



On the beaches 2009/10

Annual recreational water quality monitoring report
for the Wellington region

Quality for Life



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REGIONAL COUNCIL

Environment



On the beaches 2009/10

Annual recreational water quality monitoring report
for the Wellington region

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Contents

1.	Introduction	1
2.	Recreational water quality monitoring in the Wellington region	2
2.1	Monitoring objectives	2
2.2	Microbiological water quality indicators and guidelines	2
2.2.1	Beach grading	3
2.3	Periphyton guidelines	3
2.3.1	Nuisance periphyton guidelines	4
2.3.2	Interim cyanobacteria guidelines	4
3.	Recreational water quality in fresh waters	6
3.1	Introduction	6
3.2	Monitoring protocol	6
3.3	Guidelines	7
3.4	Data analysis	7
3.5	Results	8
3.5.1	Kapiti	8
3.5.2	Hutt and Wainuiomata	8
3.5.3	Wairarapa	9
3.6	Synthesis	10
4.	Recreational water quality in marine waters	12
4.1	Introduction	12
4.2	Monitoring protocol	12
4.3	Guidelines	13
4.4	Data analysis, limitations and cautionary notes	14
4.5	Results	14
4.5.1	Kapiti	14
4.5.2	Porirua	15
4.5.3	Hutt	16
4.5.4	Wellington City	17
4.5.5	Wairarapa	18
4.6	Synthesis	18
5.	Recreational shellfish gathering water quality	20
5.1	Introduction	20
5.2	Monitoring protocol	20
5.3	Guidelines	21
5.4	Cautionary note	21
5.5	Data analysis and limitations	21
5.6	Results	22
5.6.1	Kapiti	22
5.6.2	Porirua	22
5.6.3	Wellington City	23
5.6.4	Hutt	23
5.7	Synthesis	23
6.	References	25

Acknowledgements	27
Appendix 1: Monitoring sites	28
Appendix 2: Laboratory and field methods	30
Appendix 3: Summary statistics and SFRGs	31

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 2009/10 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 Public Health were consulted on occasions when the results of the monitoring indicated a serious health risk might exist. 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 routine sampling undertaken over the 2009/10 summer bathing season (1 November 2009 to 31 March 2010 inclusive).



Figure 1.1: Swimmers in the Waikanae River near Makora Road, 7 February 2010

2. Recreational water quality monitoring in the Wellington region

From the start of the 2000/01 summer, recreational water quality monitoring in the Wellington region has been 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 marine and fresh waters for contact recreation;
2. Determine the suitability of marine water in designated areas for the gathering of shellfish for human consumption;
3. Assist in safeguarding public health and the environment;
4. Provide a mechanism to determine the effectiveness of regional plans;
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 (e.g., 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 recent evidence shows that 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. 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 pathogens¹. The indicators used are:

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

Compliance with the MfE/MoH (2003²) 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. The guidelines for fresh and marine waters are essentially "trigger" values to help water managers 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	Closure, public warnings, increased monitoring and investigation of source

2.2.1 Beach grading

The MfE/MoH (2003) guidelines outline a process to grade the suitability of marine and fresh waters for recreational use from a public health perspective. This involves combining a qualitative assessment of the susceptibility of a recreational site to faecal contamination, and direct measurements of the appropriate bacteriological indicator at the site to generate a "Suitability for Recreation Grade" (SFRG) for the site. The SFRG describes the general condition of the water at a site at any given time.

SFRGs have already been determined for recreational sites in the Wellington region using microbiological data obtained from routine weekly sampling over the 2001/02 to 2005/06 summer bathing seasons (Milne & Wyatt 2006). Updated SFRGs reflecting the 2005/06-2009/10 microbiological water quality results are summarised in Appendix 3.

2.3 Periphyton guidelines

In addition to microbiological guidelines, nuisance periphyton and interim benthic cyanobacteria guidelines are applied at freshwater sites.

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.

2.3.1 Nuisance periphyton guidelines

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

The MfE (2000) periphyton³ guidelines provide two maximum thresholds for periphyton cover in gravel/cobble bed streams managed for aesthetic and recreational values: 30% filamentous algae >2cm long, and 60% cover for diatoms/cyanobacteria >0.3cm thick. These thresholds relate to the visible areas of stream bed only.

2.3.2 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 (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 agencies⁴. The interim guidelines for rivers identify a three-tiered alert level framework for benthic cyanobacteria (Table 2.2) which was based on a system that has been applied in the Wellington region for the past two years. Alert and action level signs used to warn the public of the risk from benthic cyanobacteria are shown in Figure 2.2.

Table 2.2: 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 Public Health, Territorial Authority and Greater Wellington staff. Close monitoring of

³ Periphyton refers to the slime coating on a riverbed, composed largely of algae and cyanobacteria.

⁴ The interim version of the cyanobacteria guidelines will be trialled until the end of the 20011/12 summer at which point they will be revised based on feedback from practitioners and released as a final version.

‘flushing’ river flows⁵ and the potential for occurrence of cyanobacteria blooms is a critical part of this process.



Figure 2.2: Alert (left) and action (right) level warnings signs used to inform the public of the health risk from cyanobacterial mats in rivers in the Wellington region

⁵ 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.

3. Recreational water quality in fresh waters

3.1 Introduction

Recreational water quality was monitored at 23 river sites across the Wellington region over 2009/10 (Figure 3.1, Appendix 1), as follows:

- Kapiti Coast District – 4 sites
- Hutt and Wainuiomata river catchments – 7 sites
- Wairarapa – 12 sites

The sites monitored reflect their use by the public for contact recreation; in particular, swimming and boating⁶.

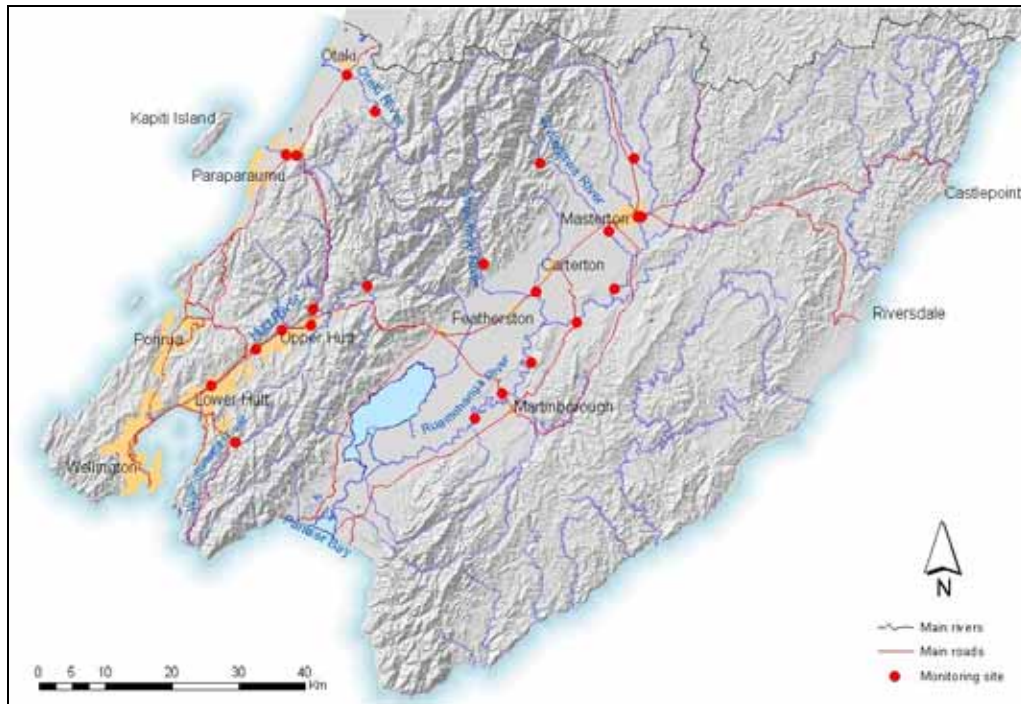


Figure 3.1: Freshwater recreation sites monitored over 2009/10

3.2 Monitoring protocol

Sites were sampled weekly during the bathing season, with the exception of the Otaki River at Pots (near Pukehinau on the Kapiti Coast) and the Waiohine River at Gorge (Wairarapa) which were sampled monthly under Greater Wellington’s Rivers State of the Environment (RSoE) monitoring programme⁷. On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth and analysed for *E. coli* indicator

⁶ 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.

⁷ Historically these sites 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.

bacteria using a membrane filtration method. This analytical method provides a result in 24 hours, therefore enabling prompt re-sampling in the event that a result exceeds recommended guideline values.

Measurements of water temperature and 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. 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 2.

3.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use bacteriological "trigger" values to help water managers 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 <i>E. coli</i> (cfu/100 mL)	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	Closure, 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 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 3.6). For this reason Greater Wellington and the Ministry of Health advise avoiding swimming and other contact recreation activities in freshwaters during and for up to several days after heavy rainfall.

3.4 Data analysis

All results have been assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines for fresh waters (Table 3.1) and the periphyton guidelines outlined in Section 2.3.

3.5 Results

Action level *E. coli* results recorded during routine weekly sampling over the 2009/10 summer are summarised below for bathing sites in Kapiti, Hutt, Wainuiomata and Wairarapa rivers. The number of surveillance, alert and action level results recorded at each of the 23 bathing sites are summarised in Appendix 3. Follow-up sampling is generally conducted when a routine sample returns a result that exceeds the alert or action guideline. The key exception is when routine sampling coincides with, or is followed by, heavy rainfall and elevated river flows. Only action level-related follow-up sampling results are discussed here.

3.5.1 Kapiti

Two of the four freshwater bathing sites on the Kapiti Coast exceeded the action guideline of 550 cfu/100 mL during the 2009/10 bathing season:

- 23 March 2010 – Waikanae River at State Highway 1 (1,810 cfu/100 mL) and Waikanae River at Jim Cooke Park (1,755 cfu/100 mL)

These exceedances coincided with 18mm of rainfall in the 24 hours prior to sampling. Results from additional samples collected the following day at both sites complied with the alert guideline and no further action was taken.

Coverage of filamentous and mat algae coverage did not exceed nuisance periphyton guidelines on any occasion.

Streambed cover of potentially toxic benthic cyanobacteria did not exceed the action guideline of 50% on any occasion. However, cyanobacteria coverage at the Waikanae River at Jim Cooke Park did exceed the alert level guideline of 20% on two occasions, once in late January and again in early February. Kapiti Coast District Council put up alert level warning signs along the river shortly after the first exceedance and these remained in place until the end of the season.

3.5.2 Hutt and Wainuiomata

Five of the seven bathing sites in the Hutt and Wainuiomata river catchments exceeded the action guideline on at least one occasion during the summer bathing season. The action level events recorded in the Hutt and Wainuiomata river catchments during 2009/10 were:

- 12 January 2010 – Wainuiomata River at Richard Prouse Park (620 cfu/100 mL).
- 19 January 2010 – Hutt River at Birchville (2,260 cfu/100 mL).
- 23 March 2010 – Pakuratahi River at Forks (780 cfu/100 mL), Hutt River at Birchville (660 cfu/100 mL), Hutt River at Maoribank Corner (560 cfu/100 mL) and Hutt River at Boulcott (580 cfu/100 mL).

All action guideline exceedances coincided with at least 10mm rainfall in the 72 hours prior to sampling. Additional samples collected following breaches of

the action guideline on 12 and 19 January 2010 complied with the surveillance guideline. No further samples were collected after the exceedances on 23 March 2010.

The Hutt River at Boulcott exceeded the filamentous periphyton guideline on 17 November 2009 and 19 January 2010. Wainuiomata River at Richard Prouse Park exceeded the filamentous periphyton guideline on three consecutive occasions in January 2010. This site also exceeded the mat periphyton guideline on 16 and 23 March 2010.

From early February onwards, coverage of potentially toxic cyanobacteria mats regularly exceeded the alert level guideline of 20% in the lower reaches of the Hutt River. The alert level guideline was first exceeded at the Hutt River at Boulcott site on 9 February 2010 and then at the Hutt River at Silverstream on 2 March. On 12 February 2010, alert level warning signs were erected by Hutt City Council at key access points to the Hutt River from Silverstream downstream. These signs remained in place for the duration of the bathing season.

The action level guideline of 50% cyanobacteria cover was exceeded on one occasion at the Hutt River at Silverstream on 16 March 2010. However, action level warning signs were not erected on this occasion as a 'fresh' occurred shortly after this date and removed algal mats from the river bed.

3.5.3 Wairarapa

Seven of the 12 river bathing sites monitored in the Wairarapa exceeded the action guideline during the summer bathing season on at least one occasion:

- 14 December 2009 – Ruamahanga River at Kokotau (580 cfu/100 mL).
- 27 January 2010 – Ruamahanga River at Kokotau (920 cfu/100 mL) and Ruamahanga River at Waihenga (900 cfu/100 mL).
- 1 February 2010 – Ruamahanga River at Double Bridges (1,080 cfu/100 mL), Ruamahanga River at Te Ore Ore (1,540 cfu/100 mL), Waipoua River at Colombo Road (2,100 cfu/100 mL), Ruamahanga River at Kokotau (2,020 cfu/100 mL), Ruamahanga River at Morrisons Bush (1,780 cfu/100 mL), Ruamahanga River at Waihenga (640 cfu/100 mL) and Ruamahanga River at Bentley's Beach (1,620 cfu/100 mL).

All breaches of the action guideline coincided with at least 10mm rainfall in the 72 hours prior to sampling. All follow up samples complied with the surveillance guideline apart from those collected following the exceedances of 1 February 2010. Although all but one of these samples exceeded the action guideline no further samples were collected as the exceedances coincided with ongoing rainfall in headwater catchments.

Four sites (Ruamahanga River at Double Bridges, Ruamahanga River at Morrisons Bush, Ruamahanga River at Bentley's Beach and Ruamahanga River at Waihenga) exceeded the filamentous periphyton threshold on one occasion.

All but one of these exceedances occurred in the last two weeks of March. There were no exceedances of the 60% cover threshold for mat-forming algae.

Potentially toxic cyanobacterial mats were widespread in the Waipoua River at Colombo Road from mid January onwards (Figure 3.2). Alert level warning signs were put up by Masterton District Council in the week of 11 January 2010 when cyanobacteria mat cover exceeded 20%. The following week these were replaced with action level warning signs; although cyanobacteria cover was only 36% there was significant accumulation of detached mats in shallow areas and on the river banks. Unfortunately a dog died on 22 February after coming into contact with cyanobacteria mats at Bentley Street, approximately 1.3km north of Colombo Road. Masterton District Council subsequently put up further warning signs at all public access points along the Waipoua River. These signs remained in place until mid April 2010.



Figure 3.2: Cyanobacterial mats in the Waipoua River at Paerau Road, 4km north-west of Masterton on 25 February 2010

(Photo courtesy of Dr Susie Wood, Cawthron Institute)

3.6 Synthesis

Of the 21 freshwater sites monitored weekly over the 2009/10 summer bathing season, 14 (66.7%) exceeded the action guideline on at least one occasion (Table 3.2).

Table 3.2: Summary of action guideline breaches from routine weekly monitoring at 21 freshwater sites over the 2009/10 summer bathing season†

No. of Times Site Exceeded the Action Guideline	No. of Sites in each Exceedance Category			Total No. of Sites (21)	% of Sites
	Kapiti (3 sites)	Hutt and Wainuiomata (7 sites)	Wairarapa (11 sites)		
0	1	2	4	7	33.3
1	2	4	5	11	52.4
2	0	1	1	2	9.5
3	0	0	1	1	4.8

† This analysis excludes the Otaki River at The Pots (Kapiti) and the Waiohine River at Gorge (Wairarapa); these sites are only sampled monthly under Greater Wellington's RSoE water quality monitoring programme.

A total of 18 (4.2%) routine sample results exceeded the action guideline of 550 cfu/100 mL. This was less than the 2008/09 and 2007/08 summers when 23 exceedances occurred (Warr 2009, Ryan & Warr 2008).

All of the 18 action level results were associated with at least 10mm of rainfall in the 72 hours prior to sampling. This finding is 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 (Milne & Wyatt 2006, Milne 2005).

4. Recreational water quality in marine waters

4.1 Introduction

Recreational water quality was monitored at 74 marine sites across the Wellington region over 2009/10 (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 20 sites
- Porirua City – 13 sites
- Hutt City – 15 sites
- Wellington City – 21 sites
- Wairarapa – 5 sites

There were three fewer sites monitored than last year. Plimmerton Beach at Queens Avenue and Paremata Beach at Pascoe Avenue (both in Porirua) were dropped from the programme because they are in close proximity to other sites. Kio Bay (Wellington City) was also dropped because it is not a commonly used recreation site. The site at Pukerua Bay was moved approximately 200 m from its previous location for safety reasons.

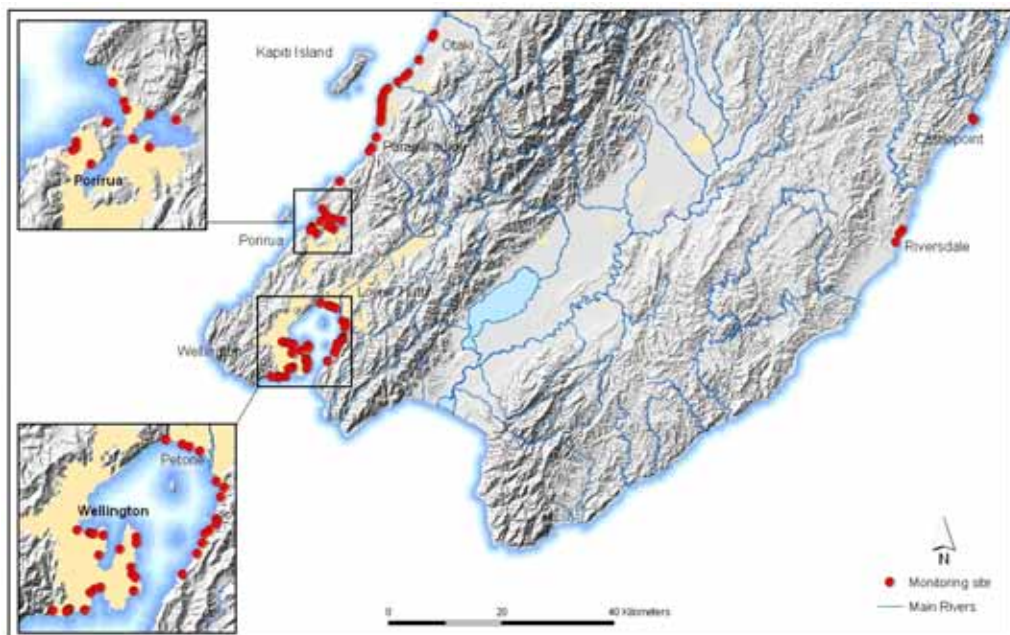


Figure 4.1: Marine recreation sites monitored over 2009/10

4.2 Monitoring protocol

Sites were sampled weekly during the bathing season, with the exception of Breaker Bay (Wellington City), Princess Bay (Wellington City) and Riversdale Beach South (Wairarapa) which were sampled fortnightly and Camp Bay (Hutt City) which was sampled monthly⁸. On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth

⁸ Milne & Wyatt (2006) recommended the frequency of sampling reduce from weekly to fortnightly from 1 November 2006 because these sites have a "very low" to "low" risk of microbiological contamination and a high level of compliance with recreational water quality guidelines. The frequency of sampling at Camp Bay was reduced to monthly in November 2009 as indicator bacteria counts at this site are consistently below surveillance guideline (140 enterococci/ 100 mL) indicating that there is a low risk to bathers.

and analysed for enterococci indicator bacteria using a membrane filtration method. This analytical method provides a result in 24 hours, therefore enabling prompt re-sampling in the event that a result exceeds recommended guideline values.

Observations of weather and the state of the tide, and visual estimates of seaweed cover, were also made at each site to assist with the 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.

A list of field and laboratory methods can be found in Appendix 2.

4.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use bacteriological "trigger" values to help water managers 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 waters

Mode	Guideline Enterococci (cfu/100 mL)	Management Response
Green/Surveillance	Single sample \leq 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	Closure, 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 marine 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. 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 marine waters (see Section 4.6). For this reason Greater Wellington and the Ministry of Health advise avoiding swimming and other contact recreation activities in marine waters during and for up to several days after heavy rainfall.

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 marine bathing site only enters the action mode when *two consecutive samples* exceed 280 enterococci/100 mL but, in practice, there can be delays in collecting a second sample (e.g., bad weather). Therefore to ensure that recreational water quality is assessed on an equal basis across all 74 marine sites, the approach taken by Greater Wellington is to treat any single result greater than 280 enterococci/100 mL obtained from routine weekly sampling as an exceedance of the red/action mode of the guidelines. This is also the approach taken by the Ministry for the Environment in its national recreational water quality monitoring reporting and means that a second consecutive action result is simply used to confirm the appropriate management response (e.g., 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 marine recreational waters in the Wellington region in the past.

4.5 Results

Action level enterococci results recorded during routine weekly sampling over the 2009/10 summer are summarised below for marine waters in Kapiti, Porirua City, Hutt City, Wellington City and the Wairarapa. The number of surveillance, alert and action level results recorded at each of the 74 bathing sites are summarised in Appendix 3. In accordance with the MfE/MoH (2003) recreational water quality guidelines, follow-up sampling is conducted when a routine sample returns a result that exceeds the alert or action guideline. Only action level- related follow-up sampling results are discussed here. On occasion, alert level follow-up sampling returns a result above the action guideline, triggering additional sampling or investigation.

4.5.1 Kapiti

Thirteen of the 20 marine sites monitored along the Kapiti Coast exceeded the action guideline of 280 cfu/100 mL during the summer bathing season:

- 29 December 2009 – Paraparaumu Beach at Ngapotiki Street (1,830 cfu/100 mL), Paraparaumu Beach at Nathan Ave (1,165 cfu/100 mL), Paraparaumu Beach at Toru Road (1,040 cfu/100 mL), Raumati Beach at Marine Gardens (2,001 cfu/100 mL), Raumati Beach at Aotea Road (1,025 cfu/100 mL) and Paekakariki Beach at Surf Club (1,270 cfu/100 mL).

- 30 December 2009 – Otaki Beach at Rangiuru Road (355 cfu/100 mL), Te Horo Beach at Mangaone Stream (580 cfu/100 mL), Te Horo Beach at Kitchener Street (480 cfu/100 mL), Peka Peka Beach at Road End (310cfu/100 mL), Waikanae Beach at William Street (440 cfu/100 mL), Waikanae Beach at Tutere Street (585 cfu/100 mL) and Waikanae Beach at Ara Kuaka Car Park (505 cfu/100 mL).
- 5 January 2010 – Paraparaumu Beach at Toru Road (810 cfu/100 mL).
- 24 March 2010 – Te Horo Beach at Mangaone Stream (380 cfu/100 mL).

All exceedances coincided with at least 10mm of rainfall in the 72 hours prior to sampling. Follow-up samples were collected by Kapiti Coast District Council staff and all but one complied with the surveillance (≤ 140 cfu/100mL) or alert (141-280 cfu/100mL) guidelines.

The number of action guideline exceedances at Kapiti Coast marine bathing sites in 2009/10 was much higher than in 2008/09 and slightly higher than in 2007/08 and 2006/07. This is likely to be related to the 2009/10 summer being slightly wetter than normal on the Kapiti Coast (Mike Thompson, Greater Wellington, pers. comm. 2010).

4.5.2 Porirua

Nine of the 13 sites monitored in Porirua City exceeded the action guideline during the bathing season, with two sites (South Beach at Plimmerton and Titahi Bay at South Beach Access Road) exceeding the guideline four times. The 2009/10 action events are summarised below:

- 24 November 2009 – Porirua Harbour at Rowing Club (396 cfu/100 mL).
- 1 December 2009 – Karehana Bay at Cluny Rd (380 cfu/100 mL), Pauatahanui Inlet at Water Ski Club (1,440 cfu/100 mL), Porirua Harbour at Rowing Club (1,696 cfu/100 mL), Titahi Bay at Bay Drive (488 cfu/100 mL) and Titahi Bay at Access Road (760 cfu/100 mL).
- 29 December 2009 – Pukerua Bay (808 cfu/100 mL), Karehana Bay at Cluny Rd (568 cfu/100 mL), South Beach at Plimmerton (660 cfu/100 mL), Pauatahanui Inlet at Browns Bay (5,332 cfu/100 mL), Titahi Bay at Bay Drive (440 cfu/100 mL), Titahi Bay at Toms Road (512 cfu/100 mL) and Titahi Bay at Access Road (1,560 cfu/100 mL).
- 19 January 2010 – South Beach at Plimmerton (396 cfu/100 mL).
- 26 January 2010 – South Beach at Plimmerton (672 cfu/100 mL) and Porirua Harbour at Rowing Club (512 cfu/100 mL).
- 16 February 2010 – Titahi Bay at Access Road (300 cfu/100 mL).
- 23 February 2010 – Titahi Bay at Access Road (400 cfu/100 mL).
- 2 March 2010 – South Beach at Plimmerton (360 cfu/100 mL).

The exceedances on 24 November 2009, 1 December 2009, 29 December 2009, 19 January 2010 and 26 January 2010 coincided with at least 10mm of rainfall in the 72 hours prior to sampling. However, little or no rainfall was recorded in the 72 hours prior to action guideline exceedances on 16 February, 23 February and 2 March 2010.

A follow-up sample taken at Titahi Bay at Access Road after the exceedance on 16 February was well above the action guideline (result of 2,240 cfu/100 mL), prompting Porirua City Council staff to put up health warning signs along Titahi Bay. A further sample taken on 18 February complied with the surveillance guideline and signs were subsequently removed. The source of the contamination was not identified.

A follow-up sample taken in response to the exceedance at Titahi Bay at Access Road on 23 February 2010 complied with the surveillance guideline.

The exceedance at South Beach at Plimmerton on 2 March 2010 was followed by further sampling on 3 March. This sample also exceeded the action guideline (result of 400 cfu/100 mL) but a further sample taken on 4 March complied with the alert guideline (result of 160 cfu/100 mL). No further action was undertaken and no source of contamination was identified by Porirua City Council.

4.5.3 Hutt

Nine of the 15 marine sites monitored in Hutt City exceeded the action guideline of 280 cfu/100 mL during the summer bathing season:

- 10 November 2009 – Rona Bay at Cliff Bishop Park (600 cfu/100 mL).
- 1 December 2009 – Petone Beach at Sydney Street (1,424 cfu/100 mL), Sorrento Bay (1,696 cfu/100 mL), Lowry Bay at Cheviot Road (1,056 cfu/100 mL), York Bay (504 cfu/100 mL), Days Bay at Wellesley College (880 cfu/100 mL), Days Bay at Wharf (1,792 cfu/100 mL), Rona Bay at Cliff Bishop Park (512 cfu/100 mL) and Robinson Bay at HW Shortt Recreation Ground (1,088 cfu/100 mL).
- 29 December 2009 – Petone Beach at Sydney Street (476 cfu/100 mL).
- 5 January 2010 – Robinson Bay at HW Shortt Recreation Ground (324 cfu/100 mL).
- 12 January 2010 – Rona Bay at Wharf (364 cfu/100 mL).

The 1 December 2009 and 12 January 2010 exceedances both coincided with at least 10mm of rainfall in the 72 hours prior to sampling. The exceedances on 29 December 2009 and 5 January 2010 also coincided with some rainfall (7mm and 8.5mm respectively) in the previous 72 hours. Follow up samples for these exceedances all complied with the surveillance guideline (\leq 140 cfu/100 mL).

No rainfall was recorded in the 72 hours prior to the action guideline exceedance at Rona Bay at Cliff Bishop Park on 10 November 2009, although

0.5mm did fall on the day of sampling. Follow up samples taken on the 11, 12 and 13 of November were also above the alert or action guideline (results were 600 cfu/100 mL, 148 cfu/100 mL and 384 cfu/100 mL respectively). Subsequent investigation undertaken by Capacity (for Hutt City Council) identified a blocked sewer main on the corner of Rona Street and Manuka Terrace as the source of the contamination. This was repaired on 12 November 2010 and a follow-up sample collected on 14 November 2010 complied with the surveillance guideline.

The number of action guideline exceedances at Hutt City marine bathing sites was much higher in 2009/10 than in 2008/09 when only one exceedance occurred. However, the number of exceedances in 2009/10 was similar to that in the 2007/08 and 2006/07 bathing seasons when fourteen and eight sites exceeded the action guideline respectively.

4.5.4 Wellington City

Three of the 21 marine sites monitored in Wellington City exceeded the action guideline during the bathing season. This is a similar result to the 2008/09 season when two sites exceeded the action guideline. Eleven sites exceeded the action guideline during the 2007/08 season, while only three sites exceeded in the 2006/07 season. The 2009/10 action events were isolated to the south coast (mainly Owhiro Bay) and are summarised below:

- 9 November 2009 – Owhiro Bay (396 cfu/100 mL).
- 7 December 2009 – Island Bay at Reef Street (492 cfu/100 mL) and Owhiro Bay (304 cfu/100 mL).
- 28 December 2009 – Owhiro Bay (476 cfu/100 mL).
- 11 January 2010 – Island Bay at Surf Club (424 cfu/100 mL).
- 25 January 2010 – Owhiro Bay (372 cfu/100 mL).
- 1 February 2010 – Owhiro Bay (612 cfu/100 mL).
- 8 February 2010 – Owhiro Bay (288 cfu/100 mL).
- 15 February 2010 – Owhiro Bay (976 cfu/100 mL).
- 1 March 2010 – Owhiro Bay (1,100 cfu/100 mL).
- 8 March 2010 – Owhiro Bay (750 cfu/100 mL).

Exceedances on 11 January and 25 January 2010 coincided with more than 10mm of rainfall in the 72 hours prior to sampling. All other exceedances coincided with little or no rainfall in the 72 hours prior to sampling.

The follow-up sample taken after the exceedance at Island Bay at Reef Street on 7 December 2009 significantly exceeded the action guideline (result of 4,320 cfu/100 mL). In response, health warning signs were erected along

Island Bay and an investigation into the source of contamination was undertaken by Capacity (for Wellington City Council). The investigation identified a blocked sewer on Dee Street as the likely source of contamination; this was subsequently fixed. A follow-up sample taken on 10 December complied with the surveillance guideline and health warning signs were removed.

Follow-up samples taken after exceedances at Owhiro Bay on 9 November, 7 December and 28 December 2009 were all within the surveillance guideline and no further action was taken. The follow-up sample taken after the exceedance on 25 January 2010 was well above the action guideline (result of 1,024 cfu/100 mL) and health warning signs were put up around Owhiro Bay.

Over the remainder of the bathing season, five out of eight routine samples taken at Owhiro Bay exceeded the action guideline, with up to three consecutive follow-up samples also exceeding the alert or action guideline. Subsequently, Capacity undertook extensive investigations within the Owhiro Bay catchment to identify the source of contamination. Several significant faults were found in the public and private sewer network and over 170 metres of sewer repairs were completed. Repairs were undertaken on sewer and stormwater systems in Reuben Avenue, Todman Street, Taft Street, Butt Street, Borlase Street, Mornington Road, Severn Street and Owhiro Bay Parade. Renewal of parts of the sewer mains along Happy Valley Road and Owhiro Bay Parade will be undertaken over the next financial year.

Health warning signs were finally removed from Owhiro Bay on 23 April 2010 after results from several consecutive samples complied with the surveillance guideline.

4.5.5 Wairarapa

In the Wairarapa four marine sites exceeded the action guideline of 280 cfu/100 mL, all on the same date. In contrast, only one site exceeded the action guideline during the 2008/09 summer. The 2009/10 action event is summarised below:

- 1 February 2010 – Castlepoint Beach at Castlepoint Stream (1,700 cfu/100 mL), Castlepoint Beach at Smelly Creek (428 cfu/100 mL), Riversdale Beach at Lagoon Mouth (520 cfu/100 mL) and Riversdale Beach between the flags (312 cfu/100 mL).

These exceedances coincided with very heavy rainfall (42.4mm) in the 72 hours prior to sampling. The results of follow-up samples collected by Greater Wellington staff all complied with the surveillance guideline.

4.6 Synthesis

Thirty eight of the 74 marine sites (51.4%) monitored over the 2009/10 summer bathing season exceeded the action guideline, although many of these (27 sites) exceeded the guideline on only one occasion (Table 4.2).

Table 4.2: Summary of action guideline breaches from routine weekly monitoring at 74 marine sites over the 2009/10 summer bathing season†

No. of Times Site Exceeded the Action Guideline	No. of Sites in each Exceedance Category					Total No. of Sites (74)	% of Sites
	Kapiti (20 sites)	Porirua (13 sites)	Hutt (15 sites)	Wellington (21 sites)	Wairarapa (5 sites)		
0	7	4	6	18	1	36	48.6
1	11	4	6	2	4	27	36.5
2	2	2	3	0	0	7	9.5
3	0	1	0	0	0	1	1.4
4	0	2	0	0	0	2	2.7
9	0	0	0	1	0	1	1.4

† Includes four sites (one in Hutt City and the Wairarapa and two in Wellington City) sampled fortnightly and one site (in Hutt City) sampled monthly.

A total of 61 (4.2%) routine sample results exceeded the action guideline of 280 cfu/100 mL. This was greater than in the 2008/09 bathing season when 32 exceedances were recorded (Warr 2009).

Apart from those in Owhiro Bay, the majority (42) of the 61 action events were associated with at least 10mm of rainfall in the three days prior to sampling. This finding is consistent with previous observations; elevated enterococci counts in marine waters are often related to urban stormwater (including sewer overflows), diffuse-source runoff into rivers and streams and re-suspension of sediments during rainfall events. Re-suspension of sediments (due to winds and/or tidal action) can also affect some beaches in dry weather as can poor water quality in rivers, streams and drains discharging directly to the coast (Milne & Wyatt 2006).

5. Recreational shellfish gathering water quality

5.1 Introduction

Recreational shellfish gathering water quality was monitored at nine marine sites across the Wellington region over 2009/10 (Figure 5.1, Appendix 1), as follows:

- Kapiti Coast District – 3 sites
- Porirua City – 3 sites⁹
- Hutt City – 1 site
- Wellington City – 2 sites

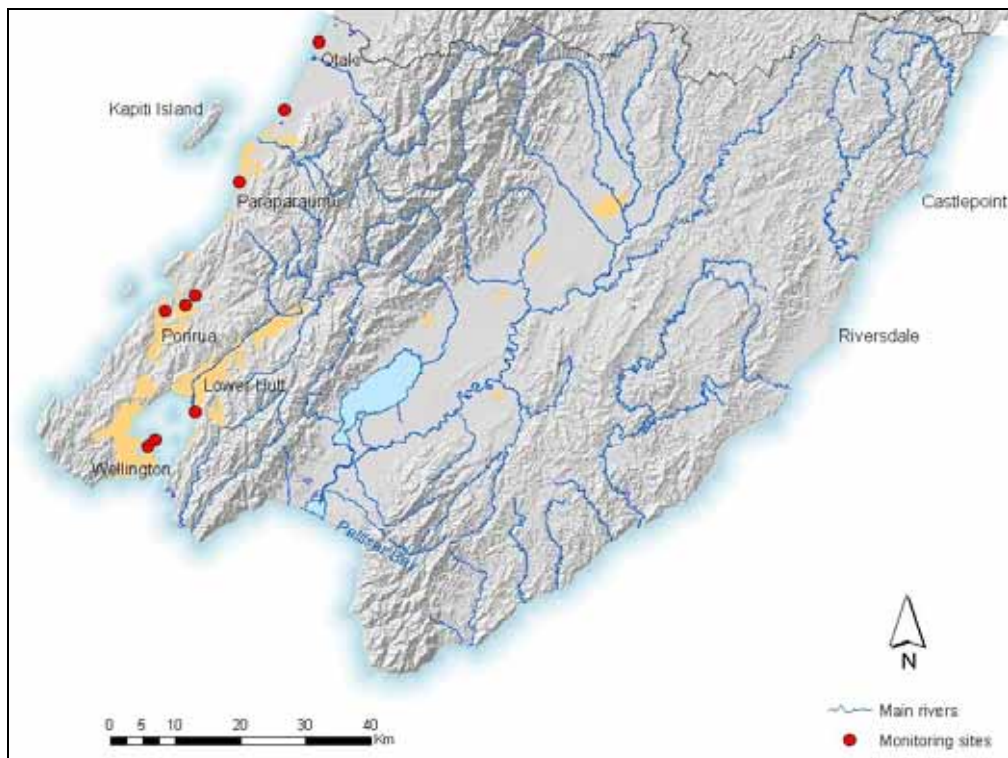


Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2009/10

5.2 Monitoring protocol

Sites were sampled weekly during 1 November 2009 to 31 March 2010 inclusive and at least monthly during the remainder of the year, at the same time as marine recreational water quality sampling (all nine sites are also marine bathing sites). On each sampling occasion a single water sample was collected 0.2 metres below the surface in 0.5 metres water depth and analysed for faecal coliform indicator bacteria using membrane filtration. Although the 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.

⁹ These sites, introduced in July 2007, are not recommended shellfish gathering sites but are monitored in response to community interest.

5.3 Guidelines

As outlined in Section 2.2, the MfE/MoH (2003) recreational water quality guidelines use faecal coliform bacteria as indicators 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/100 mL; and
- Not more than 10% of samples collected over a shellfish gathering season should exceed 43 MPN/100 mL.

The MfE/MoH (2003) guidelines also state the guideline values above should be applied in conjunction with a sanitary survey. Sanitary surveys are presented for each site in Appendix 3 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 Milne & Wyatt (2006).

5.4 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 most recent monitoring was undertaken in early 2006 (Milne 2006).

5.5 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 (i.e., 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 marine recreational water quality guidelines. The results of these follow-up samples were excluded from the calculation of compliance with the recreational shellfish gathering water quality guidelines (i.e., 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 (i.e., counts of <4 cfu/100 mL and >400 cfu/100 mL were treated as 2 cfu/100 mL and 400 mL respectively).

5.6 Results

Compliance with the shellfish gathering water quality guidelines over the 2009/10 summer season is summarised below for marine waters in Kapiti, Porirua City, Wellington City and Hutt City.

5.6.1 Kapiti

None of the three monitoring sites on the Kapiti Coast complied with the recreational shellfish gathering water quality guidelines for the 2009/10 summer period (Table 5.1). All median faecal coliform counts exceeded the guideline of 14 cfu/100mL, and more than 10% of water samples exceeded 43 cfu/100 mL.

Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2009/10 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Otaki Beach – Surf Club	35	2,200	9 (45%)	20
Peka Peka Beach – Road End	19	1,200	6 (30%)	20
Raumati Beach – Hydes Rd	25	240	8 (40%)	20

All maximum faecal coliform counts coincided with more than 10mm of rainfall in the 72 hours prior to sampling.

5.6.2 Porirua

Pauatahanui Inlet at Motukaraka Point complied with recreational shellfish gathering water quality guidelines for the 2009/10 summer period. However, both Pauatahanui Inlet at Browns Bay and Porirua Harbour at Rowing club exceeded the median faecal coliform guideline of 14 cfu/100mL, and more than 10% of water samples from these sites exceeded 43 cfu/100mL (Table 5.2).

Table 5.2: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2009/10 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Pauatahanui Inlet at Browns Bay	26	900	8 (40%)	20
Pauatahanui Inlet at Motukaraka Point	3	180	1 (5%)	20
Porirua Harbour at Rowing Club	36	780	9 (45%)	20

The maximum faecal bacteria counts recorded at the Porirua Harbour at Rowing Club on 1 December 2009 and at Browns Bay and Motukaraka Point on 29 December 2009 coincided with more than 10mm of rainfall in the 72 hours prior to sampling.

5.6.3 Wellington City

Both Wellington monitoring sites complied with the recreational shellfish gathering water quality guidelines for the 2009/10 summer period (Table 5.3).

Table 5.3: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2009/10 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Shark Bay	2	730	1 (5%)	20
Mahanga Bay	2	110	1 (5%)	20

Only a very small amount of rain (<1mm) fell in the 72 hours prior to the maximum faecal bacteria counts recorded at Shark Bay and Mahanga Bay on 9 November 2009.

5.6.4 Hutt

In Hutt City, recreational shellfish gathering water quality was monitored at one site in Sorrento Bay. This site complied fully with the recreational shellfish gathering water quality guidelines for the 2009/10 summer period, despite two faecal coliform counts exceeding 43 cfu/100 mL (Table 5.4). The maximum faecal bacteria count (590 cfu/100 mL on 1 December 2009) coincided with 25mm of rainfall in the 72 hours prior to sampling as well as rain on the day.

Table 5.4: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2009/10 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Site	Median (cfu/100 mL)	Maximum (cfu/100 mL)	No. (and percentage) of results >43 cfu/100 mL	Total no. of samples
Sorrento Bay	2	590	2 (10%)	20

5.7 Synthesis

All Wellington and Hutt sites complied fully with shellfish gathering water quality guidelines for the 2009/10 summer period. In comparison, Porirua and Kapiti Coast sites had high faecal coliform levels, and only one of these sites complied with the guidelines. These results are consistent with those from the 2008/09 bathing season (Warr 2009).

Analysis of rainfall records indicates that most elevated faecal coliform results coincided with significant rainfall prior to sampling. As discussed in section 4.6, it is advisable to avoid contact with marine recreational waters for several days after heavy rain.

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¹⁰ Published June 2002, updated June 2003.

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Appendix 1: Monitoring sites

Area	Site Name	NZTM co-ordinates		Type
		Easting	Northing	
Hutt	Hutt River @ Birchville	1776196	5449091	Freshwater
Hutt	Hutt River @ Boulcott	1760920	5437569	Freshwater
Hutt	Hutt River @ Maoribank Corner	1775882	5446696	Freshwater
Hutt	Hutt River @ Poets Park	1771461	5446092	Freshwater
Hutt	Hutt River @ Silverstream Bridge	1767598	5443172	Freshwater
Hutt	Pakuratahi River @ Forks	1784288	5452620	Freshwater
Hutt	Wainuiomata River @ Richard Prouse Park	1764536	5429141	Freshwater
Hutt	Petone Beach @ Water Ski Club	1755744	5434591	Marine
Hutt	Petone Beach @ Sydney Street	1757045	5434248	Marine
Hutt	Petone Beach @ Settlers Museum	1757555	5434056	Marine
Hutt	Petone Beach @ Kiosk	1758326	5433711	Marine
Hutt	Sorrento Bay	1759632	5431384	Marine ¹
Hutt	Lowry Bay @ Cheviot Road	1760206	5430891	Marine
Hutt	York Bay	1759977	5430160	Marine
Hutt	Days Bay @ Wellesley College	1759616	5428529	Marine
Hutt	Days Bay @ Wharf	1759654	5428313	Marine
Hutt	Days Bay @ Moana Road	1759582	5428120	Marine
Hutt	Rona Bay @ N end of Cliff Bishop Park	1759109	5427654	Marine
Hutt	Rona Bay @ Wharf	1758730	5427371	Marine
Hutt	Robinson Bay @ HW Shortt Rec Ground	1758519	5426674	Marine
Hutt	Robinson Bay @ Nikau Street	1758131	5425856	Marine
Hutt	Camp Bay	1756990	5424288	Marine
Kapiti	Otaki River @ State Highway 1	1781309	5484406	Freshwater
Kapiti	Otaki River @ Pots	1785444	5478749	Freshwater
Kapiti	Waikanae River @ Jim Cooke Park	1772155	5472377	Freshwater
Kapiti	Waikanae River @ State Highway 1	1773752	5472296	Freshwater
Kapiti	Otaki Beach @ Surf Club	1778622	5488330	Marine ¹
Kapiti	Otaki Beach @ Rangiu Road	1778010	5487069	Marine
Kapiti	Te Horo Beach S of Mangaone Stream	1775779	5482478	Marine
Kapiti	Te Horo Beach @ Kitchener Street	1775495	5481933	Marine
Kapiti	Peka Peka Beach @ Road End	1773215	5477905	Marine ¹
Kapiti	Waikanae Beach @ William Street	1771388	5475584	Marine
Kapiti	Waikanae Beach @ Tutere St Tennis Courts	1770655	5474862	Marine
Kapiti	Waikanae Beach @ Ara Kuaka Carpark	1769514	5473978	Marine
Kapiti	Paraparaumu Beach @ Ngapotiki Street	1767543	5472762	Marine
Kapiti	Paraparaumu Beach @ Nathan Avenue	1767033	5472174	Marine
Kapiti	Paraparaumu Beach @ Maclean Park	1766694	5471267	Marine
Kapiti	Paraparaumu Beach @ Toru Road	1766577	5470715	Marine
Kapiti	Paraparaumu Beach @ Wharemauku Road	1766503	5470070	Marine
Kapiti	Raumati Beach @ Tainui Street	1766531	5469229	Marine
Kapiti	Raumati Beach @ Marine Gardens	1766516	5468441	Marine
Kapiti	Raumati Beach @ Aotea Road	1766414	5467529	Marine
Kapiti	Raumati Beach @ Hydes Road	1766318	5466835	Marine ¹
Kapiti	Paekakariki Beach @ Whareroa Road	1765598	5464128	Marine
Kapiti	Paekakariki Beach @ Surf Club	1764791	5462273	Marine
Porirua	Pukerua Bay	1759058 ²	5456278 ²	Marine
Porirua	Karehana Bay @ Cluny Road	1756093	5451360	Marine
Porirua	Plimmerton Beach @ Bath Street	1756706	5450316	Marine
Porirua	South Beach @ Plimmerton	1756810	5449874	Marine
Porirua	Pauatahanui Inlet @ Water Ski Club	1758074	5449593	Marine
Porirua	Pauatahanui Inlet @ Motukaraka Point	1759486	5449338	Marine ¹

Area	Site Name	NZTM co-ordinates		Type
		Easting	Northing	
Porirua	Pauatahanui Inlet @ Browns Bay	1758039	5447833	Marine ¹
Porirua	Porirua Harbour @ Rowing Club	1754891	5446947	Marine ¹
Porirua	Titahi Bay @ Bay Drive	1754132	5448169	Marine
Porirua	Titahi Bay at Toms Road	1754110	5447857	Marine
Porirua	Titahi Bay @ South Beach Access Road	1753906	5447682	Marine
Porirua	Onehunga Bay	1755796	5449181	Marine
Porirua	Pauatahanui Inlet @ Paremata Bridge	1757153	5448284	Marine
Wairarapa	Ruamahanga River @ Bentleys Beach	1800534	5432813	Freshwater
Wairarapa	Ruamahanga River @ Double Bridges	1824350	5471775	Freshwater
Wairarapa	Ruamahanga River @ Kokotau	1815756	5447191	Freshwater
Wairarapa	Ruamahanga River @ Morrisons Bush	1808918	5441108	Freshwater
Wairarapa	Ruamahanga River @ Te Ore Ore	1825529	5462917	Freshwater
Wairarapa	Ruamahanga River @ The Cliffs	1821476	5452180	Freshwater
Wairarapa	Ruamahanga River @ Waihenga	1804610	5436461	Freshwater
Wairarapa	Waingawa River @ Kaituna	1810326	5471149	Freshwater
Wairarapa	Waingawa River @ South Road	1820550	5460878	Freshwater
Wairarapa	Waiohine River @ Gorge	1801853	5455936	Freshwater
Wairarapa	Waiohine River @ State Highway 2	1809665	5451711	Freshwater
Wairarapa	Waipoua River @ Colombo Road	1824996	5462889	Freshwater
Wairarapa	Castlepoint Beach @ Castlepoint Strea	1871366	5467559	Marine
Wairarapa	Castlepoint Beach @ Smelly Creek	1871670	5467202	Marine
Wairarapa	Riversdale Beach @ Lagoon Mouth	1858965	5447543	Marine
Wairarapa	Riversdale Beach Between the Flags	1858435	5446948	Marine
Wairarapa	Riversdale Beach South	1857834	5445514	Marine
Wellington	Aotea Lagoon	1748985	5427683	Marine
Wellington	Oriental Bay @ Freyberg Beach	1749920	5427464	Marine
Wellington	Oriental Bay @ Wishing Well	1750118	5427386	Marine
Wellington	Oriental Bay @ Band Rotunda	1750243	5427375	Marine
Wellington	Balaena Bay	1750958	5427267	Marine
Wellington	Hataitai Beach	1750632	5425730	Marine
Wellington	Shark Bay	1752211	5426197	Marine ¹
Wellington	Mahanga Bay	1753468	5427115	Marine ¹
Wellington	Scorching Bay	1753517	5426647	Marine
Wellington	Worser Bay	1753074	5424823	Marine
Wellington	Seatoun Beach @ Wharf	1753129	5424234	Marine
Wellington	Seatoun Beach @ Inglis Street	1753405	5423994	Marine
Wellington	Breaker Bay	1753312	5422970	Marine
Wellington	Lyll Bay @ Tirangi Road	1750747	5423230	Marine
Wellington	Lyll Bay @ Onepu Road	1750286	5423116	Marine
Wellington	Lyll Bay @ Queens Drive	1749990	5422868	Marine
Wellington	Princess Bay	1749586	5421504	Marine
Wellington	Island Bay @ Surf Club	1748377	5421590	Marine
Wellington	Island Bay @ Reef St Recreation Ground	1748229	5421542	Marine
Wellington	Island Bay @ Derwent Street	1748155	5421415	Marine
Wellington	Owhiro Bay	1747122	5421463	Marine

¹ Water quality is also monitored for recreational shellfish gathering purposes

² This location differs from that sampled in previous years

Appendix 2: 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
<i>Escherichia coli</i> at 44.5°C	APHA Standard Methods (20 th Ed.) 9213D, Membrane filter on mTEC agar, Urea substrate	1-4/100 mL
Enterococci at 41°C	US EPA Method 1600, Membrane filter on mEI agar	1-5 cfu/100 mL
Faecal coliforms at 44.5°C	APHA Standard Methods (20 th Ed.) 9222D, Membrane filter on mFC agar	1-5 cfu/100 mL
Water temperature	Field meter or digital thermometer	0.1°C
Turbidity	APHA Standard Methods (20 th 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%

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), Wainuiomata Reservoir (Wainuiomata River)
- Wairarapa – Mount Bruce (Ruamahanga River), Kaituna (Waipoua River, Waingawa River), Phelps (Waiohine River), Angle Knob (located in the upper Waingawa catchment and used as indicator of rainfall high in Tararua Range).

Marine Recreational Sites

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

* NIWA rainfall stations

Appendix 3: Summary statistics and SFRGs

Microbiological water quality data for the 2009/10 summer are summarised in the tables below. The Microbiological Assessment Category (MAC) values and Suitability for Recreation Grades (SFRGs) determined by Milne & Wyatt (2006)¹¹ have been updated using the 2005/06 – 2009/10 microbiological results.

(a) Freshwaters

Bathing Site	Total no. of samples	No. sample results (<i>E. coli</i> /100 mL)			Beach grading (2005/06 – 2009/10 data)		
		Surveillance (≤260)	Alert (261-550)	Action (>550)	SIC Grade	MAC Grade (95 th -ile value)	SFRG ¹
<i>Kapiti</i>							
Otaki R @ Pots	5 ²	5	0	0	Low	B (196) ³	Good ³
Otaki R @ SH 1	20	20	0	0	Moderate	B (229)	Good
Waikanae R @ SH 1	20	18	1	1	Moderate	C (325)	Fair
Waikanae R @ Jim Cooke Park	20	17	2	1	Moderate ⁴	C (370)	Fair ⁴
<i>Hutt & Wainuiomata</i>							
Pakuratahi R @ Forks	20	19	0	1	Moderate	D (792)	Poor
Hutt R @ Birchville	20	18	0	2	Moderate	D (972)	Poor
Hutt R @ Maoribank Corner	20	18	1	1	Moderate	D (686)	Poor
Hutt R @ Poets Park	20	19	1	0	Moderate	C (440)	Fair
Hutt R @ Silverstream	20	19	1	0	Moderate	D (1,950)	Poor
Hutt R @ Boulcott	20	19	0	1	Moderate	D (1,830)	Poor
Wainuiomata R @ RP Park	20	19	0	1	Moderate ⁴	D (1,120)	Poor ⁴
<i>Wairarapa</i>							
Ruamahanga R @ Double Bridges	20	19	0	1	Mod/High	D (610)	Poor/V. Poor
Ruamahanga R @ Te Ore Ore	20	18	1	1	High	D (1,372)	Very Poor
Ruamahanga R @ The Cliffs	20	20	0	0	High	C (500)	Poor
Ruamahanga R @ Kokotau	20	16	1	3	High	D (1,120)	Very Poor
Ruamahanga R @ Morrisons Bush	20	18	1	1	High	C (472)	Poor
Ruamahanga R @ Waihenga	20	18	0	2	High	D (612)	V. Poor
Ruamahanga R @ Bentleys Beach	20	18	1	1	High	D (646)	Very Poor
Waipoua R @ Colombo Rd	20	19	0	1	High	D (631)	V. Poor
Waingawa R @ Kaituna	20	20	0	0	Low	B (163)	Good
Waingawa R @ South Rd	20	20	0	0	Moderate	A (125)	ND ⁵
Waiohine R @ Gorge (Gauge)	5 ²	5	0	0	Low	A (114) ³	V. Good ³
Waiohine R @ SH 2	20	20	0	0	Moderate	A (81)	Good

¹ Note that the freshwater SFRGs better reflect the condition of the water during wet weather than dry weather when contact recreation would be greatest (see Milne & Wyatt 2006).

² From November 2006, sampled monthly under Greater Wellington's Rivers State of the Environment water quality programme.

³ Based on 2001/02 – 2006/07 data as presented in Milne & Wyatt (2006).

⁴ Interim grading (SIC grading based on previously graded sites in the same catchment or catchment knowledge, MAC grade based on 3 years of data, n=62)

⁵ Not determined as this combination of SIC and MAC grades is unexpected and indicates that re-assessment of the SIC grade is needed.

¹¹ The SFRGs are determined by the Sanitary Inspection Category (SIC) value and the MAC value. The SIC value (determined in 2006 and to be reviewed every five years) generally has the greatest influence on the SFRG. Milne & Wyatt (2006) provide a full explanation of the beach grades and the grading process.

(b) Marine waters

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2005/06 – 2009/10 data)		
		Surveillance (≤ 140)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th -ile value)	SFRG
<i>Kapiti</i>							
Otaki Beach @ Surf Club	20	19	1	0	Low	C (271)	Fair
Otaki Beach @ Rangiuuru Rd	20	19	0	1	Low	C (203)	Fair
Te Horo Beach S of Mangaone Strm	20	18	0	2	Moderate	C (381)	Fair
Te Horo Beach @ Kitchener St	20	19	0	1	Moderate	C (256)	Fair
Peka Peka Beach @ Rd End	20	19	0	1	Low	B (116)	Good
Waikanae Beach @ William St	20	19	0	1	Moderate	B (114)	Good
Waikanae Beach @ Tutere St T.C.	20	18	1	1	Moderate	B (129)	Good
Waikanae Beach @ Ara Kuaka C.P.	20	19	0	1	Moderate	B (196)	Good
Paraparaumu Beach @ Ngapotiki St	20	18	1	1	Moderate	C (328)	Fair
Paraparaumu Beach @ Nathan Ave	20	18	1	1	Moderate	C (365)	Fair
Paraparaumu Beach @ Maclean Pk	20	19	1	0	Moderate	C (240)	Fair
Paraparaumu Beach @ Toru Rd	20	18	0	2	Moderate	C (355)	Fair
Paraparaumu Beach @ Wharemauku Rd	20	17	3	0	Moderate	B (210)	Fair
Raumati Beach @ Tainui St	20	20	0	0	Moderate	B (136)	Good
Raumati Beach @ Marine Gardens	20	19	0	1	Moderate	C (258)	Fair
Raumati Beach @ Aotea Rd	20	19	0	1	Low/Mod	B (144)	Good
Raumati Beach @ Hydes Rd	20	19	1	0	Moderate	B (199)	Good
Paekakariki Beach @ Whareroa Rd	20	19	1	0	Low	B (75)	Good
Paekakariki Beach @ Surf Club	20	19	0	1	Low	B (64)	Good
Paekakariki Beach @ Memorial Hall	20	20	0	0	Low	B (51)	Good
<i>Porirua</i>							
Pukerua Bay	20	19	0	1	Low	B (168)	Good
Karehana Bay @ Cluny Rd	20	18	0	2	Moderate	C (284)	Fair
Plimmerton Beach @ Bath St	20	19	1	0	Moderate	B (186)	Good
South Beach @ Plimmerton	20	13	3	4	Moderate	D (518)	Poor
Pauatahanui Inlet @ Water Ski Club	20	19	0	1	Moderate	B (193)	Good
Pauatahanui Inlet @ Motukaraka Pt	20	19	1	0	Moderate	C (203)	Fair
Pauatahanui Inlet @ Browns Bay	20	19	0	1	Moderate	C (328)	Fair
Pauatahanui Inlet @ Paremata Bridge	20	20	0	0	Moderate ¹	B (98)	Good ¹
Porirua Harbour @ Rowing Club	20	16	1	3	Moderate	D (1,300)	Poor
Titahi Bay @ Bay Drive	20	18	0	2	Moderate	C (282)	Fair
Titahi Bay @ Toms Rd	20	19	0	1	Moderate	C (225)	Fair
Titahi Bay @ South Beach Access Rd	20	15	1	4	Moderate	C (425)	Fair
Onehunga Bay	20	19	1	0	Moderate	B (61)	Good
<i>Hutt</i>							
Petone Beach @ Water Ski Club	20	20	0	0	Moderate	C (223)	Fair
Petone Beach @ Sydney St	20	18	0	2	Moderate	C (295)	Fair
Petone Beach @ Settlers Museum	20	19	1	0	Moderate	C (205)	Fair
Petone Beach @ Kiosk	20	18	2	0	Moderate	C(212)	Fair
Sorrento Bay	20	19	0	1	Low	B (56)	Good
Lowry Bay @ Cheviot Rd	20	19	0	1	Low	C(300)	Fair

Bathing Site	Total no. of samples	No. sample results (Enterococci/100 mL)			Beach grading (2005/06 – 2009/10 data)		
		Surveillance (≤ 140)	Alert (141-280)	Action (>280)	SIC Grade	MAC Grade (95 th %-ile value)	SFRG
York Bay	20	19	0	1	Low	B (74)	Good
Days Bay @ Wellesley College	20	19	0	1	Low	B (133)	Good
Days Bay @ Wharf	20	19	0	1	Low	C (223)	Fair
Days Bay @ Moana Rd	20	18	2	0	Low	B (177)	Good
Rona Bay @ N end of Cliff Bishop Pk	20	17	1	2	Low/Mod	C (203)	Fair
Rona Bay @ Wharf	20	18	1	1	Low/Mod	C(238)	Fair
Robinson Bay @ HW Shortt Rec Grd	20	16	2	2	Low	D (677)	ND ²
Robinson Bay @ Nikau St	20	20	0	0	Low	B (113)	Good
Camp Bay	5 ³	5	0	0	Very Low	B (64)	V. Good
<i>Wellington City</i>							
Aotea Lagoon	20	18	2	0	Moderate	B (112)	Fair
Oriental Bay @ Freyberg Beach	20	20	0	0	Moderate	B (58)	Good
Oriental Bay @ Wishing Well	20	20	0	0	Moderate	C (208)	Fair
Oriental Bay @ Band Rotunda	20	20	0	0	Moderate	B (130)	Good
Balaena Bay	20	20	0	0	Low	A (34)	V. Good
Hataitai Beach	20	20	0	0	Moderate	B (93)	Good
Shark Bay	20	20	0	0	Low	B (51)	Good
Mahanga Bay	20	20	0	0	Low	B (76)	Good
Scorching Bay	20	20	0	0	Low	A (38)	V. Good
Worser Bay	20	19	1	0	Low	A (38)	V. Good
Seatoun Beach @ Wharf	20	19	1	0	Low/Mod	B (57)	Good
Seatoun Beach @ Inglis St	20	19	1	0	Low/Mod	B (65)	Good
Breaker Bay	10 ⁴	10	0	0	V. Low	A (12)	V. Good
Lyll Bay @ Tirangi Rd	20	20	0	0	Moderate	B (131)	Good
Lyll Bay @ Onepu Rd	20	20	0	0	Moderate	B (49)	Good
Lyll Bay @ Queens Drive	20	20	0	0	Moderate	B (41)	Good
Princess Bay	10 ⁴	10	0	0	Low	A (12)	V. Good
Island Bay @ Surf Club	20	18	1	1	Moderate	C (222)	Fair
Island Bay @ Reef St Recreation Grd	20	18	1	1	Moderate	B (145)	Good
Island Bay @ Derwent St	20	20	0	0	Moderate	A (39)	ND ²
Owhiro Bay	20	8	3	9	Moderate	D (617)	Poor
<i>Wairarapa</i>							
Castlepoint Beach @ Castlepoint Strm	20	18	1	1	Moderate	B (151)	Good
Castlepoint Beach @ Smelly Creek	20	18	1	1	Moderate	B (174)	Good
Riversdale Beach @ Lagoon Mouth	20	19	0	1	Moderate	B (71)	Good
Riversdale Beach Between the Flags	20	19	0	1	Low	B (51)	Good
Riversdale Beach South	12	12	0	0	Very Low	A (24)	V. Good

¹ Interim grade (SIC grading based on that for other Pauatahanui sites, MAC grade based on 3 years of data, n=62)

² Not determined as this combination of SIC and MAC grades is unexpected and indicates that re-assessment of the SIC grade is needed.

³ From November 2009, sampled monthly.

⁴ From November 2006, sampled fortnightly.

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

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