
RS46	Parkvale S at Weir	20	18	19	19.0	1.0
RS47	Waiohine R at Gorge	20	20	21	20.3	0.6
RS48	Waiohine R at Bicknells	19	15	17	17.0	2.0
RS49	Beef Ck at Headwaters	30	31	30	30.3	0.6
RS50	Mangatarere S at SH 2	19	19	17	18.3	1.2
RS51	Huangarua R at Ponatahi Br	20	17	22	19.7	2.5
RS52	Tauanui R at Whakatomotomo Rd	22	30	27	26.3	4.0
RS53	Awhea R at Tora Rd	18	20	24	20.7	3.1
RS54	Coles Ck Trib at Lagoon Hill Rd	26	28	28	27.3	1.2
RS55	Tauherenikau R at Websters	22	19	19	20.0	1.7
RS56	Waiorongomai R at Forest Pk	27	27	29	27.7	1.2

Water, air, earth and energy – elements in Greater Wellington's logo that combine to create and sustain life. Greater Wellington promotes **Quality for Life** by ensuring our environment is protected while meeting the economic, cultural and social needs of the community

For more information, contact Greater Wellington:

Wellington office
PO Box 11646
Manners Street
Wellington 6142
T 04 384 5708
F 04 385 6960

Masterton office
PO Box 41
Masterton 5840
T 06 378 2484
F 06 378 2146

Photo Credit
Sampling aquatic
invertebrates in the
Ngarara Stream, Waikanae

GW/EMI-G-09/235
October 2009
www.gw.govt.nz