On the beaches 2011/12

Annual recreational water quality monitoring report for the Wellington region

Quality for Life

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

On the beaches 2011/12

Annual recreational water quality monitoring report for the Wellington region

S Morar
S Greenfield

Environmental Science Department

Greater Wellington in association with:

Absolutely Positively Wellington
HUTT CITY TE AWA KAIRANGI
Kāpiti Coast DISTRICT COUNCIL
PORIRUA CITY COUNCIL

For more information, contact Greater Wellington:

Wellington
PO Box 11646

T 04 384 5708
F 04 385 6960
www.gw.govt.nz

GW/ESCI-G-12/153

November 2012

www.gw.govt.nz
info@gw.govt.nz

DISCLAIMER

This report has been prepared by Environmental Science staff of Greater Wellington Regional Council (Greater Wellington) and as such does not constitute Council policy.

In preparing this report, the authors have used the best currently available data and have exercised all reasonable skill and care in presenting and interpreting these data. Nevertheless, Greater Wellington does not accept any liability, whether direct, indirect, or consequential, arising out of the provision of the data and associated information within this report. Furthermore, as Greater Wellington endeavours to continuously improve data quality, amendments to data included in, or used in the preparation of, this report may occur without notice at any time.

Greater Wellington requests that if excerpts or inferences are drawn from this report for further use, due care should be taken to ensure the appropriate context is preserved and is accurately reflected and referenced in subsequent written or verbal communications. Any use of the data and information enclosed in this report, for example, by inclusion in a subsequent report or media release, should be accompanied by an acknowledgement of the source.

The report may be cited as:

Morar, S and Greenfield, S. 2012. *On the Beaches 2011/12: Annual recreational water quality monitoring report for the Wellington region.* Greater Wellington Regional Council, Publication No. GW/ESCI-G-12/153, Wellington.

Cover photo: Kids at Riversdale Beach (Matt Velde)

Contents

1. Introduction

Regional and territorial authorities monitor recreational water quality to identify risks to public health from disease-causing organisms and advise the public of these risks. People can then make informed decisions about where, when, and how they use rivers and the marine environment for recreation.

Recreational water quality monitoring in the Wellington region over 2011/12 was once again a joint effort involving the Greater Wellington Regional Council (Greater Wellington) and its constituent local councils, in particular the Kapiti Coast District Council, Porirua City Council, Hutt City Council and Wellington City Council. Regional Public Health and Wairarapa Population Health were consulted when the results of the monitoring indicated an increased likelihood of illness associated with recreational use. During the summer bathing season, weekly water test results were collated by Greater Wellington and displayed at www.gw.govt.nz/on-the-beaches.

This report summarises the results of weekly monitoring undertaken over the 2011/12 summer bathing season (1 November 2011 to 31 March 2012). A more comprehensive assessment of recreational water quality is prepared on a five-yearly basis as part of Greater Wellington's State of the Environment reporting (eg, Greenfield et al. 2012a).

2. Recreational water quality monitoring in the Wellington region

Recreational water quality monitoring in the Wellington region is a joint effort involving Greater Wellington and its constituent local councils. The sites monitored reflect their use by the public for contact recreation; in particular, swimming, canoeing, rafting, surfing and boating.

2.1 Monitoring objectives

The aims of Greater Wellington's recreational water quality monitoring programme are to:

1. Determine the suitability of selected sites in coastal and fresh waters for contact recreation;

2. Determine the suitability of coastal waters for the gathering of shellfish for human consumption;

3. Assist in safeguarding public health and the environment;

4. Provide information required to determine the effectiveness of regional plans and policies;

5. Provide information to assist in determining spatial and temporal changes in the environment (State of the Environment (SoE) monitoring); and

6. Provide information to assist in targeted investigations where remedial action or mitigation of poor water quality is desired.

2.2 Microbiological water quality indicators and guidelines

Water contaminated by human or animal excreta may contain a diverse range of pathogenic (disease-causing) micro-organisms such as bacteria, viruses and protozoa (eg, salmonella, campylobacter, cryptosporidium, giardia, etc). These organisms may pose a health hazard when the water is used for recreational activities such as swimming. The most common illness from swimming in contaminated water is gastroenteritis, but respiratory illness and skin infections are also quite common. In most cases, the ill-health effects from exposure to contaminated water are minor and short-lived, although the potential for more serious diseases such as hepatitis A, giardiasis, cryptosporidiosis, campylobacteriosis, and salmonellosis can not be discounted (Philip 1991). It is likely that many cases of illness contracted through contact recreation activities in contaminated water go unreported.

In 2003 the Ministry for the Environment (MfE) and the Ministry of Health (MoH) finalised microbiological water quality guidelines for recreational waters which are based on an assessment of the risk from exposure to contaminated water. These guidelines use bacteriological indicators associated with the gut of warm-blooded animals to assess the risk of faecal

contamination and therefore the potential presence of harmful pathogens[1]. The indicators used are:

- Freshwater (including estuarine waters): *Escherichia coli (E. coli)*
- Marine (coastal) waters: Enterococci
- Recreational shellfish-gathering waters: Faecal coliforms

Compliance with the MfE/MoH (2003[2]) microbiological water quality guidelines (from this point on referred to as *the recreational water quality guidelines*) should ensure that people using water for contact recreation are not exposed to significant health risks. The guideline values are outlined in Sections 3 (fresh waters), 4 (marine waters), and 5 (shellfish gathering waters) of this report. With regard to contact recreation in marine and fresh waters the guidelines consist of two components; faecal indicator bacteria trigger values to assess individual monitoring results throughout the bathing season and beach grades which describe the general condition of a site at any given time.

2.2.1 Trigger values

The MfE/MoH (2003) guidelines provide 'trigger' values for fresh and coastal waters to help water managers assess individual monitoring results and determine when management intervention is required. The 'trigger' values underpin a three-tier management framework analogous to traffic lights (Table 2.1).

Table 2.1: Three-tier management framework for recreational waters advocated by MfE/MoH (2003)

Mode	Management response
Green/Surveillance	Routine monitoring
Amber/Alert	Increased monitoring, investigation of source and risk assessment
Red/Action	Public warnings, increased monitoring and investigation of source

2.2.2 Suitability for Recreation Grades

The MfE/MoH (2003) guidelines outline a process to grade the suitability of coastal and fresh waters for recreational use from a public health perspective and are intended to describe the general condition of the water at any given time. Identification of beach grades involves combining a qualitative assessment of the susceptibility of a recreational site to faecal contamination (the Sanitary Inspection Category (SIC) component) with measurements of the appropriate bacteriological indicator (the Microbiological Assessment Category (MAC) component) to generate a Suitability For Recreation Grade (SFRG) for the site.

In 2012, SIC grades for all recreational water quality monitoring sites in the Wellington region were reviewed (Greenfield et al. 2012b). These updated SICs have been combined here with MAC grades based on data from the five most recent bathing seasons (2007/08–2011/12) to give updated SFRGs for each site.

[1] Indicator bacteria are monitored because individual pathogenic organisms are often present in very low numbers, can be hard to detect and the analytical tests are expensive.
[2] The guidelines were published in June 2002 and updated in June 2003.

3. Recreational water quality in freshwaters

3.1 Introduction

Recreational water quality was monitored at 24 river sites across the Wellington region over the 2011/12 bathing season (Figure 3.1, Appendix 1), as follows:

- Kapiti Coast District – 4 sites
- Hutt and Wainuiomata river catchments – 8 sites
- Wairarapa – 12 sites

The sites monitored reflect their use by the public for contact recreation; in particular, swimming and boating[3].

There were a number of changes to the freshwater monitoring network in the 2011/12 bathing season. Monitoring at the Hutt River at Boulcott and Ruamahanga River at Bentleys Beach ceased while monitoring commenced at Hutt River at Melling Bridge. Also in 2011/12, monthly microbiological data collected at the Akatarawa River at Hutt confluence and the Tauherenikau River at Websters under Greater Wellington's Rivers State of the Environment (RSoE) monitoring programme was for the first time, used to assess the suitability of these sites for contact recreation. These changes took place following a review of the recreational water quality monitoring site network documented in Greenfield et al. (2012b).

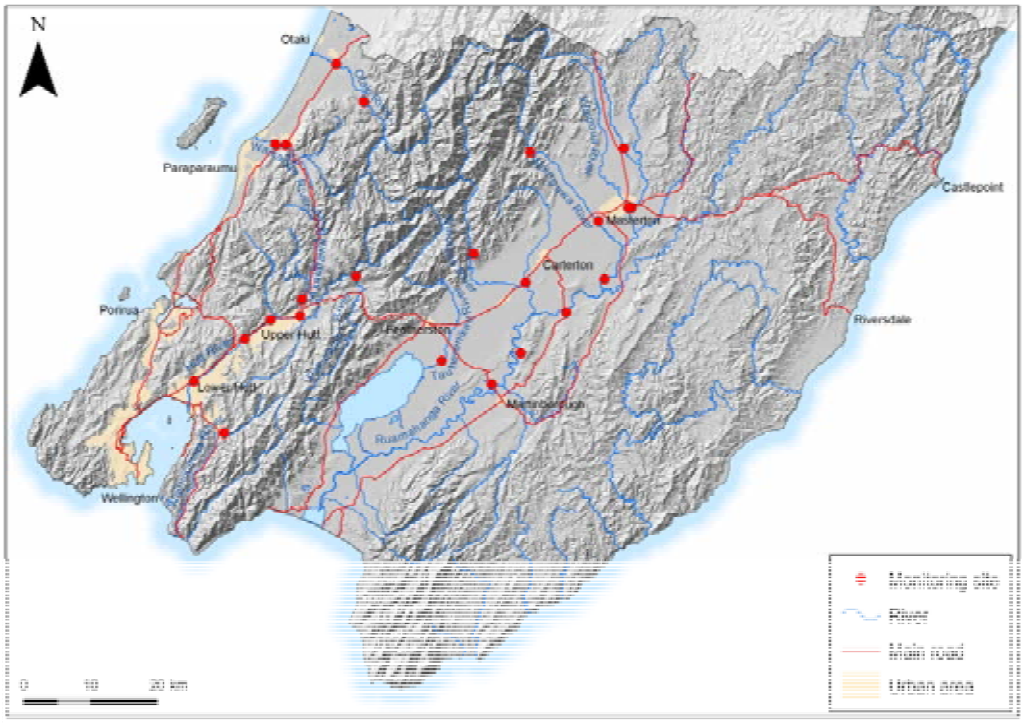

Figure 3.1: Freshwater recreation sites monitored over summer 2011/12

[3] The recreational water quality monitoring programme does not include monitoring of artificial water-bodies such as Henley Lake in Masterton or water-bodies on private land such as Lake Waitawa on the Kapiti Coast.

3.2 Monitoring protocol

Sites were sampled weekly – for 20 weeks – during the bathing season, with the exception of the Otaki River at Pots (near Pukehinau on the Kapiti Coast), the Akatarawa River at Hutt Confluence (Upper Hutt), the Waiohine River at Gorge and the Tauherenikau River at Websters (Wairarapa), which were sampled monthly under Greater Wellington's Rivers State of the Environment (RSoE) monitoring programme[4]. On each sampling occasion a single water sample was collected 0.2 m below the surface in 0.5 m water depth and analysed for *E. coli* indicator bacteria.

Measurements of water temperature, turbidity and visual estimates of periphyton (algae) cover, were also made at each site. An estimate of the daily rainfall in the catchment adjoining each site over the bathing season was made by obtaining records from the nearest rain gauge (Appendix 2). Rainfall can have a significant impact on water quality, as a result of runoff from rural or urban land and re-suspension of riverbed sediments.

A list of field and laboratory methods can be found in Appendix 3.

3.3 Guidelines

3.3.1 Microbiological water quality guidelines

(a) Compliance with trigger values

As outlined in Section 2.2, the MfE/MoH (2003) guidelines use bacteriological 'trigger' values to help water managers assess individual monitoring results and determine when management intervention is required. The 'trigger' values underpin a three-tier management framework analogous to traffic lights (Table 3.1).

Table 3.1: MfE/MoH (2003) surveillance, alert and action levels for fresh waters

Mode	Guideline *E. coli* (cfu/100mL)	Management response
Green/Surveillance	Single sample ≤260	Routine monitoring
Amber/Alert	Single sample >260 and ≤550	Increased monitoring, investigation of source and risk assessment
Red/Action	Single sample >550	Public warnings, increased monitoring and investigation of source

When water quality falls in the 'surveillance mode', this indicates that the risk of illness from bathing is acceptable (for freshwaters the accepted level of risk is 8 in every 1,000 bathers). If water quality falls into the 'alert' category, this indicates an increased risk of illness from bathing, but still within an acceptable range. However, if water quality enters the 'action' category, then the water

[4] Historically Otaki River at Pots and Waiohine River at Gorge were sampled separately under two Greater Wellington water quality monitoring programmes; recreational water quality and RSoE water quality. As both river sites have a 'very low' to 'low' risk of microbiological contamination and a high level of compliance with recreational water quality guidelines, Milne & Wyatt (2006) recommended that routine weekly sampling under the recreational water quality monitoring programme cease; the monthly microbiological water quality results obtained from these sites under the RSoE monitoring programme are now used to assess recreational water quality. Assessment of recreational water quality at the Akatarawa River at Hutt Confluence and Tauherenikau River at Websters is also based on monthly data from the RSoE monitoring programme.

poses an unacceptable health risk from bathing (MfE/MoH 2003). At this point, warning signs are erected at the bathing site, and the public is informed that it is unsafe to swim at that site. The only time a warning is unlikely to be issued is when an action level result is preceded by rainfall. This is because it is widely known that rainfall is highly correlated with elevated bacteria counts in rivers (see Section 3.5.1). Similarly, follow-up sampling is generally not conducted at freshwater sites when the alert or action exceedance follows heavy rainfall. For this reason Greater Wellington and Regional Public Health advise avoiding swimming and other contact recreation activities in freshwaters during and for up to several days after heavy rainfall.

(b) Suitability for Recreation Grades

The SIC and MAC categories used to identify SFRGs for fresh waters are shown in Table 3.2.

Table 3.2: MfE/MoH (2003) Suitability for Recreation Grades (SFRGs) for fresh waters

Susceptibility to faecal influence		Microbiological Assessment Category (MAC)[1]			
		A ≤130 *E. coli*/100mL	**B** 131–260 *E. coli*/100mL	**C** 261–550 *E. coli*/100mL	**D** >550 *E. coli*/100mL
Sanitary Inspection Category (SIC)	**Very Low**	Very Good	Very Good	Follow Up[3]	Follow Up[3]
	Low	Very Good	Good	Fair	Follow Up[3]
	Moderate	Follow Up[2]	Good	Fair	Poor
	High	Follow Up[2]	Follow Up[2]	Poor	Very Poor
	Very High	Follow Up[2]	Follow Up[2]	Follow Up[2]	Very Poor

[1] 95th percentile value calculated using the Hazen percentile method from five years of data obtained from routine weekly monitoring during the bathing season.

[2] Indicates unexpected results requiring investigation (reassess SIC and MAC).

[3] Implies non-sewage sources of indicator bacteria that require verification.

Greenfield et al. (2012b) derived two SFRGs for each freshwater site: one based on all flow conditions and one based on 'dry weather' conditions only (defined as median flow or less). Two grades were derived as it has been identified that SFRGs for many freshwater sites are heavily influenced by a small number of elevated *E. coli* results recorded following heavy rainfall. The additional 'dry weather' SFRGs are intended to better represent microbiological water quality during conditions when people are most likely to be swimming or undertaking other types of primary contact recreation[5]. Microbiological risk factors and corresponding SIC values, together with MAC values, were derived under both conditions and combined to obtain the two grades.

[5] The MfE/MoH (2003) guidelines allow for modification of a SFRG grade in this way if the modified grade better reflects the water quality conditions the public are usually exposed to and is verified by the Regional Medical Officer of Health. The caveat is that modified grades should only be used where occasional and predictable contamination events are identified (eg, heavy rainfall) and interventions can be demonstrated to be effective in discouraging recreational use during these times. This requires adequate communication to river users of the increased risk of microbial contamination through such things as signage at affected sites, media releases and website postings.

3.3.2 Nuisance periphyton guidelines

In fresh waters, excessive amounts of periphyton[6] can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers.

The MfE (2000) periphyton guidelines provide two maximum thresholds for periphyton cover in gravel/cobble bed streams managed for aesthetic and recreational values: 30% filamentous algae >2 cm long, and 60% cover for diatoms/cyanobacteria >0.3 cm thick. These thresholds relate to the visible areas of stream bed only.

3.3.3 Interim cyanobacteria guidelines

Growth of benthic cyanobacteria in rivers can pose a health risk as some species produce toxins which are harmful to humans and animals, particularly dogs (eg, Milne & Watts 2007; MfE/MoH 2009).

In 2009, interim New Zealand guidelines for cyanobacteria in recreational lakes and rivers were released (MfE/MoH 2009) for trial by monitoring and health agencies[7]. The interim guidelines for rivers identify a three-tiered alert level framework for benthic cyanobacteria (Table 3.3). The warning sign used to advise the public of the risk from benthic cyanobacteria is shown in Figure 3.2.

Table 3.3: Alert-level framework for benthic cyanobacteria cover in rivers (Modified from MfE/MoH 2009)

Alert level	Guideline	Management action
Surveillance (green mode)	≤20% coverage of potentially toxic cyanobacteria attached to substrate.	Undertake routine monitoring.
Alert (amber mode)	20–50% coverage of potentially toxic cyanobacteria attached to substrate.	Notify public health, erect signs with information on appearance of mats and potential risks and consider testing for cyanotoxins.
Action (red mode)	>50% cyanobacteria coverage or cyanobacteria are visibly detaching from substrate and accumulating on the river's edge or becoming exposed on river's edge and the river level drops.	Notify public health unit, notify the public of potential risk to health, and consider testing for cyanotoxins.

In the Wellington region, the response to toxic algal blooms in rivers is managed by a working party of Regional Public Health, Wairarapa Population Health, Territorial Authority and Greater Wellington staff. Close monitoring of 'flushing' river flows[8] and the potential for occurrence of cyanobacteria blooms is a critical part of this process.

[6] Periphyton refers to the slime coating on a riverbed, composed largely of algae and cyanobacteria.

[7] The interim version of the cyanobacteria guidelines will be trialled until the end of the 20012/13 summer at which point they will be revised based on feedback from practitioners and released as a final version.

[8] A 'flushing' flow is a high river flow (usually defined as 3x the median river flow) that generally follows a heavy rainfall event and can 'scour' periphyton from the riverbed.

Figure 3.2: Warning sign used to inform the public of the health risk from cyanobacterial mats in rivers in the Wellington region during the 2011/12 bathing season

3.4 Data analysis

All results have been assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines for fresh waters (Tables 3.1 and 3.2), the nuisance periphyton guidelines outlined in Section 3.3.2 and the interim cyanobacteria guidelines (Table 3.3).

During data processing, any *E. coli* counts reported as less than or greater than detection limits were replaced by values one half of the detection limit or the detection limit, respectively (ie, counts of <4 cfu/100mL and >400 cfu/100mL were treated as 2 cfu/100mL and 400 cfu/100mL, respectively). Rainfall was calculated for the 24, 48 and 72 hours prior to the day of sampling by summing up the rainfall for each 24 hour period ending at 9 am of each day. Any rainfall between 9 am and 3 pm on the day of sampling was defined as rainfall 'on the day' (samples were rarely collected after this time).

For most sites MAC grades were calculated using weekly *E. coli* data from samples collected over the past five summer bathing seasons (2007/08 to 2011/12). The exceptions were the four sites sampled monthly as part of Greater Wellington's RSoE programme for which a longer data period was used. MAC values for Otaki River at Pots and Waiohine River at Gorge were calculated from weekly data collected during bathing seasons from 2002/03 to 2005/06 and monthly data from 2006/07 onwards while MAC values for Akatarawa River at Hutt Confluence and Tauherenikau River at Websters were calculated from the results of monthly sampling during bathing seasons (November to March) from 2003/04 to 2011/12.

3.5 Results

3.5.1 Compliance with trigger values

Of the 20 freshwater sites monitored weekly over the 2011/12 summer bathing season, 11 sites (55%) exceeded the MfE/MoH (2003) action guideline on at least one occasion (Table 3.4, Appendix 4).

Table 3.4: Summary of action guideline breaches from routine weekly monitoring at 20 freshwater sites over the 2011/12 summer bathing season[1]

No. of times site exceeded the action guideline	No. of sites in each exceedance category			Total no. of sites (20)	% of sites
	Kapiti (3 sites)	Hutt & Wainuiomata (7 sites)	Wairarapa (10 sites)		
0	2	3	4	9	45
1	1	3	0	4	20
2	0	1	2	3	15
3	0	0	4	4	20

[1] This analysis excludes Otaki River at The Pots (Kapiti), Akatarawa River at Hutt Confluence, Waiohine River at Gorge and Tauherenikau River at Websters (Wairarapa); these sites are only sampled monthly under Greater Wellington's RSoE water quality monitoring programme.

Out of a total of 400 routine water samples, 22 (5.5%) exceeded the MfE/MoH (2003) action guideline (Table 3.5). All but two routine samples which exceeded the action guideline were associated with at least 10 mm of rainfall within the 72 hours prior to sampling. The two exceptions were samples taken from Hutt River at Birchville and Hutt River at Melling on 19 December 2011 and 12 March 2012, respectively. Although data from nearby rainfall stations indicated only a small amount of rainfall prior to these samples being taken, flow was elevated at the time of sampling at both sites (between median and three times median flow) suggesting that rainfall had occurred in the upstream catchment.

Due to the strong association with heavy rainfall, few action guidelines exceedances were followed up with further sampling. However, of the four exceedances that were, all samples taken the next day complied with the surveillance guideline. These findings are consistent with previous observations; elevated *E. coli* counts in fresh water are typically related to diffuse-source runoff, urban stormwater (including sewer overflows), and re-suspension of sediments during rainfall events (Greenfield et al. 2012a & 2012b).

Table 3.5: Summary of action guideline exceedances during routine monitoring at freshwater sites over the 2011/12 bathing season[1]. Rainfall prior to sampling and the number of follow-up samples required before compliance with the surveillance guideline was achieved are also summarised. NS = Not sampled

Date	Site	*E. coli* count (cfu/100mL)	Rainfall (mm)					Follow-up tests required
			Rainfall stn[2]	72–49 hrs before sampling	48–25 hrs before sampling	Up to 24 hrs before sampling	On the day (9am–3pm)	
Kapiti								
16/11/2011	Otaki R – SH1	2,500	Taungata Pk	1	0	48	0	1
Hutt & Wainuiomata								
21/11/2011	Hutt R – Silverstream	760	Te Marua	1.5	0	12	7.5	1
06/12/2011	Hutt R – Melling Br.	1,620	Birch Lane	0	6.5	0.5	19	NS
	Wainuiomata R – RP Park	3,200	Wainui. Rsvr	0	6	2	15	NS
19/12/2011	Hutt R – Birchville	980	Kaitoke H.w.	4.5	0.5	0	0	1
12/03/2012	Hutt R – Melling Br.	700	Birch Lane	0	0	7.5	0	1
Wairarapa								
22/11/2011	Ruamahanga R – Te Ore Ore	5,080	Mt Bruce	0	23	25	0	NS
	Ruamahanga R – The Cliffs	2,480	Angle Knob	0.5	72.5	71.5	No data	NS
	Ruamahanga R – Kokotau	1,620						NS
	Ruamahanga R – Morrisons B.	1,320	Waiohine	0	6.5	10	0	NS
	Ruamahanga R – Waihenga	1,220						NS
07/12/2011	Waipoua R – Colombo Rd	1,040	Angle Knob	23	4.5	21.5	3	NS
11/01/2012	Waipoua R – Colombo Rd	580	Angle Knob	76.5	0	3.5	0	NS
	Ruamahanga R – Kokotau	1,080	Mt Bruce	53	0	1.5	0	NS
	Ruamahanga R – Morrisons B.	940	Waiohine	58	0	0	0	NS
	Ruamahanga R – Waihenga	1,400						NS
05/03/2012	Ruamahanga – Te Ore Ore	1,520	Mt Bruce	137	32.5	0	0	NS
	Waipoua R – Colombo Rd	1,340	Angle Knob	133.5	75	5	0	NS
	Ruamahanga R – Cliffs	1,800						NS
	Ruamahanga R – Kokotau	4,080						NS
	Ruamahanga R – Morrisons B.	3,640	Waiohine	99	29.5	0	0	NS
	Ruamahanga R – Waihenga	4,840						NS

[1]This analysis excludes Otaki River at The Pots (Kapiti), Akatarawa River at Hutt Confluence, Waiohine River at Gorge and Tauherenikau River at Websters (Wairarapa); these sites are only sampled monthly under Greater Wellington's RSoE water quality monitoring programme.

[2]See Appendix 2 for more details on rainfall stations.

3.5.2 Suitability for recreation grades

The updated SFRGs for each site, based on the combined SIC and MAC values at all flows and during dry weather, are summarised in Figure 3.3. In total, 7 sites (29%) have SFRGs of 'good' or better for all weather flows and 14 sites (58%) have 'dry weather' SFRGs of 'good' or better. The highest risk of microbiological contamination across all flow conditions was identified at Ruamahanga River sites from Te Ore Ore downstream and Waipoua River at Colombo Rd – these sites were all graded 'very poor'. During dry weather conditions, when contact recreation is most likely, the highest risk of microbiological contamination was identified at Hutt River at Melling Bridge

and Ruamahanga River at the Cliffs – these sites had 'dry weather' SFRGs of 'poor'. Urban stormwater runoff (Hutt River at Melling Bridge), intensive agricultural land use and stock access to the rivers (Waipoua River at Colombo Road and sites on the Ruamahanga River) have been identified as the key contributors to the 'poor' or 'very poor' SFRGs at these sites (Greenfield et al. 2012b). The lack of information on pathogen removal efficiency of the municipal wastewater treatment plants that discharge to the Ruamahanga River mean that 'dry weather' SFRGs at sites downstream of these discharges (The Cliffs, Kokotau, Morrisons Bush and Waihenga Bridge) have conservatively been set at 'fair' or 'poor' and are regarded as interim (Greenfield et al. 2012b). SFRGs at Akatarawa River at Hutt Confluence, Hutt River at Melling and Tauherenikau River at Websters are also considered interim grades due to the limited data set available at these sites (n<100). For a full list of all flow and 'dry weather' SFRGs for the 2011/12 season as well as their respective SIC and MAC grades, see Appendix 4.

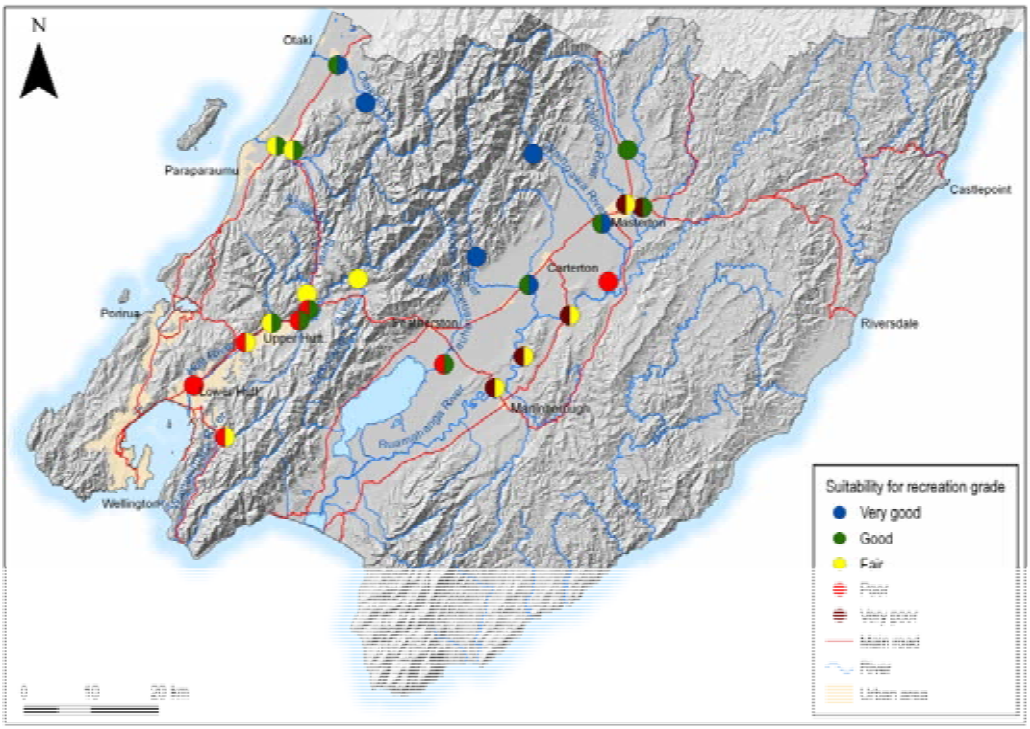

Figure 3.3: Suitability for Recreation Grades (SFRGs) for freshwater monitoring sites in the Wellington region as at the end of the 2011/12 bathing season. The left side of the symbol shows the SFRG based on all routine summer *E. coli* results while the right side of the symbol shows the 'dry weather' SFRG based on *E. coli* counts from samples collected during median flows or less. A single colour symbol indicates that 'all weather' and 'dry weather' grades are the same

SFRGs improved by one grade at a number of sites in 2011/12 compared to those as at the end of the 2010/11 bathing season reported in Greenfield et al. (2012b). 'All weather' grades improved at Pakuratahi River at Forks, Ruamahanga River at Double Bridge and Waingawa River at Kaituna while 'dry weather' grades improved at Wainuiomata River at Richard Prouse Park (although the MAC at this site places it very close to the 'fair'/'poor' boundary), Ruamahanga River at Double Bridges and Ruamahanga River at Te

Ore Ore. The only freshwater site to exhibit a deterioration in SFRG was Ruamahanga River at Morrisons Bush where the 'all weather' SFRG dropped to 'very poor' (compared to 'poor' as at the end of the 2010/11 season).

3.5.3 Compliance with nuisance periphyton and cyanobacteria guidelines

The number of periphyton cover assessments able to be made at freshwater monitoring sites ranged from just 10 at Hutt River at Melling Bridge to 20 at the two Waikanae River sites. On most occasions non-assessment of algal cover was due to poor water clarity following freshes. The exception was at Hutt River at Melling Bridge where, on eight occasions, poor water clarity was attributed to in-stream works being undertaken upstream[9]. This is reflected in the high turbidity measurements frequently recorded at this site (Appendix 5).

Wainuiomata River at Richard Prouse Park was the only site to exceed the MfE (2000) nuisance filamentous periphyton cover guideline (>30%) during the 2011/12 bathing season (Table 3.6). Filamentous periphyton cover at this site reached 70.5% on 21 February 2012 following an extended period of dry weather and low flows.

The MfE (2000) nuisance mat periphyton cover guideline (60%) was exceeded on six occasions during the bathing season (Table 3.6). Exceedances of this guideline were limited to sites on the Hutt and Waipoua rivers where algal mats are often dominated by the potentially toxic cyanobacteria *Phormidium* sp.[10]

During the 2011/12 bathing season coverage of potentially toxic cyanobacteria exceeded the alert and action level of the MfE/MoH (2009) interim cyanobacteria guidelines on 13 and 11 occasions, respectively, (Table 3.6). As with exceedances of the nuisance mat periphyton guideline, exceedances of the interim cyanobacteria guidelines occurred primarily at Hutt and Waipoua river sites although one exceedance of the alert guideline was recorded in the Waikanae River at Jim Cooke Park.

The alert and/or action cyanobacteria cover guidelines were exceeded at all Hutt River sites on one or more occasions during the 2011/12 bathing season, with most exceedances occurring between late January and late February 2012 during an extended period of warm, dry weather. The first exceedance of the alert guideline was recorded at Hutt River at Silverstream on 24 January while the first exceedance of the action guideline was recorded at Hutt River at Silverstream on 7 February. Warning signs were posted at key public access points to the river from Birchville downstream on 31 January 2012 and remained in place until the end of the bathing season. Two dogs died in mid-February after coming into contact with cyanobacteria mats, the first on 18 February at Heretaunga Park just over a kilometre upstream of the Hutt River at Silverstream site and the second on 20 February between the Melling and Ewen Bridges. Very high concentrations of homoanatoxin-a were found in samples of cyanobacteria mats taken from the Silverstream and Melling sites on 21 February (MWH 2012, Figure 3.4). Cyanobacterial mats were largely

[9] These works were undertaken by Greater Wellington's Flood Protection Department in accordance with their resource consent.

[10] Although the diatom *Cymbella kappii* was identified as abundant in a sample taken from Waipoua River at Colombo Road on 31 January 2012. *C. kappii* is similar in appearance to *Phormidium* sp. but slightly lighter in coloration.

removed from all Hutt River monitoring sites during a fresh that occurred on 22 and 23 February and no further dog deaths or exceedances of the alert or action guidelines were recorded during the remainder of the bathing season.

Table 3.6: Summary of compliance with MfE (2000) nuisance periphyton guidelines and MfE/MoH (2009) interim cyanobacteria guidelines at 20 freshwater sites, based on routine weekly monitoring over the 2011/12 summer bathing season[1]. Values in bold indicate a guideline exceedance

Site	Total site visits	Assessments made (*n*)	Filamentous		Mat		Cyanobacteria		
			Max	>30%	Max	>60%	Max	20–50% (Alert)	>50% (Action)
Kapiti									
Otaki R at SH1	20	19	9.8	0	0.0	0	0.0	0	0
Waikanae R at Jim Cooke Pk	20	20	2.5	0	19.3	0	22.0	**1**	0
Waikanae R at SH1	20	20	0.8	0	14.9	0	18.8	0	0
Hutt & Wainuiomata									
Pakuratahi R at Hutt Forks	20	19	1.0	0	1.3	0	3.0	0	0
Hutt R at Birchville	20	18	1.8	0	76.8	**1**	76.8	**1**	**2**
Hutt R at Maoribank Cnr	20	18	4.3	0	73.5	**1**	73.5	**1**	**2**
Hutt R at Poets Pk	20	18	1.3	0	71.3	**1**	71.3	**2**	**2**
Hutt R at Silverstream Br.	20	18	0.5	0	75.3	**2**	75.3	**2**	**3**
Hutt R at Melling Br.	20	10[2]	2.0	0	38.8	0	40.8	**2**	0
Wainuiomata R at RP Pk	20	19	70.5	**1**	4.5	0	7.8	0	0
Wairarapa									
Ruamahanga R at Double Br.	20	17	4.8	0	5.5	0	9.8	0	0
Ruamahanga R at Te Ore Ore	20	16	7.5	0	11.5	0	15.5	0	0
Waipoua R at Colombo Rd	20	19	13.3	0	74.0	**1**	79.5	**4**	**2**
Waingawa R at Kaituna	20	17	0.0	0	0.0	0	0.0	0	0
Waingawa R at South Rd	20	18	12.0	0	1.3	0	7.0	0	0
Ruamahanga R at The Cliffs	20	14	18.8	0	1.5	0	11.3	0	0
Ruamahanga R at Kokotau	20	15	5.3	0	3.8	0	6.3	0	0
Waiohine R at SH2	20	17	2.8	0	0.0	0	0.0	0	0
Ruamahanga R at Morrisons B.	20	15	10.3	0	2.8	0	0.8	0	0
Ruamahanga R at Waihenga Br.	20	15	17.3	0	2.5	0	9.3	0	0

[1] This analysis excludes Otaki River at The Pots (Kapiti), Akatarawa River at Hutt Confluence (Hutt) and Waiohine River at Gorge and Tauherenikau River at Websters (Wairarapa); these sites are only sampled monthly under Greater Wellington's RSoE water quality monitoring programme.

[2] Although 10 assessments were made, on two of these occasions <25% of the river channel was assessable due to poor water clarity as a result of river works.

Figure 3.4: Potentially toxic mats of *Phormidium* sp. growing on the river bed (left) and dislodged on the river's edge (right) at Hutt River at Birchville on 21 February 2012

Exceedances of the alert or action guidelines at Waipoua River at Colombo Road were recorded on six occasions during the 2011/12 bathing season. Many of these exceedances, including two exceedances of the action guideline, occurred between 7 December 2011 and 5 January 2012. However, it is possible that cyanobacteria coverage in the Waipoua River may have been overestimated on some occasions due to the presence of the diatom *Cymbella kappii* (this is difficult to distinguish from cyanobacteria mats in the field). Nonetheless warning signs were put in place by Masterton District Council staff at key access points to the river during the week of 12 December and remained in place for the rest of the season.

Following the single exceedance of the alert guideline in the Waikanae River at Jim Cooke Park on 21 February 2012 warning signs were put in place by Kapiti Coast District Council and remained in place until the end of the bathing season.

4. Recreational water quality in coastal waters

4.1 Introduction

Recreational water quality was monitored at 61 coastal sites across the Wellington region over the 2011/12 bathing season (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 14 sites
- Porirua City – 10 sites
- Hutt City – 13 sites
- Wellington City – 21 sites
- Wairarapa – 3 sites

Several changes were made to the coastal recreational water quality monitoring site network at the start of the 2011/12 bathing season. On the Kapiti Coast, seven sites (Otaki Beach at Rangiuru Road, Te Horo Beach South of Mangaone Stream, Te Horo Beach at Kitchener Street, Waikanae Beach at Tutere Street Tennis Courts, Paraparaumu Beach at Wharemauku Road, Raumati Beach at Hydes Road and Paekakariki Beach at Memorial Hall) were removed from the network and one site, Te Horo Beach at Sea Road, was added. In addition, three sites were removed in the Porirua area (Pauatahanui Inlet at Motukaraka Point, Pauatahanui Inlet at Browns Bay and Onehunga Bay), along with two sites in the Hutt (Petone Beach at Settlers Museum and Camp Bay) and two in the Wairarapa (Riversdale Beach at Lagoon Mouth and Riversdale Beach South). The rationale for these changes is documented in Greenfield et al. (2012b).

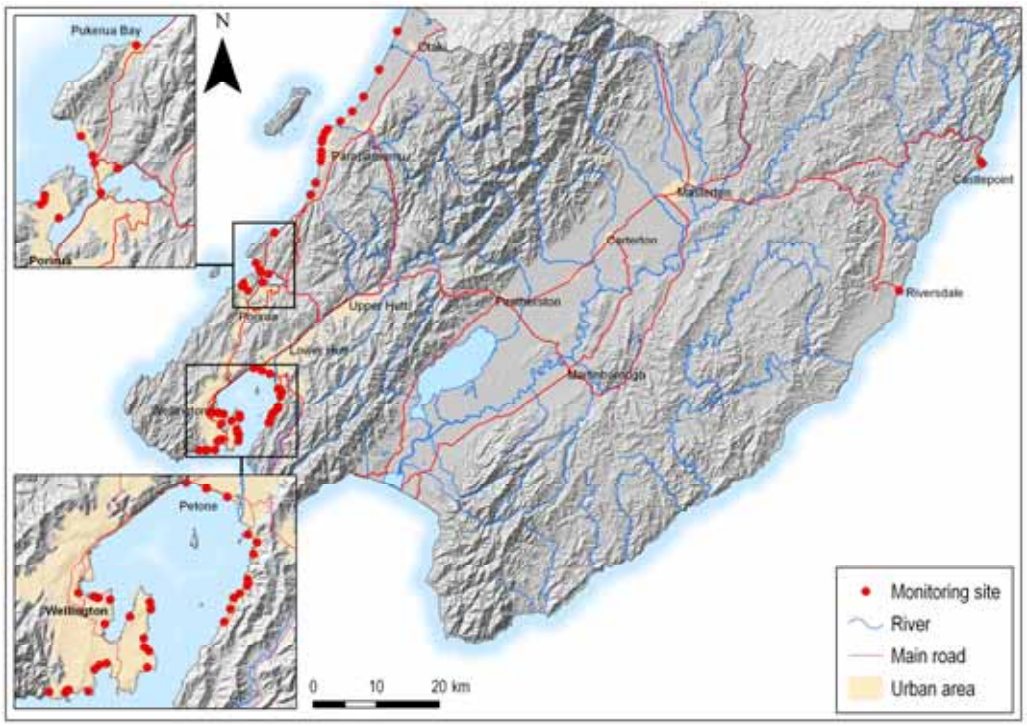

Figure 4.1: Coastal recreation sites monitored over 2011/12

4.2 Monitoring protocol

Sites were sampled weekly for 20 weeks. On each sampling occasion a single water sample was collected 0.2 m below the surface in 0.5 m water depth and analysed for enterococci indicator bacteria.

Observations of weather, the state of the tide and visual estimates of seaweed cover were also made at each site to assist with interpretation of the monitoring results. For example:

- Rainfall may increase enterococci counts by flushing accumulated debris from urban and agricultural areas into coastal waters.
- Wind direction can influence the movement of currents along the coastline and can therefore affect water quality at a particular site.
- In some cases, an increase in enterococci counts may be due to the presence of decaying seaweed. There is evidence that some strains of enterococci are able to replicate or persist in decaying seaweed (Anderson 2000).

An estimate of the daily rainfall in the catchment adjoining each site over the bathing season was made by obtaining records from the nearest rain gauge (see Appendix 2).

A list of field and laboratory methods can be found in Appendix 3.

4.3 Guidelines

4.3.1 Microbiological water quality trigger values

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use bacteriological 'trigger' values to help water managers assess individual monitoring results and determine when management intervention is required. The 'trigger' values underpin a three-tier management framework analogous to traffic lights (Table 4.1).

Table 4.1: MfE/MoH (2003) surveillance, alert and action levels for marine (coastal) waters

Mode	Guideline Enterococci (cfu/100mL)	Management response
Green/Surveillance	Single sample ≤140	Routine monitoring
Amber/Alert	Single sample >140	Increased monitoring, investigation of source and risk assessment
Red/Action	Two consecutive samples within 24 hours >280	Public warnings, increased monitoring and investigation of source

When water quality falls in the 'surveillance mode', this indicates that the risk of illness from bathing is acceptable (for coastal waters the accepted level of risk is 19 in every 1,000 bathers). If water quality falls into the 'alert' category, this indicates an increased risk of illness from bathing, but still within an

acceptable range. However, if the water quality enters the 'action' category, then the water poses an unacceptable health risk from bathing (MfE/MoH 2003). At this point, warning signs are erected at the bathing site, and the public is informed that it is unsafe to swim at that site. The only time a warning is unlikely to be issued is when an action level result is preceded by heavy rainfall. This is because it is widely known that rainfall is often correlated with elevated bacteria counts in coastal waters (see Section 4.5.1). For this reason Greater Wellington and Regional Public Health advise avoiding swimming and other contact recreation activities in coastal waters during and for up to several days after heavy rainfall.

In accordance with the MfE/MoH (2003) recreational water quality guidelines, sampling frequency is increased to daily at sites where a routine sample has exceeded the alert or action guideline. However, in some instances where an exceedance has coincided with significant and on-going rainfall, follow-up sampling may be delayed until rainfall has eased.

4.3.2 Suitability for Recreation Grades

The SIC and MAC categories used to identify SFRGs for coastal waters are shown in Table 4.2.

Table 4.2: MfE/MoH (2003) Suitability for Recreation Grades (SFRG) for marine (coastal) waters

Susceptibility to faecal influence		Microbiological Assessment Category (MAC)[1]			
		A ≤40 Enterococci/ 100mL	**B** 41–200 Enterococci/ 100mL	**C** 201–500 Enterococci/ 100mL	**D** >500 Enterococci/ 100mL
Sanitary Inspection Category (SIC)	**Very Low**	Very Good	Very Good	Follow Up[3]	Follow Up[3]
	Low	Very Good	Good	Fair	Follow Up[3]
	Moderate	Follow Up[2]	Good	Fair	Poor
	High	Follow Up[2]	Follow Up[2]	Poor	Very Poor
	Very High	Follow Up[2]	Follow Up[2]	Follow Up[2]	Very Poor

[1] 95th percentile value calculated using the Hazen percentile method from five years of data obtained from routine weekly monitoring during the bathing season.

[2] Indicates unexpected results requiring investigation (reassess SIC and MAC).

[3] Implies non-sewage sources of indicator bacteria that require verification.

4.4 Data analysis, limitations and cautionary notes

All results have been assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines. However, it is not possible to accurately specify the number of true exceedances of the red/action mode of the guidelines. The guidelines state that a coastal bathing site only enters the action mode when *two consecutive samples* exceed 280 enterococci/100mL but, in practice, there can be delays in collecting a second sample (eg, bad weather). Therefore to ensure that recreational water quality is assessed on an equal basis across all 61 coastal sites, the approach taken by Greater Wellington is to treat any single result greater than 280 enterococci/100mL obtained from routine weekly sampling as an exceedance of the red/action mode of the guidelines. This has also been the approach taken by the Ministry for the Environment in its annual national recreational water quality reporting and means that a second

consecutive action result is simply used to confirm the appropriate management response (eg, erection of public warnings), (MfE 2005).

The MfE/MoH (2003) recreational water quality guidelines do not cover toxic algal blooms, which in certain places and under certain conditions may pose a significant risk to contact recreation. Such blooms have occurred in coastal waters in the Wellington region in the past.

During data processing, any enterococci counts reported as less than or greater than detection limits were replaced by values one half of the detection limit or the detection limit, respectively (ie, counts of <4 cfu/100mL and >400 cfu/100mL were treated as 2 cfu/100mL and 400 cfu/100mL, respectively). Rainfall was calculated for the 24, 48 and 72 hours prior to the day of sampling by summing up the rainfall for each 24 hour period ending at 9 am of each day. Any rainfall in the three hours after 9am on the day of sampling was defined as rainfall 'on the day' (samples were rarely collected after midday).

4.5 Results

4.5.1 Compliance with trigger values

Eighteen of the 61 coastal sites (29.5%) exceeded the MfE/MoH (2003) action guideline during routine monitoring over the 2011/12 bathing season. Most of these sites (13) exceeded the guideline on only one occasion (Table 4.3, Appendix 4).

Table 4.3: Summary of action guideline breaches from routine weekly monitoring at 61 coastal sites over the 2011/12 summer bathing season

No. of times site exceeded the action guideline	No. of sites in each exceedance category					Total no. of Sites (61)	% of Sites
	Kapiti	Porirua	Hutt	Wellington	Wairarapa		
	(14 sites)	(10 sites)	(13 sites)	(21 sites)	(3 sites)		
0	10	6	7	17	3	43	70.5
1	4	2	5	2	0	13	21.3
2	0	1	1	1	0	3	4.9
3	0	0	0	0	0	0	0.0
4	0	1	0	0	0	1	1.6
5	0	0	0	1	0	1	1.6

A total of 28 out of 1,220 (2.3%) routine sample results exceeded the MfE/MoH (2003) action guideline of 280 cfu/100mL (Table 4.4). This was less than the 2010/11 and 2009/10 bathing seasons when 4.5% and 4.2% of results exceeded the action guideline, respectively (Morar & Warr 2011, Ryan & Warr 2010).

Table 4.4: Summary of action guideline exceedances during routine monitoring at coastal sites over the 2011/12 bathing season. Rainfall prior to sampling and the number of follow up samples required before compliance with the surveillance guideline was achieved are also summarised. Note there were no action guideline exceedances at any of the Wairarapa bathing sites in 2011/12

			Rainfall (mm)					Follow-up samples required
Date	Site	Enterococci count (cfu/100mL)	Rainfall stn[1]	72–49hrs before sampling	48–25hrs before sampling	Up to 24 hrs before sampling	On the day (9am–12pm)	
Kapiti								
07/02/2012	Paraparaumu B – Ngapotiki St	290	Paraparaumu Adr.	0.8	0	0	0	1
20/02/2012	Paraparaumu B – Nathan Ave	295	Paraparaumu Adr.	0	0	4.6	0	1
	Paraparaumu B – Toru Rd	600						4
07/03/2012	Te Horo Beach – Sea Road	495	Otaki Depot	0	0	0	0	1
Porirua								
29/11/2011	Titahi Bay – Access Rd	2,200	Whenua Tapu	0	0	1.5	0	1
28/12/2011	South Beach – Plimmerton	560	Whenua Tapu	0	0	0	0	1
31/01/2012	Pukerua Bay	390	Whenua Tapu	0	0.5	0	0	1
14/02/2012	Porirua H – Rowing Club	740	Whenua Tapu	0	0	0	0	1
28/02/2012	Porirua H – Rowing Club	1,100	Whenua Tapu	0	0	0	0	1
06/03/2012	South Beach – Plimmerton	290	Whenua Tapu	18.5	3	0	0	1
13/03/2012	Porirua H – Rowing Club	370	Whenua Tapu	0	10.5	0	0	1
20/03/2012	Porirua H – Rowing Club	610	Whenua Tapu	0	0	0	0	2
			Seton Nossiter Pk	0	0	5.6	0	
Hutt								
06/12/2011	Sorrento Bay	1500	Shandon	0.5	4.5	0	8	1
	Lowry Bay – Cheviot Rd	730						1
	Days Bay – Wellesley	350						1
	Rona Bay – CB Park	2,000						2
24/01/2012	Rona Bay – CB Park	2,200	Shandon	0	43	0	0	1
13/03/2012	Petone Beach – Kiosk	330	Shandon	0	7.5	0	0	1
27/03/2012	Robinson Bay– Nikau St	340	Shandon	4.5	0	0	0	1
Wellington City								
05/12/2011	Island Bay – Reef St	310	Wellington Airport	0	0	5.2	0.5	3
	Owhiro Bay	800						3
02/01/2012	Owhiro Bay	380	Wellington Airport	43.2	16	0	0	2
23/01/2012	Island Bay – Surf Club	290	Wellington Airport	0	0	17.8	0	1
07/02/2012	Scorching Bay	420	Wellington Airport	1.6	0	0	0	1
	Island Bay – Surf Club	580						1
	Owhiro Bay	2,200						2
12/03/2012	Owhiro Bay	540	Wellington Airport	0	0	14	0	2
19/03/2012	Owhiro Bay	650	Wellington Airport	0	0	0	0	4

[1]See Appendix 2 for more details on rainfall stations.

Just over a third (10) of the 28 action events were associated with at least 10 mm of rainfall either on the day of, or in the three days prior to, sampling (Table 4.4). Elevated enterococci counts in coastal waters during or shortly after rainfall events are common in many parts of the region due to urban stormwater (including sewer overflows), diffuse-source runoff into rivers and

streams, and re-suspension of bottom sediments (Greenfield at al. 2012a). Fourteen sites exceeded the action guideline in the absence of significant rainfall at least once. Of these 14 sites, Porirua Harbour at Rowing Club and Owhiro Bay recorded the greatest number of 'dry weather' exceedances (three each).

At Owhiro Bay, each action guideline exceedance that occurred during dry weather required at least two follow up samples before compliance with the surveillance guideline (<140 cfu/100mL) was achieved. Consecutive action guideline exceedances occurred on 5 and 6 December 2011 but following consultation with Regional Public Health, health warning signs were not erected at the site due to the onset of heavy rainfall during the week. However, health warning signage was put in place around Owhiro Bay by Wellington City Council on 14 March following two consecutive action guideline exceedances on 12 and 13 of March. Signage was removed the next day after a further sample complied with the surveillance guideline. Another action guideline exceedance on 19 March 2012 was followed by three further samples which also exceeded either the action or alert guideline on 20, 21 and 22 March. While the action guideline exceedance on 19 March was not preceded by any rainfall, follow up samples taken on 21 and 22 March were. A third follow up sample taken on 23 March complied with the surveillance guideline.

Overall, Owhiro Bay recorded the lowest level of compliance with the surveillance guideline of all coastal sites monitored during the 2011/12 bathing season; only half of the routine water samples taken from this site complied with the guideline (see Appendix 4). Inspections of nearby sewer pump stations, manholes and streams were made by Capacity on behalf of Wellington City Council following every action guideline exceedance. However, no obvious contamination issues were identified (Capacity 2012). It is noted that elevated enterococci counts were consistently associated with southerly winds, suggesting that the outflow from Owhiro Stream may be influencing water quality in the bay. Although monthly monitoring of faecal coliform counts undertaken by Capacity in the lower reaches of Owhiro Stream did not suggest any persistent gross faecal contamination during 2011/12 (the annual median count was <1,500 cfu/100mL (I. Idris[11], pers. comm. 2012)), elevated faecal counts did occur at times. Further investigation of potential sources of faecal contamination at Owhiro Bay – including the influence of large numbers of seagulls that frequent the bay – has been recommended by Greenfield et al. (2012).

Health warning signs were erected at Porirua Harbour at Rowing Club following consecutive action guideline exceedances on 20 and 22 March 2012. Signage was removed after a second follow up sample taken on 23 March complied with surveillance guideline. Samples taken the day after all other exceedances of the action guideline at Porirua Harbour at Rowing Club complied with the surveillance guideline. On-going investigation by Porirua City Council into the cause of action guideline exceedances at the Rowing Club site is focussed on the catchment of a small unnamed stream (known locally as the 'Onepoto Stream') which enters Porirua Harbour approximately

[11] Iqbal Idris, Senior Project Manager, Capacity Ltd.

50 m to the east of the site. Investigations in this catchment in the past have revealed the presence of illegal sewer connections to stormwater which have subsequently been fixed (Greenfield at al. 2012a); the cause of the 2011/12 exceedances is unclear and further investigation is recommended.

An exceedance of the action guideline at Paraparaumu Beach at Toru Road on 20 February 2012 following minimal rainfall was followed by three further samples on 21, 22 and 23 February exceeding either the action or alert guideline. The exceedances on 22 and 23 February coincided with heavy rainfall prior to sampling and so no health warning signs were erected by Kapiti Coast District Council.

4.5.2 Suitability for recreation grades

Updated SFRGs including the results from the 2011/12 bathing season at the 61 coastal recreational water quality monitoring sites in the Wellington region range from ‘very good’ to ‘poor’ (Figure 4.2). In total, 39 (64%) monitoring sites have SFRGs of ‘good’ or better. Twenty two coastal sites have SFRGs of ‘fair’ or ‘poor’, many of which (16) are located in Porirua and Hutt city. The six sites graded ‘poor’ are South Beach at Plimmerton, Porirua Harbour at Rowing Club, Titahi Bay at South Beach Access Road (Porirua), Lowry Bay at Cheviot Road, Rona Bay at Northern end of Cliff Bishop Park (Hutt) and Owhiro Bay (Wellington City). At all of these sites, urban stormwater discharges, some with potential sewage contamination, have been identified as a principal source of contamination (Greenfield et al. 2012b).

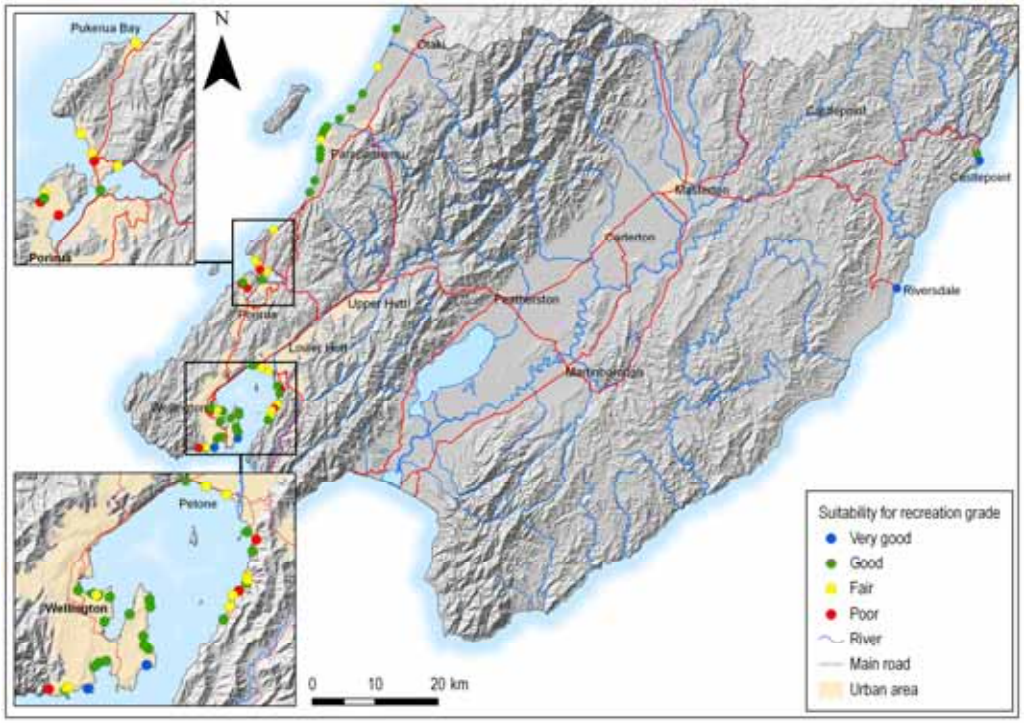

Figure 4.2: Suitability for Recreation Grades (SFRGs) for coastal recreational water quality monitoring sites in the Wellington region as at the end of the 2011/12 bathing season

SFRGs improved by one grade at five sites and deteriorated by one grade at seven sites in 2011/12 compared to the 2010/11 grades reported in Greenfield et al. (2012b). Sites where an improvement occurred were Otaki Beach at Surf Club, Raumati Beach at Marine Gardens, Titahi Bay at Toms Road, Petone Beach at Water Ski Club and Robinson Bay at HW Shortt Recreation Ground. Sites that had a drop in SFRG were Paraparaumu Beach at Toru Road, Oriental Bay at Wishing Well, Balaena Bay, Scorching Bay, Island Bay at Reef Street Recreation Ground, Lowry Bay at Cheviot Road and Rona Bay at Cliff Bishop Park (Appendix 4). At two sites (Oriental Bay at Wishing Well and Scorching Bay) the drop in SFRG was by a very small margin. For a full list of SFRGs, see Appendix 4.

5. Recreational shellfish gathering water quality

5.1 Introduction

Recreational shellfish gathering water quality was monitored at seven coastal sites across the Wellington region in 2011/12 (Figure 5.1, Appendix 1), as follows:

- Kapiti Coast District – 3 sites
- Porirua City – 1 site[12]
- Hutt City – 1 site
- Wellington City – 2 sites

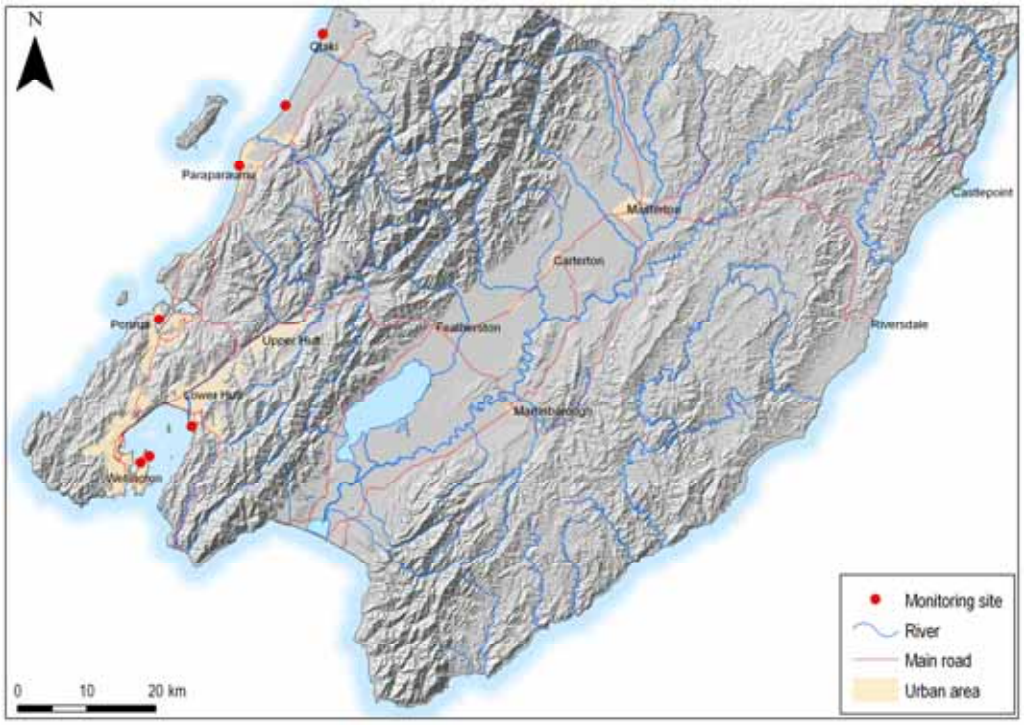

Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2011/12

As of the start of the 2011/12 season a number of changes were made to the sites monitored for shellfish gathering water quality. Monitoring ceased at Otaki Beach at Rangiuru Road, Raumati Beach at Hydes Road, Pauatahanui Inlet at Motukaraka Point and Pauatahanui Inlet at Browns Bay and commenced at Raumati Beach at Tainui Street. The rationale for these changes is documented in Greenfield et al. (2012b).

5.2 Monitoring protocol

Sites were sampled weekly for 20 weeks between mid-November 2011 and 31 March 2012 inclusive and at least monthly during the remainder of the year, at the same time as coastal recreational water quality sampling (all six sites are also coastal bathing sites). On each sampling occasion a single water sample was collected 0.2 m below the surface in 0.5 m water depth and analysed for faecal coliform indicator bacteria using membrane filtration. Although the

[12] This site, introduced in July 2007, is not recommended for shellfish gathering but is monitored in response to community interest.

MfE/MoH (2003) guidelines recommend the five-tube decimal dilution test (known as the Most Probable Number (MPN) method), membrane filtration produces an equivalent result in colony forming units (cfu) and is a faster test, providing a result in 24 hours.

5.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use faecal coliform bacteria as an indicator of microbiological contamination in shellfish-gathering waters. The guidelines state:

- The median faecal coliform content of samples taken over a shellfish-gathering season shall not exceed 14 MPN/100mL; and
- Not more than 10% of samples collected over a shellfish gathering season should exceed 43 MPN/100mL.

The MfE/MoH (2003) guidelines also state that the guideline values above should be applied in conjunction with a sanitary survey. Sanitary surveys are presented for each site in Appendix 4 in the form of the Sanitary Inspection Categories (SICs) which indicate the susceptibility of these sites to faecal contamination. More information on how these SICs were assigned can be found in Greenfield et al. (2012b).

5.3.1 Cautionary note

The MfE/MoH (2003) guidelines only address microbiological contamination. They do not address marine biotoxins, heavy metals, or harmful organic contaminants which in certain places and locations can pose a significant risk to people gathering shellfish. For this reason, the guidelines can not be used to determine whether shellfish are actually safe to eat. Monitoring of microbiological contaminants in *shellfish flesh* is needed to provide a direct measure of the risks associated with consuming shellfish. Greater Wellington periodically undertakes shellfish flesh monitoring; the last such monitoring was undertaken in early 2006 (Milne 2006). In general, Greater Wellington and Regional Public Health recommend that shellfish collection be avoided close to urban areas and mouths of rivers and streams that receive significant agricultural runoff.

5.4 Data analysis and limitations

All sampling and evaluation of results have been undertaken in accordance with the MfE/MoH (2003) recreational water quality guidelines where possible. However, the guidelines do not define a shellfish gathering season, nor do they provide any guidance on the minimum number of samples that should be used to calculate compliance with the median guideline. In the absence of such guidance, the approach taken in this report is to align the shellfish gathering season with the summer bathing season (ie, 1 November to 31 March inclusive), even though it is acknowledged that shellfish gathering is likely to occur year round at many sites to some degree.

In some cases, additional sampling was undertaken in conjunction with re-sampling of bathing sites following an exceedance of the alert or action levels

of the recreational water quality guidelines for coastal waters. The results of these follow-up samples were excluded from the calculation of compliance with the recreational shellfish gathering water quality guidelines (ie, only routine weekly sampling results are discussed here).

During data processing, any faecal coliform counts reported as less than or greater than detection limits were replaced by values one half of the detection limit or the detection limit, respectively (ie, counts of <4 cfu/100mL and >400 cfu/100mL were treated as 2 cfu/100mL and 400 cfu/100mL, respectively). Rainfall was calculated for the 24, 48 and 72 hours prior to the day of sampling by summing up the rainfall for each 24 hour period ending at 9 am of each day. Rainfall was also calculated for the period between 9 am and 12 pm on the day of sampling.

5.5 Results

Only one site, Sorrento Bay, was fully compliant with shellfish gathering water quality guidelines over the 2011/12 summer period (Table 5.1). All other sites exceeded one or both of the guideline criteria. These results differ from previous years when the two Wellington City sites were also fully compliant with the guidelines (Morar & Warr 2011; Ryan & Warr 2010; Warr 2009).

Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2011/12 summer months against the MfE/MoH (2003) guideline criteria for recreational shellfish-gathering waters

Site	Median (cfu/100mL)	Maximum (cfu/100mL)	No. (and percentage) of results >43 cfu/100mL	Total no. of samples
Kapiti				
Otaki Beach – Surf Club	17	1,180	7 (35%)	20
Peka Peka Beach – Road End	9	175	3 (15%)	20
Raumati Beach – Tainui St	40	500	10 (50%)	20
Porirua				
Porirua Harbour – Rowing Club	32	780	9 (45%)	20
Hutt				
Sorrento Bay	4	1,020	1 (5%)	20
Wellington City				
Shark Bay	3	990	4 (20%)	20
Mahanga Bay	6	100	3 (15%)	20

Faecal coliforms >43 cfu/100mL frequently occurred in the absence of significant rainfall in the 72 hours prior to sampling, particularly at Otaki Beach at Surf Club, Raumati Beach at Tainui Street and Porirua Harbour at Rowing Club. No clear pattern could be seen in wind or tide conditions associated with these elevated results.

6. Summary

Of the 20 freshwater sites monitored weekly over the 2011/12 summer season, 11 sites (55%) exceeded the MfE/MoH (2003) action guideline on at least one occasion. All of these exceedances coincided with significant rainfall in the 72 hours prior to sampling and/or elevated river flows. Of the total 24 freshwater sites monitored, seven sites (29%) now have 'all weather' SFRGs of 'good' or better while 14 sites (58%) have 'dry weather' SFRGs of 'good' or better.

Wainuiomata River at Richard Prouse Park exceeded the MfE (2000) nuisance filamentous periphyton guideline on one occasion during the 2011/12 bathing season. Widespread growth of the benthic cyanobacteria *Phormidium* sp. occurred at all Hutt River sites and at Waipoua River at Colombo Road during the season; this resulted in several exceedances of the MfE (2000) mat periphyton guideline as well as the alert and action levels of the MfE/MoH (2009) interim cyanobacteria guidelines.

Eighteen of the 61 coastal sites (30%) exceeded the MfE/MoH (2003) action guideline on at least one occasion during the 2011/12 bathing season. Sites that most frequently exceeded the action guideline were Porirua Harbour at Rowing Club and Owhiro Bay; several exceedances at these sites were not associated with significant rainfall prior to sampling. Health warning signs were erected on one occasion each at these two sites.

As of the end of the 2011/12 bathing season, 39 (64%) coastal monitoring sites now have SFRGs of 'good' or better. Six sites are graded 'poor': South Beach at Plimmerton, Porirua Harbour at Rowing Club, Titahi Bay at South Beach Access Road, Lowry Bay at Cheviot Road, Rona Bay at Cliff Bishop Park and Owhiro Bay.

Of the seven coastal sites monitored to assess water quality for recreational shellfish gathering in 2011/12, only one site (Sorrento Bay in Lower Hutt) was fully compliant with the MfE/MoH (2003) guidelines. The remaining six sites exceeded one or both guideline criteria.

References

Anderson SA. 2000. *Occurrence and characterisation of enterococci in terrestrial and aquatic environments.* PhD thesis. School of Biological Sciences, University of Auckland.

Capacity Infrastructure Services Ltd. 2012. *Stormwater discharge consent annual report: Resource consents WGN090219 [27418], [27419], [30500] & [30501]*. Unpublished report prepared for Wellington City Council.

Greenfield S, Ryan A and Milne JR. 2012a. *Recreational water quality in the Wellington region: State and trends.* Greater Wellington Regional Council, Publication No. GW/EMI-T-12/142, Wellington.

Greenfield S, Milne JR and Ryan A. 2012b. *Will I get sick if I swim? Updated suitability for recreation grades for fresh and coastal waters in the Wellington region*. Greater Wellington Regional Council, Publication No. GW/EMI-T-12/146, Wellington.

Milne JR. 2006. *Contaminants in shellfish flesh: An investigation into microbiological and trace metal contaminants in shellfish flesh from selected locations in the Wellington region.* Greater Wellington Regional Council, Publication No. GW/EMI-G-06/285, Wellington.

Milne JR and Watts L. 2007. *Toxic benthic cyanobacteria proliferations in Wellington's rivers in 2005/06.* Greater Wellington Regional Council, Publication No. GW/EMI-T-07/72, Wellington.

Milne J and Wyatt K. 2006. *Will I get sick if I swim? Suitability for recreation grades for selected marine and freshwater bathing sites in the Wellington region.* Greater Wellington Regional Council, Publication No. GW/EMI-G-06/160, 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. 2005. *Follow-up (consecutive) sampling of marine waters – proposed amendments to guidelines. Draft discussion paper.* Ministry for the Environment, Wellington.

Ministry for the Environment, Ministry of Health. 2003[13]. *Microbiological water quality guidelines for marine and freshwater recreational areas.* Ministry for the Environment, Wellington.

Ministry for the Environment, Ministry of Health. 2009. *New Zealand guidelines for cyanobacteria in recreational fresh waters – Interim guidelines.* Prepared for the Ministry for the Environment and Ministry of Health by SA Wood, DP Hamilton, WJ Paul, KA Safi and WM Williamson. Wellington.

[13] Published June 2002, updated June 2003.

Morar S and Warr S. 2011. *On the beaches: Annual recreational water quality monitoring report for the Wellington region, 2010/11*. Greater Wellington Regional Council, Publication No. GW/EMI-G-11/88, Wellington.

MHW. 2012. *Hutt River benthic ecology monitoring November 2011 to March 2012*. Unpublished report prepared for Greater Wellington Water as a condition of Resource Consent WGN00199 [30733] to take water from the Hutt River at Kaitoke weir.

Philip R. 1991. Risk assessment and microbiological hazards associated with recreational water sports. *Reviews in Medical Microbiology* 2:208–14.

Ryan A and Warr S. 2010. *On the beaches 2009/10: Annual recreational water quality monitoring report for the Wellington region*. Greater Wellington Regional Council, Publication No. GW/EMI-G-10/68, Wellington.

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, Wellington.

Acknowledgements

Thanks to Mike Thompson who assisted with the provision and analysis of hydrological data and to Juliet Milne for reviewing a draft version of this report.

There are many people that play an important role in the Wellington region's recreational water quality monitoring programme, particularly in terms of water sample collection, analysis and/or reporting. Special thanks to:

- Anne Robertson and Julie Lloyd (Kapiti Coast District Council)
- Oksana Bartlett, Nicholas MacDonald, Peter Chapman and David Redmayne (Porirua City Council)
- Paul Schuchmann and Dean Bentley (Hutt City Council)
- Iqbal Idris, Maria Charry and Bruck Gebreselassie (Capacity)
- Terry Manning, Rob Deacon, Sunita Raju and the microbiological team at Environmental Laboratory Services
- Jill McKenzie, Scott Rostron and Namomo Schaaf (Regional Public Health)
- Edward Lee, Alice Ryan, Sheree Tidswell, Joanna McVeagh, Brett Cockeram, Alton Perrie and Wendy Purdon (Greater Wellington)

Appendix 1: Monitoring sites

			NZTM coordinates	
Area	**Site type**	**Site name**	**Easting**	**Northing**
Kapiti	**Freshwater**	Otaki River at Pots[1]	1785444	5478749
		Otaki River at SH1	1781309	5484406
		Waikanae River at SH1	1773752	5472296
		Waikanae River at Jim Cooke Park	1772155	5472377
	Coastal	Otaki Beach at Surf Club[2]	1778622	5488330
		Te Horo Beach at Sea Road	1775692	5482324
		Peka Peka Beach at Road End[2]	1773215	5477905
		Waikanae Beach at William Street	1771388	5475584
		Waikanae Beach at Ara Kuaka Carpark	1769514	5473978
		Paraparaumu Beach at Ngapotiki Street	1767543	5472762
		Paraparaumu Beach at Nathan Avenue	1767033	5472174
		Paraparaumu Beach at Maclean Park	1766694	5471267
		Paraparaumu Beach at Toru Road	1766577	5470715
		Raumati Beach at Tainui Street[2]	1766531	5469229
		Raumati Beach at Marine Gardens	1766516	5468441
		Raumati Beach at Aotea Road	1766414	5467529
		Paekakariki Beach at Whareroa Road	1765598	5464128
		Paekakariki Beach at Surf Club	1764791	5462273
Porirua	**Coastal**	Pukerua Bay	1759058	5456278
		Karehana Bay at Cluny Road	1756093	5451360
		Plimmerton Beach at Bath Street	1756706	5450316
		South Beach at Plimmerton	1756810	5449874
		Pauatahanui Inlet at Water Ski Club	1758074	5449593
		Pauatahanui Inlet at Paremata Bridge	1757153	5448284
		Porirua Harbour at Rowing Club[2]	1754891	5446947
		Titahi Bay at Bay Drive	1754132	5448169
		Titahi Bay at Toms Road	1754110	5447857
		Titahi Bay at South Beach Access Road	1753906	5447682
Hutt	**Freshwater**	Pakuratahi River at Forks	1784288	5452620
		Akatarawa River at Hutt Confluence[1]	1776183	5449184
		Hutt River at Birchville	1776196	5449091
		Hutt River at Maoribank Corner	1775882	5446696
		Hutt River at Poets Park	1771461	5446092
		Hutt River at Silverstream Bridge	1767598	5443172
		Hutt River at Melling Bridge	1759906	5436831
		Wainuiomata River at Richard Prouse Park	1764536	5429141
	Coastal	Petone Beach at Water Ski Club	1755744	5434591
		Petone Beach at Sydney Street	1757045	5434248
		Petone Beach at Kiosk	1758326	5433711
		Sorrento Bay[2]	1759632	5431384
		Lowry Bay at Cheviot Road	1760206	5430891
		York Bay	1759977	5430160
		Days Bay at Wellesley College	1759616	5428529
		Days Bay at Wharf	1759654	5428313
		Days Bay at Moana Road	1759582	5428120
		Rona Bay at Northern end of Cliff Bishop Park	1759109	5427654

			NZTM coordinates	
Area	**Site type**	**Site name**	**Easting**	**Northing**
Hutt	**Coastal**	Rona Bay at Wharf	1758730	5427371
		Robinson Bay at HW Shortt Recreation Ground	1758519	5426674
		Robinson Bay at Nikau Street	1758131	5425856
Wellington City	**Coastal**	Aotea Lagoon	1748985	5427683
		Oriental Bay at Freyberg Beach	1749920	5427464
		Oriental Bay at Wishing Well	1750118	5427386
		Oriental Bay at Band Rotunda	1750243	5427375
		Balaena Bay	1750958	5427267
		Hataitai Beach	1750632	5425730
		Shark Bay[2]	1752211	5426197
		Mahanga Bay[2]	1753468	5427115
		Scorching Bay	1753517	5426647
		Worser Bay	1753074	5424823
		Seatoun Beach at Wharf	1753129	5424234
		Seatoun Beach at Inglis Street	1753405	5423994
		Breaker Bay	1753312	5422970
		Lyall Bay at Tirangi Road	1750747	5423230
		Lyall Bay at Onepu Road	1750286	5423116
		Lyall Bay at Queens Drive	1749990	5422868
		Princess Bay	1749586	5421504
		Island Bay at Reef Street Recreation Grd	1748229	5421542
		Island Bay at Surf Club	1748377	5421590
		Island Bay at Derwent Street	1748155	5421415
		Owhiro Bay	1747122	5421463
Wairarapa	**Freshwater**	Ruamahanga River at Double Bridges	1824350	5471775
		Ruamahanga River at Te Ore Ore	1825529	5462917
		Waipoua River at Colombo Road	1824996	5462889
		Waingawa River at Kaituna	1810326	5471149
		Waingawa River at South Road	1820550	5460878
		Ruamahanga River at The Cliffs	1821476	5452180
		Ruamahanga River at Kokotau	1815756	5447191
		Waiohine River at Gorge[1]	1801853	5455936
		Waiohine River at SH2	1809665	5451711
		Ruamahanga River at Morrisons Bush	1808918	5441108
		Ruamahanga River at Waihenga	1804610	5436461
		Tauherenikau River at Websters[1]	1797082	5439942
	Coastal	Castlepoint Beach at Castlepoint Stream	1871366	5467559
		Castlepoint Beach at Smelly Creek	1871670	5467202
		Riversdale Beach Between the Flags	1858435	5446948

[1] Site sampled monthly under Greater Wellington's Rivers State of the Environment water quality programme.

[2] Water quality is also monitored for recreational shellfish gathering purposes.

Appendix 2: Rainfall stations

Freshwater recreational sites

- Kapiti Coast District – Taungata Peak (Otaki River) and Waikanae Water Treatment Plant (Waikanae River)
- Hutt – Kaitoke Headworks (Pakuratahi River), Te Marua (Hutt River), Birch Lane (lower Hutt River sites) and Wainuiomata Reservoir (Wainuiomata River)
- Wairarapa – Mount Bruce (Ruamahanga River), Angle Knob (located in the upper Waingawa catchment and used as indicator of rainfall high in Tararua Range – Waipoua River, Waingawa River, and mid Ruamahanga River sites) and Waiohine Gorge (Waiohine River and lower Ruamahanga River sites).

Coastal recreational sites

- Kapiti Coast District – Otaki Depot (Otaki Beach, Te Horo Beach), Waikanae Water Treatment Plant (Peka Peka Beach, Waikanae Beach) and Paraparaumu Aerodrome* (Paraparaumu Beach, Raumati Beach, Paekakariki Beach)
- Porirua City – Whenua Tapu and Seton Nossiter Park
- Hutt City – Shandon
- Wellington City – Wellington Airport*
- Wairarapa – Castlepoint*

*NIWA rainfall stations

Appendix 3: Laboratory and field methods

Kapiti Coast District Council collected and analysed water samples collected in their district. Water samples collected in Porirua, Wellington City, Hutt City and the Wairarapa were analysed by Environmental Laboratory Services (ELS).

Methods and detection limits

Determinant	Method	Detection limit
Escherichia coli at 44.5°C	APHA Standard Methods (20th Ed.) 9213D, Membrane filter on mTEC agar, Urea substrate	1–4/100mL
Enterococci at 41°C	US EPA Method 1600, Membrane filter on mEI agar	1–5 cfu/100mL
Faecal coliforms at 44.5°C	APHA Standard Methods (20th Ed.) 9222D, Membrane filter on mFC agar	1–5 cfu/100mL
Water temperature	Field meter or digital thermometer	0.1°C
Turbidity	APHA Standard Methods (20th Ed.) 2130B	0.1 NTU
Periphyton cover (including filamentous and mat-forming algae as well as cyanobacteria)	Cyanobacteria cover was assessed using the method outlined in Section 4.4.3 of the interim Cyanobacteria Guidelines (MfE&MoH 2009). Assessment of filamentous and mat-forming algae was undertaken using the same method	5%
Seaweed cover	Visual estimate within 5 m radius around sample point, including both floating and attached seaweed	5%

Appendix 4: Summary statistics and SFRGs

Microbiological water quality data for the 2011/12 summer are summarised in the tables below. The Microbiological Assessment Category (MAC) values and Suitability for Recreation Grades (SFRGs) determined by Greenfield et al. (2012b) have been updated using the 2007/08–2011/12 microbiological water quality results. Arrows beside grades indicate changes in SFRG from those assigned at the end of the 2010/11 bathing season (as presented in Greenfield et al. (2012b)).

(A) Fresh waters

Bathing site	*n*	No. sample results (*E. coli*/100 mL)			Beach grading (2007/08–2011/12 data)					
					All flows			Dry weather flows		
		Surveillance (≤ 260)	Alert (261–550)	Action (>550)	SIC Grade	MAC Grade (95th%-ile value)	SFRG	SIC Grade	MAC Grade (95th%-ile value)	SFRG
Kapiti										
Otaki R @ Pots[1]	5	5	0	0	Low	A (84)[2]	V. good	V. low	A (42)[2]	V. good
Otaki R @ SH1	20	19	0	1	Moderate	B (217)	Good	Low	B (207)	Good
Waikanae R @ SH1	20	18	2	0	Moderate	C (415)	Fair	Low	B (196)	Good
Waikanae R @ Jim Cooke Pk	20	18	2	0	Moderate	C (326)	Fair	Low	B (211)	Good
Hutt & Wainuiomata										
Pakuratahi R @ Forks	20	19	1	0	Moderate	C (416)	Fair (↑)	Low	C (264)	Fair
Akatarawa R @ Hutt Confl.[1]	5	4	1	0	Moderate	C (495)[3]	Fair[3]	Low	C (281)[3]	Fair[3]
Hutt R @ Birchville	20	19	0	1	Moderate	D (788)	Poor	Moderate	B (161)	Good
Hutt R @ Maoribank Cnr	20	20	0	0	Moderate	D (776)	Poor	Low	B (244)	Good
Hutt R @ Poets Pk	20	20	0	0	Low	C (290)	Fair	Low	B (142)	Good
Hutt R @ Silverstream	20	19	0	1	Moderate	D (688)	Poor	Moderate	C (302)	Fair
Hutt R @ Melling Br.	20	16	2	2	Moderate	D (1,160)[4]	Poor[4]	Moderate	D (1,465)[4]	Poor[4]
Wainuiomata R @ RP Pk	20	18	1	1	Moderate	D (716)	Poor	Moderate	C (513)	Fair (↑)
Wairarapa										
Ruamahanga R @ Double Br.	20	20	0	0	Moderate	B (178)	Good (↑)	Moderate	B (175)	Good (↑)
Ruamahanga R @ Te Ore Ore	20	17	1	2	High	D (1,084)	V. poor	Moderate	B (241)	Good (↑)
Ruamahanga R @ The Cliffs	20	18	0	2	High	C (532)	Poor	High	A (84)	Poor[5]
Ruamahanga R @ Kokotau	20	16	1	3	High	D (1,032)	V. poor	Moderate	A (125)	Fair[5]
Ruamahanga R @ Morrisons B	20	17	0	3	High	D (1,092)	V. poor (↓)	Moderate	A (115)	Fair[5]
Ruamahanga R @ Waihenga	20	16	1	3	High	D (964)	V. poor	Moderate	A (119)	Fair[5]
Waipoua R @ Colombo Rd	20	17	0	3	High	D (864)	V. poor	Moderate	C (368)	Fair
Waingawa R @ Kaituna	20	20	0	0	Low/moderate	A (64)	V. good (↑)	Low	A (38)	V. good
Waingawa R @ South Rd	20	20	0	0	Low/moderate	A (110)	Good	Low	A (98)	V. good
Waiohine R @ Gorge[1]	5	5	0	0	Low	A (85)[2]	V. good	V. low	A (46)[2]	V. good
Waiohine R @ SH2	20	20	0	0	Low/moderate	A (82)	Good	Low	A (43)	V. good
Tauherenikau R @ Websters[1]	5	4	1	0	High	C (490)[3]	Poor[3]	Moderate	B (210)[3]	Good[3]

[1] Sampled monthly under Greater Wellington's Rivers State of the Environment (RSoE) water quality programme.
[2] Based on summer-time data collected weekly from 2002/03–2005/06 and monthly from 2006/07–2011/12.
[3] Interim MAC grade (*n*=45) based on summer-time data collected monthly under Greater Wellington's RSoE water quality programme (2003/04–2011/12).
[4] Interim grading (SIC grading based on that for historic site at Boulcott and MAC based on one year of data (*n*=20 for 'all flows' and *n*=12 for 'dry flows').
[5] Interim grades altered to reflect the uncertainty associated with the effects of upstream municipal wastewater treatment plant discharges on public health.

(B) Coastal waters

Bathing site	*n*	No. sample results (Enterococci/100 mL)			Beach grading (2006/07–2011/12 data)		
		Surveillance (≤ 140)	Alert (141–280)	Action (>280)	SIC Grade	MAC Grade (95th%-ile value)	SFRG[1]
Kapiti							
Otaki Beach @ Surf Club	20	20	0	0	Moderate	B (106)	Good (↑)
Te Horo Beach @ Sea Road[2]	20	19	0	1	Moderate	C (308)	Fair
Peka Peka Beach @ Rd End	20	20	0	0	Low	B (77)	Good
Waikanae Beach @ William St	20	20	0	0	Moderate	B (103)	Good
Waikanae Beach @ Ara Kuaka C.P.	20	20	0	0	Moderate	B (101)	Good
Paraparaumu Beach @ Ngapotiki St	20	19	0	1	Moderate	B (141)	Good
Paraparaumu Beach @ Nathan Ave	20	19	0	1	Moderate	B (190)	Good
Paraparaumu Beach @ Maclean Pk	20	20	0	0	Moderate	B (158)	Good
Paraparaumu Beach @ Toru Rd	20	19	0	1	Moderate	C (232)	Fair (↓)
Raumati Beach @ Tainui St	20	20	0	0	Moderate	B (115)	Good
Raumati Beach @ Marine Gardens	20	20	0	0	Moderate	B (165)	Good (↑)
Raumati Beach @ Aotea Rd	20	20	0	0	Moderate	B (152)	Good
Paekakariki Beach @ Whareroa Rd	20	20	0	0	Low	B (65)	Good
Paekakariki Beach @ Surf Club	20	20	0	0	Low	B (54)	Good
Porirua							
Pukerua Bay	20	19	0	1	Moderate	C (240)	Fair
Karehana Bay @ Cluny Rd	20	20	0	0	Moderate	C (208)	Fair
Plimmerton Beach @ Bath St	20	19	1	0	Moderate	C (210)	Fair
South Beach @ Plimmerton	20	18	0	2	Moderate	D (665)	Poor
Pauatahanui Inlet @ Water Ski Club	20	19	1	0	Moderate	C (268)	Fair
Pauatahanui Inlet @ Paremata Bridge	20	20	0	0	Moderate	B (120)	Good
Porirua Harbour @ Rowing Club	20	15	1	4	Moderate	D (1,360)	Poor
Titahi Bay @ Bay Drive	20	20	0	0	Moderate	C (360)	Fair
Titahi Bay @ Toms Rd	20	20	0	0	Moderate	B (176)	Good (↑)
Titahi Bay @ South Beach Access Rd	20	17	2	1	Moderate	D (706)	Poor
Hutt							
Petone Beach @ Water Ski Club	20	18	2	0	Moderate	B (184)	Good (↑)
Petone Beach @ Sydney St	20	19	1	0	Moderate	C (424)	Fair
Petone Beach @ Kiosk	20	18	1	1	Moderate	C (206)	Fair
Sorrento Bay	20	19	0	1	Low	B (186)	Good
Lowry Bay @ Cheviot Rd	20	19	0	1	Moderate	D (508)	Poor (↓)
York Bay	20	20	0	0	Low	B (110)	Good
Days Bay @ Wellesley College	20	18	1	1	Moderate	C (390)	Fair
Days Bay @ Wharf	20	20	0	0	Moderate	C (232)	Fair
Days Bay @ Moana Rd	20	20	0	0	Moderate	B (94)	Good
Rona Bay @ N end of Cliff Bishop Pk	20	17	1	2	Moderate	D (531)	Poor (↓)
Rona Bay @ Wharf	20	20	0	0	Moderate	C (273)	Fair
Robinson Bay @ HW Shortt Rec Grd	20	20	0	0	Moderate	C (295)	Fair (↑)
Robinson Bay @ Nikau St	20	19	0	1	Moderate	B (98)	Good
Wellington City							
Aotea Lagoon	20	20	0	0	Moderate	B (187)	Good
Oriental Bay @ Freyberg Beach	20	20	0	0	Moderate	B (59)	Good
Oriental Bay @ Wishing Well	20	19	1	0	Moderate	C (208)	Fair (↓)
Oriental Bay @ Band Rotunda	20	20	0	0	Moderate	B (124)	Good

Bathing site	*n*	No. sample results (Enterococci/100 mL)			Beach grading (2006/07–2011/12 data)		
		Surveillance (≤ 140)	Alert (141–280)	Action (>280)	SIC Grade	MAC Grade (95th%-ile value)	SFRG[1]
Balaena Bay	20	20	0	0	Low	B (62)	Good (↓)
Hataitai Beach	20	19	1	0	Moderate	B (50)	Good
Shark Bay	20	19	1	0	Moderate	B (106)	Good
Mahanga Bay	20	20	0	0	Low	B (62)	Good
Scorching Bay	20	19	0	1	Low	B (42)	Good (↓)
Worser Bay	20	20	0	0	Moderate	B (120)	Good
Seatoun Beach @ Wharf	20	19	1	0	Moderate	B (94)	Good
Seatoun Beach @ Inglis St	20	19	1	0	Moderate	B (103)	Good
Breaker Bay[3]	20	20	0	0	Low	A (8)	V. good
Lyall Bay @ Tirangi Rd	20	20	0	0	Moderate	B (118)	Good
Lyall Bay @ Onepu Rd	20	19	1	0	Moderate	A (36)	Good
Lyall Bay @ Queens Drive	20	20	0	0	Moderate	A (30)	Good
Princess Bay	20	20	0	0	Low	A (10)	V. good
Island Bay @ Surf Club	20	17	1	2	Moderate	C (326)	Fair
Island Bay @ Reef St Recreation Grd	20	16	3	1	Moderate	C (234)	Fair (↓)
Island Bay @ Derwent St	20	20	0	0	Moderate	A (34)	Good
Owhiro Bay	20	10	5	5	Moderate	D (770)	Poor
Wairarapa							
Castlepoint Beach @ Castlepoint Strm	20	19	1	0	Moderate	B (127)	Good
Castlepoint Beach @ Smelly Creek	20	20	0	0	Low	A (38)	V. good
Riversdale Beach Between the Flags	20	19	1	0	Low	A (32)	V. good

[1] Arrows beside grades indicate changes in SFRG from those presented in Greenfield et al. (2012b) based on data from 5 years (2006/07– 2010/11) data.
[2] Interim grade (SIC based on that from historic site at Mangaone Stream outflow, MAC grade based on one year of data (*n*=20).
[3] Sampled fortnightly between 2006/07 & 2010/11 and weekly in 2011/12.

Appendix 5: Turbidity results

Summary of turbidity results (NTU) from routine weekly monitoring at 20 freshwater sites over the 2011/12 summer bathing season. This analysis excludes Otaki River at Pots (Kapiti), Akatarawa River at Hutt Confluence (Hutt), Waiohine River at Gorge and Tauherenikau River at Websters (Wairarapa); these sites are sampled monthly under Greater Wellington's RSoE water quality monitoring programme

Site	*n*	Median	Min	Max
Kapiti				
Otaki River – SH1	20	0.95	0.53	103
Waikanae River – SH1	20	0.63	0.39	1.35
Waikanae River – Jim Cooke Park	20	0.59	0.35	1.53
Hutt & Wainuiomata				
Pakuratahi River – Hutt Forks	20	0.81	0.46	4.04
Hutt River – Birchville	20	0.82	0.51	4.62
Hutt River – Maoribank Corner	20	0.77	0.48	5.03
Hutt River – Poets Park	20	0.81	0.50	4.36
Hutt River – Silverstream Bridge	20	1.07	0.57	5.56
Hutt River – Melling Bridge	20	4.45	0.68	40.0
Wainuiomata River – Richard Prouse Park	20	1.31	0.70	4.05
Wairarapa				
Ruamahanga River – Double Bridges	20	0.82	0.48	9.85
Ruamahanga River – Te Ore Ore	20	1.68	0.51	30.6
Waipoua River – Colombo Rd	20	0.62	0.33	10.2
Waingawa River – Kaituna	20	0.72	0.39	4.63
Waingawa River – South Rd	20	0.69	0.46	29.2
Ruamahanga River – The Cliffs	20	2.52	0.66	36.4
Ruamahanga River – Kokotau	20	1.45	0.66	119
Waiohine River – SH2	20	1.18	0.41	27.3
Ruamahanga River – Morrisons Bush	20	2.16	0.77	81.9
Ruamahanga River – Waihenga Bridge	20	1.55	0.72	87.6

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, social and cultural 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

Wairarapa office
PO Box 41
Masterton 5840

T 06 378 2484
F 06 378 2146

info@gw.govt.nz
www.gw.govt.nz

November 2012
GW/ESCI-G-12/153

Please recycle
Produced sustainably