Bathing and Shellfish Surveillance Report 2011/2012

Bay of Plenty Regional Council
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5 Quay Street
P O Box 364
Whakatane
NEW ZEALAND

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REGIONAL COUNCIL

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5 Quay Street
PO Box 364
Whakatāne 3158
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Prepared by Paul Scholes Environmental Scientist

Cover Photo:
Bridge Jumpers, Whakatāne Bridge taken by Shane Iremonger

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Thanks to Curtis Blyth, Rose Greenfield, document specialists and the laboratory crew who have made this report possible.

Executive summary

The Bay of Plenty Regional Council undertakes annual water quality surveys of popular recreational (bathing) sites and shellfish beds over the warmer months (October to March). The surveys assist in identifying the risk to public health from faecal contamination at these areas. The information is then used by public health and local authorities to advise the community on the suitability of water for bathing or shellfish consumption. The breadth of the programme has recently been increased to include monitoring of benthic cyanobacteria (*Phormidium*) in rivers and streams.

The main objective of this report is to report on the bathing suitability of approximately 80 river, lake and marine sites over the 2011/2012 bathing season. A three tiered management framework has been adopted to help signal when recreational waters are potentially at risk to users. The system uses the colours green (safe mode), orange (cautionary mode) and red (unsafe mode) to denote risk. Two indicator bacteria are used in this assessment for recreational waters, these are;

- Freshwaters – Escherichia coli (E.coli); and
- Marine waters – Enterococci.

The results of the 2011/2012 bathing surveys show that most sites in the Bay of Plenty are generally suitable for bathing. However, the Suitability for Recreation Grading (SFRG) system highlights that there is a higher risk to bathers using river and stream sites than for lake and coastal sites. For example, 80% of lake sites are graded 'very good' while 50% of river sites are graded 'poor'. This is consistent with previous monitoring and reflects the greater vulnerability of rivers and streams to diffuse and point source discharges of contaminants sourced from faecal material.

The table below shows the status of monitored bathing sites against the New Zealand Microbiological Water Quality Guidelines (Red/Action mode). Generally lake sites show the highest quality overall against this guideline, followed by marine and river sites.

Table: Percentage of samples from monitored bathing sites with indicator bacteria levels less than the Red/Action Mode as defined by the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003).

		Rivers	Lakes	Marine
Samples less than the Red/Action Mode	2011/12	92.1%	99.0%	96.6%
	last 5 Years	93.9%	99.2%	96.8%

As indicated above, lake sites consistently had very low levels of faecal contamination although as with the previous season (2010/2011) three sites exceeded the Orange/Alert mode in 2011/2012. In addition two sites exceeded the Red/Action mode following extreme weather.

River and stream sites showed improved levels of faecal contamination compared to the previous season but are more influenced by the effects of rainfall events than lake sites. In 2011/2012 many of these sites (17 of 28 monitored) exceeded the Red/Action mode at some time.

The faecal bacteria results for a number of stream sites are notable;

- The Kaiate Stream site has shown an improvement over the past two seasons. This is probably due to the fencing of some waterways in the catchment.

- The Ngongotahā Stream site has shown consistent elevated results predominantly after rainfall.

- The Tuapiro Stream site has a high base load of faecal contamination and this may indicate that there is a more consistent source of contamination which cannot be attributed to rainfall events.

- The Ngamuwahine Stream site has a large proportion of indigenous vegetation in its catchment and yet often has elevated faecal bacteria levels. Addressing the source of this contamination would also benefit the Wairoa River which often experiences elevated faecal bacteria levels.

Open coastal sites typically have excellent water quality with only four exceeding the Orange/Alert mode in 2011/2012. Most (93%) of the open coastal sites have been graded as 'good' or 'very good' under the SFRG system with only one site graded as 'poor'. More estuarine sites exceeded the Orange/Alert mode than the previous season (13 compared to 8 in 2010/2011). Of the estuarine sites 50% are graded 'fair' with higher faecal contamination levels due to the enclosed nature of estuaries and river influences.

Shellfish at one estuarine site (pipi in Waiotahi Estuary) were found to have faecal bacteria levels above safe consumption guidelines. In the Waiotahi Estuary an intensive monitoring effort showing that elevated bacteria levels occurred in pipi after rainfall. Monitoring of the estuary will continue to track the success of future catchment management actions.

Phormidium was generally only found at low levels in rivers in 2011/2012. However, some sites in the Western Bay of Plenty were found to have coverage near to the interim recreational threshold. Sites in the east of the region had low levels of coverage compared to previous years.

The bathing and shellfish monitoring programme does not specifically identify the factors causing faecal contamination. However, it does highlight areas where more detailed investigation should be carried out. Targeted studies are used to address these more specific water quality issues. Recommendations for future targeted investigations are made below;

- Initiate studies in the catchments of the Waitetī and Ngongotahā streams to identify sources of faecal contamination. This information will help to prioritise catchment management actions.

- Investigate faecal contamination sources in the catchment of the Tuapiro Stream. The use of molecular techniques may be required as there appears to be a more consistent source of contamination occurring in this catchment.

- Investigate faecal contamination sources in the catchment of the Ngamuwahine Stream, In particular, attempt to determine the relative loading rates from the DOC reserve area compared to pastoral land-use and other activities.

Finally, while the current bathing surveillance programme is working well it does not meet the sampling frequency recommended in the New Zealand Microbiological Water Quality Guidelines (MfE/MOH 2003). This issue will be considered in a wider review of the NERMN Programme in 2012/2013.

Contents

Part 1: Introduction

1.1 Overview

The Bay of Plenty Regional Council undertakes annual water quality surveys of popular recreational (bathing) sites and shellfish beds over the warmer months (October to March). The surveys assist in identifying the risk to public health from faecal contamination at these areas. The information is then used by public health and local authorities to advise the community on the suitability of water for bathing or shellfish consumption. The breadth of the programme has recently been increased to include monitoring of benthic cyanobacteria (*Phormidium*) in rivers and streams.

The Ten Year Plan 2009-2019 has a Key Performance Indicator (KPI) targeting microbiological water quality at recreational bathing sites. This KPI is based on the percentage of samples with indicator bacteria levels less than the Red/Action Mode as defined by the New Zealand Microbiological Water Quality Guidelines (MfE/MoH 2003). For marine and lake sites the target is 95% while for rivers the target is 85%. There are also a number of regional plans that have objectives based on a contact recreation standard, these are;

- On-site Effluent Treatment (OSET) Regional Plan
- Regional Water and Land Plan
- Regional Coastal Environmental Plan
- Regional Policy Statement

This report summarises the annual bathing survey monitoring results for the 2011/2012 season and also presents recent shellfish and *Phormidium* monitoring results.

1.2 Legislative framework and responsibilities

The agencies with responsibilities related to recreational water quality are regional councils, district councils, district health boards and the medical officer of health. There is no legislation dictating which agency is responsible for recreational bathing monitoring, but under the Health Act (1956) and the Resource Management Act (1991) local agencies and the health authority have defined responsibilities.

The Microbiological Guidelines (MfE/MoH 2003) provide a recommended framework for roles and responsibilities of the agencies involved in recreational water quality monitoring. Based on this framework a protocol for monitoring and reporting has been developed.

1.3 Recreational water quality objectives

The objectives of the Bay of Plenty Regional Council's recreational water quality monitoring programme are to;

- Assess the suitability of approximately 80 river, lake and marine sites in the Bay of Plenty for contact recreation.
- Assess the suitability of shellfish for human consumption.

- Assist in safeguarding the life-supporting capacity of the water, including public health.
- Provide a mechanism to determine the effectiveness of regional plans.
- Provide information for State of the Environment monitoring, regionally and nationally.
- Assist in identifying areas of poor water quality to help identify causes so remedial action can be initiated.

The bathing surveillance monitoring sites are shown in the maps that follow (Figure 1.1).

Figure 1.1 Bathing surveillance sites, Bay of Plenty

Part 2: Methods

2.1 Sampling and analysis

Sampling and analyses where performed in accordance with established internal procedures. Most analyses were performed by the Regional Council laboratory or the Tauranga City Council laboratory.

Table 2.1 Methods used for analysis of water samples

Parameter (abbreviation)	Method	Detection Limit/ Units
Escherichia coli (E.coli)	Membrane filtration (APHA 2005)	1 cfu/100 ml
Faecal coliform (FC)	Membrane filtration (APHA 2005)	1 cfu/100 ml
Enterococci (Ent)	Method No 1600, USEPA 1986 EPA-821-R-97-004	1 cfu/100 ml

Sampling occurred between 8.00 am and 6.00 pm and was undertaken by either wading or by use of a sample pole. Sterile 500 ml polyethylene bottles were used to sample water at a representative location in the water column. Water quality analyses were completed using the methods in Table 2.1. All samples were stored and returned within the time period stipulated by the methods.

Shellfish were collected by hand and placed in plastic bags with immediate cool storage in a chilly bin. The samples were then transported to the laboratory within six hours.

Shellfish were analysed for Escherichia coli, enterococci and faecal coliforms. The most probable number (MPN) method was used for faecal coliform and enterococci analysis (APHA 2005), and *E.coli* analysis (APHA 1985).

Part 3: Microbiological Guidelines and Indicators

3.1 Introduction

If human or animal faecal matter finds its way into recreational waters there is a risk that water users will be exposed to a diverse range of pathogenic (disease causing) micro-organisms. A variety of organisms are present in faecal matter such as viruses, bacteria, protozoa (single cell organisms), and helminths (nematodes). These can reach water bodies via a variety of pathways and in variable concentrations.

The impacts of pathogenic micro-organisms on human health are most commonly manifest as gastro-enteritis, but other common illnesses include respiratory problems and skin rashes. Serious illness can also be attributed to infection from pathogens contained in waters, for example, hepatitis A, giardiasis, cryptosporidiosis, campylobacteriosis, and salmonellosis (MfE/MoH, 2003).

Indicator micro-organisms are used to assess recreational water quality as it is difficult and impractical to measure all potentially pathogenic micro-organisms. Indicator micro-organisms give an indirect measure of pathogen levels. The bacteriological indicators chosen are associated with the gut of warm blooded animals and are common in faecal matter. While these indicator bacteria are not generally harmful themselves, they do indicate the presence of harmful pathogens. Two indicator bacteria are commonly used in recreational waters:

- freshwaters – Escherichia coli (E.coli), and
- marine waters – Enterococci.

The use of these two indicators is stipulated in the New Zealand microbiological water quality guidelines (MfE/MoH 2003). Research relating illness to indicator bacterial levels has been used to develop guideline levels for which a tolerable risk to healthy people is established. The Microbiological Guidelines provide trigger levels which can be used by water managers and the public to assess the potential risk of using recreational waters. Single water sample results can be compared to guideline values to help determine if a health alert or other action should be implemented.

Comparison of monitoring results with the microbiological guidelines over a bathing season provides water managers with a tool for water quality assessment to be used in conjunction with beach grades. Beach grading provides an analysis of the suitability of recreation over time using combined information on microbiological bathing survey results and catchment characteristics.

A three-tiered management framework has been adopted to help signal when recreational waters are potentially at risk to users. The system uses the colours green (safe mode, ‘surveillance’), orange (cautionary mode, ‘alert’) and red (unsafe mode, ‘action’) to denote the level of risk to users. The indicator bacteria levels and recommended management responses to these different modes are listed in Table 3.1.

Table 3.1 Surveillance, alert and action levels for fresh and marine waters (MfE/MoH, 2003).

Mode	Guideline - Freshwaters (*E.coli* count in colony forming units per 100 mL)	Recommended Management Response
Green/Surveillance	Single sample ≤ 260	Routine monitoring
Orange/Alert	Single sample > 260 and ≤ 550	Increased monitoring, identify possible sources
Red/Action	Single sample > 550	Public warnings, increased monitoring, source investigation

Mode	Guideline - Marine (Enterococci count in colony forming units per 100 mL)	Recommended Management Response
Green/Surveillance	Single sample ≤ 140	Routine monitoring
Orange/Alert	Single sample > 140 and ≤ 280	Increased monitoring, identify possible sources
Red/Action	Two consecutive single samples > 280	Public warnings, increased monitoring, source investigation

Surveillance mode indicates there is an acceptable risk to recreational water users. Should waters be found to be in *Alert mode* then there is an increased risk of illness if contact is made with recreational waters. *Action mode* indicates waters pose an unacceptable health risk to recreational water users. In such a case the health authority will assess the risk to public health and if necessary issue health warnings in conjunction with local authorities.

Use of the Microbiological Guidelines and issuing of health warnings will be dependent on the circumstances surrounding any contamination event.

3.2 Bathing surveillance grading

The New Zealand Microbiological Water Quality Guidelines outline a process to grade the suitability of marine and fresh waters for recreational use. A 'Suitability for Recreation Grade' (SFRG) is generated from the combination of a qualitative assessment of the susceptibility of a recreational site to faecal contamination and direct measurements of the appropriate bacteriological indicator at the site. The SFRG describes the general risk of faecal contamination at a site at any given time.

SFRG's have been determined for recreational sites in the Bay of Plenty region since 2005. Updated SFRG's, reflecting the 2011/2012 microbiological water quality results, are summarised in Appendix 1 for the last five years.

3.3 Additional risk to recreational users

The Bay of Plenty Regional Council monitors a number of freshwater sites that experience blooms of potentially toxic blue-green algae. These include several of the Rotorua Lakes and the Kaituna River. When monitoring indicates the high risk to water users a health warning or health advisory is issued for the affected area. Media releases, websites and recorded telephone messages also provide the public with information on the status of these sites.

Monitoring for the mat-forming cyanobacteria *Phormidium* also occurs in a number of eastern Bay of Plenty rivers, including the Rangitāiki, Whakatāne, Otara and Waimana. The Otara River was not sampled in 2011/2012. Other sites are now also monitored in the western Bay of Plenty including the Uretara Stream. The beds of these rivers and streams can support substantial mats of this toxin producing algae at times of low flow. The mats may contain neurotoxins that are highly toxic to humans and animals. New Zealand studies have shown that at times of high biomass, *Phormidium* can also produce high levels of free toxins in the water (Heath 2009).

The Microbiological Water Quality Guidelines do not include guidance on the risk posed by potentially toxic algal blooms. Interim New Zealand Guidelines for Cyanobacteria are given in MfE/MoH (2009).

Part 4: 2011/2012 Bathing Surveillance Season

4.1 Recreational surveillance monitoring

Before the start of the bathing season a monitoring plan was designed and circulated for comment to Toi Te Ora Public Health and the district councils. The criteria for selection of sites included whether they were high-use bathing locations and whether there was known contamination risk.

Monitoring began on 25 October 2011 and ran until 15 March 2012. Approximately 80 sites around the region were monitored with sites sampled weekly or once every two weeks.

The results of the water quality analyses are generally available after 24-hours and these are then posted onto the Bay of Plenty Regional Council website[1]. Media releases also help keep the public informed of the situation with regards to bathing water quality.

If orange or red modes are flagged these results are directly communicated to Toi Te Ora Public Health and the relevant district council. Follow-up sampling then occurs within a 24-hour period. Should a water quality problem be found to be recurring Toi Te Ora Public Health have the responsibility to decide if a public health warning needs to be issued. If a warning is required Toi Te Ora Public Health will initiate media releases and inform the district council of the need for warning signs and any further monitoring.

4.2 Results

The detailed results of the monitoring are presented in tabular form in Appendix 1. These tables give information on the Hazen percentile (P) value, MAC score, SIC score, SFRG, and a conservative interim grade where applicable. Grades and MAC scores are based on the last five years of data from October 2008 to March 2012. The Suitability for Recreation Grades (SFRG's) are presented in Figure 4.1 and 4.2.

Note that some SFRG grades are provisional as the microbiological data has not reached an optimum level according to the New Zealand Microbiological Water Quality Guidelines. The data does provide useful information to allow an assessment of the risk to recreational users of waterways. Follow up grades are also assigned where not enough data has been collected or the catchment assessment is not consistent with the indicator bacteria results. The grading system can be biased by only one or two elevated results, as these push the percentile figures upwards. Such results can be more frequent in years where monitoring has coincided with rainfall events.

The grading system shows that 80% of lake sites are graded 'very good' while 50% of river sites are graded 'poor'. The 'poor' river grading is also reflected at many of the estuarine sites of which 50% are graded 'fair'. Most (93%) of the open coastal sites have been graded as 'good' or 'very good' with only one site graded as 'poor'.

[1] http://www.boprc.govt.nz/environment/water/swimming-water-quality/

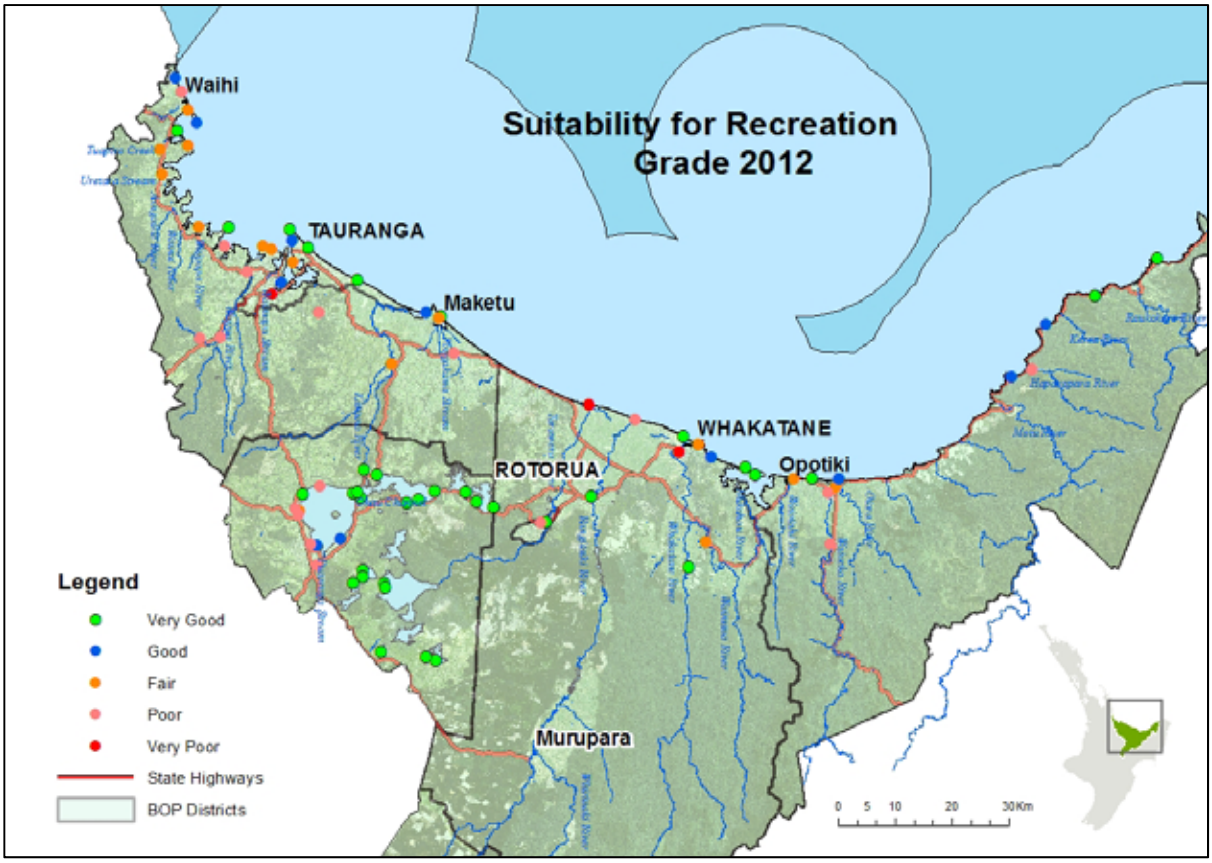

Figure 4.1 Suitability for Recreation Grades, 2011/12.

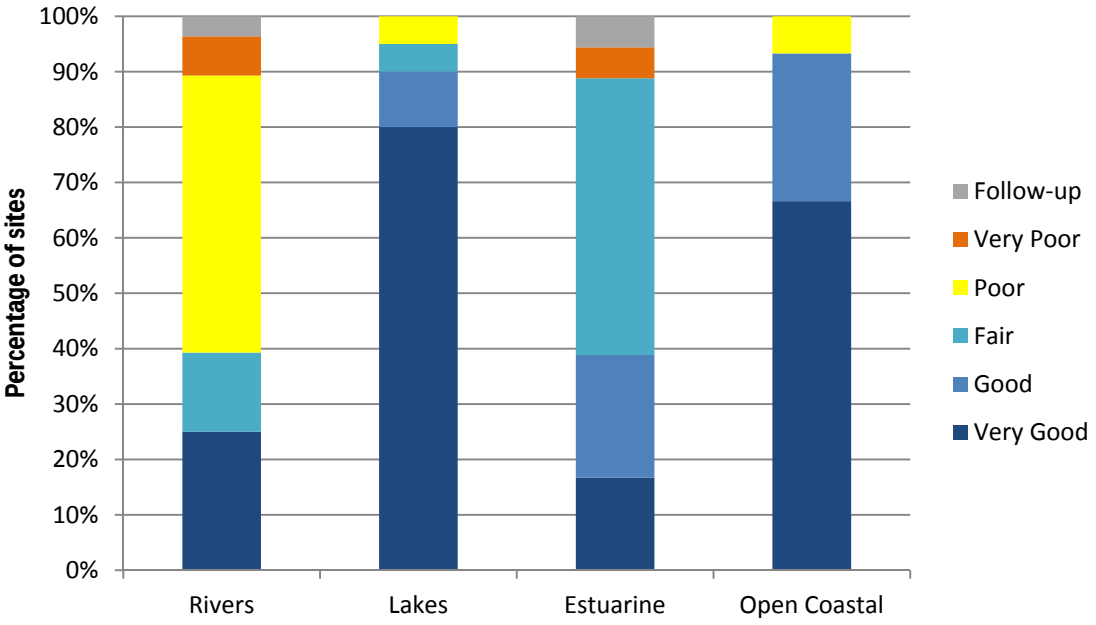

Figure 4.2 Comparison of the results for the Suitability for Recreation Grade (SFRG).

Table 4.1 also shows the status of monitored bathing sites in the Bay of Plenty against the NZ Microbiological Water Quality Guidelines (Red/Action mode). Generally lake sites showed the highest quality overall against this guideline, followed by marine and river sites.

Table 4.1 Percentage of samples from monitored bathing sites with indicator bacteria levels less than the Red/Action Mode as defined by the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003).

		Rivers	Lakes	Marine
Samples less than the Red/Action Mode	2011/12	92.1%	99.0%	96.6%
	last 5 Years	93.9%	99.2%	96.8%

More detailed results are presented in the following sections showing the percentage of samples at each site that exceeded guideline levels throughout the 2011/2012 season. The five yearly 95-percentile and median (50-percentile) data are also presented to give a longer-term perspective.

4.3 River and stream sites

River and stream sites were monitored on a weekly or two-weekly basis.

Figure 4.2 shows the range of E.coli results recorded at each site ranked in order of percentage of samples over the Red/Action mode. Of the 28 sites monitored 20 had instances where the Orange/Alert mode was exceeded and 17 of these had results over 550 E.coli cfu/100 ml (Red/Action mode).

Over the 2011/12 season seven sites exceeded the Orange/Alert mode 25% of the time. The Ngongotahā and Waimapu Streams were over this level on 35% of monitoring days. The Ngamuwahine Stream was the third most contaminated of the river sites. The cause of this should be investigated further as a large proportion of the Ngamuwahine catchment is in native bush and therefore the stream would normally be expected to have elevated levels of faecal contamination.

Both the Ngongotahā Stream and the Waitetī Stream exceeded the Red/Action mode more than 20% of the time during the season, although both have lower median *E.coli* levels than a number of other streams (Figure 4.3). This would seem to indicate that the results from these spring-fed streams have been affected by seasonal storm events. Likewise, multiple storm events that occurred over the summer have driven many of the results at other sites above the Red/Action mode.

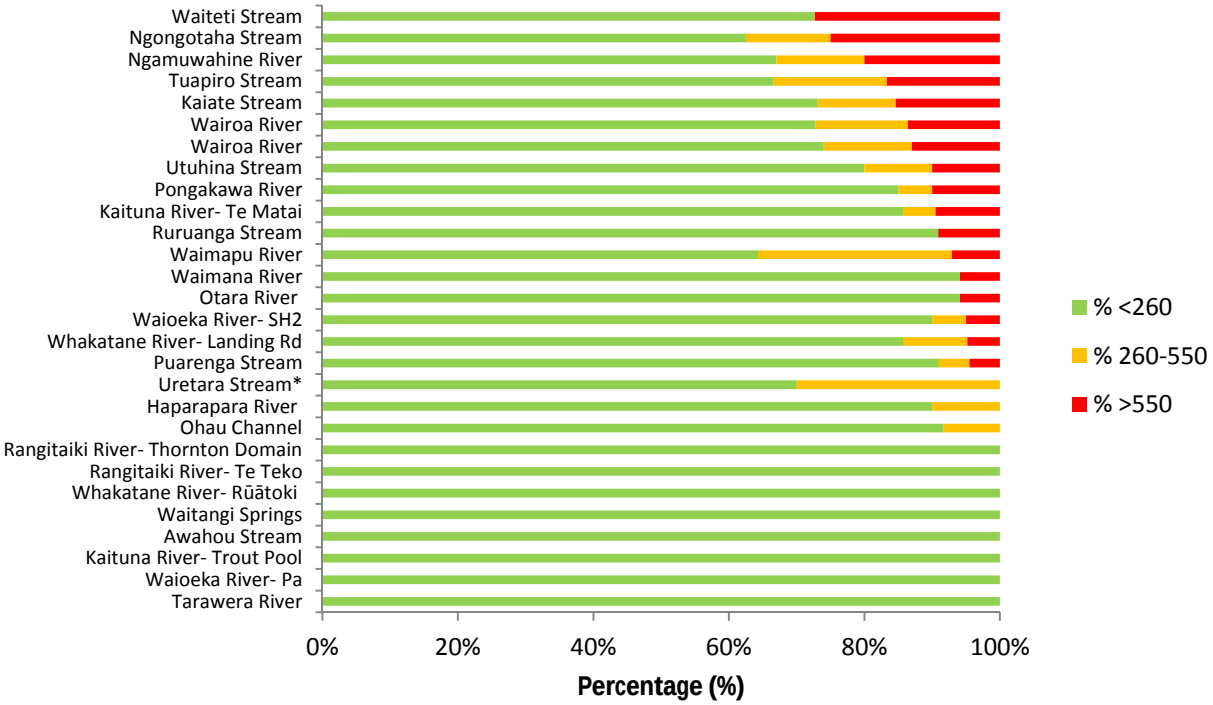

Figure 4.2 *River and stream E.coli levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2011/2012 bathing season.*

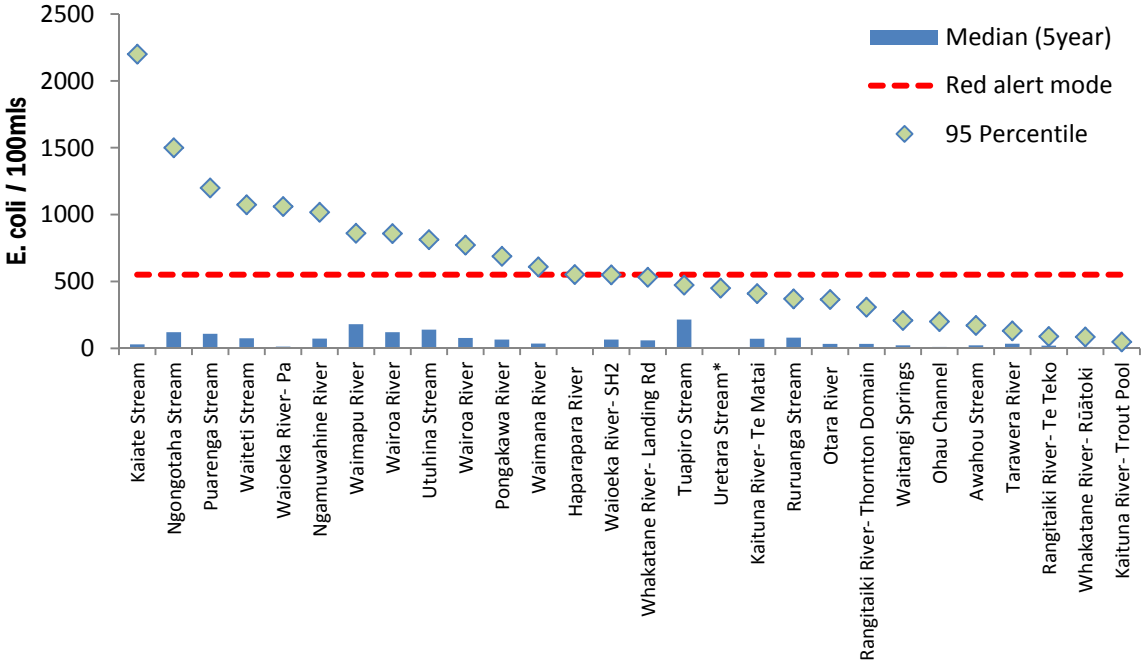

Figure 4.3 *95-percentile and median E.coli concentrations, river and stream sites over the past five years.*

4.3.1 Lake sites

Sampling occurred at 20 lake sites once every two weeks.

Two Lake Rotorua sites (Hamurana and Ngongotahā) reached the Red/Action mode during the 2011/2012 season (Figure 4.4). The Orange/Alert mode was also reached at Holden's Bay. These results are thought to be due to strong prevailing winds disturbing the sediments in the shallow littoral zone.

The median E.coli concentrations for lake sites were generally below 15 cfu/100 ml indicating a low level of faecal contamination overall (Figure 4.5). Lake Rerewhakaaitu at Brett Road had the highest median E.coli concentrations of the lake sites (36 cfu/100 ml), although the site did not have any samples above the Orange/Alert mode.

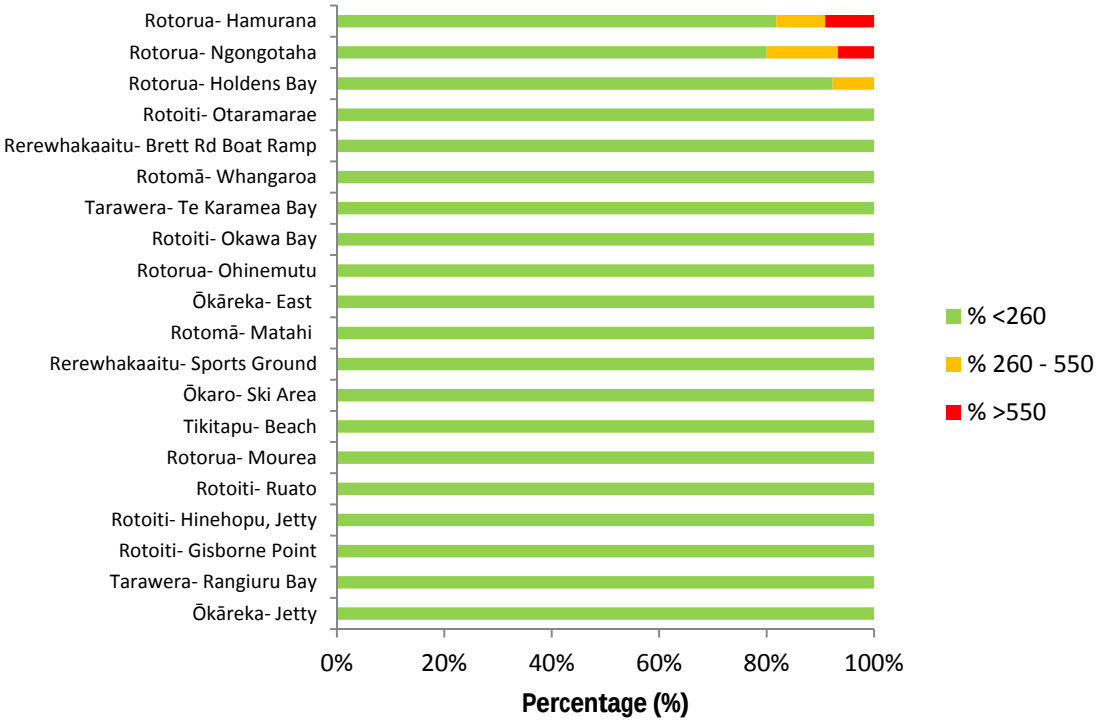

Figure 4.4 Lake E.coli levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2011/2012 bathing season.

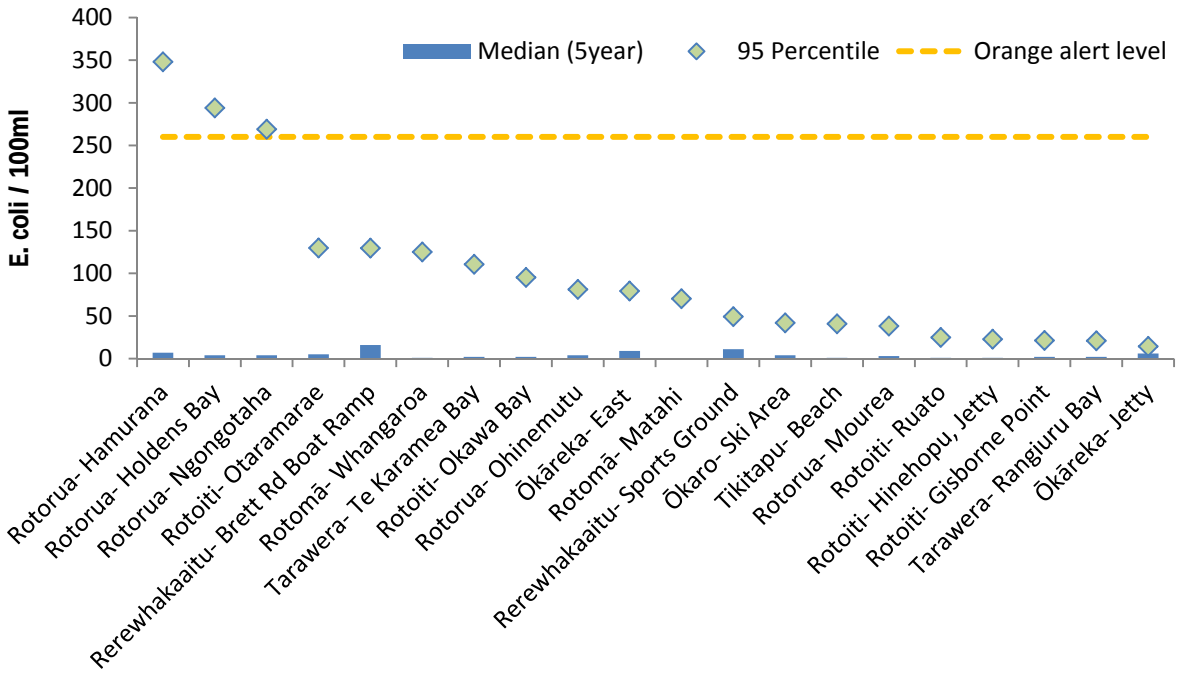

Figure 4.5 95-percentile and median results of E.coli concentrations, lake sites over the past 5 years.

4.3.2 Marine sites

Open coastal

Of the 15 open coastal marine sites five were monitored weekly and the others every second week.

Figure 4.6 shows the percentage of enterococci results at each site that exceeded the microbiological guideline levels ranked in order. No sites reached the Red/Action mode (two consecutive samples greater than 280 enterococci/100ml). The Orange/Alert mode was reached at Te Kaha (Maraetai Bay), Whanarua Bay, Ohope Beach (Surf club) and Waihi Beach (at 3 Mile Creek).

Twelve open coastal sites had median enterococci concentrations below 10 cfu/100 ml in 2011/2012, indicating a low level of contamination (Figure 4.7). The three sites above this level were Waihau Bay (73 cfu/100ml), Te Kaha at Maraetai (32 cfu/100ml) and Whanarua Bay (21 cfu/100ml). The Te Kaha results were unusual for this site and may have been a result of on-site waste water treatment failures. Known problems have been resolved and no alert levels have been discovered subsequently.

Overall the open coastal waters have very low levels of contamination as indicated by the enterococci indicator bacteria levels over the past 5 years (Figure 4.7).

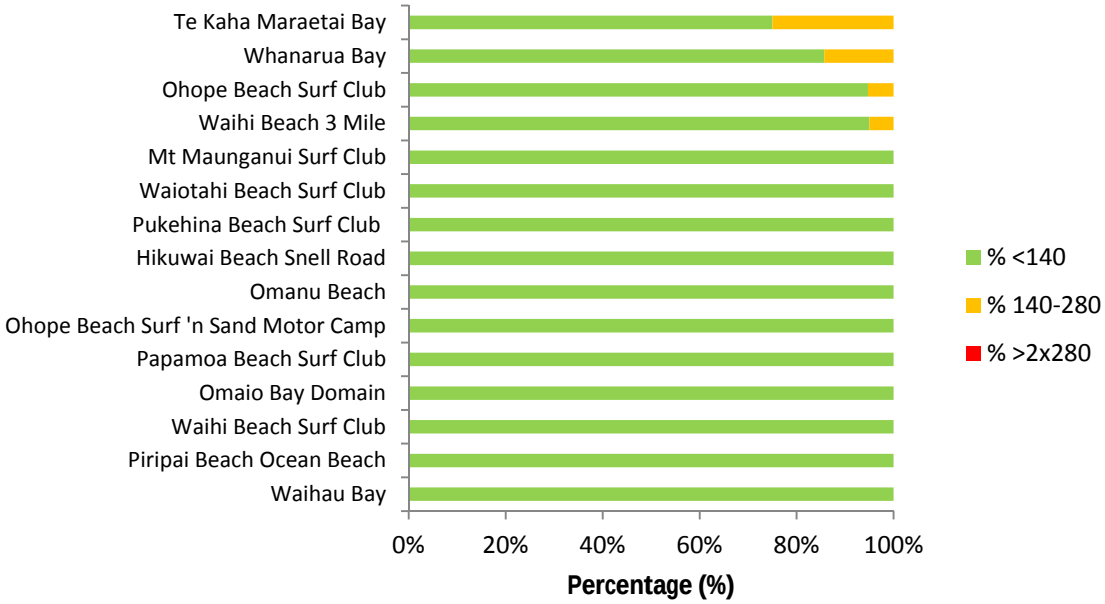

Figure 4.6 *Coastal marine enterococci levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2011/2012 bathing season.*

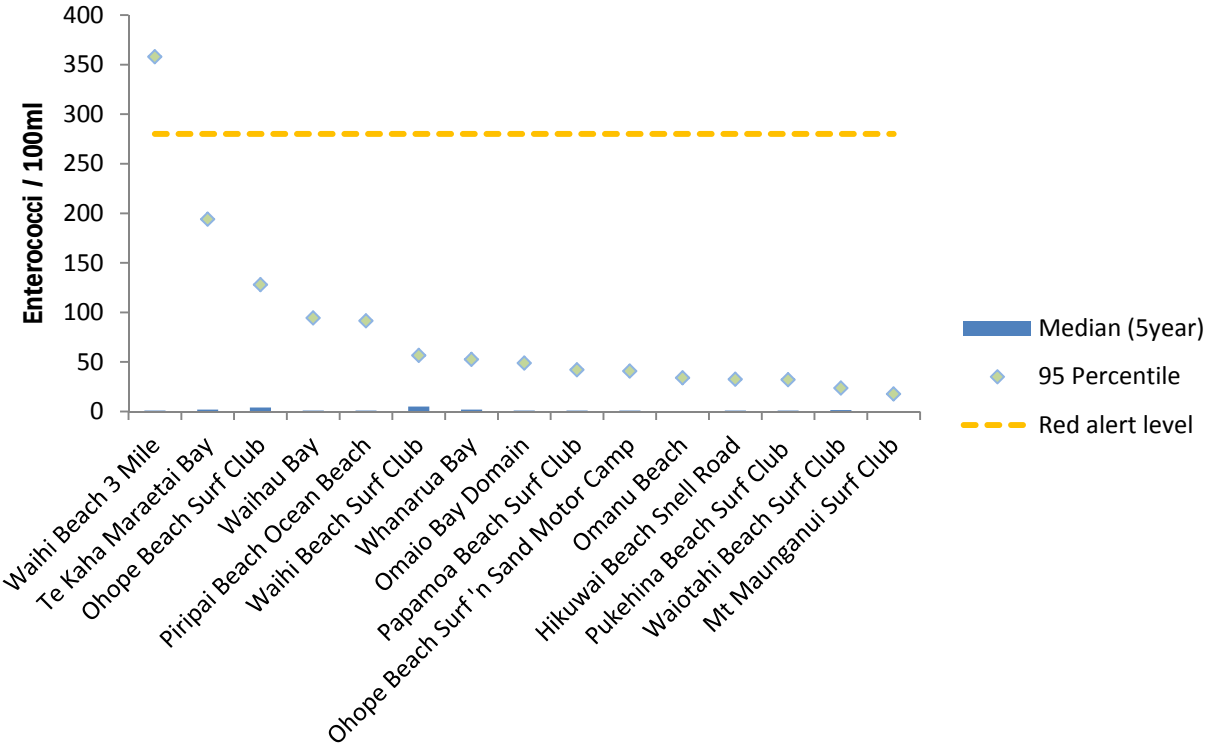

Figure 4.7 *95-percentile and median results of enterococci concentrations, coastal marine sites over the past five years.*

Estuarine

Thirteen of the 18 estuarine sites reached the Orange/Alert mode during the season (Figure 4.8). No sites reached the Red/Action mode. The median enterococci concentrations were generally well below the Orange/Alert mode, with the highest median level being 41.5 cfu/100ml at Waiotahi Estuary.

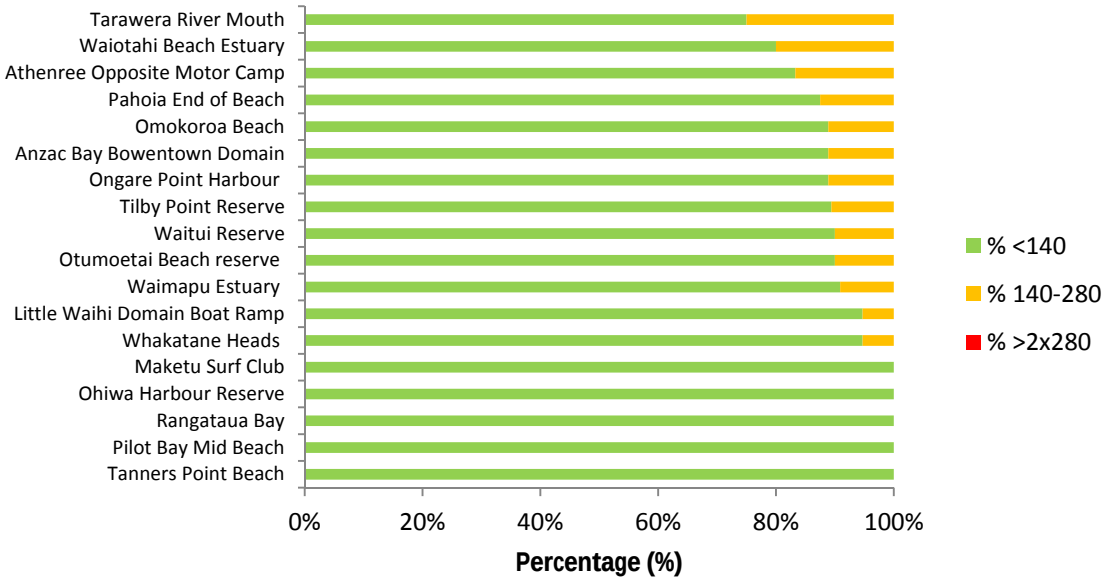

Figure 4.8 Estuarine marine enterococci levels compared against each of the modes in the NZ Microbiological Water Quality Guidelines (MfE/MoH 2003), 2011/2012 bathing season.

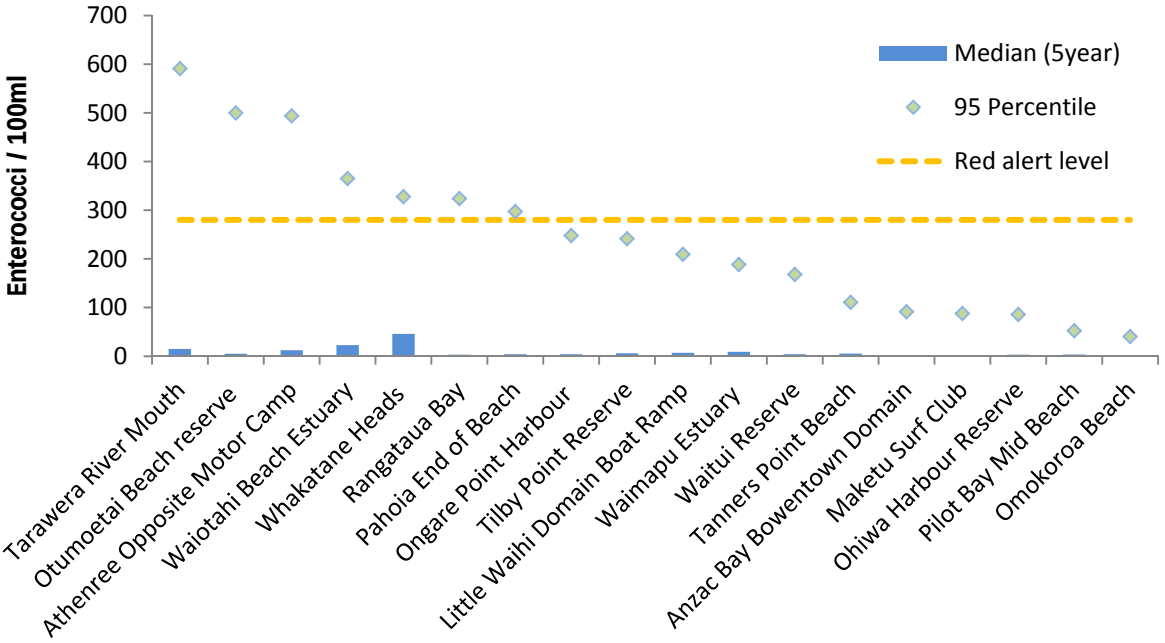

Figure 4.9 95-percentile and median results of enterococci concentrations, estuarine marine sites over the past five years.

Part 5: Shellfish

5.1 Sampling and analysis

Collection of shellfish occurred at a number of open coastal and estuarine sites in 2011/2012. At each site sampling was conducted over a 20 m transect of the shellfish bed/area. A minimum of 24 individual shellfish were taken per site to make up at least 200 g of flesh. The species sampled were;

- Cockle *(Austrovenus stuchburyi)*; found throughout muddier intertidal and subtidal areas, only abundant in harvestable numbers at a few locations.
- Pipi *(Paphies australis);* often abundant around the mouth of the estuaries but extend to sandy areas of the inner estuary.
- Oyster *(Tiostrea chilensis lutria);* commonly found cemented to rocks or mangroves in the intertidal zone.
- Tuatua *(Paphies subtriangulata);* found on open coastal beaches, most commonly in the surf zone.

Shellfish were analysed for E.coli, faecal coliforms and enterococci and the results expressed as MPN (most probable number) per 100 g of flesh.

The standard used for shellfish quality for consumption is based on the 'Ministry of Health Microbiological Reference Criteria for Food' (1995). This standard is listed in the 13th schedule of the Regional Coastal Environment Plan. To comply with the standard faecal coliform levels in flesh should be less than 330 MPN/100 g, and levels from 230 to 330 MPN/100 g are marginally acceptable.

Microbiological limits have also been specified by NZFSA (2006)[2]. Faecal coliform limits have been used historically for shellfish quality assessment but these have been abandoned in recent years in favour of E.coli. The E.coli median MPN of the shellfish samples must not exceed 230 per 100 g and no more than 10% of the samples must exceed an MPN of 700 per 100 g.

5.2 Results

Table 5.1 gives the results for shellfish sampled over the 2011/2012 summer.

Faecal coliform concentrations in shellfish were found to be over the MoH safe consumption guideline (330 MPN/100g) in pipi from Waiotahi Estuary. All other sites were well within safe consumption limits.

The levels of *E.*coli found in pipi from the Waiotahi Estuary were highest from December to early January after several rain events (Figure 5.1). Pipi returned to safe consumption levels in late summer/autumn reflecting a period of relatively dry weather.

[2] New Zealand Food Safety Animal Products (Specifications for Bivalve Molluscan Shellfish) Notice 2006.

Table 5.1 Shellfish indicator bacteria results. Samples exceeding the MoH guideline are indicated in red

Site		Sampled	Shellfish type	*E.coli* (MPN/100g)	ENT (MPN/100g)	FC (MPN/100g)
Waiotahi Estuary	Reserve	23/11/2011	Pipi	280		280
Waiotahi Estuary	Reserve	6/12/2011	Pipi	350		1600
Waiotahi Estuary	Reserve	16/12/2011	Pipi	330		330
Waiotahi Estuary	Reserve	18/01/2012	Pipi	540	130	540
Waiotahi Estuary	Reserve	2/02/2012	Pipi	540	170	540
Waiotahi Estuary	Reserve	21/02/2012	Pipi	220	170	220
Waiotahi Estuary	Reserve	10/04/12	Pipi	70	240	70
Waiotahi Estuary	Reserve	23/04/12	Pipi	17	49	79
Waiotahi Estuary	Reserve	7/05/12	Pipi	220		220
Ōhiwa Harbour	Uretara Channel	7/03/2012	Pipi	34		240
Ōhiwa Harbour	Off main Channel	7/03/2012	Cockle	17		17
Tauranga Harbour	Tilby Point	8/12/2011	Pipi	23		23
Tauranga Harbour	Pilot Bay	8/11/2011	Pipi			20
Tauranga Harbour	Pilot Bay	8/12/2011	Pipi	8		23
Tauranga Harbour	Pio's Beach	8/12/2011	Cockle	2		2
Tauranga Harbour	Pio's Beach – Yellow point	8/12/2011	Pipi	4		7
Tauranga Harbour	Waipu Bay	8/12/2011	Cockle	8		23
Tauranga Harbour	Hunter Creek	8/12/2011	Cockle	17		22
Pāpāmoa	Taylors Reserve	25/10/2011	Tuatua			<1

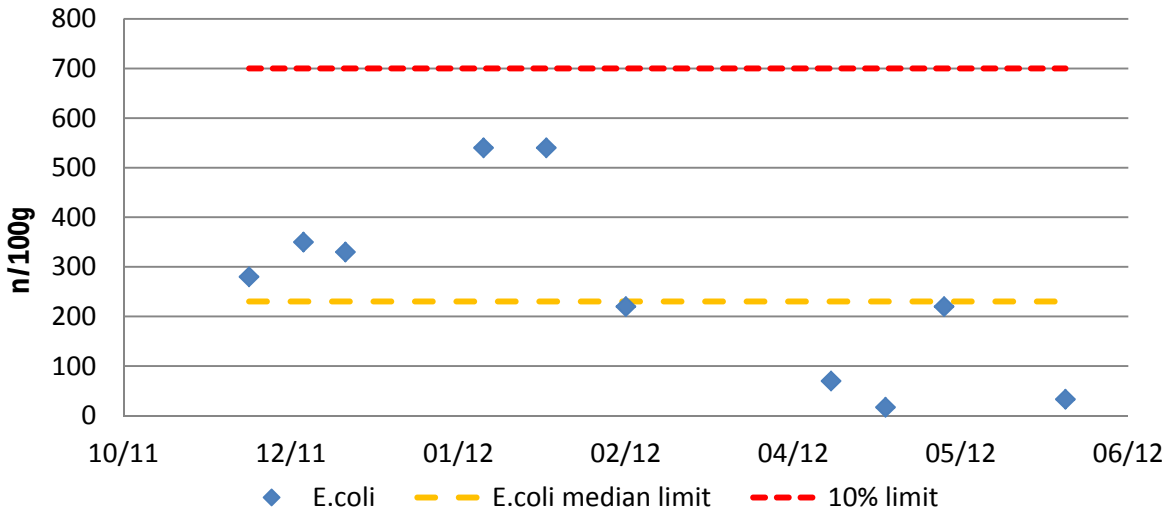

Figure 5.1 Indicator bacteria levels in pipi, Waiotahi Estuary. Limits shown are from the NZ Food Safety Authority (NZFSA 2006)

The monitoring results again show that the there is a heightened risk to shellfish consumers after storm events. Other studies (e.g. the Joint Agency Report, 2009) have shown that shellfish may take a week or longer to depurate (expel) potential pathogens before safe consumption level are reached. Raising public awareness of the risks of eating contaminated shellfish in this area should be implemented.

Part 6: River Algae Monitoring Programme

6.1 Introduction

Rivers and lakes are monitored over the summer-autumn period for blue-green algae (cyanobacteria).

Blue-green algae are widespread throughout New Zealand. Lake and rivers in the Bay of Plenty are at times affected by free living algal blooms (leading to soupy looking water or surface scums) or blooms of attached 'benthic' algae (often in the form of mats covering the river bed). These blooms may or may not be toxic.

Phormidium is a benthic mat-forming cyanobacteria that can proliferate during periods of sustained river low flows, and form expansive black/brown leathery mats across large areas of river bed (Wood and Heath, 2010). *Phormidium* produces a potent neurotoxin and has been linked worldwide with dog and stock deaths (Heath, 2009). While ingestion of the mats is the most direct route of exposure, there is one account in the international literature of dog deaths occurring after they drank from a bloom affected river.

Stable substrate provides attachment points for these cyanobacteria and other algae and for this reason blooms are most often associated with cobbled river beds. However, investigation following the death in 2007 of a dog near the Rangitāiki River revealed that *Phormidium* can also form continuous mats over pumice beds after prolonged low-flow events. This is significant for a number of rivers in the Bay of Plenty.

When extensive mats of blue-green algae are found a warning may be issued by the health authority. This will advise the public not to drink or use affected water and to keep away from the areas affected.

When a warning is issued the district council places signs at major public access points. Updated information on warnings is also posted on the Bay of Plenty Regional Council and Toi Te Ora Public Health websites and on recorded telephone messages.

6.2 Monitoring method

Benthic cyanobacteria are monitored at sites along the Rangitāiki, Whakatāne, and Waimana rivers. The following sites were only monitored once in 2011/2012; Tuapiro Creek, Uretara Stream (two sites on the same day) and Sapphire Springs. The Rangitāiki River was also only sampled once this season due to high water levels. The Otara River was not sampled this season.

Monitoring involves estimating the percentage cover of cyanobacteria at five points along four transects. Transects begin downstream and progress upstream to avoid disturbance to areas not yet surveyed. A transect is made across the river, if shallow, or to a maximum depth of 0.6 metres, for larger, deeper rivers. A mean percentage cover is generated for each site using cover estimates at all 20 points.

The sites monitored include river entry points of known recreational value. River reaches that contain optimum habitat for *Phormidium*, and that are shown perennially to support large mats, are also monitored as these provide a comparative measure of mat development (even if they receive little recreational use).

6.3 Phormidium - monitoring framework

An early warning system is operated on the Whakatāne and Rangitāiki Rivers based on telemetered flow recorders[3]. The status level for the Whakatāne River is also used to represent the situation in the Waimana River. As each alert level is reached, a range of actions follow, potentially culminating in health warnings if and when mat cover reaches or exceeds 50% cover (Table 6.1). The alert level framework generally follows that given in the interim 'New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters' (MfE/MoH 2009).

A network of river users also informs the council when *Phormidium* is present at levels that may require field measurements.

Table 6.1 Alert level framework in place for Phormidium

Alert level	Trigger	Action
Phormidium Surveillance (green mode)	Up to 20% coverage of potentially toxigenic cyanobacteria attached to substrate	Undertake fortnightly surveys between spring and autumn at representative locations in the water body where known mat proliferations occur and where there is recreational use.
Phormidium Yellow Alert	No flush in last 14 days	Continue to monitor the situation.
Phormidium Orange Alert	Flow <10-percentile	Begin field assessments. If coverage of potentially toxigenic cyanobacteria 20−50%, notify the public health unit and Increase sampling to weekly.
Phormidium Red Alert	Phormidium mat covering ≥50% of the bed	Immediately notify the public health unit. Health warning instated. If municipal water takes are at risk SPATT may be established to monitor for free toxins

6.4 Results

6.4.1 Waimana River

The Waimana River is monitored at two sites including Wardlaw Reserve and Lowe Road.

As with the 2009/2010 and 2010/2011 summer season *Phormidium* coverage was low in the 2011/2012 summer season (1-2%) and no health warnings were issued. After very low cover in spring *Phormidium* was effectively absent at both sites over summer and autumn (Figure 6.1). The last health advisory for this river was in February 2009.

[3] The telemetered flow recorder sites are based around established gauging stations at Valley Road (Whakatāne River) and Te Teko (Rangitāiki River).

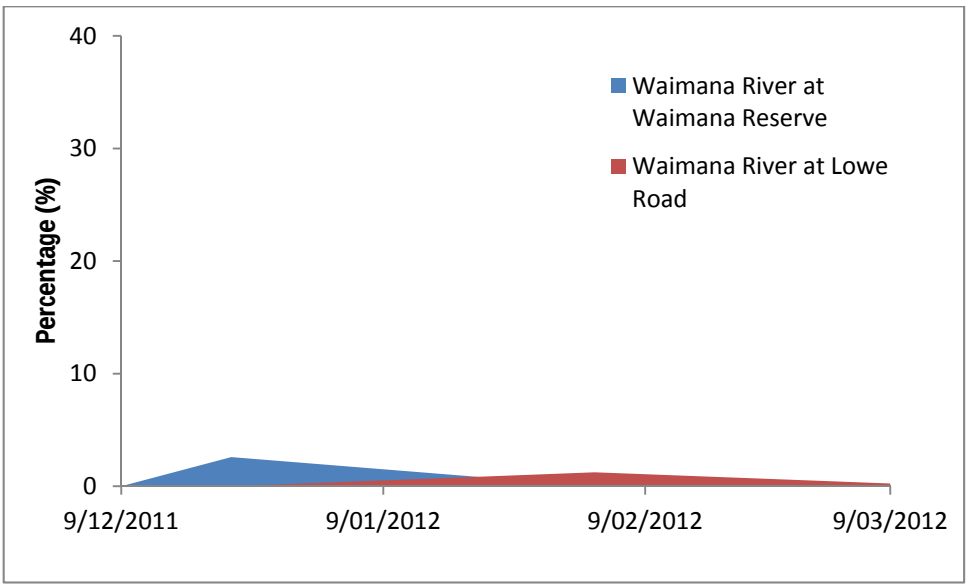

Figure 6.1 Percentage Phormidium cover, Waimana River

6.4.2 Whakatāne River

The Whakatāne River is monitored at two sites including Reid Memorial Reserve and Pekatahi Bridge. *Phormidium* was recorded at low levels at both monitoring sites in 2011/2012 (Figure 6.2). Growths, where present, were generally restricted to individual cobbles and did not reach the levels seen in the previous summer. The last health advisory, covering both the Whakatāne and Waimana Rivers, was issued in December 2008.

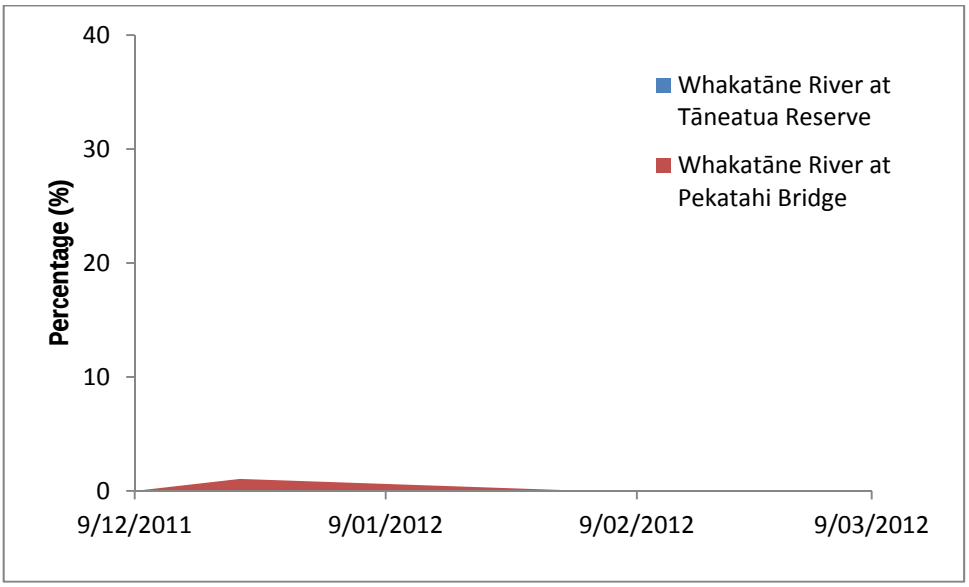

Figure 6.2 Percentage Phormidium cover, Whakatāne River

No other Eastern Bay rivers (e.g. the Otara or Waioeka Rivers) were sampled for bloom activity over the 2011/2012 monitoring period.

6.4.3 Rangitāiki River

The Rangitāiki River is monitored at six sites including at the Edgecumbe playing field, Edgecumbe substation, Te Teko (occasional), Rabbit Bridge (occasional), Galloway's farm, and above the Murupara State Highway 38 road bridge.

These sites were only sampled once or not at all (Galloway's farm) in 2011/2012 as unusually high summer rainfall inhibited the development of blooms.

No *Phormidium* was observed in the lower Rangitāiki over the 2011/2012 monitoring season. Moderate mat development occurred at upstream sites including at the SH38 river side reserve at Murupara. On no occasion did levels trigger health warnings. Mat development at Murupara reached 7% cover in March, well under levels that would trigger a health advisory. It was only sampled once so it is unknown if it declined to low levels by the end of summer.

6.4.4 Western Bay of Plenty rivers

As for the eastern rivers the Western Bay of Plenty sites were only sampled once in 2011/2012.

Te Rereatukahia Stream was added to the *Phormidium* monitoring programme along with three other Western Bay of Plenty sites in 2010. This stream runs through Sapphire Springs, a popular thermal spring and camping ground. While the thermal springs are probably the main attraction for campers and locals, the stream runs through the complex and contains pools and run sections attractive for bathing.

A gradual build-up of mats occurred in Te Rereatukahia Stream (Sapphire Springs) reaching its highest level (20.75 %) in the weeks prior to floods in January (Figure 6.3). The *Phormidium* was very concentrated above and below the bridge. The high flows that resulted from the early January floods removed almost all of the mats.

Tuapiro Stream was very near the threshold at 41% cover, the *Phormidium* was very concentrated just above the ford. Mats did not re-establish after the January floods. No other Western Bay of Plenty sites recorded extensive *Phormidium* development.

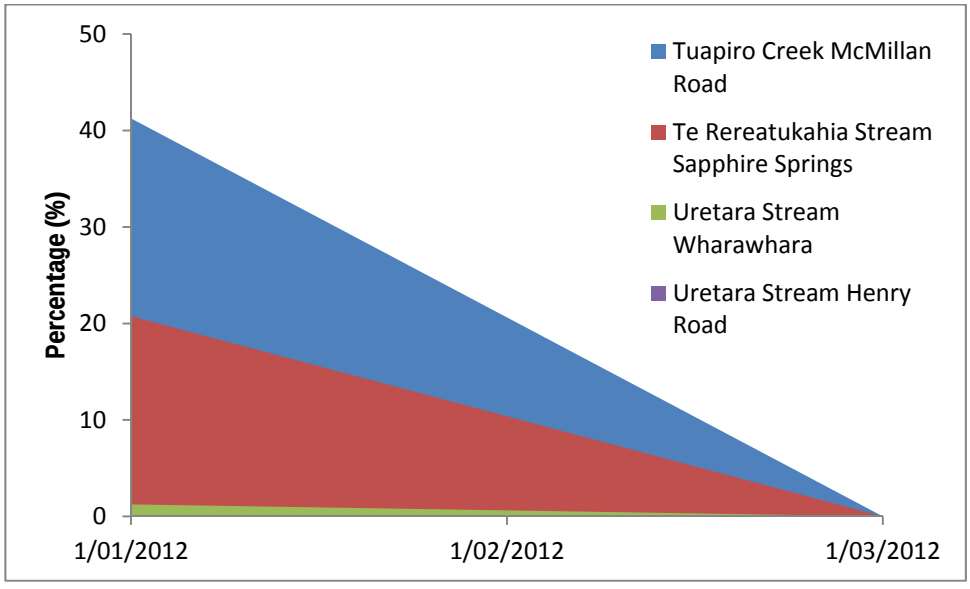

Figure 6.3 Percentage Phormidium cover, Western Bay of Plenty

Part 7: Discussion and Recommendations

The results of the 2011/2012 bathing surveys show that most sites in the Bay of Plenty are generally suitable for bathing. However, the Suitability for Recreation Grading (SFRG) system highlights that there is a higher risk to bathers using river and stream sites than for lake and coastal sites. For example, 80% of lake sites are graded 'very good' while 50% of river sites are graded 'poor'. This is consistent with previous monitoring and reflects the greater vulnerability of rivers and streams to diffuse and point source discharges of contaminants sourced from faecal material.

As indicated above, lake sites consistently had very low levels of faecal contamination although as with the previous season (2010/2011) three sites exceeded the Orange/Alert mode in 2011/2012. In addition two sites exceeded the Red/Action mode following extreme weather.

River and stream sites showed improved levels of faecal contamination compared to the previous season but are more influenced by the effects of rainfall events than lake sites. In 2011/2012 many of these sites (17 of 28 monitored) exceeded the Red/Action mode at some time.

The faecal bacteria results for a number of stream sites are notable;

- The Kaiate Stream site has shown an improvement over the past two seasons. This is probably due to the fencing of some waterways in the catchment.

- The Ngongotahā Stream site has shown consistent elevated results predominantly after rainfall.

- The Tuapiro Stream site has a high base load of faecal contamination and this may indicate that there is a more consistent source of contamination which cannot be attributed to rainfall events.

- The Ngamuwahine Stream site has a large proportion of indigenous vegetation in its catchment and yet often has elevated faecal bacteria levels. Addressing the source of this contamination would also benefit the Wairoa River which often experiences elevated faecal bacteria levels.

Open coastal sites typically have excellent water quality with only four exceeding the Orange/Alert mode in 2011/2012. Most (93%) of the open coastal sites have been graded as 'good' or 'very good' under the SFRG system with only one site graded as 'poor'. More estuarine sites exceeded the Orange/Alert mode than the previous season (13 compared to 8 in 2010/2011. Of the estuarine sites 50% are graded 'fair' with higher faecal contamination levels due to the enclosed nature of estuaries and river influences.

Shellfish in pipi from Waiotahi Estuary were found to have faecal bacteria levels above safe consumption guidelines. An intensive monitoring effort showed that elevated bacteria levels occurred in pipi after rainfall. Monitoring of the estuary will continue to track the success of future catchment management actions.

Phormidium was generally only found at low levels in rivers in 2011/2012. However, some sites in the Western Bay of Plenty were found to have coverage near to the interim recreational threshold. Sites in the east of the region had low levels of coverage compared to previous years.

7.1 Recommendations

The bathing and shellfish monitoring programme does not specifically identify the factors causing faecal contamination. However, it does highlight areas where more detailed investigation should be carried out. Targeted studies are used to address these more specific water quality issues. Recommendations for future targeted investigations are made below:

- Initiate studies in the catchments of the Waitetī and Ngongotahā streams to identify sources of faecal contamination. This information will help to prioritise catchment management actions.

- Investigate faecal contamination sources in the catchment of the Tuapiro Stream. The use of molecular techniques may be required as there appears to be a more consistent source of contamination occurring in this catchment.

- Investigate faecal contamination sources in the catchment of the Ngamuwahine Stream, In particular, attempt to determine the relative loading rates from the DOC reserve area compared to pastoral land-use and other activities.

Finally, while the current bathing surveillance programme is working well it does not meet the sampling frequency recommended in the New Zealand Microbiological Water Quality Guidelines (MfE/MOH 2003). This issue will be considered in a wider review of the NERMN Programme in 2012/2013.

Part 8: References

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Appendices

Appendix 1a – SFRG Grades for Marine sites

District	Site	Description	BOP Site Number	P	MAC	SIC	SFRG	% samples less than the Red/Action mode 2011/2012	% samples less than the Red/Action mode over 5 years
Ōpōtiki	Hikuwai Beach End of Snell Road	Hikuwai	160005	32.6	A	Moderate	**Good**	100	100
Ōpōtiki	Omaio Bay Domain	Omaio	160004	48.8	B	Moderate	**Good**	100	100
Ōpōtiki	Te Kaha Beach Maraetai Bay	Te Kaha	160003	194.1	B	Low	**Good**	75	95
Ōpōtiki	Waihau Bay	Waihau	160001	94.4	B	Very Low	**Very Good**	100	100
Ōpōtiki	Waiotahi Beach Estuary	Waiotahi Est	160008	365	C	Moderate	**Fair**	88	95
Ōpōtiki	Waiotahi Beach Surf Club	Waiotahi	160007	23.6	A	Low	**Very Good**	100	97
Ōpōtiki	Whanarua Bay	Whanarua Bay	160002	52.6	B	Very Low	**Very Good**	100	100
Tauranga	Mt Maunganui Ocean Beach Surf Club	Mount	160025	17.7	A	Very Low	**Very Good**	100	100
Tauranga	Omanu Beach	Omanu Surf Club	900096	34	A	Very Low	**Very Good**	100	98
Tauranga	Otumoetai Beach reserve end of Beach	Otumoetai	160021	500	C	Moderate	**Fair**	88	92
Tauranga	Papamoa Beach Surf Club	Papamoa	160026	42.1	B	Very Low	**Very Good**	100	100
Tauranga	Pilot Bay Mid Beach	Pilot Bay	160042	52.2	B	Moderate	**Good**	100	98
Tauranga	Rangataua Bay	Maungatapu	160049	324	C	Moderate	**Fair**	100	92
Tauranga	Tilby Point Reserve	Tilby Pt	160020	241.5	C	Moderate	**Fair**	94	96
Tauranga	Waimapu Estuary Motel-Motor Camp	Waimapu	160019	188.5	B	Low	**Good**	100	96
WBOP	Anzac Bay Bowentown Domain	Anzac Bay	160028	91.6	B	Very Low	**Good**	88	95
WBOP	Athenree Opposite Motor Camp	Athenree	160030	494	C	Low	**Fair**	81	89
WBOP	Little Waihi Domain Boat Ramp	Little Waihi	160016	209.5	C	Moderate	**Fair**	100	97
WBOP	Maketu Surf Club	Maketu	160017	87.7	B	Moderate	**Good**	100	100
WBOP	Omokoroa Beach	Omokoroa	160022	40.6	B	Very Low	**Very Good**	100	100
WBOP	Ongare Point Harbour View Road	Ongare Pt	160032	248	C	Low	**Fair**	100	94
WBOP	Pahoia End of Beach	Pahoia	160023	297.5	C	Low	**Fair**	87	95
WBOP	Pukehina Beach Surf Club	Pukehina	160170	32	A	Very Low	**Very Good**	100	100
WBOP	Tanners Point Beach	Tanners Pt	160031	111	B	Very low	**Very Good**	100	97
WBOP	Waihi Beach Surf Club	Waihi Beach	160027	56.6	B	Low	**Good**	100	100
WBOP	Waihi Beach	3 Mile Creek	900077	358	C	High	**Poor**	94	93
WBOP	Waitui Reserve	Te Puna	800087	168	B	High	**Follow-up**	100	96
Whakatāne	Ohiwa Harbour Reserve Boat Ramp	Ohiwa	160009	86	B	Very Low	**Very Good**	100	100
Whakatāne	Ohope Beach Surf Club	Ohope 2	160011	128	B	Moderate	**Good**	94	97
Whakatāne	Ohope Beach Surf 'n Sand Motor Camp	Ohope 1	160010	40.8	B	Very Low	**Very Good**	100	100
Whakatāne	Piripai Beach Ocean Beach	Piripai	160014	91.5	B	Very Low	**Very Good**	100	100
Whakatāne	Whakatane Heads Oceanside of Boat Ramp	Whakatane	160013	328	C	Moderate	**Fair**	100	93
Whakatāne	River Mouth	Tarawera River	110125	591	D	High	**Very Poor**	100	91

Appendix 1b – SFRG Grades for River and stream sites

District	Site	Description	BOP Site Number	P	MAC	SIC	SFRG	% samples less than the Red/Action mode 2011/2012	% samples less than the Red/Action mode over 5 years
Kawerau	Ruruanga Stream	Cricket Pavilion	160111	370	C	High	**Poor**	90	96
Kawerau	Tarawera River	Boyce Park	160110	131	B	Very Low	**Very Good**	100	100
Ōpōtiki	Haparapara River	Omaio d/s SH35 Bridge	160100	551.5	D	Low	**Poor**	100	95
Ōpōtiki	Otara River	d/s SH35 Bridge	160101	365	C	Moderate	**Fair**	93	96
Ōpōtiki	Waioeka River	bend near Waioeka Pa	160102	1060.5	D	Moderate	**Poor**	100	94
Ōpōtiki	Waioeka River	SH2 Bridge	160103	550	C	High	**Poor**	94	95
Rotorua	Awahou Stream	Glouster Road	160118	171.5	B	Very Low	**Very Good**	100	100
Rotorua	Kaituna River	Trout Pool Rd	160112	47.9	A	Very Low	**Very Good**	100	100
Rotorua	Ngongotaha Stream	Railway Bridge	160114	1500	D	Moderate	**Poor**	73	89
Rotorua	Ohau Channel	SH 33 Bridge	160119	200.3	B	Very Low	**Very Good**	100	100
Rotorua	Puarenga Stream	Whakarewarewa	160113	1200	D	Moderate	**Poor**	95	90
Rotorua	Utuhina Stream	Lake Road	160117	812.5	D	Moderate	**Poor**	89	90
Rotorua	Waitangi Springs	Lake Rotoehu	160120	209	B	Very Low	**Very Good**	100	100
Rotorua	Waiteti Stream	Ngongotaha	160115	1073.5	D	Moderate	**Poor**	71	86
Tauranga	Waimapu River	Greerton Park Footbridge	160150	861	D	High	**Very Poor**	89	92
Tauranga	Wairoa River	Bethlehem	160122	772.5	D	Moderate	**Poor**	85	91
WBOP	Kaituna River	Te Matai Rail Bridge	160129	410	C	Moderate	**Fair**	90	95
WBOP	Ngamuwahine River	at Reserve	160125	1017	D	Moderate	**Poor**	78	89
WBOP	Tuapiro Stream	McMillan Road	160126	472.5	C	Moderate	**Fair**	81	95
WBOP	Uretara Stream*	Henry Road Ford	210004	450	C	Moderate	**Fair**	100	-
WBOP	Wairoa River	below McLaren Falls Dam	160124	858.5	D	Moderate	**Poor**	86	90
WBOP	Kaiate Stream	Kaiate Falls	160130	2200	D	High	**Poor**	84	73
WBOP	Pongakawa River	SH2 Bridge	110030	688	D	Moderate	**Poor**	89	93
Whakatāne	Rangitaiki River	Te Teko	110018	88.6	A	Very Low	**Very Good**	100	100
Whakatāne	Rangitaiki River	Thornton Domain	160109	308	C	High	**Poor**	100	98
Whakatāne	Waimana River	Waimana Gorge Picnic Area	160105	610	D	Very Low	**Follow-up**	93	94
Whakatāne	Whakatāne River	Landing Road Bridge	160106	568	D	High	**Very Poor**	100	94
Whakatāne	Whakatāne River	Ruatoki Bridge	110010	85.5	A	Very Low	**Very Good**	100	100

* Uretara Stream is a new site. The P & MAC grades are based on data from one season.

Appendix 1c – SFRG Grades for Lake sites

Site	Description	Site No.:	P	MAC	SIC	SFRG	% samples less than the Red/Action mode 2011/2012	% samples less than the Red/Action mode over 5 years
Lake Rotoma	Matahi Lagoon Road, Beach	160050	70.3	A	Very Low	**Very Good**	100	97
Lake Rotoma	Whangaroa	160052	125.1	A	Very Low	**Very Good**	100	100
Lake Rotoiti	Hinehopu, Jetty	160053	22.8	A	Very Low	**Very Good**	100	100
Lake Rotoiti	Gisborne Point	160054	21.3	A	Very Low	**Very Good**	100	100
Lake Rotoiti	Ruato	160055	24.8	A	Very Low	**Very Good**	100	100
Lake Rotoiti	Okawa Bay	160056	95.2	A	Very Low	**Very Good**	100	100
Lake Rotoiti	Otaramarae	160058	104.4	A	Very Low	**Very Good**	100	97
Lake Okareka	East end of dwellings	160061	79.2	A	Very Low	**Very Good**	100	100
Lake Okareka	Jetty	160062	41.4	A	Very Low	**Very Good**	100	100
Lake Tikitapu	Beach	160063	40.8	A	Very Low	**Very Good**	100	100
Lake Tarawera	Rangiuru Bay	160072	21	A	Very Low	**Very Good**	100	100
Lake Tarawera	Te Karamea Bay	160291	110.6	A	Very Low	**Very Good**	100	100
Lake Rotorua	Mourea	160065	38.1	A	Very Low	**Very Good**	100	100
Lake Rotorua	Holdens Bay	160066	294	C	Moderate	**Good**	100	98
Lake Rotorua	Ohinemutu	160068	81.2	A	Moderate	**Good**	100	100
Lake Rotorua	Ngongotaha	160069	269	C	Moderate	**Fair**	92	98
Lake Rotorua	Hamurana	160070	348	C	High	**Poor**	90	97
Lake Okaro	Ski Area	160073	42	A	Very Low	**Very Good**	100	100
Lake Rerewhakaaitu	Brett Road Boat Ramp*	160079	129.5	A	Very Low	**Very Good**	100	100
Lake Rerewhakaaitu	Sports Ground*	160078	49.2	A	Very Low	**Very Good**	100	100

* The P and MAC grades for the Lake Rerewhakaaitu sites are based on data from the 2010/11 & 2011/12 season. The other grades are based on data from 5 seasons.