Is it safe to swim?

Recreational water quality monitoring results for the 2015/16 summer

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

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Executive summary

This report summarises the results of weekly recreational water quality monitoring undertaken over the 2015/16 summer bathing season (1 November 2015 to 31 March 2016). The recreational water quality monitoring programme is undertaken by Greater Wellington Regional Council along with Kapiti Coast District Council, Porirua City Council, Hutt City Council and Wellington City Council to identify risks to public health from disease-causing organisms and toxic cyanobacteria.

Over the 2015/16 bathing season recreational water quality was monitored at 24 river sites, one estuarine site and 63 coastal sites. At each site, water samples were taken for analysis of faecal indicator bacteria (*E. coli* at river and estuarine sites, enterococci at coastal sites and faecal coliforms at coastal shellfish gathering sites) and results were assessed against the Ministry for Environment (MfE)/Ministry of Health (MoH) (2003) national microbiological water quality guidelines. At river sites, filamentous algae, mat algae and benthic cyanobacteria (toxic algae) cover were assessed and results compared to the MfE (2000) nuisance periphyton guidelines and the MfE/MoH (2009) interim cyanobacteria guidelines. Water clarity was also assessed at river sites and results compared to the MfE (1994) guideline for recreational waters.

Of the 20 river sites and one estuarine site monitored weekly over the 2015/16 summer season, three sites (14%) exceeded the MfE/MoH (2003) action guideline on at least one occasion. Eighty percent of these exceedances coincided with significant rainfall in the 24 hours prior to sampling and/or elevated river flows. Of the total 25 sites monitored overall, ten sites (40%) have 'all weather' Suitability For Recreation Grades (SFRGs) of 'good' or better while 17 sites (68%) have 'dry weather' SFRGs of 'good' or better.

The MfE (2000) nuisance filamentous periphyton guideline was not met at several sites on several occasions during the season, most notably on eight occasions at Ruamahanga River at Waihenga Bridge and six occasions at Ruamahanga River at Kokotau. The filamentous periphyton guideline breaches mostly occurred in February and early March 2016, following a prolonged period of low, stable river flows. The guideline for nuisance mat periphyton was met at all sites on all sampling occasions.

The action level of the MfE/MoH (2009) interim cyanobacteria guidelines was breached at five sites (Hutt River at Birchville, Hutt River at Maoribank Corner, Hutt River at Poets Park, Hutt River at Silverstream Bridge and Waipoua River at Colombo Road), due to the presence of significant amounts of detached cyanobacteria mats. Toxic algae information signs were put up at these sites by local councils and up-to-date warnings posted on GWRC and LAWA websites. A dog died after contact with the lower reaches of the Otaki River in February 2016 but this could not be confirmed as being a result of toxic algae poisoning.

The MfE (1994) guideline for water clarity was met most of the time (95% of sampling occasions). Poor water clarity following freshes accounted for over half (55%) of the occasions when the guideline was not met, while upstream river works accounted for the 45% of water clarity guideline breaches.

Twenty one of the 63 coastal sites (33%) monitored weekly during the 2015/16 bathing season exceeded the MfE/MoH (2003) action guideline on at least one occasion. Sites that most frequently exceeded the action guideline were Plimmerton Beach at Bath Street, South Beach at Plimmerton and Lyall Bay at Tirangi Road (twice each). None of the exceedances at these sites were associated with significant rainfall prior to sampling.

As of the end of the 2015/16 bathing season, 32 (51%) coastal monitoring sites have SFRGs of 'good' or better. Twenty two sites are graded 'fair' and the remaining eight sites are graded 'poor': Plimmerton Beach at Bath Street, South Beach at Plimmerton, Porirua Harbour at Rowing Club, Titahi Bay at South Beach Access Road, Island Bay at Reef Street Recreation Ground, Island Bay at Surf Club, Island Bay at Derwent Street and Owhiro Bay.

Of the seven coastal sites monitored to assess water quality for recreational shellfish gathering in 2015/16 only the two Wellington City sites (Shark Bay and Mahanga Bay) were fully compliant with shellfish gathering water quality guidelines over the summer period. All other sites breached one or both of the guideline criteria.

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Petone Beach at Sydney Street. This site is graded 'fair' for contact recreation.

Waiohine River at State Highway 2. This site is graded ‘very good’ for contact recreation.

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 during 2015/16 was once again a joint effort involving the Greater Wellington Regional Council (GWRC) and its constituent local councils, in particular the Kapiti Coast District Council, Porirua City Council, Hutt City Council, Wellington City Council as well as Wellington Water. Regional Public Health was consulted when the results of the monitoring indicated an increased likelihood of illness associated with recreational use. During the summer bathing season (mid-November 2015 to 31 March 2016), Suitability for Recreation Grades (SFRGs) as well as weekly water test results and cyanobacteria (toxic algae) warnings were displayed at *www.gw.govt.nz/summer-check*. Weekly test results and other information are also displayed on a national website, Land and Water Aotearoa (*www.lawa.org.nz*).

This report summarises the results of weekly monitoring undertaken over the 2015/16 summer bathing season and presents updated SFRGs for the region based on these results. A more comprehensive assessment of recreational water quality is prepared on a five-yearly basis as part of GWRC's State of the Environment reporting (eg, see Greenfield et al. 2012a).

Paekakariki Beach at Whareroa Road. This site is graded 'good' for contact recreation

2 Recreational water quality monitoring in the Wellington region

Recreational water quality monitoring in the Wellington region is a joint effort involving GWRC 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 GWRC's recreational water quality monitoring programme are to:

- Determine the suitability of selected sites in coastal and fresh waters for contact recreation;
- Determine the suitability of coastal waters for the gathering of shellfish for human consumption;
- Assist in safeguarding public health and the environment;
- Provide information required to determine the effectiveness of regional plans and policies;
- Provide information to assist in determining spatial and temporal changes in the environment (State of the Environment (SoE) monitoring); and
- 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 cannot 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 that 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) 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:

1. Faecal indicator bacteria trigger values to assess individual monitoring results throughout the bathing season and
2. Beach grades that describe the general condition of a site at any given time.

[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.

2.2.1 Trigger values

The MfE/MoH (2003) guidelines provide 'trigger' values for fresh and coastal waters to help water managers assess individual microbiological 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 fresh and coastal waters for recreational use from a public health perspective. The grades are intended to describe the general condition of the water at any given time with the potential for the water to be unsuitable for swimming increasing as the grades decline. The two components providing a SFRG for the water at an individual site are:

- the Sanitary Inspection Category (SIC), which is a qualitative assessment of the susceptibility of the water body to faecal contamination; and
- the Microbiological Assessment Category (MAC), which is a measure of the actual water quality over time based on bacteriological test results.

The SIC allows the principal source of faecal contamination in a catchment (eg, sewage overflows, stormwater discharges, agricultural runoff, wildlife, etc.) to be identified and assigns a category (value) according to risk. This value is 'very high', 'high', 'moderate', 'low', or 'very low', and is found for a specific water body by use of a SIC flow chart. For more information see Greenfield et al. 2012b). SIC are reviewed every five years.

The MAC component of the SFRG is based on a 95th percentile of sample results from a five-year period (ie, typically 100 data points). MAC are updated each year at the end of the bathing season.

There are five SFRGs ranging from 'very good' to 'very poor' with risk to human health increasing as the grades decline (Table 2.2). For ease of interpretation, grades are expressed as letters from A to F in summary cards accompanying this report. Summary cards can be accessed from www.gw.govt.nz/Annual-monitoring-reports.

Lake Wairarapa

Table 2.2: Suitability for Recreation Grades (SFRGs) and explanation of human health risk associated with each

SFRG		Summary card annotation	Explanation
	Very good	A	Generally excellent water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming almost all of the time.
	Good	B	Suitable for swimming most of the time. Swimming should be avoided during or following heavy rain.
	Fair	C	Generally suitable for swimming but extra care should be taken to avoid contact with the water during or following rainfall or if there are signs of pollution such as discoloured water, odour or debris in the water.
	Poor	D	Susceptible to faecal pollution and water quality is not always suitable for swimming. During dry weather ensure that the site is free of signs of pollution such as discoloured water, odour or debris in the water and avoid swimming at all times during and for up to two days following rainfall.
	Very poor	F	Very susceptible to faecal pollution and water quality may often be unsuitable for swimming. It is generally recommended to avoid swimming at these sites.

In 2012, SIC grades for all recreational water quality monitoring sites in the Wellington region were reviewed (Greenfield et al. 2012b). These SICs have been combined here with MAC grades based on data from the five most recent bathing seasons (2011/12 –2015/16) to give updated SFRGs for each site.

It should be noted that because the MAC component of the SFRG is based on a 95th percentile calculated over five summer seasons, this value is heavily influenced by high indicator bacteria counts, often from wet weather sampling events. This means that from year to year a MAC (and therefore a SFRG) can fluctuate as high test results are added (from the latest bathing season) or removed (due to the first season of results being replaced by the most recent results) from the data set. In many cases changes in MAC/SFRG may simply reflect the difference between the addition or loss of a wetter summer season from the data set, rather than a significant shift in water quality. All grade changes are checked to assess whether further investigation is required.

3 Recreational water quality in freshwaters

3.1 Introduction

Recreational water quality was monitored at 24 river sites and one estuarine site (Riversdale Lagoon) across the Wellington region over the 2015/16 bathing season (Figure 3.1, Appendix 1), as follows:

- Kapiti Coast District – 4 sites
- Hutt and Wainuiomata river catchments – 8 sites
- Wairarapa – 13 sites

The sites monitored reflect their use by the public for contact recreation; in particular, swimming and boating[2].

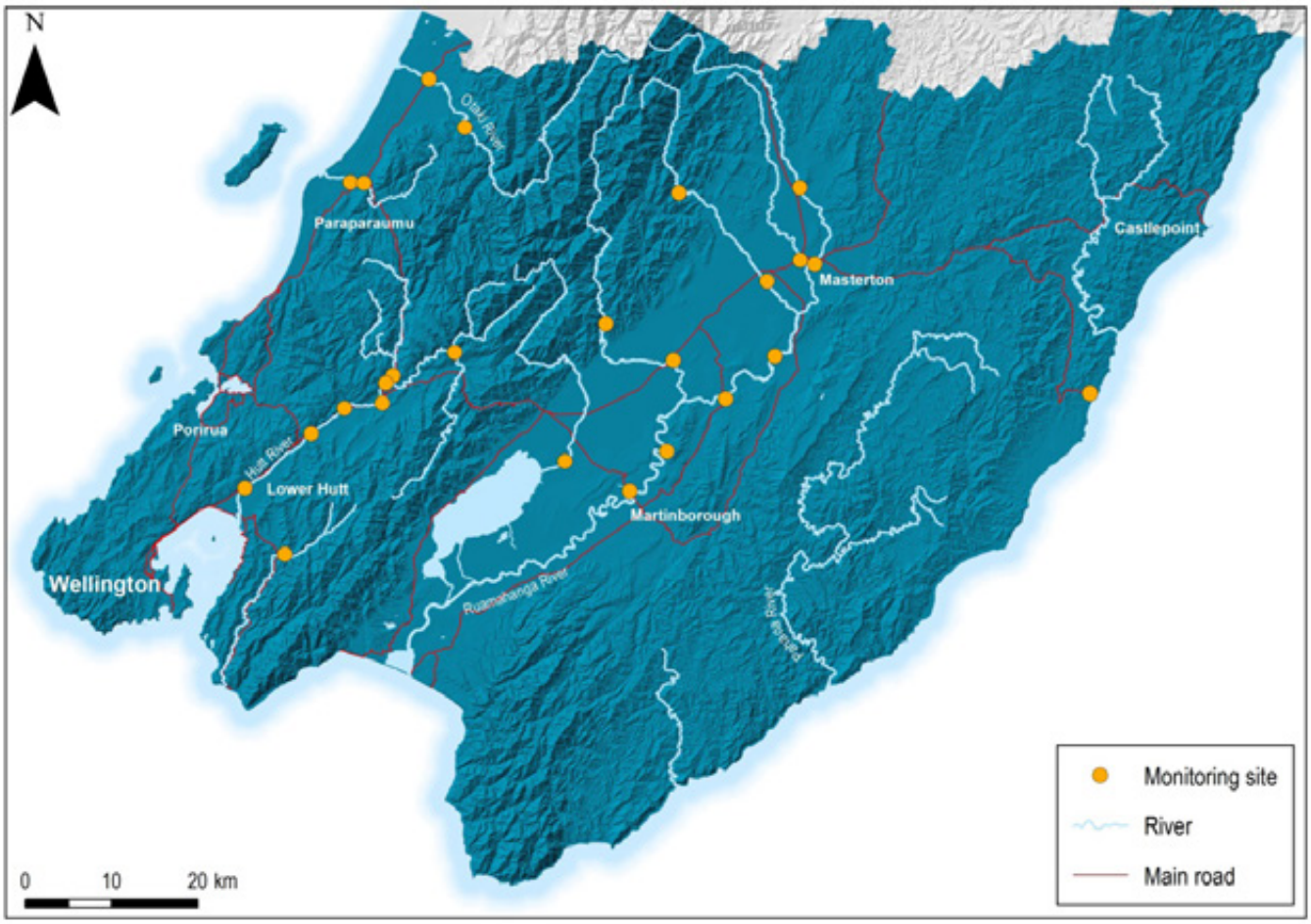

Figure 3.1: Freshwater recreation sites monitored over summer 2015/16

[2] 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. Riversdale Lagoon is not recommended for swimming (permanent health warning signs are in place) but is monitored in response to community interest.

3.2 Monitoring protocol

Sites were sampled weekly – for 20 weeks – between mid-November 2015 and 31 March 2016. The exceptions were Otaki River at Pots (in Otaki Gorge on the Kapiti Coast), Akatarawa River at Hutt Confluence (Upper Hutt), Waiohine River at Gorge and Tauherenikau River at Websters (Wairarapa), which were sampled monthly under GWRC's Rivers State of the Environment (RSoE) monitoring programme[3]. 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 were also collected at each site. Visual estimates of water clarity and periphyton (algae) and cyanobacteria cover were made at all river sites. Daily rainfall records were obtained for the nearest rain gauge for each site (Appendix 2), to give an indication of rainfall in the upstream catchment. 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 *E. coli* in freshwaters

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 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; it is widely known that rainfall is highly correlated with elevated bacteria counts in rivers (see Section 3.5.1). For this reason GWRC and Regional Public Health advise avoiding swimming and other contact recreation activities in freshwaters during and for up to two days after heavy rainfall.

[3] Historically Otaki River at Pots and Waiohine River at Gorge were sampled separately under two GWRC 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.

(b) Suitability for Recreation Grades

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

Greenfield et al. (2012b) derived two SFRGs for each river 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[4]. Microbiological risk factors and corresponding SIC values, together with MAC values, were derived under both conditions and combined to obtain the two grades.

3.3.2 Nuisance periphyton guidelines

Excessive amounts of periphyton[5] 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.

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

Susceptibility to faecal influence		Microbiological Assessment Category (MAC)[1]			
		A	**B**	**C**	**D**
		≤130	131–260	261–550	>550
		E. coli/100mL	*E. coli*/100mL	*E. coli/100mL*	*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.

[4] 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.

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

3.3.3 Interim cyanobacteria guidelines

Growth of benthic cyanobacteria (toxic algae) 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. The interim guidelines for rivers identify a three-tiered alert level framework for benthic cyanobacteria (Table 3.3).

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, Territorial Authority and GWRC staff. Close monitoring of 'flushing' river flows[6] and the potential for occurrence of cyanobacteria blooms is a critical part of this process. Warnings based on latest weekly results are displayed on www.gw.govt.nz/summer-check. The information sign used to advise the public of the risk from benthic cyanobacteria is shown in Figure 3.2.

Figure 3.2: Sign used to inform the public of the health risk from cyanobacteria in rivers in the Wellington region

3.3.4 Water clarity guidelines

Smith et al. (1991) and Smith and Davies-Colley (1992) demonstrated that the perception of water clarity at a freshwater site markedly affected a site's overall suitability for swimming when clarity was poor. As well as being aesthetically pleasing, clear water is important for recreational users to be able to estimate depth and spot any submerged hazards. In 1994, MfE developed guidelines for the management of water colour and clarity in New Zealand waters (MfE 1994). The guidelines state that water clarity should be greater than 1.6 m (measured horizontally through the water column) if the waters are being managed for contact recreation.

[6] 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.

3.4 Data analysis

All results were assessed in accordance with the MfE/MoH (2003) recreational water quality guidelines for freshwaters (Tables 3.1 and 3.2), the nuisance periphyton guidelines outlined in Section 3.3.2, the interim national cyanobacteria guidelines (Table 3.3) and the water clarity guideline outlined in Section 3.3.4.

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 sampling by summing up the rainfall for each 24 hour period.

For most sites MAC grades were calculated using weekly *E. coli* data from samples collected over the past five summer bathing seasons (2011/12 to 2015/16). The exceptions were the four sites sampled monthly as part of GWRC's RSoE programme for which a longer data period was used. The MAC values for Otaki River at Pots and Waiohine River at Gorge were calculated from weekly data collected during bathing seasons from 2003/04 to 2005/06 and monthly data from 2006/07 onwards, while interim MAC values for Akatarawa River at Hutt Confluence and Tauherenikau River at Websters (n=65) were calculated from the results of monthly sampling during bathing seasons (November to March) between 2003/04 and 2015/16. All 95th percentiles were calculated using the Hazen method as recommended in the MfE/MoH (2003) guidelines.

3.5 Results

3.5.1 Compliance with trigger values

Of the 20 river sites and one estuarine site monitored weekly over the 2015/16 summer bathing season, three sites (14%) went above the MfE/MoH (2003) action guideline on at least one occasion (Table 3.4, Appendix 4).

Out of a total of 420 routine water samples, five (1.2%) returned *E. coli* counts above the MfE/MoH (2003) action guideline (Table 3.5). This was considerably less than the 2014/15 and 2013/14 seasons, when 3.3% and 3.8 % of samples, respectively, exceeded the action guideline (Morar & Greenfield 2014, Keenan et al. 2015). The dry weather conditions in the 2015/16 summer are likely to be the main driver of the low number of action guideline breaches. There were fewer rainfall events over the 2015/16 summer compared to other years, particularly in the Wairarapa, Hutt Valley and Wellington areas (GWRC 2016).

Four of the five action guideline breaches were associated with significant rainfall (≥ 10 mm in 24 hour period prior to sampling). 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).

The cause of the 'dry weather' action guideline breach at Wainuiomata River at Richard Prouse Park on 18 January 2016 is unclear. The follow up water sample taken on 20 January (resampling was delayed due to heavy rainfall) was within the surveillance guideline. No health warning was issued.

All action guideline exceedances required only one follow-up sample before *E. coli* counts dropped back below the surveillance guideline.

Table 3.4: Summary of action guideline breaches from routine weekly monitoring at 21 river sites and one estuarine site over the 2015/16 summer bathing season[1]

No. of times site breached the action guideline	No. of sites			Total no. of sites (21)	% of sites
	Kapiti (3 sites)	Hutt & Wainuiomata (7 sites)	Wairarapa (11 sites)		
0	1	6	11	18	86
1	0	1	0	1	5
2	2	0	0	2	9

[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 GWRC's RSoE water quality monitoring programme.

Table 3.5: Summary of action guideline breaches during routine monitoring at freshwater sites over the 2015/16 bathing season1. Rainfall prior to sampling and the number of follow-up samples required before compliance with the surveillance guideline was achieved are also summarised

			Rainfall (mm)				
Date	Site name	*E.coli* count (cfu/100mL)	Rainfall station[2]	Up to 24hrs before sampling	48–25hrs before sampling	72–49hrs before sampling	follow up samples required
Kapiti							
19/01/2016	Waikanae R at SH 1	815	Waikanae WTP	28	0	0	1
	Waikanae R at JC Park	695					
16/03/2016	Waikanae R at SH 1	585	Waikanae WTP	10.5	0.5	0	1
	Waikanae R at JC Park	580					
Hutt & Wainuiomata							
18/01/2016	Wainuiomata R at RP Park	1,120	Wainui Reservoir	0	0	1.5	1

[1] This analysis excludes the four sites sampled monthly under GWRC's RSoE water quality monitoring programme.
[2] See Appendix 2 for more details on rainfall stations.

3.5.2 Suitability for recreation grades

Updated SFRGs (as at the end of March 2016) for all river and estuarine sites, based on the combined SIC and MAC values at all flows and during dry weather (excluding Riversdale Lagoon), are summarised in Figure 3.3 and listed in Appendix 4. In total, ten sites (40%) have SFRGs of 'good' or better for 'all weather' flows and 17 sites (68%) have 'dry weather' SFRGs of 'good' or better.

Ruamahanga River sites from Te Ore Ore downstream to Morrisons Bush and Waipoua River at Colombo Road carry the highest risk of microbiological contamination across all flow conditions – these sites are all graded 'very poor'. During dry weather conditions, when contact recreation is most likely, the highest risk of microbiological contamination is present at Hutt River at Melling Bridge, Wainuiomata River at Richard Prouse Park and Ruamahanga River at the Cliffs; these sites have dry weather SFRGs of 'poor'.

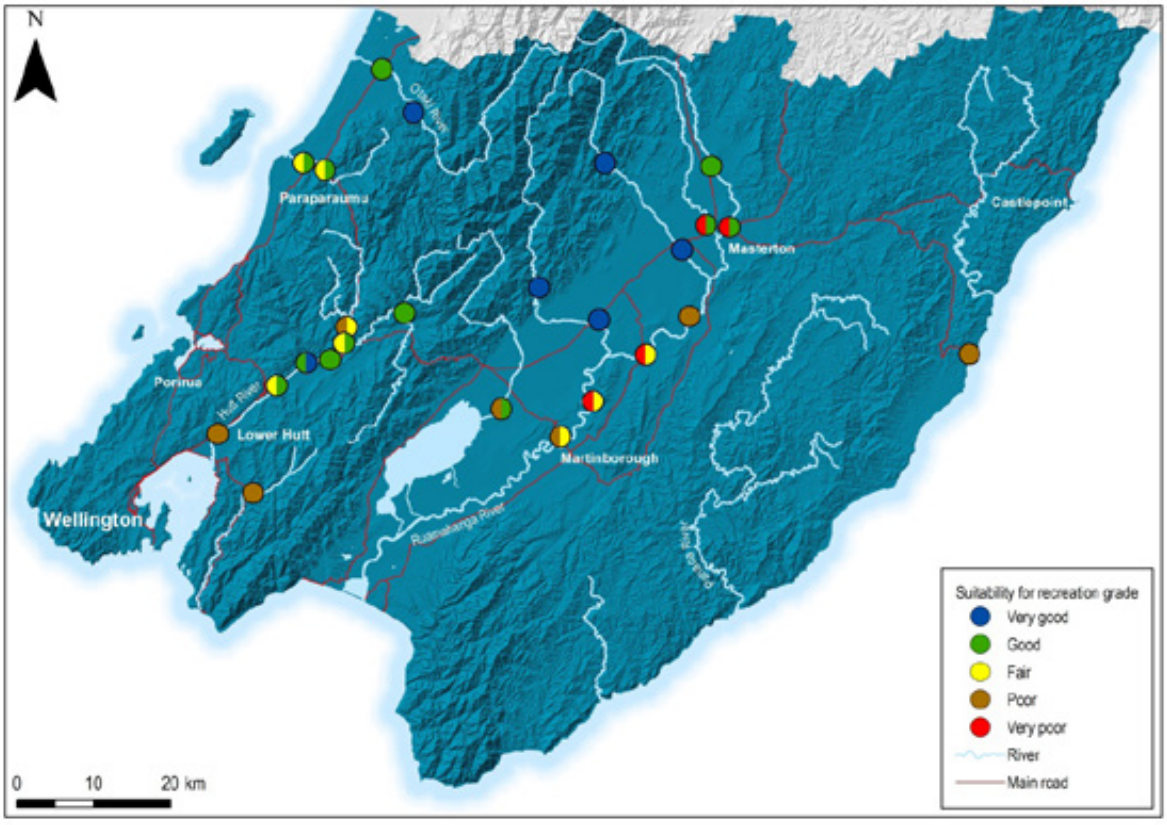

Figure 3.3: Suitability for Recreation Grades (SFRGs) for freshwater and estuarine monitoring sites in the Wellington region as at the end of the 2015/16 bathing season. The left side of the symbol shows the 'all weather' SFRG while the right side of the symbol shows the 'dry weather' SFRG based on *E. coli* counts from samples collected during median flows or less. The SFRG for the single estuarine site is 'all weather' only

Runoff from agricultural land use during heavy or prolonged rainfall has been identified as the key contributor to 'very poor' all weather grades at Waipoua River at Colombo Road and Ruamahanga River sites (Greenfield et al. 2012b). Contamination from rural runoff is also likely to be a factor in 'poor' all weather grades at sites on the Akatarawa, Tauherenikau, Ruamahanga and Waingawa rivers, and Riversdale Lagoon. Urban runoff is likely to be the key contributor to the 'poor' all weather and dry weather grade at Hutt River at Melling. 'Poor' grades during both all weather and dry weather conditions at Wainuiomata River at Richard Prouse Park are likely to be linked to contamination from rural land use and on-site wastewater systems in upstream tributaries (Morar & Greenfield 2014).

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 'poor' or 'fair' and are regarded as interim grades (Greenfield et al. 2012b). Masterton District Council's (MDC) operation to discharge treated wastewater from Masterton to land, rather than to the Ruamahanga River, during low flow conditions was fully operational for the first time in 2015/16. In light of this change, the SIC component of dry weather grades for Ruamahanga River sites downstream of Masterton will be reassessed in 2016/17 to reflect any reduction in risk to human health from contact recreation. SFRGs at Akatarawa River at Hutt Confluence and Tauherenikau River at Websters are also considered interim grades due to the limited data set available at these sites (*n*=65 at both sites).

All weather SFRGs improved at eight sites in the 2015/16 bathing season compared with those reported at the end of the 2014/15 season by Keenan et al. (2015). Waiohine River at State Highway Two increased from 'good' to 'very good', Otaki River at State Highway One and Hutt River at Maoribank Corner improved from 'fair' to 'good', Hutt River at Birchville and Hutt River at Silverstream improved from 'poor' to 'fair', and Ruamahanga River at the Cliffs and Ruamahanga River at Waihenga Bridge improved from 'very poor' to poor'. Meanwhile, Waingawa River at South Road improved three grades from 'poor' to 'very good'. This improvement in all weather grades is likely to be primarily a result of the rainfall associated with years used to calculated SFRGs over the two time periods. Grades calculated for 2014/15 include data from the 2010/11 summer which was a relatively wet. In comparison, grades for 2015/16 are based on data from 2011/12 summers onwards including the 2015/16 summer which was relatively dry in most areas. 'Dry weather' SFRGs did not change in 2015/16 compared to 2014/15.

For a full list of all flow and 'dry weather' SFRGs for the 2015/16 season, as well as their respective SIC and MAC grades, see Appendix 4.

3.5.3 Compliance with nuisance periphyton and cyanobacteria guidelines

The number of weekly periphyton cover assessments able to be made at freshwater monitoring sites ranged from 17 for Otaki River at State Highway One to 20 for both Waikanae River sites, Pakuratahi River at Hutt Forks, all Hutt River sites, Wainuiomata River at Richard Prouse Park, Ruamahanga River at Te Ore Ore, Waipoua River at Colombo Road and both Waingawa River sites. On most occasions, non-assessment of algal cover was due to poor water clarity and/or high flows following freshes.

The greater number of breaches of the MfE (2000) nuisance filamentous periphyton cover guideline (>30%) during the 2015/16 bathing season was recorded in the Ruamahanga River with eight breaches recorded at Waihenga Bridge and six recorded at Kokotau. In addition, four breaches of the guidelines were recorded at Wainuiomata River at Richard Prouse Park and Ruamahanga River at Morrisons Bush. (Table 3.6). Filamentous periphyton cover at Ruamahanga River at Waihenga Bridge reached 99% of the river bed on 21 March 2016 following an extended period of dry weather and low flows.

The MfE (2000) nuisance mat periphyton cover guideline (60%) was not breached at any site during the 2015/16 bathing season.

Table 3.6: Summary of compliance with MfE (2000) nuisance periphyton guidelines and MfE/MoH (2009) interim cyanobacteria guidelines at 20 river sites, based on routine weekly monitoring over the 2015/16 summer bathing season[1]. Values in bold indicate a guideline breach

Site	Total site visits (*n*)	Assessments made (*n*)	Filamentous		Mat		Cyanobacteria		
			Max (%)	>30% (*n*)	Max (%)	>60% (*n*)	Max (%)	'Alert' level[2] (*n*)	'Action' level[3] (*n*)
Kapiti									
Otaki R at SH1	20	17	**47**	2	9	0	0	0	0
Waikanae R at SH1	20	20	2	0	2	0	8	0	0
Waikanae R at Jim Cooke Pk	20	20	1	0	1	0	7	0	0
Hutt & Wainuiomata									
Pakuratahi R at Hutt Forks	20	20	1	0	2	0	8	0	0
Hutt R at Birchville	20	20	1	0	3	0	**25**	0	2
Hutt R at Maoribank Cnr	20	20	2	0	5	0	**25**	2	1
Hutt R at Poets Pk	20	20	4	0	2	0	**22**	0	1
Hutt R at Silverstream Br.	20	20	15	0	3	0	**44**	6	2
Hutt R at Melling Br.	20	20	15	0	23	0	4	0	0
Wainuiomata R at RP Pk	20	20	**49**	4	1	0	14	0	0
Wairarapa									
Ruamahanga R at Double Br.	20	19	3	0	0	0	0	0	0
Ruamahanga R at Te Ore Ore	20	20	23	0	0	0	0	0	0
Waipoua R at Colombo Rd	20	20	17	0	38	0	**70**	7	2
Waingawa R at Kaituna	20	20	0	0	0	0	0	0	0
Waingawa R at South Rd	20	20	26	0	0	0	14	0	0
Ruamahanga R at The Cliffs	20	17	**53**	2	0	0	1	0	0
Ruamahanga R at Kokotau	20	18	**71**	6	0	0	0	0	0
Waiohine R at SH2	20	19	**63**	1	0	0	0	0	0
Ruamahanga R at Morrisons B.	20	18	**69**	4	0	0	0	0	0
Ruamahanga R at Waihenga Br.	20	18	**99**	8	0	0	0	0	0

[1] This analysis excludes the four sites sampled monthly under GWRC's RSoE water quality monitoring programme, and Riversdale Lagoon.
[2] As in Table 3.3, 'alert' level is when there is 20-50% coverage of potentially toxic cyanobacteria attached to substrate.
[3] As in Table 3.3, 'action' level is when there is >50% coverage OR cyanobacteria are visibly detaching from substrate or becoming exposed on river's edge.

The coverage of potentially toxic cyanobacteria breached the alert level of the MfE/MoH (2009) interim cyanobacteria guidelines (>20% coverage) at three sites: Hutt River at Maoribank Corner (two times), Hutt River at Silverstream Bridge (six times) and Waipoua River at Colombo Road (seven times). The action level of the guidelines was breached at five sites (twice at Hutt River at Birchville, Hutt River at Silverstream Bridge and Waipoua River at Colombo Road, and once at Hutt River at Maoribank Corner and Hutt River at Poets Park) due to the presence of significant amounts of detached mats on the rivers' edge. The following bullet points explain the actions taken by GWRC and territorial authorities at specific sites:

- At Waipoua River at Colombo Road, the alert level was exceeded on 21 December 2015. The following day, toxic algae information signs were put up along the river by Masterton District Council and a media release issued. A further media release was issued on 18 January 2016 when the action level was breached. Toxic algae information signs stayed up for the rest of the summer season.
- The alert level was exceeded at Hutt River at Silverstream during the week of 29 December 2015. The following day, toxic algae information signs were put up at key public access points to this part of the river by local councils (Upper Hutt City Council and Hutt City Council) and a media release issued. Media releases were also issued following an alert level exceedance at Hutt River at Silverstream on 18 January 2016 and action level exceedances at Hutt River at Birchville, Poets Park and Silverstream on 9 February. Toxic algae information signs were put up at key river access points near each site the first time a breach of the alert or action occurred and stayed in place until the end of the summer season.
- A health warning was issued for the lower reaches of the Otaki River during the week of 5 February when a dog died after showing symptoms typical of toxic algae poisoning. The dog had been in the Otaki River near the river mouth prior to its death. However, the dog death could not be confirmed as being due to toxic algae poisoning as only low cyanobacteria cover was recorded at the site (10-15% cover of the

river bed) and cyanotoxins were not detected in algal samples taken from the site. A media release was issued advising of the health warning but no warning signs were put up.

- A site in the lower reaches of the Pakuratahi River as it runs through Kaitoke Regional Park exceeded the action level on 16 February. Warning signs were put up by GWRC along this part of the river. The site (Pakuratahi River 50m downstream of Farm Creek) is not part of the Recreational Water Quality monitoring programme but is assessed monthly as part of the Rivers State of the Environment programme. The site also exceeded the alert level between 8 March and the end of the bathing season.

- All guideline exceedances were reported at *www.gw.govt.nz/summer-check* and *www.gw.govt.nz/is-it-safe-to-swim/*. These webpages were advertised on radio and noted on toxic algae information signs as providing up-to-date toxic algae warning information. Warnings were also posted on the Land Air Water Aotearoa (LAWA) website *www.lawa.org.nz* .

Cyanobacteria mats growing on the river bed at Pakuratahi River at Kaitoke Regional Park on 15 February 2016

3.5.4 Compliance with water clarity guideline

Of the 400 occasions water clarity was assessed, the MfE (1994) water clarity guideline of more than 1.6 m was met 95% of the time (380 occasions) (Table 3.7).

Table 3.7: Summary of compliance with the MfE (1994) water clarity guideline for contact recreation at 20 river sites, based on routine weekly monitoring over the 2015/16 summer bathing season[1]

Site	Assessments made (*n*)	Guideline >1.6 m met (*n*)
Kapiti		
Otaki R at SH1	20	15
Waikanae R at SH1	20	20
Waikanae R at Jim Cooke Pk	20	20
Hutt & Wainuiomata		
Pakuratahi R at Hutt Forks	20	20
Hutt R at Birchville	20	20
Hutt R at Maoribank Cnr	20	20
Hutt R at Poets Pk	20	19
Hutt R at Silverstream Br.	20	20
Hutt R at Melling Br.	20	20
Wainuiomata R at RP Pk	20	20
Wairarapa		
Ruamahanga R at Double Br.	20	20
Ruamahanga R at Te Ore Ore	20	19
Waipoua R at Colombo Rd	20	20
Waingawa R at Kaituna	20	20
Waingawa R at South Rd	20	20
Ruamahanga R at The Cliffs	20	16
Ruamahanga R at Kokotau	20	18
Waiohine R at SH2	20	18
Ruamahanga R at Morrisons B.	20	17
Ruamahanga R at Waihenga Br.	20	18

[1] This analysis excludes the four sites sampled monthly under GWRC's RSoE water quality monitoring programme and Riversdale Lagoon.

Of the 20 occasions the guideline was not meet, eleven (55%) were due to poor water clarity following freshes, while nine (45%) were attributed to turbid water created by river works upstream[7]. In general, river works were linked to poor water clarity on one or two occasions each at lower sites on the Otaki, Waiohine and Ruamahanga rivers as well as one site on the Hutt River (Poets Park - middle of Hutt River)[8].

[7] In some cases upstream river works were observed by samplers, in others river works were not observed but were scheduled to occur in the area.
[8] These works were undertaken by GWRC's Flood Protection Department in accordance with their resource consent.

3.6 Summary

Of the 20 river sites and one estuarine site monitored weekly over the 2015/16 summer season, three sites (14%) exceeded the MfE/MoH (2003) action guideline for microbiological water quality on at least one occasion. Eighty percent of these exceedances coincided with significant rainfall in the 24 hours prior to sampling and/or elevated river flows. Of the total 25 sites monitored overall, ten sites (40%) have 'all weather' SFRGs of 'good' or better while 17 sites (68%) have 'dry weather' SFRGs of 'good' or better.

The MfE (2000) nuisance filamentous periphyton guideline was not met at several sites on several occasions, most notably on eight occasions at Ruamahanga River at Waihenga Bridge and six occasions at Ruamahanga River at Kokotau. The filamentous periphyton guideline breaches mostly occurred in February and early March 2016, following a prolonged period of low, stable river flows. The guideline for nuisance mat periphyton was met at all sites on all sampling occasions.

The action level of the MfE/MoH (2009) interim cyanobacteria guidelines was breached at five sites (Hutt River at Birchville, Hutt River at Maoribank Corner, Hutt River at Poets Park, Hutt River at Silverstream Bridge and Waipoua River at Colombo Road), due to the presence of significant amounts of detached cyanobacteria mats. Toxic algae information signs were put up at these sites by local councils and up-to-date warnings posted on GWRC and LAWA websites. A dog died after contact with the lower reaches of the Otaki River in February 2016 but this could not be confirmed as being a result of toxic algae poisoning.

The MfE (1994) guideline for water clarity was met most of the time (95% of sampling occasions). Poor water clarity following freshes accounted for over half (55%) of the occasions when the guideline was not met, while upstream river works accounted for the 45% of water clarity guideline breaches.

4 Recreational water quality in coastal waters

4.1 Introduction

Recreational water quality was monitored at 63 coastal sites across the Wellington region over the 2015/16 bathing season (Figure 4.1, Appendix 1), as follows:

- Kapiti Coast District – 14 sites
- Porirua City – 11 sites
- Wellington City – 22 sites
- Hutt City – 13 sites
- Wairarapa – 3 sites

Weekly water quality sampling resumed at Onehunga Bay in Porirua in 2015/16 for one season. Low land use intensity and consistently good water quality means that monitoring is not required at this site every summer. However, weekly summer time sampling is undertaken every five years in order to update the SFRG for the site.

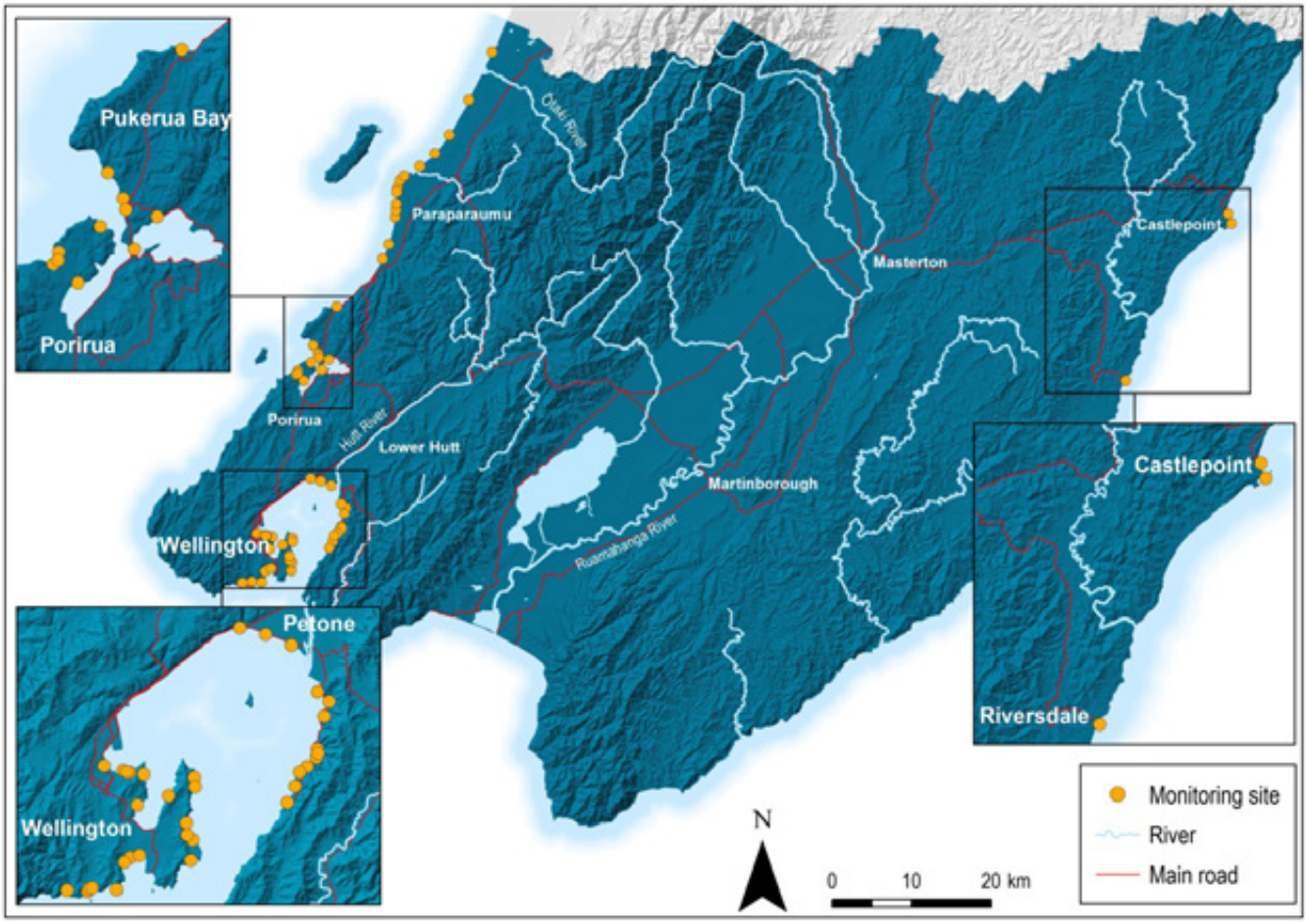

Figure 4.1: Coastal recreation sites monitored over the 2015/16 summer

4.2 Monitoring protocol

Sites were sampled weekly for 20 weeks between mid-November 2015 and 31 March 2016. 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).

Daily rainfall records were obtained from the rain gauge nearest to each bathing site to give an indication of rainfall in the catchment adjoining each site (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 associated with elevated bacteria counts in coastal waters. For this reason GWRC and Regional Public Health advise avoiding swimming and other contact recreation activities in coastal waters during and for up to two 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 when 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, due to bad weather). Therefore, to ensure that recreational water quality is assessed on an equal basis across all 63 coastal sites, the approach taken by GWRC 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 sampling by summing up the rainfall for each 24 hour period. All 95th percentiles associated with the MAC category of the SFGR were calculated using the Hazen method as recommended in the MfE/MoH (2003) guidelines.

4.5 Results

4.5.1 Compliance with trigger values

Twenty one of the 63 coastal sites (33%) exceeded the MfE/MoH (2003) action guideline during routine monitoring over the 2015/16 bathing season. Most of these sites (18) exceeded the guideline only once (Table 4.3, Appendix 4).

Table 4.3: Summary of action guideline breaches from routine weekly monitoring at 63 coastal sites over the 2015/16 summer bathing season

No. of times site breached the action guideline	No. of sites					Total no. of sites (63)	% of sites
	Kapiti (14 sites)	Porirua (11 sites)	Wellington (22 sites)	Hutt (13 sites)	Wairarapa (3 sites)		
0	10	7	13	9	3	42	66.7
1	4	2	8	4	0	18	28.6
2	0	2	1	0	0	3	4.8

A total of 24 out of 1,258 (1.9%) routine sample results exceeded the MfE/MoH (2003) action guideline of 280 cfu/100mL (Table 4.4). This was less than in the last three bathing seasons; 3.5%, 5.8% and 7.6% of samples exceeded the action guideline in 2014/15, 2013/14 and 2012/13, respectively (Keenan et al. 2015, Morar & Greenfield 2014, Morar & Greenfield 2013). The weather conditions in the 2015/16 summer are likely to be the main driver of the low number of action guideline breaches. There were fewer rainfall events over the 2015/16 summer compared to other years, particularly in the Wairarapa, Hutt Valley and Wellington areas (GWRC 2016).

Table 4.4: Summary of action guideline breaches during routine monitoring at coastal sites over the 2015/16 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

Date	Site Name	Enterococci count (cfu/100mL)	Rainfall (mm)				follow-up samples required
			Rainfall Station	Up to 24hrs before sampling	48–25hrs before sampling	72–49hrs before sampling	
Kapiti							
16/03/2016	Waikanae Beach at William St	488	Waikanae WTP	10.5	0.5	0	1
21/03/2016	Raumati Beach at Aotea Rd	610	Waikanae WTP	1.5	0	0	1
	Paraparaumu Beach at Toru Rd	1,470					1
	Paraparaumu Beach at Maclean Pk	2,170					2
Porirua							
24/11/2015	Plimmerton Beach at Bath St	2,800	Whenua Tapu	0	0	0	1
19/01/2016	Titahi Bay at South Beach Access Rd	720	Whenua Tapu	20	0	0	2
	South Beach at Plimmerton	680					1
9/02/2016	Titahi Bay at Bay Dr	460	Whenua Tapu	0	0	0	2
	South Beach at Plimmerton	290					1
29/03/2016	Plimmerton Beach at Bath St	1,200	Whenua Tapu	0	0	0	1
Wellington City							
16/11/2015	Island Bay at Surf Club	390	Berhampore Nursery	1.8	0.4	0	1
4/01/2016	Wellington Harbour at Taranaki St Dive Platform	300	Te Papa	36.2	7	6	1
15/02/2016	Lyall Bay at Tirangi Rd	600	Wellington Airport	0	0	0	1
22/02/2016	Owhiro Bay	380	Berhampore Nursery	0	0	0	1
29/02/2016	Shark Bay	960	Wellington Airport	0	0	0	1
	Seatoun Beach at Wharf	860					1
	Seatoun Beach at Inglis St	1,100					1
	Lyall Bay at Tirangi Rd	750					1
	Lyall Bay at Onepu Rd	880					1
	Lyall Bay at Queens Dr	1,200					1
Hutt							
4/01/2016	Petone Beach at Sydney St	440	Shandon	25.5	2.5	4	1
	Lowry Bay at Cheviot Rd	360		25.5	3	3.5	1
	Robinson Bay at Nikau St	410		25.5	5.5	1.5	1
	Robinson Bay at HW Shortt Rec Gr.	320		25.5	6	0.5	1

A third (eight) of the 24 action events were associated with significant rainfall (defined as at least 5 mm of rainfall in the 24 hours prior to sampling or 10 mm or more in the three days prior) (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 et al. 2012a).

Sixteen action guideline breaches occurred following little or no rainfall prior to sampling. The greatest number of dry weather action guideline breaches occurred at Plimmerton Beach at Bath Street and Lyall Bay at Tirangi Road (two each). Warning signs were put up by Porirua City Council at Plimmerton Beach at Bath Street after an enterococci count of 1,200 cfu/100mL was recorded on 29 March 2016. Signs were taken down the next day when a follow up sample returned a result well within the surveillance guidelines. Warning signs were not erected at Lyall Bay Beach at Tirangi Road by Wellington City Council after action guideline breaches on 15 February and 29 February 2016. Follow up samples collected the following day after these exceedances yielded results well within the surveillance guidelines (4 and 40 cfu/100 mL, respectively). Sanitary surveys were undertaken by Wellington Water following both exceedances but did not identify any sources of contamination.

On 29 February 2016, six sites at Shark Bay, Seatoun Beach and Lyall Bay exceeded the action guideline in dry weather conditions. The reason for these exceedances is unclear as sanitary surveys revealed no clear source of contamination. It is possible that the high counts recorded at these sites were associated with sediment stirred up by strong southerly winds that occurred at the time of sampling. Follow up samples collected the next day were within the surveillance guideline at all six sites.

Overall, Plimmerton Beach at Bath Street and Lyall Bay at Tirangi Road recorded the lowest level of compliance with the surveillance guideline of all coastal sites monitored during the 2015/16 bathing season, each with three routine samples exceeding the guideline (see Appendix 4). Paraparaumu Beach at Toru Road, Raumati Beach a Aotea Road, South Beach at Plimmerton, Titahi Bay at Bay Drive and Titahi bay at South Beach Access Road had the second lowest level of compliance with the surveillance guideline (two exceedances each). Warning signs were put up by Porirua City Council at Titahi Bay at South Beach Access Road after two consecutive exceedances of the action guideline were recorded from 19 January 2016. These exceedances were associated with rainfall but given the good weather conditions that followed and the high level of use of the site at the time it was considered appropriate to issue a health warning.

4.5.2 Suitability for recreation grades

Updated SFRGs (as at the end of the 2015/16 bathing season) for 63 coastal recreational water quality monitoring sites in the Wellington region range from 'very good' to 'poor' (Figure 4.2, Appendix 4)[9]. In total, 32 (51%) monitoring sites now have SFRGs of 'good' or better, 30 coastal sites have SFRGs of 'fair' or 'poor', while Wellington Harbour at Taranaki Street Dive Platform has insufficient data to be graded. The eight sites graded 'poor' are Plimmerton Beach at Bath Street, South Beach at Plimmerton, Porirua Harbour at Rowing Club, Titahi Bay at South Beach Access Road (all Porirua), Island Bay at Reef Street Recreation Ground, Island Bay at Surf Club, Island Bay at Derwent Street and Owhiro Bay (all on the South Coast of Wellington City). At all of these sites, urban stormwater discharges, some with potential sewage contamination, have been identified as a principal source of faecal contamination (Greenfield et al. 2012b).

[9]There are insufficient data to assign a SFRG to Wellington Harbour at Taranaki St Wharf Dive Platform. Onehunga Bay is assigned a SFRG even though it was not monitored in 2014/15, as explained in Section 4.1.

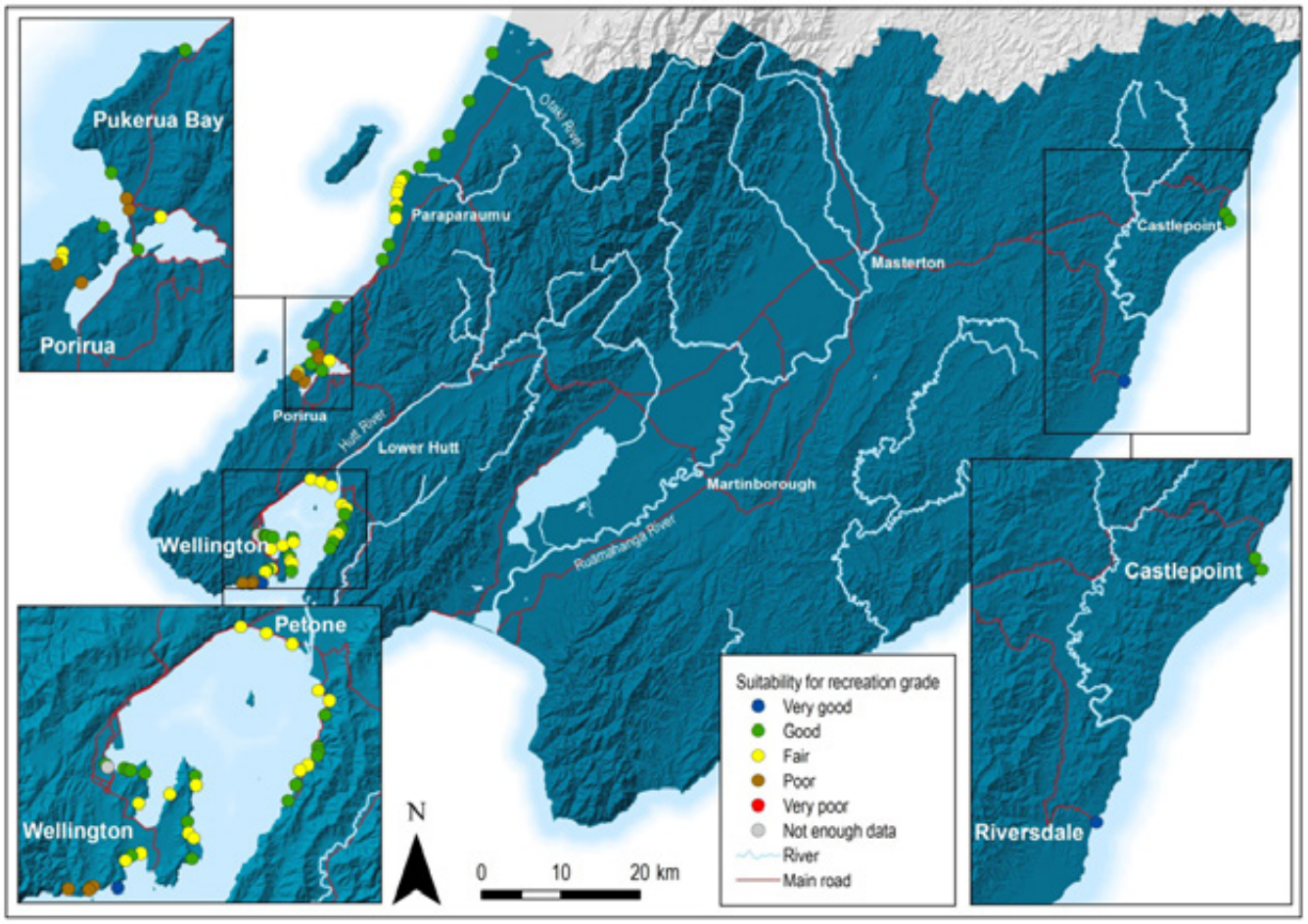

Figure 4.2: Suitability for Recreation Grades (SFRGs) for coastal recreational water quality monitoring sites in the Wellington region as at the end of the 2015/16 bathing season

Wellington Water has programmes to find and fix sewer faults in catchments of each of the 'poor' sites. In 2015/16 a number of faults were found and fixed in the sewer network in the Island Bay catchment. In 2016/17 a number of sewer mains the catchment are planned to be replaced (Michelle Chew[10], pers. comm.).

SFRGs improved at seven sites and deteriorated at three sites in 2015/16 compared to the 2014/15 grades reported by Keenan et al. (2015). SFRGs improved from 'poor' to 'fair' at Rona Bay at Northern end of Cliff Bishop Park and 'fair' to 'good' at Te Horo Beach at Sea Road, Raumati Beach at Marine Gardens, Pukerua Bay, Pauatahanui Inlet at Paremata Bridge and Worser Bay. The SFRG at Riversdale Beach between the Flags improved from 'good' to 'very good' in 2015/16. SFRGs deteriorated from 'very good' to 'good' at Breaker Bay, 'good' to 'fair' at Lyall Bay at Queens Drive and 'fair' to 'poor' at Plimmerton Beach at Bath Street. See Appendix 4 for more information on current SFRGs.

The reason for the drop in grade at Plimmerton Beach at Bath Street is unclear but is likely to be due to issues with sewer infrastructure in the area (Michelle Chew, pers. comm.). Wellington Water will undertake investigations in the catchment of this site while renewal of a number of sewer mains in the area is also planned in 2016/17. The reason for the drop in grade at Lyall Bay and Breaker Bay are unclear. Results collected from these sites will be closely scrutinised over the 2016/17 season to assess whether an investigation of contamination sources is required.

4.6 Summary

Twenty one of the 63 coastal sites (33%) monitored weekly during the 2015/16 bathing season exceeded the MfE/MoH (2003) action guideline for microbiological water quality on at least one occasion. Sites that most frequently exceeded the action guideline were Plimmerton Beach at Bath Street, South Beach at Plimmerton and Lyall Bay at Tirangi Road (twice each). None of the exceedances at these sites were associated with significant rainfall prior to sampling.

As of the end of the 2015/16 bathing season, 32 (51%) coastal monitoring sites have SFRGs of 'good' or better. Twenty two sites are graded 'fair' and the remaining eight sites are graded 'poor': Plimmerton Beach at Bath Street, South Beach at Plimmerton, Porirua Harbour at Rowing Club, Titahi Bay at South Beach Access Road, Island Bay at Reef Street Recreation Ground, Island Bay at Surf Club, Island Bay at Derwent Street and Owhiro Bay.

Wellington Water is undertaking investigations within the catchments of most sites graded 'poor' to identify specific sources of contamination.

[10] Michelle Chew, Investigations Engineer, Wellington Water.

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 2015/16 (Figure 5.1, Appendix 1), as follows:

- Kapiti Coast District – 3 sites
- Porirua City – 1 site[11]
- Hutt City – 1 site
- Wellington City – 2 sites

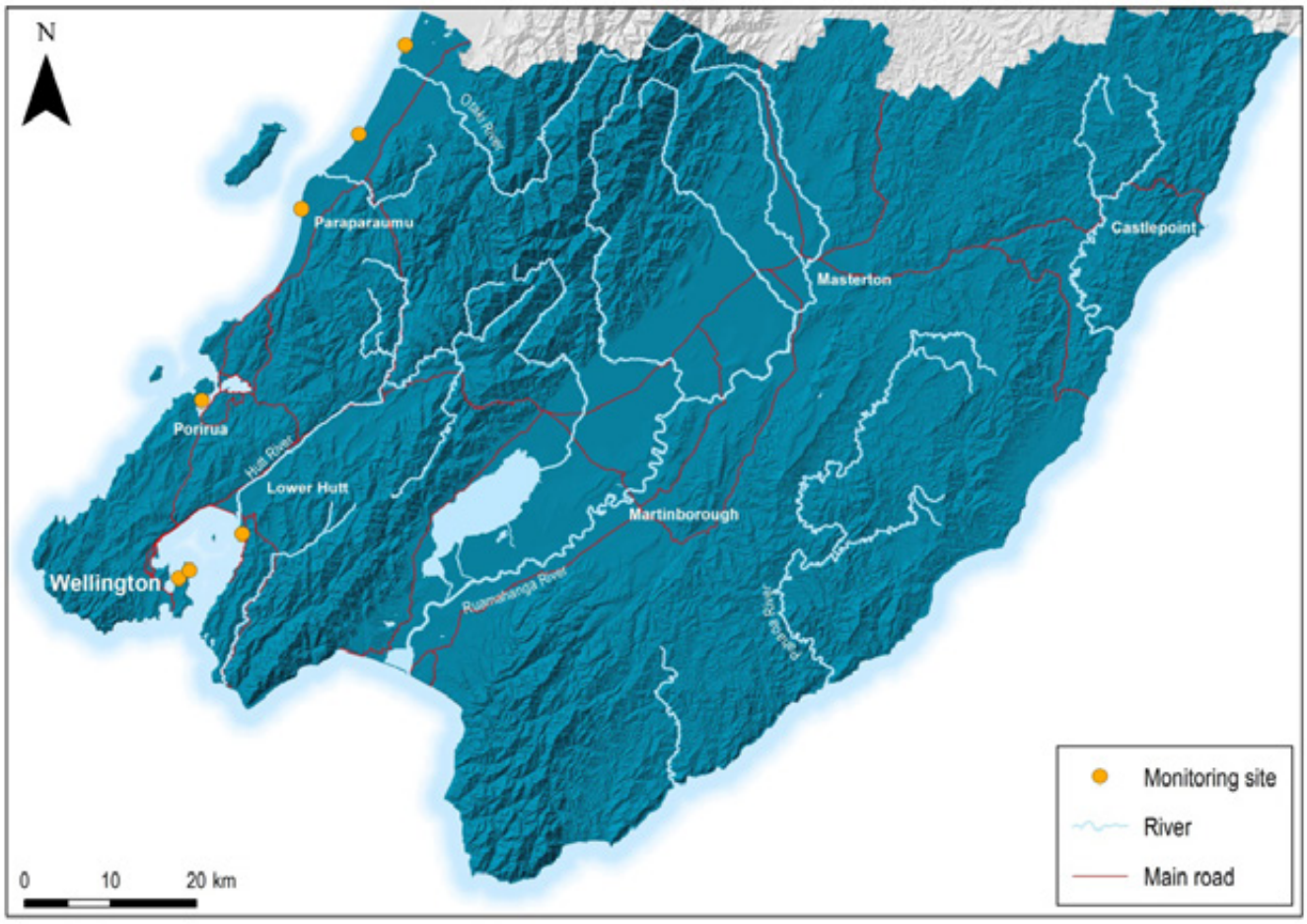

Figure 5.1: Recreational shellfish gathering water quality monitoring sites, 2015/16

5.2 Monitoring protocol

Sites were sampled weekly for 20 weeks between mid-November 2015 and 31 March 2016 at the same time as coastal recreational water quality sampling (all seven 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 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.

[11] This site, introduced in July 2007, is not recommended for shellfish gathering but is 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 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. In addition the guidelines often don't accurately represent the risk of contact with viruses. For this reason, the guidelines cannot 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. GWRC periodically undertakes shellfish flesh monitoring; the last such monitoring was undertaken in early 2006 (Milne 2006). In general, GWRC 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, mid-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 the two Wellington City sites (Shark Bay and Mahanga Bay) were fully compliant with shellfish gathering water quality guidelines over the 2015/16 summer period (Table 5.1). All other sites breached one or both of the guideline criteria. This result differs from the 2014/15 season (Keenan et al. 2015) when only Mahanga Bay complied with the guideline.

Table 5.1: Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2015/16 summer months against the MfE/MoH (2003) guideline criteria for recreational shellfish-gathering waters. Values in bold font indicate non-compliance with guideline criteria

Site	Median (cfu/100mL)	Maximum (cfu/100mL)	No. (and percentage) of results >43 cfu/100mL	Total no. of samples
Kapiti				
Otaki Beach – Surf Club	10	190	3 (**15%**)	20
Peka Peka Beach – Road End	11.5	114	4 (**20%**)	20
Raumati Beach – Tainui St	**33.5**	264	8 (**40%**)	20
Porirua				
Porirua Harbour – Rowing Club	**16**	240	5 (**25%**)	20
Wellington City				
Shark Bay	2	460	2 (10%)	20
Mahanga Bay	2	150	1 (5%)	20
Hutt				
Sorrento Bay	2	150	3 (**15%**)	20

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[12] Published June 2002, updated June 2003.

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- Dean Bentley and Vanessa Coull (Hutt City Council)
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- Geneva Guinee, Emily Martin, and Joanna McVeagh (Greater Wellington Regional Council)

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	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
		Onehunga Bay	1755796	5449181
		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

Area	Site type	Site name	NZTM coordinates	
			Easting	Northing
Wellington City	Coastal	Aotea Lagoon	1748985	5427683
		Wellington Harbour at Taranaki St Dive Platform	1749092	5427538
		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
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
		Rona Bay at Wharf	1758730	5427371
		Robinson Bay at HW Shortt Recreation Ground	1758519	5426674
		Robinson Bay at Nikau Street	1758131	5425856

			NZTM coordinates	
Area	**Site type**	**Site name**	**Easting**	**Northing**
	Freshwater	Ruamahanga River at Double Bridges	1824350	5471775
		Ruamahanga River at Te Ore Ore	1825529	5462917
Wairarapa		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
		Riversdale Lagoon	1858304	5447128
	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 GWRC'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 – Centre Ridge (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 – Te Papa (Aotea Lagoon, Wellington Harbour at Taranaki Street Dive Platform and Oriental Bay), Berhampore Nursery (Island Bay and Owhiro Bay sites) and Wellington Airport* (remaining Wellington City sites)

Wairarapa – Castlepoint*

*NIWA rainfall stations

Note: Some GWRC rainfall data used in the preparation of this report were raw/processed data that were yet to be formally quality checked and archived in GWRC's Hilltop Database.

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 Eurofins ELS.

Methods and detection limits

Determinant	Method	Detection limit
Escherichia coli at 44.5°C	APHA Standard Methods (22nd 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 (22nd Ed.) 9222D, Membrane filter on mFC agar	1–5 cfu/100mL
Water temperature	Field meter or digital thermometer	0.1°C
Visual clarity	Modified version of the horizontal black disc method (Davies-Colley 1988). Instead of measuring the distance at which the 200 mm black disc disappears from view, a 'yes' or a 'no' was recorded depending on whether the disc was visible at 1.6 m.	–
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 2015/16 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 2011/12–2015/16 microbiological water quality results. Up and down arrows beside grades indicate positive and negative changes, respectively, in SFRGs from those assigned at the end of the 2014/15 bathing season (as presented in Keenan et al. (2015)).

(A) Fresh waters

Bathing site	No. sample results (*E. coli*/100 mL)				Beach grading (2011/12 – 2015/16 data)					
					All flows			Dry flows		
	n	Surveillance (≤ 260)	Alert (261–550)	Action (>550)	SIC Grade	MAC Grade (95th %ile value)	2015/16 SFRG	SIC Grade	MAC Grade (95th %ile value)	2015/16 SFRG
Kapiti										
Otaki – Pots[1]	5	5	0	0	Low	A (85)[2]	Very Good	Very Low	A (75)[2]	Very Good
Otaki - SH1	20	19	1	0	Moderate	B (213)	Good↑	Low	B (150)	Good
Waikanae - SH1	20	18	0	2	Moderate	C (443)	Fair	Low	B (244)	Good
Waikanae - Jim Cooke Park	20	18	0	2	Moderate	C (458)	Fair	Low	B (259)	Good
Hutt & Wainuiomata										
Pakuratahi - Hutt Forks	20	19	1	0	Moderate	B (253)	Good	Low	B (212)	Good
Akatarawa - Hutt Confluence[1]	5	5	0	0	Moderate	D (570)[3]	Poor	Low	C (400)[3]	Fair
Hutt - Birchville	20	20	0	0	Moderate	C (350)	Fair↑	Moderate	B (160)	Good
Hutt - Maoribank Cr	20	20	0	0	Moderate	B (200)	Good↑	Low	B (176)	Good
Hutt - Poets Pk	20	20	0	0	Low	B (159)	Good	Low	A (102)	Very Good
Hutt - Silverstream	20	20	0	0	Moderate	C (440)	Fair↑	Moderate	B (194)	Good
Hutt - Melling Br	20	19	1	0	Moderate	D (835)	Poor	Moderate	D (829)	Poor
Wainuiomata - RP Park	20	19	0	1	Moderate	D (770)	Poor	Moderate	D (608)	Poor
Wairarapa										
Ruamahanga - Dble Bridges	20	20	0	0	Moderate	B (160)	Good	Moderate	A (112)	Good[4]
Ruamahanga - Te Ore Ore	20	20	0	0	High	D (635)	Very Poor	Moderate	B (155)	Good
Waipoua - Colombo Rd	20	20	0	0	High	D (750)	Very Poor	Moderate	B (195)	Good
Waingawa - Kaituna	20	20	0	0	Low/moderate	A (79)	Very good	Low	A (57)	Very Good
Waingawa - South Rd	20	20	0	0	Low/moderate	A (121)	Very good↑↑↑	Low	A (81)	Very Good
Ruamahanga - The Cliffs	20	20	0	0	High	C (354)	Poor↑	High	A (76)	Poor[5]
Ruamahanga - Kokotau	20	20	0	0	High	D (680)	Very Poor	Moderate	A (113)	Fair[5]
Waiohine – Gauge[1]	4[6]	4	0	0	Low	A (99)2	Very Good	Very Low	A (49)2	Very Good
Waiohine - SH2	20	20	0	0	Low/moderate	A (74)	Very good↑	Low	A (44)	Very Good
Ruamahanga - Morrisons Bush	20	20	0	0	High	D (570)	Very Poor	Moderate	A (124)	Fair[5]
Ruamahanga - Waihenga	20	20	0	0	High	C (550)	Poor↑	Moderate	A (97)	Fair[5]
Tauherenikau - Websters[1]	5	4	0	1	High	C (490)3	Poor	Moderate	B (233)3	Good↓
Riversdale Lagoon	20	19	1	0	Moderate	D (1,020)	Poor	N/A		

[1] Sampled monthly under GWRC's Rivers State of the Environment (RSoE) water quality programme.
[2] Based on summer-time data collected weekly from 2003/04–2005/06 and monthly from 2006/07–2015/16.
[3] Interim MAC grade (n=65) based on summer-time data collected monthly under GWRC's RSoE water quality programme (2003/04–2015/16).
[4] The combination of dry weather SIC and MAC for this site is unexpected and the grade assigned is interim. The SIC for this site will be reviewed in 2016/17
[5] Interim grades altered to reflect the uncertainty associated with the effects of upstream municipal wastewater treatment plant discharges on public health.
[6] Only four samples were collected at this site in the 2015/16 season as the 5th sample was collected after the 31 March 2016.

(B) Coastal waters

Site	*n*	No. sample results (Enterococci cfu/100mL)			Beach grading (2011/12–2015/16 data)		
		Surveillance (≤ 140)	Alert (141–280)	Action (>280)	SIC Grade	MAC Grade (95th %ile value)	2015/16 SFRG
Kapiti							
Otaki - Surf Club	20	20	0	0	Moderate	B (68)	Good
Te Horo Beach - Sea Road	20	18	2	0	Moderate	B (175)	Good↑
Peka Peka	20	20	0	0	Low	B (43)	Good
Waikanae - William St	20	19	0	1	Moderate	B (47)	Good
Waikanae - Ara Kuaka	20	20	0	0	Moderate	B (87)	Good
Paraparaumu - Ngapotiki St	20	19	1	0	Moderate	B (198)	Good
Paraparaumu - Nathan Ave	20	19	1	0	Moderate	C (218)	Fair
Paraparaumu - Maclean Pk	20	19	0	1	Moderate	C (251)	Fair
Paraparaumu - Toru Rd	20	18	1	1	Moderate	C (313)	Fair
Raumati - Tainui St	20	20	0	0	Moderate	C (213)	Fair
Raumati - Marine Gdns	20	20	0	0	Moderate	B (158)	Good↑
Raumati - Aotea Rd	20	18	1	1	Moderate	C (229)	Fair
Paekakariki - Whareroa Rd	20	20	0	0	Low	B (81)	Good
Paekakariki - Surf Club	20	20	0	0	Low	B (49)	Good
Porirua							
Pukerua Bay	20	19	1	0	Moderate	B (180)	Good↑
Karehana - Cluny Rd	20	20	0	0	Moderate	B (125)	Good
Onehunga Bay[1]	18[2]	18	0	0	Low	B (82)	Good
Plimmerton - Bath St	20	17	1	2	Moderate	D (530)	Poor↓
South - Plimmerton	20	18	0	2	Moderate	D (825)	Poor
Pauatahanui - Water Ski Club	20	20	0	0	Moderate	C (205)	Fair
Pauatahanui - Paremata Br	20	20	0	0	Moderate	B (175)	Good↑
Porirua – Rowing Club	20	19	1	0	Moderate	D (820)	Poor
Titahi - Bay Dr	20	18	1	1	Moderate	C (235)	Fair
Titahi - Toms Rd	20	20	0	0	Moderate	C (255)	Fair
Titahi Bay - Access Rd	20	18	1	1	Moderate	D (630)	Poor
Wellington City							
Aotea Lagoon	20	20	0	0	Moderate	B (98)	Good
Taranaki St Dive Platform[3]	20	19	0	1	N/A	C (210)	N/A
Oriental - Freyberg	20	20	0	0	Moderate	B (76)	Good
Oriental – Well	20	20	0	0	Moderate	B (125)	Good
Oriental - Rotunda	20	20	0	0	Moderate	B (130)	Good
Balaena Bay	20	20	0	0	Low	B (70)	Good
Hataitai Beach	20	20	0	0	Moderate	C (315)	Fair
Shark Bay	20	19	0	1	Moderate	C (460)	Fair
Mahanga Bay	20	20	0	0	Low	B (109)	Good
Scorching Bay	20	20	0	0	Low	C (265)	Fair
Worser Bay	20	20	0	0	Moderate	B (185)	Good↑
Seatoun – Wharf	20	19	0	1	Moderate	C (270)	Fair
Seatoun - Inglis St	20	19	0	1	Moderate	C (250)	Fair
Breaker Bay	20	20	0	0	Low	B (42)	Good↓
Lyall - Tirangi Rd	20	17	1	2	Moderate	C (405)	Fair
Lyall - Onepu Rd	20	19	0	1	Moderate	B (140)	Good
Lyall - Queens Dr	20	19	0	1	Moderate	C (215)	Fair↓
Princess Bay	20	20	0	0	Low	A (28)	Very Good
Island - Reef St	20	20	0	0	Moderate	D (1,440)	Poor
Island -Surf Club	20	19	0	1	Moderate	D (620)	Poor

Site	*n*	No. sample results (Enterococci cfu/100mL)			Beach grading (2011/12–2015/16 data)		
		Surveillance (≤ 140)	Alert (141–280)	Action (>280)	SIC Grade	MAC Grade (95th %ile value)	2015/16 SFRG
Island - Derwent St	20	20	0	0	Moderate	D (700)	Poor
Owhiro Bay	20	19	0	1	Moderate	D (2,650)	Poor
Hutt							
Petone - Water Ski Club	20	19	1	0	Moderate	C (335)	Fair
Petone - Sydney St	20	19	0	1	Moderate	C (285)	Fair
Petone – Kiosk	20	19	1	0	Moderate	C (330)	Fair
Sorrento Bay	20	20	0	0	Low	C (375)	Fair
Lowry - Cheviot Rd	20	19	0	1	Moderate	C (335)	Fair
York Bay	20	20	0	0	Low	B (94)	Good
Days – Wellesley	20	20	0	0	Moderate	B (130)	Good
Days – Wharf	20	20	0	0	Moderate	B (100)	Good
Days - Moana Rd	20	20	0	0	Moderate	B (130)	Good
Rona - CB Pk	20	20	0	0	Moderate	C (475)	Fair↑
Rona – Wharf	20	20	0	0	Moderate	C (240)	Fair
Robinson - HWS Rec Gd	20	19	0	1	Moderate	B (185)	Good
Robinson - Nikau St	20	19	0	1	Moderate	B (195)	Good
Wairarapa							
Castlepoint - Castlepoint Stm	20	20	0	0	Moderate	A (36)	Good[4]
Castlepoint - Smelly Crk	20	20	0	0	Low	B (72)	Good
Riversdale - Flags	20	20	0	0	Low	A (22)	Very Good↑

[1] Grade based on data collected between 2007/08-2010/11 and then 2015/16.
[2] This site could not be sampled on two occasions during the 2015/16 season due to lack of site access.
[3] Insufficient data available to assign a SIC grade, MAC grade, and SFRG at this stage.
[4] The combination of SIC and MAC for this site is unexpected and the grade assigned is interim. The SIC for this site will be reviewed in 2016/17

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