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Recreational water quality technical report

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Executive summary

Recreational water quality monitoring is currently undertaken at 23 freshwater and 76 marine sites across the Wellington Region. The suitability of marine waters for recreational shellfish gathering is also monitored at seven locations.

This report presents the results of all routine recreational water quality monitoring undertaken over the period 1 November to 31 March 2005 inclusive, focusing in particular on the results of the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons. These results are assessed against the Ministry for the Environment/Ministry of Health (MfE/MoH 2003) Microbiological Water Quality Guidelines for Marine and Fresh Water Recreational Areas. Filamentous algae cover is also monitored at the fresh water sites and the results of this monitoring are assessed against the Ministry for the Environment (MfE 2000) Periphyton Guidelines for aesthetic and recreational values in gravel/cobble bed streams.

Fresh waters

Of the 23 freshwater monitoring sites, 26% complied with the surveillance level of the recreational water quality guidelines on more than 90% of summer sampling occasions. Compliance with the guidelines was highest at sites located within relatively unmodified bush catchments, notably the Waiohine River at the Gauge, the Waingawa River at Kaituna and the Otaki River at The Pots. Compliance was lower at sites draining agricultural catchments. The sites that exceeded the action level of the guidelines on the most occasions were Riversdale Lagoon (12), the Waipoua River at Colombo Road (9), and the Hutt River at both Silverstream (9) and Birchville (9).

All of the action level events at sites in Kapiti coincided with rainfall events. In the Hutt Valley and Wairarapa, rainfall appears to account for 90% of all action level events. Those sites recording one or more action level events that coincided with little or no rainfall included:

- Hutt Valley– Hutt River at Maoribank Corner, Birchville and Silverstream
- Wairarapa – Ruamahanga River at Double Bridges, Riversdale Lagoon

Overall compliance with the guidelines was highest over the 2002/2003 summer when rainfall was below average and lowest over the 2003/2004 summer when rainfall was above average.

Periphyton cover exceeded guidelines for aesthetic and recreational values on one or more occasions over the reporting period at a number of monitoring sites, including most sites on the Ruamahanga River, both sites on the Waingawa River and one site on the Waiohine River. At all sites, the nuisance growths occurred in late summer, coinciding with low and relatively stable river flows and warmer water temperatures.

Using protocol outlined by the MfE/MoH (2003), interim suitability for recreation grades (SFRGs) were determined for each site. Only 13% of sites received a “very good” or “good” grade, with the majority of the sites (74%) receiving a grade of “poor” or “very poor.” The applicability of these grades is questioned as they are influenced by contamination arising from wet weather monitoring. Therefore the interim SFRGs

better reflect the condition of the bathing sites during wet weather than dry weather when contact recreation would be greatest.

Marine waters

Of the 76 marine monitoring sites, 77% complied with the surveillance level of the recreational water quality guidelines on more than 90% of summer sampling occasions. Paekakariki Beach (at the Surf Club), Days Bay (at Moana Road), Scorching Bay, Lyall Bay (at Onepu Road) and Riversdale Beach did not exceed the action level of the guidelines on any occasion over the last four summers. The sites that exceeded this level on the most occasions were Titahi Bay (at Bay Drive), Pauatahanui Inlet (at Browns Bay), South Beach at Plimmerton, Porirua Harbour (at the Rowing Club) and Plimmerton Beach (at Bath Street).

All of the action level events at sites in the Wairarapa coincided with rainfall events and at sites in Kapiti, Wellington City and Porirua City, rainfall appears to account for 70 to 80% of all action level exceedances. At sites in Hutt City, rainfall may only account for approximately 55% of all action level exceedances recorded from routine monitoring over the reporting period.

At some sites, a number of action level results coincided with little or no rainfall. These sites include:

- Kapiti – Paraparaumu Beach (at Ngapoti Street and Nathan Avenue)
- Porirua City – Titahi Bay (at Bay Drive), Plimmerton Beach, South Beach (at Plimmerton) and Pauatahanui Inlet (at Browns Bay)
- Hutt City – Petone Beach (in particular at Sydney Street), Lowry Bay, Rona Bay (at the wharf) and Robinson Bay (at HW Shortt Recreation Ground and Nikau Street)
- Wellington City – Oriental Bay (at Wishing Well), Island Bay (all sites but especially at Old Bait Shed), Owhiro Bay and, on occasion, Seatoun Beach.

It is unclear why a number of elevated results coincided with little or no rainfall. At some sites, local streams may be affecting coastal water quality at times. It is also likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some locations. Water quality at some beaches, notably Petone Beach in Hutt City and beaches on Wellington City's south coast, may also be influenced by debris and other material pushed up onto the beaches at times of high tide and strong southerly winds.

Compliance with the recreational water quality guidelines was highest at sites in the Wairarapa, Wellington City and Kapiti over the 2002/2003 summer when rainfall was below average. In contrast, compliance with the guidelines was highest at sites in Porirua City and Hutt City over the 2004/2005 summer.

At sites in Kapiti, Porirua City, Hutt City and the Wairarapa, the lowest level of compliance with the guidelines coincided with above average rainfall over the 2003/2004 summer. In contrast, at sites in Wellington City, compliance with the guidelines was lowest over the 2004/2005 summer. In all four summer bathing seasons, Porirua City consistently had the greatest percentage of sites exceeding guideline values.

Using protocol outlined by the MfE/MoH (2003), 62% of the monitoring sites received an interim suitability for recreation grade of "good" or "very good." Just 12.6% of sites received a grade of "poor" or "very poor." All but one of these sites was located in Porirua City.

Marine shellfish gathering waters

Only three sites consistently complied with the seasonal median recreational water quality guideline over the reporting period; Shark Bay and Mahanga Bay in Wellington City, and Sorrento Bay in Hutt City. None of the sites consistently met the requirement that no more than 10% of samples in a season exceed 43 faecal coliforms/100 mL. Faecal bacteria counts in Porirua Harbour adjacent to Te Hiko Street are very high and it is not recommended that people consume shellfish taken from this site.

Compliance with the MfE/MoH (2003) shellfish gathering water quality guidelines differed between summer seasons. The highest level of compliance with the guidelines coincided with below average rainfall over the 2002/2003 summer. In contrast, the lowest level of compliance was obtained over the 2001/2002 summer; all seven sites monitored exceeded the threshold that no more than 10% of samples in a season exceed 43 faecal coliforms/100 mL. This poor level of compliance is attributed to above average rainfall over the 2001/2002 summer.

Synthesis

The relatively high correlation between the occurrence of heavy rainfall and elevated bacteria counts at the majority of monitoring sites in both fresh and marine waters across the region supports advice from the Greater Wellington Regional Council and the Ministry of Health to avoid swimming and other contact recreation activities during, and for up to two days after, heavy rain. Urban stormwater (including sewer overflows during heavy rainfall) and diffuse-source runoff into rivers and streams are considered to be the major contributors to faecal contamination of recreational waters in the Wellington Region.

Recommendations

1. Monitoring of recreational water quality at freshwater and marine bathing sites continues in accordance with the MfE/MoH (2003) microbiological water quality guidelines.

2. Follow-up sampling in the event of an exceedance of the alert or action levels of the microbiological water quality guidelines is conducted at all fresh water bathing sites where the cause of the exceedance can not be attributed to rainfall.

3. A suitable site on the Akatarawa River is investigated and included in the freshwater recreational monitoring programme, commencing in the 2005/2006 summer.

4. Catchment assessments are undertaken at all freshwater monitoring sites and existing assessments for all marine monitoring sites are reviewed over 2005/2006.

5. Suitability for recreation grades are finalised for freshwater and marine monitoring sites following the 2005/2006 summer, and reviewed annually upon the conclusion of each summer bathing season.

6. Annual reporting of recreational water quality monitoring results continues, with inclusion of suitability for recreation grades in all reports prepared following the 2005/2006 summer.

7. Monitoring of recreational shellfish gathering waters is reviewed, with greater emphasis given to monitoring microbiological contaminants in shellfish flesh at recreational shellfish gathering sites.

8. Data collection, archiving and retrieval methods are reviewed to ensure that all historic and future recreational water quality data are stored electronically in one location on Greater Wellington Regional Council's water quality database.

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1. Introduction

1.1 Background

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.

The Greater Wellington Regional Council has monitored water quality at selected recreational sites in both fresh and marine waters across the Wellington Region for over 10 years. The logistics of monitoring recreational water quality were comprehensively reviewed in 2000 and monitoring since has been a joint effort involving the Greater Wellington Regional Council and its constituent local councils, in particular the Kapiti Coast District Council, Porirua City Council, Hutt City Council, and Wellington City Council. Choice Health and Hutt Valley Health are consulted on occasions when the results of the monitoring indicate a serious health risk might exist. In 2001, the monitoring programme was further rationalised, with a comprehensive review of the sites monitored across the region.

The Greater Wellington Regional Council produces annual "On the Beaches" reports summarising the results of recreational water quality monitoring conducted during the summer bathing season. This report focuses in detail on the results of the last four years of recreational water quality monitoring, covering the period 1 November 2001 to 31 March 2005 inclusive.

1.2 Legislative framework and responsibilities

The Resource Management Act 1991 (RMA) and the Health Act 1956 (HA) are the two principal Acts that address water quality aspects of recreational water use. Responsibility for overseeing these Acts is shared between regional councils (RMA), territorial authorities (RMA and HA), and district health boards (HA). Neither Act specifies which agency had primary responsibility for recreational water quality monitoring, although the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (Ministry of Health (MoH), Ministry for the Environment (MfE), 2003) attempt to outline the various responsibilities.

In the Wellington Region, the Greater Wellington Regional Council has taken responsibility as the lead agency for coordinating and reporting on the results of recreational water quality monitoring. The territorial authorities collect the majority of the water samples, and are also responsible for erecting signs when results indicate a bathing site should be closed and undertaking sanitary surveys when required. Choice Health and Hutt Valley Health have responsibility for informing the public when an exceedance of the guidelines occurs although during the summer bathing season, weekly water test results are collated by the Greater Wellington Regional Council and displayed at www.gw.govt.nz/on-the-beaches.

1.2.1 Resource Management Act and Regional Plans

Part IV of the RMA sets out the functions, powers and duties of regional councils under the RMA. Included in the functions of regional councils is the maintenance and enhancement of the quality of fresh and coastal waters (s30(1)). Regional councils also have a duty to gather information and monitor the state of the environment to ensure they are effectively carrying out their functions under the RMA (s35(1) and (2)).

The Greater Wellington Regional Council has set out its responsibilities with respect to fresh and coastal water quality in three documents; the Regional Policy Statement, the Regional Freshwater Plan, and the Regional Coastal Plan. The relevant objectives and policies in each of these documents are outlined below.

The Regional Policy Statement (RPS)

- Freshwater (Chapter 5) -
  - Objective 2: the quality of fresh water meets the range of uses and values for which it is required, safeguards its life supporting capacity, and has the potential to meet the reasonably foreseeable needs of future generations.
  - Objective 3: Freshwater resources of significance or of high value for cultural, spiritual, scenic, ecosystem, natural, recreational, or other amenity reasons are protected or enhanced.
- Freshwater (Chapter 7) -
  - Objective 3: Coastal water quality is of a high standard.

The RPS also outlines a range of policies to address fresh and coastal water quality (Policies 4 to 9 in Chapter 5 (freshwater) and Policy 7 in Chapter 7 (coastal water)). More specific guidance is provided in the Regional Freshwater Plan and the Regional Coastal Plan.

The Regional Freshwater Plan

- Policy 5.2.4: To manage water quality for contact recreation purposes in selected stretches of the following water bodies:
  - The Otaki River
  - The Waikanae River
  - The Hutt River
  - The Pakuratahi River
  - The Akatarawa River
  - The Waingawa River
  - The Waiohine River
  - The Ruamahanga River

The Regional Coastal Plan

- Policy 10.2.1: To manage water quality in selected areas for shellfish gathering purposes – this policy relates to parts of the coastal marine area except those described in Policy 10.2.2.

- Policy 10.2.2: To manage water quality in selected areas for contact recreation purposes – these areas include Otaki Beach, Te Horo Beach, Waikanae Beach, Paraparaumu Beach, Raumati Beach, Paekakariki Beach, Plimmerton Beach, Porirua Harbour, Titahi Bay, Wellington Harbour, Lake Onoke, Castlepoint Beach and Riversdale Beach.

1.3 Monitoring and reporting objectives

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

1. Determine the suitability of selected sites in fresh and marine 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 the determination of 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.

The primary aim of this report is to assess the *state* of recreational water quality at selected freshwater and marine sites in the Wellington Region to determine their suitability for contact recreation and shellfish gathering. In particular, the following questions are addressed:

- What is the level of compliance with recreational water quality guidelines at these sites?
- Are there any trends or changes in recreational water quality in the region over the reporting period, and if so, what are the possible reasons for these trends or changes?

The information contained in this report will be used to assess the effectiveness of objectives in the RPS relating to recreational water quality. The report period is limited to 1 November 2001 to 31 March 2005 inclusive. Changes in monitoring sites, sampling methodology, microbiological indicators and data archiving prevent assessment of trends over a greater length of time, despite the existence of over 10 years of microbiological water quality data for some sites.

1.4 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.

In 2003 the Ministry for the Environment (MfE) and the Ministry of Health (MoH) finalised microbiological water quality guidelines for recreational waters which are based on an assessment of the risk from exposure to contaminated water. These guidelines use bacteriological indicators associated with the gut of warm blooded animals to assess the risk of faecal contamination and therefore the potential presence of harmful pathogens[1]. The indicators used are:

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

Compliance with the MfE/MoH (2003[2]) microbiological 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 later sections of this report. In essence, the guidelines are "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 1.1).

Table 1.1: 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

1.4.1 Beach grading

In recent years there has been a move away from the sole use of quantitative “guideline” values of bacteriological indicators to assess the risk of faecal contamination and therefore the potential for the presence of pathogens. Instead, the MFE/MoH (2003) guidelines advocate a risk-based approach to managing recreational waters. This involves combining a qualitative assessment of the susceptibility of a recreational site to faecal contamination, and direct measurements of appropriate bacteriological indicators at the site to generate a “Suitability for Recreation Grade” (SFRG) for the site (Figure 1.1).

[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.

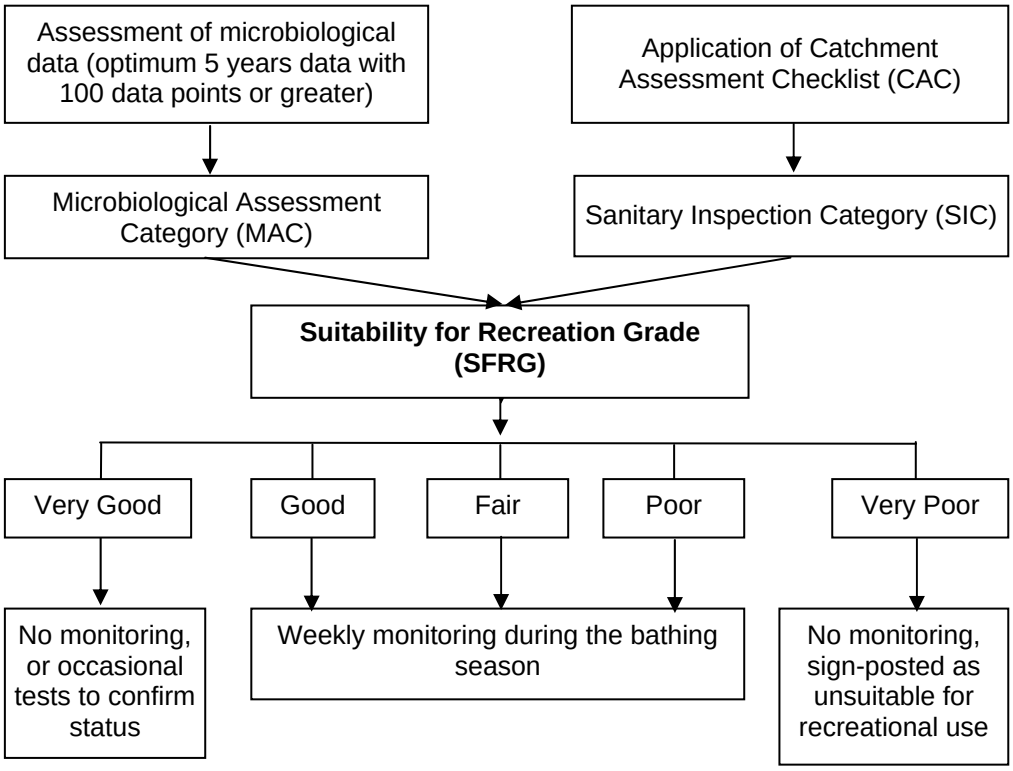

Figure 1.1: Overview of the bathing site grading process and surveillance requirements

The SFRG describes the general condition of the water at a site at any given time, based on both risk and indicator bacteria counts. This grade helps determine whether on-going monitoring is required, and provides the basis for advising people whether or not the water at a site is suitable for recreational use from a public health perspective. The risk of becoming sick from contact with the water at a site increases as the grading shifts from "very good" to "very poor". Conditions affecting water quality will vary the most for the middle range of grades ("good", "fair", and "poor"). For example, the water at "good" sites will usually comply with the guidelines, but events such as high rainfall can increase the risk of microbiological contamination from run-off. Consequently, weekly water quality monitoring at these middle-range sites is recommended during the bathing season.

The two components providing a SFRG for the water at an individual site are:

- the Sanitary Inspection Category (SIC), which is a measure of the susceptibility of the water body to faecal contamination based on a Catchment Assessment Checklist (CAC); 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 (e.g., sewage overflows, stormwater discharge, agricultural runoff, wildlife, etc.) to be identified and assigns a category according to risk. This category is "very high", "high", "moderate", "low", or "very low", and is found for a specific water body by use of a SIC flow chart. The information for using the flow chart

comes from a Catchment Assessment Checklist (CAC). The Greater Wellington Regional Council completed CACs for the majority of the 76 coastal recreational water quality monitoring sites in 2002. Preliminary CACs were also completed for the 23 freshwater monitoring sites at the same time, although formal CACs are still required for all of the freshwater sites.

The MAC is established from existing or collected microbiological data. The MFE/MoH (2003) guidelines state that ideally there should be 100 data points or greater, collected over the previous five years, although it is feasible to consider grading with a minimum of 20 data points collected over one full bathing season. The grading is considered interim until five years of data have been collected. As only four years of data are available for this report, the SFRGs are to be considered as *interim* grades.

1.5 Outline of report

This report presents the results of recreational water quality monitoring conducted in the Wellington Region over the period 1 November 2001 to 31 March 2005 inclusive, focusing in detail on the results collected over the summer bathing seasons. Section 2 provides a brief overview of the primary sources of microbiological contamination in recreational waters. Results for fresh waters, marine waters and shellfish-gathering recreational waters are then presented separately in Sections 3, 4 and 5 respectively. Each of these three sections outlines the monitoring sites and protocol, guideline values, and concludes with a discussion of the results, including any spatial or temporal patterns that may be present. Overall conclusions and recommendations are presented in Section 6.

2. Sources of microbiological contamination in recreational waters

The primary sources of bacteria and pathogens in waters used for recreation include sewage, stormwater, rural run-off and stock. Each is outlined briefly below.

2.1 Sewage

Sewage (wastewater) from many communities is collected via a network of pipes and pumped to a central facility for treatment prior to being discharged into the environment. In the Wellington Region, treated wastewater is discharged into fresh and marine waters at a number of locations. For example, in Porirua, treated wastewater is discharged into the sea at Rukatane Point and in Wellington City, treated wastewater is discharged into the sea at the mouth of Karori Stream and off Moa Point. The locations of other municipal wastewater treatment discharges in the vicinity of recreational waters are outlined in Sections 3 and 4.

At times sewage can enter the environment before completing its journey through the treatment process. Some examples include:

- Broken or leaky pipes – usually as a result of ageing pipes, construction activities or road works.
- Overflows, during rainfall – the treatment facility may not be able to cope with the volumes of water and sewage entering the system, and raw or partially treated sewage is discharged directly into the environment. This situation can be exacerbated where households have stormwater from roofs and other hard surfaces illegally connected to the sewerage system. Also, some older sewerage systems do not have completely separated sewage and stormwater pipes. During high rainfall, stormwater can enter the sewerage system and cause sewage to overflow into the stormwater pipes and, subsequently, directly into surface waters. This currently occurs in a number of areas in Wellington City (Figure 2.1), Porirua City and Hutt City.
- Emergency overflows – these can occur periodically during maintenance of sewerage systems.

There are also other sources of sewage. For example:

- Some older properties, especially holiday homes, are still connected to septic tanks. Where these tanks have deteriorated, they may leak contaminated water into the groundwater which, in turn, ends up in surface waters. In Wellington City, a few suburbs are still serviced by septic tanks (e.g., Makara, Ohariu Valley) and in smaller towns throughout the Wellington Region, septic tanks are the only means of treating household wastes.
- Some boat owners discharge wastes directly into the sea, without treatment.

Figure 2.1: Stormwater outfall at Evans Bay in Wellington City – diluted raw sewage can be discharged with stormwater from this outfall during times of heavy rainfall

2.2 Stormwater

In urban areas in the Wellington Region, as is the case in urban areas elsewhere in New Zealand, rainwater collected from roofs, driveways, roads, carparks and other sealed surfaces is piped directly to rivers, streams and coastal waters without treatment (Figure 2.2). During its travels, this stormwater picks up wastes from a number of sources, including faecal matter from domestic animals which collect on footpaths, gutters and lawns.

Figure 2.2: Wharemauku Stream receives stormwater from the urban settlements of Paraparaumu and Raumati prior to discharging to Raumati Beach

2.3 Rural run-off and stock

Run-off from farms and other rural areas during rainfall can contribute significantly to faecal contamination of waterways. This is primarily because a large amount of animal waste ends up on paddocks. Depending on a number of factors – including distance to the nearest stream, rainfall intensity and stock numbers – faecal material washes off the paddocks and into rivers and streams, which ultimately discharge to the marine environment. Where stock have direct access to streams and rivers for drinking, faecal matter may be deposited directly into the water (Figure 2.3).

Figure 2.3: Cows in the Otakura Stream in the southern Wairarapa

2.4 Other sources

Other sources of microbiological contamination in recreational waters include faecal inputs from birdlife and feral animals. For example, some recreational areas such as Hataitai Beach in Wellington City attract a large number of ducks.

3. Recreational water quality in fresh waters

3.1 Introduction

Recreational water quality is currently monitored at 23 freshwater sites across the Wellington Region. These sites were selected on the basis of their use by the public for contact recreation; in particular, swimming, canoeing, and rafting. Four of the sites are located in the Kapiti Coast District, six in the Hutt Valley and 13 in the Wairarapa. The locations of the monitoring sites are shown in Figure 3.1. A full site list can be found in Appendix 1.

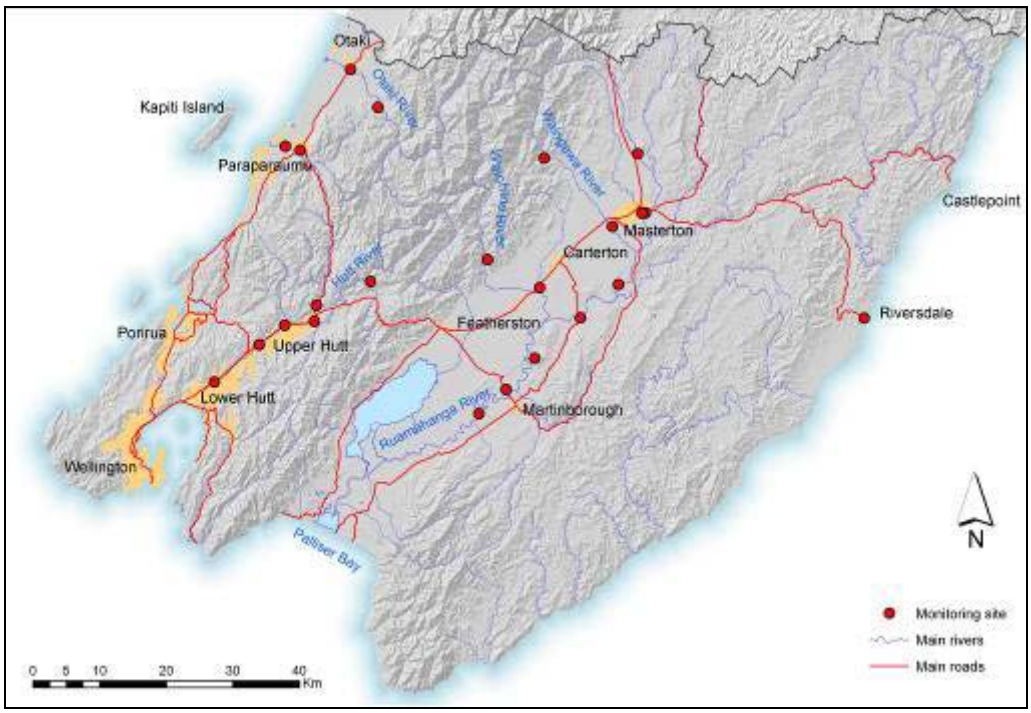

Figure 3.1: Freshwater recreational water quality monitoring sites in the Wellington Region

3.1.1 Monitoring protocol

Sites are sampled weekly during the bathing season. On each occasion a single water sample is collected 0.2 metres below the surface in 0.5 metres water depth and analysed for *Escherichia coli (E. coli)* indicator bacteria using membrane filtration. 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, are also made at each freshwater site. Excessive amounts of periphyton, in particular filamentous algae, can reduce the amenity value of waterways by decreasing their aesthetic appearance, reducing visibility, and being a physical nuisance to swimmers.

An estimate of the daily rainfall in the catchment adjoining each site over the bathing season is made by obtaining records from the nearest rain gauge. Rainfall can have a significant impact on water quality, as a result of runoff and re-suspension of river sediments.

3.1.2 Guidelines

As outlined in Section 1.4, 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 for freshwater recreational sites underpin a three-tier management framework analogous to traffic lights (Table 3.1).

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

Mode	Guideline (*E. coli* count in colony-forming units (cfu) per 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 (8/1,000 risk). 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. 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.

Annapolis protocol/beach grading

The process for grading the suitability of sites for contact recreation purposes was outlined in Section 1.4.1. The suitability for recreation grades (SFRGs) for fresh waters are shown in Table 3.2. Further details about the SFRGs can be found in Appendix 2.

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

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

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

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

3 Implies non-sewage sources of indicators requiring verification

Periphyton

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

3.1.3 Data analysis, limitations and reporting

All sampling and evaluation of results has been undertaken in accordance with the MfE/MoH (2003) microbiological water quality guidelines for freshwater recreational areas.

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 (i.e., counts of <1 cfu/100 mL and >400 cfu/100 mL were treated as 0.5 cfu/100 mL and 400 mL respectively). *E. coli* counts are presented on a logarithmic scale in all time-series graphs.

Cautionary note

The number of exceedances of recreational water quality guidelines reported may differ from those previously reported by Greater Wellington Regional Council or other authorities. There are two primary reasons for this:

- Water quality results reported on prior to the 2003/2004 summer will have been assessed against either the MfE/MoH (1999) or the MfE/MoH(2002) *interim* microbiological water quality guidelines for freshwater recreational areas. The guidelines used in this report were only finalised in June 2003 and differ from the interim guidelines.
- In a few instances, the Greater Wellington Regional Council's water quality database may be missing some monitoring results.

3.2 Kapiti

The Kapiti Coast area is comprised of seven major catchments; Waitohu, Otaki, Mangaone, Waikanae, Whareroa, Wharemauku and Wainui. The Regional Freshwater Plan identifies specific stretches on the major rivers within two of these catchments, the Otaki and the Waikanae, as being particularly important for contact recreation.

The Otaki catchment is roughly "T" shaped and drains the central portion of the Tararua Ranges. The catchment is bordered by the Waikanae catchment to the south, the Waiohine catchment to the east and the Waitohu catchment to the north. The catchment rises at elevations of between 1,100 and 1,500 m, and has a total area of 348 km^2. The Otaki River flows through a series of gorges within the Tararua Ranges before exiting onto the coastal plain (Figure 3.2). Downstream of State Highway 1 the naturally braided channels exhibited up until the 1930s have been modified by river management to a straight and relatively narrow channel (Wellington Regional Council, 1994). Major tributaries of the Otaki River include the Waitewaewae River, Waiotauru River, Waitatapia Stream, Pukehinau Stream, Pukeatua Stream, Kahiwiroa Stream, Penn Creek, Whatiuru Creek and Rahui Stream.

The Waikanae River drains the southwestern portion of the Tararua Ranges and shares a drainage divide with the Hutt and Otaki catchments where elevations reach 1,100 m in altitude. The total area of the Waikanae catchment is 149 km^2. The Waikanae River has a gravel bed and follows a meandering channel form. Downstream of State Highway 1, the river becomes a more narrow, single thread channel. This is the result of past channel management and gravel extraction policies (Wellington Regional Council, 1994). Major tributaries of the Waikanae River include the Maungakotukutuku Stream, Reikorangi Stream, Rangiora River and Ngatiawa River. Treated wastewater from the townships of Waikanae, Paraparaumu and Raumati enters the lower reaches of the Waikanae River via the Mazengarb Drain.

Figure 3.2: Otaki River at The Pots

3.2.1 Otaki River

Both monitoring sites on the Otaki River (Figure 3.2) exceeded the action level of the recreational water quality guidelines on just one occasion during routine monitoring over the last four summer bathing seasons (Table 3.3). The number of alert level exceedances was higher, with the State Highway 1 site recording eight in total. Overall, The Pots and State Highway 1 monitoring sites complied with the surveillance level of the guidelines on 95% and 89% of sampling occasions respectively (Figure 3.3).

Table 3.3: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
THE POTS								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	20	95.2	1	4.8	0	0.0	21	100
2004-2005	18	100.0	0	0.0	0	0.0	18	100
Total	**77**		**3**		**1**		**81**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
STATE HIGHWAY 1								
2001-2002	18	85.7	3	14.3	0	0.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	18	85.7	3	14.3	0	0.0	21	100
2004-2005	17	89.5	1	5.3	1	5.3	19	100
Total	**73**		**8**		**1**		**82**	

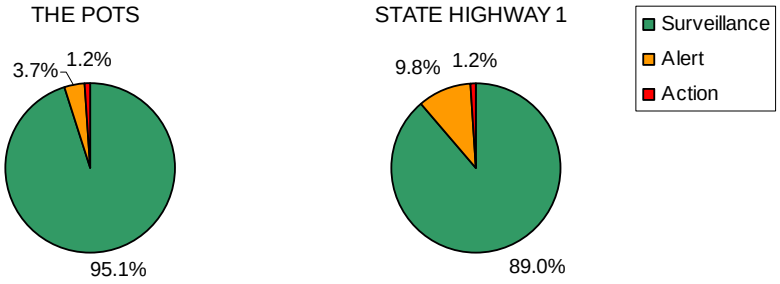

Figure 3.3: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The action level exceedances were recorded on 3 February 2002 (The Pots) and 11 November 2004 (State Highway 1), (Figure 3.4). In both instances, heavy rainfall was recorded prior to sampling (Table 3.4).

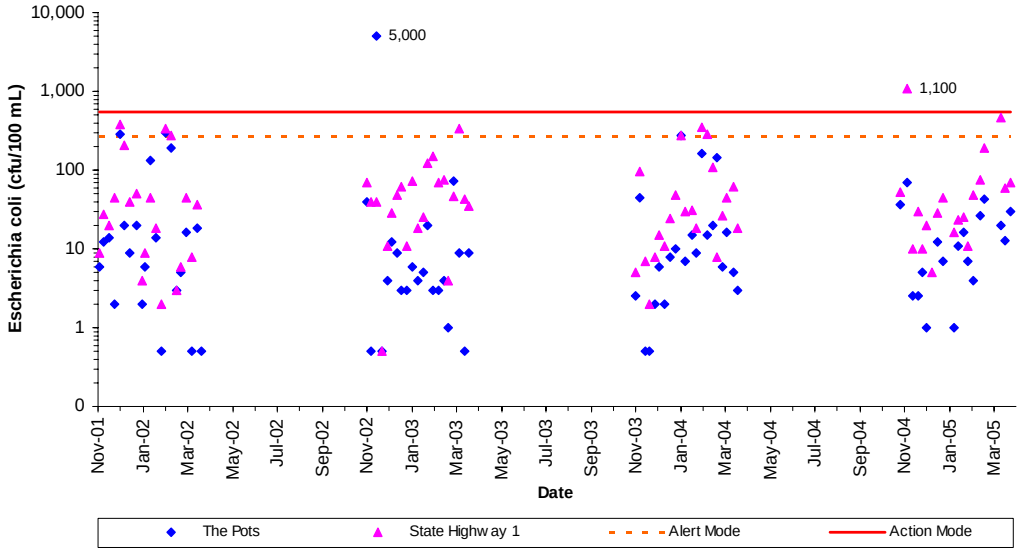

Figure 3.4: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.4: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Taungata Water Treatment Plant rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	The Pots	S.H. 1	24 hrs	48 hrs	72 hrs	
03/02/2004	5,000		43.5	122.0	132.5	15.5
11/11/2004		1,100	70.5	71.0	71.0	0

Neither site exceeded the MfE (2000) thresholds for periphyton cover during any of the four summer bathing seasons.

3.2.2 Waikanae River

Both Waikanae River monitoring sites exceeded the action level of the recreational water quality guidelines on seven occasions over the last four summer bathing seasons (Table 3.5). The timing of the exceedances was the same for both sites. Overall, the State Highway 1 and Greenaway Road sites complied with the surveillance level of the guidelines on over 84% and 86% of sampling occasions respectively (Figure 3.5).

Table 3.5: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
STATE HIGHWAY 1								
2001-2002	17	81.0	2	9.5	2	9.5	21	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	16	76.2	2	9.5	3	14.3	21	100
2004-2005	18	90.0	1	5.0	1	5.0	20	100
Total	**70**		**6**		**7**		**83**	
GREENAWAY ROAD								
2001-2002	17	81.0	2	9.5	2	9.5	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	17	81.0	1	4.8	3	14.3	21	100
2004-2005	18	90.0	1	5.0	1	5.0	20	100
Total	**72**		**4**		**7**		**83**	

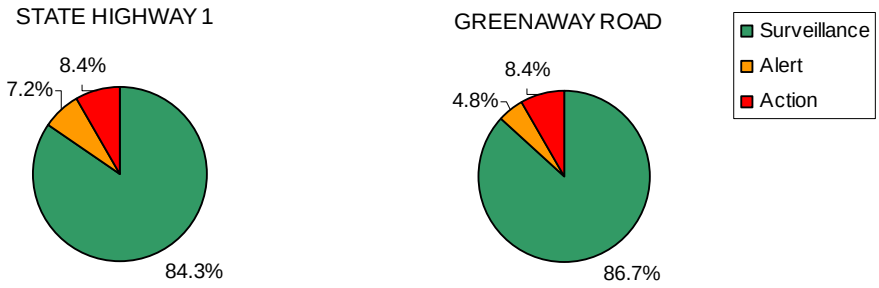

Figure 3.5: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The highest *E. coli* counts recorded at the State Highway 1 and Greenaway Road sites were 6,300 cfu/100 mL and 7,000 cfu/100 mL respectively (Figure 3.6). Both of these counts were recorded on 4 December 2001 and followed 60 mm of rainfall on the day preceding sampling and further rainfall on the day of sampling (Table 3.6). All of the other action level exceedances also coincided with heavy rainfall events. Four of the exceedances at each site were at least an order of magnitude above the surveillance level of the guidelines.

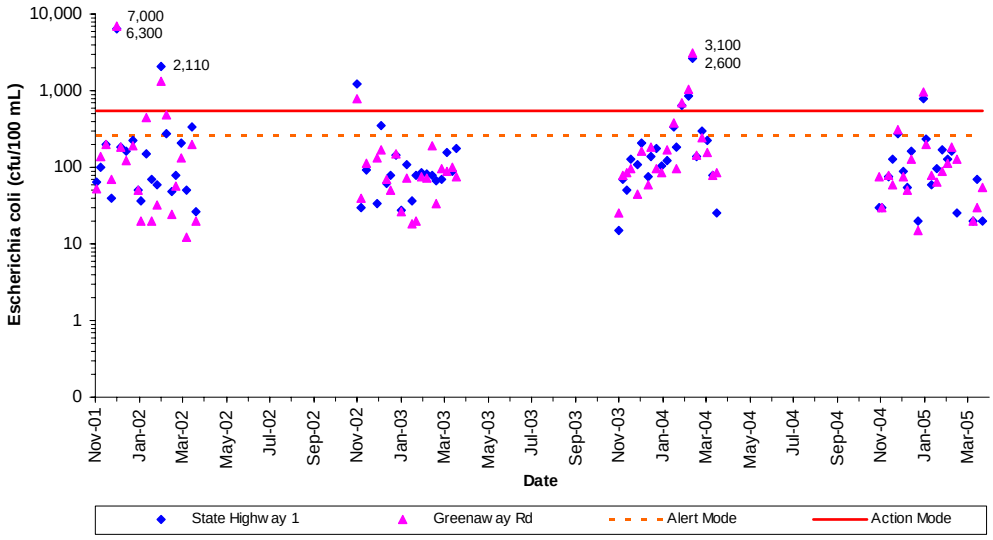

Figure 3.6: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.6: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Taungata Water Treatment Plant rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	S.H. 1	Greenaway	24 hrs	48 hrs	72 hrs	
04/12/2001	6,300	7,000	60.5	84	101	60
05/02/2002	2,110	1,310	16.5	16.5	16.5	22
05/11/2002	1,220	780	45.5	46.0	50.5	22.5
03/02/2004	630	685	43.5	122.0	132.5	15.5

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	S.H. 1	Greenaway	24 hrs	48 hrs	72 hrs	
12/02/2004	840	1,040	131	169.5	183.5	0
17/02/2004	2,600	3,100	26	134	176	14
05/01/2005	780	980	6.5	6.5	6.5	75.5

Neither site exceeded the MfE (2000) thresholds for periphyton cover during any of the four summer bathing seasons.

3.2.3 Discussion

Of the four monitoring sites in the Kapiti Coast District, the Otaki River at The Pots recorded the highest level of compliance with the recreational water quality guidelines (Figure 3.7). The Waikanae River at State Highway 1 recorded the lowest level of compliance, exceeding the surveillance level guideline on more than 15% of sampling occasions.

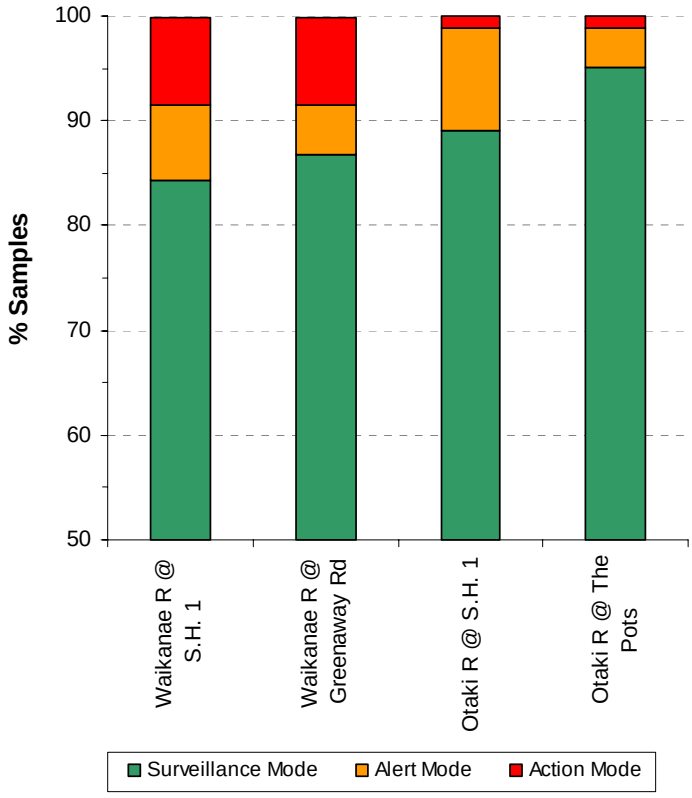

Figure 3.7: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

Periphyton cover did not exceed the MfE (2000) guidelines for aesthetic and recreational values at any site during the last four summer bathing seasons.

Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer, when two of the four sites exceeded the action level guideline on one occasion (Table 3.7). In contrast, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer. Three sites exceeded the action level over this period, with two sites exceeding the action level on at least three occasions.

Table 3.7: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly summer sampling undertaken at the four monitoring sites in the Kapiti Coast District

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3-4	≥ 5
2001/2002	0	2	0	2	0	0
2002/2003	0	2	2	0	0	0
2003/2004	0	3	1	0	2	0
2004/2005	0	3	3	0	0	0

Analysis of rainfall records indicates that rainfall events appear to account for all of the action level events recorded over the reporting period. The influence of rainfall was clearly evident over the 2003/2004 summer; all seven action level events recorded over this summer were recorded in February which had exceptionally high rainfall compared with the longterm average (Figure 3.8).

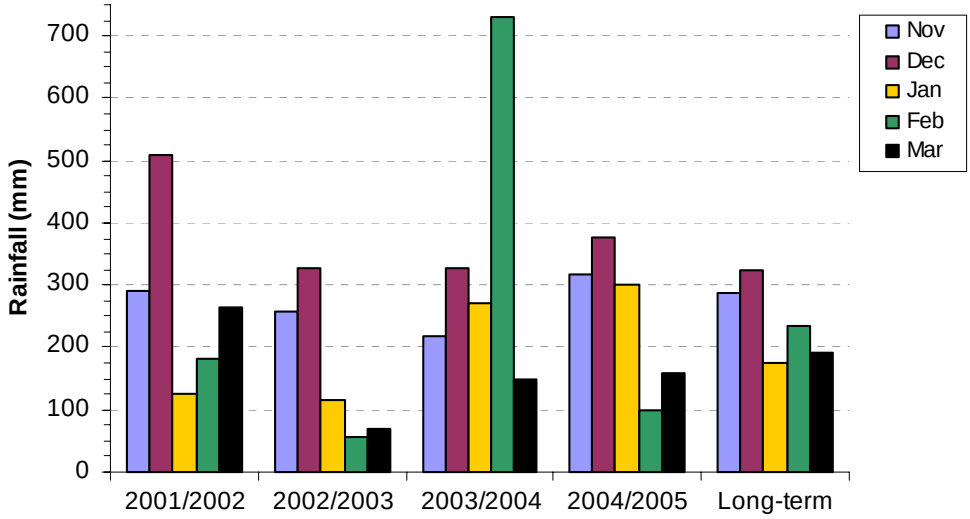

Figure 3.8: Monthly rainfall recorded at the Taungata Water Treatment Plant over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1991 to present)

Suitability for recreation

The number of exceedances of the recreational water quality guidelines over the last four summer seasons was low for the two Otaki River monitoring sites

(in particular at The Pots), resulting in relatively low MAC values (Table 3.8). These low MAC values combine with low to moderate SIC values to give interim SFRGs of "good" and "fair" for The Pots and State Highway 1 respectively. The interim SFRG is "very poor" for both Waikanae River monitoring sites, reflecting both the higher MAC and SIC values for these sites.

Table 3.8: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for freshwater bathing sites in the Kapiti Coast District

Site	MAC*	SIC**	Interim SFRG
OTAKI RIVER			
The Pots	B (95^{th} percentile = 226, n=81)	Low	Good
State Highway 1	C (95^{th} percentile = 346, n=82)	Moderate	Fair
WAIKANAE RIVER			
State Highway 1	D (95^{th} percentile = 973, n=83)	High	Very Poor
Greenaway Road	D (95^{th} percentile = 1,001, n=83)	High	Very Poor

* Based on *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

** Estimates only – catchment assessments required

The interim SFRGs for the two Waikanae River sites appear very conservative, and reflect the influence of action level events on the MAC values. All of these action level events coincided with significant rainfall events and if removed from the dataset used to calculate the MAC, the MAC value would be significantly lower and the interim SFRG higher. Therefore, it is considered that the interim SFRGs better reflect the condition of the bathing sites during wet weather than dry weather when contact recreation would be greatest.

3.3 Hutt

The Hutt River catchment is comprised of six major subcatchments; Pakuratahi, Mangaroa, Akatarawa, Whakatiki and Waiwhetu. The Regional Freshwater Plan identifies specific stretches of the Hutt River, Pakuratahi River (Figure 3.9) and Akatarawa River as being particularly important for contact recreation. Currently only the Hutt River (five sites) and Pakuratahi River (one site) are monitored for recreational water quality.

The Hutt River is a gravel bed river that rises in the southern end of the Tararua Ranges. The headwaters are deeply entrenched within steep greywacke country, with the highest elevations reaching 1,261 m at Mount Alpha. The area of the catchment is 240 km^2, and includes a forested catchment area (above Kaitoke) of 88 km^2. The remainder of the area is predominantly urbanised floodplain. The catchment is bordered by the Otaki and Tauherenikau catchments to the north, and the various Hutt tributary catchments to the east and west. The Hutt City Council holds resource

consents authorising sewer overflows into the Hutt River at Silverstream, Manor Park, Taita and Barber Grove (Moera). These overflows occur at times when the sewerage system is overloaded due to heavy rain (refer Section 2.1).

The Pakuratahi River is also a gravel bed river and drains the Rimutaka Ranges in the northeastern corner of the Hutt catchment. The Pakuratahi catchment has a total area of 81 km^2 and shares a drainage divide with the Mangaroa catchment to the southwest, the Hutt catchment above Kaitoke to the north and the Wairarapa Valley to the east. The majority of the catchment is covered in indigenous forest with large areas of scrub land. In the lower catchment, the landuse is predominantly pasture. The main tributaries of the Pakuratahi River include Redington Stream, Climie Creek and Rimutaka Stream.

Figure 3.9: Pakuratahi River

3.3.1 Pakuratahi River

The Pakuratahi River at the Forks exceeded the alert and action levels of the recreational water quality guidelines on seven and six occasions respectively over the last four summer bathing seasons (Table 3.8). Overall the site complied with the surveillance level of the guidelines on almost 85% of sampling occasions (Figure 3.9).

Table 3.8: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	18	81.8	2	9.1	2	9.1	22	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	19	86.4	1	4.5	2	9.1	22	100
2004-2005	16	80.0	3	15.0	1	5.0	20	100
Total	**72**		**7**		**6**		**85**	

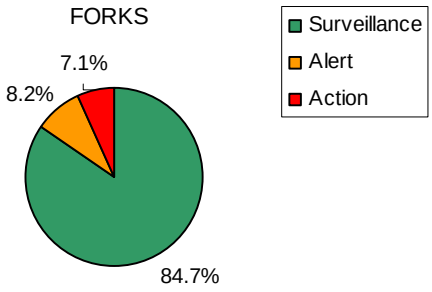

Figure 3.9: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Four of the six exceedances of the action level were at least an order of magnitude above the surveillance level of the guidelines (Figure 3.10). The highest *E. coli* count (7,000 cfu/100 mL) was recorded on 17 February 2004 and followed over 200 mm of rain in the three days prior to sampling (Table 3.9). Four of the five other action level exceedances also coincided with heavy rainfall events.

The monitoring site at the Forks did not exceed the MfE (2000) guidelines for periphyton cover during any of the four summer bathing seasons.

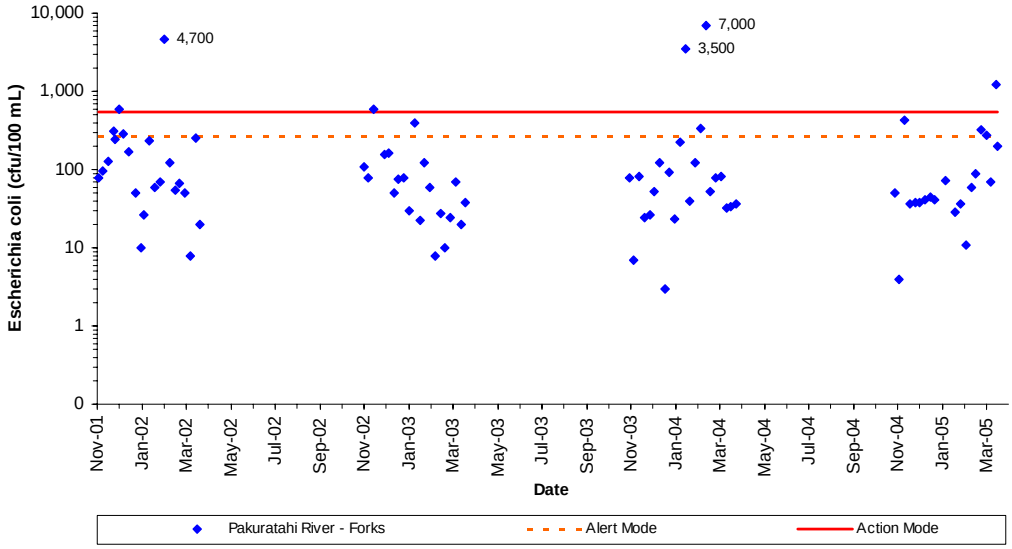

Figure 3.10: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.9: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Kaitoke Headworks rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
04/12/2001	580	14.5	21.0	26.5	47.5
05/02/2002	4,700	10.5	10.5	10.5	18.5
19/11/2002	600	12.0	18.5	41.5	21.0
20/01/2004	3,500	50.0	79.5	79.5	62.5
17/02/2004	7,000	19.5	142.5	201.5	16.0
22/03/2005	1,200	5.5	5.5	8.0	0

3.3.2 Hutt River (upper and middle reaches)

All three monitoring sites on the upper and middle reaches of the Hutt River exceeded the recreational water quality guidelines during one or more of the last four summer bathing seasons (Table 3.10). Birchville exceeded the alert and action levels on the most occasions (7 and 9 respectively), while Poets Park recorded the least number of exceedances (3 alert and 5 action exceedances). Overall, Birchville, Maoribank Corner and Poets Park complied with the surveillance guideline level on 76.5%, 80.7% and 90.4% of sampling occasions respectively (Figure 3.11).

Table 3.10: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
BIRCHVILLE								
2001-2002	14	66.7	4	19.0	3	14.3	21	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	18	81.8	1	4.5	3	13.6	22	100
2004-2005	14	66.7	5	23.8	2	9.5	21	100
Total	**65**		**11**		**9**		**85**	
MAORIBANK CORNER								
2001-2002	16	76.2	3	14.3	2	9.5	21	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	17	77.3	2	9.1	3	13.6	22	100
2004-2005	15	78.9	3	15.8	1	5.3	19	100
Total	**67**		**9**		**7**		**83**	
POETS PARK								
2001-2002	18	85.7	2	9.5	1	4.8	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	20	90.9	0	0.0	2	9.1	22	100
2004-2005	17	89.5	1	5.3	1	5.3	19	100
Total	**75**		**3**		**5**		**83**	

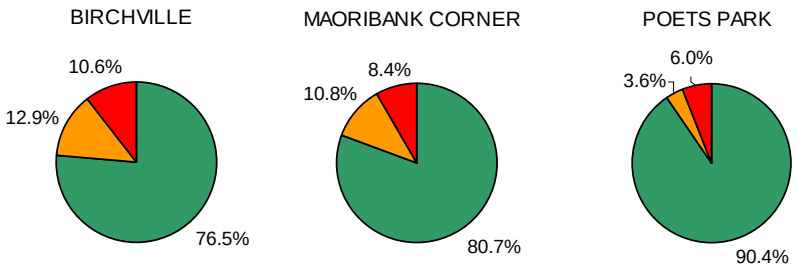

Figure 3.11: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The action level was exceeded at all three sites on 4 December 2001, 19 November 2002, 20 January 2004 and 17 February 2004 (Figure 3.12). These action events all coincided with heavy rainfall events (Table 3.11). The majority of the other action events also coincided with significant rainfall events prior to, or on, the day of sampling, the key exceptions being the *E. coli* counts recorded at Maoribank Corner on 25 November 2003 (1,000 cfu/100 mL) and Birchville on 22 March 2005 960 cfu/100 mL). The cause of these action level events is not known and no follow-up sampling was conducted the next day to determine whether water quality returned to the surveillance level.

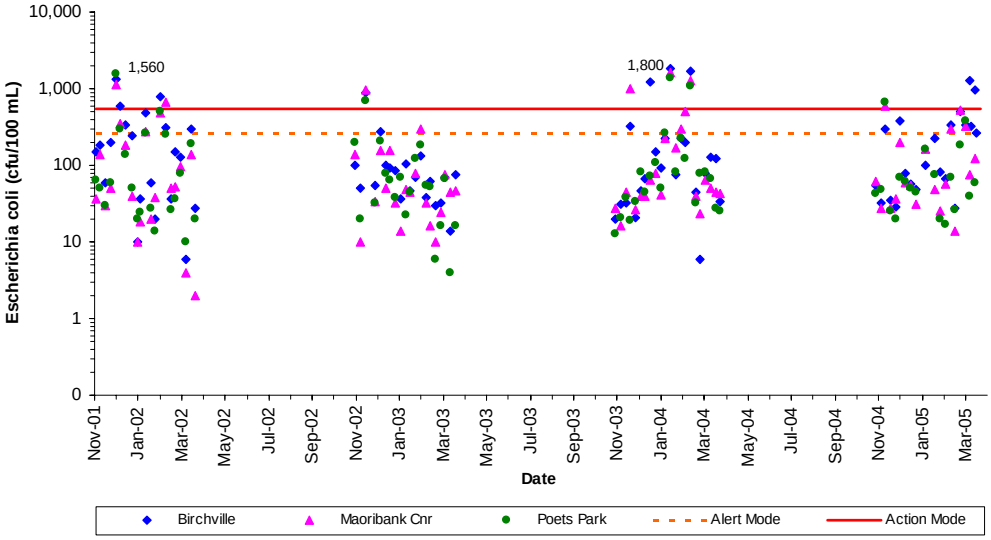

Figure 3.12: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.11: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Te Marua rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Birchville	Maoribank Corner	Poets Park	24 hrs	48 hrs	72 hrs	
04/12/2001	1,330	1,150	1,560	14.0	22.0	24.0	39.0
11/12/2001	580			1.0	18.5	47.0	20.0
05/02/2002	800			11.0	11.0	11.0	20.5
12/02/2002		680		11.0	23.5	23.5	8.5
19/11/2002	900	970	700	12.5	19.5	51.5	16.0
25/11/2003		1,000		0	0	6.0	0.5
23/12/2003	1,200			0	0	20.5	23.0
20/01/2004	1,800	1,600	1,400	30.0	57.0	57.0	52.5
17/02/2004	1,700	1,300	1,100	16.0	120.5	153.0	17.0
16/11/2004		600	660	41.0	69.5	69.5	0
15/03/2005	1,300			0	0	0	13.5
22/03/2005	960			1.0	1.0	1.5	0

None of the three sites exceeded the MfE (2000) guidelines for periphyton cover during any of the four summer bathing seasons.

3.3.3 Hutt River (lower reaches)

Both monitoring sites on the lower reaches of the Hutt River exceeded the recreational water quality guidelines during one or more of the last four summer bathing seasons (Table 3.12). The site at Silverstream Bridge exceeded the action level on nine occasions over the four summers while the site at Boulcott exceeded this level on eight occasions. Overall the sites at Silverstream Bridge and Boulcott complied with the surveillance level of the guidelines on 78% and 81% of sampling occasions respectively (Figure 3.13).

Table 3.12: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001-2002, 2002-2003, 2003-2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
SILVERSTREAM BRIDGE								
2001-2002	15	71.4	3	14.3	3	14.3	21	100
2002-2003	19	90.5	0	0.0	2	9.5	21	100
2003-2004	15	68.2	4	18.2	3	13.6	22	100
2004-2005	16	84.2	2	10.5	1	5.3	19	100
Total	**65**		**9**		**9**		**83**	
BOULCOTT								
2001-2002	16	76.2	1	4.8	4	19.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	16	72.7	4	18.2	2	9.1	22	100
2004-2005	16	80.0	2	10.0	2	10.0	20	100
Total	**68**		**8**		**8**		**84**	

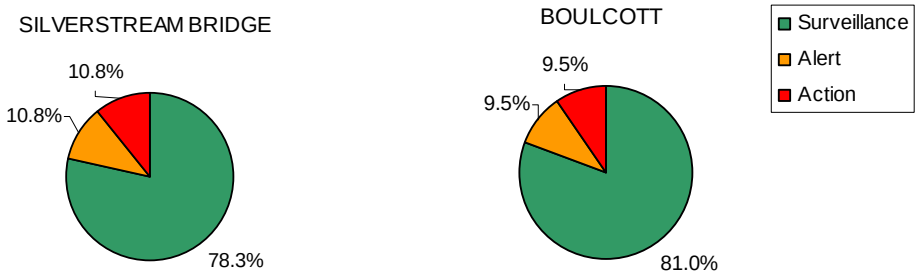

Figure 3.13: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

A number of the action level events were at least an order of magnitude above the surveillance level of the guidelines, especially at Boulcott (Figure 3.14). The highest *E. coli* counts were recorded at both sites on 4 December 2001 and are likely to be rainfall related; the Te Marua rainfall station recorded 24 mm of rain in the 72 hour period prior to sampling and further rain on the day of sampling (Table 3.13). The majority of the other action level exceedances also coincided with rainfall either prior to, or on the day of sampling. The exception to this is a result of 680 *E. coli*/100 mL recorded at Silverstream on 13 January 2004. The cause of this action level event is not known, although 50 mm of rain fell in the catchment in the week prior to sampling. No follow-up sampling was conducted the next day to determine whether water quality returned to the surveillance level.

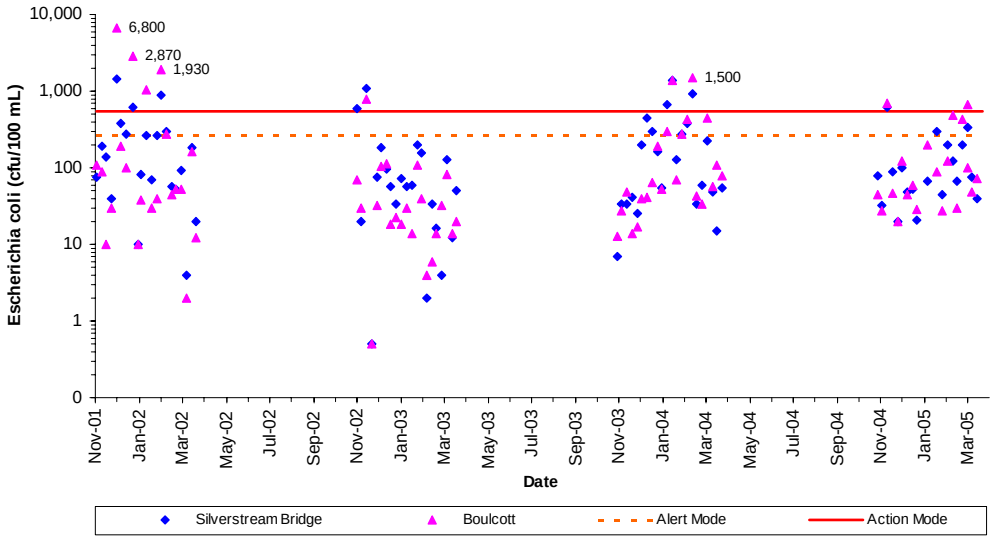

Figure 3.14: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.13: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Te Marua rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Silverstream	Boulcott	24 hrs	48 hrs	72 hrs	
04/12/2001	1,430	6,800	14.0	22.0	24.0	39.0
27/12/2001	610	2,870	0	0	0	40.5
15/01/2002		1,040	5.0	7.0	48.5	2.5
05/02/2002	870	1,930	11.0	11.0	11.0	20.5
05/11/2002	600		6.0	6.0	6.5	16.5
19/11/2002	1,070	800	12.5	19.5	51.5	16.0
13/01/2004	680		0	0	0	0
20/01/2004	1,400	1,400	30.0	57.0	57.0	52.5
17/02/2004	920	1,500	16.0	120.5	153.0	17.0
16/11/2004	620	700	41.0	69.5	69.5	0
08/03/2005		680	0	26.0	26.0	1.5

The Boulcott site reached 30% periphyton cover on one occasion in February 2003 when the river experienced very low and relatively stable flows (Figure 3.15). Cover exceeded 30% at this site by a small margin in late March 2004 but it is not possible to determine whether the MfE (2000) guidelines for periphyton cover were exceeded as the type of cover (filamentous, diatoms, etc) was not recorded.

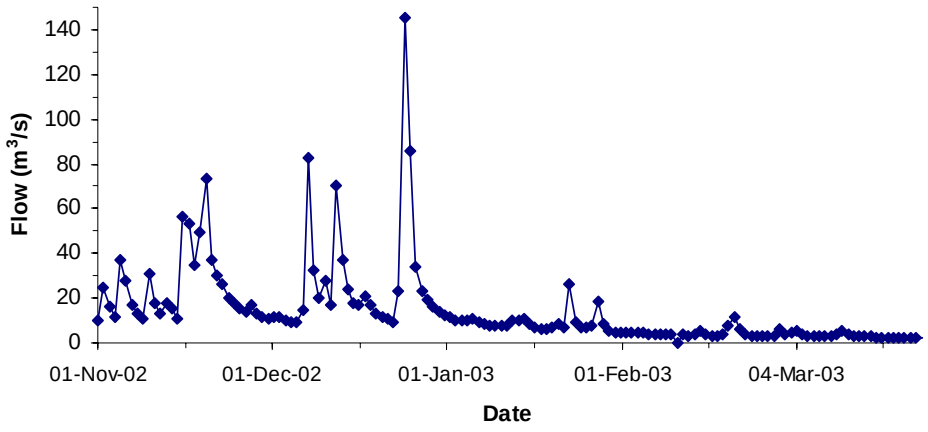

Figure 3.15: Mean daily flows for the Hutt River recorded at the Taita Gorge flow monitoring station over the 2002/2003 summer

3.3.4 Discussion

Of the six monitoring sites in the Hutt Valley, the Hutt River at Poets Park recorded the highest level of compliance with the recreational water quality guidelines, followed by the Pakuratahi River at Forks (Figure 3.16). The Hutt River at Birchville and Silverstream recorded the lowest level of compliance, exceeding the surveillance level guideline on more than 23% and 21 % of sampling occasions respectively.

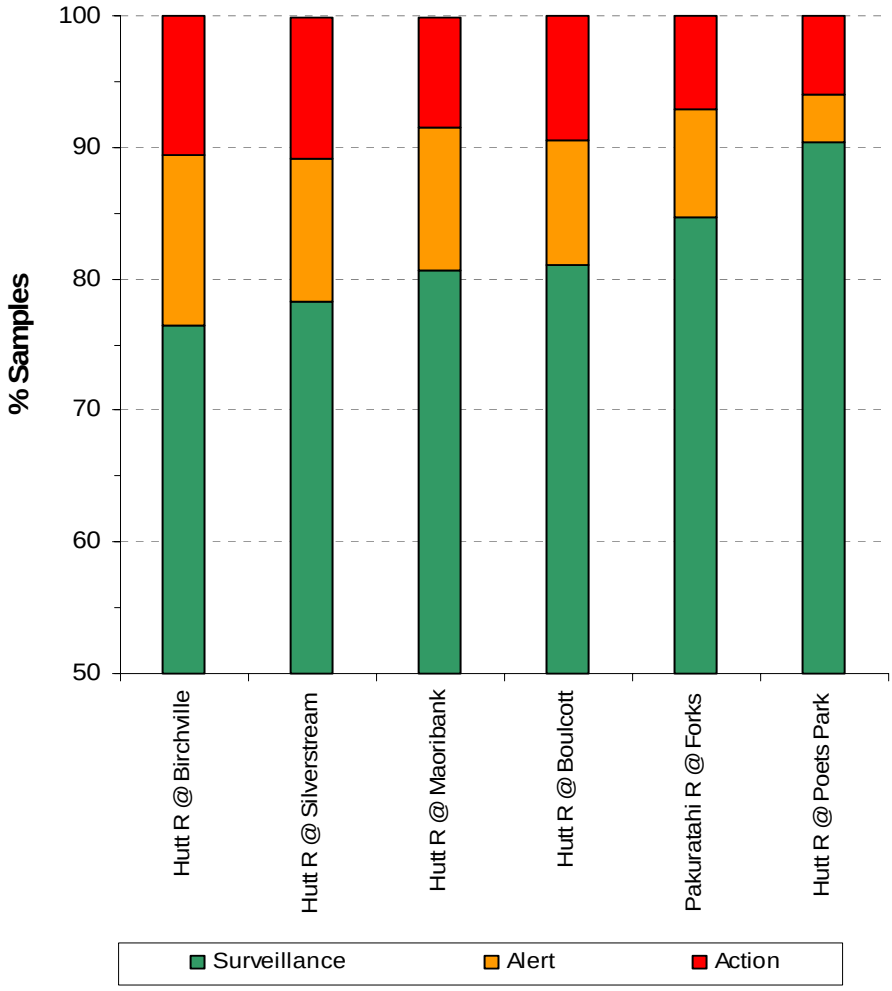

Figure 3.16: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

Significant periphyton cover was only recorded on one occasion at one site over the four summer bathing seasons; the Hutt River at Boulcott in March 2004.

Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer. Although five of the six sites exceeded the action level guideline over this summer, only one site exceeded this level on more than one occasion (Table 3.14). The lowest level of compliance with the guidelines was obtained over the 2003/2004 summer. All six sites exceeded the action level over this period, with several sites exceeding the action level on at least three occasions.

Table 3.14: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly summer sampling undertaken at the six monitoring sites in the Hutt Valley

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3-4	≥ 5
2001/2002	0	6	1	2	3	0
2002/2003	0	5	4	1	0	0
2003/2004	0	6	0	4	2	0
2004/2005	0	6	4	2	0	0

Analysis of rainfall records indicates that rainfall events may account for up to 93% of the action level exceedances recorded over the reporting period. The influence of rainfall was evident over the 2001/2002 summer. Nine of the 15 action level events recorded over this summer coincided with above average rainfall in December 2001 (Figure 3.17). Similarly, 13 of the 15 action level events recorded over the 2003/2004 summer coincided with above average rainfall in January and February 2004. In contrast, the lower number of action level events recorded over the 2002/2003 summer coincided with below average rainfall over the summer period; all six action level events recorded during this summer occurred early in the season when rainfall was higher.

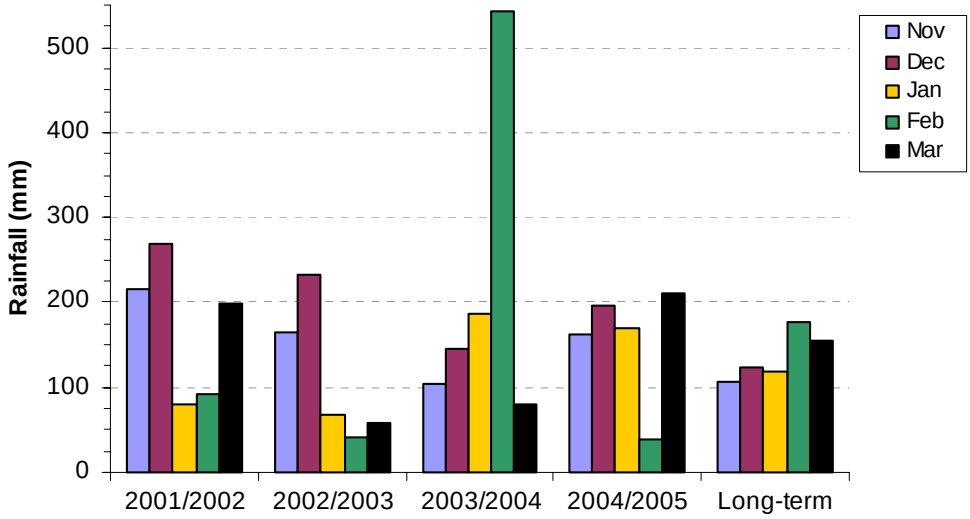

Figure 3.17: Monthly rainfall recorded at Te Marua over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1993 to present)

Despite the high correlation between rainfall and action level events, on a few occasions at several sites on the Hutt River, the action level events coincided with little or no rainfall. It is recommended that follow-up sampling is undertaken in such circumstances in the future.

Suitability for recreation

The number of action level events recorded over the last four summer seasons, in particular, the large number of *E. coli* counts that were an order of magnitude above the surveillance level of the recreational water quality guidelines, resulted in high MAC values for all six sites in the Hutt Valley (Table 3.15). These high MAC values combine with moderate to high SIC values to give interim SFRGs of "poor" or "very poor" for all sites.

Table 3.15: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for freshwater bathing sites in the Hutt Valley

Site	MAC*	SIC**	Interim SFRG
PAKURATAHI RIVER			
The Forks	D (95^{th} percentile = 750, n=85)	High	Very Poor
HUTT RIVER			
Birchville	D (95^{th} percentile = 1,225, n=85)	Moderate	Poor
Maoribank Corner	D (95^{th} percentile = 981, n=83)	Moderate	Poor
Poets Park	D (95^{th} percentile = 674, n=83)	Moderate	Poor
Silverstream Bridge	D (95^{th} percentile = 887, n=83)	High	Very Poor
Boulcott	D (95^{th} percentile = 1,430, n=84)	High	Very Poor

* Based on *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

** Estimates only – catchment assessments required

The interim SFRGs for the six sites appear conservative, and reflect the influence of action level events on the MAC values. The majority of action level events coincided with significant rainfall events and if removed from the dataset used to calculate the MAC, the MAC value would be significantly lower and the interim SFRG higher. Therefore, it is considered that the interim SFRGs better reflect the condition of the bathing sites during wet weather than dry weather when contact recreation would be greatest.

It is recommended that a suitable site on the Akatarawa River is investigated and included in future recreational water quality monitoring in the Hutt Valley. The Akatarawa River is specifically listed under Policy 5.2.4 of the Regional Freshwater Plan as a water body that is to be managed for contact recreation purposes. However, no recreational water quality monitoring is currently undertaken on the river.

3.4 Wairarapa

The Regional Freshwater Plan identifies specific stretches on a number of rivers in the Wairarapa as being particularly important for contact recreation. These include the Ruamahanga River (Figure 3.18), the Waingawa River, and

the Waiohine River. Recreational water quality is currently monitored at a number of sites on all of these rivers, as well as at sites on the Waipoua River and Riversdale Lagoon.

Figure 3.18: Ruamahanga River at Double Bridges

The Ruamahanga River is the largest river in the Wellington Region. Topography is steep in the upper reaches and flat in the lower reaches. The bed of the Ruamahanga River consists primarily of boulders, cobbles and gravels. The Waipoua River, Waingawa River and Waiohine River are all western tributaries of the Ruamahanga River and have their headstream reaches in the Tararua Forest Park.

The Ruamahanga River receives treated wastewater from a number of townships either directly or indirectly via tributary rivers or streams as follows:

- Masterton: treated wastewater is discharged into Makoura Stream, which flows a short distance prior to entering into the Ruamahanga River below Wardells.
- Carterton: treated wastewater is discharged into Mangatarere Stream which flows into the Waiohine River below State Highway 2.
- Greytown: treated wastewater is discharged into Papawai Stream, which flows for approximately 1.5 km to its confluence with the Ruamahanga River upstream of Morrisons Bush.
- Martinborough: treated wastewater is discharged directly into the Ruamahanga River, approximately 2.5 km downstream of Waihenga Bridge.

The Masterton District Council holds several resource consents authorising the discharge of stormwater into the lower reaches of the Waipoua River.

3.4.1 Ruamahanga River (upper reaches)

With the exception of the Te Ore Ore site over the 2002/2003 summer, both monitoring sites on the upper reaches of the Ruamahanga River exceeded the action level of the recreational water quality guidelines on one or more occasions during each of the last four summer bathing seasons (Table 3.16). The site at Double Bridges exceeded the action level on seven occasions, with three of these occurring over the 2004/2005 summer. Nine exceedances of the alert level were also recorded over this same season. The site at Te Ore Ore also exceeded the action level on three occasions over the 2004/2005 summer. Overall, compliance with the surveillance level guideline of 260 *E. coli*/100 mL was only a little over 73% and 78% for Double Bridges and Te Ore Ore respectively (Figure 3.19).

Table 3.16: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
DOUBLE BRIDGES								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	19	79.2	4	16.7	1	4.2	24	100
2003-2004	13	76.5	2	11.8	2	11.8	17	100
2004-2005	12	50.0	9	37.5	3	12.5	24	100
Total	**63**		**16**		**7**		**86**	
TE ORE ORE								
2001-2002	13	61.9	4	19.0	4	19.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	15	75.0	4	20.0	1	5.0	20	100
2004-2005	17	81.0	1	4.8	3	14.3	21	100
Total	**65**		**10**		**8**		**83**	

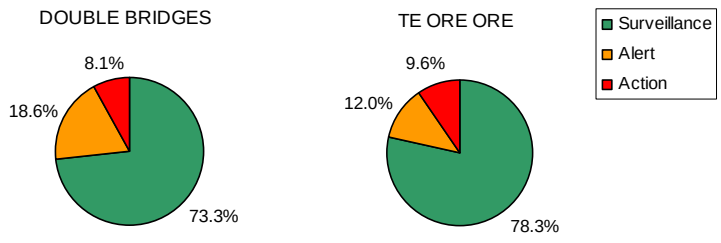

Figure 3.19: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The highest *E. coli* counts recorded at Double Bridges and Te Ore Ore were 6,200 cfu/100 ml and 11,400 cfu/100 mL respectively (Figure 3.20). These counts are one and two orders of magnitude greater than the surveillance level of the guidelines, and were recorded on 21 January 2004 following over 80 mm

of rain in the 24 hours prior to sampling (Table 3.17). Analysis of the other action level exceedances against rainfall records from the Mount Bruce rainfall station indicates that, for Te Ore Ore, all coincided with heavy rainfall prior to the day of sampling (Table 3.17). However, several of the exceedances recorded at Double Bridges coincided with little or no rainfall. For example, an *E. coli* count of 5,400 cfu/100 mL was recorded on 23 March 2005 and only 6 mm of rain had fallen in the three days prior to sampling. It is possible that a small tributary entering the Ruamahanga River from the Mauriceville area might be contributing to elevated bacteria counts in the river at times (Watts and Sevicke-Jones, 2001).

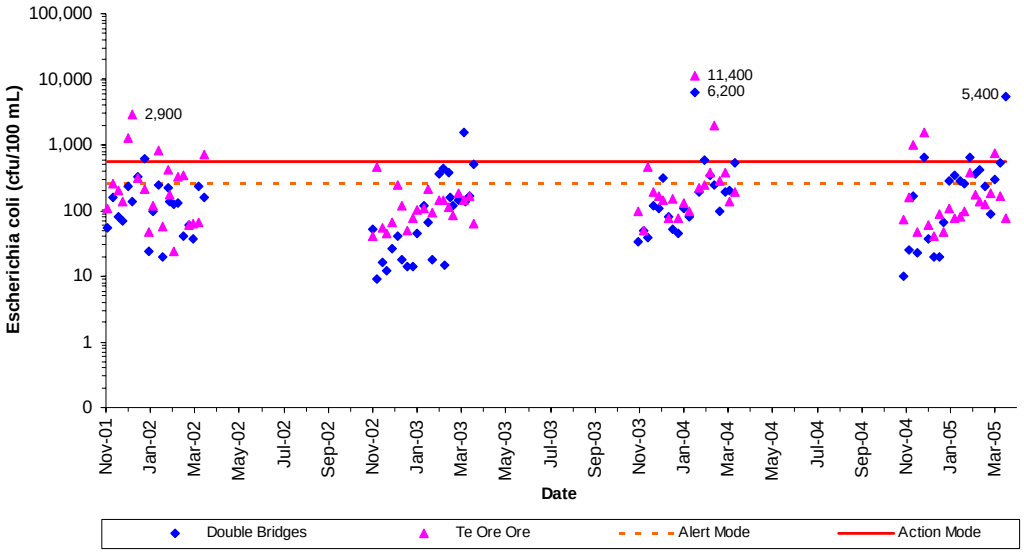

Figure 3.20: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.17: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Mount Bruce rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Double Bridges	Te Ore Ore	24 hrs	48 hrs	72 hrs	
05/12/2001		1,250	11.0	11.0	11.0	0
11/12/2001		2,900	0.5	24.0	57.9	3.0
27/12/2001	620		0	0	0	26.3
15/01/2002		820	7.9	15.3	34.2	8.4
19/03/2002		700	26.9	76.0	110.9	1.1
11/03/2003	1,514		3.8	3.8	7.1	14.7
21/01/2004	6,200	11,400	80.9	114.2	116.8	11.2
04/02/2004	590		24.6	27.7	61.5	5.1
17/11/2004		980	11.5	67.0	75.0	0
01/12/2004	650	1,575	15.5	18.0	19.5	0
02/02/2005	647		5.0	9.0	9.0	0.5
09/03/2005		760	21.0	21.0	25.5	0
23/03/2005	5,400		0	6.0	6.0	2.5

The monitoring site at Te Ore Ore exceeded the MfE (2003) periphyton guideline of 60% cyanobacteria/diatoms coverage on a number of occasions during January and February 2002. This site also exceeded the guideline by a small margin on one occasion in late February 2005. The presence of nuisance periphyton growth during late January and February 2002 is not surprising as the river experienced very low and relatively stable flows prior to and during this period (Figure 3.21). River flows increased significantly after rainfall in mid March and would have removed much of the nuisance periphyton cover from the river bed.

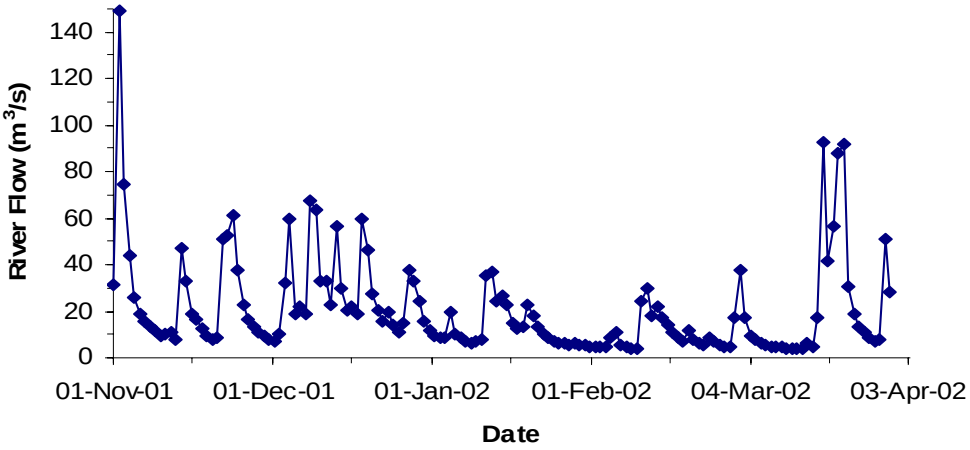

Figure 3:21 Mean daily flows for the Ruamahanga River recorded at the Wardells flow monitoring station over the 2001/2002 summer

3.4.2 Waipoua River

The Waipoua River at Colombo Road exceeded the alert and action levels of the recreational water quality guidelines on six and nine occasions respectively since routine monitoring began in November 2002 (Table 3.18). The majority of these exceedances were recorded over the 2003/2004 summer. Overall, the Waipoua River complied with the surveillance level of the guidelines on just over 76% of sampling occasions (Figure 3.22).

Table 3.18: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	NS	-	NS	-	NS	-	-	100
2002-2003	20	90.9	1	4.5	1	4.5	22	100
2003-2004	10	50.0	3	15.0	7	35.0	20	100
2004-2005	18	85.7	2	9.5	1	4.8	21	100
Total	**48**		**6**		**9**		**63**	

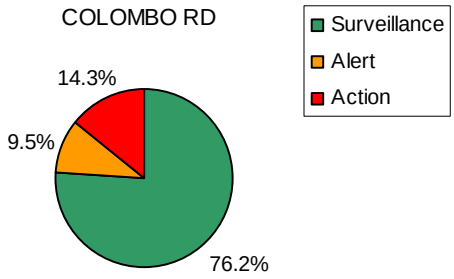

Figure 3.22: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Four of the nine action level events were at least an order of magnitude above guideline levels (Figure 3.23). The highest *E. coli* count was recorded on 21 January 2004 and coincided with over 123 mm of rainfall in the 48 hours prior to sampling (Table 3.19). All other action level events also coincided with rainfall events.

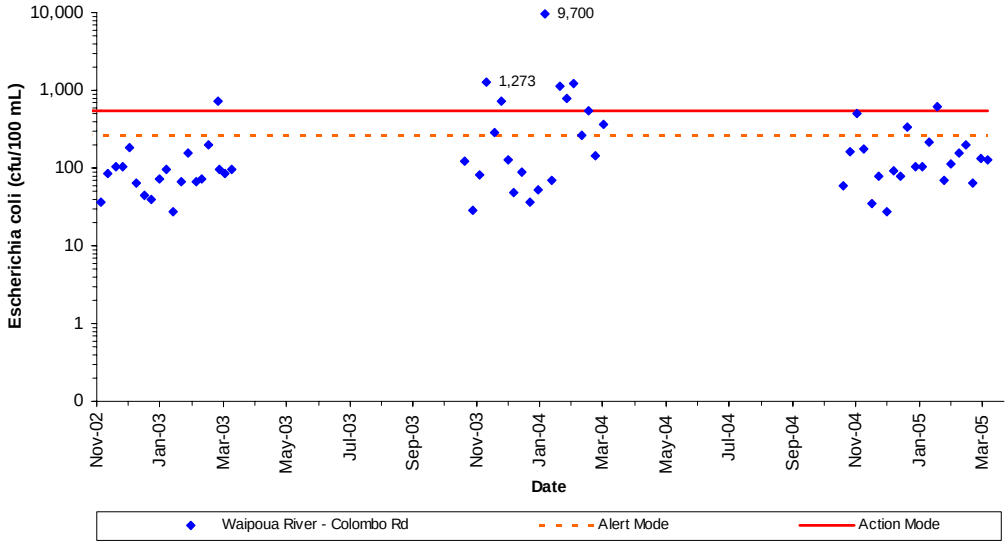

Figure 3.23: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.19: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Kaituna rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
11/03/2003	717	8.5	8.5	9.7	14.5
26/11/2003	1,273	3.9	3.9	3.9	80.5
10/12/2003	718	16.8	17.9	17.9	5.6
21/01/2004	9,700	80.7	123.5	123.5	12.6
04/02/2004	1,127	20.3	20.3	39.5	5.3
11/02/2004	783	19.0	27.4	33.2	73.8
18/02/2004	1,229	14.2	22.6	153.4	12.6

Date	*E. coli* (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
03/03/2004	553	13.2	14.8	0.5	2.1
02/02/2005	620	4.0	6.5	6.5	0.5

Significant periphyton cover (90-100%) was recorded at the monitoring site on one occasion in both February and March 2004. However is not possible to determine which of the two MfE (2000) guidelines for periphyton cover was exceeded as the type of cover (filamentous, diatoms, etc) was not recorded.

3.4.3 Waingawa River

Both Waingawa River monitoring sites achieved a relatively high level of compliance with the recreational water quality guidelines during routine monitoring over the 2001-2005 summer bathing seasons (Table 3.20). The action level was not exceeded at either site over the 2001/2002 or 2002/2003 summers, with the site at Kaituna recording only one action level exceedance over the entire reporting period. South Road exceeded this level on three occasions over the reporting period. Overall, both sites complied with the surveillance level of the guideline on 94% of sampling occasions (Figure 3.24).

Table 3.20: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
KAITUNA								
2001-2002	20	100.0	0	0.0	0	0.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	17	85.0	2	10.0	1	5.0	20	100
2004-2005	19	90.5	2	9.5	0	0.0	21	100
Total	**77**		**4**		**1**		**82**	
SOUTH ROAD								
2001-2002	19	95.0	1	5.0	0	0.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	18	90.0	0	0.0	2	10.0	20	100
2004-2005	19	90.5	1	4.8	1	4.8	21	100
Total	**77**		**2**		**3**		**82**	

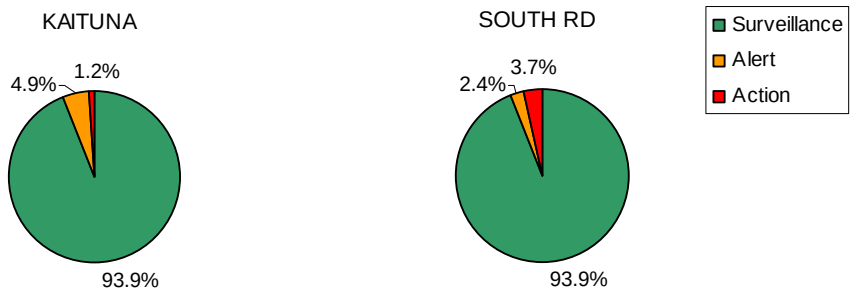

Figure 3.24: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Like a number of other sites in the Wairarapa, the majority of the action level events coincided with very heavy rainfall during January and February 2004 (Figure 3.25, Table 3.21). The only action level event recorded at Kaituna occurred on 11 February 2004 and coincided with heavy rainfall prior to, and on, the day of sampling. South Road also exceeded the action level on 1 December 2004.

Table 3.21: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Kaituna rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Kaituna	South Rd	24 hrs	48 hrs	72 hrs	
21/01/2004		3,400	80.7	123.5	123.5	12.6
04/02/2004		700	20.3	20.3	39.5	5.3
11/02/2004	760		19.0	27.4	33.2	73.8
01/12/2004		1,200	8.0	8.0	9.0	0

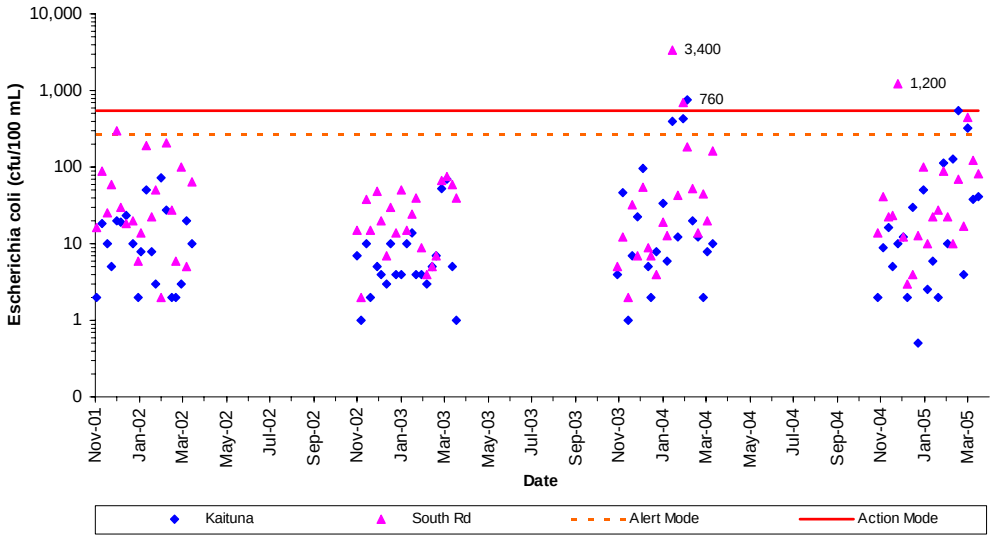

Figure 3.25: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

The MfE (2003) periphyton guidelines were exceeded on several occasions during early 2002 when river flows were low and relatively stable (Figure 3.26). Both sites exceeded 60% cyanobacteria/diatoms coverage on at least one occasion and the monitoring site at South Road also exceeded 30% filamentous coverage on one occasion.

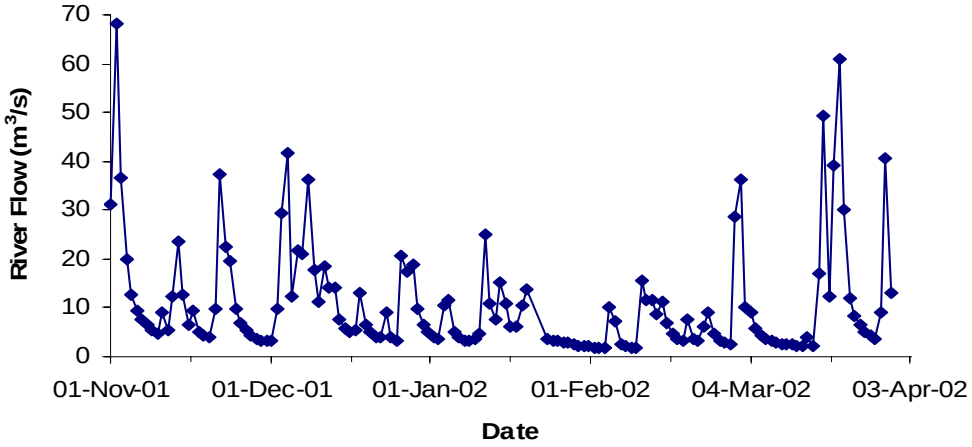

Figure 3.26: Mean daily flows for the Waingawa River recorded at the Kaituna flow monitoring station over the 2001/2002 summer

3.4.4 Ruamahanga River (mid reaches)

With the exception of The Cliffs over the 2002/2003 summer, both bathing sites on the mid reaches of the Ruamahanga River exceeded the action level of the recreational water quality guidelines on one or more occasions during each of the last four summer bathing seasons (Table 3.22). The Cliffs exceeded the action level on seven occasions, with three of these occurring over the 2001/2002 summer and three occurring over the 2003/2004 summer. Kokotau exceeded the action level on nine occasions, with five of these occurring over the 2001/2002 summer. Overall, The Cliffs and Kokotau monitoring sites complied with the surveillance level of the guidelines on 84.1% and 81.9% of sampling occasions respectively (Figure 3.27).

Table 3.22: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
THE CLIFFS								
2001-2002	14	70.0	3	15.0	3	15.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	16	80.0	1	5.0	3	15.0	20	100
2004-2005	18	85.7	2	9.5	1	4.8	21	100
Total	**69**		**6**		**7**		**82**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
KOKOTAU								
2001-2002	14	66.7	2	9.5	5	23.8	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	16	80.0	1	5.0	3	15.0	20	100
2004-2005	18	85.7	3	14.3	0	0.0	21	100
Total	**68**		**7**		**8**		**83**	

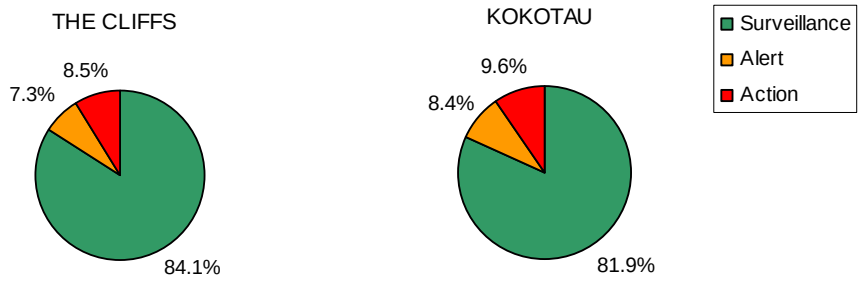

Figure 3.27: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

A number of *E. coli* counts were one or two orders of magnitude greater than guideline levels (Figure 3.28). The highest count recorded at The Cliffs was 10,400 cfu/100 mL on 21 January 2004. This result coincided with heavy rainfall; over 80 mm of rain fell in the 24 hours prior to sampling (Table 3.23). The highest *E. coli* count recorded at Kokotau was 16,000 cfu/100 mL on 18 December 2001. Although only 5.3 mm of rain had fallen in the 24 hours prior to sampling, heavy rain fell on the day of sampling. Table 3.23 indicates that all other action level events also coincided with rainfall events.

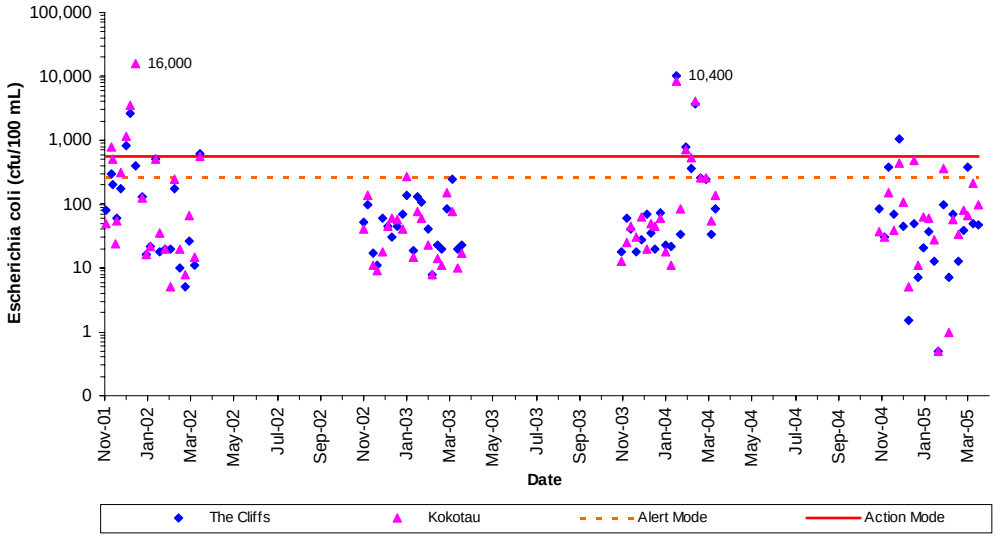

Figure 3.28: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.23: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Mount Bruce rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	The Cliffs	Kokotau	24 hrs	48 hrs	72 hrs	
14/11/2001		800	22.0	22.0	22.0	23.0
05/12/2001	833	1,167	11.0	11.0	11.0	0
11/12/2001	2,590	3,450	0.5	24.0	57.9	3.0
18/12/2001		16,000	5.3	9.3	9.3	29.9
19/03/2002	627	567	26.9	76.0	110.9	1.1
21/01/2004	10,400	8,500	80.9	114.2	116.8	11.2
04/02/2004	783	700	24.6	27.7	61.5	5.1
18/02/2004	3,633	4,000	9.7	20.5	148.9	15.4
01/12/2004	1,050		15.5	18.0	19.5	0

Both monitoring sites exceeded the MfE (2000) periphyton guidelines during early 2002 when river flows were very low (Figure 3.29). At The Cliffs, cyanobacteria/diatom coverage ranged from just over 60% to over 90% during the period 29 January through to 5 March 2002 inclusive. Significant cover of filamentous algae was also present at this site during some of this period. Elevated periphyton cover was also recorded at The Cliffs in March 2004 and early February 2005 when river flows were again very low.

Figure 3.29: Filamentous algae in the Ruamahanga River
(Photo courtesy of Ron Haverland (Beca Consultants) and Masterton District Council)

3.4.5 Waiohine River

Both bathing sites on the Waiohine River achieved a high level of compliance with the recreational water quality guidelines during routine monitoring over the 2001-2005 summer bathing seasons (Table 3.24). The Gauge (in the

Waiohine Gorge) was the only site out of the 23 freshwater sites in the Greater Wellington Regional Council's recreational water quality monitoring programme not to exceed the action level on any occasion. The site at State Highway 2 exceeded this level on two occasions over the 2003/2004 summer. Overall, both sites complied with the surveillance level of the guidelines on more than 97% of sampling occasions (Figure 3.30).

Table 3.24: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
GAUGE								
2001-2002	19	95.0	1	5.0	0	0.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	95.0	1	5.0	0	0.0	20	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**80**		**2**		**0**		**82**	
STATE HIGHWAY 2								
2001-2002	20	100.0	0	0.0	0	0.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	18	90.0	0	0.0	2	10.0	20	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**80**		**0**		**2**		**82**	

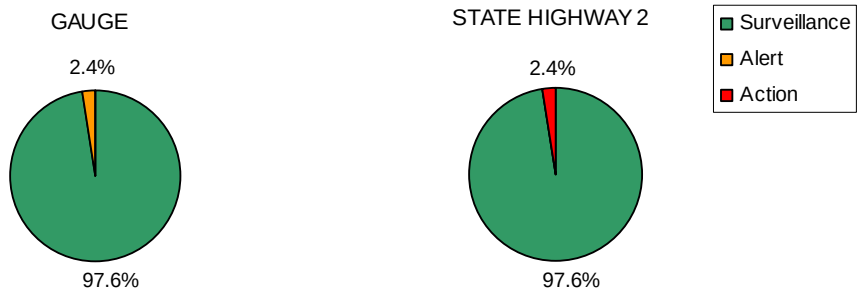

Figure 3.30: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The two action level events recorded at State Highway 2 both occurred during very heavy rainfall in January and February 2004 (Table 3.25, Figure 3.31,). One of the two alert level events recorded at the Gauge also occurred during this period.

Table 3.25: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Phelps rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Gauge	S.H. 2	24 hrs	48 hrs	72 hrs	
21/01/2004		600	57.0	116.5	118.0	27.0
11/02/2004		2,700	32.5	37.5	38.0	74.5

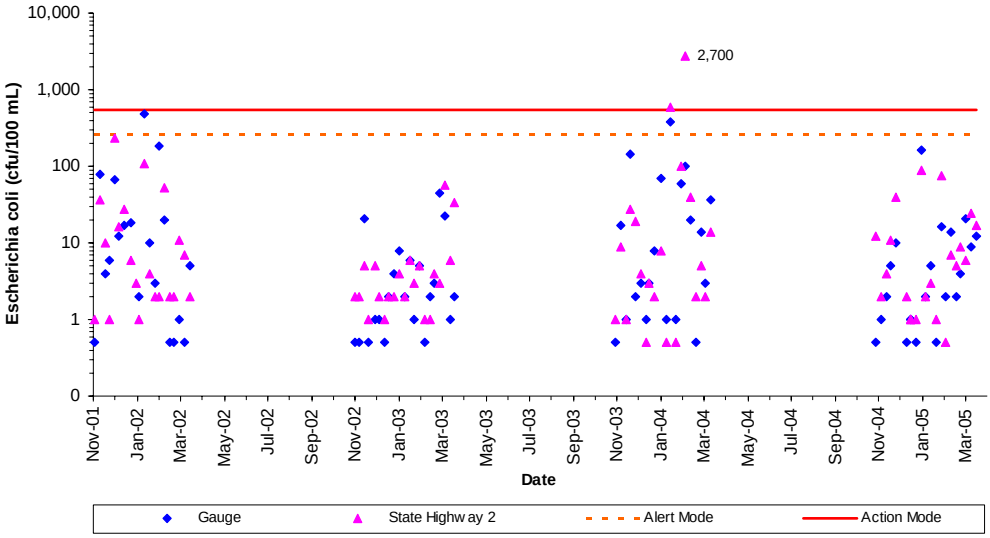

Figure 3.31: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

The Waiohine River at State Highway 2 exceeded the MfE (2000) periphyton guideline for cyanobacteria/diatoms coverage by a small amount on one occasion during February 2002 when river flows were low and relatively stable (Figure 3.32). Significant periphyton growth was also recorded at the Gauge on one occasion in March 2004 (50% cover) although it is not known whether the MfE (2000) guidelines were exceeded as the type of cover (filamentous, diatoms, etc) was not recorded.

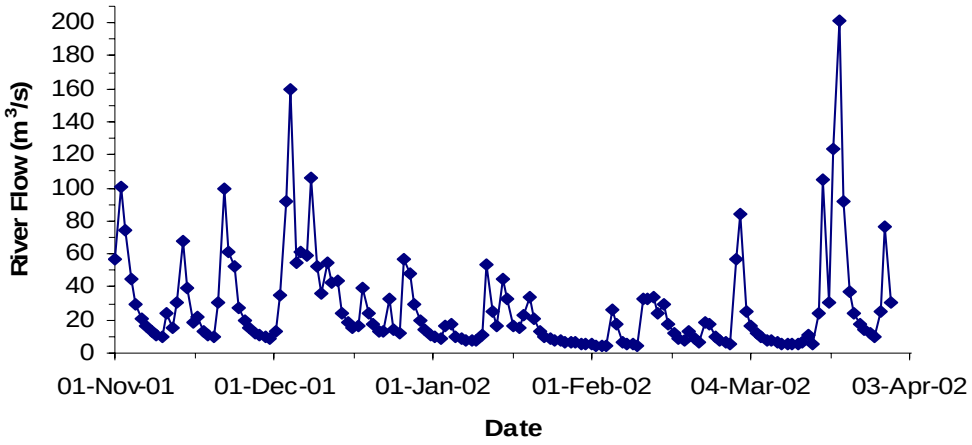

Figure 3.32: Mean daily flows for the Waiohine River recorded at the Waiohine Gorge flow monitoring station over the 2001/2002 summer

3.4.6 Ruamahanga River (lower reaches)

All three monitoring sites on the lower reaches of the Ruamahanga River exceeded the action level of the recreational water quality guidelines during one or more of the last four summer bathing seasons (Table 3.26). At Morrisons Bush and Waihenga, the majority of these exceedances were recorded over the 2001/2002 and 2003/2004 summers. Bentleys Beach was not monitored over the 2001/2002 summer and four of the five exceedances at this site were recorded over the 2003/2004 summer. Overall compliance with the surveillance level of the guidelines ranged from 81% to 84.5% of sampling occasions (Figure 3.33).

Table 3.26: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
MORRISONS BUSH								
2001-2002	15	71.4	1	4.8	5	23.8	21	100
2002-2003	21	95.5	1	4.5	0	0.0	22	100
2003-2004	15	75.0	3	15.0	2	10.0	20	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**71**		**5**		**8**		**84**	
WAIHENGA								
2001-2002	15	71.4	2	9.5	4	19.0	21	100
2002-2003	19	86.4	2	9.1	1	4.5	22	100
2003-2004	14	70.0	3	15.0	3	15.0	20	100
2004-2005	20	95.2	1	4.8	0	0.0	21	100
Total	**68**		**8**		**8**		**84**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
BENTLEYS BEACH								
2001-2002	NS	-	NS	-	NS	-	-	-
2002-2003	15	93.8	1	6.3	0	0.0	16	100
2003-2004	15	75.0	1	5.0	4	20.0	20	100
2004-2005	17	81.0	3	14.3	1	4.8	21	100
Total	**47**		**5**		**5**		**57**	

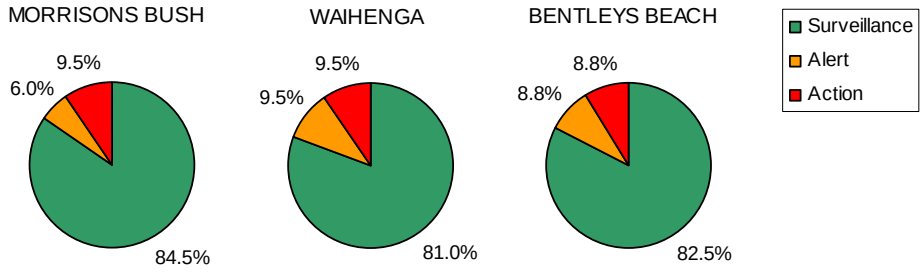

Figure 3.33: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

As was the case for the monitoring sites on the middle and upper reaches of the Ruamahanga River, the majority of exceedances of the action guideline level at the three monitoring sites on the lower reaches of the river also coincided with heavy rainfall events (Table 3.27). Bentley Beach recorded the highest *E. coli* count (30,000 cfu/100 mL) on 21 January 2004 (Figure 3.34). The highest counts at Morrisons Bush and Waihenga were both recorded on 18 December 2001 (7,455 cfu/100 mL and 20,000 cfu/100 mL) respectively.

Table 3.27: Analysis of exceedances of the MfE/MoH (2003) action level arising from routine summer monitoring against rainfall recorded at the Mount Bruce rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Morrisons	Waihenga	Bentleys	24 hrs	48 hrs	72 hrs	
14/11/2001	580			22.0	22.0	22.0	23.0
05/12/2001	1,200	1,433		11.0	11.0	11.0	0
11/12/2001	2,480	1,590		0.5	24.0	57.9	3.0
18/12/2001	7,455	20,000		5.3	9.3	9.3	29.9
15/01/2002	560	580		7.9	15.3	34.2	8.4
19/11/2002		2,560		0	8.2	13.8	11.3
21/01/2004	3,200	19,500	29,800	80.9	114.2	116.8	11.2
04/02/2004			1,233	24.6	27.7	61.5	5.1
11/02/2004		1,000	1,233	26.1	35.8	41.9	131.5
18/02/2004	5,000	5,433	5,800	9.7	20.5	148.9	15.4
01/12/2004	1,225			15.5	18.0	19.5	0
02/02/2005			1,120	5.0	9.0	9.0	0.5

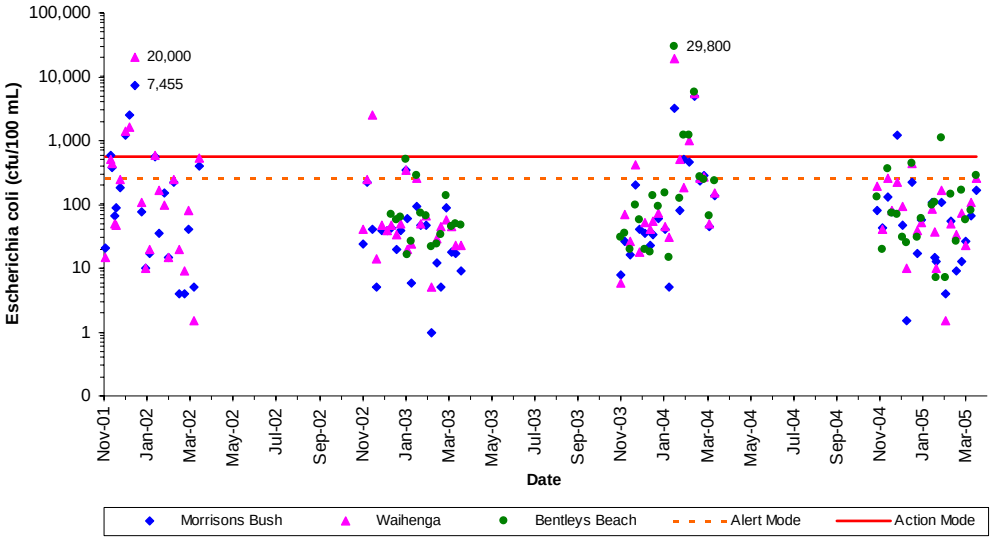

Figure 3.34: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

The Ruamahanga River at both Morrisons Bush and Waihenga exceeded the MfE (2003) periphyton guidelines on a number of occasions during January and February 2002, coinciding with very low river flows (Figure 3.35). Total periphyton cover reached up to 90% at Morrisons Bush and up to 100% at Waihenga during this period. Significant periphyton growth was also observed at all three monitoring sites on one occasion in early March 2005.

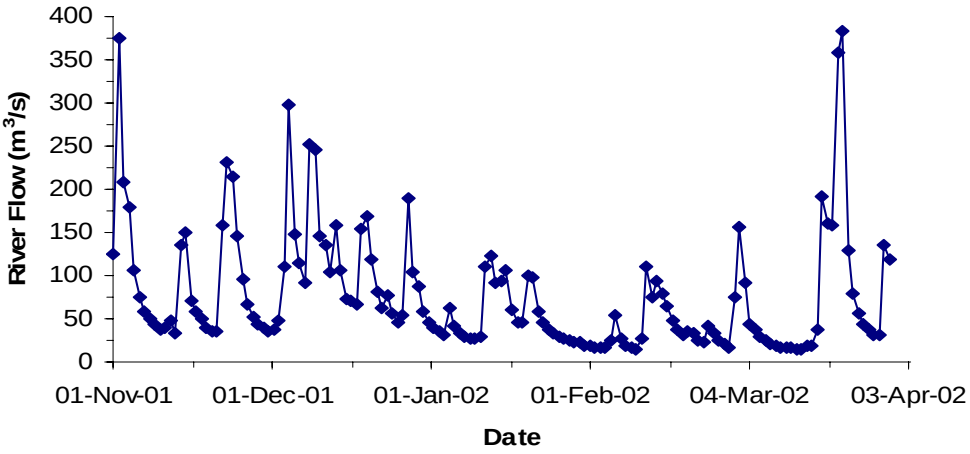

Figure 3.35: Mean daily flows for the Ruamahanga River recorded at the Waihenga flow monitoring station over the 2001/2002 summer

3.4.7 Riversdale Lagoon (Motuwaireka Lagoon)

After complying with the surveillance level of the recreational water quality guidelines on just 40% of sampling occasions over the 2001/2002 summer, it was concluded that Riversdale Lagoon was unsuitable for swimming. Subsequently this site was dropped from the freshwater recreational water quality monitoring programme for the 2002/2003 summer. However, as the lagoon drains onto Riversdale Beach, one of the Wairarapa's most popular bathing beaches, monitoring of water quality in the lagoon was reinstated in

November 2003. Table 3.28 indicates that this site exceeded the alert and action levels of the guidelines on 14 and 12 occasions respectively during the three summer bathing seasons over which it was monitored. Overall, Riversdale Lagoon complied with the surveillance level of the guidelines on just over 57% of sampling occasions (Figure 3.36).

Table 3.28: Analysis of *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for freshwater recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	8	40.0	7	35.0	5	25.0	20	100
2002-2003	NS	-	NS	-	NS	-	-	-
2003-2004	11	57.9	4	21.1	4	21.1	19	100
2004-2005	16	72.7	3	13.6	3	13.6	22	100
Total	**35**		**14**		**12**		**61**	

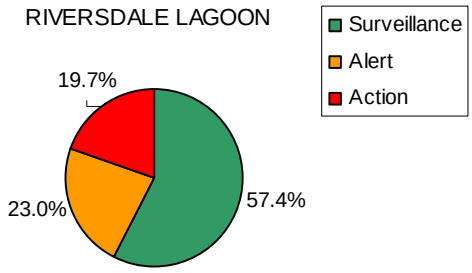

Figure 3.36: Summary of compliance with the MfE/MoH (2003) freshwater surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Seven *E. coli* counts were at least one order of magnitude greater than the surveillance level of the guidelines (Figure 3.37). The highest count (9,180 cfu/100 mL) was recorded on 17 February 2004. This result coincided with very heavy rainfall; over 138 mm of rain fell in the 72 hours prior to sampling (Table 3.29). The majority of the other action level events also coincided with rainfall events. The two exceptions are the *E. coli* counts recorded on 21 December 2003 (850 cfu/100 mL) and 27 January 2004 (910 cfu/100 mL). The cause of these action level events is unclear, but water quality in the lagoon is believed to be influenced by a number of potential sources including agricultural activity and septic tank seepage (Stansfield 2000).

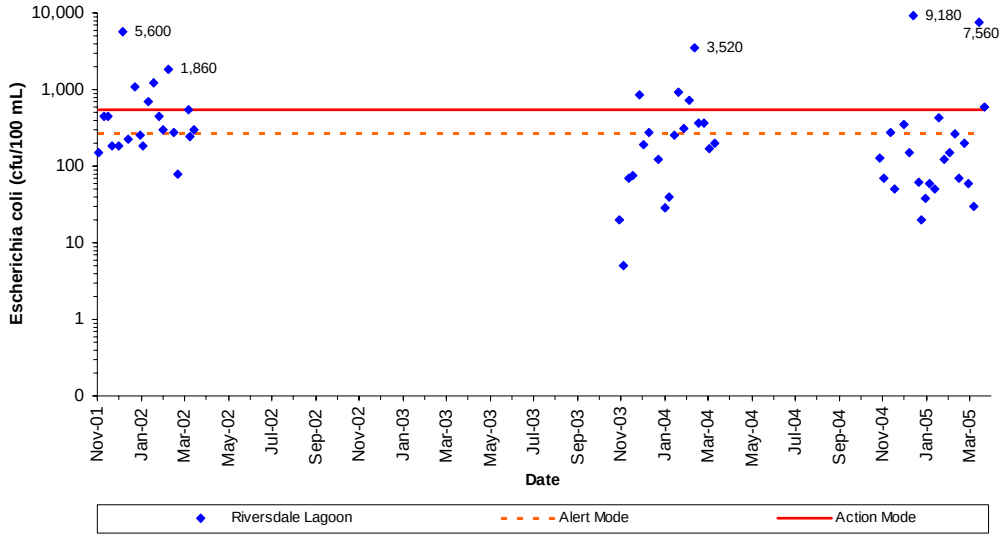

Figure 3.37: *E. coli* counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 3.29: Analysis of exceedances of the MfE/MoH (2003) alert and action levels from all routine monitoring against rainfall recorded at the Castlepoint rainfall station prior to sample collection

Date	*E. coli* (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
11/12/2001	5,600	0	1.6	21.9	0
27/12/2001	1,070	0.8	0.8	0.8	17.8
15/01/2002	700	1.1	12.3	23.7	2.9
22/01/2002	1,220	0	4.8	37.8	0
12/02/2002	1,860	12.0	16.9	17.1	7.7
02/12/2003	850	0	0	0	0.6
27/01/2004	910	0.1	0.1	0.1	2.3
10/02/2004	730	0	19.7	20.6	0
17/02/2004	3,520	10.1	128.8	138.8	3.3
20/12/2004	9,180	5.8	36.9	38.2	0
22/03/2005	7,560	13.8	14.4	18.6	1.0
29/03/2005	590	0	0.2	0.4	30.2

3.4.8 Discussion

Of the 13 monitoring sites in the Wairarapa, nine complied with the surveillance level of the recreational water quality guidelines on over 80% of sampling occasions over the last four summer seasons, with four of these sites complying on well over 90% of sampling occasions. The Waiohine River at the Gauge and at State Highway 2 recorded the highest level of compliance with the guidelines, followed by the Waingawa River at both Kaituna and at South Road (Figure 3.38). This is to be expected as these sites are located in, or not far from, forest park boundaries. Riversdale Lagoon recorded the lowest level of compliance, exceeding the surveillance level guideline on 43% of sampling occasions. All seven sites on the Ruamahanga River recorded a

similar number of action level events but the site at Double Bridges recorded a large number of alert level events.

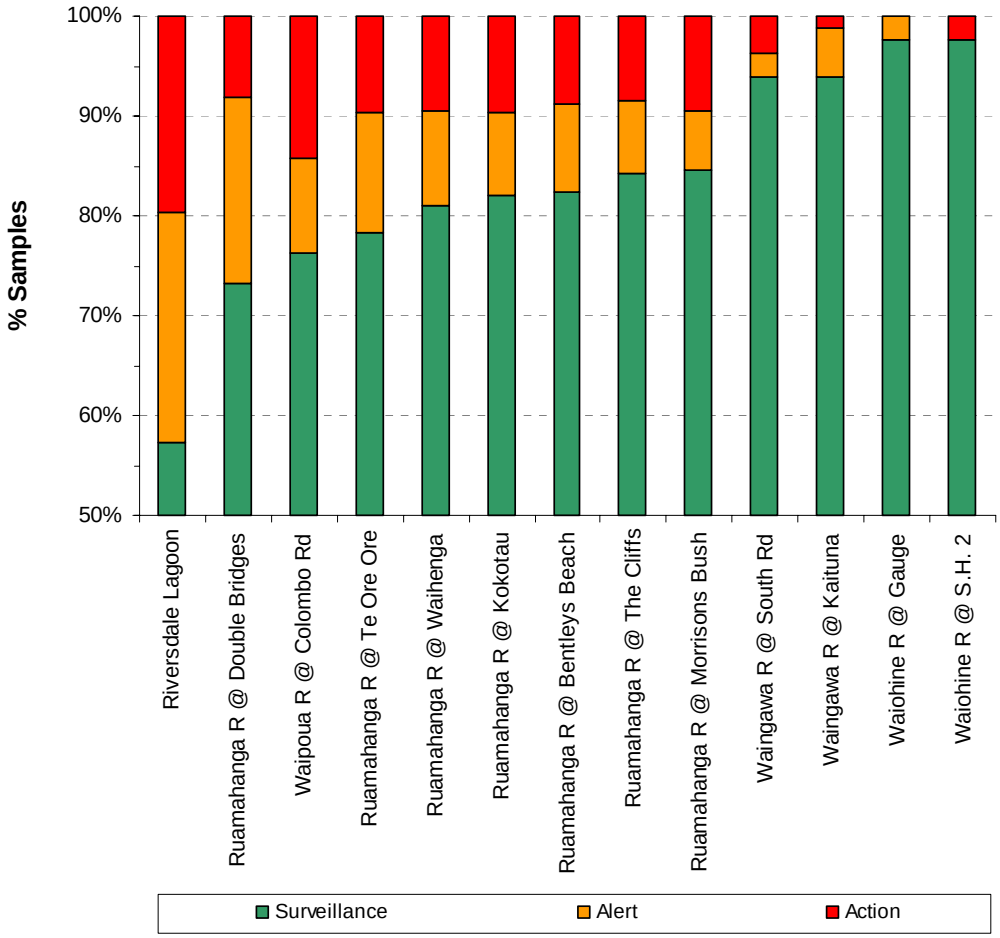

Figure 3.38: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

Periphyton cover exceeded the MfE (2000) guidelines for aesthetic and recreational values at most monitoring sites on the Ruamahanga River for an extended period during the 2002/2003 summer and at some sites on one occasion in March 2005. Both monitoring sites on the Waingawa and one site on the Waiohine River also exceeded the periphyton guideline on a few occasions over the 2001/2002 summer, while elevated cover was observed in the Waipoua River growth on two occasions over the 2003/2004 summer. At all sites, the nuisance growths coincided with low and relatively stable river flows.

Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer, with just three of the 13 sites recording an action level event (Table 3.30). In contrast, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer.

Twelve sites exceeded the action level over this period, with five sites exceeding the action level on at least three occasions.

Table 3.30: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly summer sampling undertaken at the 13 monitoring sites in the Wairarapa

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3-4	≥ 5
2001/2002*	2	7	1	0	0	3
2002/2003*	5	3	3	0	0	0
2003/2004	0	12	2	4	4	1
2004/2005	2	8	5	0	0	0

* Only 11 sites were monitored in 2001/2002 and only 12 sites were monitored in 2002/2003

Analysis of rainfall records indicates that rainfall events probably account for over 90% of the action level events recorded over the reporting period. The influence of rainfall was evident over the 2003/2004 summer. Over half of the 27 action level events recorded over this summer coincided with exceptionally high rainfall during February 2004 (Figure 3.39). In contrast, the very low number of action level events (three) recorded over the 2002/2003 summer coincided with below average rainfall over the much of the summer period.

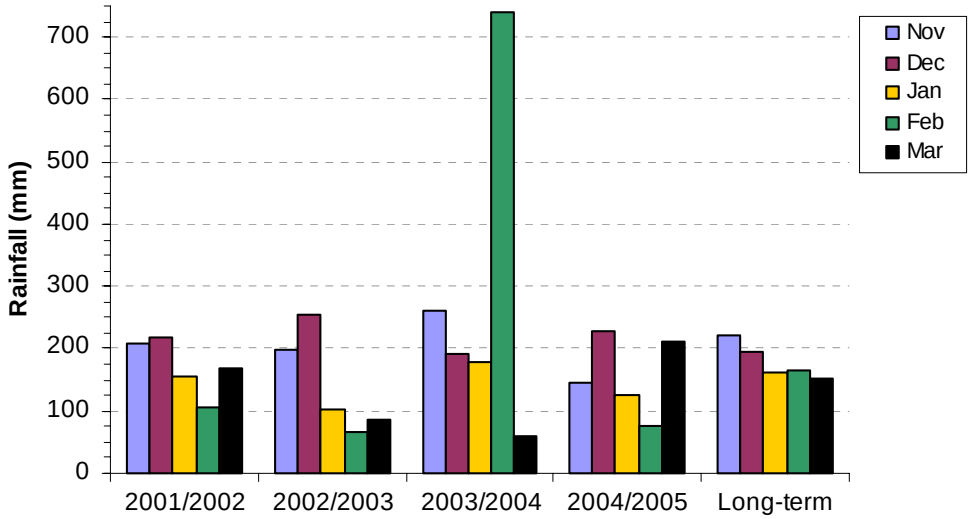

Figure 3.39: Monthly rainfall recorded at Mount Bruce over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1984 to present)

Despite the high correlation between rainfall and action level events, on a few occasions action level events at the Ruamahanga River at Double Bridges and Riversdale Lagoon coincided with little or no rainfall. It is recommended that follow-up sampling is undertaken in such circumstances in the future.

Suitability for recreation

The number of action level events recorded over the last four summer seasons, in particular, the large number of *E. coli* counts that were an order of magnitude above the surveillance level of the recreational water quality guidelines, resulted in high MAC values for all seven sites on the Ruamahanga River, and also the Waipoua River and Riversdale Lagoon (Table 3.31). These high MAC values combine with high SIC values to give interim SFRGs of "very poor" for all sites. The exception is the Waipoua River which has an interim SFRG of "poor", reflecting its moderate SIC value. The MAC values for sites on the Waiohine and Waingawa Rivers are significantly lower as are the estimated SIC values. Subsequently the interim SFRGs are much better, ranging from "very good" for the Waiohine River at the Gauge to "fair" for the two Waingawa River sites.

Table 3.31: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for freshwater bathing sites in the Wairarapa

Site	MAC*	SIC**	Interim SFRG
RUAMAHANGA RIVER			
Double Bridges	D (95^{th} percentile = 648, n=86)	High	Very Poor
Te Ore Ore	D (95^{th} percentile = 1,647, n=83)	High	Very Poor
The Cliffs	D (95^{th} percentile = 909, n=83)	High	Very Poor
Kokotau	D (95^{th} percentile = 1,852, n=84)	High	Very Poor
Morrisons Bush	D (95^{th} percentile = 1,539, n=85)	High	Very Poor
Waihenga	D (95^{th} percentile = 1,833, n=85)	High	Very Poor
Bentleys Beach	D (95^{th} percentile = 1,233, n=57)	High	Very Poor
WAIPOUA RIVER			
Colombo Road	D (95^{th} percentile = 1,163, n=63)	Moderate	Poor
WAINGAWA RIVER			
Kaituna	C (95^{th} percentile = 348, n=82)	Low	Fair
South Road	C (95^{th} percentile = 356, n=82)	Moderate	Fair
WAIOHINE RIVER			
Gauge	B (95^{th} percentile = 149, n=82)	Very Low	Very Good
State Highway 2	B (95^{th} percentile = 149, n=82)	Moderate	Good
RIVERSDALE LAGOON			
Lagoon	D (95^{th} percentile = 4,456, n=61)	Very High	Very Poor

* Based on *E. coli* counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

** Estimates only – catchment assessments required

The interim SFRGs for the monitoring sites on the Ruamahanga and Waipoua Rivers appear conservative, and reflect the influence of action level events on the MAC values. The majority of action level events coincided with significant rainfall events and if removed from the dataset used to calculate the MAC, the MAC value would be significantly lower and the interim SFRG higher. Therefore, it is considered that the interim SFRGs better reflect the condition of the bathing sites during wet weather than dry weather when contact recreation would be greatest.

3.5 Synthesis

Recreational water quality is currently monitored at 23 freshwater sites across the Wellington Region. Compliance with the MfE/MoH (2003) recreational water quality guidelines over the last four summer bathing seasons is summarised for these sites in Figure 3.40.

Of the 23 monitoring sites:

- None of the sites complied with the surveillance level of the MfE/MoH (2003) recreational water quality guidelines on 100% of sampling occasions over the last four summer bathing seasons. However, one site – The Waiohine River at the Gauge – did not exceed the action level of the guidelines on any occasion over the reporting period.

- Three (13%) of the sites exceeded the action level of the guidelines on only one occasion over the last four summer bathing seasons; the Otaki River at both The Pots and State Highway 1, and the Waingawa River at Kaituna. However, all of these sites also exceeded the alert level on at least one summer sampling occasion, with one site – the Otaki River at State Highway 1 - exceeding this level on eight occasions.

- Six (26%) of the sites complied with the surveillance level of the guidelines on more than 90% of summer sampling occasions. The lowest level of compliance with the surveillance level of the guidelines was recorded at Riversdale Lagoon (57.4%), the Ruamahanga River at Double Bridges (73.3%), the Waipoua River at Colombo Road (76.2%) and the Hutt River at Birchville (76.5%).

- 16 (69.6%) of the sites exceeded the action level of the guidelines on more than five occasions over the last four summer bathing seasons. The sites with the greatest percentage of action level exceedances were Riversdale Lagoon (19.7%), the Waipoua River at Colombo Road (14.3%), the Hutt River at Silverstream (10.8%) and the Hutt River at Birchville (10.6%).

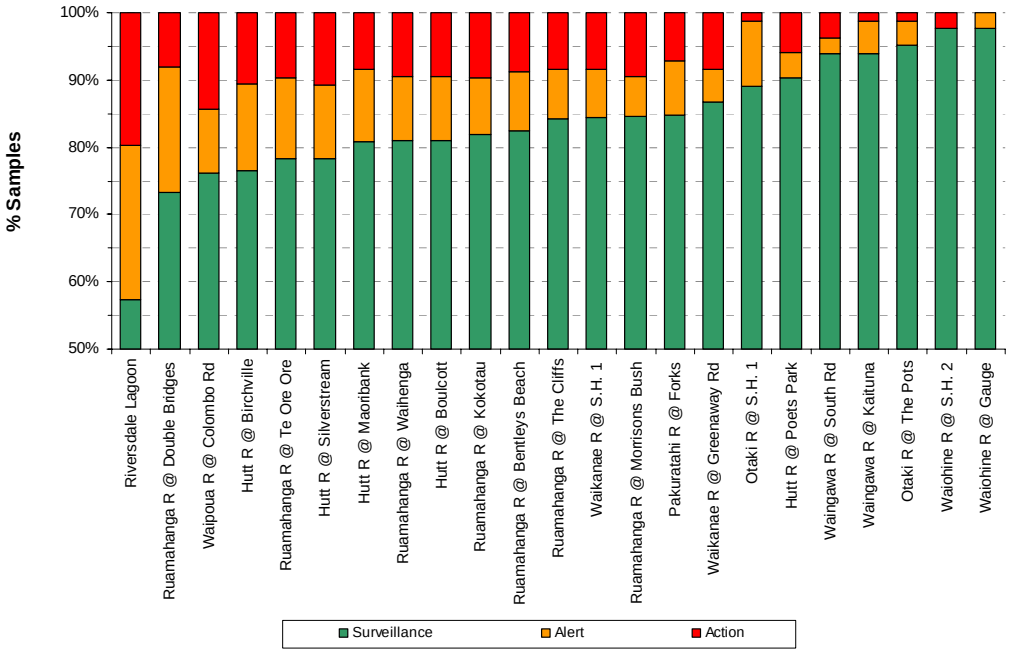

Figure 3.40: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

Analysis of rainfall records indicates that all of the action level events at sites in Kapiti coincided with rainfall events. In the Hutt Valley and Wairarapa, rainfall appears to account for 90% of all action level events. Those sites recording action level events that coincided with little or no rainfall include:

- Hutt Valley – Hutt River at Maoribank Corner, Birchville and Silverstream
- Wairarapa – Ruamahanga River at Double Bridges, Riversdale Lagoon

The reason for the action events at these sites is not known. All turbidity measurements taken on the day of sampling were low, suggesting that the water at all sites was running clear. However, it is not possible to conclude much from the turbidity measurements as the correlation between turbidity and *E. coli* counts is relatively weak for most sites, including the Hutt River at Birchville (Figure 3.41).

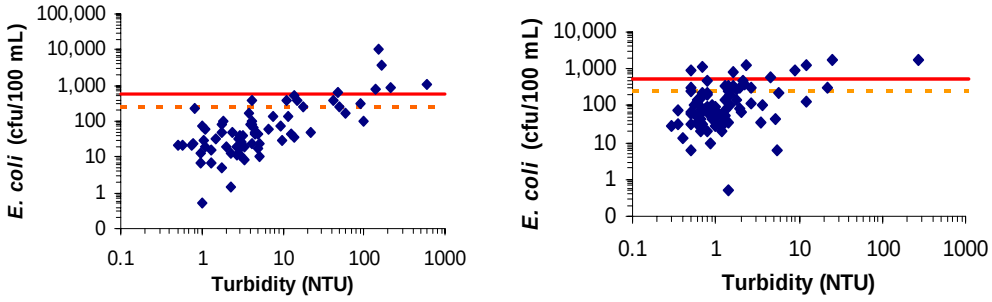

Figure 3.41: *E. coli* counts vs turbidity measurements for the Ruamahanga River at The Cliffs (left) and the Hutt River at Birchville (right), based on routine monitoring undertaken over the reporting period

Periphyton

Periphyton cover exceeded the MfE (2000) guidelines for aesthetic and recreational values on one or more occasions over the reporting period at a number of monitoring sites, including the Ruamahanga River (most sites), the Waingawa River (both sites) and the Waiohine River (one site). The most exceedances were recorded at sites in the Ruamahanga River. No exceedances were recorded at any of the monitoring sites in the Kapiti Coast District.

3.5.1 Spatial and temporal patterns

Table 3.32 summarises compliance with the action level of the MfE/MoH (2003) recreational water quality guidelines over each of the last four summer bathing seasons. Several spatial and temporal patterns are evident:

- The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer; 12 of the 22 sites monitored over this period did not exceed the action level on any occasion. Of the 11 sites that did, all but one exceeded the action level on just one occasion.
- The lowest level of compliance with the recreational water quality guidelines was obtained over the 2003/2004 summer; just two of the 23 sites monitored over this period did not exceed the action level on any occasion. Of the 21 sites that did exceed the action level, 43% exceeded this level on three or more occasions.

Table 3.32: Comparison of compliance with the action level of the MfE/MoH (2003) recreational water quality guidelines between sites over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Summer	Exceedances of Action Level	No. of Sites in each Exceedance Category			Total No. of Sites	% of Sites
		Kapiti (4 sites)	Hutt (6 sites)	Wairarapa (13 sites*)		
2001/2002	0	2	0	4	6	28.6
	1	0	1	1	2	9.5
	2	2	2	0	4	19.0
	3-4	0	3	3	6	28.6
	≥ 5	0	0	3	3	14.3
2002/2003	0	2	1	9	12	54.5
	1	2	4	3	9	41.0
	2	0	1	0	1	4.5
	3-4	0	0	0	0	0
	≥ 5	0	0	0	0	0
2003/2004	0	1	0	1	2	8.7
	1	1	0	2	3	13.0
	2	0	4	4	8	34.8
	3-4	2	2	5	9	39.1
	≥ 5	0	0	1	1	4.3
2004/2005	0	1	0	5	6	26.1
	1	3	4	5	12	52.2
	2	0	2	0	2	8.7
	3-4	0	0	3	3	13.0
	≥ 5	0	0	0	0	0

* Only 11 sites in 2001/2002 and 12 sites in 2002/2003

There is a strong relationship between compliance with the recreational water quality guidelines and weather patterns, notably rainfall. For example, overall compliance with the guidelines was highest over the 2002/2003 summer when rainfall was below average (Figure 3.42). Conversely, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer when rainfall was above average.

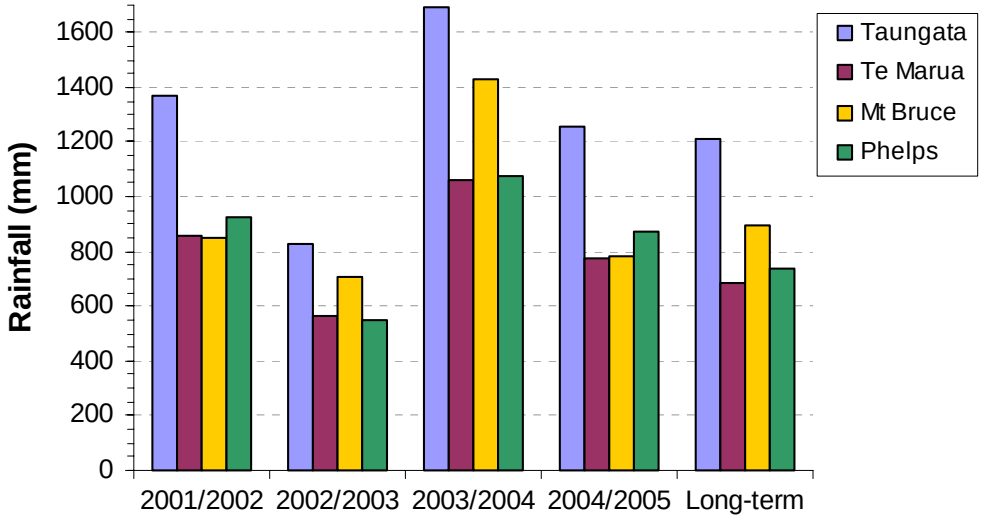

Figure 3.42: Total rainfall recorded at selected rainfall stations over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons, together with the longterm average summer rainfall

In terms of periphyton cover, the MfE (2000) guidelines for aesthetic and recreational values were exceeded at the greatest number of sites over the 2001/2002 summer and at no sites over the 2002/2003 summer. At all sites, the nuisance growths occurred later in the summer (at some stage during the late January to late March period), coinciding with low and relatively stable river flows and warmer water temperatures. This is illustrated for the Ruamahanga River at Wardells in Figure 3.43, although the flows were not very stable over the 2003/2004 summer, reflecting the number of high intensity rainfall events that occurred over this period.

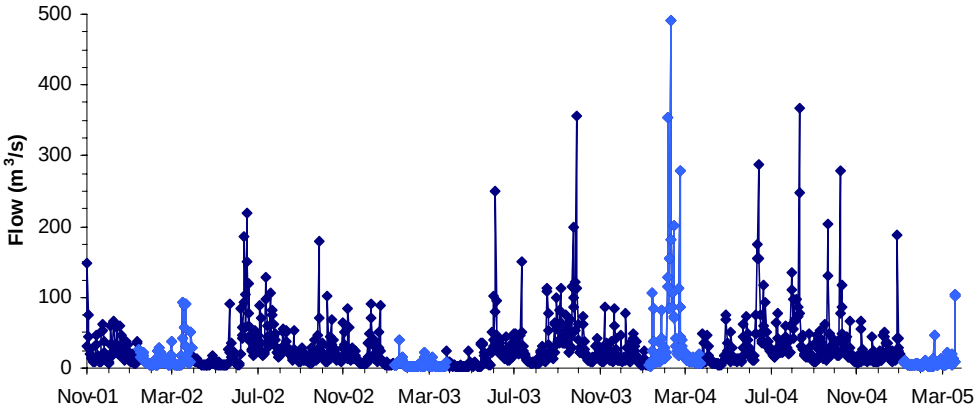

Figure 3.43: Mean daily flows for the Ruamahanga River recorded at the Wardell flow monitoring station from 1 November 2001 to 31 March 2005 inclusive
(mid January to late March flows are coloured light blue)

3.5.2 Suitability for recreation grades

The interim SFRGs for each of the 23 sites are illustrated in Figure 3.44. It can be seen that:

- One site (4.3%) has an interim grade of *very good*; the Waiohine River at the Gauge.
- Two sites (8.7%) have an interim grade of *good*; the Otaki River at The Pots and the Waiohine River at State Highway 2.
- Three sites (13%) have an interim grade of *fair*; the Otaki River at State Highway 1 and the Waingawa River at both Kaituna and South Road.
- Six sites (26.1%) have an interim grade of *poor*: one in the Kapiti Coast District, three in the Hutt Valley and one in the Wairarapa.
- 11 sites (47.8%) have an interim grade of *very poor*: three in the Hutt Valley and eight in the Wairarapa.

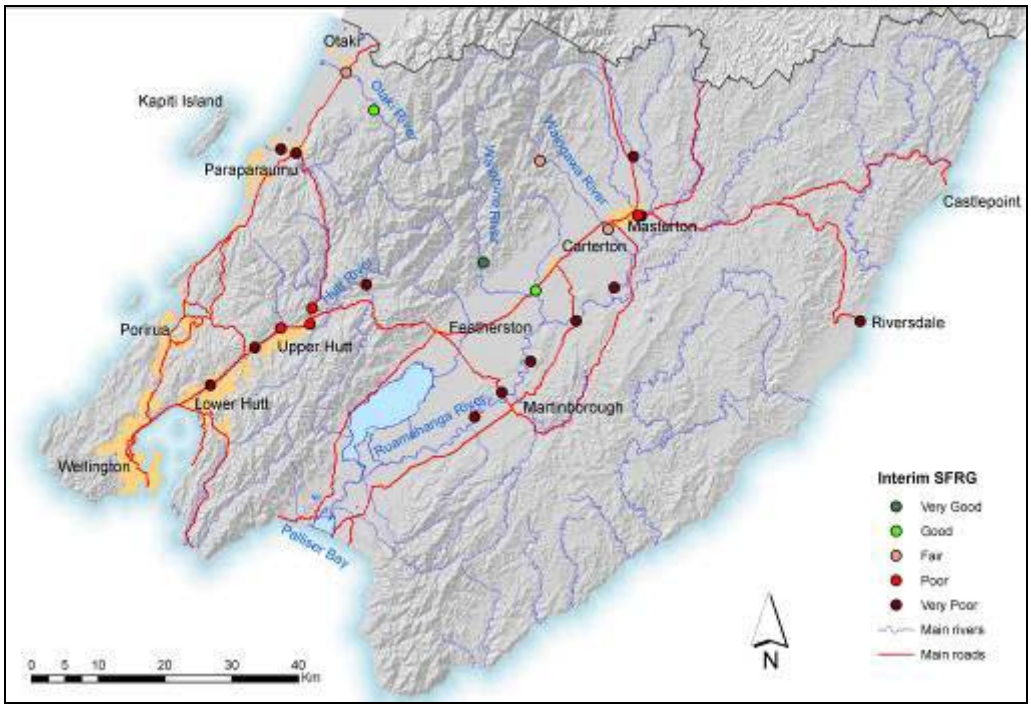

Figure 3.44: Interim suitability for recreation grades for the 23 freshwater monitoring sites in the Wellington Region, based on estimated microbiological risk and *E. coli* counts measured at weekly intervals over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

According to the MfE/MoH (2003) guidelines, the SFRG describes the general condition of the water at a site at any given time, taking into account both microbiological risk (determined from a catchment assessment) and actual microbiological counts measured over time. However, as discussed earlier in this section, the poor and very poor interim SFRGs determined for a number of sites are largely the result of very high MAC grades. The MAC grades are

determined directly from the 95th percentile *E. coli* counts at each site (Figure 3.45), which relate to bacteria counts during rainfall events. Therefore the interim SFRGs appear conservative, and better reflect the condition of the bathing sites during wet weather than dry weather when use of the sites for contact recreation would be greatest.

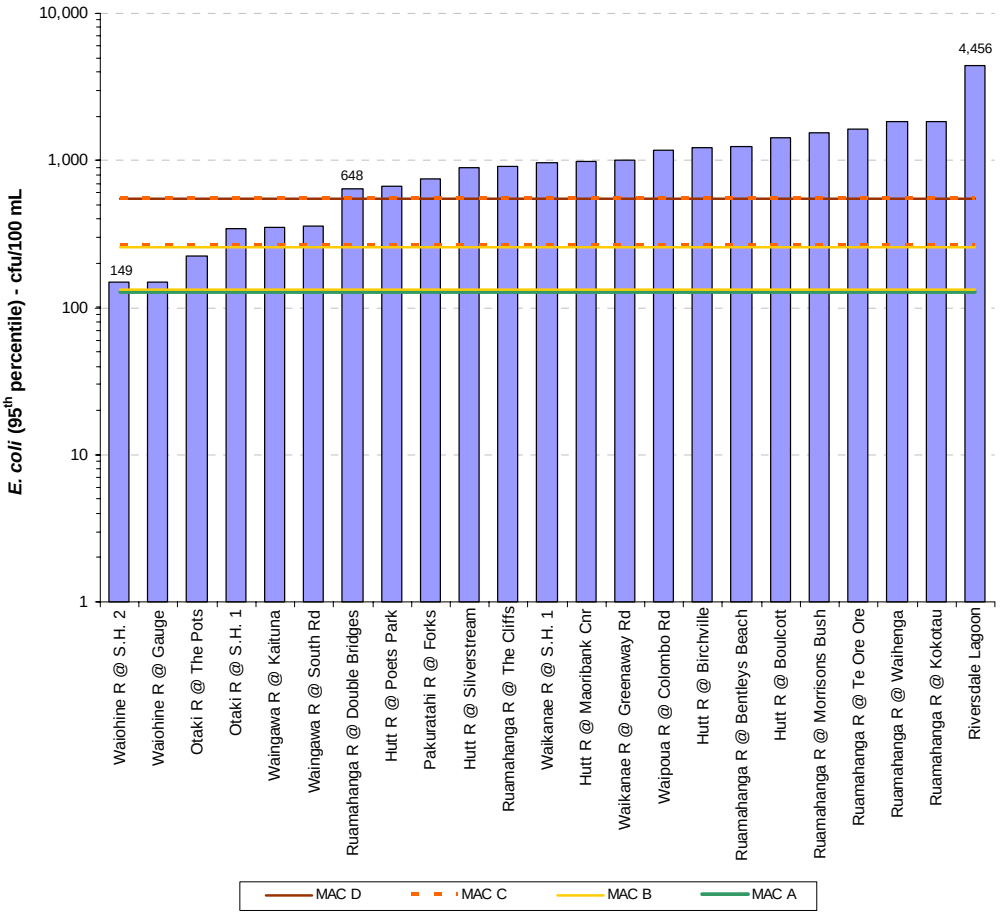

Figure 3.45: MAC grades, ranked from lowest to highest, for each of the 23 freshwater monitoring sites in the Wellington Region, based on 95th percentile values from routine monitoring over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The MfE/MoH (2003) guidelines do set out protocol for "modifying" beach grades, where there are known and predictable period of high risk, such as following heavy rain. Essentially this means removing rainfall related data. However, this has a 'sanitising' effect on the data and before an SFRG can be modified, local and regional authorities must be able to demonstrate that management interventions have been effective at deterring bathing during, and for several days following, rainfall.

The SFRGs should also be interpreted with caution for several other reasons:

- The grades given are only interim grades based on four summer bathing seasons (only three seasons for a few sites); one further year of data needs to be collected before the grades can be finalised.
- Detailed sanitary inspections have not been undertaken at all sites.

- The grades are only indicative of the condition of the water at a site during the summer bathing season.
- The Ministry for the Environment and Ministry of Health are considering reviewing the methodology used to determine the MAC (and therefore the SFRG), following advice from a number of regional and local authorities that the assessment criteria are unrealistic and do not differentiate between sites (Thompson, pers. comm. 2005[3]).

The results of all monitoring undertaken over the 1 November to 31 March 2005 reporting period are summarised for each monitoring site in Figure 3.46. Although the median values recorded at most of the sites are well below the alert level guideline, at many sites, including the Waikanae River, the Hutt River and the Ruamahanga River, a number of action level results are more than one order of magnitude above the surveillance level guideline. These results highlight that on many occasions, particularly following rainfall events, water quality at these sites is extremely poor.

Overall, the high correlation between rainfall events and high bacteria counts supports advice from the Greater Wellington Regional Council and the Ministry of Health to avoid swimming and other contact recreation activities during and for up to several days after heavy rainfall. As outlined in Section 2, urban stormwater (including sewer overflows) and diffuse-source runoff following rainfall are the major contributors to faecal contamination in rivers and streams in the region.

[3] Mike Thompson, Ministry for the Environment

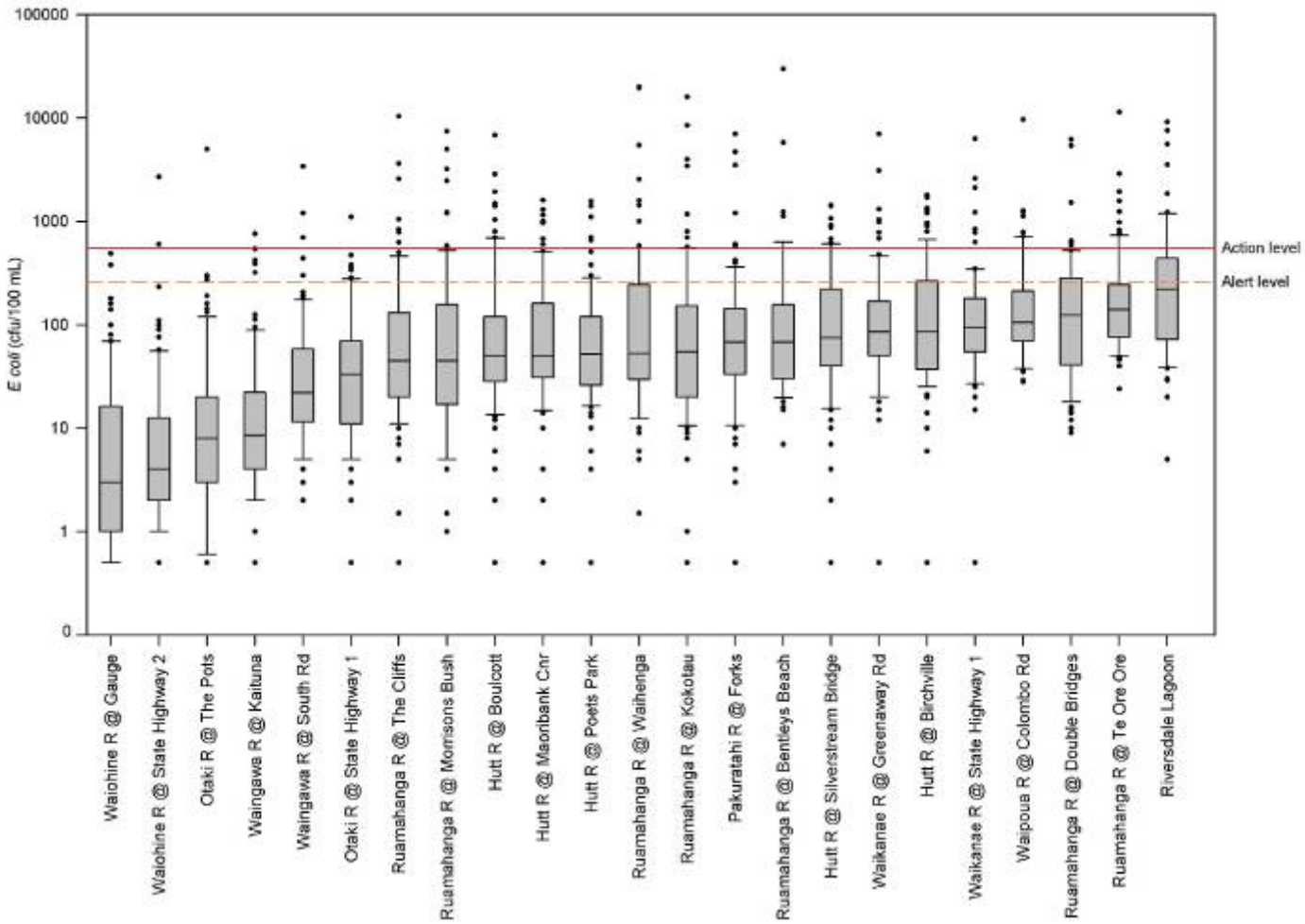

Figure 3.46: Comparison of the median and range of *E. coli* counts recorded at each of the 23 freshwater monitoring sites monitored over the November 2001 to March 2005 reporting period - ranked from the lowest to the highest median value

(Note: the horizontal black line across each box plot represents the median value)

4. Recreational water quality in marine waters

4.1 Introduction

Recreational water quality is currently monitored at 76 marine sites across the Wellington Region. These sites were selected on the basis of their use by the public for contact recreation; in particular, swimming, surfing, and boating. Twenty of the sites are located in the Kapiti Coast District, 14 in Porirua City, 15 in Hutt City, 22 in Wellington City, and five in the Wairarapa. The locations of the monitoring sites are shown in Figure 4.1. A full site list can be found in Appendix 1.

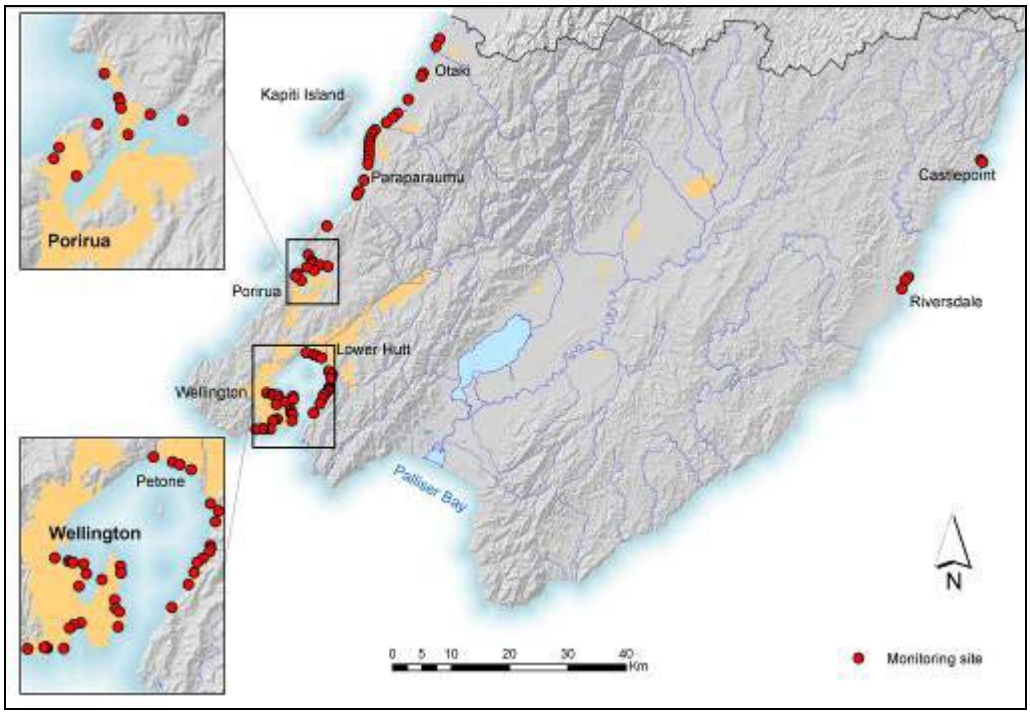

Figure 4.1: Marine recreational water quality monitoring sites in the Wellington Region

4.1.1 Monitoring protocol

Sites are sampled weekly during the bathing season and at least monthly during the remainder of the year. On each sampling occasion a single water sample is collected 0.2 metres below the surface in 0.5 metres water depth and analysed for enterococci indicator bacteria using membrane filtration. 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, are 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 seaweed. Under warm conditions when seaweed is excessively photosynthesising or decaying, enterococci may feed off the decayed seaweed or increased carbonaceous material produced by the seaweed during photosynthesis.

An estimate of the daily rainfall in the catchment adjoining each site over the bathing season is made by obtaining records from the nearest rain gauge.

4.1.2 Guidelines

As outlined in Section 1.4, 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 count in colony-forming units (cfu) per 100 mL)	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	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 (19/1000 risk). 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.

Annapolis protocol/beach grading

The process for grading the suitability of sites for contact recreation purposes was outlined in Section 1.4.1. The suitability for recreation grades for marine waters are shown in Table 4.2. Further details about the SFRGs can be found in Appendix 2.

Table 4.2: MfE/MoH (2003) Suitability for Recreation Grades (SFRG) for marine 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). If after reassessment the SFRG is still "follow-up", assign a conservative grade

3 Implies non-sewage sources of indicators requiring verification. If after verification the SFRG is still "follow-up", assign a conservative grade

4.1.3 Data analysis, limitations and reporting

All sampling and evaluation of results has been undertaken in accordance with the MfE/MoH (2003) microbiological water quality guidelines for marine recreation areas where feasible. However, it is not possible to accurately specify the number of true exceedances of the red/action mode of the guidelines. The guidelines specify that a bathing site only enters the action mode when *two consecutive samples* exceed 280 enterococci/100 mL but in Wellington, as occurs in some other regions, a second sample is not always collected, particularly when the first exceedance coincides with a heavy rainfall event. Therefore to ensure that recreational water quality at all 76 sites is assessed on an equal basis, the approach taken in this report is to treat any single result greater than 280 enterococci/100 mL obtained from routine weekly monitoring as an exceedance of the red/action mode of the guidelines.

In this report, assessment of compliance with the water quality guidelines, is limited to the results of routine weekly samples collected over the official summer bathing season (1 November to 31 March inclusive). This is the approach recommended in the MfE/MoH (2003) guidelines. However, as a degree of recreational activity occurs year round at many sites, the results of all monitoring are presented in time-series graphs for each site to provide a more complete picture of recreational water quality over the course of the reporting period. These graphs present enterococci counts on a logarithmic scale and also include the results of additional sampling (where undertaken and available) following an exceedance of the alert or action levels of the guidelines.

For the purposes of deriving the MAC grade, only routine summer sampling results were included. This means that results arising from a second consecutive sample taken to confirm an action level event, and any subsequent follow-up samples, were excluded from the data-set. This practice is consistent

with recent advice from the Ministry for the Environment (2005); previous advice had recommended exclusion of the first routine sample result in favour of the second consecutive sample result.

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 (i.e., counts of <1 cfu/100 mL and >400 cfu/100 mL were treated as 0.5 cfu/100 mL and 400 mL respectively).

Cautionary note

The number of exceedances of recreational water quality guidelines reported may differ from those previously reported by the Greater Wellington Regional Council or other authorities. There are two primary reasons for this:

- Water quality results reported on prior to the 2003/2004 summer will have been assessed against either the MfE/MoH (1999) or the MfE/MoH(2002) *interim* microbiological water quality guidelines for recreational areas. The guidelines used in this report were only finalised in June 2003 and differ from the interim guidelines.
- In some instances, the Greater Wellington Regional Council's water quality database may be missing some water quality results, particularly where additional sampling has been undertaken following an alert or action level event.

As outlined in Section 4.1.2, any *single* enterococci result greater than 280 cfu/100 mL obtained from routine monitoring is taken as an exceedance of the action level of the guidelines. Clearly not all exceedances of the action level arising during routine monitoring will have been followed by a second exceedance. Therefore the approach used in this report provides a conservative estimate of the number of *potential* action mode events that occurred over the November 2001-March 2005 period.

4.2 Kapiti

The Kapiti coastline extends from Otaki in the north to Paekakariki in the south. The shoreline consists predominantly of sandy beaches (Figure 4.2). Urban areas lie in the middle and lower reaches of the catchments while the upper reaches are primarily agricultural. Areas adjacent to the coast have experienced significant residential growth in recent years, particularly at Paraparaumu.

The major freshwater inputs come from the Waitohu Stream, Otaki River, Mangaone Stream, and Waikanae River. These rivers and streams can influence water quality at four of the six main beach areas; Otaki, Te Horo, Waikanae, and Paraparaumu. The other two main beaches (Raumati and Paekakariki) lie to the south of the small Wharemauku Stream and Whareroa Stream respectively.

Swimming is popular along all of the Kapiti Coast beaches, whilst shellfish gathering is most popular along the Otaki, Te Horo, Peka Peka and Paekakariki

Beaches. The suitability of these areas for shellfish gathering is discussed in Section 5.

Figure 4.2: Paekakariki Beach

4.2.1 Otaki Beach

Otaki Beach achieved a high level of compliance with the recreational water quality guidelines. The Surf Club site exceeded the action level on only one occasion over the last four summer bathing seasons (Table 4.3, Figure 4.3), while the site adjacent to Rangiuru Road exceeded the action level on two occasions. The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.4.

Table 4.3: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
SURF CLUB								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	95.0	0	0.0	1	5.0	20	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**81**		**1**		**1**		**83**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
RANGIURU ROAD								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	90.5	1	4.8	1	4.8	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**79**		**3**		**2**		**84**	

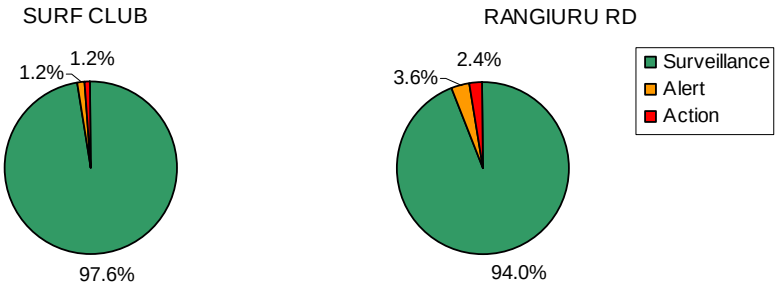

Figure 4.3: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

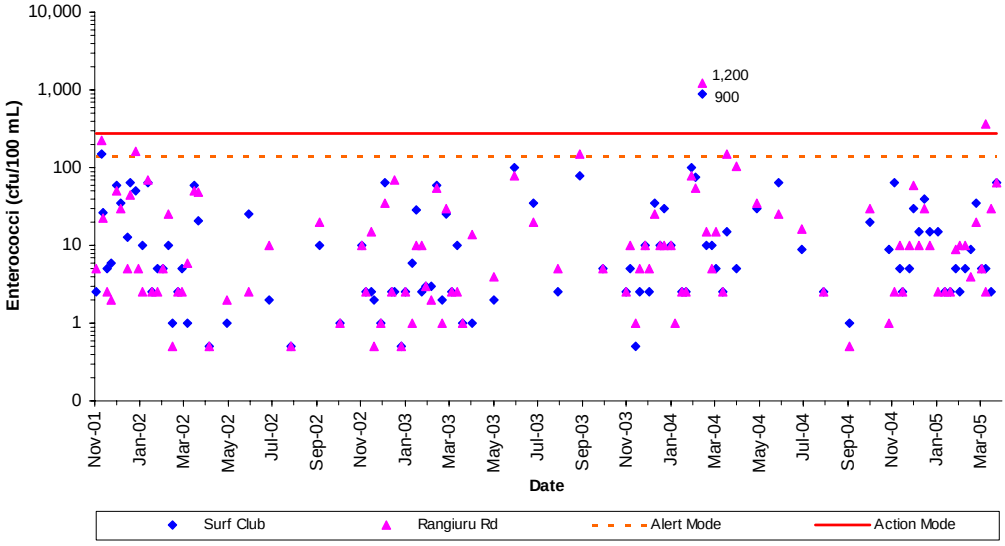

Figure 4.4: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

It can be seen from Table 4.4 that exceedances of the action level at both monitoring sites on 19 February 2004 followed 36 mm of rainfall in the 72 hours preceding sampling and further rainfall on the day of sampling. However, the action level result at Rangiuru Road on 16 March 2005 (360 cfu/100 mL) and several alert level results did not coincide with rainfall.

Table 4.4: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Otaki Depot rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Surf Club	Rangiuru Rd	24 hrs	48 hrs	72 hrs	
19/02/2004	900	1,200	2.5	11.5	36	17.5
16/03/2005		360	0	0	0	0.5
Total No. of Exceedances	1	2				
Total No. of Samples	104	105				

4.2.2 Te Horo Beach

Te Horo Beach south of Mangaone Stream exceeded the action level of the recreational water quality guidelines on five occasions over the last four summer bathing seasons (Table 4.5). Most of these exceedances occurred over the 2003/2004 summer. In contrast, neither the alert level nor the action level were exceeded at either monitoring site over the 2002/2003 summer. There were also no exceedances at Kitchener Street over the 2004/2005 summer. Overall, the Mangaone Stream and Kitchener Street sites complied with the surveillance level on 90.4% and 94% of sampling occasions respectively (Figure 4.5).

Table 4.5: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
SOUTH OF MANGAONE STREAM								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	17	85.0	0	0.0	3	15.0	20	100
2004-2005	18	85.7	2	9.5	1	4.8	21	100
Total	**75**		**3**		**5**		**83**	
KITCHENER STREET								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	18	85.7	1	4.8	2	9.5	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**79**		**3**		**2**		**84**	

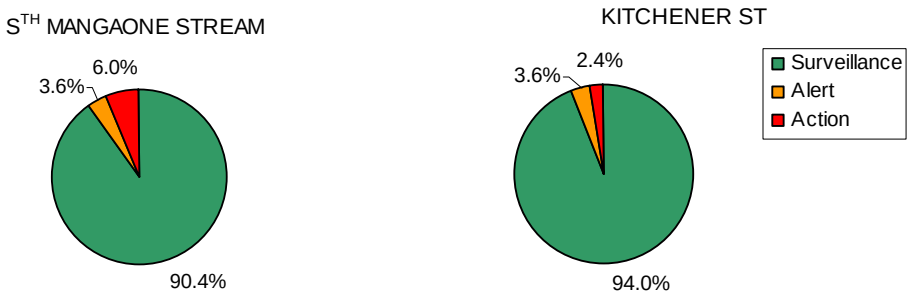

Figure 4.5: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The highest enterococci count was 1,200 cfu/100 mL, recorded at Kitchener Street on 19 February 2004 (Figure 4.6). This result followed significant rainfall prior to and on the day of sampling. Table 4.6 indicates that all exceedances of the action level coincided with rainfall events. Rural discharges and runoff in the Mangaone Stream catchment during wet weather will influence water quality at the beach, particularly at the monitoring site located to the south of Mangaone Stream.

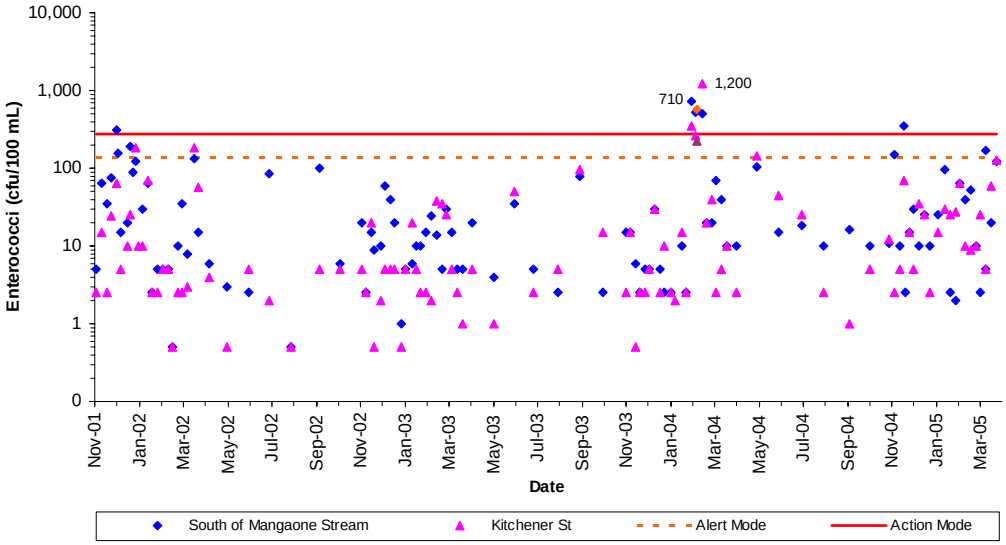

Figure 4.6: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.6: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Otaki Depot rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Sth of Mangaone Stream	Kitchener St	24 hrs	48 hrs	72 hrs	
05/12/2001	310		NR	NR	NR	NR
04/02/2004	710	350	8	17.5	55	9.5
11/02/2004	525		3	10	11.5	57
19/02/2004	500	1,200	2.5	11.5	36	17.5
24/11/2004	350		18	18	18	1
Total No. of Exceedances	5	2				
Total No. of Samples	104	105				

NR No rainfall record available

4.2.3 Peka Peka Beach

Peka Peka Beach achieved a very high level of compliance with the recreational water quality guidelines, with only one exceedance of the action level arising from routine monitoring over the last four summer bathing seasons (Table 4.7). Overall, Peka Peka Beach complied with the surveillance level on almost 98% of sampling occasions (Figure 4.7).

Table 4.7: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	20	95.2	1	4.8	0	0.0	21	100
Total	**82**		**1**		**1**		**84**	

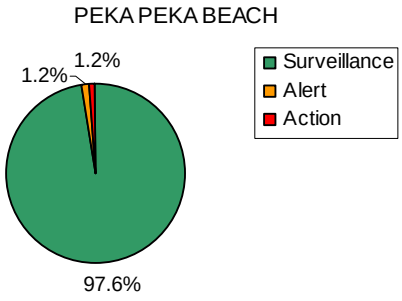

Figure 4.7: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.8. It can be seen from Figure 4.8 that the greatest enterococci count (300 cfu/100 mL) was only just above the action level guideline. This result was recorded on 19 February 2004 and followed 36 mm of rainfall in the three days preceding sampling (Table 4.8). Further rainfall was also recorded on the day of sampling. The exceedance of the alert level on 8 February 2005 did not coincide with any significant rainfall.

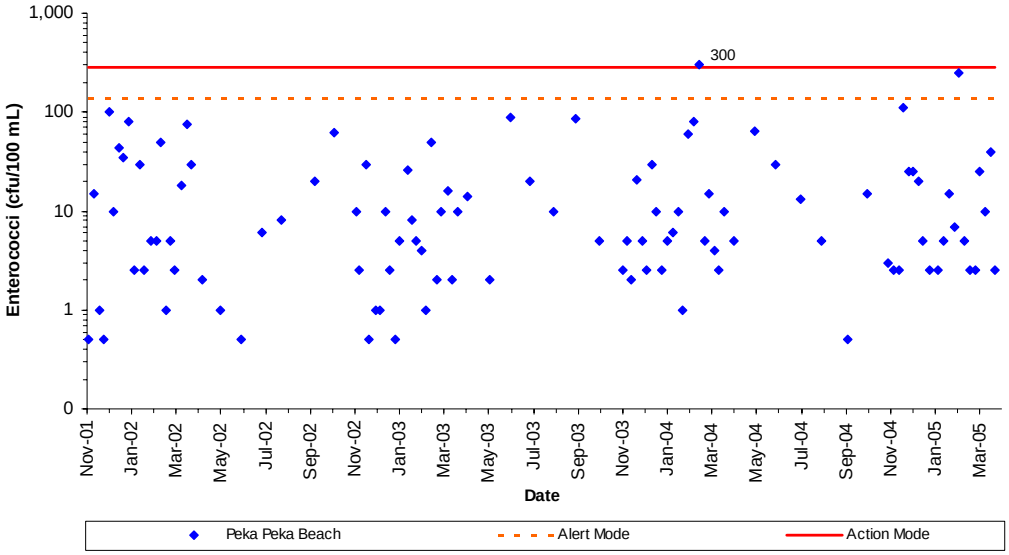

Figure 4.8: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.8: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Waikanae Water Treatment Plant rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
19/02/2004	300	2.5	11.5	36	17.5
Total No. of Exceedances	1				
Total No. of Samples	105				

4.2.4 Waikanae Beach

All three Waikanae Beach monitoring sites exceeded the recreational water quality guidelines during one or more of the last four summer bathing seasons (Table 4.9). The William Street site exceeded the action level on two occasions over the four summers while the Tutere Street and Ara Kuaka sites both exceeded this level on three occasions. Overall the three sites complied with the surveillance level on 94% or more of sampling occasions (Figure 4.9).

Table 4.9: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WILLIAM STREET								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	18	85.7	2	9.5	1	4.8	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**80**		**2**		**2**		**84**	
TUTERE STREET TENNIS COURTS								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	90.5	0	0.0	2	9.5	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**81**		**0**		**3**		**84**	
ARA KUAKA CARPARK								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	18	85.7	1	4.8	2	9.5	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**79**		**2**		**3**		**84**	

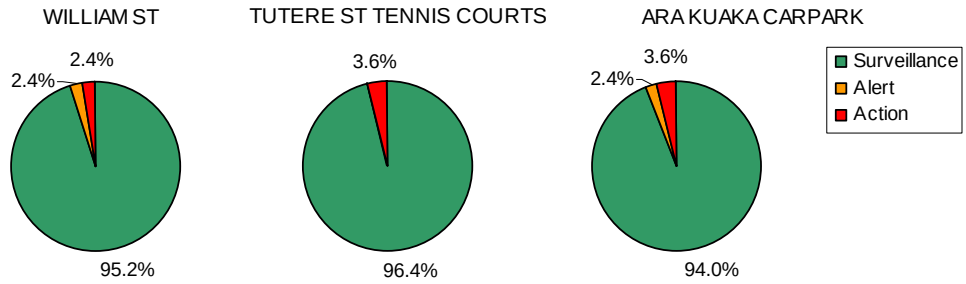

Figure 4.9: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Exceedances of guidelines at all three sites on 12 February and 17 February 2004 are almost certainly rainfall related, with 125.5 and 114 mm of rain falling in the 72 hour period prior to sampling respectively (Table 4.10). However, the 8 February 2005 action level exceedance is unlikely to be rainfall related. The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.10.

Table 4.10: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Waikanae Water Treatment Plant rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	William St	Tutere St	Ara Kuaka	24 hrs	48 hrs	72 hrs	
12/02/2004	285	325	330	70.5	115	125.5	0
17/02/2004	280	400	350	36	98.6	114	9
08/02/2005	455	560	300	1.5	1.5	1.5	0
Total No. of Exceedances	3	3	3				
Total No. of Samples	105	105	105				

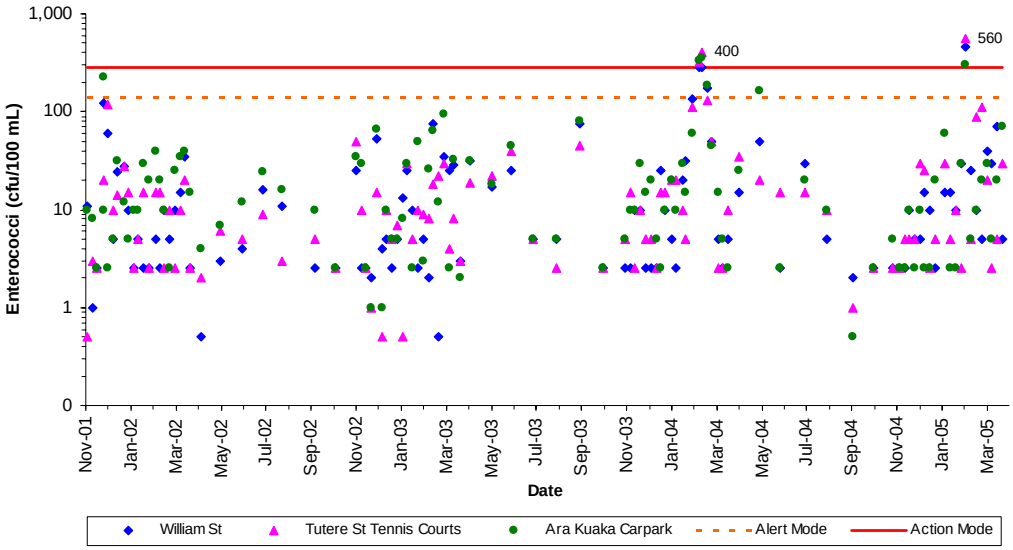

Figure 4.10: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

4.2.5 Paraparaumu Beach

Exceedances of either the alert or action levels of the recreational water quality guidelines were recorded during each of the last four summer bathing seasons at all five monitoring sites along Paraparaumu Beach (Table 4.11). The site adjacent to Maclean Park recorded the greatest number of exceedances, including eight exceedances of the alert level and 3 exceedances of the action level. The site at Wharemaukau Road recorded the least number of exceedances and complied with the surveillance level of the guidelines on 94% of sampling occasions (Figure 4.11).

Table 4.11: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
NGAPOTIKI STREET								
2001-2002	18	85.7	2	9.5	1	4.8	21	100
2002-2003	18	85.7	1	4.8	2	9.5	21	100
2003-2004	20	95.2	1	4.8	0	0.0	21	100
2004-2005	19	90.5	2	9.5	0	0.0	21	100
Total	**75**		**6**		**3**		**84**	
NATHAN AVENUE								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	19	90.5	1	4.8	1	4.8	21	100
Total	**77**		**4**		**3**		**84**	
MACLEAN PARK								
2001-2002	18	85.7	3	14.3	0	0.0	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	18	85.7	2	9.5	1	4.8	21	100
2004-2005	18	85.7	1	4.8	2	9.5	21	100
Total	**73**		**8**		**3**		**84**	
TORU ROAD								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	19	90.5	1	4.8	1	4.8	21	100
Total	**77**		**5**		**2**		**84**	
WHAREMAUKU ROAD								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**79**		**3**		**2**		**84**	

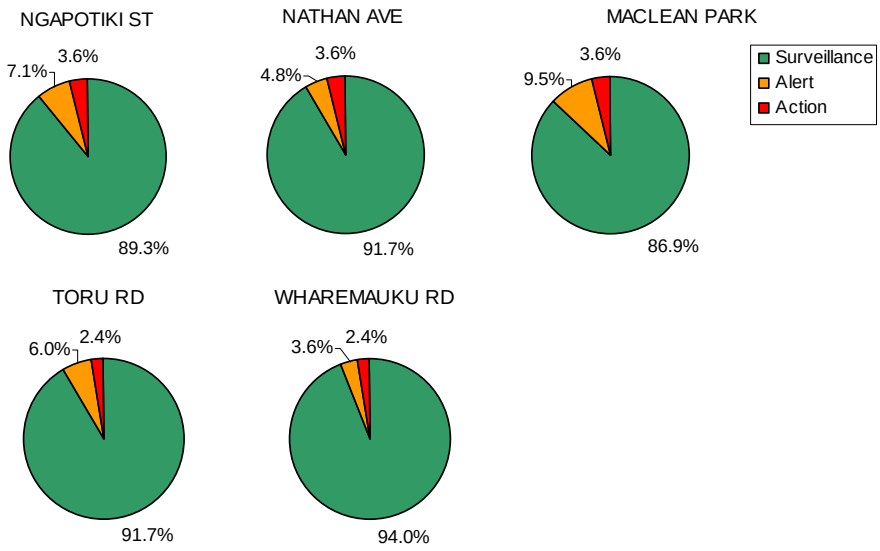

Figure 4.11: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of exceedances of both the alert and action guideline levels is higher for most sites when the results of all sampling for the 2001-2005 reporting period are considered (Figure 4.12). The greatest enterococci counts were recorded at Ngapotiki Street on 28 January 2002 (1,690 cfu/100 mL), at Maclean Park on 29 March 2005 (1,300 cfu/100 mL) and at Wharemauku Road on 9 October 2003 (1,200 cfu/100 mL), (Figure 4.12). Table 4.12 indicates that two of these results, together with a number of other action level events, coincided with little or no rainfall. Elevated results at four of the five sites on 18 February 2004 are clearly rainfall related; over 91 mm of rain fell in the 72 hours prior to sampling.

Rain-related exceedances are likely to be related to urban runoff. Stormwater pipes discharge onto Paraparaumu Beach at a number of locations (e.g., Maclean Street, Tahi Road and Mannson Lane) and are likely to contribute elevated bacteria levels during rainfall. However, it is unclear why a number of elevated results coincided with little or no rainfall. Seaweed cover was nil on all of these sampling occasions and there does not appear to be a consistent pattern with respect to tides or wind direction. It is possible that water quality at the Maclean Street site is at times influenced by Tikotu Stream. This stream drains urban Paraparaumu and runs under a number of sewer laterals. Berry (1999) reported that a study in 1997 identified faecal contamination near the golf club on McKay Street. Local sewage pump stations were checked for leaks by Kapiti District Council staff. Although no direct discharges to the stream were found, the 1997 study concluded that the stream was often influenced by low flows, receives diffuse stormwater runoff from residential properties, and flows through peaty soils. All of these factors may be conducive to promoting bacteria growth.

Table 4.12: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kapiti Aerodrome rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)					Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Ngapotiki St	Nathan Ave	Maclean Park	Toru Rd	Wharemauku Rd	24 hrs	48 hrs	72 hrs	
28/01/2002	1,690	360				0	0	0	0
05/07/2002			290			13.8	22.4	22.4	0.8
08/01/2003	540					0	0	0.2	0.2
18/02/2003	440					0	0	0	0
09/10/2003					1,200	0	0	0	0
18/02/2004		430	520	380	380	11.2	28.6	91.2	0
07/07/2004			1,100	930	910	1.8	9.2	9.2	20.4
07/02/2005		580				0	0	0	0.2
08/03/2005			295	330	325	0	12.4	13.6	0.8
29/03/2005			1,300			0	0.6	9.4	15.8
Total No. of Exceedances	3	3	5	3	4				
Total No. of Samples	105	106	106	106	105				

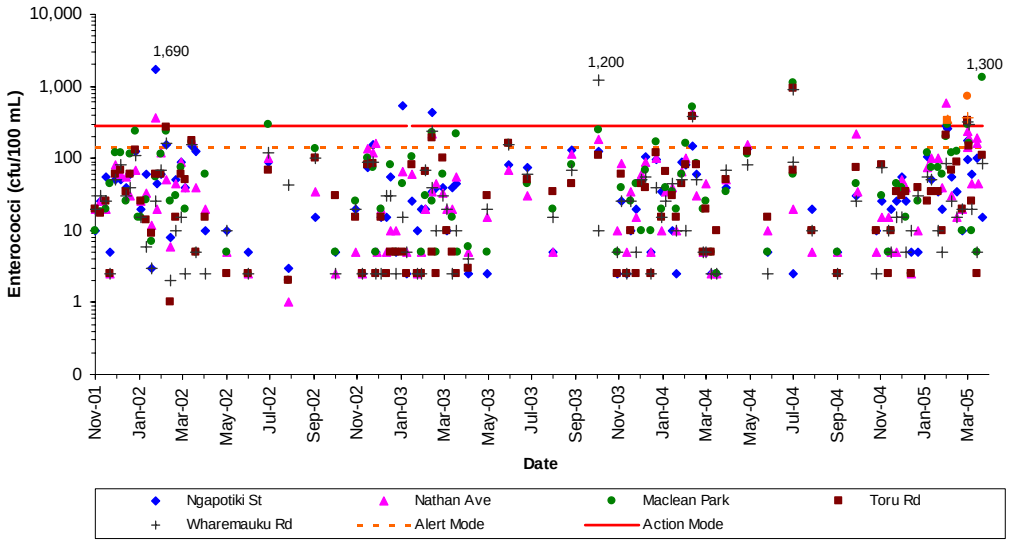

Figure 4.12: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

4.2.6 Raumati Beach

Of the four monitoring sites along Raumati Beach, the site adjacent to Aotea Street was the most suitable for contact recreation over the last four summer bathing seasons (Table 4.13). This site exceeded the alert and action levels of the recreational water quality guidelines on just one and two occasions respectively. The Marine Gardens site actually recorded one less exceedance of the action level, but 10 exceedances of the alert level. Subsequently this site only complied with the surveillance level of the guidelines on 86.9% of sampling occasions (Figure 4.13).

Table 4.13: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
TAINUI STREET								
2001-2002	20	95.2	0	0.0	1	4.8	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	19	90.5	0	0.0	2	9.5	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**80**		**1**		**3**		**84**	
MARINE GARDENS								
2001-2002	18	85.7	3	14.3	0	0.0	21	100
2002-2003	18	85.7	3	14.3	0	0.0	21	100
2003-2004	16	76.2	4	19.0	1	4.8	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**73**		**10**		**1**		**84**	
AOTEA STREET								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	22	100.0	0	0.0	0	0.0	22	100
2003-2004	20	90.9	0	0.0	2	9.1	22	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**83**		**1**		**2**		**86**	
HYDES ROAD								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	86.4	1	4.5	2	9.1	22	100
2004-2005	19	90.5	0	0.0	2	9.5	21	100
Total	**80**		**1**		**4**		**85**	

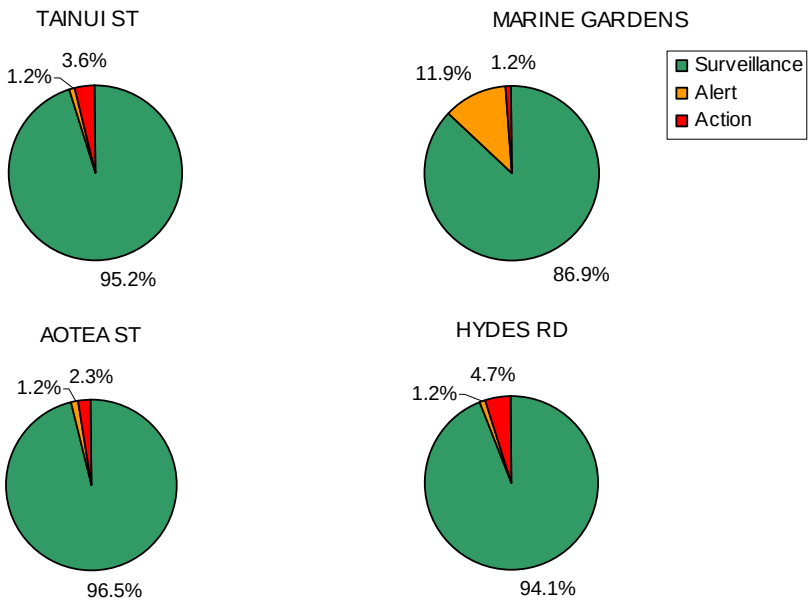

Figure 4.13: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The greatest enterococci count was recorded at the Hydes Road site on 29 March 2005 (2,100 cfu/100 ml, Figure 4.14). This was the only exceedance at any of the Raumati Beach sites that was more than one order of magnitude above guideline values. No rainfall was recorded on the day preceding sampling, although 15.8 mm of rain fell on the day of sampling (Table 4.14). Exceedances of the action level at all four sites on 18 February 2004 followed 91.2 mm of rainfall in the three days prior to sampling. In contrast, exceedances on 28 January 2002 (Tainui Street), 24 February 2002 (Aotea Street and Hydes Road) and 27 February 2005 coincided with little or no rainfall.

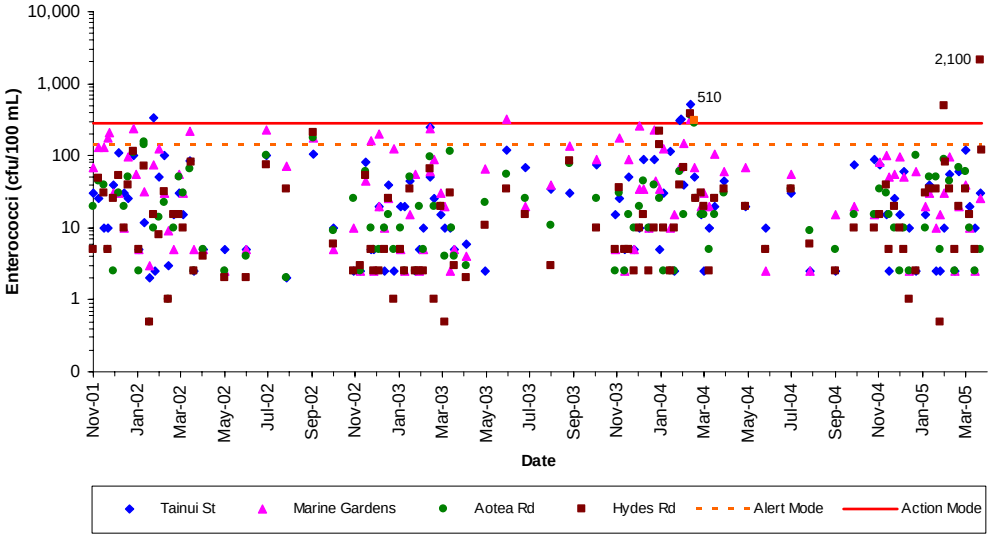

Figure 4.14: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.14: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kapiti Aerodrome rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)				Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Tainui St	Marine Gardens	Aotea St	Hydes Rd	24 hrs	48 hrs	72 hrs	
28/01/2002	335				0	0	0	0
05/06/2003		320			7	30.4	30.4	14.2
03/02/2004	310				6.2	42	51	0.2
18/02/2004	510	320	360	390	11.2	28.6	91.2	0
24/02/2004			285	310	2.8	2.8	2.8	0
07/02/2005				505	0	0	0	0.2
29/03/2005				2,100	0	0.6	9.4	15.8
Total No. of Exceedances	3	2	2	4				
Total No. of Samples	105	105	107	107				

Rain-related exceedances are likely to be related to urban runoff. However, it is unclear as to why a number of elevated results coincided with little or no rainfall. Seaweed cover was nil on all of these sampling occasions and there does not appear to be a consistent pattern with respect to tides or wind direction. It is possible that water quality at some site is at times influenced by Wharemauku Stream. Berry (1999) reported that water quality sampling undertaken by the Kapiti District Council staff over 1995/1996 identified elevated bacteria levels in this stream.

4.2.7 Paekakariki Beach

Paekakariki Beach achieved a very high level of compliance with the recreational water quality guidelines over the last four summer bathing seasons. The Surf Club was the only site out of a total of 76 sites in the Greater Wellington Regional Council's marine recreational water quality monitoring programme to achieve 100% compliance with the guidelines during this period (Table 4.15, Figure 4.15). The sites at Whareroa Road and Memorial Hall also exhibited good water quality, each exceeding the action level on just one of over 80 sampling occasions.

Table 4.15: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WHAREROA ROAD								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	90.5	2	9.5	0	0.0	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**80**		**3**		**1**		**84**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
SURF CLUB								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**84**		**0**		**0**		**84**	
MEMORIAL HALL								
2001-2002	21	95.5	1	4.5	0	0.0	22	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	20	95.2	0	0.0	1	4.8	21	100
Total	**83**		**1**		**1**		**85**	

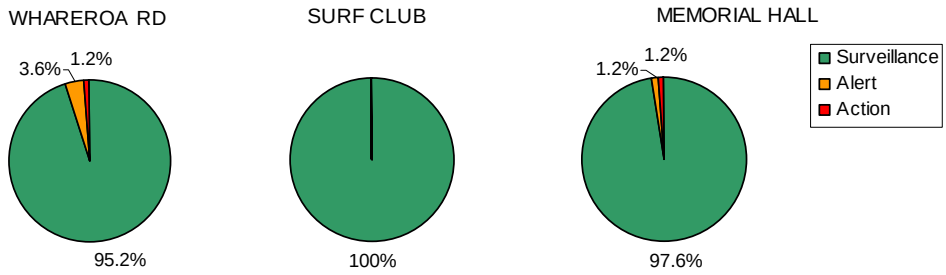

Figure 4.15: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The action level exceedances at the Memorial Hall and Whareroa Road sites occurred on 7 February 2005 and 7 March 2005 respectively. The former exceedance is unlikely to be rainfall related (Table 4.16). A follow-up sample collected the next day yielded a greater result (680 cfu/100 mL, Figure 4.16). No further follow-up samples were collected.

Table 4.16: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kapiti Aerodrome rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Whareroa Rd	Memorial Hall	24 hrs	48 hrs	72 hrs	
07/02/2005		360	0	0	0	0.2
07/03/2005	360		12.4	13.6	13.6	0
Total No. of Exceedances	1	1				
Total No. of Samples	105	105				

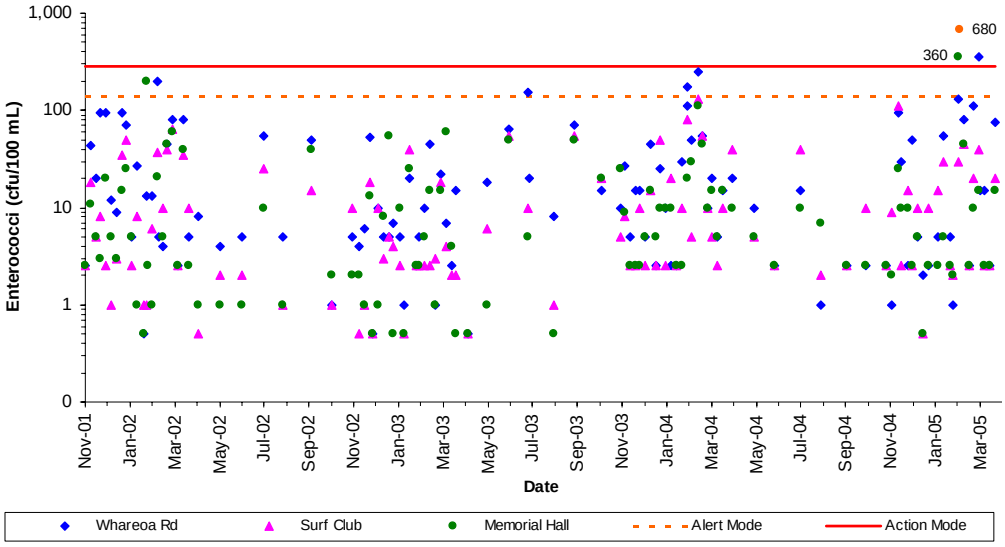

Figure 4.16: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

4.2.8 Discussion

Monitoring undertaken over 2001-2005 indicates that water quality is very high at most marine recreational areas in the Kapiti Coast District. Eighteen of the 20 monitoring sites complied with the surveillance level of the recreational water quality guidelines (<140 enterococci/100 mL) on over 90% of routine summer sampling occasions, with nine of these sites complying on over 95% of sampling occasions. Paekakariki Beach recorded the highest level of compliance with the guidelines, followed by Peka Peka Beach, Otaki Beach and Waikanae Beach (Figure 4.17). Paraparaumu Beach at Maclean Park and Raumati Beach at Marine Gardens recorded the lowest level of compliance and exceeded the surveillance level guideline on more than 13% of sampling occasions. Water quality at both of these latter sites is likely to be influenced by stormwater discharges.

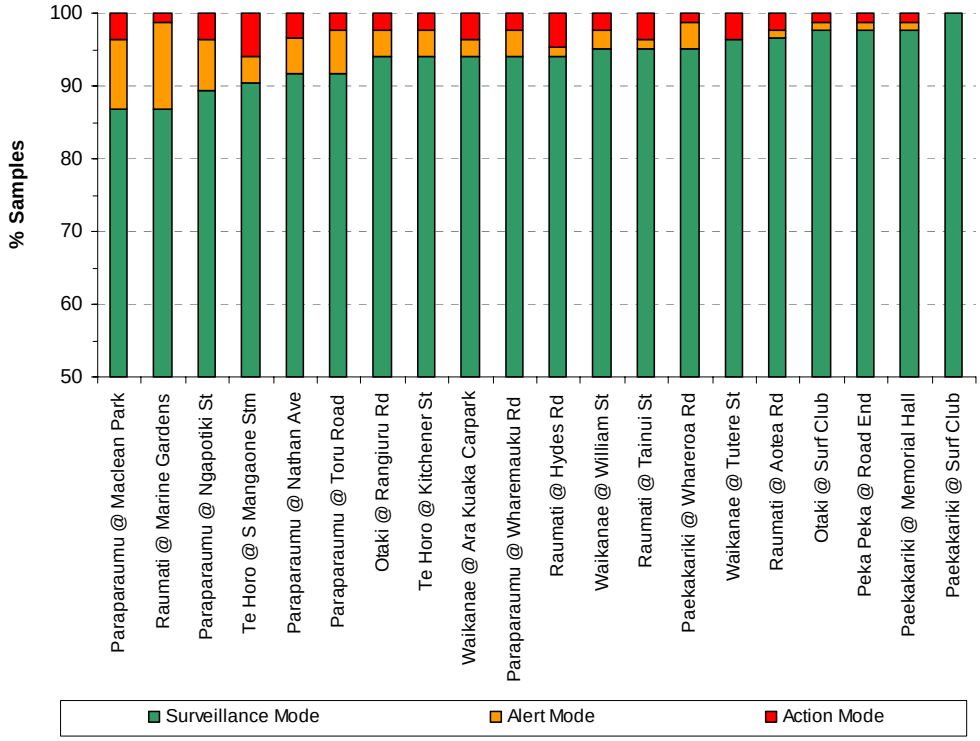

Figure 4.17: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer, with just two of the 20 sites recording an exceedance of the action level guideline (Table 4.17). In contrast, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer. Sixteen sites exceeded the action level over this period, with five sites exceeding the action level on at least two occasions.

Table 4.17: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly summer sampling undertaken at the 20 monitoring sites in the Kapiti Coast District

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3	≥ 4
2001/2002	5	4	4	0	0	0
2002/2003	12	2	0	2	0	0
2003/2004	2	16	10	5	1	0
2004/2005	7	11	9	2	0	0

Analysis of rainfall records indicates that rainfall events may account for approximately 70% of the action level exceedances recorded over the full reporting period. The total number of sites recording exceedances in each

summer season certainly shows a relationship with rainfall (Figure 4.18). For example, the high degree of compliance with guidelines over the 2002/2003 summer coincides with very low rainfall; the monthly rainfall recorded in November 2002 and January, February and March 2003 was significantly lower than the longterm average for these same months. In contrast, the high number of exceedances over the 2003/2004 summer correlates with very heavy rainfall in February 2004. Analysis of the timing of exceedances over the 2003/2004 summer indicates that all 21 of the action level exceedances (across 16 sites) occurred in February 2004. In the case of Peka Peka Beach, the only action level exceedance recorded during the entire November 2001 to March 2005 period occurred in February 2004.

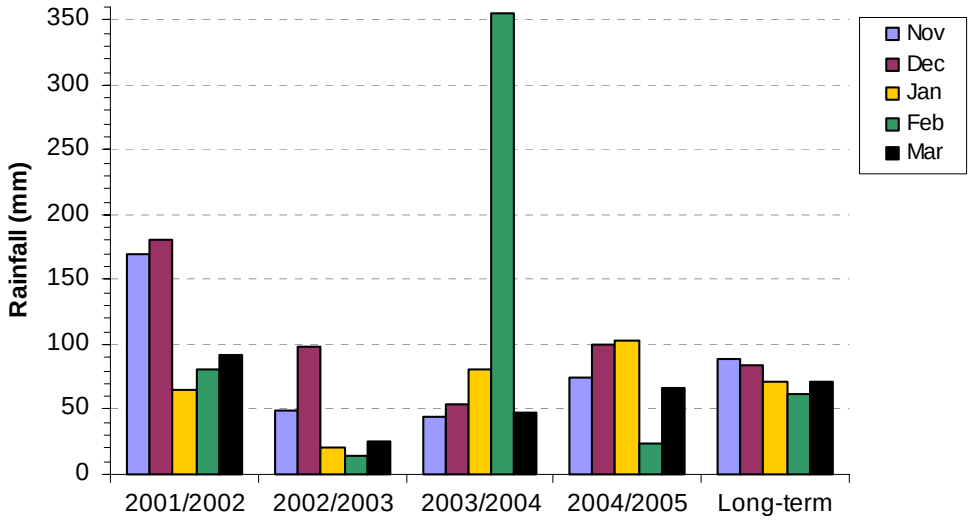

Figure 4.18: Monthly rainfall recorded at Kapiti Aerodrome over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1951 to present)

Several monitoring sites recorded a number of exceedances of the action level that did not coincide with rainfall events, notably the sites along Paraparaumu Beach adjacent to Ngapotiki Street and Nathan Avenue. In addition, the only action level exceedance recorded at Paekakariki Beach adjacent to the Memorial Hall over the entire reporting period occurred during dry weather in February 2005. The reason for this exceedance is unclear.

Suitability for recreation

The number of exceedances of the recreational water quality guidelines over the last four summer seasons was low at most sites, resulting in relatively low MAC values (Table 4.18). These low MAC values combine with low to moderate SIC values to give an interim SFRG of "good" for 14 of the 20 monitoring sites in the Kapiti Coast District. The SFRG is "fair" for the remainder of the sites, including three of the five sites along Paraparaumu Beach. This reflects the higher MAC values recorded for these sites. The "fair" grading for Te Horo Beach south of Mangaone Stream is at odds with its low SIC grade. It is recommended that the catchment risk factors for this site are reassessed over 2005/2006 to determine whether the SIC grade needs to be downgraded. The site is located approximately 50 metres from the Mangaone

Stream which is known to have poor water quality and could therefore be expected to impact on beach water quality at times.

Table 4.18: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for marine bathing sites in the Kapiti Coast District

Site	MAC*	SIC	Interim SFRG
OTAKI BEACH			
Surf Club	B (95th percentile = 68, n=83)	Moderate	Good
Rangiuru Road	B (95th percentile = 153, n=84)	Moderate	Good
TE HORO BEACH			
South of Mangaone Stream	C (95th percentile = 324, n=83)	Low	Fair
Kitchener Street	B (95th percentile = 180, n=84)	Low	Good
PEKA PEAK BEACH			
Peka Peka Beach	B (95th percentile = 84, n=86)	Moderate	Good
WAIKANAE BEACH			
William Street	B (95th percentile = 147, n=84)	Moderate	Good
Tutere Street Tennis Courts	B (95th percentile = 123, n=84)	Moderate	Good
Ara Kuaka Carpark	B (95th percentile = 197, n=84)	Moderate	Good
PARAPARAUMU BEACH			
Ngapotiki Street	C (95th percentile = 210, n=84)	Moderate	Fair
Nathan Avenue	C (95th percentile = 203, n=84)	Moderate	Fair
Maclean Park	C (95th percentile = 240, n=84)	Moderate	Fair
Toru Road	B (95th percentile = 198, n=84)	Moderate	Good
Wharemauku Road	B (95th percentile = 157, n=84)	Moderate	Good
RAUMATI BEACH			
Tainui Street	B (95th percentile = 159, n=84)	Moderate	Good
Marine Gardens	C (95th percentile = 232, n=84)	Moderate	Fair
Aotea Road	B (95th percentile = 111, n=86)	Moderate	Good
Hydes Road	C (95th percentile = 243, n=85)	Moderate	Fair

Site	MAC*	SIC	Interim SFRG
PAEKAKARIKI BEACH			
Whareroa Road	B (95^{th} percentile = 144, n=84)	Low	Good
Surf Club	B (95^{th} percentile = 54, n=84)	Moderate	Good
Memorial Hall	B (95^{th} percentile = 67, n=84)	Moderate	Good

* Based on enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

4.3 Porirua

The Porirua coastline extends from Paekakariki to just below Rock Point. The coastline is predominantly rocky from Pukerua Bay to Karehana Bay, around the Whitireia Peninsula, and south of Titahi Bay. Sandy beaches are present at Plimmerton, Onehunga Bay (Figure 4.19) and Titahi Bay. Porirua Harbour, comprised of the Onepoto Arm and the Pauatahanui Arm, lies in the centre of the area. The catchments of both of these inlets are being developed for residential use, and substantial areas have been subdivided in recent years.

Figure 4.19: Onehunga Bay

Freshwater inputs influence water quality at many of Porirua's beaches. Wairaka Stream drains into the sea at Pukerua Bay. The upper and lower reaches of this stream receive runoff from farms and reserve areas, whilst the mid reaches adjoin the urban area of Pukerua Bay. Stormwater from the western Pukerua Bay urban area is discharged into the stream. Taupo Stream drains rural areas, the Taupo Wetland, and urban Plimmerton, and discharges to the coast on Plimmerton Beach. This stream is likely to receive faecal inputs from animals living in all of these areas. The Kakaho, Horokiri, Ration Point, and Pauatahanui Streams, and Duck Creek, enter the Pauatahanui Arm of Porirua Harbour. Duck Creek drains a predominantly urban catchment while the other streams drain largely agricultural and forestry lands. Porirua Stream discharges into the head of the Onepoto Arm of the Porirua Harbour and receives runoff from agricultural, commercial, industrial and urban areas. Major urban stormwater outlets discharge into the Onepoto Arm in the vicinity of Semple Street and Te Hiko Street. A small stream draining Whitireia Park discharges to the coast at Onehunga Bay. The Porirua Wastewater Treatment

Plant is located to the south of Titahi Bay and discharges treated wastewater via a short outfall to the sea at Rukutane Point. The treatment plant was upgraded in 2002 with the addition of an ultraviolet disinfection system to reduce microbiological contaminants in the discharge.

The Porirua coastline is used for a wide range of recreational activities. Swimming is most popular at Titahi Bay and Plimmerton Beach. Surfing is also popular at Titahi Bay, whilst windsurfing is popular at Pauatahanui Inlet and at Plimmerton Beach. The Onepoto Arm of Porirua Harbour is mainly used for boating. People collect shellfish from Porirua Harbour and some of the more isolated parts of the coastline.

4.3.1 Pukerua Bay

Pukerua Bay exceeded the action level of the recreational water quality guidelines on three occasions during routine monitoring over the last four summer bathing seasons (Table 4.19, Figure 4.20). All three exceedances occurred following heavy rainfall events (Table 4.20) and are therefore likely to be a result of runoff from the adjacent urban area. The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.21.

Table 4.19: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	18	90.0	1	5.0	1	5.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	90.5	0	0.0	2	9.5	21	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**80**		**1**		**3**		**84**	

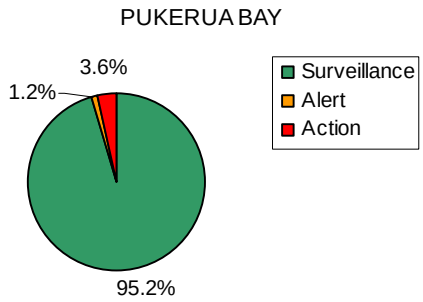

Figure 4.20: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Table 4.20: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
05/02/2002	444	25	25	25	20.5
18/02/2004	620	4.5	25.5	88	0
17/03/2004	1,218	15.5	15.5	15.5	9.5
Total No. of Exceedances	3				
Total No. of Samples	110				

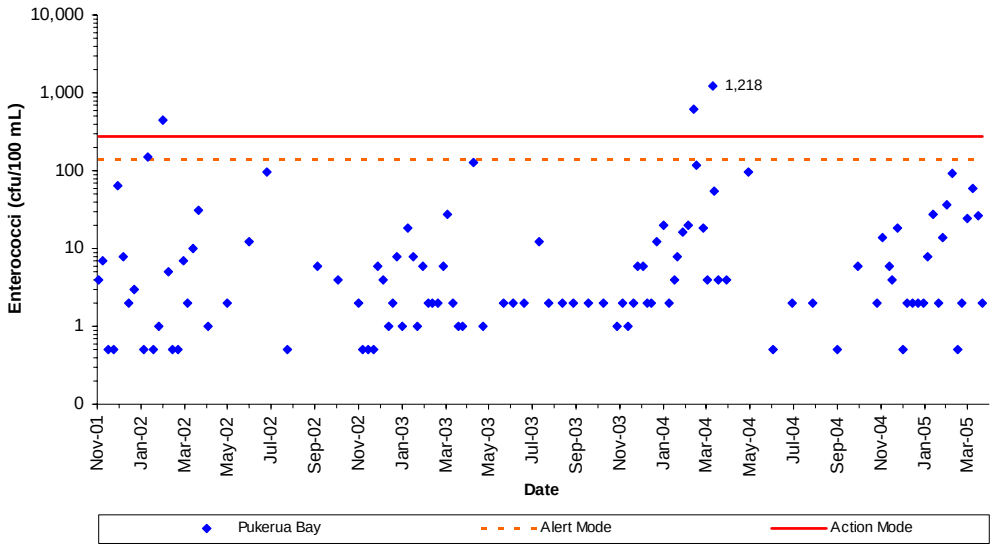

Figure 4.21: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

4.3.2 Karehana Bay

Karehana Bay exceeded both the alert and action levels of the recreational water quality guidelines on four occasions during routine monitoring over the last four summer bathing seasons (Table 4.21). Three of the action exceedances were recorded over the 2001/2002 summer. Overall, Karehana Bay complied with the surveillance level of the guidelines on almost 91% of sampling occasions (Figure 4.22).

Table 4.21: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	18	81.8	1	4.5	3	13.6	22	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	18	85.7	2	9.5	1	4.8	21	100
2004-2005	22	95.7	1	4.3	0	0.0	23	100
Total	**79**		**4**		**4**		**87**	

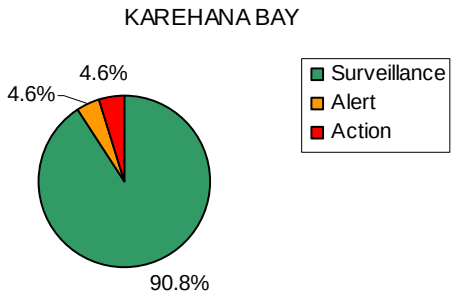

Figure 4.22: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The highest enterococci count was 9,700 cfu/100 mL, recorded on 5 February 2002. This result followed 25 mm of rainfall on the day preceding sampling. All of the other action level results also occurred following rainfall events (Table 4.22). The results of all sampling for the 2001-2005 reporting period, including the results of follow-up sampling, are shown in Figure 4.23.

Table 4.22: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
06/11/2001	1,700	0	1.5	17	0
04/12/2001	2,700	6	10	14	18
05/02/2002	9,700	25	25	25	20.5
15/10/2003	2,000	0	2	36	0
18/02/2004	8,000	4.5	25.5	88	0
Total No. of Exceedances	5				
Total No. of Samples	113				

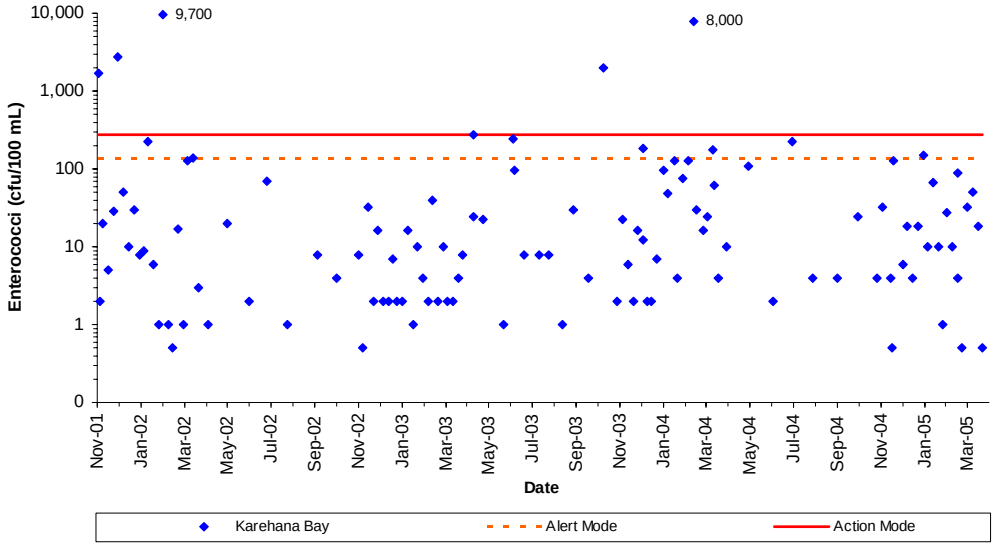

Figure 4.23: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

4.3.3 Plimmerton Beach

Both Plimmerton Beach monitoring sites exceeded the action level of the recreational water quality guidelines during routine monitoring over the last four summer bathing seasons (Table 4.23). The Bath Street site recorded at least one action level exceedance during each summer and seven exceedances in total. The Queens Avenue site recorded four action level exceedances, two during the 2001/2002 summer and two during the 2003/2004 summer. Overall, the Bath Street and Queens Avenue sites complied with the surveillance level of the guidelines on 86 and 88.5% of sampling occasions respectively (Figure 4.24).

Table 4.23: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
BATH STREET								
2001-2002	18	85.7	1	4.8	2	9.5	21	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	16	76.2	2	9.5	3	14.3	21	100
2004-2005	21	91.3	1	4.3	1	4.3	23	100
Total	**74**		**5**		**7**		**86**	
QUEENS AVENUE								
2001-2002	17	81.0	2	9.5	2	9.5	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	19	90.5	0	0.0	2	9.5	21	100
2004-2005	22	91.7	2	8.3	0	0.0	24	100
Total	**77**		**6**		**4**		**87**	

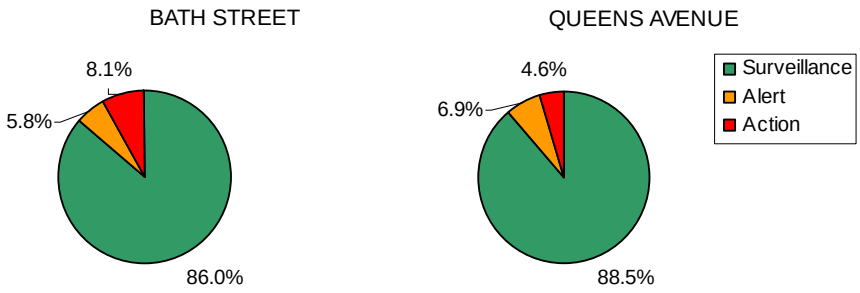

Figure 4.24: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

When the results for the entire 2001-2005 reporting period are considered (Figure 4.25), the number of action level exceedances increases to a total of eight for the Bath Street site and seven for the Queens Avenue site. The highest enterococci count recorded at Bath Street was 10,000 cfu/100 mL on 18 February 2004. Although only 4.5 mm of rainfall had fallen in the day preceding sampling, a total of 88 mm of rainfall had fallen in the three days preceding sampling (Table 4.24). The highest enterococci count recorded at Queens Avenue was 32,200 cfu/100 mL on 5 June 2002. This count is two orders of magnitude above guideline values and did not coincide with any significant rainfall in the 48 hours prior to sampling. The next highest enterococci count recorded at Queens Avenue (1,800 cfu/100 mL, 26 February 2002) also did not coincide with any significant rainfall and no rainfall was recorded in the three days prior to the action level exceedance at Bath Street on 3 December 2002.

Table 4.24: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Bath Street	Queens Ave	24 hrs	48 hrs	72 hrs	
04/12/2001	522		6	10	14	18
15/01/2002	1,200	800	28.5	28.5	64.5	7
26/02/2002		1,800	0	0	4.5	0
05/06/2002		32,200	0	0	8.5	0
03/12/2002	1,274		0	0	0	0
11/06/2003	620	380	1.5	58.5	58.5	0
16/07/2003		350	0	6.5	6.5	3
22/01/2004	498	518	0.5	15	21.5	0.5
18/02/2004	10,000	1,670	4.5	25.5	88	0
17/03/2004	342		15.5	15.5	15.5	9.5
22/02/2005	612		0	0	0	0
Total No. of Exceedances	8	7				
Total No. of Samples	113	113				

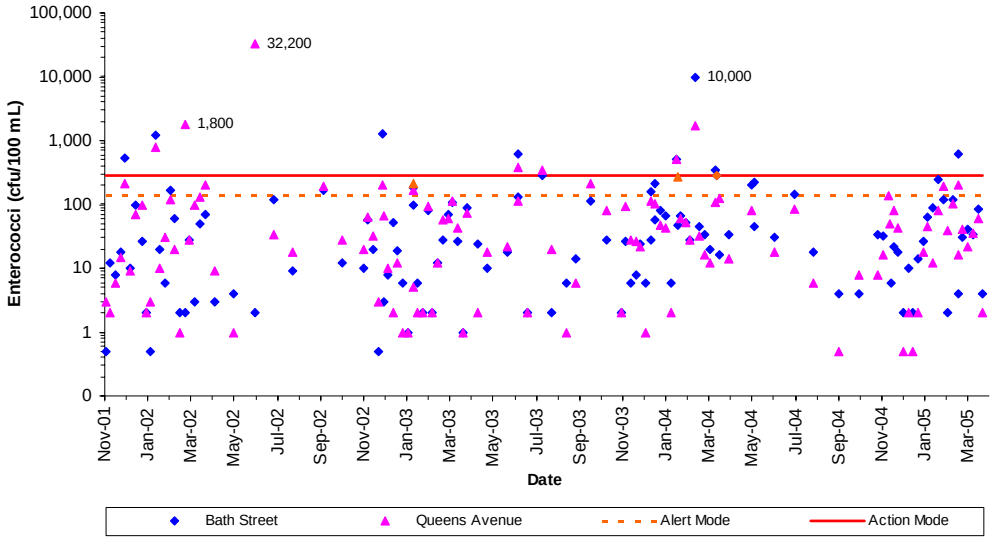

Figure 4.25: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Rain-related exceedances are likely to be related to urban runoff. It is unclear as to why a number of elevated results coincided with little or no rainfall, although it is possible that water quality is at times influenced by Taupo Stream. This stream discharges onto South Beach to the south of both monitoring sites and has historically carried high bacteria counts that have been found to influence coastal water quality at Plimmerton (McBride *et al.* 1995).

4.3.4 South Beach

South Beach recorded a poor level of compliance with the recreational water quality guidelines over the last four summer bathing seasons. The action level was exceeded on 12 occasions, with four of these occurring over the 2003/2004 summer (Table 4.25). Overall, South Beach complied with the surveillance level of the guidelines on 84% of sampling occasions (Figure 4.26).

Table 4.25: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	17	81.0	1	4.8	3	14.3	21	100
2002-2003	18	85.7	0	0.0	3	14.3	21	100
2003-2004	17	81.0	0	0.0	4	19.0	21	100
2004-2005	21	87.5	1	4.2	2	8.3	24	100
Total	**73**		**2**		**12**		**87**	

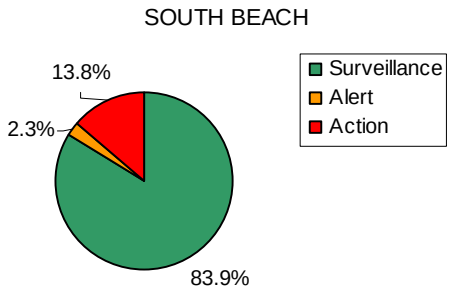

Figure 4.26: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Five of the 12 exceedances recorded during the summer bathing period were at least one order of magnitude above the surveillance level of the guidelines (Figure 4.27). The highest enterococci count was 59,000 cfu/100 mL. This was recorded on 15 January 2002, following very heavy rainfall (Table 4.26). However, not all action level events coincided with rainfall. For example, a count of 2,712 cfu/100 mL was recorded on 30 December 2002 but no rainfall was recorded in the three days prior to sample collection. Similarly action level events recorded on 9 February 2004, and 2 and 8 February 2005 coincided with little no rainfall. In the case of the 8 February 2005 result, follow-up sampling conducted the next day yielded an even greater enterococci count (490 cfu/100 mL). The result obtained from a further sample collected on 10 February complied with the surveillance level of the guidelines.

Taupo Stream discharges onto South Beach in the vicinity of the sampling site and is likely to influence water quality as it has historically carried high bacteria counts. This stream drains rural areas, the Taupo wetland and urban Plimmerton.

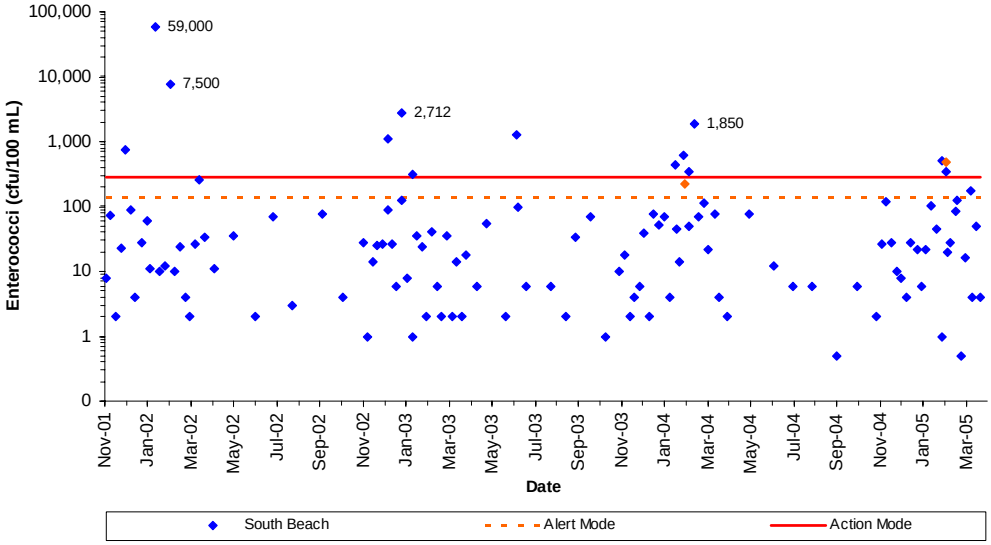

Figure 4.27: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.26: Analysis of exceedances of the MfE/MoH (2003) action level from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
04/12/2001	764	6	10	14	18
15/01/2002	59,000	28.5	28.5	64.5	7
05/02/2002	7,500	25	25	25	20.5
10/12/2002	1,080	0	5.5	38	0
30/12/2002	2,712	0	0	0	0
14/01/2003	320	17	27	27	4
11/06/2003	1,270	1.5	58.5	58.5	0
22/01/2004	434	0.5	15	21.5	0.5
03/02/2004	618	3.5	54.5	67.5	0.5
09/02/2004	346	0.5	0.5	0.5	0
18/02/2004	1,850	4.5	25.5	88	0
02/02/2005	514	2	2	2	0
08/02/2005	348	0	0	0	0
Total No. of Exceedances	13				
Total No. of Samples	112				

4.3.5 Pauatahanui Inlet

All three monitoring sites in the Pauatahanui Arm of Porirua Harbour (Pauatahanui Inlet) exceeded the action level of the recreational water quality guidelines during routine monitoring over the 2001-2005 summer bathing seasons (Table 4.27). Browns Bay, which was only added to the monitoring programme from the start of the 2002/2003 summer, recorded the greatest number of action level exceedances and only complied with the surveillance level on just over 78% of sampling occasions (Figure 4.28). In contrast, the Water Ski Club and Motukaraka Point monitoring sites both complied with the surveillance level on over 90% of sampling occasions.

Table 4.27: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WATER SKI CLUB								
2001-2002	19	90.5	0	0.0	2	9.5	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	17	81.0	1	4.8	3	14.3	21	100
2004-2005	21	91.3	1	4.3	1	4.3	23	100
Total	**78**		**2**		**6**		**86**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
MOTUKARAKA POINT								
2001-2002	18	85.7	0	0.0	3	14.3	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	19	90.5	0	0.0	2	9.5	21	100
2004-2005	22	95.7	1	4.3	0	0.0	23	100
Total	**78**		**3**		**5**		**86**	
BROWNS BAY								
2001-2002	NS	-	NS	-	NS	-	-	-
2002-2003	17	81.0	1	4.8	3	14.3	21	100
2003-2004	12	57.1	3	14.3	6	28.6	21	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**50**		**5**		**9**		**64**	

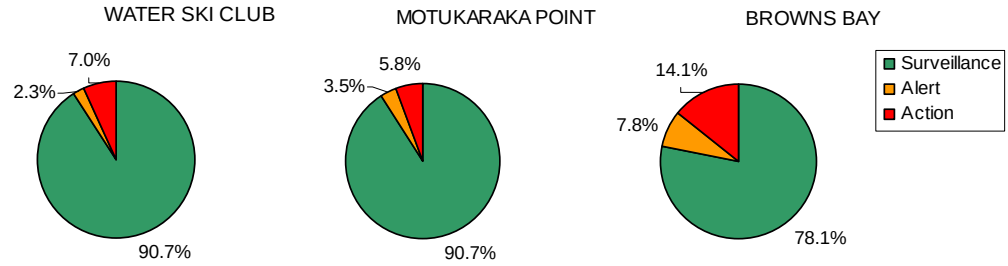

Figure 4.28: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons
(Note: Browns Bay was not sampled in 2001/2002)

When the results for the entire 2001-2005 reporting period are considered (Figure 4.29), the number of action level exceedances increases to a total of seven for the Water Ski Club and a total of six for Motukaraka Point. Some of the exceedances were very high. All three sites had three results at least one order of magnitude above the guideline values. Motukaraka Point recorded the highest enterococci count of 37,000 cfu/100 mL on 5 February 2002. This result followed 25 mm of rainfall on 4 February and further rain on the day of sampling (Table 4.28).

The majority of the alert and action level events at Browns Bay occurred during the 2003/2004 summer and also coincided with rainfall events. However exceedances recorded at this site on 18 March 2003, 9 March 2004 and 2 February 2005 can not be attributed to rainfall. Similarly, exceedances of the action level at Motukaraka Point on 30 July 2003 and the Water Ski Club on 2 February 2005 can not be attributed to rainfall.

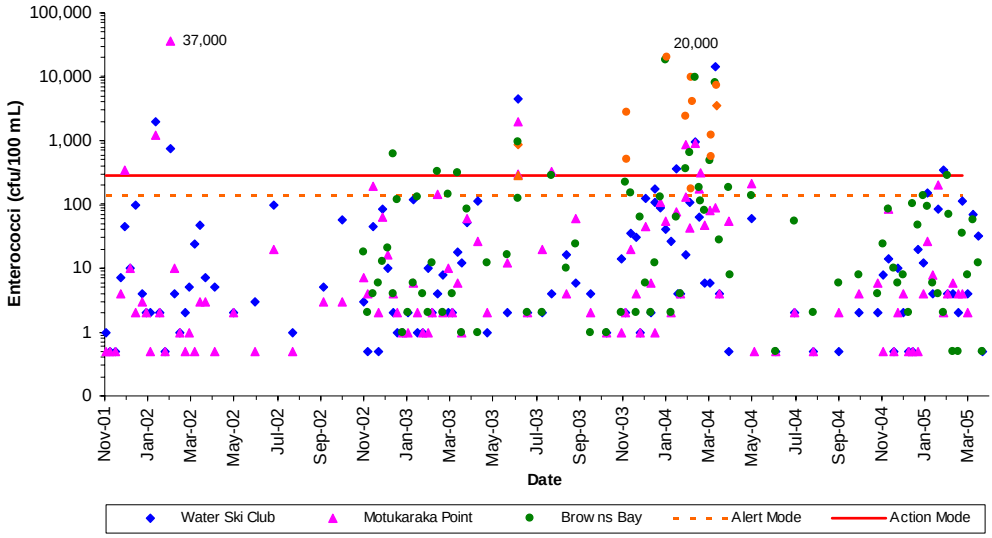

Figure 4.29: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.28: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Water Ski Club	Motukaraka Point	Browns Bay	24 hrs	48 hrs	72 hrs	
04/12/2001		338		6	10	14	18
15/01/2002	2,000	1,200		28.5	28.5	64.5	7
05/02/2002	740	37,000		25	25	25	20.5
17/12/2002			630	0	0	0	18
18/02/2003			334	0.5	0.5	0.5	0
18/03/2003			312	0	0	0	0
11/06/2003	4,400	1,960		1.5	58.5	58.5	0
30/07/2003		324		0	0	0	0
07/01/2004			18,600	4	4	4	23
22/01/2004	356			0.5	15	21.5	0.5
03/02/2004			356	3.5	54.5	67.5	0.5
10/02/2004			640	5	5	5	19.5
18/02/2004	940	920	10,000	4.5	25.5	88	0
09/03/2004			480	0	0	0	0
17/03/2004	14,703		8,178	15.5	15.5	15.5	9.5
02/02/2005	342			2	2	2	0
Total No. of Exceedances	7	6	9				
Total No. of Samples	112	113	83				

Rain-related exceedances are likely to be related to urban runoff. However, it is unclear as to why a number of elevated results coincided with little or no rainfall. There does not appear to be a consistent pattern with respect to seaweed cover, tides or wind direction. It is possible that water quality at some

site is at times influenced by streams draining into Pauatahanui Inlet. These streams drain a mixture of urban and rural environments and are a likely source of faecal material. One source of gross contamination was identified as coming from sewage surcharging from a manhole on a private property. This problem has subsequently been rectified (Porirua City Council, pers. comm. 2005).

4.3.6 Paremata Beach

Paremata Beach exceeded the alert and action levels of the recreational water quality guidelines on five and six occasions respectively during routine monitoring over the last four summer bathing seasons (Table 4.29). Overall, Paremata Beach complied with the surveillance level of the guidelines on 87.4% of sampling occasions (Figure 4.30).

Table 4.29: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	17	81.0	2	9.5	2	9.5	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	17	77.3	2	9.1	3	13.6	22	100
2004-2005	22	95.7	0	0.0	1	4.3	23	100
Total	**76**		**5**		**6**		**87**	

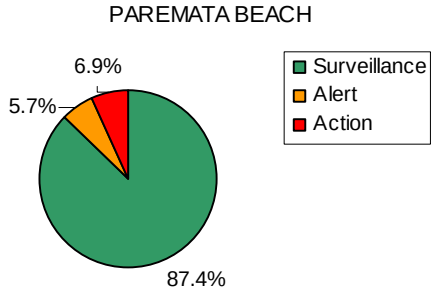

Figure 4.30: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

A total of seven action level results were recorded for the entire 2001-2005 reporting period (Table 4.30). The highest enterococci count was 8,800 cfu/100 mL recorded on 7 January 2004 (Figure 4.31). Only 4 mm of rainfall had been recorded in the 72 hours prior to the day of sampling, although 23 mm was recorded on the day of sampling (Table 4.30). This rainfall event is likely to have influenced the follow-up sample result of 6,500 cfu/100 mL obtained the next day. The majority of the other action level exceedances also coincided with significant rainfall events.

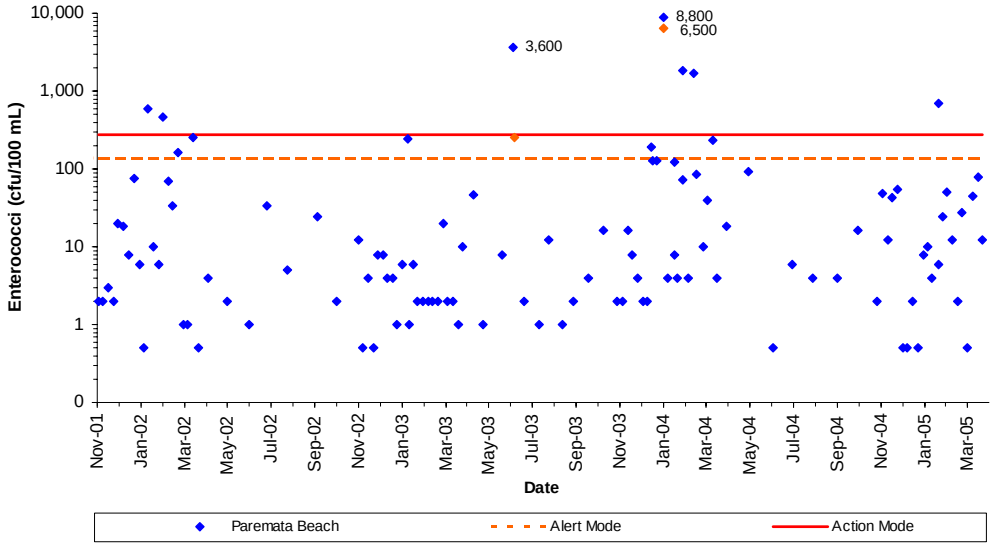

Figure 4.31: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.30: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
15/01/2002	600	28.5	28.5	64.5	7
05/02/2002	470	25	25	25	20.5
11/06/2003	3,600	1.5	58.5	58.5	0
07/01/2004	8,800	4	4	4	23
03/02/2004	1,840	3.5	54.5	67.5	0.5
18/02/2004	1,720	4.5	25.5	88	0
26/01/2005	696	0	1	4	0
Total No. of Exceedances	7				
Total No. of Samples	113				

4.3.7 Porirua Harbour

Both monitoring sites in the Onepoto Arm of Porirua Harbour exceeded the action levels of the recreational water quality guidelines during routine monitoring over the last four summer bathing seasons (Table 4.31, Figure 4.32). Te Hiko Street recorded 12 exceedances over the 2001-2002 summer and is clearly not suitable for swimming. Subsequently this site was dropped from the monitoring programme and signs established in the vicinity to advise people against swimming. Water quality is better at the Porirua Rowing Club, although this site exceeded the action level on eight occasions over the four summers, and on 11 occasions when the results of the full reporting period are considered (Figure 4.33).

Table 4.31: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
ROWING CLUB								
2001-2002	17	81.0	1	4.8	3	14.3	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	15	78.9	1	5.3	3	15.8	19	100
2004-2005	19	79.2	4	16.7	1	4.2	24	100
Total	**71**		**6**		**8**		**85**	
TE HIKO STREET								
2001-2002	9	40.9	1	4.5	12	54.5	22	100
2002-2003	NS	-	NS	-	NS	-	-	-
2003-2004	NS	-	NS	-	NS	-	-	-
2004-2005	NS	-	NS	-	NS	-	-	-
Total	**9**		**1**		**12**		**22**	

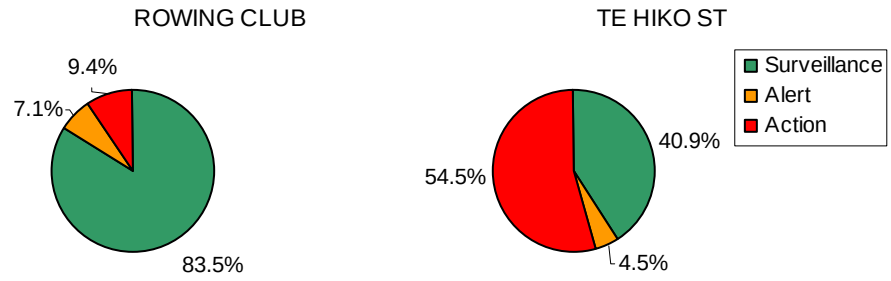

Figure 4.32: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons
(Note: the Te Hiko Street site was only sampled over 2001/2002)

Some of the exceedances were very high (Figure 4.33, Table 4.32). On three occasions enterococci counts at Te Hiko Street exceeded 10,000 cfu/100 mL. The highest of these counts was 85,000 cfu/100 mL on 5 February 2002. Counts at the Porirua Rowing Club were lower, although the greatest count (9,802 cfu/100 mL, 17 March 2004) was nearly two orders of magnitude above guideline values. This result followed 15.5 mm of rainfall on 16 March 2004 and further rain on the day of sampling (Table 4.32). This further rainfall is likely to have influenced the follow-up sample result of 6,300 cfu/100 mL obtained the next day. The majority of the other action level exceedances also coincided with significant rainfall events. The key exception is the enterococci count of 954 cfu/100 mL recorded at the Porirua Rowing Club on 26 March 2002. The reason for this elevated result is unclear. No follow-up sampling was conducted and so it is not known whether water quality returned to guideline levels the next day.

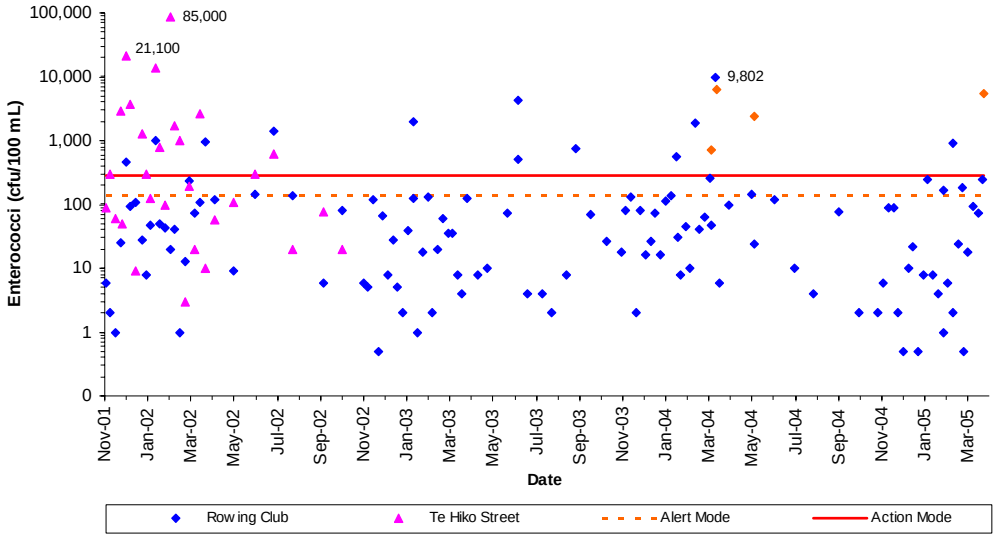

Figure 4.33: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.32: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL) (Rowing Club)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
04/12/2001	460	6	10	14	18
15/01/2002	1,000	28.5	28.5	64.5	7
26/03/2002	954	0	0	0	0
01/07/2002	1,390	9.8*	21.2*	41.2*	1.2*
14/01/2003	2,000	17	27	27	4
11/06/2003	4,298	1.5	58.5	58.5	0
02/09/2003	732	8.5	12.5	12.5	0
22/01/2004	568	0.5	15	21.5	0.5
18/02/2004	1,860	4.5	25.5	88	0
17/03/2004	9,802	15.5	15.5	15.5	9.5
15/02/2005	912	1	15	15	0
Total No. of Exceedances	11				
Total No. of Samples	113				

* Seton Nossiter Park Rainfall Station

Rain-related exceedances are likely to be related to urban runoff. Stormwater pipes discharge into Porirua Harbour at a number of locations, particularly in the vicinity of the Te Hiko Street monitoring site. Porirua Stream, which receives runoff from Porirua City, and the Churton Park, Tawa and Cannons Creek residential areas, also discharges into the harbour in close proximity to this site and is likely to contribute elevated bacteria levels to the harbour.

4.3.8 Titahi Bay

Of the three monitoring sites along Titahi Bay, Bay Drive exceeded the recreational water quality guidelines on the most occasions during routine monitoring over the last four summer bathing seasons (Table 4.33). This site exceeded the action level on 13 occasions, of which five were recorded over 2001/2002. The majority of the action level events at South Beach Access Road also occurred over the 2001/2002 summer. Overall, Toms Bay complied with surveillance level of the guideline on the most occasions (90.9%), although this site was only added to the monitoring programme from the start of the 2002/2003 summer (Figure 4.34).

Table 4.33: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
BAY DRIVE								
2001-2002	15	71.4	1	4.8	5	23.8	21	100
2002-2003	18	85.7	1	4.8	2	9.5	21	100
2003-2004	14	66.7	3	14.3	4	19.0	21	100
2004-2005	20	87.0	1	4.3	2	8.7	23	100
Total	**67**		**6**		**13**		**86**	
TOMS ROAD								
2001-2002	NS	-	NS	-	NS	-	-	-
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	19	82.6	1	4.3	3	13.0	23	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**60**		**2**		**4**		**66**	
SOUTH BEACH ACCESS ROAD								
2001-2002	16	76.2	1	4.8	4	19.0	21	-
2002-2003	17	81.0	3	14.3	1	4.8	21	100
2003-2004	18	81.8	3	13.6	1	4.5	22	100
2004-2005	22	95.7	1	4.3	0	0.0	23	100
Total	**73**		**8**		**6**		**87**	

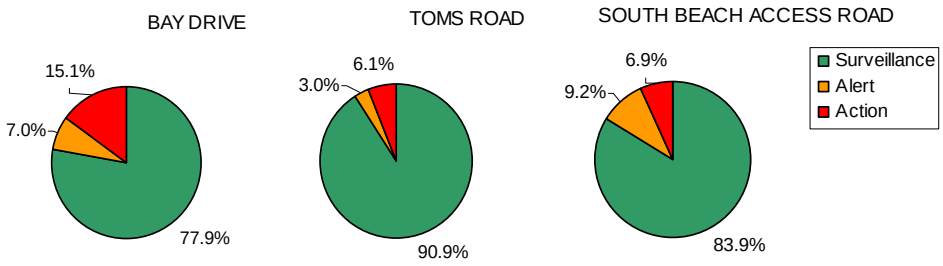

Figure 4.34: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons
(Note: the Toms Road site was not sampled over 2001/2002)

The number of action level results at Bay Drive increases from 13 to 15 when the results of all sampling for the 2001-2005 reporting period are considered. Some of the exceedances were very high (Figure 4.35). An enterococci count of 11,700 cfu/100 mL was recorded at Bay Drive on 5 February 2002, two orders of magnitude above guideline values. A count of 2,950 cfu/100 mL was recorded at the South Beach site on the same day. These results followed 25 mm of rainfall on 4 February and further rain on the day of sampling (Table 4.34). However, a number of other exceedances of the action level, including enterococci counts of 2,436 cfu/100 mL, 1,566 cfu/100 mL and 435 cfu/100 mL at Bay Drive on 5 April 2004, 26 January 2005 and 8 February 2005 respectively, coincided with little or no rainfall. The reason for these elevated results is unclear; there is no correlation with seaweed cover or tides, although on almost all occasions, the wind direction was from the north or northwest.

Follow-up sampling was conducted after the 5 April 2004 exceedance and the results complied with the surveillance level. Follow-up sampling conducted after the 8 February 2005 exceedance resulted in higher enterococci counts (688 cfu/100mL and 1,462 cfu/100 mL on 9 and 10 February respectively). Subsequently, Porirua City Council conducted daily sampling for a further six days at all three monitoring sites. Nearly 20 mm of rain fell on 11 February 2005 and this will probably have contributed to the elevated bacteria counts determined from some of the follow-up samples.

Porirua City Council staff investigated possible sources of faecal contamination following the January and February 2005 exceedances. Dye tests were undertaken of sewer pipes and a very small leak found in one pipe. This leak was subsequently fixed, although it is unlikely that the leak was the cause of the elevated enterococci counts due to the sporadic pattern of elevated counts and because the leak was believed to be contained within the sleeve pipe (Porirua City Council, pers. comm. 2005). A preliminary sanitary survey undertaken by Porirua City Council has also identified boat sheds on the beach as a possible source of contamination. This requires further investigation.

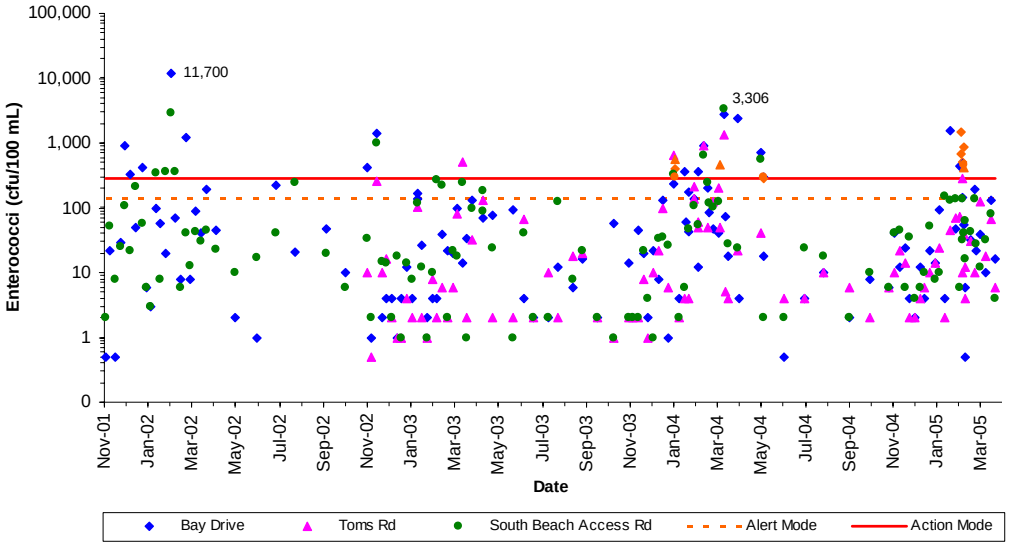

Figure 4.35: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.34: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Bay Drive	Toms Rd	South Beach	24 hrs	48 hrs	72 hrs	
04/12/2001	920			6	10	14	18
11/12/2001	330			0	0	0	0
27/12/2001	424			0.5	0.5	0.5	18.5
15/01/2002			344	28.5	28.5	64.5	7
29/01/2002			368	0	0	0	0
05/02/2002	11,700		2,950	25	25	25	20.5
12/02/2002			360	5	25	25	4
26/02/2002	1,200			0	0	4.5	0
05/11/2002	416			0	0	0	4.5
19/11/2002	1,400	260	1,000	1	7.5	25	6.5
18/03/2003		504		0	0	0	0
07/01/2004		644	330	4	4	4	23
22/01/2004	360			0.5	15	21.5	0.5
09/02/2004	366			0	4.5	25.5	36.5
18/02/2004	920	900	640	4.5	25.5	88	0
17/03/2004	2,784	1,362	3,306	15.5	15.5	15.5	9.5
05/04/2004	2,436			1.5	1.5	1.5	0
06/05/2004	722		562	1	1	13	1.5
26/01/2005	1,566			0	1	4	0
08/02/2005	435			0	0	0	0
Total No. of Exceedances	15	5	9				
Total No. of Samples	112	85	113				

4.3.9 Onehunga Bay

Onehunga Bay exceeded the action level of the recreational water quality guidelines on seven occasions over the last four summer bathing seasons (Table 4.35). Most of these exceedances occurred over the 2001/2002 and 2003/2004 summers. Overall, Onehunga Bay complied with the surveillance level of the guidelines on just over 87% of sampling occasions (Figure 4.36).

Table 4.35: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	16	76.2	3	14.3	2	9.5	21	100
2002-2003	19	90.5	1	4.8	1	4.8	21	100
2003-2004	18	85.7	0	0.0	3	14.3	21	100
2004-2005	22	95.7	0	0.0	1	4.3	23	100
Total	**75**		**4**		**7**		**86**	

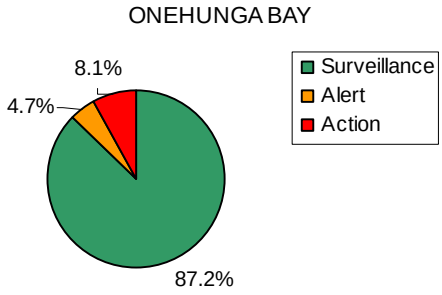

Figure 4.36: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Figure 4.37 indicates that there were no further exceedances of the action level when the results of all routine monitoring for the November 2001-March 2005 period are considered. The highest enterococci count (2,436 cfu/100 mL) was recorded on 17 March 2004. This result followed 15.5 mm of rainfall in the 24 hours preceding the day of sampling (Table 4.36). The majority of the other six action level events also coincided with significant rainfall events, the exception being the action level enterococci result of 696 cfu/100 mL recorded on 23 March 2005. A stream enters the coast in the vicinity of the site and is likely to contribute to elevated bacteria levels at times (Berry 1999).

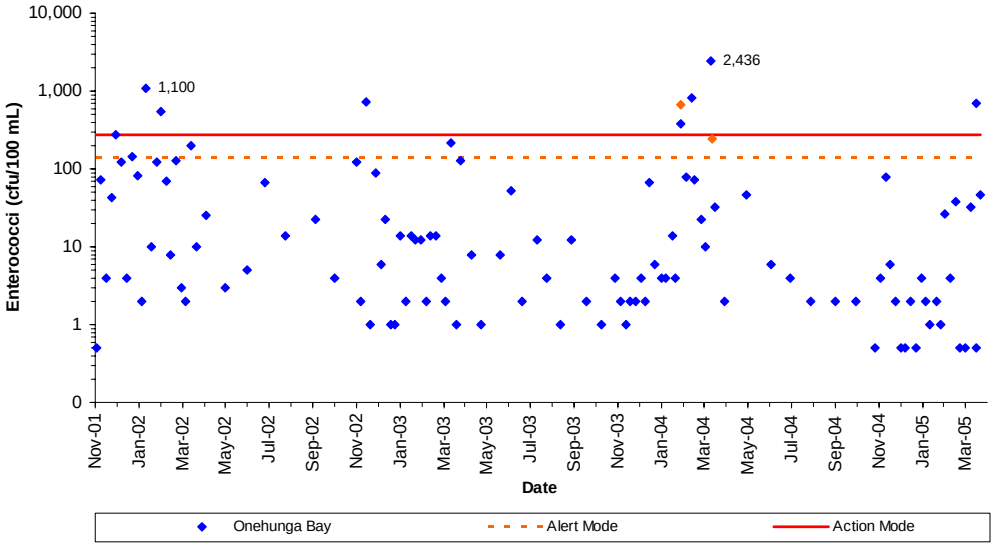

Figure 4.37: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.36: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Whenua Tapu rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
15/01/2002	1,100	28.5	28.5	64.5	7
05/02/2002	540	25	25	25	20.5
19/11/2002	730	1	7.5	25	6.5
03/02/2004	380	3.5	54.5	67.5	0.5
18/02/2004	816	4.5	25.5	88	0
17/03/2004	2,436	15.5	15.5	15.5	9.5
23/03/2005	696	0	1	4	0
Total No. of Exceedances	7				
Total No. of Samples	111				

4.3.10 Discussion

Monitoring undertaken over the 2001-2005 summer seasons indicates that water quality is impacted on a regular basis at the majority of marine recreational sites in Porirua City, particularly after rainfall events. Twelve of the 14 monitoring sites exceeded the surveillance level of the recreational water quality guidelines (<140 enterococci/100 mL) on more than 10% of routine summer sampling occasions, with two sites exceeding this level on more than 20% of sampling occasions. Porirua Harbour at Te Hiko Street was only monitored for one season before being dropped from the monitoring programme. This site exceeded the surveillance level guideline on nearly 60% of sampling occasions over the 2001/2002 summer.

Pukerua Bay recorded the highest level of compliance with the recreational water quality guidelines, followed by Titahi Bay at Toms Road, Karehana Bay, and Pauatahanui Inlet at the Water Ski Club (Figure 4.38). Titahi Bay at Bay Drive and Pauatahanui Inlet at Browns Bay recorded the lowest level of compliance (77.9% and 87.1% respectively). At many sites, a number of exceedances were one or two orders of magnitude above the recreational water quality guidelines.

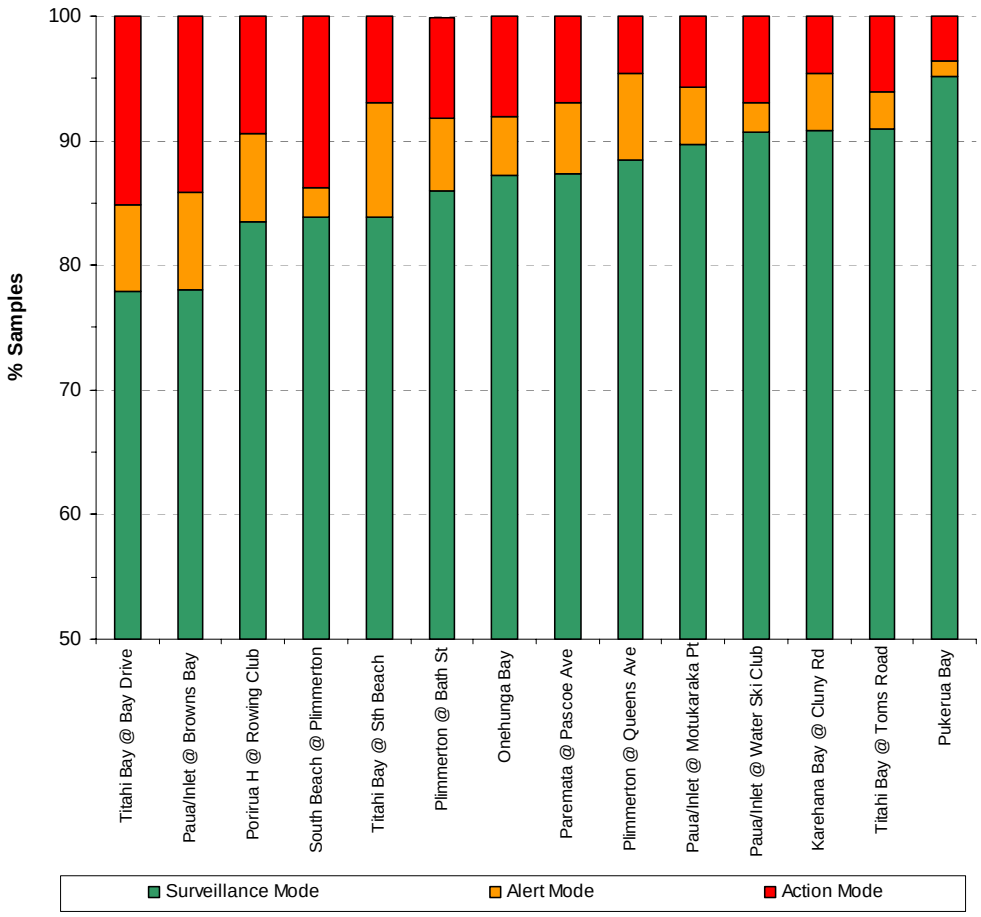

Figure 4.38: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

4.3.11 Trends over time

Seven or more of the 14 routine monitoring sites recorded an exceedance of the action level guideline during each of the four summer seasons (Table 4.37). The lowest level of compliance with the recreational water quality guidelines was obtained over the 2003/2004 summer. All 14 sites exceeded the action level over this period, of which nine exceeded the action level on at least three occasions. Twelve sites also exceeded the action level over the 2001/2002 summer, of which six exceeded the action level on at least three occasions.

Table 4.37: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly summer sampling undertaken at the 14 monitoring sites in Porirua City

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3	≥4
2001/2002*	0	12	1	5	4	2
2002/2003	3	8	5	1	2	0
2003/2004	0	14	2	3	6	3
2004/2005	2	7	5	2	0	0

* Only 12 sites were monitored in 2001/2002

Analysis of rainfall records indicates that rainfall events, via subsequent stormwater discharges and diffuse run-off, may account for approximately 80% of the action level exceedances recorded from routine monitoring over the full reporting period. The total number of sites recording exceedances in each summer season certainly shows some relationship with rainfall, although this is not consistent (Figure 4.39). For example, the large number of exceedances over the 2003/2004 summer correlates with very heavy rainfall in February 2004. Analysis of the timing of exceedances over the 2003/2004 summer indicates that more than half of the action level exceedances occurred in February 2004; all 14 monitoring sites exceeded the action level on 18 February 2004, following heavy rainfall in the 72 hours preceding sampling. In contrast, five of the nine action level exceedances that were recorded over the 2004/2005 summer occurred in February 2005 when the total monthly rainfall was well below the longterm average.

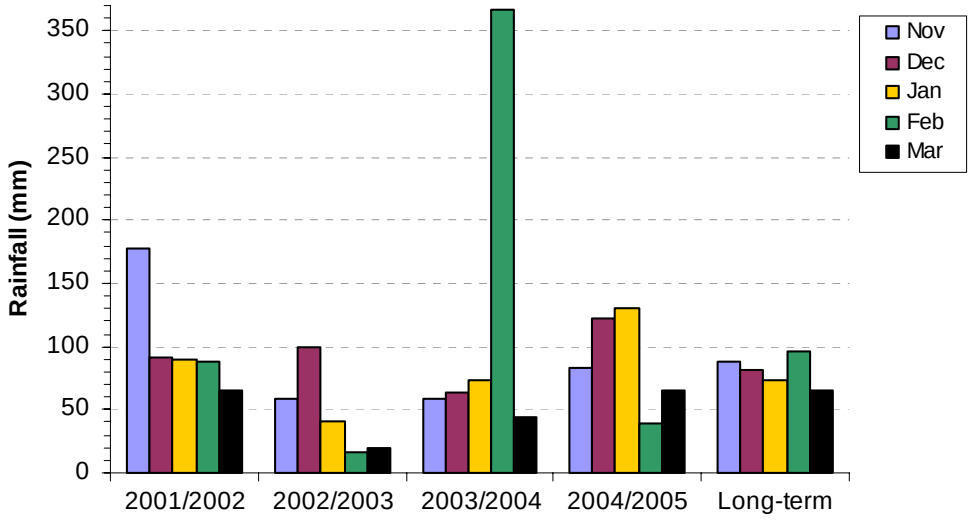

Figure 4.39: Monthly rainfall recorded at the Whenua Tapu Rainfall Station over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1991 to present)

Several monitoring sites exceeded the action level on a number of occasions that did not coincide with significant rainfall events, notably Titahi Bay at Bay Drive, South Beach, Plimmerton Beach (at both sites), and Pauatahanui Inlet at

Browns Bay. The cause of these exceedances is not known, although in the case of Plimmerton Beach and Pauatahanui Inlet, local streams may be affecting water quality at times. It is also likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some coastal locations.

4.3.12 Suitability for recreation

The large number of exceedances of the recreational water quality guidelines recorded over the last four summer seasons at most sites, resulted in high MAC values (Table 4.38). For example, over half of the sites had a "D" MAC value as the 95th percentile enterococci counts were greater than 500 cfu/100 mL. The high MAC values combine with moderate and a few high SIC values to give an interim SFRG of "poor" or "very poor" for 9 of the 14 monitoring sites in Porirua City. Pukerua Bay is the only site with an interim SFRG of "good". The interim SFRG is "fair" for the remainder of the sites.

Table 4.38: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for marine bathing sites in Porirua City

Site	MAC*	SIC	Interim SFRG
PUKERUA BAY			
Pukerua Bay	B (95th percentile = 127, n=87)	Moderate	Good
KAREHANA BAY			
Cluny Road	C (95th percentile = 445, n=87)	Moderate**	Fair
PLIMMERTON BEACH			
Bath Street	D (95th percentile = 540, n=86)	Moderate**	Poor
Queens Avenue	C (95th percentile = 261, n=87)	Moderate**	Fair
SOUTH BEACH			
Plimmerton	D (95th percentile = 1,196, n=87)	Moderate**	Poor
PAUATAHANUI INLET			
Water Ski Club	C (95th percentile = 433, n=86)	Moderate	Fair
Motukaraka Point	C (95th percentile = 415, n=87)	Very High	Very Poor
Browns Bay	D (95th percentile = 2,901, n=64)	Moderate**	Poor
PAREMATA BEACH			
Pascoe Avenue	D (95th percentile = 614, n=87)	High	Very Poor
PORIRUA HARBOUR			
Rowing Club	D (95th percentile = 961, n=87)	Moderate	Poor

Site	MAC*	SIC	Interim SFRG
TITAHI BAY			
Bay Drive	D (95th percentile = 1,240, n=86)	Moderate	Poor
Toms Road	D (95th percentile = 532, n=66)	Moderate**	Poor
South Beach Access Road	C (95th percentile = 409, n=87)	Moderate	Fair
ONEHUNGA BAY			
Onehunga Bay	D (95th percentile = 703, n=86)	Low	Poor

* Based on enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

** Estimates only – catchment assessments required.

The "low" SIC grading for Onehunga Bay is at odds with its high MAC grade. It is recommended that the catchment risk factors for this site are reassessed over 2005/2006 to determine whether the SIC grade needs to be downgraded. Should the SIC grade been downgraded, then this would alter the SFRG from "poor" to "very poor".

4.4 Hutt

The Eastern Wellington Harbour area extends from Korokoro to Windy Point and has many contrasting landscapes. Petone Beach (Figure 4.40) is located at the head of the harbour and the Korokoro Stream and Hutt River discharge to the sea at its western and eastern ends respectively. The Seaview Marina lies to the east of the river mouth. The lower part of the Hutt River catchment is urban, while the upper area is comprised of agricultural land and both native and exotic forest. The eastern shoreline of the harbour is predominantly rocky, but includes a number of sandy beaches and a more extensive sandy shore in Fitzroy Bay. Small streams and stormwater drains discharge into the sea as far south as Eastbourne. Treated wastewater from the Hutt Valley area is discharged into the sea via a short outfall at Pencarrow Head. To the east of Baring Head, the Wainuiomata and Orongorongo Rivers enter the sea. The upper part of the Wainuiomata River catchment is used for water collection purposes. The river then passes through the Wainuiomata urban area where, up until January 2002, treated wastewater was discharged directly into the river. The remaining portion of the catchment is agricultural. The Orongorongo River catchment is comprised largely of native forest.

Beaches from Petone to Eastbourne are popular for swimming. Shellfish gathering and diving occur in the Pencarrow area, south of Eastbourne.

Figure 4.40: Petone Beach at Sydney Street

4.4.1 Petone Beach

Of the four monitoring sites along Petone Beach, the sites adjacent to the Settlers Museum and the Kiosk were the most suitable for contact recreation over the last four summer bathing seasons (Table 4.39, Figure 4.41). These sites exceeded the action levels of the recreational water quality guidelines on just one and two occasions respectively. The Sydney Street site recorded the highest number of action exceedances (seven), most of which occurred over the 2003/2004 summer. Two of the four sites achieved full compliance with the recreational water quality guidelines over the 2002/2003 summer and three sites achieved full compliance over the 2004/2005 summer.

Table 4.39: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WATER SKI CLUB								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	20	90.9	0	0.0	2	9.1	22	100
2003-2004	19	90.5	1	4.8	1	4.8	21	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**80**		**3**		**3**		**86**	
SYDNEY STREET								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	21	95.5	0	0.0	1	4.5	22	100
2003-2004	14	63.6	3	13.6	5	22.7	22	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**76**		**4**		**7**		**87**	

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
SETTLERS MUSEUM								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	23	100.0	0	0.0	0	0.0	23	100
2003-2004	19	86.4	2	9.1	1	4.5	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**82**		**5**		**1**		**88**	
KIOSK								
2001-2002	18	85.7	2	9.5	1	4.8	21	100
2002-2003	22	100.0	0	0.0	0	0.0	22	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**83**		**2**		**2**		**87**	

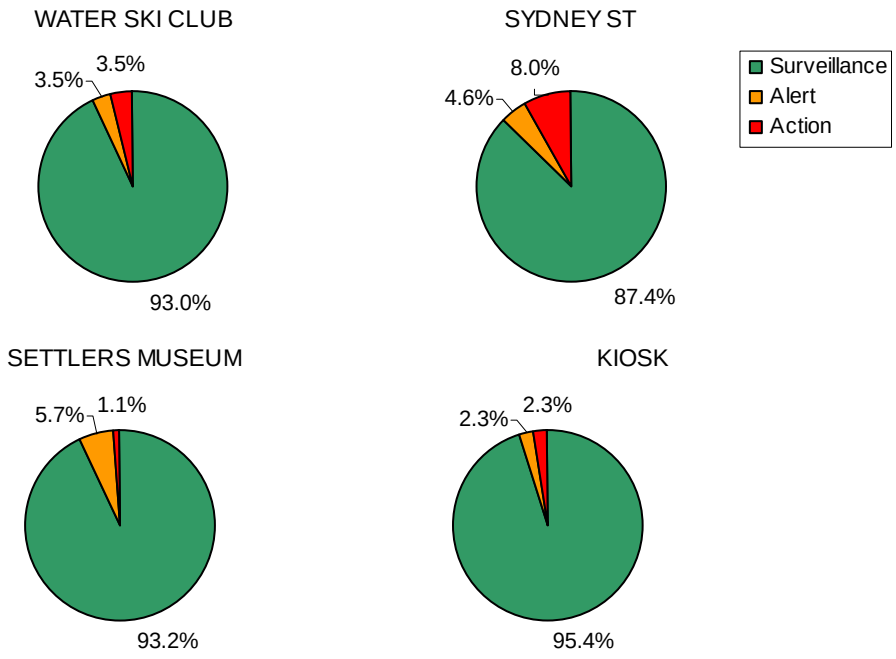

Figure 4.41: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

All four monitoring sites also recorded at least one further exceedance during routine winter monitoring over the reporting period (Figure 4.42), with the site adjacent to Sydney Street recording a total of 10 action level events for the full reporting period (Table 4.40). The greatest enterococci counts were recorded at the Sydney Street site on 22 December 2003 (2,300 cfu/100 ml) and the Settlers Museum site four days later (1,560 cfu/100 mL). These were the only two exceedances at Petone Beach sites that were an order of magnitude above the surveillance guideline level of 140 cfu/100 mL. Table 4.40 indicates that there was very little rainfall in the three days preceding sample collection. The majority of the other elevated enterococci counts recorded at the Sydney Street site also coincided with little or no rainfall.

The reason for a number of the elevated results is unclear. There does not appear to be any consistent pattern with respect to seaweed cover, tides or wind direction. Although Petone Beach receives local stormwater discharges, these are ephemeral and discharge onto upper beach areas following rainfall (Berry 1999). It is possible that water quality at some sites may at times be influenced by the Hutt River, particularly when a high tide and strong southerly wind coincide; during this time debris and other material from the Hutt River can be pushed up against the beach. Water quality at the Petone Water Ski Club may also be influenced by Korokoro Stream.

Hutt City Council often resamples the beach on occasions when exceedances have occurred. Low bacteria counts were found on all re-sampling occasions.

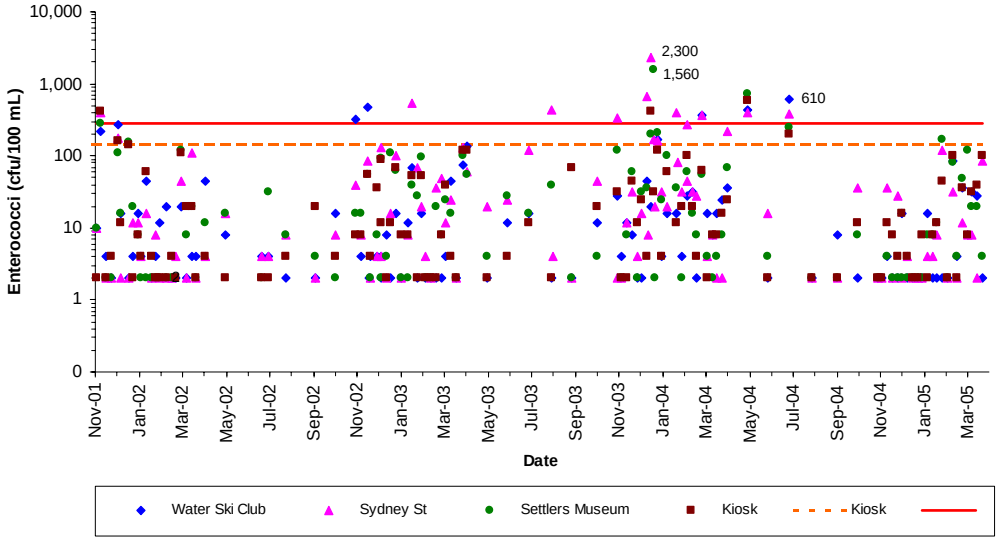

Figure 4.42: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.40: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)				Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Water Ski Club	Sydney St	Settlers Museum	Kiosk	24 hrs	48 hrs	72 hrs	
13/11/2001		400		420	0	0	1.5	8
04/11/2002	320				0	0.5	1.5	0.5
21/11/2002	480				1.5	6.5	13.5	6.5
21/01/2003		530			0	0	0	0
05/08/2003		444			0	0	0.5	0
04/11/2003		340			0	0	1	0
16/12/2003		680			1	1	1	0.5
22/12/2003		2,300		410	0	1	1	0
26/12/2003			1,560		0	0	1.5	0.5
27/01/2004		400			0.5	0.5	0.5	0
02/03/2004	370	370			1	1	12.5	6

Date	Enterococci (cfu/100 mL)				Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Water Ski Club	Sydney St	Settlers Museum	Kiosk	24 hrs	48 hrs	72 hrs	
04/05/2004	430	400	720	580	14	14.5	17	0
01/07/2004	610	380			0	0	0	0
Total No. of Exceedances	5	10	2	3				
Total No. of Samples	108	110	110	109				

4.4.2 Sorrento Bay

Sorrento Bay recorded just three exceedances of the alert level and one exceedance of the action level of the recreational water quality guidelines over the last four summer bathing seasons (Table 4.41). No exceedances were reported over the 2004/2005 summer and, overall, Sorrento Bay complied with the surveillance level of the guidelines on over 95% of sampling occasions (Figure 4.43).

Table 4.41: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**81**		**3**		**1**		**85**	

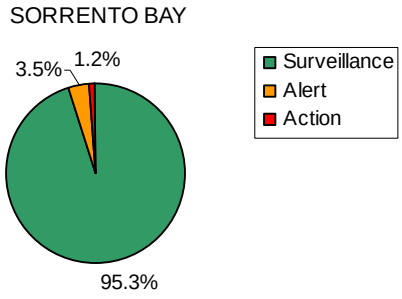

Figure 4.43: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The only action level exceedance occurred on 2 March 2004 (Figure 4.44). Although just 1 mm of rainfall had been recorded in the 24 hours prior to the day of sampling, over 13 mm had fallen in the 72 hours prior to sampling, and further rain fell on the day of sampling (Table 4.42). No follow-up samples were collected.

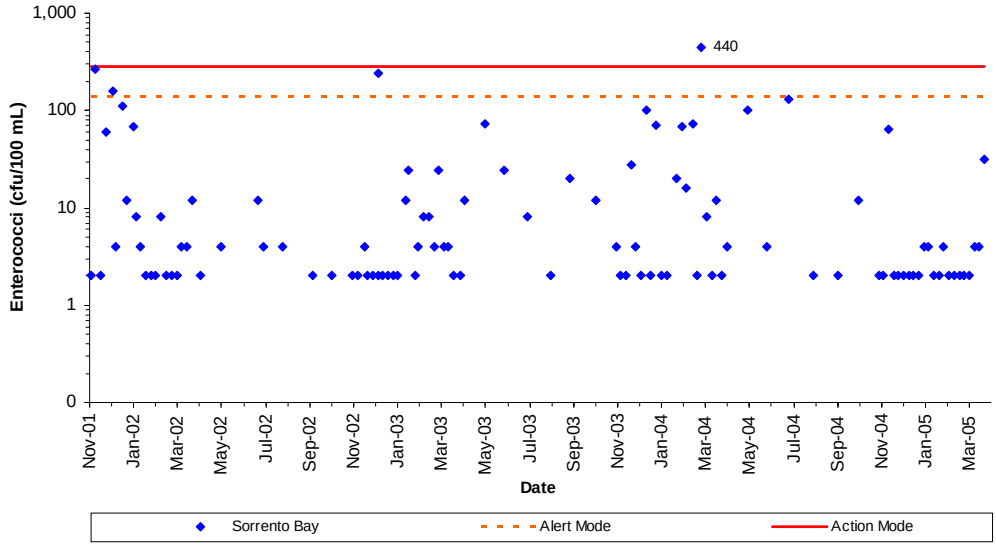

Figure 4.44: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.42: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
02/03/2004	440	1.0	1.0	12.5	6.0
Total No. of Exceedances	1				
Total No. of Samples	107				

4.4.3 Lowry Bay

Lowry Bay exceeded the action level of the recreational water quality guidelines on five occasions over the last four summer bathing seasons (Table 4.43). Most of these exceedances occurred over the 2003/2004 summer. In contrast, there were no exceedances of alert or action levels at either monitoring site over the 2002/2003 summer. Overall, this site complied with the surveillance level of the guidelines on more than 90% of sampling occasions (Figure 4.45).

Table 4.43: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	20	95.2	0	0.0	1	4.8	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	17	77.3	1	4.5	4	18.2	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**78**		**3**		**5**		**86**	

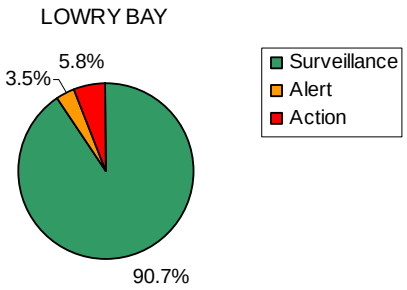

Figure 4.45: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The greatest enterococci count (8,400 cfu/100 mL, 2 March 2004) was an order of magnitude above the surveillance level of the guidelines (Figure 4.46). Rainfall records from the Shandon rainfall station indicate that 13.5 mm of rain had fallen in the three days preceding sampling and further rain fell on the day of sampling (Table 4.44). In contrast, the two action level events recorded in December 2003 coincided with minimal rainfall. No follow-up sampling was conducted and so it is not known whether water quality returned to guideline levels the next day.

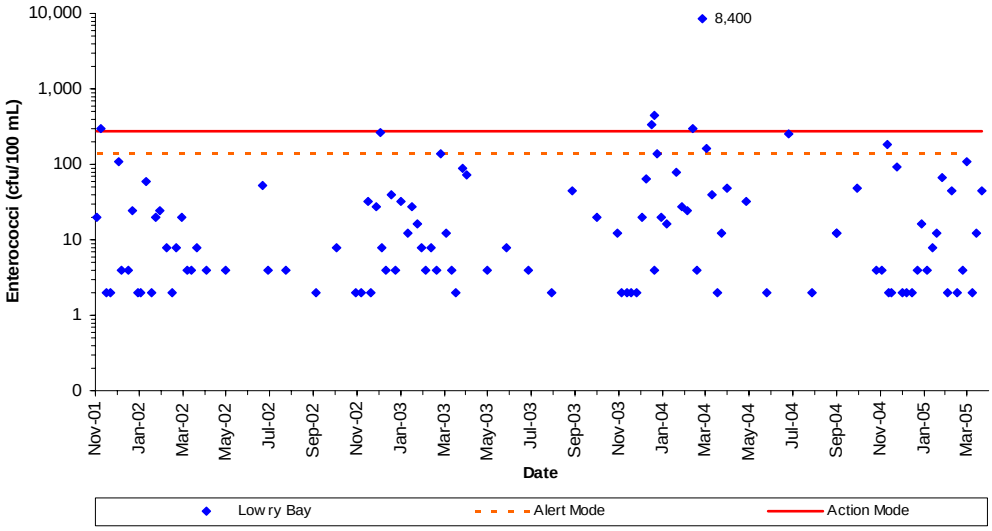

Figure 4.46: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.44: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
13/11/2001	300	0	0	1.5	8
22/12/2003	330	0	1	1	0
26/12/2003	440	0	0	1.5	0.5
18/02/2004	300	5.5	16.5	94.5	0
02/03/2004	8,400	1	1	12.5	6
Total No. of Exceedances	5				
Total No. of Samples	109				

4.4.4 York Bay

York Bay achieved a high level of compliance with the recreational water quality guidelines, with only two exceedances of the alert level and one exceedance of the action level arising from routine monitoring over the last four summer bathing seasons (Table 4.45). Overall, York Bay complied with the surveillance level of the guidelines on over 96% of sampling occasions (Figure 4.47).

Table 4.45: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	22	100.0	0	0.0	0	0.0	22	100
2003-2004	20	95.2	0	0.0	1	4.8	21	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**83**		**2**		**1**		**86**	

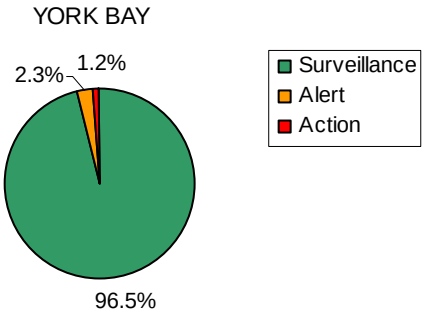

Figure 4.47: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.48. Although the action level guideline was only exceeded on one occasion, the enterococci count was an order of magnitude above the surveillance level. This result was recorded on 2 March 2004 and coincided with the greatest enterococci count recorded at Lowry Bay (8,400 cfu/100 mL). As discussed in Section 4.4.3, 13.5 mm of rain had fallen in the three days preceding sampling and further rain fell on the day of sampling (Table 4.46). No follow-up sampling was conducted to determine whether water quality returned to guideline levels the next day.

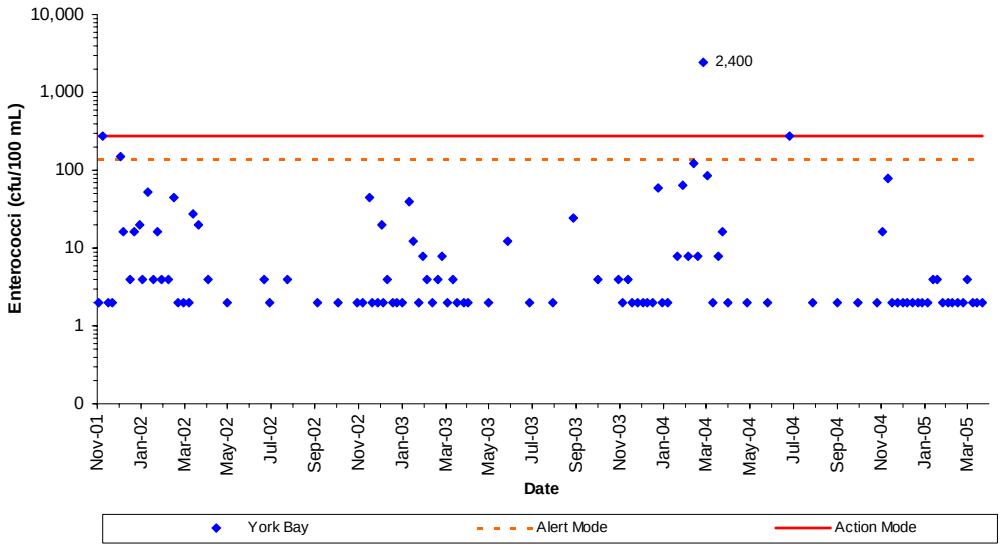

Figure 4.48: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.46: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
02/03/2004	2,400	1.0	1.0	12.5	6.0
Total No. of Exceedances	1				
Total No. of Samples	108				

4.4.5 Days Bay

Days Bay achieved a very high level of compliance with the recreational water quality guidelines over the last four summer bathing seasons. The monitoring sites adjacent to Wellesley College and the wharf exceeded the action level on just one occasion each (Table 4.47). The Moana Road site did not exceed the action level on any sampling occasions but did exceed the alert level on three sampling occasions. When the four summers are considered as whole, the three monitoring sites complied with the surveillance level of the guidelines on more than 96% of sampling occasions (Figure 4.49). Unlike numerous other

sites which recorded a greater number of exceedances over the 2003/2004 summer, there was 100% compliance with the recreational water quality guidelines at all three sites in Days Bay over the this period.

Table 4.47: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WELLESLEY COLLEGE								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**84**		**0**		**1**		**85**	
WHARF								
2001-2002	20	95.2	1	4.8	0	0.0	21	-
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	21	100.0	0	0.0	0	0.0	21	100
Total	**82**		**1**		**1**		**84**	
MOANA ROAD								
2001-2002	20	95.2	1	4.8	0	0.0	21	-
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**82**		**3**		**0**		**85**	

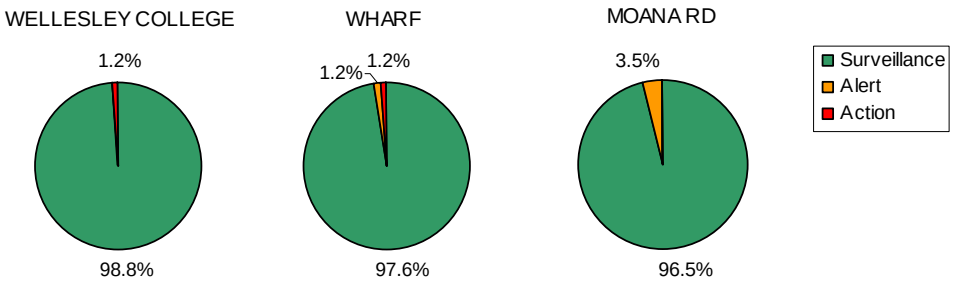

Figure 4.49: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The action level exceedances at the Wellesley College and wharf sites both occurred on 9 December 2002 (Figure 4.50). Over 38 mm of rainfall was recorded at the Shandon rainfall station in the 72 hours prior to the day of sampling (Table 4.48). All exceedances of the alert level also coincided with rainfall events.

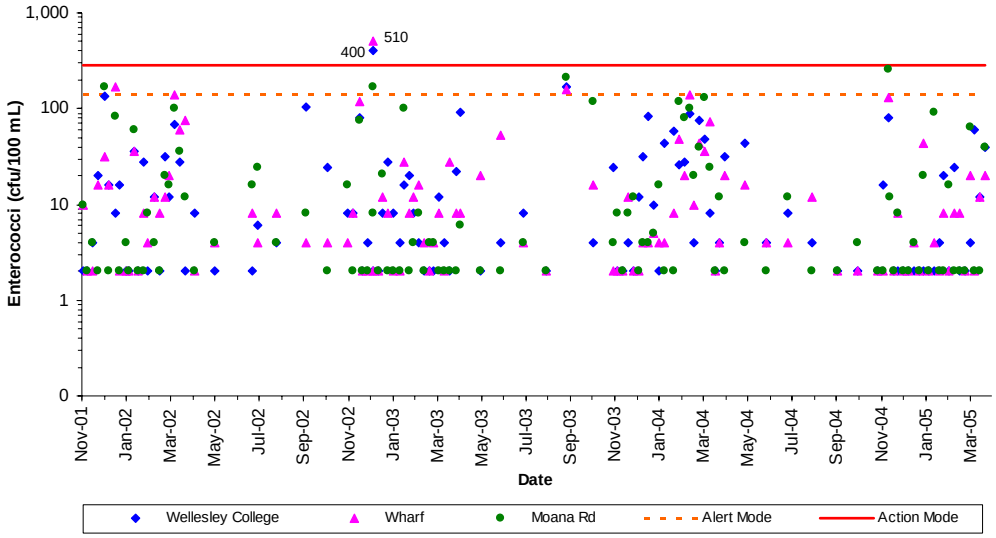

Figure 4.50: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.48: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Wellesley College	Wharf	Moana Rd	24 hrs	48 hrs	72 hrs	
09/12/2002	400	510		3.5	37.5	38.5	0
Total No. of Exceedances	2	3	4				
Total No. of Samples	108	109	107				

4.4.6 Rona Bay

Both Rona Bay monitoring sites exceeded the action level of the recreational water quality guidelines during routine monitoring over the last four summer bathing seasons (Table 4.49, Figure 4.51). The site adjacent to the northern end of Cliff Bishop Park recorded five exceedances in total, three of which occurred over the 2003/2004 summer. In contrast, the monitoring site at the wharf achieved 100% compliance with the guidelines over this same summer, but recorded three alert and three action level exceedances over the other three summer seasons. The site at the wharf also exceeded the action level on two further occasions during routine winter monitoring over the reporting period. Overall, the Cliff Bishop Park and wharf monitoring sites complied with the surveillance level of the guidelines on 94% and 93% of summer sampling occasions respectively (Figure 4.51).

Table 4.49: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
N END OF CLIFF BISHOP PARK								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	18	85.7	0	0.0	3	14.3	21	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**80**		**0**		**5**		**85**	
WHARF								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	18	85.7	1	4.8	2	9.5	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**79**		**3**		**3**		**85**	

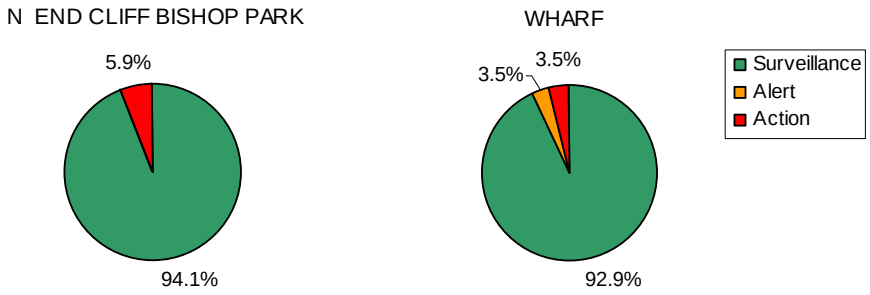

Figure 4.51: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The two highest enterococci counts were recorded at the Cliff Bishop Park site on 10 February and 2 March 2004 (Figure 4.52). Both of these counts were an order of magnitude above the action level and, unlike exceedances of the action level recorded at this site on 9 December 2002 and 18 February 2004, did not coincide with heavy rainfall (Table 4.50). Follow-up sampling for the 10 February 2004 exceedance yielded two further elevated results (Figure 4.52) which were probably influenced by rainfall; 14.5 mm of rain was recorded on 11 February. No follow-up sampling was conducted following the 2 March 2004 exceedance.

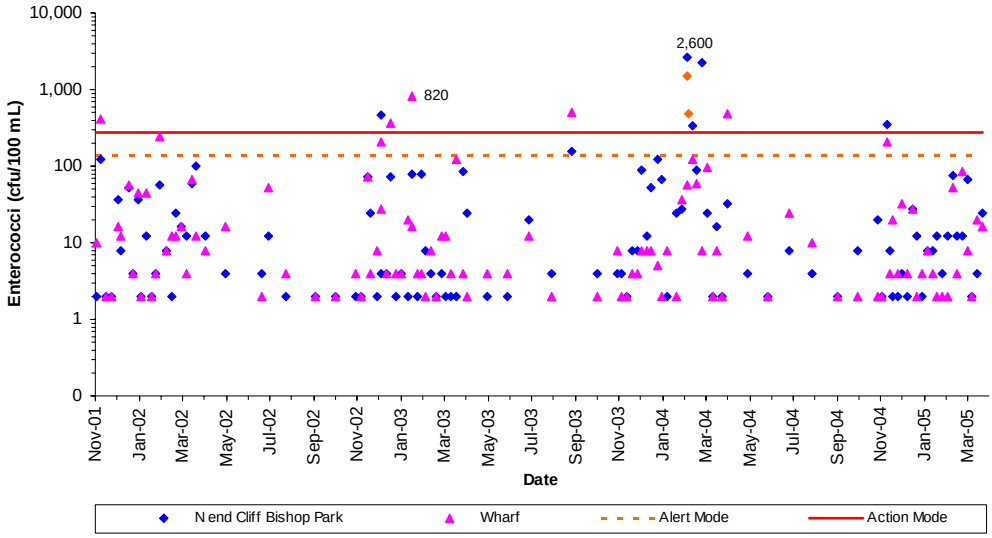

Figure 4.52: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.50: Analysis of exceedances of the MfE/MoH (2003) action levels arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Cliff Bishop Park	Wharf	24 hrs	48 hrs	72 hrs	
13/11/2001		410	0	0	1.5	8
09/12/2002	460		3.5	37.5	38.5	0
23/12/2002		360	0	0	0	0
21/01/2003		820	0	0	0	0
02/09/2003		510	10	10.5	10.5	0
10/02/2004	2,600		0	0	0	3.5
18/02/2004	340		5.5	16.5	94.5	0
02/03/2004	2,200		1	1	12.5	6
06/04/2004		490	0	0	0	18.5
16/11/2004	350		1.5	11.5	11.5	0
Total No. of Exceedances	5	5				
Total No. of Samples	107	107				

4.4.7 Robinson Bay

With the exception of Nikau Street over the 2001/2002 summer, the two Robinson Bay monitoring sites both exceeded the recreational water quality guidelines during one or more of the last four summer bathing seasons (Table 4.51). The HW Shortt Recreation Ground site and Nikau Street site both exceeded the alert and action levels on three occasions over the four summers. The site at the recreation ground also exceeded the action level on one further occasion during routine winter monitoring over the reporting period. Overall the two sites complied with the surveillance level of the guidelines on 93% of sampling occasions (Figure 4.53).

Table 4.51: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
HW SHORTT REC GROUND								
2001-2002	20	95.2	0	0.0	1	4.8	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	19	86.4	2	9.1	1	4.5	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**80**		**3**		**3**		**86**	
NIKAU STREET								
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	17	81.0	1	4.8	3	14.3	21	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**79**		**3**		**3**		**85**	

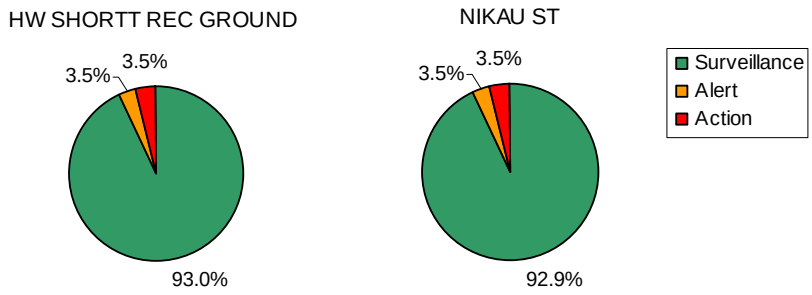

Figure 4.53: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The highest enterococci count was 1,600 cfu/100 mL, recorded at Nikau Street on 22 December 2003. Table 4.52 indicates that this action level exceedance, together with action level exceedances recorded at both sites on 10 February 2004 and the HW Shortt Recreation Ground site on 13 November 2001 and 6 May 2002, did not coincide with significant rainfall. Where follow-up sampling was conducted, almost all of the results complied with guideline levels. The exception was at the HW Shortt Recreation Ground site where a result of 320 cfu/100 mL on 9 December 2002 was followed by a result of 276 cfu/100 ml the next day. The results of all sampling for the 2001-2005 reporting period, including the results of follow-up sampling, are shown in Figure 4.54.

Table 4.52: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Rec Ground	Nikau St	24 hrs	48 hrs	72 hrs	
13/11/2001	400		0	0	1.5	8
06/05/2002	400		0	0	0	0
09/12/2002	320		3.5	37.5	38.5	0
22/12/2003		1,600	0	1	1	0
10/02/2004	850	360	0	0	0	3.5
18/02/2004		480	5.5	16.5	94.5	0
Total No. of Exceedances	4	3				
Total No. of Samples	108	108				

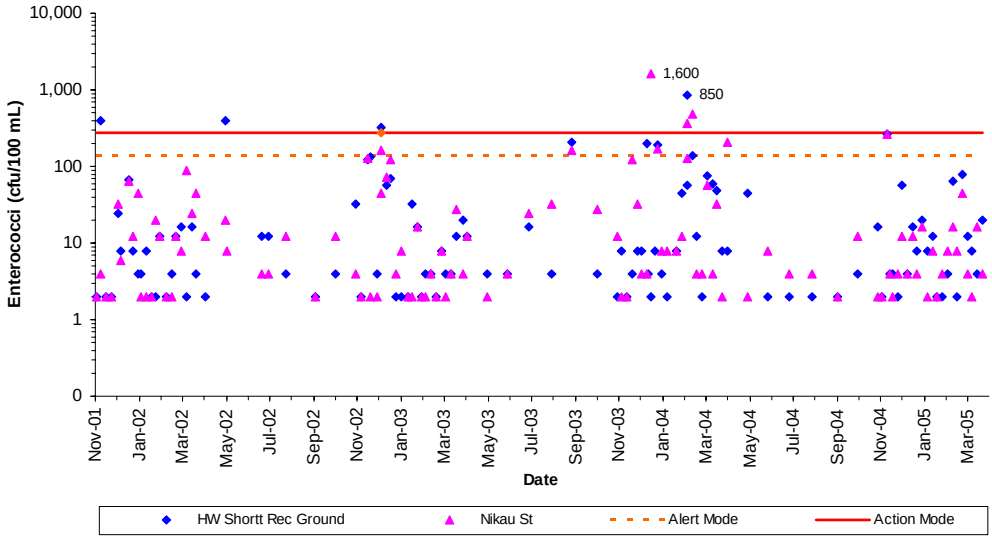

Figure 4.54: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

It is unclear as to why a number of elevated results coincided with little or no rainfall. There does not appear to be any consistent pattern with respect to these results and seaweed cover or tides, although the wind direction on most occasions was from the south.

4.4.8 Camp Bay

Camp Bay exceeded both the alert and action levels of the recreational water quality guidelines on two occasions over the last four summer bathing seasons (Table 4.53). Neither guideline was exceeded over the 2001/2002 summer. Overall, Camp Bay complied with the surveillance level of the guidelines on over 95% of sampling occasions (Figure 4.55).

Table 4.53: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	19	90.5	2	9.5	0	0.0	21	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**81**		**2**		**2**		**85**	

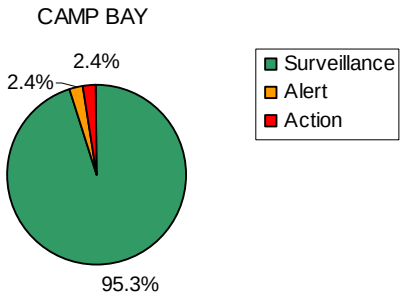

Figure 4.55: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The two exceedances of the action level occurred on 9 December 2002 and 16 November 2004 (Figure 4.56). In the case of the former, over 38 mm of rain had fallen in the 72 hours prior to sampling (Table 4.54). Further sampling was undertaken the following day and low bacteria counts were found. The 16 November 2004 exceedance also coincided with rainfall prior to sample collection.

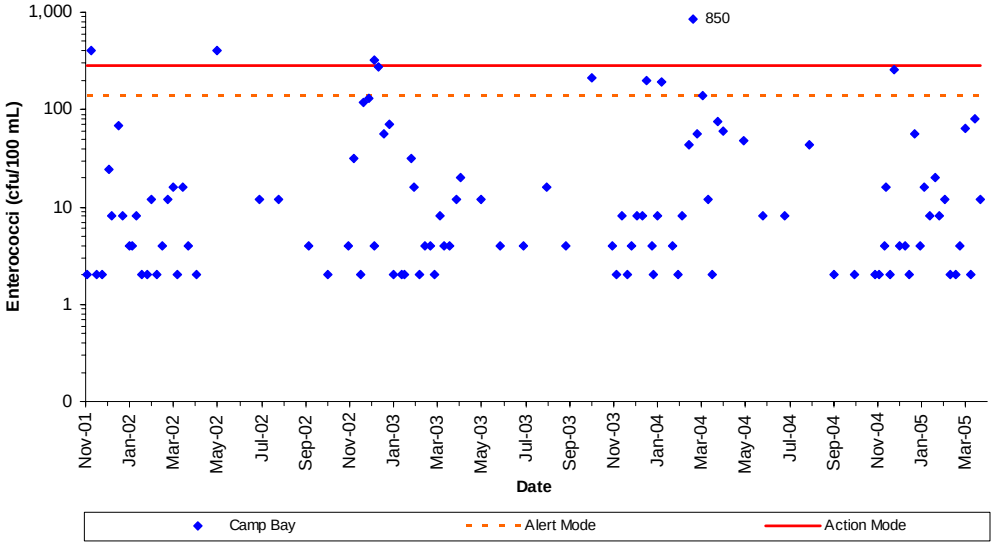

Figure 4.56: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.54: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Shandon rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hrs	48 hrs	72 hrs	
09/12/2002	320	3.5	37.5	38.5	0
16/11/2004	530	1.5	11.5	11.5	0
Total No. of Exceedances	2				
Total No. of Samples	107				

4.4.9 Discussion

Monitoring undertaken over 2001-2005 indicates that water quality is very good at most marine recreational areas in Hutt City. Fourteen of the 15 monitoring sites complied with the surveillance level of the recreational water quality guidelines (<140 enterococci/100 mL) on over 90% of routine summer sampling occasions, with 7 of these sites compliant on over 95% of sampling occasions. Days Bay recorded the highest level of compliance with the guidelines, followed by York Bay and Camp Bay (Figure 4.57). Petone Beach at Sydney Street recorded the lowest level of compliance and exceeded the surveillance level guideline on more than 12% of routine sampling occasions.

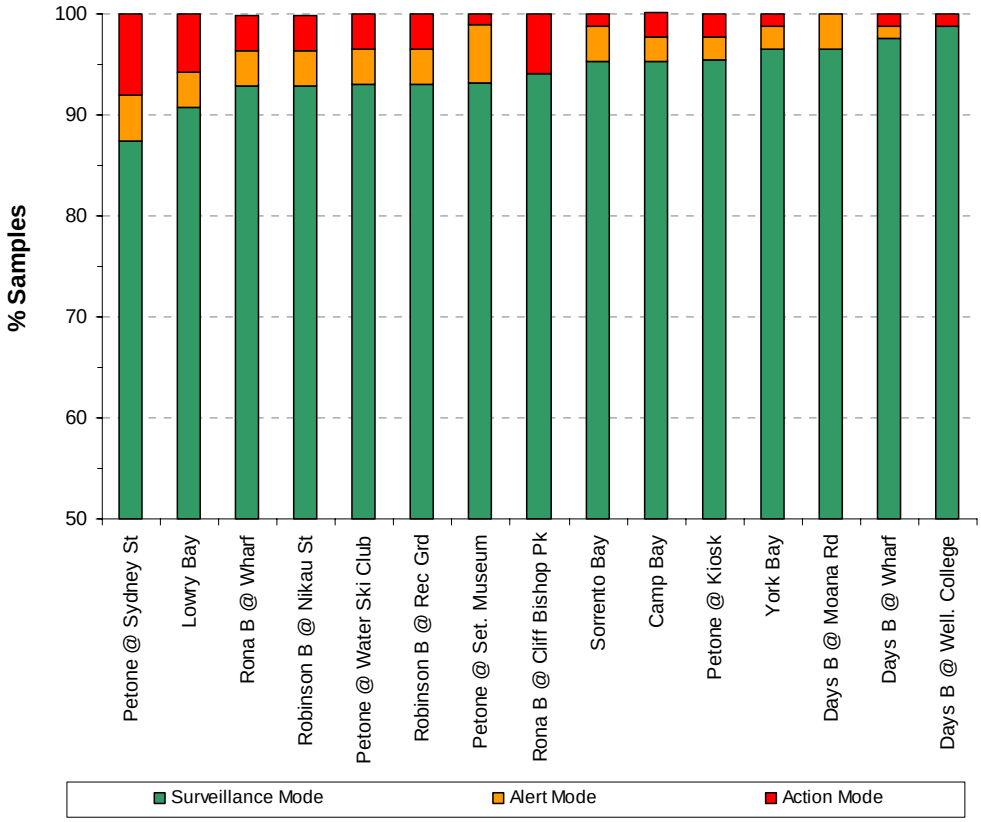

Figure 4.57: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

4.4.10 Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2004/2005 summer, with just two of the 15 monitoring sites exceeding the action level (Table 4.55). In contrast, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer. Ten sites exceeded the action level over this period, with four sites exceeding the action level on three or more occasions.

Table 4.55: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly sampling undertaken at the 15 monitoring sites in Hutt City

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3	≥4
2001/2002	4	5	5	0	0	0
2002/2003	3	8	6	2	0	0
2003/2004	4	10	6	0	2	2
2004/2005	7	2	2	0	0	0

Unlike other parts of the Wellington Region, the correlation between the number of action level exceedances and rainfall is poor for many marine bathing sites in Hutt City; analysis of rainfall records indicates that rainfall may only account for approximately 55% of all action level exceedances recorded in Hutt City during routine monitoring over the entire reporting period. The 2003/2004 summer highlights this well. For example, despite February 2004 being exceptionally wet (Figure 4.58), only six of the 20 action level exceedances recorded over the 2003/2004 summer occurred during this month. In contrast, seven of the exceedances recorded over this summer occurred over the November 2003-December 2003 period when rainfall was well below the longterm average.

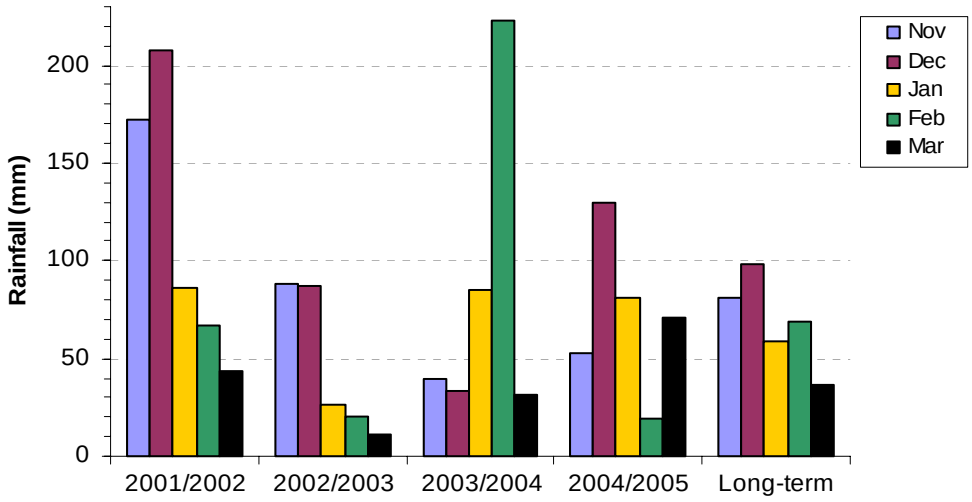

Figure 4.58: Monthly rainfall recorded at the Shandon Rainfall Station over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (2000 to present)

The correlation between the number of action level exceedances and rainfall is lowest for Petone Beach, Lowry Bay, Rona Bay (at the wharf) and Robinson Bay (at both the HW Shortt Recreation Ground and Nikau Street). The reasons why a large number of elevated results at these coincide with little or no rainfall are unclear. There does not appear to be any consistent pattern with respect to seaweed cover, tides or wind direction. At some sites, local streams may be affecting coastal water quality at times. For example, water quality at Petone Beach can be influenced by the Hutt River, particularly when a high tide and strong southerly wind coincide. It is also likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some locations.

4.4.11 Suitability for recreation

The number of exceedances of the recreation water quality guidelines over the last four summer seasons was low for many sites, resulting in relatively low MAC values for nine sites (Table 4.56). These low MAC values combine with moderate SIC values to give an interim SFRG of "good" for 8 of the 15 monitoring sites in Hutt City. The exception is Camp Bay which, due to its very low SIC grade, has an interim SFRG of "very good".

The interim SFRG is "fair" for the remainder of the sites, including both Rona Bay sites and two of the four monitoring sites along Petone Beach. The lower SFRG reflect the higher MAC values recorded for these sites. Sydney Street recorded the greatest MAC (400 enterococci/100 mL).

Table 4.56: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for marine bathing sites in Hutt City

Site	MAC*	SIC	Interim SFRG
PETONE BEACH			
Water Ski Club	C (95^{th} percentile = 231, n=86)	Moderate	Fair
Sydney Street	C (95^{th} percentile = 400, n=87)	Moderate	Fair
Settlers Museum	B (95^{th} percentile = 173, n=88)	Moderate	Good
Kiosk	B (95^{th} percentile = 124, n=87)	Moderate	Good
SORRENTO BAY			
Sorrento Bay	B (95^{th} percentile = 122, n=85)	Moderate	Good
LOWRY BAY			
Cheviot Road	C (95^{th} percentile = 300, n=86)	Moderate	Fair
YORK BAY			
York Bay	B (95^{th} percentile = 91, n=86)	Moderate	Good

Site	MAC*	SIC	Interim SFRG
DAYS BAY			
Wellesley College	B (95th percentile = 81, n=85)	Moderate	Good
Wharf	B (95th percentile = 133, n=85)	Moderate	Good
Moana Road	B (95th percentile = 123, n=85)	Moderate	Good
RONA BAY			
N end Cliff Bishop Park	C (95th percentile = 343, n=85)	Moderate	Fair
Wharf	C (95th percentile = 218, n=85)	Moderate	Fair
ROBINSON BAY			
HW Shortt Rec Ground	C (95th percentile = 212, n=86)	Moderate	Fair
Nikau Street	B (95th percentile = 193, n=85)	Moderate	Good
CAMP BAY			
Camp Bay	B (95th percentile = 148, n=85)	Very Low	Very Good

* Based on enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

4.5 Wellington City

The Wellington City area extends from Rock Point to Korokoro. The coastline is predominantly rocky with a number of small, embayed, gravely or sandy beaches, particularly along the outer coast east of Sinclair Head and within Wellington Harbour. However, between Oriental Bay and Korokoro, the shoreline consists of almost entirely artificial structures associated with the port and arterial transport systems.

The Ohariu/Makara Stream system drains predominantly pastoral catchments and discharges to the coast at Ohariu Bay. The Karori Stream discharges to the coast to the west of Sinclair Head and receives stormwater from the suburb of Karori. Treated wastewater from the Western Wastewater Treatment Plant is also discharged into the coast adjacent to the mouth of Karori Stream. Owhiro Stream discharges into Owhiro Bay and receives stormwater from the suburb of Brooklyn. Three operative landfills and one closed landfill are located in this catchment. Stormwater enters Island Bay and Lyall Bay from adjoining suburbs and a long outfall discharges treated wastewater at Moa Point, just to the east of Lyall Bay. This outfall, together with a new wastewater treatment plant at Moa Point, was commissioned in 1998. Coastal water quality in the vicinity of the former outfall has improved since this time (Robertson, 2000).

Beaches within Wellington Harbour are influenced by stormwater from adjoining suburbs, and in the case of Oriental Bay, from as far inland as Brooklyn. Major stormwater drains associated with the central business district of Wellington City discharge into the harbour within the port area. The Kaiwharawhara Stream receives stormwater and runoff from the suburbs of Karori, Northland and Ngaio, as well as from a small industrial area in its

lower reaches. Beyond Kaiwharawhara the harbour coastline is rocky and the only other main freshwater input is the Ngauranga Stream. This stream receives stormwater from industrial areas and the suburbs of Johnsonville and Newlands, as well as leachate from the closed Raroa landfill.

The Wellington City Council currently holds 12 resource consents authorising the discharge of contaminated stormwater into the coast at various locations in Wellington City. For the reasons outlined in Section 2.1, during very heavy rain events, these stormwater discharges may contain partially diluted untreated sewage. Outfalls in close proximity to marine recreational areas include Lyall Bay, Island Bay and Owhiro Bay. As improvements have been made to the quality of the discharge into Owhiro Bay in recent years, the resource consent for this discharge did not need to be renewed upon its expiry in June 2003. Improvements in the quality of the 12 remaining consented stormwater discharges continue in line with conditions of consent.

Many of the beaches in the vicinity of Wellington City are popular for swimming. Wellington Harbour is used for both windsurfing and boating. Surfing occurs on the south coast, particularly at Lyall Bay (Figure 4.59). Diving is popular along the coast between Sinclair Head and the entrance to Wellington Harbour. Shellfish gathering is popular at many locations along the south coast.

Figure 4.59: Surfer at Lyall Bay

4.5.1 Aotea Lagoon

Aotea Lagoon exceeded both the alert level and the action level of the recreational water quality guidelines on two occasions over the last four summer bathing seasons (Table 4.57, Figure 4.60). There was 100% compliance with the guidelines over the 2003/2004 summer.

Table 4.57: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	23	95.8	0	0.0	1	4.2	24	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	90.9	2	9.1	0	0.0	22	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**85**		**2**		**2**		**89**	

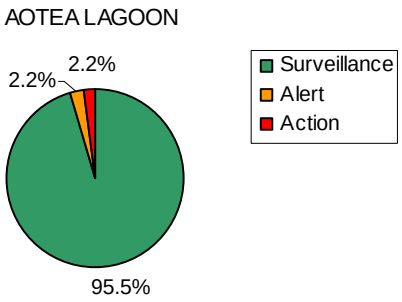

Figure 4.60: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

There were a total of four action level exceedances when the results of all routine sampling for the 2001-2005 reporting period are considered (Figure 4.61). All four exceedances coincided with rainfall events (Table 4.58), and are likely to be a result of urban runoff.

Where follow-up sampling was conducted in response to an exceedance of the alert or action level, the results generally complied with the surveillance level of the guidelines. The key exception was in March 2004; an alert level enterococci result of 260 cfu/100 mL recorded on 15 March 2004 was followed by results of <4 cfu/100 mL and 1,300 cfu/100 mL on 16 and 17 March respectively (Capacity, 2004). A third follow-up sample taken on 18 March complied with the surveillance level of the guidelines.

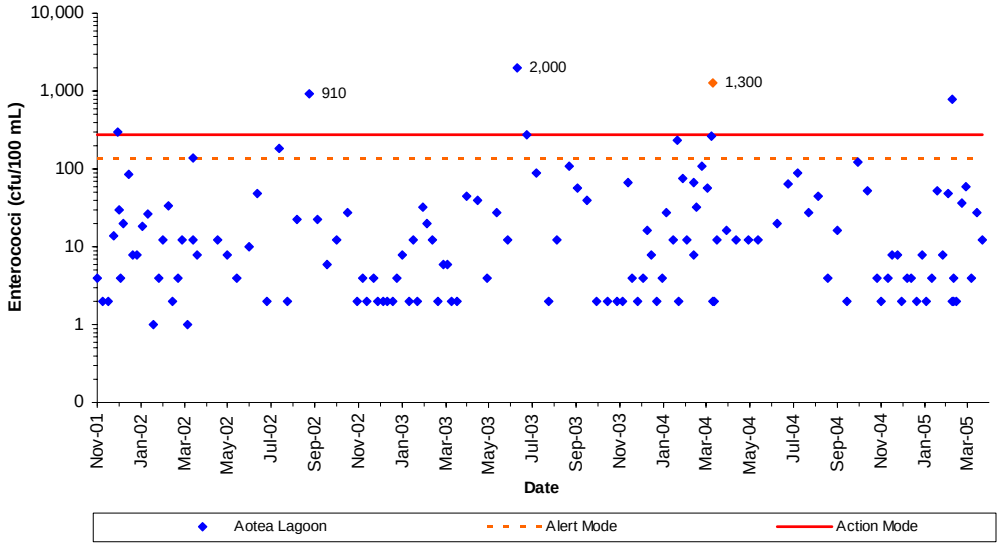

Figure 4.61: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.58: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
04/12/2001	300	11.5	17.1	17.4	14.4
28/08/2002	910	4.2	4.3	13.7	1.1
16/06/2003	2,000	11.5	11.7	11.7	0
14/02/2005	800	13.8	14.4	26.6	1.3
Total No. of Exceedances	**4**				
Total No. of Samples	**132**				

4.5.2 Oriental Bay

With the exception of the 2002/2003 summer, exceedances of either the alert or action levels of the recreational water quality guidelines were recorded over each of the last four summer bathing seasons at all three monitoring sites along Oriental Bay (Table 4.59). The site adjacent to the wishing well recorded the greatest number of exceedances, including two exceedances of the alert level and six exceedances of the action level. Freyberg Beach recorded the greatest level of compliance with the surveillance guideline level (Figure 4.62), although less samples were collected at this site due to beach works undertaken over the 2002/2003 and 2003/2004 summers.

Table 4.59: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
FREYBERG BEACH								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	5	100.0	0	0.0	0	0.0	5	100
2003-2004	9	81.8	2	18.2	0	0.0	11	100
2004-2005	21	21.0	0	0.0	1	4.5	22	100
Total	**55**		**3**		**1**		**59**	
WISHING WELL								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	16	100.0	0	0.0	0	0.0	16	100
2003-2004	16	80.0	0	0.0	4	20.0	20	100
2004-2005	19	86.4	1	4.5	2	9.1	22	100
Total	**71**		**2**		**6**		**79**	
BAND ROTUNDA								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	14	100.0	0	0.0	0	0.0	14	100
2003-2004	19	86.4	1	4.5	2	9.1	22	100
2004-2005	19	86.4	1	4.5	2	9.1	22	100
Total	**72**		**3**		**4**		**79**	

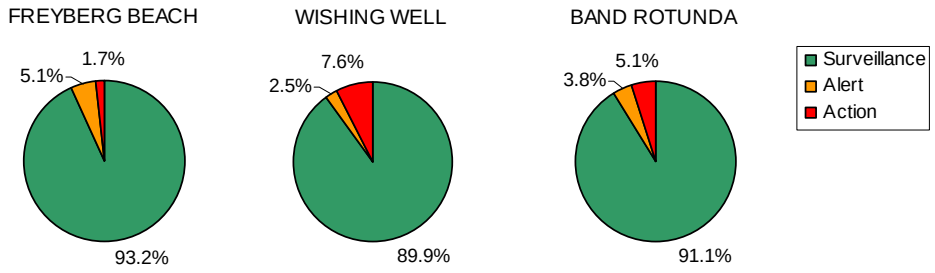

Figure 4.62: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons
(Note: Freyberg Beach was sampled on few occasions over 2002/2003 and 2003/2004)

Both the Wishing Well and Band Rotunda monitoring sites recorded one further exceedance of the action level during routine winter monitoring over the reporting period (Figure 4.63). The greatest enterococci counts recorded at the Wishing Well on 18 February 2002 (1,800 cfu/100 mL) and the Band Rotunda on 29 March 2005 (3,400 cfu/100 mL) were an order of magnitude above the surveillance level of the guidelines. Although the former result coincided with significant rainfall, Table 4.60 indicates that the majority of action level results recorded at the Wishing Well site did not coincide with rainfall events. The reason for this is unclear; sampling notes indicate that most of these results coincided with northerly winds and an ebb tide. Elevated results during the 2003/2004 summer may be related to the deposition of

sediment and vegetation on the beach as a result of land clearance (Capacity, 2004).

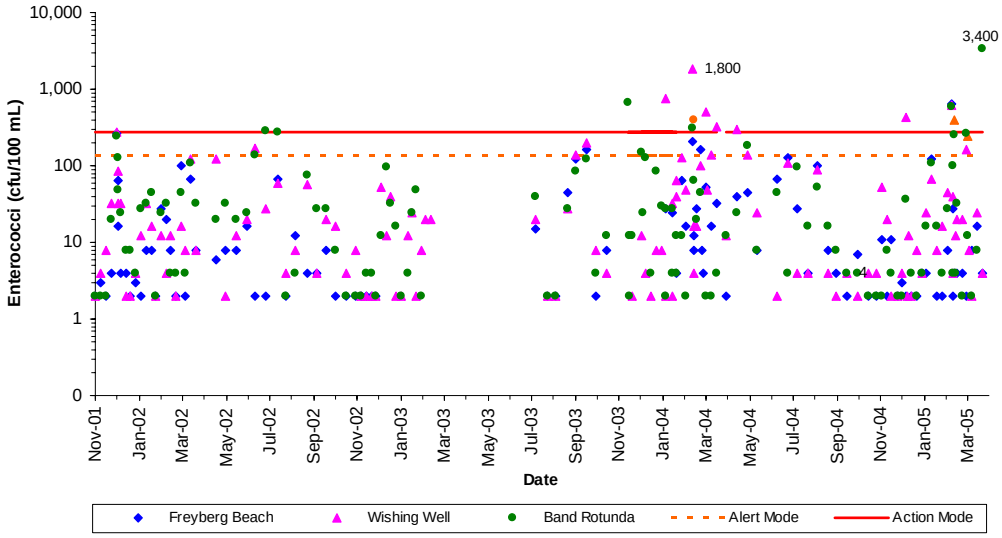

Figure 4.63: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.60: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Freyberg Beach	Wishing Well	Band Rotunda	24 hours	48 hours	72 hours	
01/07/2002			290	12.9	39.1	49.9	3.7
19/11/2003			680	0	3.8	8.5	0
12/01/2004		760		0	0	0.2	1
18/02/2004		1,800	310	17.7	42.6	93.4*	0.1
08/03/2004		500		0	0	0	0
22/03/2004		320		0	0	0	0
19/04/2004		300		0	0	0	0
13/12/2004		430		0	0	14.3	0
14/02/2005	630	620	580	13.8	14.4	26.6	1.3
29/03/2005			3,400	0.1	4.3	5.6	11.3
Total No. of Exceedances	1	7	5				
Total No. of Samples	95	115	115				

* Regional Council Centre rainfall station

4.5.3 Balaena Bay

Balaena Bay achieved a high level of compliance with the recreational water quality guidelines, with only one exceedance of both the alert and action levels arising from routine monitoring over the last four summer bathing seasons (Table 4.61). As a result, Balaena Bay complied with the surveillance level of the guidelines on almost 98% of sampling occasions (Figure 4.64).

Table 4.61: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**84**		**1**		**1**		**86**	

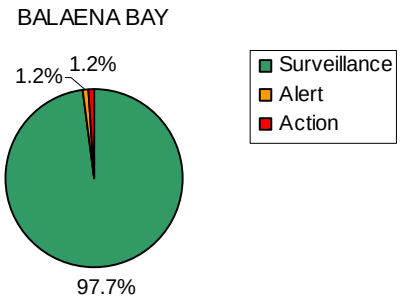

Figure 4.64: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

It can be seen from Figure 4.65 that the number of action level exceedances remains at one even when the results of all sampling for the 2001-2005 reporting period are considered, although the number of alert level events increased from one to three. The action level exceedance occurred on 19 November 2003. Only 8.5 mm of rain had fallen in the three days preceding sampling (Table 4.62). A further sample was collected on 21 November and the results complied with the surveillance level.

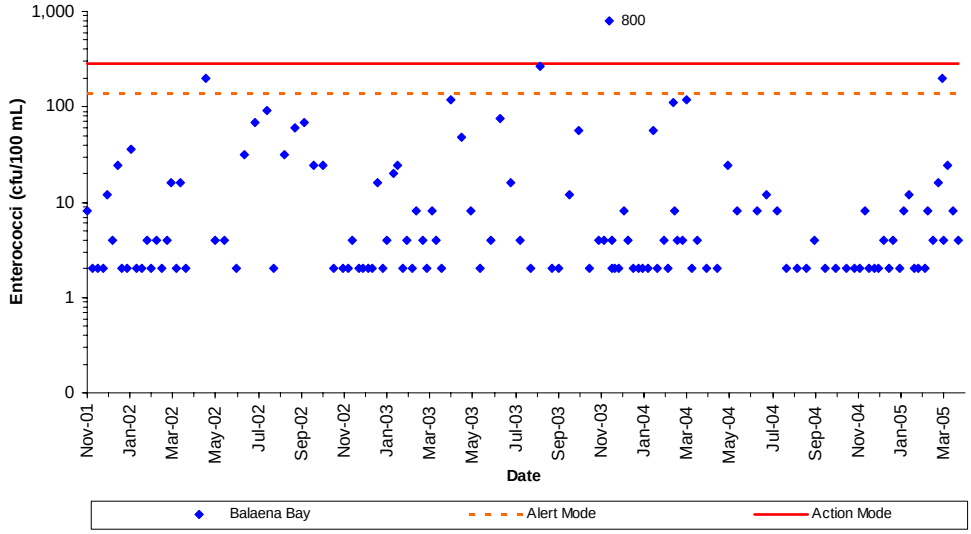

Figure 4.65: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.62: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
19/11/2003	800	0	3.8	8.5	0
Total No. of Exceedances	1				
Total No. of Samples	129				

4.5.4 Kio Bay

Kio Bay was similar to Balaena Bay and achieved a high level of compliance with the recreational water quality guidelines, with only one exceedance of the action level arising from routine monitoring over the last four summer bathing seasons (Table 4.63). However, the alert level was exceeded on three occasions. As a result, Balaena Bay complied with the surveillance level of the guidelines on just over 95% of sampling occasions (Figure 4.66).

Table 4.63: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	20	95.2	0	0.0	1	4.8	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	90.9	2	9.1	0	0.0	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**82**		**3**		**1**		**86**	

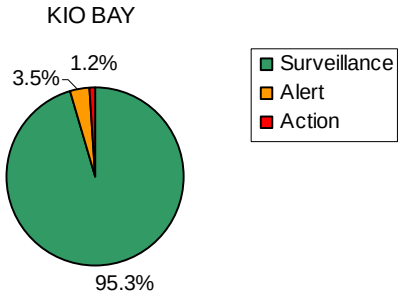

Figure 4.66: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of alert level events increases from three to five when the results of all sampling for the 2001-2005 reporting period are considered (Figure 4.67). The only action level exceedance was recorded on 25 March 2002. The

reason for this exceedance is not clear; no rainfall was recorded during the three days prior to sampling or on the day of sampling (Table 4.64). The results of further sampling conducted over the next three days all complied with the surveillance level.

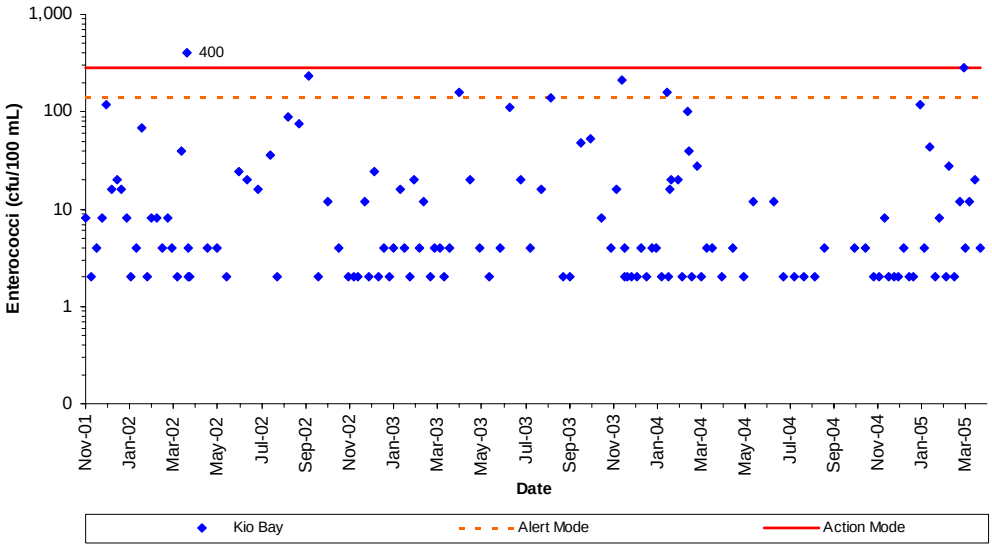

Figure 4.67: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.64: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
25/03/2002	400	0	0	0	0
Total No. of Exceedances	1				
Total No. of Samples	127				

4.5.5 Hataitai Beach

Exceedances of either the alert or action levels of the recreational water quality guidelines were recorded over each of the last four summer bathing seasons at Hataitai Beach (Table 4.65). The greatest number of action level exceedances was recorded over the 2004/2005 summer. Overall, this site exceeded the surveillance level of the guidelines on nearly 14% of sampling occasions (Figure 4.68)

Table 4.65: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters.

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	19	86.4	2	9.1	1	4.5	22	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	18	81.8	3	13.6	1	4.5	22	100
2004-2005	19	82.6	1	4.3	3	13.0	23	100
Total	**76**		**7**		**5**		**88**	

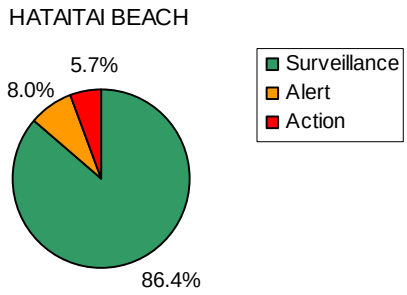

Figure 4.68: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The greatest enterococci count recorded (10,000 cfu/100 mL, 1 March 2004) was two orders of magnitude above guideline levels. This result followed over 64 mm of rainfall in the three days prior to sampling (Table 4.66). The action level exceedance on 17 February 2005 did not coincide with significant rainfall in the 72 hours prior to sampling, although over 25 mm of rain was recorded over 11-13 February.

The number of alert level exceedances increases from seven to eleven when the results of all sampling for the 2001-2005 reporting period are considered (Figure 4.69). On the majority of occasions where follow-up samples were collected in response to an exceedance of the action or alert level, the results complied with the surveillance guideline level. Two of the three exceptions were:

- 18 March 2002 – an alert level result of 170 cfu/100 mL was followed by an action level result of 360 cfu/100 mL the following day. A further sample collected two days later complied with the surveillance level.
- 8 March 2004 – an alert level result of 150 cfu/100 mL was followed by results of 48 cfu/100 mL and 1,200 cfu/100 mL on 9 and 10 March respectively. A further sample collected on 11 March complied with the surveillance level.

Table 4.66: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
04/03/2002	990	0	0.5	12.8	0.2
01/03/2004	10,000	0	36.6	64.4	0.5
16/11/2004	400	2.7	21.1	21.9	0
17/02/2005	670	0	0	1.3	0
07/03/2005	400	10.8	11.3	11.3	0.4
Total No. of Exceedances	**5**				
Total No. of Samples	**131**				

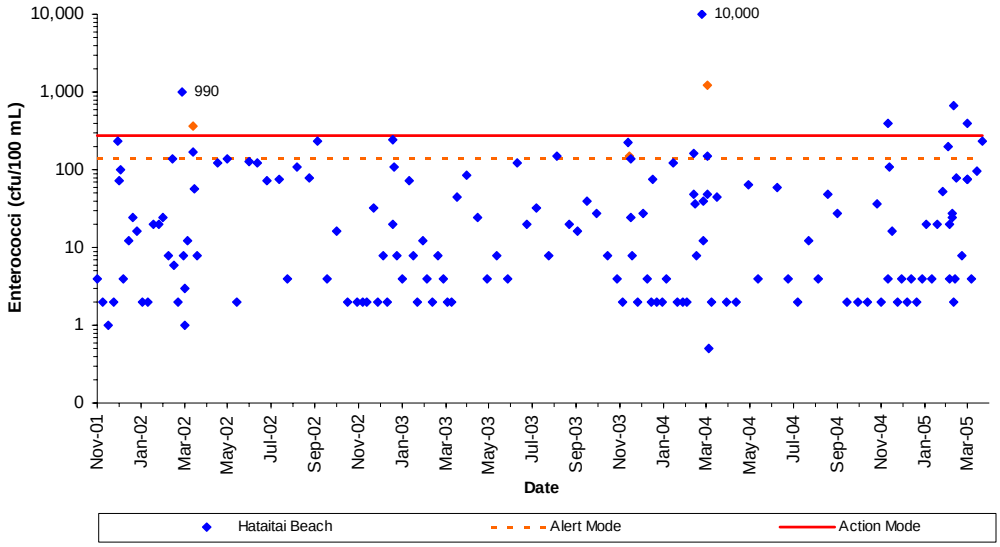

Figure 4.69: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Historically, sewer and stormwater problems have influenced water quality in the Hataitai Beach area. During most of 1998 the beach was closed for bathing while the Wellington City Council undertook sewer and stormwater upgrades. Problems with discharges appear to still arise on occasion. For example, elevated bacteria counts recorded in March 2004 were attributed to a blockage in stormwater drain, resulting in stormwater discharging into the water in close proximity to the beach (Capacity 2004).

High indicator bacteria counts at the beach have also been attributed to ducks frequenting the area (Robertson 2000). Capacity (pers. comm. 2005) has also identified the birds nesting in trees behind the bathing beach as a potential problem.

4.5.6 Shark Bay

Shark Bay exceeded the alert and action levels of the recreational water quality guidelines on one and two occasions respectively over the last four summer bathing seasons (Table 4.67). No exceedances were recorded from routine monitoring over the 2003/2004 summer. Overall, Shark Bay complied with the surveillance level on over 96% of summer sampling occasions (Figure 4.70).

Table 4.67: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	20	95.2	0	0.0	1	4.8	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	21	100.0	0	0.0	0	0.0	21	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**82**		**1**		**2**		**85**	

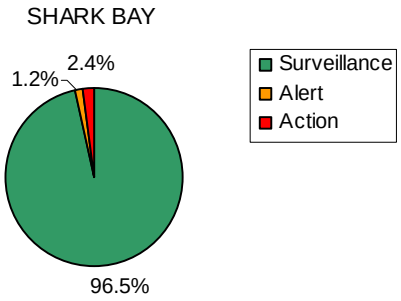

Figure 4.70: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of action level exceedances increases from two to three when the results of all routine sampling for the 2001-2005 reporting period are considered (Figure 4.71). Two of these exceedances coincided with significant rainfall events (Table 4.68). While the result of 910 cfu/100 mL recorded on 20 November 2001 appears to be unrelated to rainfall, a second exceedance recorded from follow-up sampling on 22 November (1,600 cfu/100 mL) coincided with more than 32 mm of rainfall in the 24 hours preceding sampling. A second sample collected the next day yielding a result of 180 cfu/100 mL coincided with even more rainfall. Results of further samples collected on 24 and 25 November 2001 complied with the surveillance level of the guidelines.

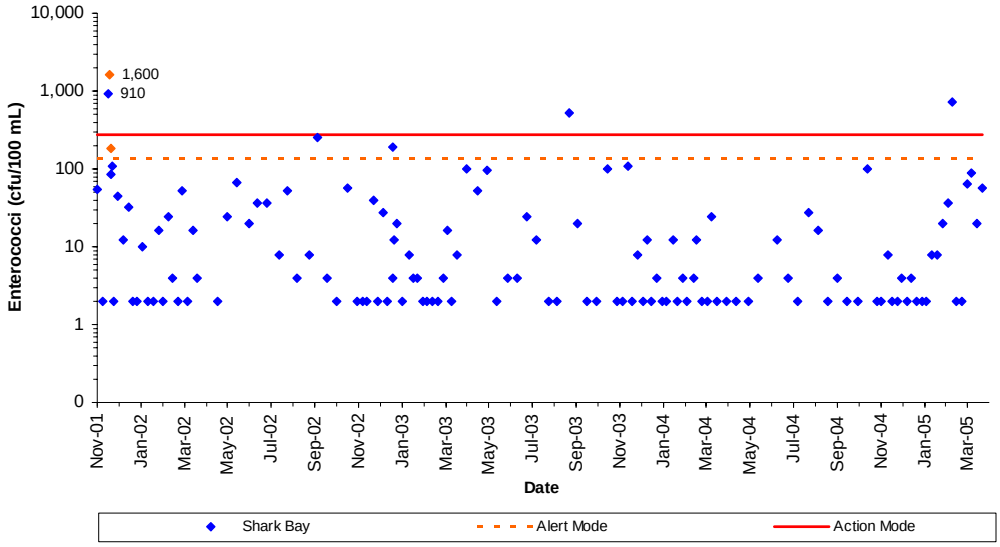

Figure 4.71: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.68: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
20/11/2001	910	0	0	0	1.5
28/08/2003	520	20.8	20.8	20.8	32.7
14/02/2005	710	13.8	14.4	26.6	1.3
Total No. of Exceedances	3				
Total No. of Samples	128				

4.5.7 Mahanga Bay

Mahanga Bay exceeded the alert level and action level of the recreational water quality guidelines on three and two occasions respectively over the last four summer bathing seasons (Table 4.69). These exceedances were confined to the 2002/2003 and 2004/2005 summers. Overall, Mahanga Bay complied with the surveillance level of the guidelines on over 94% of summer sampling occasions (Figure 4.72).

Table 4.69: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	20	95.2	0	0.0	1	4.8	21	100
2003-2004	23	100.0	0	0.0	0	0.0	23	100
2004-2005	18	81.8	3	13.6	1	4.5	22	100
Total	**82**		**3**		**2**		**87**	

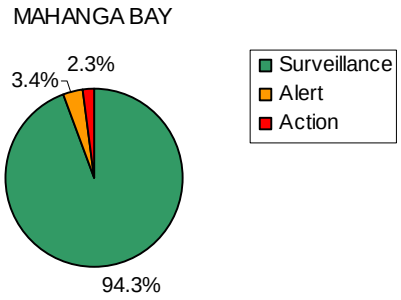

Figure 4.72: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of alert level exceedances increases from three to six when the results of all routine sampling for the 2001-2005 reporting period are considered (Figure 4.73). The two exceedances of the action level were recorded on 18 November 2002 and 7 March 2005 and coincided with rainfall events (Table 4.70). On all but one of the sampling occasions where follow-up samples were collected in response to an exceedance of the alert or action level, the results complied with the surveillance guideline level.

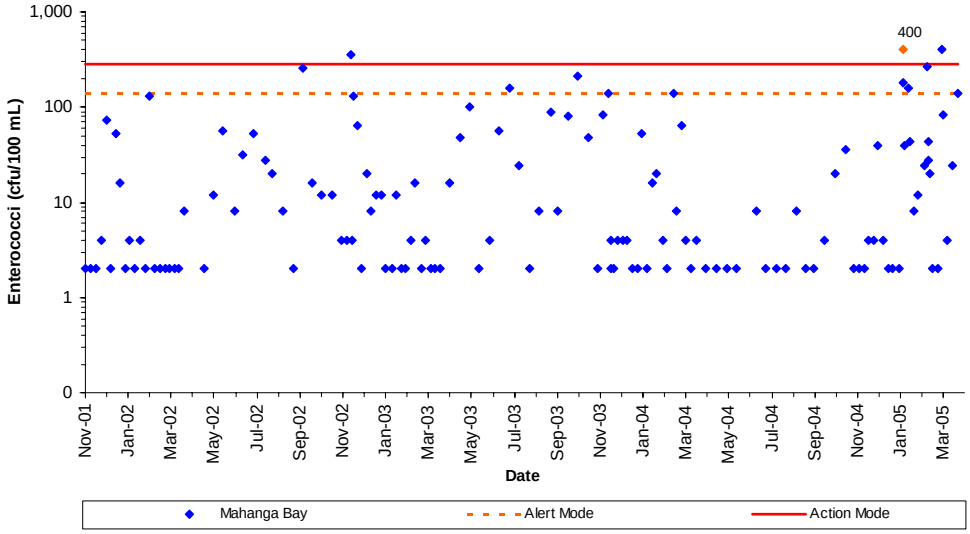

Figure 4.73: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.70: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
18/11/2002	350	0.1	44.0	52.7	3.4
07/03/2005	400	10.8	11.3	11.3	0.4
Total No. of Exceedances	2				
Total No. of Samples	130				

4.5.8 Scorching Bay

Scorching Bay achieved a very high level of compliance with the recreational water quality guidelines, with only one exceedance of the alert guideline level arising from routine monitoring over the last four summer bathing seasons (Table 4.71). Overall, Scorching Bay complied with the surveillance level of the guidelines on almost 99% of sampling occasions (Figure 4.74).

Table 4.71: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**85**		**1**		**0**		**86**	

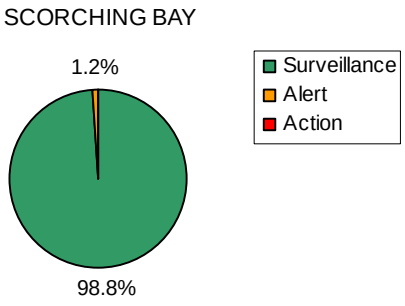

Figure 4.74: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

It can be seen from Figure 4.75 that there was one minor exceedance of the action level when the results of all sampling for the 2001-2005 reporting period are considered. This exceedance occurred on 10 September 2002. No rainfall

was recorded in the 24 hours prior to the day of sampling but 10.8 mm of rainfall fell in the 72 hours prior to sampling (Table 4.72).

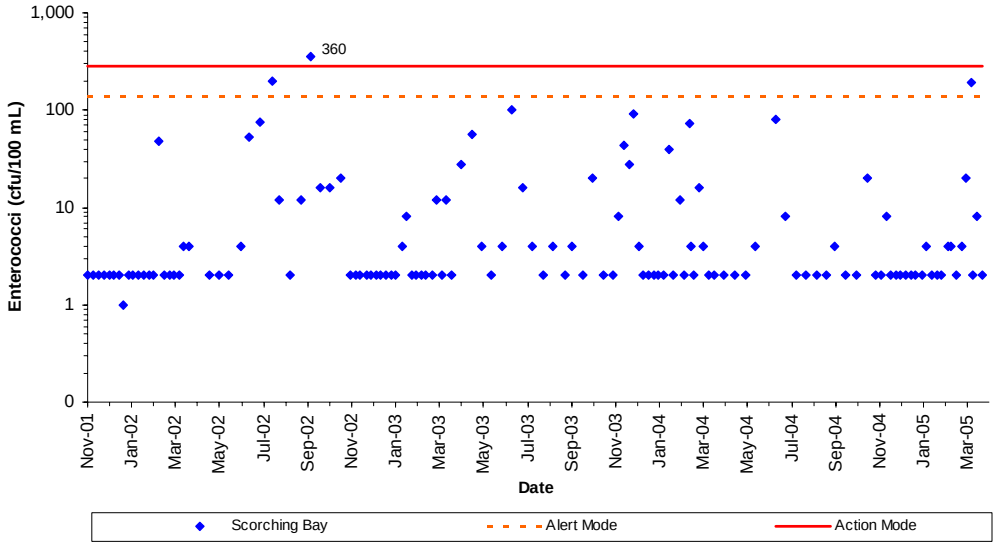

Figure 4.75: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.72: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Kelburn rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
10/09/2002	360	0	6.6	10.8	0.1
Total No. of Exceedances	1				
Total No. of Samples	129				

4.5.9 Worser Bay

Worser Bay achieved a very high level of compliance with the recreational water quality guidelines, with only one exceedance of the action level arising from routine monitoring over the last four summer bathing seasons (Table 4.73). Overall, Worser Bay complied with the surveillance level of the guidelines on almost 99% of sampling occasions (Figure 4.76).

Table 4.73: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	23	95.8	0	0.0	1	4.2	24	100
Total	**87**		**0**		**1**		**88**	

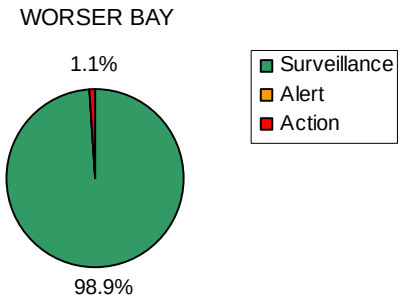

Figure 4.76: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

There was one further exceedance of the action level when the results of all routine sampling for the 2001-2005 reporting period are considered (Figure 4.77). Both action level results coincided with rainfall, although only the result recorded on 28 August 2003 is likely to be influenced by rainfall (Table 4.74). Follow-up sampling was conducted following the March 2005 exceedance - the results complied with the surveillance level of the guidelines.

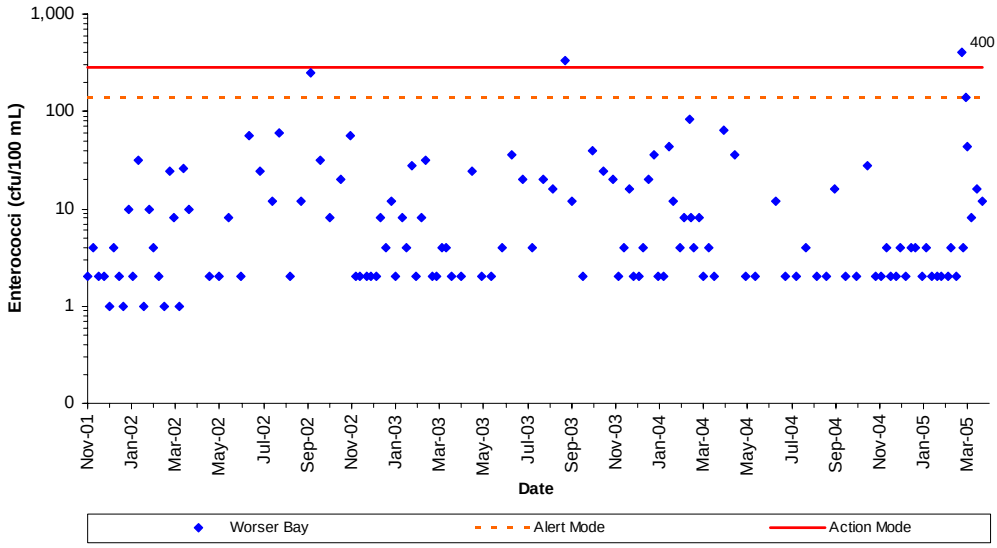

Figure 4.77: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.74: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
28/08/2003	330	10	10	10	10.6
01/03/2005	400	1.4	4.2	4.2	0
Total No. of Exceedances	2				
Total No. of Samples	130				

4.5.10 Seatoun Beach

Both Seatoun Beach monitoring sites exceeded the action level of the recreational water quality guidelines during routine monitoring over the last four summer bathing seasons (Table 4.75). The site at the wharf exceeded the action level once over the 2004/2005 summer while the Inglis Street site exceeded this level once over each of the 2001/2002 and 2003/2004 summers. Overall the wharf and the Inglis Street monitoring sites complied with the surveillance level of the guidelines on over 95% and 96% of sampling occasions respectively (Figure 4.78).

Table 4.75: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
WHARF								
2001-2002	19	90.5	2	9.5	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	20	90.9	1	4.5	1	4.5	22	100
Total	**82**		**3**		**1**		**86**	
INGLIS STREET								
2001-2002	19	90.5	1	4.8	1	4.8	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**83**		**1**		**2**		**86**	

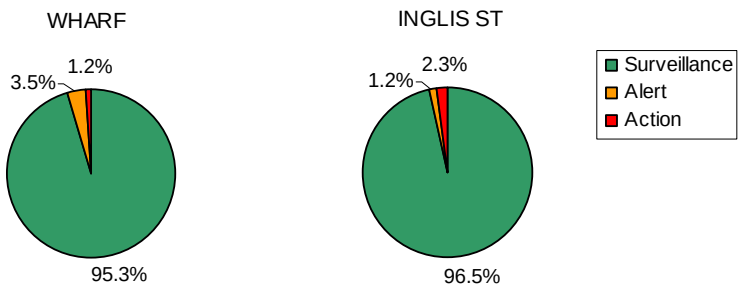

Figure 4.78: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Figure 4.79 illustrates that each site recorded one further exceedance of the action level when the results of all sampling for the 2001-2005 reporting period are considered. The greatest enterococci count recorded at the wharf site was 6,200 cfu/100 mL on 21 March 2005. This result is more than one order of magnitude above the surveillance level of the guidelines and does not appear to be related to rainfall (Table 4.76). Similarly, an enterococci count of 670 cfu/100 mL recorded at the Inglis Street site on 26 January 2004 does not appear to be related to rainfall. Where follow-up sampling was conducted, all of the results complied with the surveillance level.

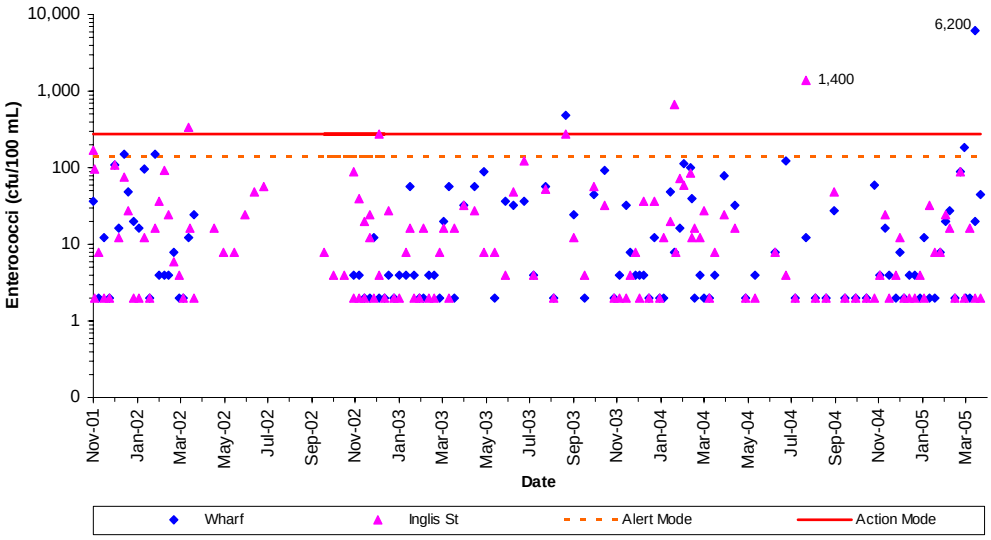

Figure 4.79: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.76: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Wharf	Inglis St	24 hours	48 hours	72 hours	
18/03/2002		340	9	9	9	4.8
28/08/2003	330		10	10	10	10.6
26/01/2004		670	0	0	0	2.2
28/07/2004		1,400	0	4.4	4.4	15.6
21/03/2005	6,200		0.2	1.2	1.4	1.4
Total No. of Exceedances	2	3				
Total No. of Samples	115	129				

4.5.11 Breaker Bay

Breaker Bay achieved a very high level of compliance with the recreational water quality guidelines, with only one exceedance of the action level arising from routine monitoring over the last four summer bathing seasons (Table 4.77). Subsequently, Breaker Bay complied with the surveillance level of the guidelines on almost 99% of sampling occasions (Figure 4.80).

Table 4.77: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**85**		**0**		**1**		**86**	

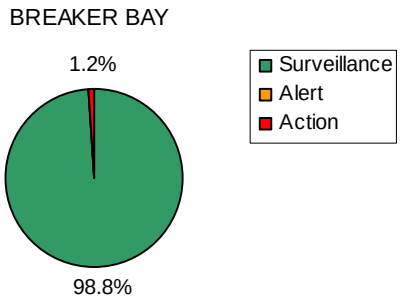

Figure 4.80: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of action level results increases from one to two when the results of all sampling for the 2001-2005 reporting period are considered (Figure

4.81). Both action level results coincided with more than 15 mm of rainfall in the 72 hours prior to the day of sampling (Table 4.78), and are likely to be a result of urban runoff. Follow-up sampling was conducted following the November 2004 exceedance - the results complied with the surveillance level of the guidelines.

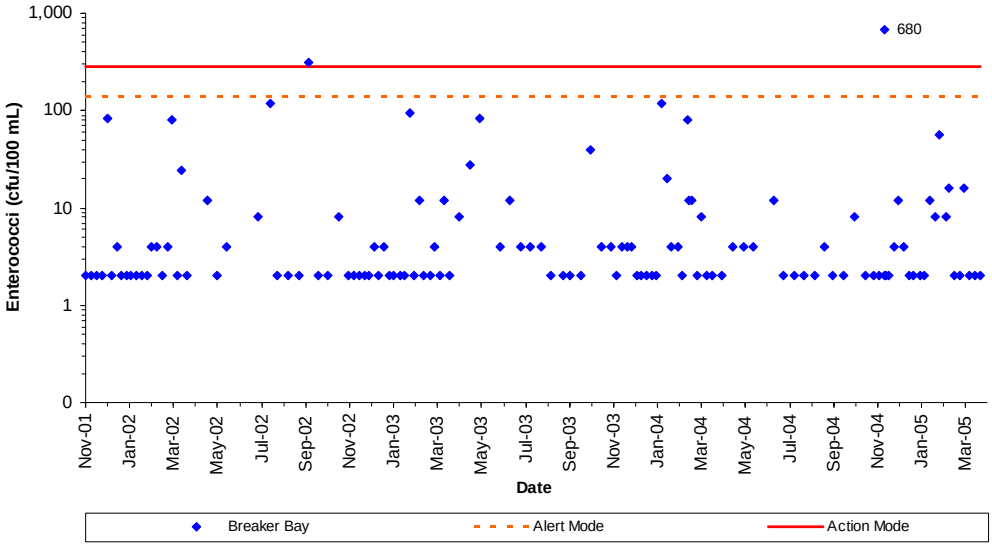

Figure 4.81: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.78: Analysis of exceedances of the MfE/MoH (2003) action levels arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
10/09/2002	310	4	10	16.2	2.8
16/11/2004	680	2	19.4	19.4	0
Total No. of Exceedances	2				
Total No. of Samples	126				

4.5.12 Lyall Bay

Of the three monitoring sites at Lyall Bay, the site adjacent to Onepu Road was the most suitable for contact recreation over the last four summer bathing seasons (Table 4.79, Figure 4.82). This site exceeded the alert level of the recreational water quality guidelines on just two occasions and never exceeded the action level. The Tirangi Road and Queens Drive monitoring sites both exceeded the action level on one occasion, and the alert level on six and three occasions respectively.

Table 4.79: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
TIRANGI ROAD								
2001-2002	21	95.5	1	4.5	0	4.3	22	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	18	81.8	4	18.2	0	0.0	22	100
Total	**80**		**6**		**1**		**87**	
ONEPU ROAD								
2001-2002	20	95.2	1	4.8	0	0.0	21	-
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**84**		**2**		**0**		**86**	
QUEENS DRIVE								
2001-2002	18	85.7	2	9.5	1	4.8	21	-
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	22	100.0	0	0.0	0	0.0	22	100
2004-2005	21	95.5	1	4.5	0	0.0	22	100
Total	**82**		**3**		**1**		**86**	

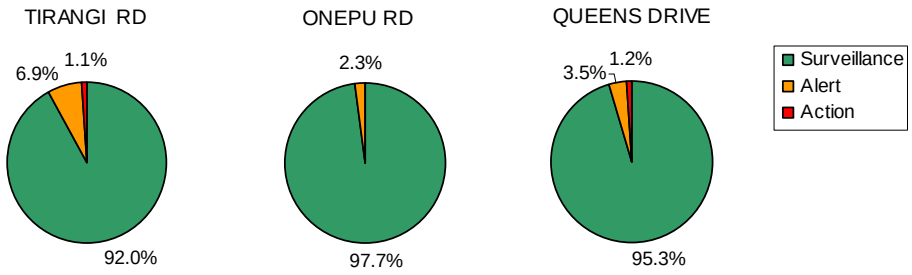

Figure 4.82: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of exceedances of both the alert and action guideline levels increases when the results of all sampling for the 2001-2005 reporting period are considered (Figure 4.83). The greatest enterococci counts recorded from routine monitoring were 10,000 cfu/100 mL and 3,900 cfu/100 mL at Onepu Road and Queens Drive respectively. Both of these counts were recorded on 28 August 2003. Wellington Airport rainfall records indicate that 10 mm of rain had fallen in the 24 hours preceding sampling and further rain fell on the day of sampling (Table 4.80).

In several instances where follow-up sampling was conducted, the results exceeded guideline levels by a greater margin. For example, a result of 310 cfu/100 mL recorded at the Queens Drive site on 4 December 2001 was

followed by an action level exceedance of 1,400 cfu/100 mL when further sampling was conducted two days later (Figure 4.83). Similarly, a result of 280 cfu/100 mL recorded at the Tirangi Road site on 4 February 2002 was followed by an action level exceedance of 1,400 cfu/100 mL on 6 February. In both cases, follow-up sampling coincided with significant rainfall events. However, an alert level exceedance arising from routine monitoring undertaken at Tirangi Road on 9 February 2005 and a follow-up action level exceedance recorded the next day did not coincide with rainfall.

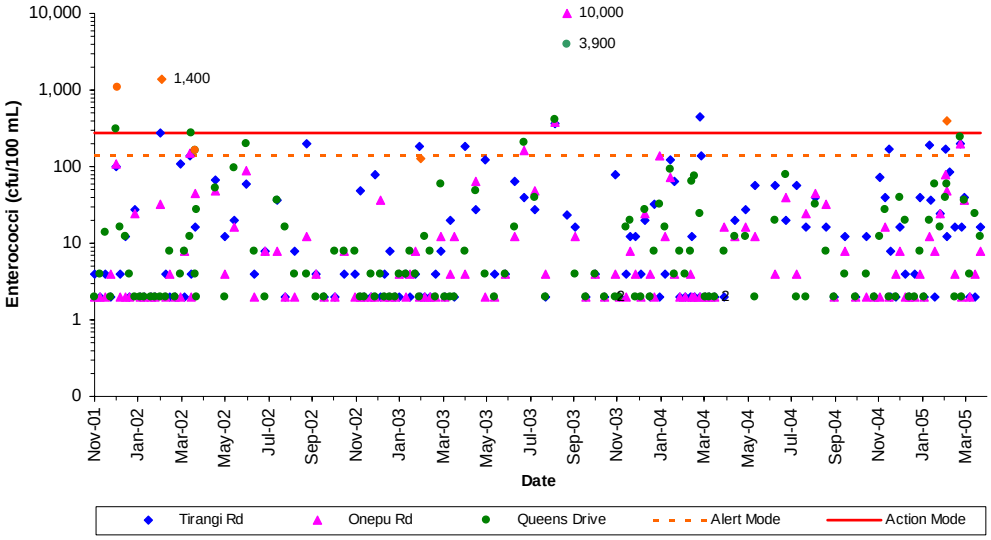

Figure 4.83: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.80: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Tirangi Rd	Onepu Rd	Queens Dr.	24 hours	48 hours	72 hours	
04/12/2001			310	7	9.4	9.4	8.6
11/08/2003	360	380	410	1	1	4.6	9.6
28/08/2003		10,000	3,900	10	10	10	10.6
01/03/2004	440			0	27.8	54.2	0.2
Total No. of Exceedances	3	2	3				
Total No. of Samples	131	129	129				

Due to the relatively high number of alert level events recorded at the Tirangi Road site over the 2004/2005 summer, Wellington City Council is to instigate a detailed survey of the local wastewater system (Capacity 2005). The main source of pollution at Lyall Bay during wet weather is stormwater which discharges into the bay at its eastern end. At times during heavy rain events, the capacity of the sewerage network is exceeded due to groundwater and

infiltration flows. As outlined in Section 4.5, in extreme events, this can cause partially diluted untreated sewage to discharge from this stormwater outfall. These overflows are the reason why people should avoid swimming and other contact recreation activities in Lyall Bay during and for at least 48 hours after heavy rainfall.

4.5.13 Princess Bay

Princess Bay exceeded the action level of the recreational water quality guidelines on two occasions over the last four summer bathing seasons (Table 4.81). Both of these exceedances occurred over the 2003/2004 summer. Overall, Princess Bay was suitable for bathing on almost 98% of sampling occasions (Figure 4.84).

Table 4.81: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	21	100.0	0	0.0	0	0.0	21	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	90.9	0	0.0	2	9.1	22	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**84**		**0**		**2**		**86**	

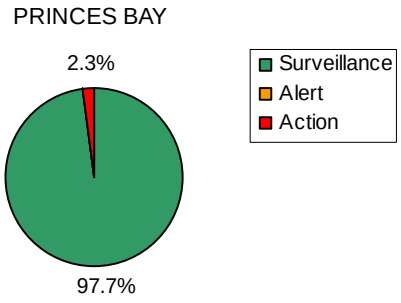

Figure 4.84: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Both exceedances of the action level were relatively minor (Figure 4.85) and coincided with heavy rainfall events (Table 4.82). The results of follow-up sampling conducted the next day complied with the surveillance level guideline.

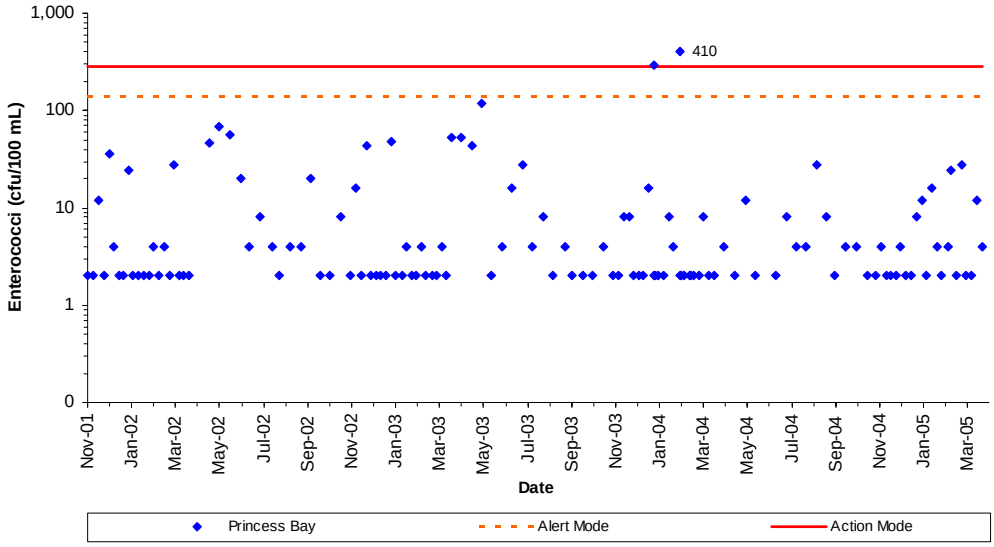

Figure 4.85: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.82: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
29/12/2003	290	0	29	29	4.8
03/02/2004	410	0	59.8	66.6	0
Total No. of Exceedances	2				
Total No. of Samples	129				

4.5.14 Island Bay

All three Island Bay monitoring sites recorded a similar number of exceedances of the alert and action levels of the recreational water quality guidelines (Table 4.83). However, the timing of the exceedances differed between sites. The Old Bait Shed site recorded the greatest number of exceedances over the 2001/2002 summer while the Reef Street site recorded the greatest number of exceedances over the 2004/2005 summer. Overall, the Old Bait Shed, Surf Club and Reef Street monitoring sites complied with the surveillance level of the recreational water quality guidelines on 93%, 94.3% and 91.9% of routine sampling occasions respectively (Figure 4.86).

Table 4.83: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
OLD BAIT SHED								
2001-2002	17	81.0	2	9.5	2	9.5	21	100
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**80**		**3**		**3**		**86**	
SURF CLUB								
2001-2002	20	90.9	2	9.1	0	0.0	22	-
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	20	90.9	1	4.5	1	4.5	22	100
Total	**82**		**3**		**2**		**87**	
REEF STREET RECREATION GROUND								
2001-2002	20	95.2	1	4.8	0	0.0	21	-
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	21	95.5	0	0.0	1	4.5	22	100
2004-2005	17	77.3	3	13.6	2	9.1	22	100
Total	**79**		**4**		**3**		**86**	

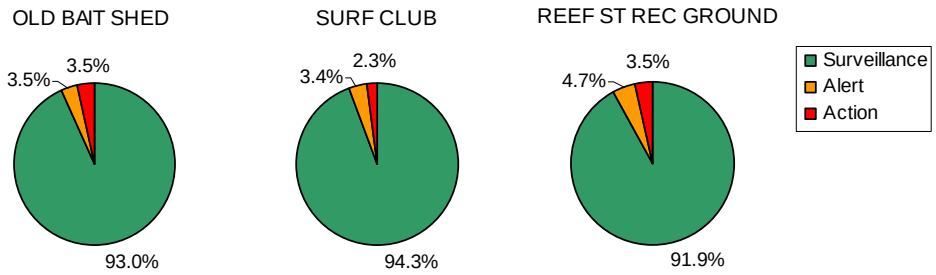

Figure 4.86: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

It can be seen from Figure 4.87 and Table 4.84 that all three monitoring sites recorded further exceedances of the action level when the results of all routine sampling for the 2001-2005 reporting period are considered. For example, the Old Bait Shed site recorded a further five exceedances compared with three exceedances during the four summer bathing periods.

On 19 May 2003 and 28 August 2003, all three monitoring sites recorded enterococci counts that were at least an order of magnitude above guideline levels (Figure 4.87). Overall, the highest enterococci counts arising from routine monitoring were recorded adjacent to the Reef Street Recreation Ground. Four of the seven action level exceedances recorded at this site were

at least an order of magnitude above guideline levels. All four of these results were recorded outside of the summer bathing season.

Analysis of rainfall records from Wellington Airport indicate that rainfall may account for many, but certainly not all, of the action level events recorded at the three sites (Table 4.84). For example, action level results recorded at all three site on 28 August 2003 coincided with 10 mm of rainfall in the 24 hours prior to sampling and further rain on the day of sampling. In contrast, action level results recorded at the Old Bait Shed on 31 December 2001 and 22 April 2002, and at the Reef Street Recreation Ground on 1 March 2005 coincided with little or no rainfall. The reason for these elevated results is unclear. Capacity (pers. comm. 2005) has noted that at times of high tide and strong southerly winds, debris and other material pushed into the bay may influence water quality.

In several instances where follow-up sampling was conducted, the follow-up results exceeded guideline levels by a greater margin. For example, an alert level result of 170 cfu/100 mL recorded at the Old Bait Shed site during routine monitoring on 14 January 2002 was followed by action level exceedances of 1,500 cfu/100 mL and 4,200 cfu/100 mL on 16 and 17 January 2002 respectively (Figure 4.87). Similarly, an alert level result of 220 cfu/100 mL recorded at the Surf Club site during routine monitoring on 4 March 2002 was followed by an action level exceedance of 1,100 cfu/100 mL the next day. Of the guideline exceedances that arose from follow-up sampling, only those recorded at the Old Bait Shed site coincided with significant rainfall.

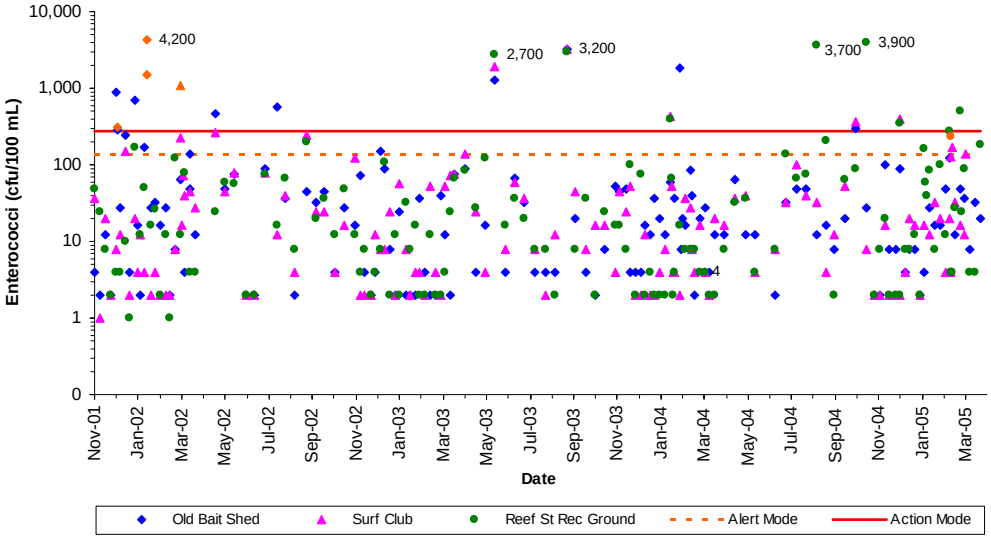

Figure 4.87: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.84: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Old Bait Shed	Surf Club	Reef St Rec Ground	24 hours	48 hours	72 hours	
04/12/2001	870			7	9.4	9.4	8.6
31/12/2001	690			0	0	0	0
22/04/2002	460			0	0	0	0.4
18/07/2002	570			10.4	20.8	36	0
19/05/2003	1,300	1,900	2,700	0	0	0	10
28/08/2003	3,200	3,200	3,000	10	10	10	10.6
20/01/2004		430	400	19.8	29.8	29.8	51
03/02/2004	1,800			0	59.8	66.6	0
11/08/2004			3,700	16.4	16.4	16.6	0
06/10/2004	300	360		3	5.2	5.2	0
20/10/2004			3,900	0.2	1.0	9.6	0
06/12/2004		400	350	10	10	10	0
01/03/2005			500	1.8	4.2	4.2	0
Total No. of Exceedances	8	5	7				
Total No. of Samples	129	130	129				

Due to the relatively high number of alert and action level results recorded at Island Bay sites over the 2004/2005 summer, the Wellington City Council undertook a detailed investigation of all the local wastewater and stormwater drains. However, no sources of pollution were found (Capacity 2005). The main source of pollution at Island Bay during wet weather is stormwater which discharges into the bay opposite the Reef Street Recreation Ground. At times during heavy rain events, the capacity of the sewerage network is exceeded due to groundwater and infiltration flows. As outlined in Section 4.5, in extreme events, this can cause partially diluted untreated sewage to discharge from this stormwater outfall. Therefore swimming and other contact recreation activities should be avoided during and for at least 48 hours after heavy rainfall as advised by health warning signs erected in the vicinity of the stormwater discharge.

The value of the Old Bait Shed monitoring site has been questioned as it is not used as a bathing beach, only a boat ramp. Moreover, the monitoring site at the Island Bay Surf Club is not far away. Wellington City Council therefore proposes to relocate the Old Bait Shed monitoring site to the beach opposite Derwent Street (Capacity 2005). This new site was monitored over February and March 2005 and exceeded the action level on one occasion (1 March 2005).

4.5.15 Owhiro Bay

Owhiro Bay exceeded the alert and action levels of the recreational water quality guidelines on three and five occasions respectively over the last four summer bathing seasons (Table 4.85). Most of these exceedances occurred

over the 2004/2005 summer, including three action level exceedances. In contrast, there were no exceedances of alert or action levels at either monitoring site over the 2002/2003 summer. Overall, Owhiro Bay complied with the surveillance level of the guidelines on 91% of sampling occasions (Figure 4.88).

Table 4.85: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
2001-2002	22	91.7	1	4.2	1	4.2	24	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	90.9	1	4.5	1	4.5	22	100
2004-2005	18	81.8	1	4.5	3	13.6	22	100
Total	**81**		**3**		**5**		**89**	

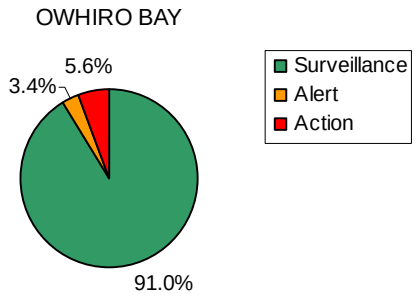

Figure 4.88: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The number of exceedances of the action level doubles from five to ten when the results of all sampling for the 2001-2005 reporting period are considered (Figure 4.89). The greatest enterococci count recorded was 50,000 cfu/100 mL on 14 July 2004. This result is more than two orders of magnitude above guideline levels and can not be attributed to rainfall (Table 4.86). As this result was recorded in the winter months, no follow-up sampling was conducted. Therefore it is not known how quickly water quality returned to the surveillance guideline level.

As with the Island Bay sites, in several instances where follow-up sampling was conducted, the follow-up results exceeded guideline levels by a greater margin. For example, a result of 620 cfu/100 mL recorded during routine monitoring on 20 November 2001 was followed by a further action level result of 7,100 cfu/100 mL on 22 November. Subsequent follow-up samples collected on 23, 24 and 25 November also resulted in exceedances of the action level (Figure 4.89). Although the initial exceedance on 20 November 2001 did not coincide with rainfall (Table 4.86), exceedances arising from subsequent

ollow-up samples are likely to be rainfall related; 81.8 mm of rainfall was recorded in the 72 hour period from 9:00 am on 21 November to 09:00 am on 24 November inclusive.

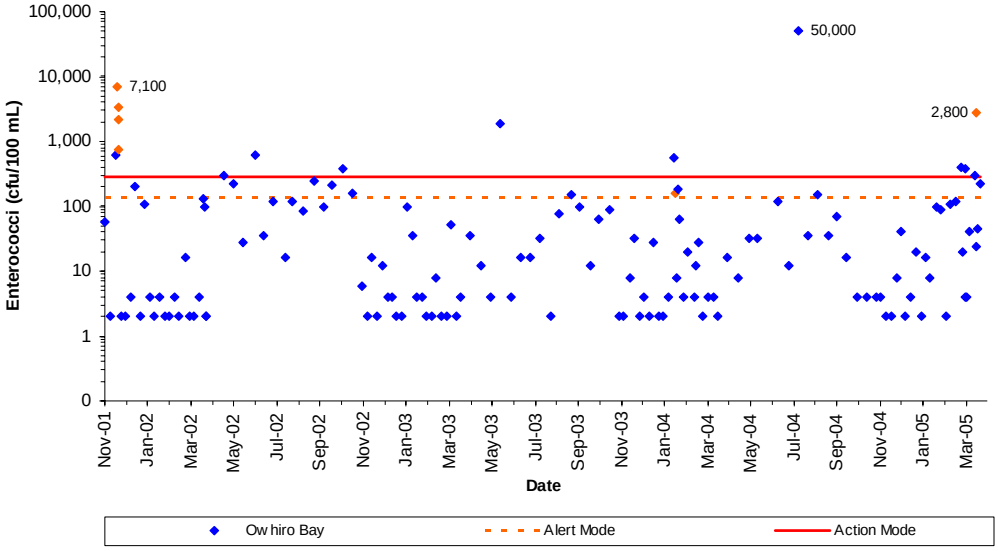

Figure 4.89: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive
(Note: Follow-up sample results that exceed guideline values are coloured orange)

Table 4.86: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Wellington Airport rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)	Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
		24 hours	48 hours	72 hours	
20/11/2001	620	0	0	0	0.4
22/04/2002	300	0	0	0	0.4
05/06/2002	620	0	0	0	1.8
07/10/2002	380	1.2	4.0	4.0	0.8
19/05/2003	1,900	0	0	0	10
20/01/2004	570	19.8	29.8	29.8	51
14/07/2004	50,000	0	0.2	0.4	0.2
01/03/2005	400	1.8	4.2	4.2	0
07/03/2005	380	11.8	11.8	11.8	0
21/03/2005	300	0.2	1.2	1.4	1.4
Total No. of Exceedances	10				
Total No. of Samples	132				

Table 4.86 indicates that little or no rainfall was recorded in the 72 hours preceding the majority of the action level results, suggesting that some other factor is influencing water quality. There does not appear to be any consistent pattern with respect to these elevated 'dry weather' results and seaweed cover or tides, although the wind direction on all occasions was from the north.

It is likely that water quality at Owhiro Bay is at times influenced by Owhiro Stream. This stream discharges directly into Owhiro Bay and is known to carry elevated bacteria levels at times; all three tributaries of this stream are affected by urban development to a significant extent. Up until June 2003, the Wellington City Council held a resource consent to discharge stormwater contaminated with partially diluted untreated sewage into Owhiro Bay via Owhiro Stream. As outlined in Section 5.1, this consent was not renewed when it expired in 2003 as works undertaken by the Wellington City Council had improved receiving water quality; no significant dry wet weather sewage leaks and no significant wet weather sewage overflows were identified (Montgomery Watson Harza 2003).

The possibility of illegal cross connections between stormwater and sewer drains at subdivisions on Happy Valley Road has been raised as a possible reason for elevated enterococci counts recorded in March 2005 (Capacity 2005). Greater Wellington Regional Council pollution control staff investigated this possibility following an action level event at Owhiro Bay on 21 March 2005 but did not find any evidence that such cross connections exist.

4.5.16 Discussion

Monitoring undertaken over 2001-2005 indicates that water quality is very good at most marine recreational areas in Wellington City. Twenty of the 22 monitoring sites complied with the surveillance level of the recreational water quality guidelines (<140 enterocococi/100 mL) on over 90% of routine summer sampling occasions, with 12 of these sites compliant on over 95% of sampling occasions. Scorching Bay, Lyall Bay at Onepu Road, Worser Bay and Breaker Bay recorded the highest level of compliance with the guidelines, followed by Balaena Bay and Princes Bay (Figure 4.90). Scorching Bay and Lyall Bay at Onepu Road were the only two sites not to exceed the action level guideline during any summer season. Hataitai Beach and Oriental Bay (at Wishing Well and Band Rotunda) recorded the lowest level of compliance. Hataitai Beach exceeded the surveillance level guideline on more than 13% of routine sampling occasions. Stormwater discharges and birdlife are likely contributors to faecal contamination at this site.

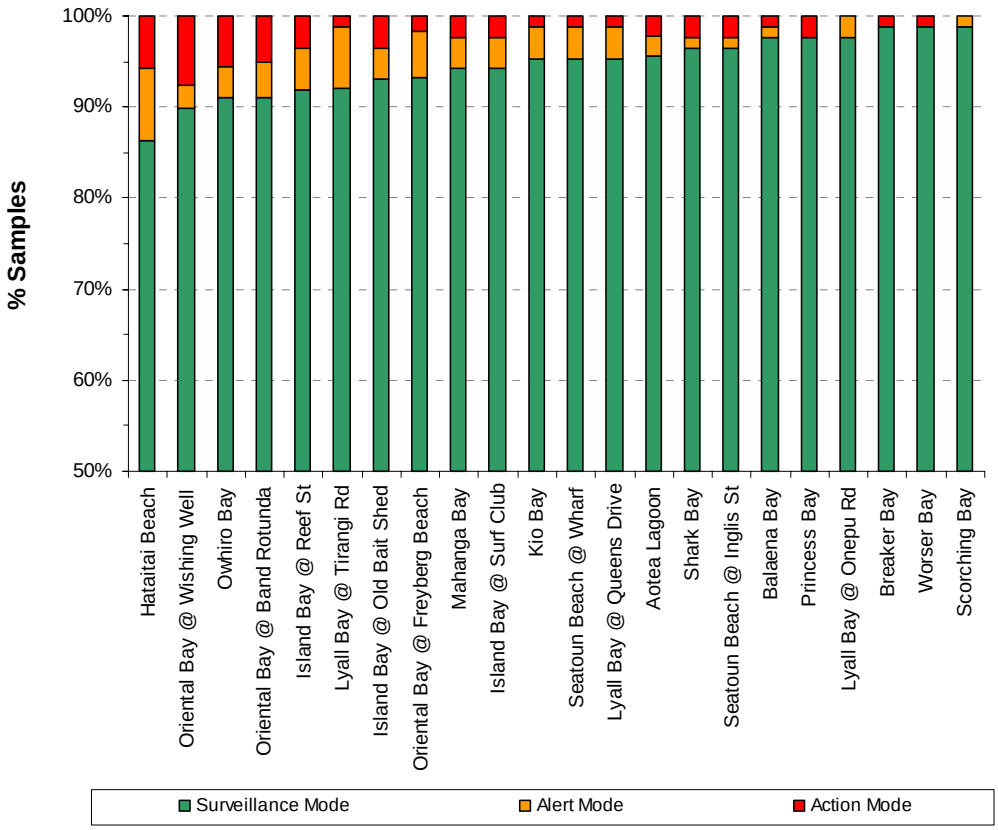

Figure 4.90: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

4.5.17 Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer, with just one of the 22 sites exceeding the action level guideline (Table 4.87). In contrast, the lowest level of compliance with the guidelines was obtained over the 2004/2005 summer. Thirteen sites exceeded the action level over this period, with five sites exceeding the action level on at least two occasions.

Table 4.87: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly sampling undertaken at the 22 monitoring sites in Wellington City

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3	≥4
2001/2002	6	8	7	1	0	0
2002/2003	17	1	1	0	0	0
2003/2004	8	11	8	2	0	1
2004/2005	3	13	8	3	2	0

Analysis of rainfall records indicates that rainfall events may account for just over 70% of the action level exceedances recorded from routine monitoring over the full reporting period. The total number of sites recording exceedances over each summer season certainly shows a relationship with rainfall. For example, the high degree of compliance with the guidelines over the 2002/2003 summer coincides with very low rainfall; the rainfall recorded in each of January, February and March 2003 was significantly lower than the longterm average for these same months (Figure 4.91). In contrast, the high number of exceedances over the 2003/2004 summer correlates with above average rainfall for January and February 2004; eight of the 16 action level exceedances were recorded during these two months. Although the total monthly rainfall recorded over the 2004/2005 summer months was significantly less than that recorded for the 2003/2004 summer, it was still above the longterm average due to a very wet March. Analysis of the timing of action level exceedances for the 2003/2004 summer shows that almost half of the exceedances occurred in March alone.

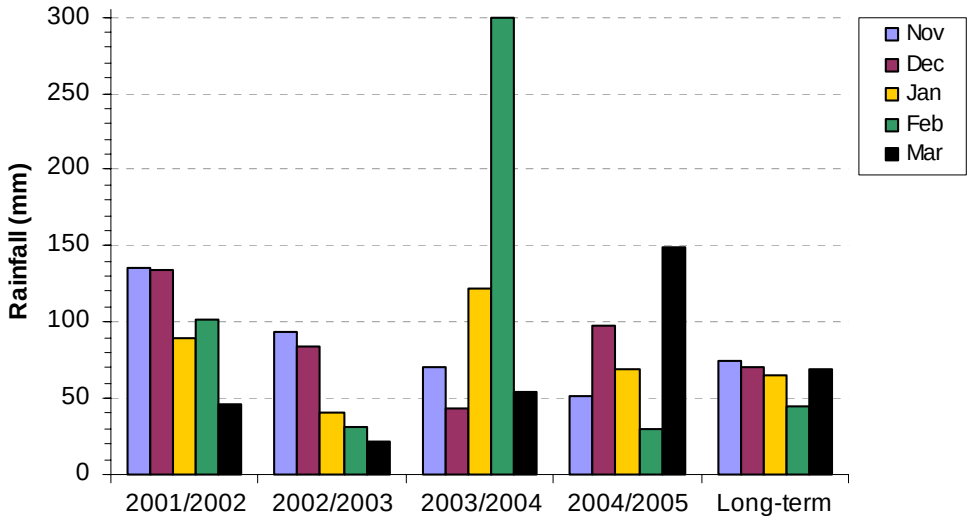

Figure 4.91: Monthly rainfall recorded at Wellington Airport over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1960 to present)

Although there is an overall correlation between the occurrence of action level exceedances and rainfall events, several monitoring sites exceeded the action level on a number of occasions that coincided with little or no rainfall. These include Oriental Bay (at Wishing Well), Island Bay (particularly at Old Bait Shed), Owhiro Bay and, on occasion, Seatoun Beach.

It is unclear why a number of elevated results coincided with little or no rainfall. It is likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some locations. It is also possible that water quality at beaches on the Wellington City's south coast is influenced by debris and other material pushed up onto the beaches at times of high tide and strong southerly winds.

4.5.18 Suitability for recreation

The number of exceedances of the recreational water quality guidelines over the last four summer seasons was low for many sites, resulting in relatively low MAC values for the majority of sites (Table 4.88). These low MAC values combine with moderate SIC values to give an interim SFRG of "good" for 14 of the 22 monitoring sites in Wellington City. Breaker Bay and Princes Bay, due to their very low SIC grades, both have an interim SFRG of "very good".

The interim SFRG is "fair" for the remainder of the sites, with the exception of Hataitai Beach which has an interim SFRG of "poor". The lower SFRGs reflect the higher MAC values recorded for these sites and also, in the case of Hataitai Beach, a very high SIC grade. Oriental Bay at the Wishing Well recorded the greatest MAC (468 enterococci/100 mL).

Table 4.88: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for marine bathing sites in Wellington City

Site	MAC*	SIC	Interim SFRG
AOTEA LAGOON			
Aotea Lagoon	B (95^{th} percentile = 144, n=89)	Moderate	Good
ORIENTAL BAY			
Freyberg Beach	B (95^{th} percentile = 188, n=59)	Moderate	Good
Wishing Well	C (95^{th} percentile = 468, n=79)	Moderate	Fair
Band Rotunda	C (95^{th} percentile = 287, n=79)	Moderate	Fair
BALAENA BAY			
Balaena Bay	B (95^{th} percentile = 67, n=86)	Moderate	Good
KIO BAY			
Kio Bay	B (95^{th} percentile = 128, n=86)	Moderate	Good
HATAITAI BEACH			
Hataitai Beach	C (95^{th} percentile =400, n=88)	High	Poor
SHARK BAY			
Shark Bay	B (95^{th} percentile = 94, n=85)	Moderate	Good
MAHANGA BAY			
Mahanga Bay	C (95^{th} percentile = 163, n=87)	Moderate	Fair
SCORCHING BAY			
Scorching Bay	B (95^{th} percentile = 45, n=86)	Moderate	Good
WORSER BAY			
Worser Bay	B (95^{th} percentile = 45, n=88)	Moderate	Good

Site	MAC*	SIC	Interim SFRG
SEATOUN BEACH			
Wharf	B (95th percentile = 120, n=86)	Moderate	Good
Inglis Street	B (95th percentile = 89, n=86)	Moderate	Good
BREAKER BAY			
Breaker Bay	B (95th percentile = 81, n=86)	Very Low	Very Good
LYALL BAY			
Tirangi Road	C (95th percentile = 182, n=87)	Moderate	Good
Onepu Road	B (95th percentile = 86, n=86)	Moderate	Good
Queens Drive	B (95th percentile = 106, n=86)	Moderate	Good
PRINCES BAY			
Princes Bay	B (95th percentile = 45, n=86)	Very Low	Very Good
ISLAND BAY			
Old Bait Shed	B (95th percentile = 184, n=86)	Moderate	Good
Surf Club	B (95th percentile = 153, n=87)	Moderate	Good
Reef Street Rec Ground	B (95th percentile = 198, n=86)	Moderate	Good
OWHIRO BAY			
Owhiro Bay	C (95th percentile = 304, n=89)	Moderate	Fair

* Based on enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The interim SFRGs apply to the summer bathing season only and several sites, notably Island Bay and Owhiro Bay, recorded a greater number of elevated enterococci counts during the winter months. In the case of the three sites at Island Bay, if the winter results were included in the determination of the MAC values, then the interim SFRGs would be downgraded from "good" to "fair" as the 95th percentile enterococci counts for the full reporting period would result in "C" MAC values.

Capacity, on behalf of the Wellington City Council, has also determined SFRGs for the 22 marine bathing sites in Wellington City. The grades differ from those provided in Table 4.88, reflecting different SIC grades assigned to the majority of the sites and, to a lesser extent, slightly different methodology used to calculate the MAC values. These differences highlight the need to review the SIC grades (and MAC values) for Wellington City monitoring sites over 2005/2006. This review should be undertaken in conjunction with Capacity.

4.6 Wairarapa

Marine recreational water quality monitoring is conducted at two sandy beaches in the Wairarapa, Riversdale and Castlepoint. Both beaches are popular for swimming, surfing and boating. Both beaches are also influenced by discharges from streams.

Castlepoint Stream and Smelly Creek discharge onto Castlepoint Beach (Figure 4.92). Both of these streams have predominantly agricultural catchments, with the former also receiving treated wastewater from the Castlepoint township during the winter months.

At Riversdale, the Motuwaireka Stream flows into the Motuwaireka Lagoon (more commonly known as Riversdale Lagoon), before entering the sea. The stream has its headwaters in the Ngamu Forest and Riversdale area and follows a course that is predominantly surrounded by pastoral farming. Water quality in the lagoon is affected by agricultural activity, particularly following periods of high rainfall, and also by possible septic tank seepage and leachate from a decommissioned landfill entering a tributary of the Motuwaireka Stream (Stansfield 2000). The other stream to discharge to Riversdale Beach is located to the south and drains a predominantly pastoral farming catchment. A composting toilet is located near the stream in its lower reaches behind the sand dunes. Stormwater from the Riversdale township is collected in a drain and discharges onto the beach approximately one kilometre south of the lagoon mouth, near the designated swimming area.

Figure 4.92: Castlepoint Beach from Smelly Creek

4.6.1 Castlepoint Beach

Castlepoint Beach achieved a high level of compliance with the recreational water quality guidelines over the last four summer bathing seasons (Table 4.89). The Smelly Creek site exceeded each of the alert and action levels on only one occasion and complied with the surveillance level on nearly 98% of all routine sampling occasions (Figure 4.93). The site at Castlepoint Stream

exceeded the alert and action levels on four and two occasions respectively. The results of all sampling for the 2001-2005 reporting period are shown in Figure 4.94.

Table 4.89: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
CASTLEPOINT STREAM								
2001-2002	20	95.2	1	4.8	0	0.0	21	100
2002-2003	19	90.5	2	9.5	0	0.0	21	100
2003-2004	17	89.5	1	5.3	1	5.3	19	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**77**		**4**		**2**		**83**	
SMELLY CREEK								
2001-2002	20	100.0	0	0.0	0	0.0	20	-
2002-2003	19	95.0	1	5.0	0	0.0	20	100
2003-2004	19	95.0	0	0.0	1	5.0	20	100
2004-2005	23	100.0	0	0.0	0	0.0	23	100
Total	**81**		**1**		**1**		**83**	

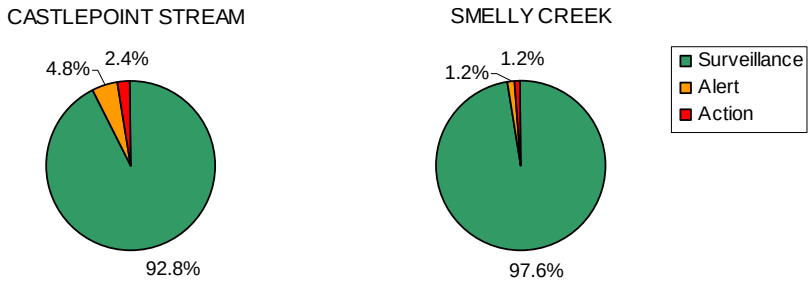

Figure 4.93: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

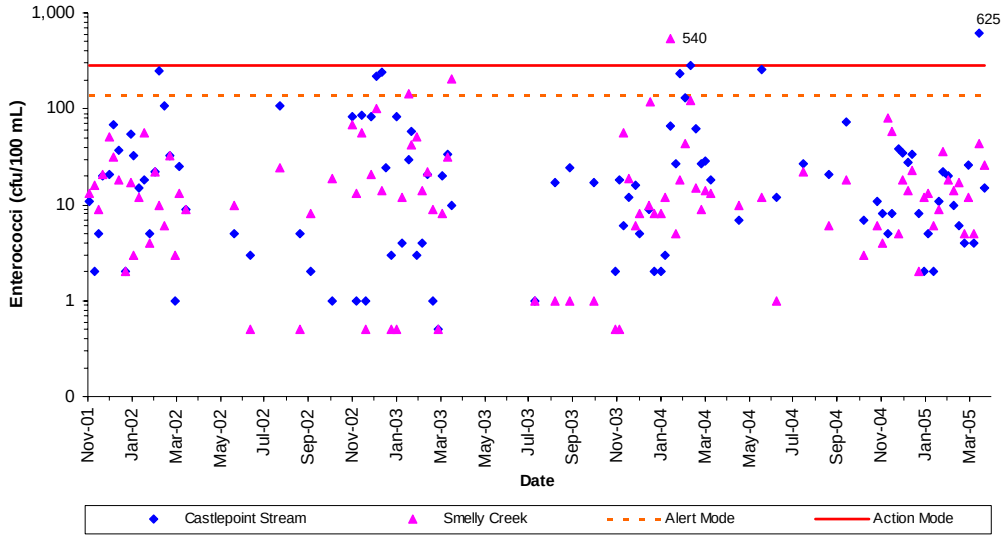

Figure 4.94: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

All of the action level events (and almost all of the alert level events) coincided with rainfall in the 72 hours prior to sampling (Table 4.90). This is probably not surprising given that both sampling sites are located near stream mouths. As outlined in Section 4.6, Castlepoint Stream and Smelly Creek both drain predominantly rural catchments and are likely to have poorer water quality as a result of agricultural runoff following rainfall events. Smelly Creek is in fact ephemeral, with stormwater from the Castlepoint settlement being its primary source of flow (Watts and Sevicke-Jones, 2001). Castlepoint Stream also receives treated wastewater from the Castlepoint township during the winter months.

Table 4.90: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Castlepoint rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)		Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm
	Castlepoint Stream	Smelly Creek	24 hrs	48 hrs	72 hrs	
20/01/2004		540	36.7	38.2	38.2	0
17/02/2004	284		10.1	128.8	138.2	3.3
22/03/2005	625		13.8	14.4	18.6	1
Total No. of Exceedances	4	1				
Total No. of Samples	99	99				

4.6.2 Riversdale Beach

Two of the three Riversdale Beach monitoring sites achieved a very high level of compliance with the recreational water quality guidelines over the last four summer bathing seasons (Table 4.91). The main swimming area between the flags exceeded each of the alert and action levels on only one occasion and

complied with the surveillance level guideline on nearly 98% of all routine sampling occasions (Figure 4.95). The southern monitoring site also had very high water quality and exceeded the alert level only once. In contrast the monitoring site adjacent to Riversdale Lagoon exceeded the action level on four occasions.

Table 4.91: Analysis of enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons against the MfE/MoH (2003) surveillance, alert and action levels for marine recreational waters

Bathing Season	Surveillance		Alert		Action		Total	
	No.	%	No.	%	No.	%	No.	%
LAGOON MOUTH								
2001-2002	17	85.0	1	5.0	2	10.0	20	-
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	19	95.0	0	0.0	1	5.0	20	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**78**		**1**		**4**		**83**	
BETWEEN THE FLAGS								
2001-2002	19	95.0	1	5.0	0	0.0	20	100
2002-2003	21	100.0	0	0.0	0	0.0	21	100
2003-2004	20	100.0	0	0.0	0	0.0	20	100
2004-2005	21	95.5	0	0.0	1	4.5	22	100
Total	**81**		**1**		**1**		**83**	
RIVERSDALE SOUTH								
2001-2002	20	100.0	0	0.0	0	0.0	20	-
2002-2003	20	95.2	1	4.8	0	0.0	21	100
2003-2004	19	100.0	0	0.0	0	0.0	19	100
2004-2005	22	100.0	0	0.0	0	0.0	22	100
Total	**81**		**1**		**0**		**82**	

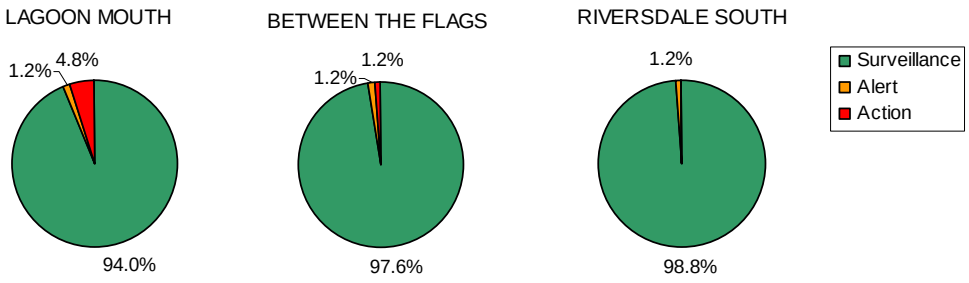

Figure 4.95: Summary of compliance with the MfE/MoH (2003) surveillance, alert and action levels for the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

The exceedances of the recreational water quality guidelines are illustrated in Figure 4.96, together with the results of all sampling for the 2001-2005 reporting period. Analysis of rainfall records from the Castlepoint rainfall station indicate that the majority of alert and action level results coincided with significant rainfall events in the 72 hours prior to the day of sampling (Table

4.92). For example, the highest enterococci count recorded adjacent to the lagoon was 604 cfu/100 mL on 17 February 2004 and over 138 mm of rainfall had fallen in the 72 hours prior to sampling.

It is not surprising that the beach adjacent to Riversdale Lagoon exceeded the action level of the guidelines on the most occasions. As discussed in Section 3.4.7, the lagoon is known to have poor water quality at times. Previous reports (e.g., Stansfield, 2000) have attributed this to possible septic tank seepage from the Riversdale settlement, a decommissioned landfill in the Motuwaireka catchment and agricultural runoff.

Figure 4.96: Enterococci counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

Table 4.92: Analysis of exceedances of the MfE/MoH (2003) action level arising from all routine monitoring against rainfall recorded at the Castlepoint rainfall station prior to sample collection

Date	Enterococci (cfu/100 mL)			Rainfall prior to day of sampling (mm)			Rainfall on day of sampling (mm)
	Lagoon Mouth	Between the Flags	South	24 hrs	48 hrs	72 hrs	
11/12/2001	322			0	39.1	76.3	0
22/01/2002	475			0	4.8	37.8	0
17/02/2004	604			10.1	128.8	138.2	3.3
22/03/2005	430	1		13.8	14.4	18.6	1
Total No. of Exceedances	4	2	0				
Total No. of Samples	100	100	99				

4.6.3 Discussion

Monitoring undertaken over 2001-2005 indicates that water quality is very good at the main bathing beaches in the Wairarapa. All five of the monitoring sites complied with the surveillance level of the recreational water quality

guidelines (<140 enterococci/100 mL) on over 90% of routine summer sampling occasions, with three of these sites compliant on over 95% of sampling occasions. The southern Riversdale Beach site recorded the highest level of compliance with the guidelines (Figure 4.97).

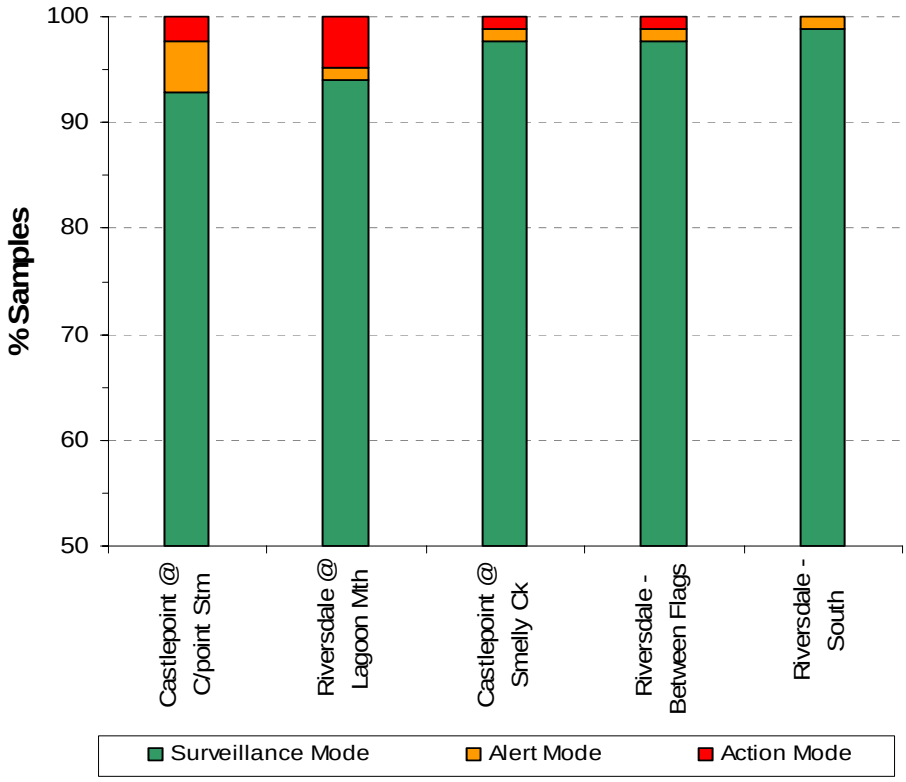

Figure 4.97: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

4.6.4 Trends over time

The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer. None of the five sites exceeded the action level during this summer (although three sites exceeded the alert level), (Table 4.93). In contrast, the lowest level of compliance with the guidelines was obtained over the 2003/2004 and 2003/2004 summer seasons. In each of these summers, three sites exceeded the action level.

Table 4.93: Summary of seasonal compliance with the surveillance and action levels of the MfE/MoH (2003) recreational water quality guidelines, based on routine weekly sampling undertaken at the five monitoring sites in the Wairarapa

Summer	No. of Sites 100% Compliant with Surveillance Level	No. of Sites with Exceedances of Action Level and No. of Exceedances				
		Total	1	2	3	≥ 4
2001/2002	2	1	1	0	0	0
2002/2003	2	0	0	0	0	0
2003/2004	2	3	3	0	0	0
2004/2005	2	3	3	0	0	0

All exceedances of the action level coincided with rainfall events, and the total number of sites recording exceedances in each summer season also correlates with total summer rainfall. For example, more sites exceeded the action level over the 2003/2004 and 2004/2005 summer seasons compared with the two previous summer seasons and this correlates with above average rainfall over the majority of the 2003/2004 and 2004/2005 summer months (Figure 4.98).

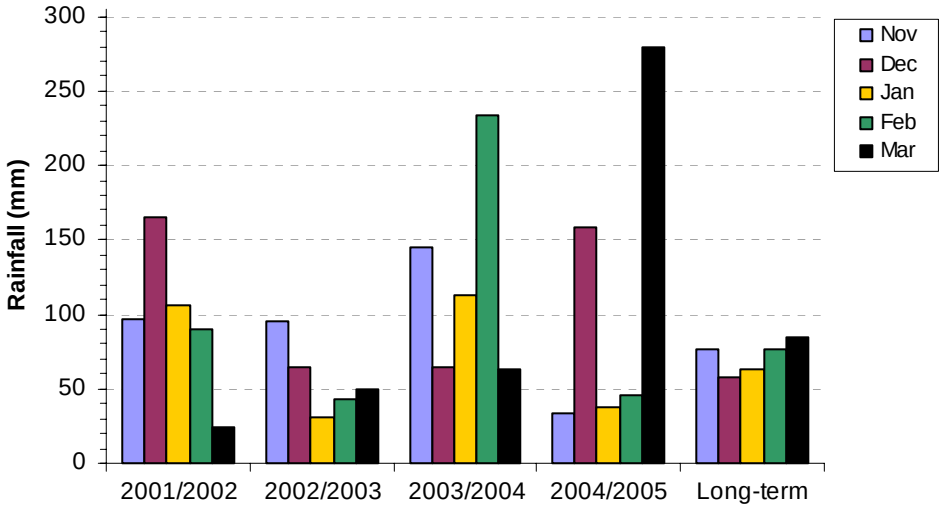

Figure 4.98: Monthly rainfall recorded at Castlepoint over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months, together with the longterm average monthly rainfall (1985 to present)

4.6.5 Suitability for recreation

The number of exceedances of the recreational water quality guidelines over the last four years was low at all five monitoring sites, resulting in relatively low MAC values (Table 4.94). These low MAC values combine with low to moderate SIC values to give an interim SFRG of "good" for Castlepoint Beach at Smelly Creek, Riversdale Beach at the designated bathing area and the monitoring site at the southern end of Riversdale Beach. The SFRG is "fair" for both Castlepoint Beach at Castlepoint Stream and Riversdale Beach at the lagoon mouth, reflecting the higher MAC values recorded for these sites.

Table 4.94: Microbiological assessment category (MAC), sanitary inspection category (SIC) and interim suitability for recreation grades (SFRG) for marine bathing sites in the Wairarapa

Site	MAC*	SIC	Interim SFRG
CASTLEPOINT BEACH			
Castlepoint Stream	C (95^{th} percentile = 234, n=83)	Moderate	Fair
Smelly Creek	B (95^{th} percentile = 119, n=83)	Moderate	Good
RIVERSDALE BEACH			
Lagoon Mouth	C (95^{th} percentile = 207, n=83)	Moderate	Fair
Between the Flags	B (95^{th} percentile = 80, n=83)	Moderate	Good
South	B (95^{th} percentile = 46, n=82)	Low	Good

* Based on enterococci counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

4.7 Synthesis

Recreational water quality is currently monitored at 76 marine sites across the Greater Wellington Region. Compliance with the MfE/MoH (2003) recreational water quality guidelines over the last four summer bathing seasons is summarised for these sites in Figure 4.99.

Of the 76 monitoring sites:

- Only one site - Paekakariki Beach (at the Surf Club) - complied with the surveillance level of the MfE/MoH (2003) recreational water quality guidelines on 100% of sampling occasions over the last four summer bathing seasons. This site also achieved 100% compliance with the surveillance level during routine winter monitoring undertaken during the reporting period.

- In addition to Paekakariki Beach (at the Surf Club), four other sites - Days Bay (at Moana Road), Scorching Bay, Lyall Bay (at Onepu Road) and Riversdale Beach (south) did not exceed the action level of the guidelines on any occasion over the last four summer bathing seasons. However, all exceeded the alert level on one or more occasions, and both Scorching Bay and Lyall Bay exceeded the action level on one or more routine winter monitoring occasions.

- Nineteen (25%) of the sites exceeded the action level of the guidelines on only one occasion over the last four summer bathing seasons. However, 16 of these sites also exceeded the alert level on at least one summer sampling occasion, with nine sites exceeding this level on two or more occasions. Raumati Beach (at Marine Gardens) and Lyall Bay (at Tirangi Road) exceeded the alert level on 10 and 6 occasions respectively.

- Fifty nine (77%) of the sites complied with the surveillance level of the guidelines on more than 90% of summer sampling occasions. The lowest level of compliance with the surveillance level of the guidelines was recorded at Titahi Bay at Bay Drive (77.9%), Pauatahanui Inlet at Browns Bay (78.1%), Porirua Harbour at the Rowing Club (83.5%), South Beach at Plimmerton (83.9%) and Titahi Bay at South Beach (83.9%).

- Eleven (14.5%) of the sites exceeded the action level of the guidelines on more than five occasions over the last four summer bathing seasons; Plimmerton Beach (at Bath Street), South Beach, Pauatahanui Inlet (at Water Ski Club and Browns Bay[4]), Paremata Beach, Porirua Harbour (at Rowing Club), Titahi Bay (at Bay Drive and South Beach), Onehunga Bay, Petone Beach (at Sydney Street), and Oriental Bay (at Wishing Well). The sites with the greatest percentage of action level exceedances were Titahi Bay at Bay Drive (15.1%), Pauatahanui Inlet at Browns Bay (14.1%), South Beach at Plimmerton (13.8%), Porirua Harbour at the Rowing Club (9.4%), and Plimmerton Beach at Bath Street (8.1%).

Analysis of rainfall records indicates that the majority of action level exceedances coincided with rainfall events. However, the relationship with rainfall varies. For example, rainfall may only account for approximately 55% of all action level exceedances recorded at sites in Hutt City during routine monitoring over the November 2001-March 2005 reporting period. In contrast, in the Wairarapa rainfall appears to account for 100% of all action level exceedances. At sites in Kapiti, Wellington City and Porirua City, rainfall appears to account for 70 to 80% of all action level exceedances.

Although the majority of action level results coincided with rainfall events, at some monitoring sites, a number of exceedances of the action level coincided with little or no rainfall. These sites include:

- Kapiti – Paraparaumu Beach (at Ngapoti Street and Nathan Avenue)

- Porirua City – Titahi Bay (at Bay Drive), Plimmerton Beach, South Beach at Plimmerton and Pauatahanui Inlet (at Browns Bay),

- Hutt City – Petone Beach (in particular at Sydney Street), Lowry Bay, Rona Bay (at the wharf) and Robinson Bay (at HW Shortt Recreation Ground and Nikau Street)

- Wellington City – Oriental Bay (at Wishing Well), Island Bay (all sites but especially at Old Bait Shed), Owhiro Bay and, on occasion, Seatoun Beach.

[4] This site was not monitored over the 2001/2002 summer.

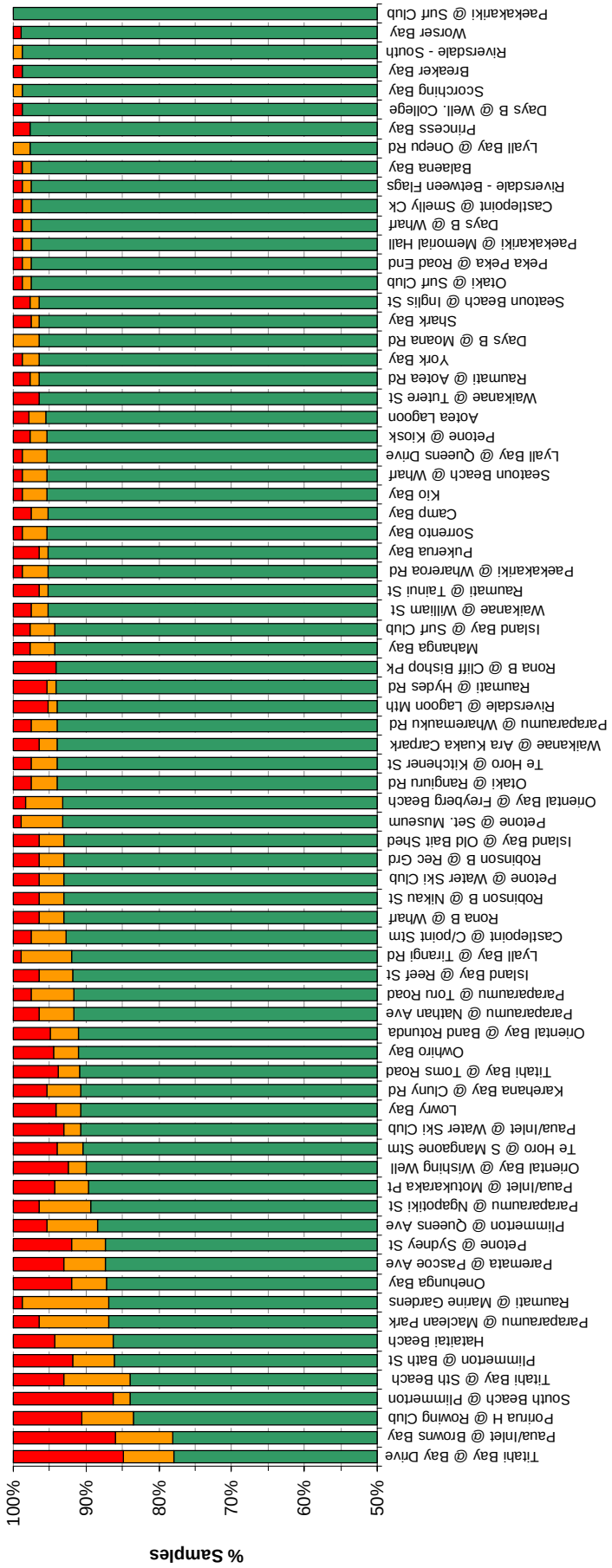

Figure 4.99: Summary of compliance with the surveillance, alert and action modes of the MfE/MoH (2003) recreational water quality guidelines, expressed as a percentage of the total number of routine sampling events undertaken over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons

It is unclear why a number of elevated results coincided with little or no rainfall. At some sites, local streams may be affecting coastal water quality at times. It is also likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some coastal locations. It is also possible that water quality at some beaches, notably Petone Beach in Hutt City and beaches on the Wellington City's south coast, are influenced by debris and other material pushed up onto the beaches at times of high tide and strong southerly winds.

At some of the sites, additional samples were not collected following an alert or action level exceedance. In future, if alert or action level exceedances do not coincide with significant rainfall, follow-up sampling should be undertaken the next day.

4.7.1 Spatial and temporal patterns

Table 4.94 summarises compliance with the action level of the MfE/MoH (2003) recreational water quality guidelines over each of the last four summer bathing seasons. Several spatial and temporal patterns are evident:

- The highest level of compliance with the recreational water quality guidelines was obtained over the 2002/2003 summer; 57 of the 76 sites did not exceed the action level on any occasion over this summer. Wairarapa, Wellington City and Kapiti had the highest percentage of sites that did not exceed the action level over this period (100%, 95% and 90% respectively).

- While sites in Wairarapa, Wellington City and Kapiti obtained the highest level of compliance with the guidelines over the 2002/2003 summer, in the Hutt City and Porirua City, the highest percentage of sites that did not exceed the action level was recorded over the 2004/2005 summer (87% and 50% respectively).

- The lowest level of compliance with the recreational water quality guidelines was obtained over the 2003/2004 summer; just 22 of the 76 sites did not exceed the action level on any occasion over this summer. Of the 52 sites that did exceed the action level, almost 20% exceeded this level on three or more occasions. Porirua City, Kapiti and Hutt City had the highest percentage of sites exceeding the action level over the 2003/2004 summer (100%, 80% and 67% respectively).

- While Porirua City, Kapiti and Hutt City had the highest percentage of sites exceeding the action level over the 2003/2004 summer, in Wellington City, the highest percentage of sites that exceeded the action level was recorded over the 2004/2005 summer (59% of sites).

- In all four summer bathing seasons, Porirua City consistently had the greatest percentage of sites exceeding the action level of the guidelines.

Table 4.95: Comparison of compliance with the action level of the MfE/MoH (2003) recreational water quality guidelines between sites over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

Summer	Exceedances of Action Level	No. of Sites in each Exceedance Category					Total No. of Sites	% of Sites
		Kapiti (20 sites)	Porirua (14 sites*)	Hutt (15 sites)	Wellington (22 sites)	Wairarapa (5 sites)		
2001/2002	0	16	0	10	14	4	44	59.5
	1	4	1	5	7	1	18	24.3
	2	0	5	0	1	0	6	8.1
	3	0	4	0	0	0	4	5.4
	≥ 4	0	2	0	0	0	2	2.7
2002/2003	0	18	6	7	21	5	57	75.0
	1	0	5	6	1	0	12	15.8
	2	2	1	2	0	0	5	6.6
	3	0	2	0	0	0	2	2.6
	≥ 4	0	0	0	0	0	0	0
2003/2004	0	4	0	5	11	2	22	28.9
	1	10	2	6	8	3	29	38.2
	2	5	3	0	2	0	10	13.2
	3	1	6	2	0	0	9	11.8
	≥ 4	0	3	2	1	0	6	7.9
2004/2005	0	9	7	13	9	2	40	52.6
	1	9	5	2	8	3	27	35.5
	2	2	2	0	3	0	7	9.2
	3	0	0	0	2	0	2	2.6
	≥ 4	0	0	0	0	0	0	0

* Only 12 sites in 2001/2002

There is a clear relationship between compliance with the recreational water quality guidelines and weather patterns, notably rainfall. For example, overall compliance with the guidelines was highest over the 2002/2003 summer when rainfall was below average (Figure 4.100). Conversely, the lowest level of compliance with the guidelines was obtained over the 2003/2004 summer when rainfall was above average. While this general pattern holds true for most areas, the relationship between compliance with the guidelines and rainfall is less obvious for sites in Hutt City; 50% of these sites exceeded the action level guideline on one or more occasions over the 2002/2003 summer which was significantly drier than the 2004/2005 summer when just 13% of sites exceeded the action level guideline.

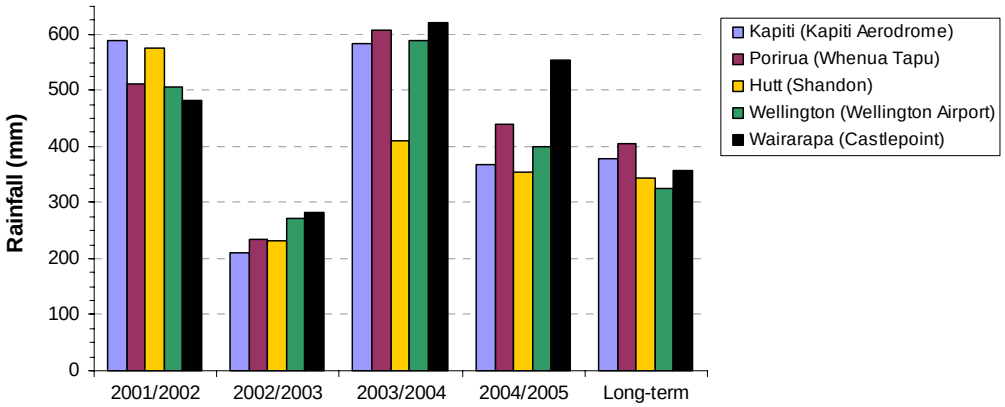

Figure 4.100: Total rainfall recorded at selected rainfall stations over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons, together with the longterm average summer rainfall

4.7.2 Suitability for recreation grades

The interim SFRGs for each of the 76 sites are illustrated in Figure 4.101. It can be seen that:

- Three sites (4.0%) have an interim grade of *very good*; Camp Bay (Hutt City) and Scorching Bay and Princes Bay (both Wellington City).
- 44 sites (58%) have an interim grade of *good*; 15 in Wellington City, 14 in Kapiti, 8 in Hutt City, 3 in the Wairarapa and 1 in Porirua City.
- 22 sites (29%) have an interim grade of *fair*; 6 in both Kapiti and Hutt City, 4 in both Porirua City and Wellington City, and 2 in the Wairarapa.
- Eight sites (10%) have an interim grade of *poor*: 7 in Porirua City, 1 in Wellington City
- Two sites (2.6%), both in Porirua City, have an interim grade of *very poor*; Pauatahanui Inlet at Motukaraka Point and Paremata Beach at Pascoe Avenue.

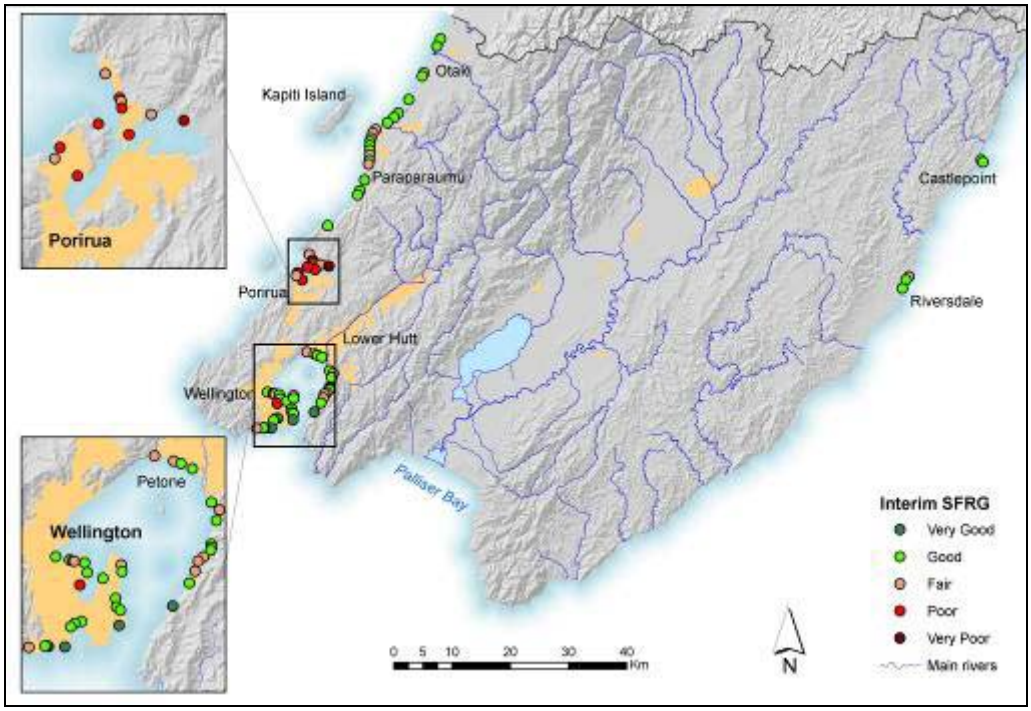

Figure 4.101: Interim suitability for recreation grades for the 76 marine recreational water quality sites in the Wellington Region, based on microbiological risk (determined from a catchment assessment) and enterococci counts measured at weekly intervals over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

According to the MfE/MoH (2003) guidelines, the SFRG describes the general condition of the water at a site at any given time, taking into account both microbiological risk (determined from a catchment assessment) and actual microbiological counts measured over time. It is for this reason that the sites with the lowest or highest number of alert and action level exceedances do not necessarily correlate with the very good and very poor interim SFRGs.

The SFRGs should be interpreted with caution for several reasons:

- The grades given are only interim grades based on four summer bathing seasons (only three seasons for a few sites); one further year of data needs to be collected before the grades can be finalised.

- Sanitary inspections have not been undertaken at all sites and, at some sites, need to be undertaken again as the MAC grade suggests that the SIC grade is not appropriate for the site.

- The grades are only indicative of the condition of the water at a site during the summer bathing season – microbiological results indicate that several sites in Wellington City, notably Island Bay and Owhiro Bay, would have a lower SFRG if the grade was determined using both summer and winter monitoring results.

- The Ministry for the Environment and Ministry of Health are considering reviewing the methodology used to determine the MAC (Thompson, pers. comm. 2005[5]).

The MAC grades for the 76 sites are shown in Figure 4.102. None of the 76 sites recorded an "A" MAC grade, which equates to a 95th percentile enterococci count of <43 cfu/100 mL, even though one site (Paekakariki Beach at the Surf Club) never exceeded the alert or action levels of the guidelines during the last four summer bathing seasons. Therefore this site, and the four other sites that did not exceed the action level on any occasion during the summer months, have the same MAC grade as sites such as Karehana Bay and Oriental Bay (at Wishing Well) which have significantly higher 95th percentile values and exceeded the action level on a number of occasions (six occasions in the case of Oriental Bay).

The 95th percentile values are very high for a number of sites, particularly those in Porirua City. For example, three sites have 95th percentile values that are at least an order of magnitude above the surveillance guideline level (Figure 4.102). Such values highlight that on many occasions, particularly following heavy rainfall events, water quality at these sites is extremely poor.

[5] Mike Thompson, Ministry for the Environment

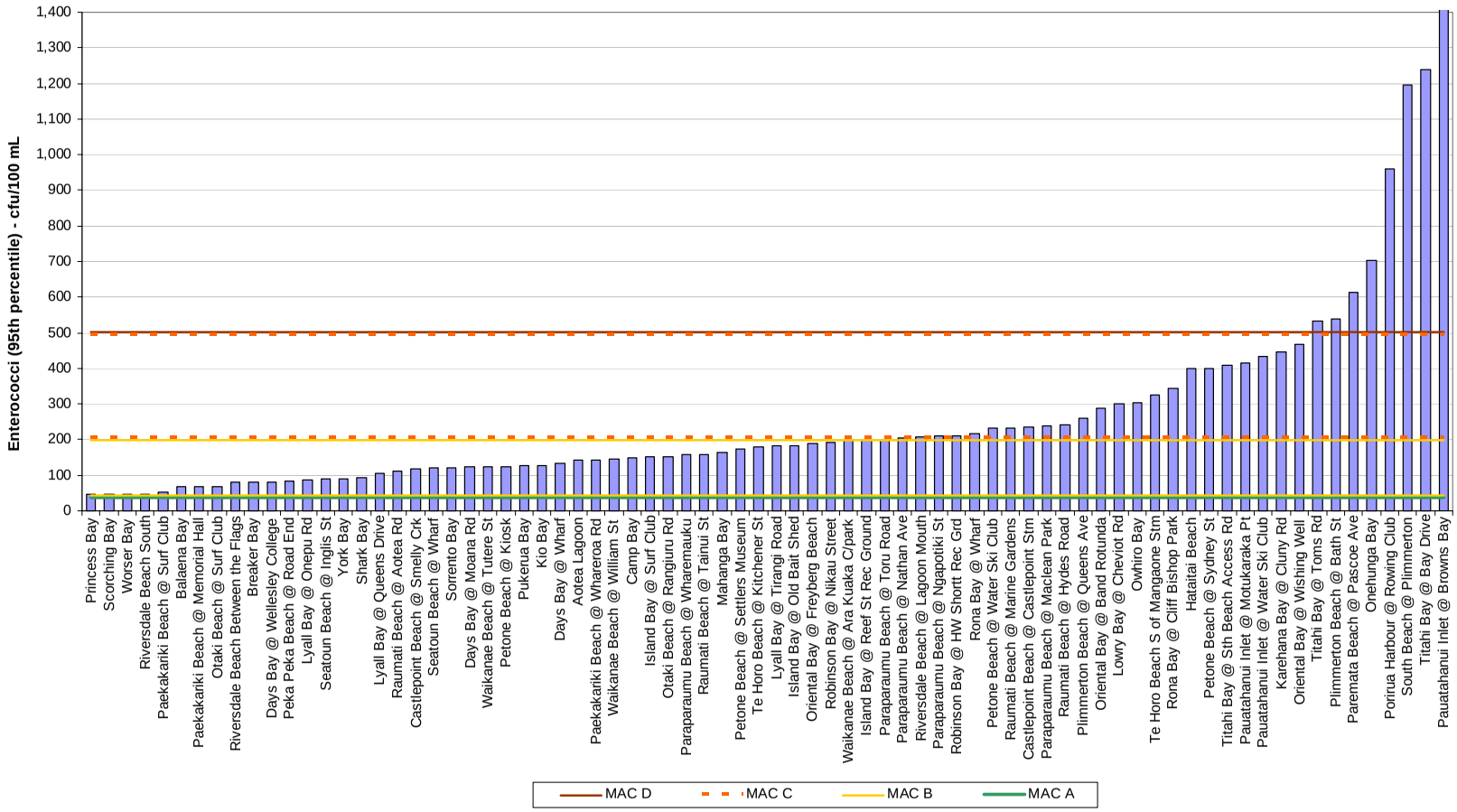

Figure 4.102: MAC grades, ranked from lowest to highest, for each of the 76 marine recreational water quality sites in the Wellington Region, based on 95th percentile values from routine monitoring over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer bathing seasons

5. Recreational shellfish gathering water quality

5.1 Introduction

Recreational shellfish gathering water quality is currently monitored at seven marine sites in the Wellington Region. Three of the sites are located along the Kapiti Coast, one in Porirua City, one in Hutt City and two in Wellington City. The locations of the monitoring sites are shown in Figure 5.1. A full site list can be found in Appendix 1.

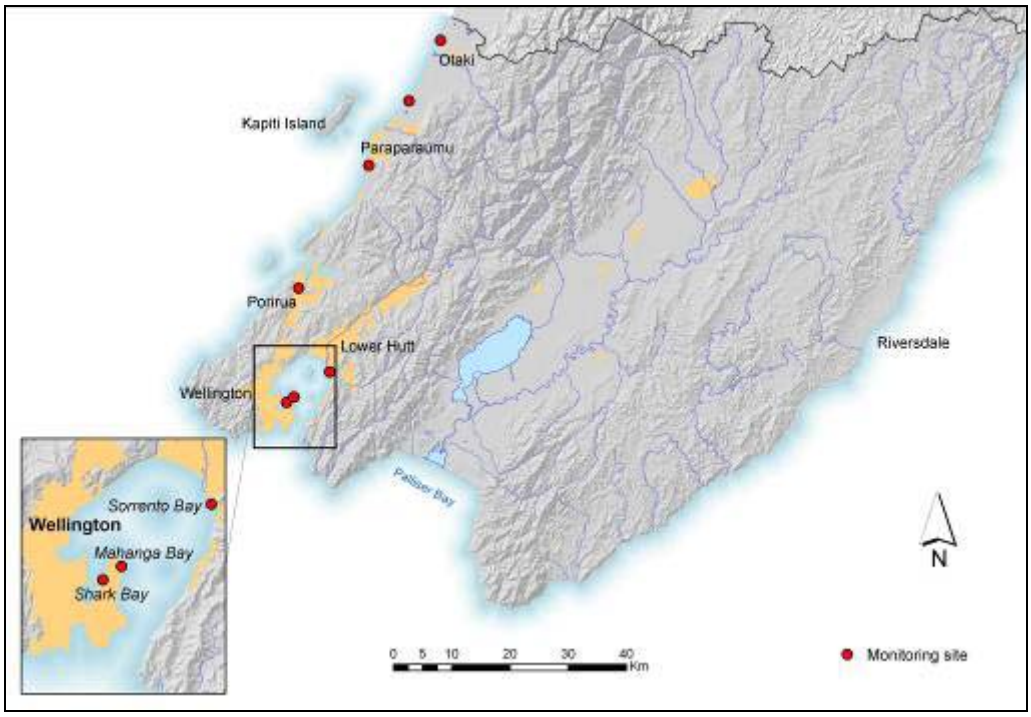

Figure 5.1: Recreational shellfish gathering water quality monitoring sites in the Wellington Region

5.1.1 Monitoring protocol

Monitoring sites are sampled weekly during 1 November to 31 March inclusive and at least monthly during the remainder of the year, to coincide with marine recreational water quality sampling which is also undertaken at six of the seven sites. The exception is Porirua Harbour at Te Hiko Street. This site was dropped from the marine recreational water quality monitoring programme following the 2001/2002 summer and, subsequently, recreational shellfish gathering water quality sampling was reduced to monthly intervals.

On each sampling occasion a single water sample is collected 0.2 metres below the surface in 0.5 metres water depth and analysed for faecal coliform indicator bacteria using a five-tube decimal dilution test, the Most Probable Number (MPN) method. This is the analytical method for shellfish gathering waters recommended in the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (MfE/MoH 2003).

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

- Rainfall may increase faecal bacteria 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.

An estimate of the daily rainfall in the catchment adjoining each site over the bathing season is made by obtaining records from the nearest rain gauge.

5.1.2 Guidelines

As outlined in Section 1.4, 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 a 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.

5.1.3 Data analysis, limitations and reporting

All sampling and evaluation of results has been undertaken in accordance with the MfE/MoH (2003) microbiological water quality guidelines for shellfish gathering waters 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 in calculating 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., the shellfish-gathering season is defined as the period from 1 November to 31 March inclusive). However, as shellfish gathering is likely to occur year round at many sites to some degree, the results of all monitoring are presented in time-series graphs for each site to provide a more complete picture of water quality over the course of the reporting period. 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 but are presented on the time-series graphs.

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 <1 cfu/100 mL and >400 cfu/100 mL were treated as 0.5 cfu/100 mL and 400 mL respectively).

Cautionary notes

- 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.
- In some instances, the Greater Wellington Regional Council's water quality database may be missing some water quality results.

5.2 Kapiti

Recreational shellfish gathering water quality is monitored at three sites in the Kapiti Coast District; Otaki Beach at the surf club, Peka Peka Beach, and Raumati Beach at Hydes Road. The monitoring results for each of the last four summer seasons are summarised for each site in Table 5.1. The results of all monitoring, including monthly winter monitoring, are also summarised in Table 5.1 and are presented in full in Figure 5.2.

Table 5.1 Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Summer	Median	Maximum	Percentage of Results >43 MPN/100 mL	Total No. of Samples
MfE/MoH Guideline	**14 MPN/100 mL**	**-**	**10%**	
OTAKI BEACH – Surf Club				
2001-2002	35	1,350	45.0	20
2002-2003	10	1,080	14.3	21
2003-2004	35	5,100	35.0	20
2004-2005	60	735	52.4	21
All data*	25	5,100	35.6	104
PEKA PEKA BEACH				
2001-2002	26	1,200	47.6	21
2002-2003	7	530	14.3	21
2003-2004	20	6,600	38.1	21
2004-2005	20	830	33.3	21
All data*	20	6,600	32.4	105
RAUMATI BEACH – Hydes Rd				
2001-2002	35	350	33.3	21
2002-2003	15	175	33.3	21
2003-2004	58	2,020	73.7	19
2004-2005	30	605	47.6	21
All data*	20	2,020	45.0	109

* Includes the results of routine winter monitoring

With the exception of Otaki Beach and Peka Peka Beach over the 2002/2003 summer, all three monitoring sites exceeded the median guideline of 14 MPN/100 mL during each of the last four summer seasons. Raumati Beach exceeded this guideline by a significant margin over the 2003/2004 summer (median 58 MPN/100 ml), as did Otaki Beach over the 2004/2005 summer (median 60 MPN/100 ml). None of the three sites complied with requirement that no more than 10% of samples exceed 43 MPN/100 mL, although both Otaki Beach and Peka Peka Beach only marginally exceeded the 10% threshold over the 2002/2003 summer (both 14.3%). When the results of all routine sampling for the 2001-2005 period are considered, 32.4% of samples collected from Peka Peka Beach exceeded the upper guideline value of 43 MPN/100 mL. This compares with 35.6% and 45% for Otaki Beach and Raumati Beach respectively.

Maximum faecal bacteria counts recorded at each site ranged from one to more than two orders of magnitude above the median guideline value (Figure 5.2).

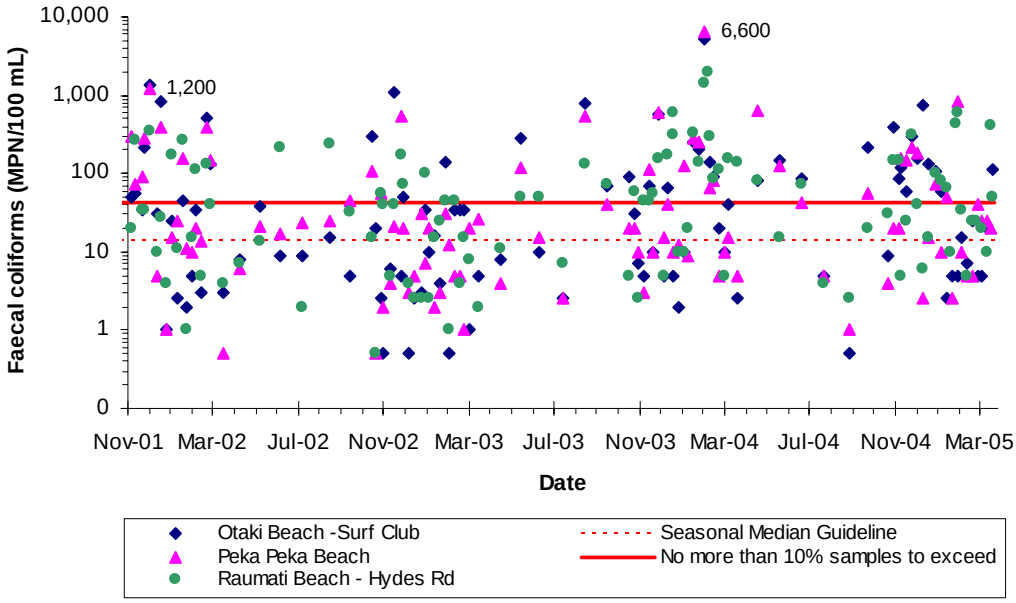

Figure 5.2: Faecal coliform counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

5.3 Porirua

In Porirua City, recreational shellfish gathering water quality is monitored at one site in the Onepoto Arm of Porirua Harbour, adjacent to Te Hiko Street. The monitoring results for each of the last four summer seasons are summarised for this site in Table 5.2. The results of all monitoring, including monthly winter monitoring, are also summarised in Table 5.2 and are presented in full in Figure 5.3.

Table 5.2 Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Summer	Median	Maximum	Percentage of Results >43 MPN/100 mL	Total No. of Samples
MfE/MoH Guideline	**14 MPN/100 mL**	**-**	**10%**	
2001-2002	900	20,600	86.4	22
2002-2003	24	87	25.0	4
2003-2004	811	1,700	75.0	4
2004-2005	62	146	50.0	4
All data*	138	20,600	64.8	54

* Includes the results of routine winter monitoring

Caution is needed when interpreting the data in Table 5.2 as only four samples were collected over the 2002/2003, 2003/2004 and 2004/2005 summer months. This is an insufficient number of samples to provide reasonable statistical power in testing for compliance with the median and upper guideline values. However, the 2001/2002 summer sampling results clearly indicate that Porirua Harbour, in the vicinity of Te Hiko Street, was unsafe for shellfish gathering over this period. The median faecal coliform count was 900 MPN/100 mL compared with the median guideline of 14 MPN/100 mL and over 86% of the results exceeded 43 MPN/100 mL. Some of the faecal bacteria counts were very high (Figure 5.3); over 45% were at least two orders of magnitude above the median guideline. The highest count (20,600 MPN/100 mL) was recorded on 4 December 2001 and coincided with heavy rainfall; 14 mm was recorded at the Whenua Tapu rainfall station in the 72 hours prior to sampling and further rain fell on the day of sampling. Many of the other very elevated counts also coincided with rainfall events.

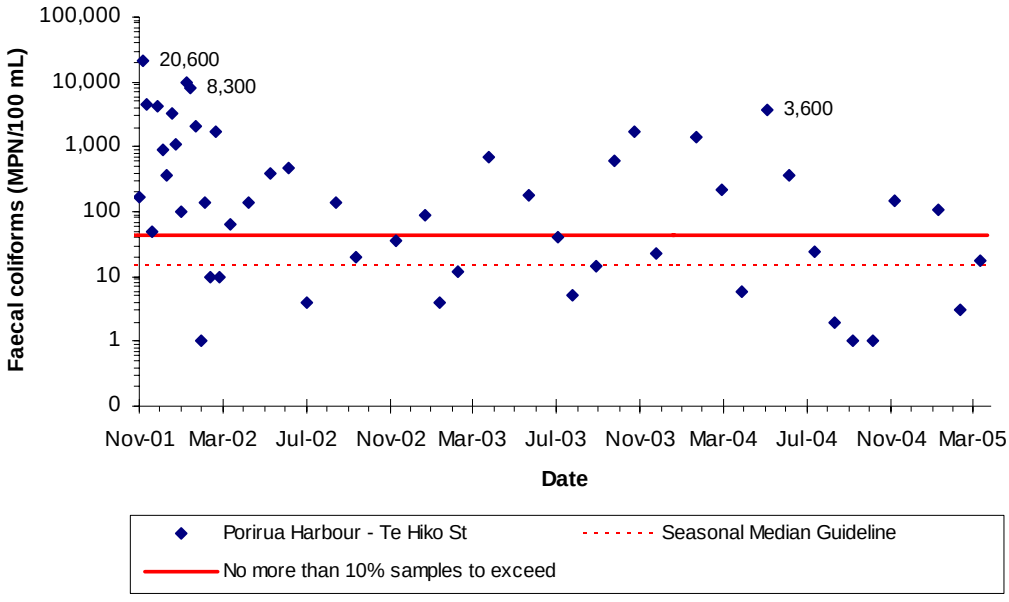

Figure 5.3: Faecal coliform counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

As explained in Section 4.3.7, stormwater pipes discharge into Porirua Harbour at a number of locations in the vicinity of Te Hiko Street and are likely to contribute significant faecal contamination to the harbour during rainfall. Porirua Stream, which receives runoff from Porirua City, and the Churton Park, Tawa and Cannons Creek residential areas, also discharges into the harbour in close proximity to this site and is likely to contribute elevated bacteria levels.

Based on the results of monitoring to date, and the results of water quality monitoring conducted at other locations within the Onepoto Arm of Porirua Harbour in the past (e.g., adjacent to the Porirua Surf Club), it is not recommended that people consume shellfish taken from Porirua Harbour.

5.4 Hutt

In Hutt City, recreational shellfish gathering water quality is monitored at one site in Sorrento Bay. The monitoring results for this site are summarised in Table 5.3 for each of the last four summer seasons. The results of all monitoring, including monthly winter monitoring, are also summarised in Table 5.3 and are presented in full in Figure 5.4.

Table 5.3 Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Summer	Median	Maximum	Percentage of Results >43 MPN/100 mL	Total No. of Samples
MfE/MoH Guideline	**14 MPN/100 mL**	**-**	**10%**	
2001-2002	8	620	33.3	21
2002-2003	4	510	19.0	21
2003-2004	4	400	28.6	21
2004-2005	2	170	13.6	22
All data*	4	620	20.4	108

* Includes the results of routine winter monitoring

Sorrento Bay complied with the median guideline of 14 MPN/100 mL during each of the last four summer bathing seasons. However the requirement that no more than 10% of samples exceed 43 MPN/100 mL was only met for the 2004/2005 summer. When the results of all routine sampling for the 2001-2005 period are considered, just over 20% of samples collected exceeded the upper guideline value of 43 MPN/100 mL. Maximum faecal bacteria counts recorded during each summer were no more than one order of magnitude above the median guideline value. The highest count (620 MPN/100 mL) was recorded on 21 December 2001 and coincided with heavy rainfall; 29 mm was recorded at the Shandon rainfall station in the 72 hours prior to sampling.

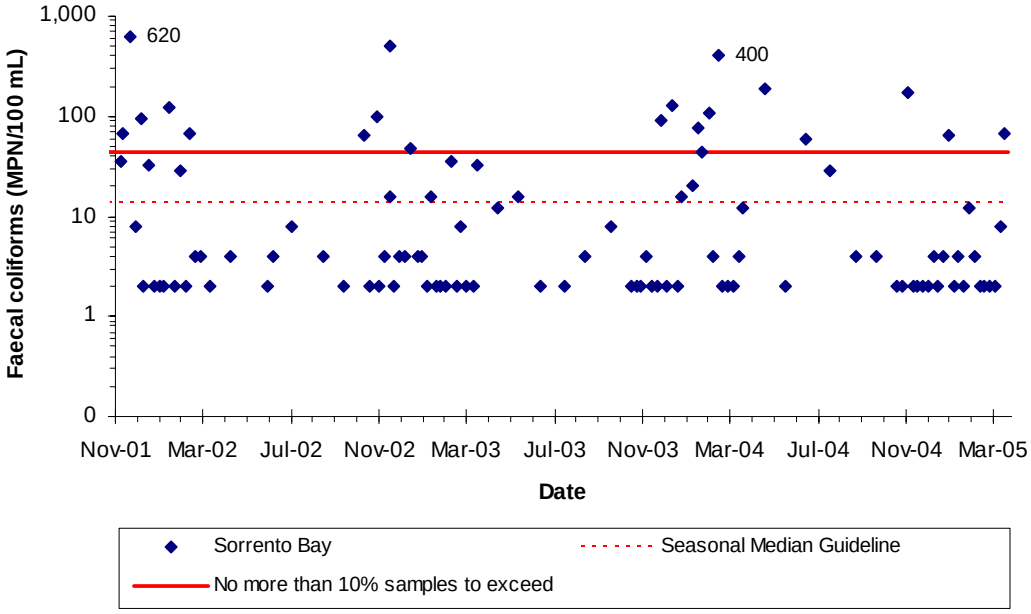

Figure 5.4: Faecal coliform counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

5.5 Wellington City

Recreational shellfish gathering water quality is currently monitored at two sites in Wellington City; Shark Bay and Mahanga Bay. The results of monitoring undertaken over each of the last four summer seasons are summarised for each site in Table 5.4. The results of all monitoring, including monthly winter monitoring, are also summarised in Table 5.4 and are presented in full in Figure 5.5.

Table 5.4 Analysis of faecal coliform counts obtained from routine weekly monitoring during the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer months against the MfE/MoH (2003) guideline levels for recreational shellfish-gathering waters

Summer	Median	Maximum	Percentage of Results >43 MPN/100 mL	Total No. of Samples
MfE/MoH Guideline	**14 MPN/100 mL**	**-**	**10%**	
SHARK BAY				
2001-2002	4	290	19.0	21
2002-2003	2	80	10.5	19
2003-2004	4	56	4.8	21
2004-2005	10	280	22.7	22
All data*	4	290	14.3	126

Summer	Median	Maximum	Percentage of Results >43 MPN/100 mL	Total No. of Samples
MfE/MoH Guideline	14 MPN/100 mL	-	10%	
MAHANGA BAY				
2001-2002	2	270	14.3	21
2002-2003	4	890	14.3	21
2003-2004	4	120	4.8	21
2004-2005	8	80	18.2	22
All data*	4	340	16.4	128

* Includes the results of routine winter monitoring

Both Shark Bay and Mahanga Bay complied with the median guideline of 14 MPN/100 mL during each of the last four summer bathing seasons. However, the requirement that no more than 10% of samples exceed 43 MPN/100 mL was only met by both sites for the 2003/2004 summer. When the results of all routine sampling for the 2001-2005 period are considered, 14.3% and 16.4% of samples collected from Shark Bay and Mahanga Bay exceeded the upper guideline value of 43 MPN/100 mL respectively.

With the exception of an additional sample collected at Shark Bay on 21 November 2001[6], maximum faecal bacteria counts recorded during each summer were no more than one order of magnitude above the median guideline value. The highest count recorded from routine sampling during the full reporting period was 890 MPN/100 mL at Mahanga Bay. This result was recorded on 18 November 2002 and coincided with heavy rainfall; 52.7 mm was recorded at the Kelburn rainfall station in the 72 hours prior to sampling and further rain fell on the day of sampling.

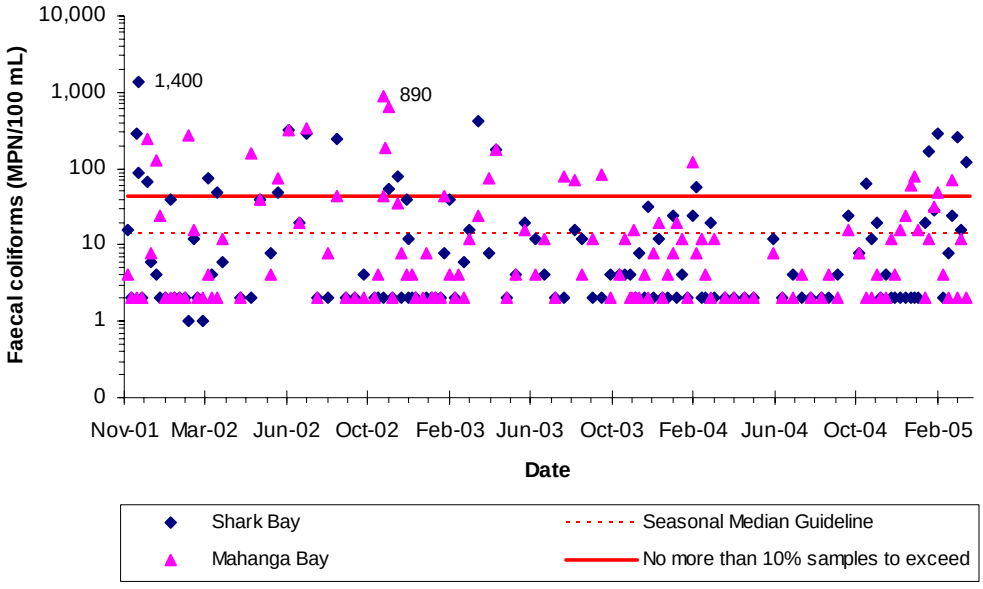

Figure 5.5: Faecal coliform counts obtained from all monitoring undertaken during the period 1 November 2001 to 31 March 2005 inclusive

[6] This sample was collected at the same time as an additional sample was taken and analysed for enterococci and followed an enterococci count on 20 November 2001 that exceeded the action level of the marine recreational water quality guidelines. The elevated result is attributed to rainfall: more than 22 mm of rain fell in the 24 hours preceding sampling (refer Section 3.5.6).

5.6 Synthesis

Recreational shellfish gathering water quality is currently monitored at seven marine sites in the Wellington Region. Compliance with the MfE/MoH (2003) shellfish gathering water quality guidelines over the last four summer seasons is summarised for these sites in Figures 5.6 and 5.7.

Of the seven monitoring sites:

- Only three sites consistently complied with the MfE/MoH (2003) seasonal median guideline of 14 faecal coliforms/100 mL; Shark Bay, Mahanga Bay and Sorrento Bay (Figure 5.6).

- None of the sites consistently met the requirement that no more than 10% of samples in a season exceed 43 faecal coliforms/100 mL (Figure 5.7). Shark Bay, and Mahanga Bay complied with this guideline over the 2003/2004 summer.

- The median faecal coliform count recorded for Porirua Harbour at Te Hiko Street over the 2001/2002 summer was an order of magnitude above the median guideline value, and over 86% of samples collected over this period exceeded 43 MPN/100 mL. It is not recommended that people consume shellfish taken from this site.

- The three monitoring sites in the Kapiti Coast District recorded the greatest faecal coliform counts over the 2003/2004 summer months. The median count at Raumati Beach was also greatest over the 2003/2004 summer, and is probably a reflection of the higher rainfall recorded over this summer (refer Section 4.6.1).

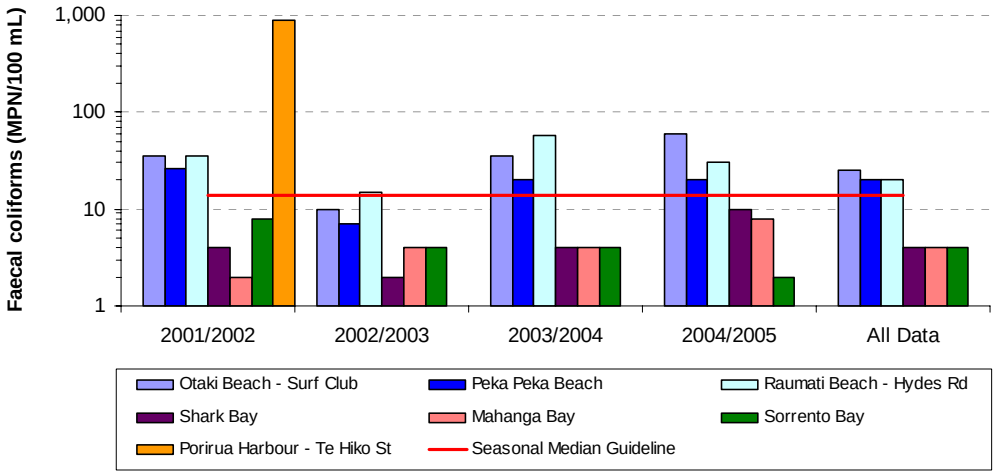

Figure 5.6: Median faecal coliform counts recorded at each site over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons, together with median counts from all routine monitoring conducted during November 2001 to March 2005 inclusive

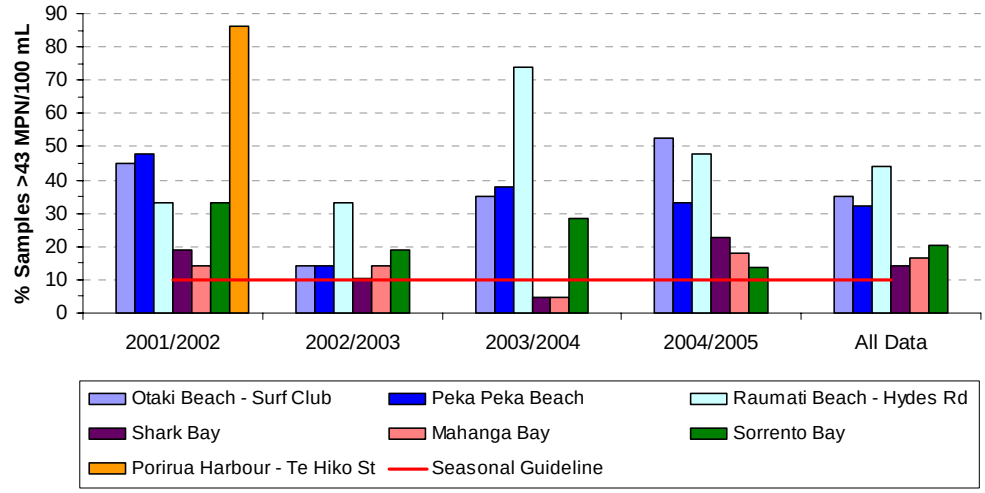

Figure 5.7: The percentage of faecal coliform counts recorded at each site over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons that exceed 43 MPN/100 mL, together with the percentage from all routine monitoring conducted during November 2001 to March 2005 inclusive

When the results of all monitoring undertaken over the 1 November to 31 March 2005 reporting period are considered, Mahanga Bay, Shark Bay and Sorrento Bay each recorded the lowest median faecal coliform count (14 MPN/100 ml at all three sites), followed by Peka Peka Beach (20 MPN/100 mL), Otaki Beach (25 MPN/100 mL), Raumati Beach (35 MPN/100 mL) and Porirua Harbour (138 MPN/100 mL), (Figure 5.8). A number of the faecal coliform results recorded at the three sites along the Kapiti Coast and at the monitoring site in Porirua Harbour were two orders of magnitude above guideline levels. Analysis of rainfall records indicates that the majority of these results coincided with significant rainfall events.

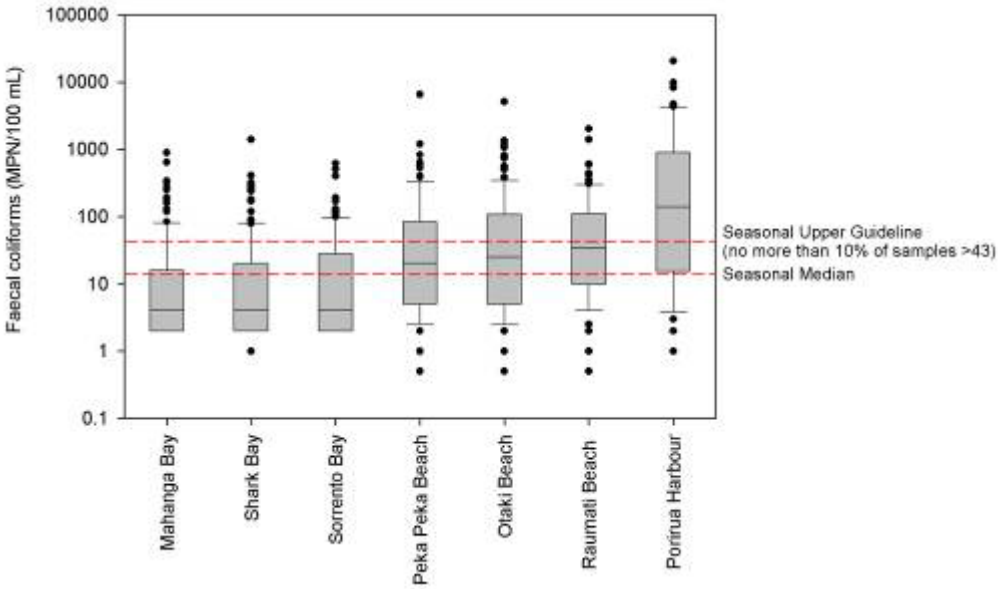

Figure 5.8: Comparison of the median and range of faecal coliform counts from all water quality monitoring undertaken at each of the seven shellfish gathering sites over the November 2001 to March 2005 reporting period
(Note: the horizontal black line across each box plot represents the median value)

5.6.1 Spatial and temporal patterns

Compliance with the MfE/MoH (2003) shellfish gathering water quality guidelines differed between sites and seasons:

- The quality of shellfish gathering waters was highest at monitoring sites located in Wellington City and Hutt City (Figures 5.6 and 5.7).

- The highest level of compliance with the MfE/MoH (2003) seasonal median guideline was obtained over the 2002/2003 summer; five sites complied with the median guideline over this period. This higher level of compliance is attributed to below average rainfall for the 2002/2003 summer period (Figure 5.9).

- The highest level of compliance with the MfE/MoH (2003) requirement that no more than 10% of samples in a season exceed 43 faecal coliforms/100 mL was obtained over the 2003/2004 summer; two sites met this requirement. In contrast, all seven sites monitored over the 2001/2002 summer failed to meet this requirement, five by a significant margin. This poor level of compliance is attributed to above average rainfall for the 2001/2002 summer (Figure 5.9). Above average rainfall is some areas over the 2003/2004 and 2004/2005 summers may also account for some of the poor results recorded at sites in the Kapiti Coast District over these two summer periods.

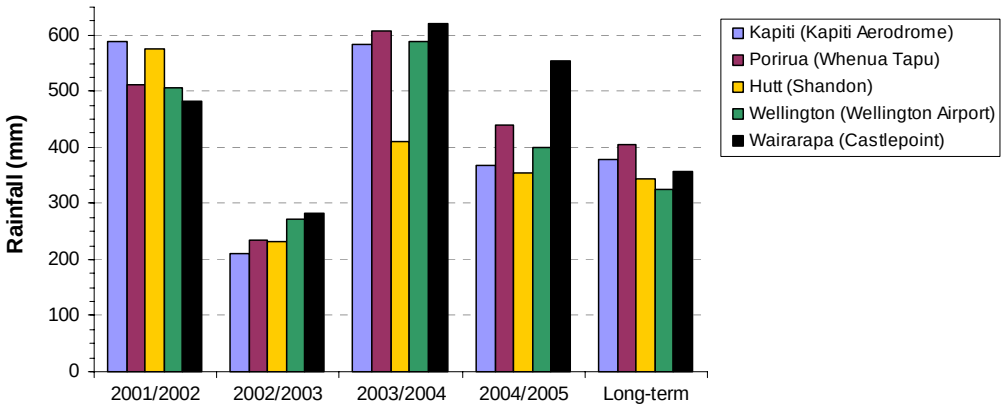

Figure 5.9: Total rainfall recorded at selected rainfall stations over the 2001/2002, 2002/2003, 2003/2004 and 2004/2005 summer seasons, together with the longterm average summer rainfall

The high correlation between the occurrence of heavy rainfall and elevated faecal bacteria counts supports advice from the Greater Wellington Regional Council and the Ministry of Health to avoid contact with recreational waters for up to two days after heavy rain. As discussed in earlier sections of this report, urban stormwater and diffuse-source runoff into rivers and streams are considered to be the major contributors to faecal contamination of marine waters in the Wellington Region.

While monitoring microbiological water quality at shellfish gathering sites provides an indication of the potential health risk to people collecting shellfish, monitoring of microbiological contaminants in *shellfish flesh* is needed to provide a direct measure of the risks associated with consuming shellfish. The Greater Wellington Regional Council undertakes shellfish flesh monitoring on a four-yearly basis at present. Consideration should be given to increasing the frequency of this monitoring.

6. Conclusions and recommendations

The key findings of recreational water quality monitoring undertaken over 1 November 2001 to 31 March 2005 inclusive are presented below for fresh waters, marine waters and recreational shellfish gathering waters.

6.1 Fresh waters

- Compliance with the recreational quality guidelines was highest at sites located within relatively unmodified bush catchments, notably the Waiohine River at the Gauge, the Waingawa River at Kaituna and the Otaki River at The Pots. Compliance was lower at sites draining agricultural catchments.

- There was a high correlation between rainfall events and elevated indicator bacteria counts, although a number of sites recorded one or more action level events that coincided with little or no rainfall. These sites include:
  - Hutt Valley – Hutt River at Maoribank Corner, Birchville and Silverstream
  - Wairarapa – Ruamahanga River at Double Bridges, Riversdale Lagoon

- Periphyton cover exceeded guidelines for aesthetic and recreational values on one or more occasions over the reporting period at a number of monitoring sites, including most of the sites on the Ruamahanga River, both sites on the Waingawa River and one site on the Waiohine River. At all sites, the nuisance growths occurred in late summer, coinciding with low and relatively stable river flows and warmer water temperatures.

- Using protocol outlined by the MfE/MoH (2003), only 13% of sites received a “very good” or “good” interim SFRG grade, with the majority of the sites (74%) receiving a grade of “poor” or “very poor.” The applicability of these grades is questioned as they are influenced by contamination arising from wet weather monitoring. Therefore the interim SFRGs better reflect the condition of the bathing sites during wet weather than dry weather when contact recreation would be greatest.

6.2 Marine waters

- Highest compliance with the recreational quality guidelines was generally found at sites located away from urban stormwater outfalls and stream mouths, notably Paekakariki Beach, Days Bay, Scorching Bay, Princes Bay and Riversdale Beach.

- Many monitoring sites in Porirua City exceeded the recreational quality guidelines on a regular basis, with a number of results one or two orders of magnitude above guideline values.

- With the exception of a number of sites in Hutt City, there is a relatively high correlation between rainfall events and elevated indicator bacteria

counts. In the Wairarapa, all exceedances of the action level guideline coincided with significant rainfall events.

- At some sites, a number of action level results coincided with little or no rainfall. These sites include:
  - Kapiti – Paraparaumu Beach (at Ngapoti Street and Nathan Avenue)
  - Porirua City – Titahi Bay (at Bay Drive), Plimmerton Beach, South Beach at Plimmerton and Pauatahanui Inlet (at Browns Bay)
  - Hutt City – Petone Beach (in particular at Sydney Street), Lowry Bay, Rona Bay (at the wharf) and Robinson Bay (at HW Shortt Recreation Ground and Nikau Street)
  - Wellington City – Oriental Bay (at Wishing Well), Island Bay (all sites but especially at Old Bait Shed), Owhiro Bay and, on occasion, Seatoun Beach

- It is unclear why a number of elevated results coincided with little or no rainfall. At several sites, local streams may be affecting coastal water quality at times. It is also likely that elevated enterococci counts occur with sediment resuspension as a result of high wave energies at some locations. Water quality at some beaches, notably Petone Beach in Hutt City and beaches on the Wellington City's south coast, may also be influenced by debris and other material pushed up onto the beaches at times of high tide and strong southerly winds.

- Using protocol outlined by the MfE/MoH (2003), 62% of the monitoring sites received an interim suitability for recreation grade of "good" or "very good." Just 12.6% of sites received a grade of "poor" or "very poor." All but one of these sites were located in Porirua City.

6.3 Marine shellfish gathering waters

- Only three sites consistently complied with the seasonal median recreational water quality guideline over the reporting period; Shark Bay, Mahanga Bay and Sorrento Bay.

- None of the sites consistently met the requirement that no more than 10% of samples in a season exceed 43 faecal coliforms/100 mL.

- Faecal bacteria counts in Porirua Harbour adjacent to Te Hiko Street are very high and it is not recommended that people consume shellfish taken from this site.

- Very high faecal bacteria counts generally coincided with rainfall events. However, counts above guideline values did not always coincide with rainfall events – guideline values are an order of magnitude lower than the marine recreational water quality guidelines and are therefore exceeded more frequently.

The relatively high correlation between the occurrence of heavy rainfall and elevated bacteria counts at the majority of monitoring sites in both fresh and marine waters across the region supports advice from the Greater Wellington Regional Council and the Ministry of Health to avoid swimming and other contact recreation activities during, and for up to two days after, heavy rain. Urban stormwater (including sewer overflows during heavy rainfall) and diffuse-source runoff into rivers and streams are considered to be the major contributors to faecal contamination of recreational waters in the Wellington Region.

6.4 Recommendations

1. Monitoring of recreational water quality at freshwater and marine bathing sites continues in accordance with the MfE/MoH (2003) microbiological water quality guidelines.

2. Follow-up sampling in the event of an exceedance of the alert or action levels of the microbiological water quality guidelines is conducted at all fresh water bathing sites where the cause of the exceedance can not be attributed to rainfall.

3. A suitable site on the Akatarawa River is investigated and included in the freshwater recreational monitoring programme, commencing in the 2005/2006 summer.

4. Catchment assessments are undertaken at all fresh water monitoring sites and existing assessments for all marine monitoring sites are reviewed over 2005/2006.

5. Suitability for recreation grades are finalised for freshwater and marine monitoring sites following the 2005/2006 summer, and reviewed annually upon the conclusion of each summer bathing season.

6. Annual reporting of recreational water quality monitoring results continues, with inclusion of suitability for recreation grades in all reports prepared following the 2005/2006 summer.

7. Monitoring of recreational shellfish gathering waters is reviewed, with greater emphasis given to monitoring microbiological contaminants in shellfish flesh at recreational shellfish gathering sites.

8. Data collection, archiving and retrieval methods are reviewed to ensure that all historic and future recreational water quality data are stored electronically in one location on Greater Wellington Regional Council's water quality database.

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Appendix 1: List of Monitoring Sites

Area	Site Name	NZ Map Grid		Type
		Easting	Northing	
Hutt	Petone Beach @ Water Ski Club	2665765	5996304	Marine
Hutt	Petone Beach @ Sydney Street	2667067	5995961	Marine
Hutt	Petone Beach @ Settlers Museum	2667577	5995770	Marine
Hutt	Petone Beach @ Kiosk	2668348	5995425	Marine
Hutt	Sorrento Bay	2669654	5993098	Marine & Shellfish Gathering
Hutt	Lowry Bay @ Cheviot Road	2670228	5992605	Marine
Hutt	York Bay	2669999	5991874	Marine
Hutt	Days Bay @ Wellesley College	2669639	5990243	Marine
Hutt	Days Bay @ Wharf	2669677	5990027	Marine
Hutt	Days Bay @ Moana Road	2669605	5989834	Marine
Hutt	Rona Bay @ N end of Cliff Bishop Park	2669132	5989367	Marine
Hutt	Rona Bay @ Wharf	2668753	5989084	Marine
Hutt	Robinson Bay @ HW Shortt Rec Ground	2668542	5988387	Marine
Hutt	Robinson Bay @ Nikau Street	2668154	5987569	Marine
Hutt	Camp Bay	2667013	5986001	Marine
Hutt	Hutt River @ Silverstream Bridge	2677619	6004887	Freshwater
Hutt	Hutt River @ Boulcott	2670941	5999283	Freshwater
Kapiti	Otaki Beach @ Surf Club	2688639	6050044	Marine & Shellfish Gathering
Kapiti	Otaki Beach @ Rangiuru Road	2688028	6048783	Marine
Kapiti	Te Horo Beach S of Mangaone Stream	2685797	6044192	Marine
Kapiti	Te Horo Beach @ Kitchener Street	2685513	6043648	Marine
Kapiti	Peka Peka Beach @ Road End	2683233	6039620	Marine & Shellfish Gathering
Kapiti	Waikanae Beach @ William Street	2681406	6037299	Marine
Kapiti	Waikanae Beach @ Tutere St Tennis Courts	2680673	6036577	Marine
Kapiti	Waikanae Beach @ Ara Kuaka Carpark	2679532	6035693	Marine
Kapiti	Paraparaumu Beach @ Ngapotiki Street	2677561	6034477	Marine
Kapiti	Paraparaumu Beach @ Nathan Avenue	2677051	6033889	Marine
Kapiti	Paraparaumu Beach @ Maclean Park	2676712	6032982	Marine
Kapiti	Paraparaumu Beach @ Toru Road	2676595	6032430	Marine
Kapiti	Paraparaumu Beach @ Wharemauku Road	2676521	6031785	Marine
Kapiti	Raumati Beach @ Tainui Street	2676549	6030944	Marine
Kapiti	Raumati Beach @ Marine Gardens	2676535	6030156	Marine
Kapiti	Raumati Beach @ Aotea Road	2676433	6029244	Marine
Kapiti	Raumati Beach @ Hydes Road	2676337	6028550	Marine & Shellfish Gathering
Kapiti	Paekakariki Beach @ Whareroa Road	2675617	6025843	Marine
Kapiti	Paekakariki Beach @ Surf Club	2674810	6023988	Marine
Kapiti	Paekakariki Beach @ Memorial Hall	2674452	6023305	Marine
Kapiti	Otaki River @ The Pots	2695461	6040455	Freshwater
Kapiti	Otaki River @ State Highway 1	2691326	6046120	Freshwater
Kapiti	Waikanae River @ State Highway 1	2683770	6034011	Freshwater
Kapiti	Waikanae River @ Greenaway Road	2681549	6034626	Freshwater
Porirua	Pukerua Bay	2669309	6017968	Marine
Porirua	Karehana Bay @ Cluny Road	2666113	6013074	Marine

Area	Site Name	NZ Map Grid		Type
		Easting	Northing	
Porirua	Plimmerton Beach @ Bath Street	2666726	6012030	Marine
Porirua	Plimmerton Beach @ Queens Avenue	2666790	6011888	Marine
Porirua	South Beach @ Plimmerton	2666830	6011588	Marine
Porirua	Pauatahanui Inlet @ Water Ski Club	2668094	6011307	Marine
Porirua	Pauatahanui Inlet @ Motukaraka Point	2669506	6011052	Marine
Porirua	Pauatahanui Inlet @ Browns Bay	2668059	6009547	Marine
Porirua	Paremata Beach @ Pascoe Avenue	2667137	6010447	Marine
Porirua	Porirua Harbour @ Rowing Club	2664911	6008661	Marine
Porirua	Porirua Harbour @ Te Hiko Street	2664347	6007493	Shellfish Gathering
Porirua	Titahi Bay @ Bay Drive	2664152	6009883	Marine
Porirua	Titahi Bay at Toms Road	2664130	6009571	Marine
Porirua	Titahi Bay @ South Beach Access Road	2663926	6009396	Marine
Porirua	Onehunga Bay	2665816	6010895	Marine
Upper Hutt	Pakuratahi River @ Forks	2694308	6014337	Freshwater
Upper Hutt	Hutt River @ Birchville	2686216	6010807	Freshwater
Upper Hutt	Hutt River @ Maoribank Corner	2685902	6008412	Freshwater
Upper Hutt	Hutt River @ Poets Park	2681482	6007807	Freshwater
Wairarapa	Ruamahanga River @ Double Bridges	2734363	6033494	Freshwater
Wairarapa	Ruamahanga River @ Te Ore Ore	2735543	6024638	Freshwater
Wairarapa	Waipoua River at Colombo Road	2735010	6024610	Freshwater
Wairarapa	Waingawa River @ Kaituna	2720341	6032867	Freshwater
Wairarapa	Waingawa River @ South Road	2730565	6022599	Freshwater
Wairarapa	Ruamahanga River @ The Cliffs	2731492	6013902	Freshwater
Wairarapa	Ruamahanga River @ Kokotau	2725774	6008913	Freshwater
Wairarapa	Waiohine River @ Gauge	2711871	6017655	Freshwater
Wairarapa	Waiohine River @ State Highway 2	2719683	6013431	Freshwater
Wairarapa	Ruamahanga River @ Morrisons Bush	2718938	6002829	Freshwater
Wairarapa	Ruamahanga River @ Waihenga	2714631	5998182	Freshwater
Wairarapa	Ruamahanga River @ Bentleys Beach	2710556	5994533	Freshwater
Wairarapa	Riversdale Lagoon	2768314	6008860	Freshwater
Wairarapa	Castlepoint Beach @ Castlepoint Stream	2781366	6029287	Marine
Wairarapa	Castlepoint Beach @ Smelly Creek	2781670	6028931	Marine
Wairarapa	Riversdale Beach @ Lagoon Mouth	2768974	6009275	Marine
Wairarapa	Riversdale Beach Between the Flags	2768445	6008680	Marine
Wairarapa	Riversdale Beach South	2767844	6007246	Marine
Wellington	Aotea Lagoon	2659007	5989395	Marine
Wellington	Oriental Bay @ Freyberg Beach	2659942	5989176	Marine
Wellington	Oriental Bay @ Wishing Well	2660140	5989098	Marine
Wellington	Oriental Bay @ Band Rotunda	2660265	5989087	Marine
Wellington	Balaena Bay	2660980	5988979	Marine
Wellington	Kio Bay	2661163	5988311	Marine
Wellington	Hataitai Beach	2660654	5987442	Marine
Wellington	Shark Bay	2662233	5987909	Marine & Shellfish Gathering
Wellington	Mahanga Bay	2663490	5988828	Marine & Shellfish Gathering
Wellington	Scorching Bay	2663539	5988360	Marine
Wellington	Worser Bay	2663097	5986535	Marine
Wellington	Seatoun Beach @ Wharf	2663152	5985946	Marine
Wellington	Seatoun Beach @ Inglis Street	2663428	5985706	Marine
Wellington	Breaker Bay	2663335	5984682	Marine
Wellington	Lyall Bay @ Tirangi Road	2660770	5984942	Marine

Area	Site Name	NZ Map Grid		Type
		Easting	Northing	
Wellington	Lyall Bay @ Onepu Road	2660309	5984828	Marine
Wellington	Lyall Bay @ Queens Drive	2660013	5984580	Marine
Wellington	Princess Bay	2659609	5983216	Marine
Wellington	Island Bay @ Old Bait Shed	2658484	5983228	Marine
Wellington	Island Bay @ Surf Club	2658400	5983302	Marine
Wellington	Island Bay @ Reef St Recreation Ground	2658252	5983254	Marine
Wellington	Owhiro Bay	2657145	5983174	Marine

Appendix 2: Suitability for recreation grades

(Source: pp. H20-21, MfE/MoH 2003)

Beaches are graded by considering microbiological monitoring results from previous years in combination with the factors in the catchment that may contribute faecal contamination to the beach[8]. It is a risk-associated grading of the beach, meaning that it provides an indication of what the likely condition of the beach will be on any day. The following general explanation provides a description of each of the beach grades.

Very good

Water quality tests and assessment of potential contamination sources indicate beaches within this category are considered to have very good water quality. This suggests there may be some indirect run-off from low intensity agricultural/urban/rural/bush catchments, but there are likely to be no significant sources of faecal contamination.

Recommendation: Considered satisfactory for swimming at all times, and therefore may not require monitoring on a regular basis.

Good

Water quality tests and assessment of potential contamination sources indicate beaches within this category are considered to have generally good water quality. On occasions (such as after high rainfall) there may be an increased risk of contamination from run-off. Such sites receive run-off from one or more of the following sources which may contain animal or human faecal material:

- River discharges impacted by tertiary treated wastewater, combined sewer overflows, sewer overflows, intensive agricultural/rural catchments, significant feral/bird/animal populations.
- River discharges impacted by; run-off from low-intensity agricultural/urban/rural catchment.
- Direct discharges from stormwater not contaminated by sewage, boat moorings or marinas
- Direct discharges from low-intensity agriculture.

Recommendation: Satisfactory for swimming most of the time. Exceptions may include following rainfall. Such beaches are monitored regularly throughout the summer season and warning signs will be erected if water quality deteriorates.

Fair

Water quality tests and assessment of potential contamination sources indicate beaches within this category are considered to have generally fair water quality. However, events such as high rainfall increase the risk of contamination levels from run-off. Such sites receive run-off from one or more of the following sources which may contain animal or human faecal material:

- River discharges impacted by tertiary treated wastewater, combined sewer overflows, sewer overflows, intensive agricultural/rural catchments, significant feral bird/animal populations.

[8] Note that "beach" refers to both freshwater and marine bathing areas.

- River discharges impacted by; run-off from low-intensity agricultural/urban/rural catchment.
- Direct discharges from stormwater not contaminated by sewage, boat moorings or marinas
- Direct discharges from low-intensity agriculture.

Recommendation: Generally satisfactory for swimming, though there may be potential sources of faecal material. Caution should be taken during periods of high rainfall, and swimming should be avoided if water is discoloured. Sites are monitored weekly throughout the summer season and warning signs erected if water quality deteriorates.

Poor

Water quality tests and assessment of potential contamination sources indicate beaches within this category are considered to have generally poor water quality. These sites receive run-off from one or more of the following sources which may contain animal or human faecal material:

- Tertiary treated wastewater.
- Urban stormwater, intensive agriculture, unrestricted stock access, dense bird populations.
- Low-intensity agriculture, marinas or boat moorings, urban stormwater not contaminated by sewage.
- River discharges containing untreated/primary/secondary treated wastewater or on-site waste treatment systems.
- River discharges impacted by tertiary treated wastewater, combined sewer overflows, intensive agricultural/rural catchments, feral bird/animal populations.

Recommendation: Generally not okay for swimming, as indicated by historical water quality results. Swimming should be avoided, particularly by the very young, the very old and those with compromised immunity. Permanent warning signs may be erected at these sites, although councils may monitor these sites weekly and post temporary warnings.

Very poor

Water quality tests and assessment of potential contamination sources indicate beaches within this category are considered to have very poor water quality. These sites receive run-off from one or more of the following sources which may contain animal or human faecal material:

- Untreated/primary/secondary treated wastewater
- On-site waste treatment systems.
- Tertiary treated wastewater.
- Urban stormwater, intensive agriculture, unrestricted stock access, dense bird populations.
- River discharges containing untreated/primary/secondary treated wastewater or on-site waste treatment systems.

Recommendation: Avoid swimming, as there are direct discharges of faecal material. Permanent signage will be erected at the beach stating that swimming is not recommended.