MARLBOROUGH DISTRICT COUNCIL

Recreational Water Quality Report 2014-2015

Technical Report No: 15-006
August 2015

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MDC Technical Report No: 15-006

ISSN 1179-819X (Online)

ISBN 978-1-927159-56-9 (Online)

File Reference/Record No: E370-007-001/15170405

August 2015

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Executive Summary

Twenty two popular beaches and river sites were sampled weekly from the beginning of November 2014 until the end of March 2015. The samples were analysed for faecal indicator bacteria in order to determine the health risk to recreational users from waterborne diseases (i.e. Campylobacteriosis). Long-term trends of faecal indicator bacteria levels at the sites were assessed using the 5-year-95%ile concentrations. This measure is also used in the determination of Suitability for Contact Recreation Grades, which give an overall assessment of recreational water quality.

Below average rainfall for most of the region meant that there was little surface run-off carrying animal droppings from farmland and urban surfaces into waterways. Consequently, at the majority of sites, recreational water quality was good during the whole of the summer season. Three river sites and one coastal site had faecal indicator bacteria concentrations exceed levels considered safe for contact recreation due to rainfall, and the exceedences only occurred on one or two occasions. Ten sites had faecal indicator bacteria concentrations that were consistently below guideline levels.

The two sites with the worst recreational water quality were the Taylor River at Riverside and Momorangi Bay. High faecal bacteria levels here were unrelated to rainfall. In the Taylor River, low river flows resulted in reduced dilution of faecal contamination, most likely originating from ducks and dogs, but the possible contribution of additional sources may have caused the large variation in results observed. High indicator bacteria concentrations in Momorangi Bay were potentially caused by a leakage in the campground sewage system. Subsequently, warning signs were posted, advising the public of the potential health risk in the bay for most of the season.

Figure 1: Whites Bay.

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1. Introduction

Marlborough has a number of beautiful beaches and rivers that are popular with visitors and local residents during the warmer months of the year. Swimming, boating, surfing and fishing are only a few of the many water based recreational activities that take place in the region. The Resource Management Act (RMA 1991) and Health Act require Councils to monitor popular beaches and river locations and assess the risk to human health from faecal contamination. Accidental ingestion of water during recreational activities (i.e. swimming) can result in illness when faecal bacteria concentrations in the water are high. Weekly samples are taken from the beginning of November until the end of March and analysed for faecal indicator bacteria. Results are assessed according to national guidelines published by the Ministry for the Environment [MfE, 2003] in order to evaluate the risk from disease-causing bacteria, viruses and protozoa.

This report presents the results for the samples taken during the summer season of 2014/2015 and investigates long term trends in the microbial water quality where possible. It is important to note that the recreational water quality program is exclusively focused on health based risks associated with faecal contamination and results are not reflective of the general water quality of a site, the presence of toxic algae or other risks associated with a site (i.e. high water flows or strong currents).

2. The Microbiological Water Quality Guidelines

In 2003 the Ministry for the Environment and the Ministry of Health published a Guideline document providing a framework for the monitoring of the microbiological water quality of recreational areas [MfE, 2003]. The document provides general recommendations in regard to the management of recreational water quality and guideline values allowing the assessment of results from individual samples. The guideline document also provides a method to evaluate the overall bacterial risk at a site, not just at the time a sample is taken, the Suitability for Contact Recreation Grade (SFR Grade). This grade takes into account the risks of faecal contamination from the surrounding areas and the sampling results over a five year period.

2.1. Guideline values for individual samples

Measuring the concentrations of all microorganisms that can be hazardous for the health of water users is both difficult and expensive. A more cost effective approach to assessing the number of pathogens present is the use of indicator bacteria. These are comparatively easily measured and are generally present when water is contaminated with harmful organisms such as Salmonella, Campylobacter, Giardia or Cryptosporidium. Scientific research has shown that high concentrations of indicator bacteria are a sign that there is an increased health risk associated with the use of a water body for contact recreation and the water is potentially contaminated with human sewage or animal faeces.

Two different indicator bacteria are used depending on the type of water being sampled. Freshwater samples are analysed for the concentration of E. coli, while Enterococci are the preferred indicator bacterium for coastal samples. The MfE Guideline document provides two guideline values for each of the two indicator bacteria. Based on these guidelines, sample results are categorised into three “Modes”, which then allow a decision to be made on whether the water can be considered safe for contact recreation. Table 1 outlines these “Modes” and their meaning as well as the actions that need to be taken as a result. In this report the lower limit for the Alert Mode is referred to as Alert Guideline, which corresponds to concentrations of 260 E. coli/100mL and 140 Enterococci/100mL. The upper limit for the Alert Mode (lower limit of the Action Mode) is referred to as the Action Guideline, corresponding to 550 E. coli/100mL and 280 Enterococci/100mL.

Mode	Freshwater E. coli/100mL	Coastal Enterococci/100mL	Meaning	Required Action
Green Mode	<260	<140	**Safe** for contact recreation	Conitue routine monitoring
	260	140	**Alert Guideline**	
Alert Mode	260 - 550	140 - 280	**Increased risk** for health	Investigate possible causes and increase sampling frequency if no cause can be found, otherwise continue routine sampling
	550	280	**Action Guideline**	
Action Mode	>550	>280	**Unsafe** for conctact recreation	Increase sampling frequency and warn the public that the beach is considered unsafe (Warning signs)

Table 1: Modes and the corresponding Guidelines as outlined by the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (2003).[1]

The process followed when samples are in the Alert or Action Mode is described in Section 3.

2.2. Suitability for Contact Recreation Grades

Suitability for Contact Recreation Grades (SFR Grades) provide an overall measure for the microbial water quality of a beach or river site. The Grades are based on a 'reasonable risk' approach in regard to the possibility of contracting water borne diseases associated with faecal contamination when pursuing recreational activities in and around the water.

The SFR Grade is the combination of a catchment assessment (Sanitary Inspection Category, SIC) and an assessment of the Microbiological Water Quality (Microbiological Assessment Category, MAC).

The catchment assessment is primarily focused on potential sources of faecal contamination. SICs based on this assessment range from Very Low, Low, Moderate, High to Very High (Risk). Sites surrounded by bush and forest are given a SIC of Very Low. Low intensity agriculture in the catchment results in a SIC of Low. Categories of High and Very High are given to sites likely to directly receive treated or untreated sewage or run-off from high-intensity agriculture.

The MAC is derived from the Enterococci or E. coli concentrations in routine samples taken from a site over five consecutive summers. MACs range from "A" to "D" (Table 2) and are based on the upper 95th percentile (95%ile) calculated with the Hazen method.

The SIC and the MAC for a site are then combined into the Suitability for Contact Recreation Grade (SFR Grade).The SFR Grades range from Very Good, Good, Fair, Poor to Very Poor. Table 3 outlines the definitions for the individual Grades.

The SFR Grades for the sites currently sampled were reviewed in the Recreational Water Quality Report for the 2013-2014 summer season and will therefore not be reviewed as part of this report.

[1] For coastal samples the Action Mode is usually only applied after concentrations in two consecutive samples exceed 280 Enterococci/100mL; however if a high number of people is expected to visit the beach (i.e. during holiday periods), a precautionary approach is taken and warning signs are erected after only one exceedance.

MAC (Microbiological Assessment Category)	**Coastal** Enterococci/100mL*	**Freshwater** E. coli/100mL*
A	<41	<131
B	41 - 200	131 - 260
C	201 - 500	261 - 550
D	>500	>550

* upper 95th Percentile (95%ile) of routine sampling over 5 consecutive summers

Table 2: Microbiological Assessment Categories (MAC).

SFR Grade	Meaning
Very Good	Considered satisfactory for swimming at all times.
Good	Satisfactory for swimming most of the time with exceptions following rainfall.
Fair	Generally satisfactory for swimming. Caution should be taken during periods of high rainfall and swimming avoided if water is discoloured.
Poor	Swimming should be avoided, particularly by the very young, the very old and those with compromised immunity.
Very Poor	Generally swimming is not recommended.

Table 3: Suitability for Contact Recreation (SFR) Grades and their meaning.

SFR Grades are not indicative of the general water quality at a site as their assignment is purely based on the health risk posed by potential faecal bacteria contamination and does not take into consideration other water quality parameters.

3. Recreational Water Quality Monitoring

The recreational water quality of thirteen coastal beaches and nine river sites was monitored from the beginning of November 2014 until the end of March 2015. Samples were taken weekly, usually at the beginning of each week, independent of weather conditions and tides. Hill Laboratories in Blenheim was contracted to measure the E. coli or Enterococci concentrations in the samples. Bacteria levels were determined as MPN counts using Enterolert for Enterococci and Colilert for E. coli after 24 hour incubation at 41^{o}C and 35^{o}C respectively.

As soon as analysis results were received from the laboratory, the Marlborough District Council website (www.marlborough.govt.nz) was updated in order to provide the public with up-to-date information. The same information can also be viewed in a slightly different form on the LAWA website (www.lawa.org.nz). If indicator bacteria concentrations were above the Alert or Action Guideline (Table 1) possible causes were considered and the District Health Board was informed. A joint decision was then made on how to proceed. Usually, warning signs were erected at the sites with unsafe levels of faecal bacteria. Additional samples were then taken from these sites until bacteria concentrations were at a low enough level for the water to be considered safe again. A flowchart outlining the process is shown in Appendix 4.

4. Influence of Rainfall

Rainfall greatly influences recreational water quality at the majority of sites monitored. Even small rainfall events can wash animal droppings from pastures, roofs, roads and other surfaces into rivers and coastal waters. In urban areas run-off from hard surfaces that picks up bird droppings, dog faeces and other contaminants is collected in the stormwater system, which is discharging directly into the local waterways. Larger amounts of rainfall can also cause septic tanks to overflow if these are not properly sealed or maintained.

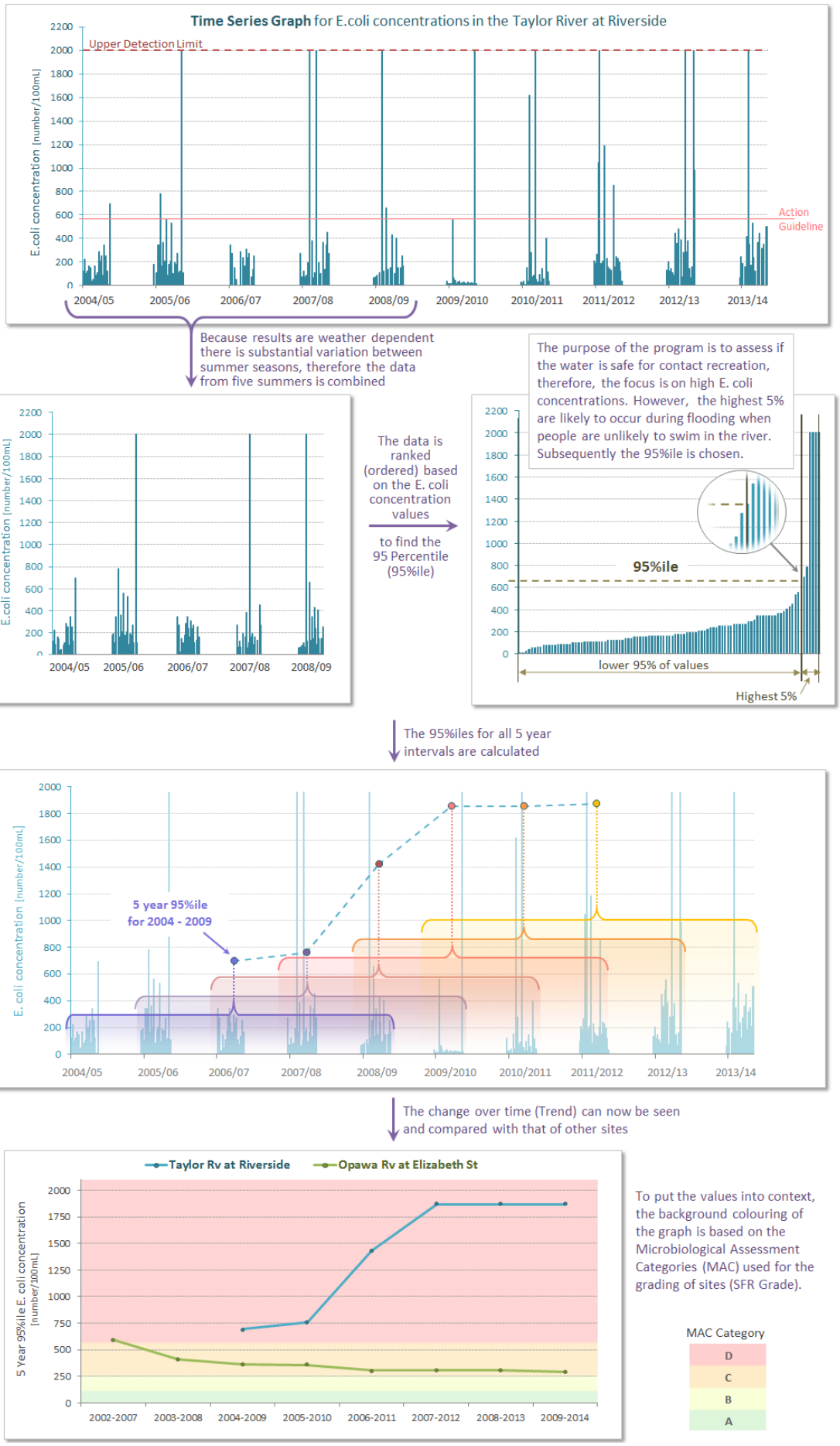
It is generally recommended not to swim for 48 hours after rainfall, particularly in waterways that are known to be affected by rural or urban run-off.

5. Results

The following chapters present the results for this summer as well as changes of faecal bacteria concentrations over time (long-term trends). Where appropriate, sites are grouped into sets of two or three sites. For each group the concentration of faecal indicator bacteria in the samples taken from each site during the summer of 2014/15 is shown together with rainfall and flow data recorded at nearby sites. This allows the results to be viewed with regard to rainfall and flood events. A map shows the location of the sampling sites as well as the rainfall and/or flow recorder. For sites with longer monitoring records, the changes over time are shown using the 5-year-95%ile (MAC) values (Figure 2) which are also used for the calculation of the SFR Grades (see Section 2.2).

Summary tables showing the numerical results for all samples taken this season can be found in the Appendices. Additionally, Appendix 2 contains graphs showing the compliance history and box and whiskers plots for sites that have been monitored for more than five years.

▶ Figure 2: Creation of 5-Year-95%ile Graphs, used to display long-term trends.


Time Series Graph for E.coli concentrations in the Taylor River at Riverside
Upper Detection Limit
Action Guideline
E.coli concentration [number/100mL]
2004/05
2005/06
2006/07
2007/08
2008/09
2009/2010
2010/2011
2011/2012
2012/13
2013/14
Because results are weather dependent there is substantial variation between summer seasons, therefore the data from five summers is combined
The data is ranked (ordered) based on the E. coli concentration values
to find the 95 Percentile (95%ile)
The purpose of the program is to assess if the water is safe for contact recreation, therefore, the focus is on high E. coli concentrations. However, the highest 5% are likely to occur during flooding when people are unlikely to swim in the river. Subsequently the 95%ile is chosen.
95%ile
lower 95% of values
Highest 5%
The 95%iles for all 5 year intervals are calculated
5 year 95%ile for 2004 - 2009
E. coli concentration [number/100mL]
The change over time (Trend) can now be seen and compared with that of other sites
Taylor Rv at Riverside
Opawa Rv at Elizabeth St
5 Year 95%ile E. coli concentration [number/100mL]
2002-2007
2003-2008
2004-2009
2005-2010
2006-2011
2007-2012
2008-2013
2009-2014
To put the values into context, the background colouring of the graph is based on the Microbiological Assessment Categories (MAC) used for the grading of sites (SFR Grade).
MAC Category
D
C
B
A

5.1. Moetapu Bay

Sites

Moetapu Bay is located in the Pelorus Sound in relative close proximity to the mouth of the Pelorus River and water quality in the bay is impacted when the river is in flood.

The Bay was recently added to the program as a result of a beach usage survey carried out in 2011 [MDC, 2012]. Initially sampling was carried out at the Department of Conservation (DoC) campground only, but field observations showed that the Double Bay Reserve was a more popular site. A greater number of homes and batches located in the catchment of Double Bay also means that the potential risk for contamination is greater compared to the DoC campground (Figure 3). It was decided to sample both sites in order to investigate differences in recreational water quality.

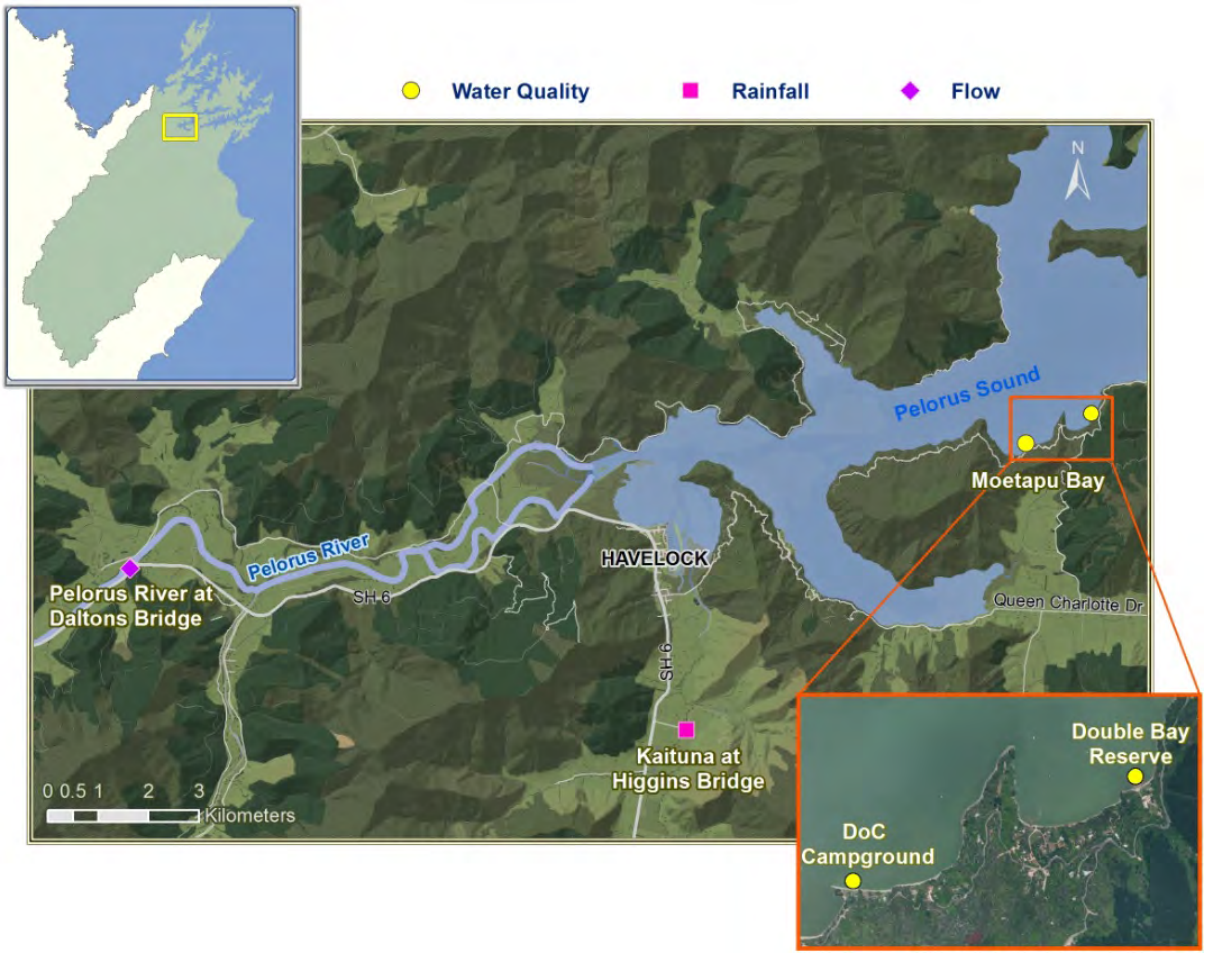


Figure 3: Map of the Moetapu Bay sampling sites, Kaituna rainfall and Pelorus flow site[2].

Results

None of the samples taken during this summer season had Enterococci concentrations above guideline values (Figure 4). The sample with the highest concentration was taken in February from the Double Bay Reserve following localised rainfall. Enterococci levels in the sample taken from the DoC campground on the same day were considerably lower. Nevertheless, in previous years, rainfall did also result in elevated Enterococci concentrations at the DoC campground and it can therefore not be assumed that localised sources only affect the water quality of Double Bay. Nevertheless, the results from this season show that overall Enterococci concentrations are slightly higher at the Double Bay Reserve.

[2] The Pelorus River flow at the Daltons Bridge is simulated from flows recorded further upstream.

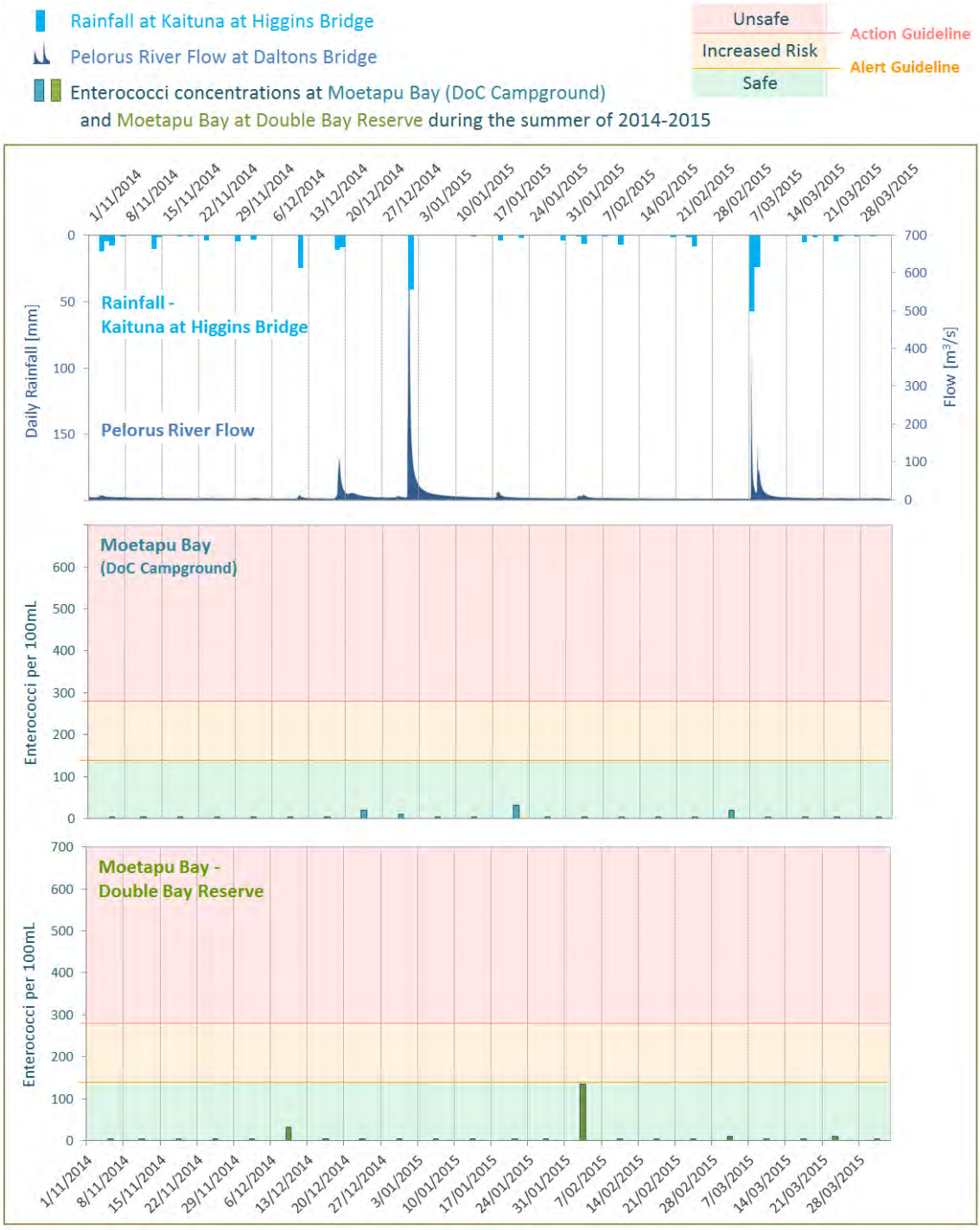


Figure 4: Results for Moetapu Bay for the summer season of 2014/15.

Two larger floods of the Pelorus River did not coincide with sampling dates and are therefore not reflected in the Enterococci results for the two Moetapu Bay sites. In the future only one of the sites should be sampled. This season again, more users were observed in the Double Bay Reserved than at the DoC campground. The greater usage combined with a larger number of potential sources for faecal contamination result in an overall greater risk for recreational users. For this reason, monitoring should continue at the Double Bay Reserve only.

5.2. Anakiwa and Mistletoe Bay

Sites

Anakiwa is located in the innermost part of the Queen Charlotte Sound. The microbiological water quality is influenced by the surrounding residential development and a large numbers of seabirds (i.e. oystercatcher, swans and ducks). Water quality is most likely also influence by Linkwater Stream and Ada Creek. These two streams drain pastoral land and flow into the Sound less than 2 km from the Anakiwa sampling site. Monthly monitoring of Linkwater Stream has shown that water quality is marginal and E. coli concentrations are frequently high [MDC, 2014]. The council is currently conducting a catchment-wide investigation of the water quality in Linkwater Stream in order to identify the sources of faecal contamination.

Compared to Anakiwa, Mistletoe Bay has few possible sources of faecal contamination. The enclosed Bay is surrounded by bush-clad hills. The Mistletoe Bay Trust facility and a few houses are the only residential developments in the catchment.

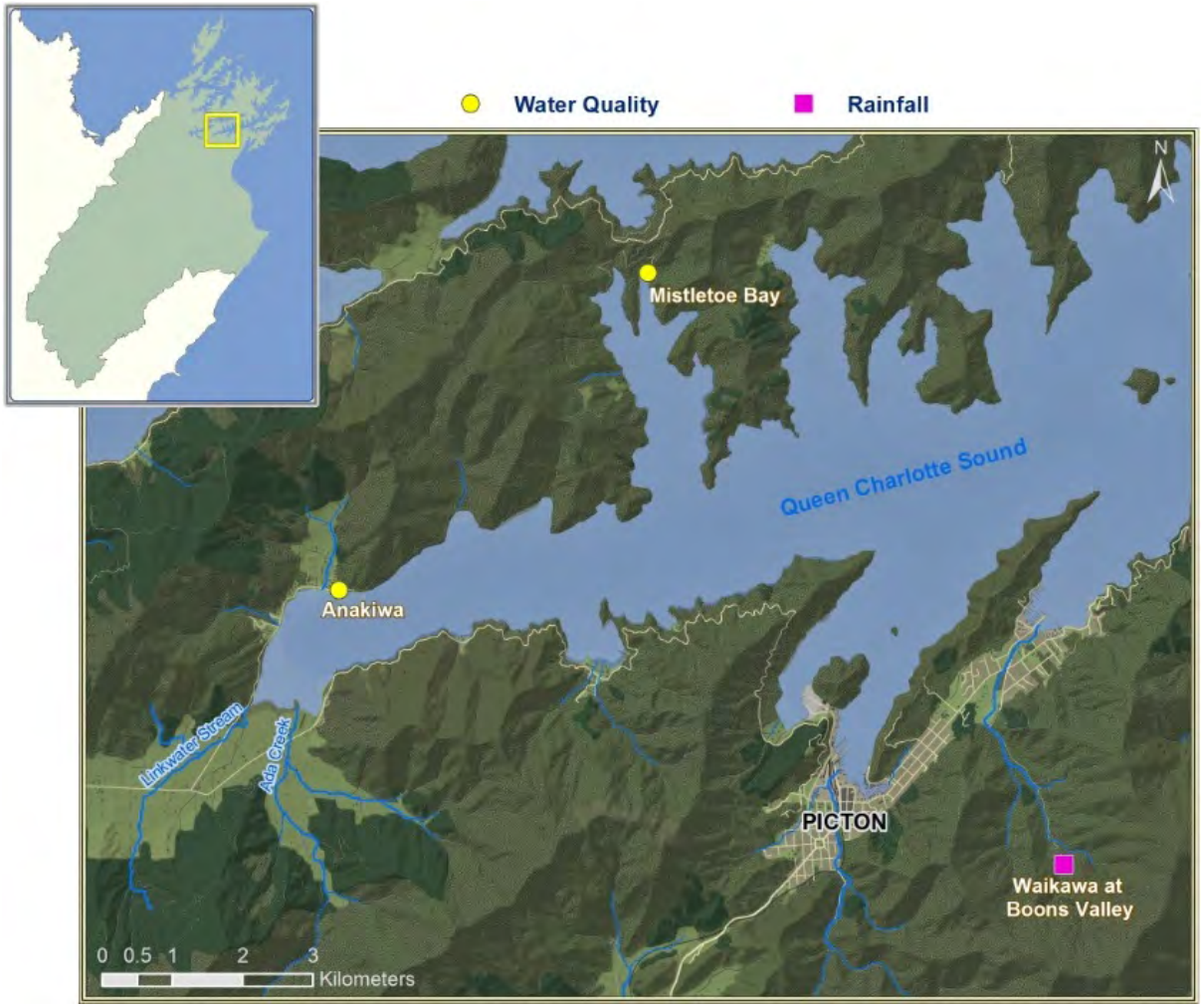


Figure 5: Map showing the location of the Anakiwa and Mistletoe Bay sampling sites and the Waikawa rainfall recorder.

Results

As can be expected, levels of faecal indicator bacteria in Mistletoe Bay were mostly lower compared to those measured in Anakiwa.

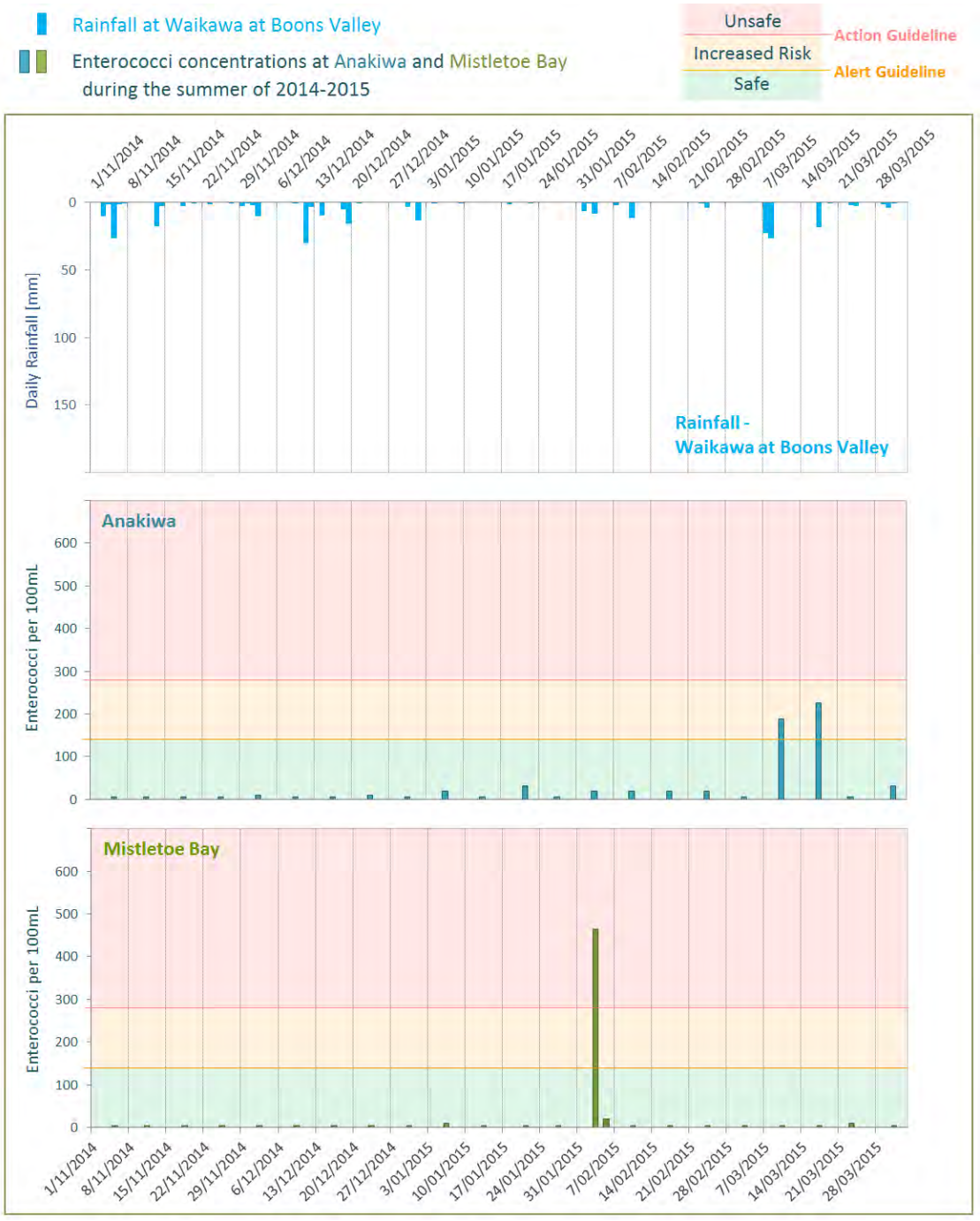


Figure 6: Rainfall recorded at Boons Valley and enterococci concentrations measured in Anakiwa and Mistletoe Bay during the summer season of 2014/15.

The only sample with Enterococci bacteria concentrations indicating potentially unsafe faecal contamination was taken from Mistletoe Bay following rainfall. Although the amount of rainfall recorded at Waikawa was low, there could have been localised heavy showers effecting smaller areas only. This might explain the comparatively low Enterococci numbers in Anakiwa Bay on the same day. Conversely, two samples taken from Anakiwa in March with Enterococci concentrations above Alert Guideline levels were taken after rainfall, but Enterococci concentrations in Mistletoe Bay remained low. It needs to be noted, that the water was discoloured in only one of the samples from Anakiwa, while it was clear and calm when the other samples with high bacteria counts from Anakiwa and Mistletoe Bay were taken. This means, that there were no visible signs of contamination of the water from run-off, which is concerning particularly in regard to the higher bacteria counts in Mistletoe

Bay. Following rainfall in the area, Enterococci concentrations in Mistletoe Bay have been significantly higher compared to Anakiwa on several occasions over the years. This is surprising as Anakiwa has a greater number of potential sources. Therefore, the sources of faecal contamination in Mistletoe Bay during or shortly after rainfall should be investigated further.

Long term trends show no significant changes in recent years (Figure 7). Enterococci concentrations remain comparatively low at both of the sites. The 5-year 95%ile Enterococci concentration measured in Anakiwa are slightly higher than those observed in Mistletoe Bay. Consequently, the SFR Grade for Anakiwa is 'Fair', while Mistletoe Bay is graded as 'Good'.

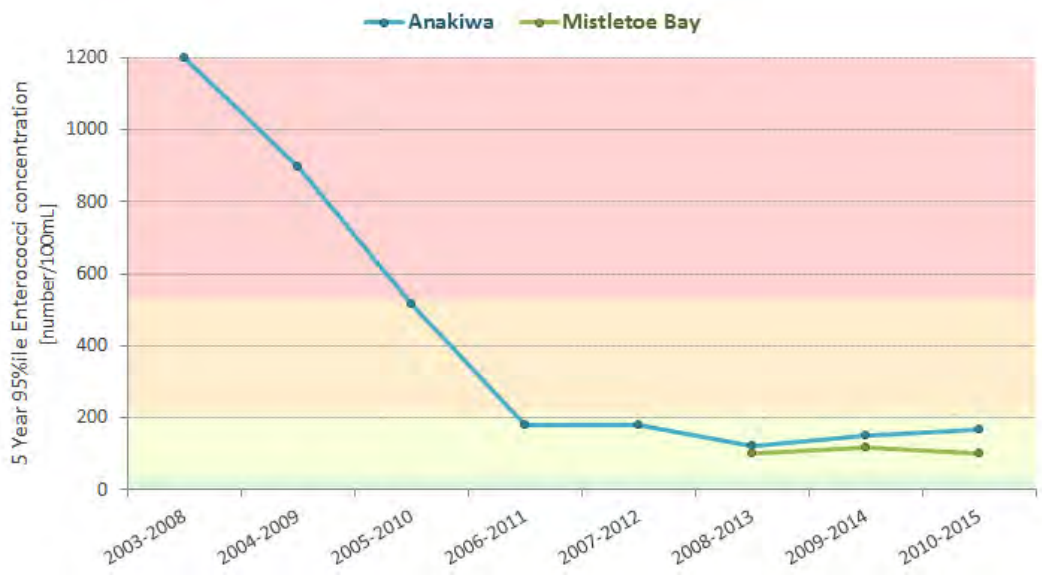


Figure 7: The 5-year-95%ile Enterococci concentrations in Anakiwa and Mistletoe Bay for all of the summer seasons monitored.

Figure 8: Anakiwa.

5.3. Momorangi, Ngakuta and Governors Bay

Sites

Momorangi Bay, Ngakuta Bay and Governors Bay are neighbouring bays in the Queen Charlotte Sound. Ngakuta Bay is the largest and most enclosed bay in this group with the greatest amount of residential development. There are nearly 100 houses and holiday homes in the catchment compared to less than 20 in Momorangi Bay and none in Governors Bay. Momorangi Bay, however, has a very popular campground, which attracts more visitors during the summer months than the other two bays combined.

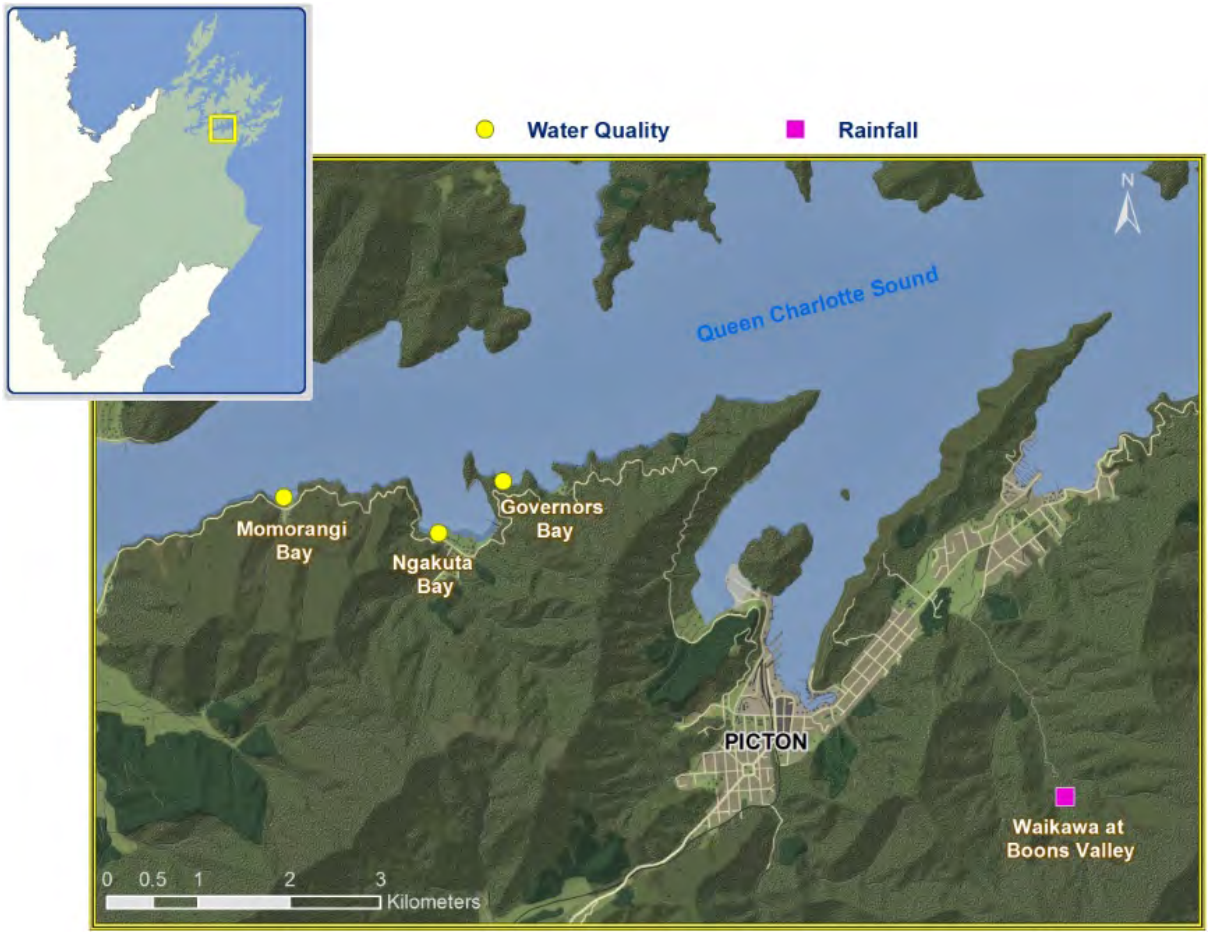


Figure 9: Map showing the sampling sites at Momorangi Bay, Ngakuta Bay and Governors Bay, as well as the rainfall recorder at Boons Valley.

Results

The first of a number of samples from Momorangi Bay with very high Enterococci concentrations that were not related to rainfall run-off was taken in late November (Figure 10). Follow-up samplling two days later showed comparatively low Enterococci concentrations. When a second sample taken during dry weather conditions on 23 December had Enterococci concentration above the Action Guideline, warning signs were erected in the bay; advising the public of the potential health risk. The signs were taken down again on Christmas Day after the results of the follow-up sample showed again low numbers of Enterococci. However, another sample was taken as a precautionary measure and Enterococci concentrations in this sample were again above the Action Guidelines. Warning signs were re-erected around the bay and remained in place until the end of the season. The situation was further investigated by the council in early January. The Department of Conservation (DoC) that operates the popular campground and attached sewage treatment system in the bay was involved a short time later.

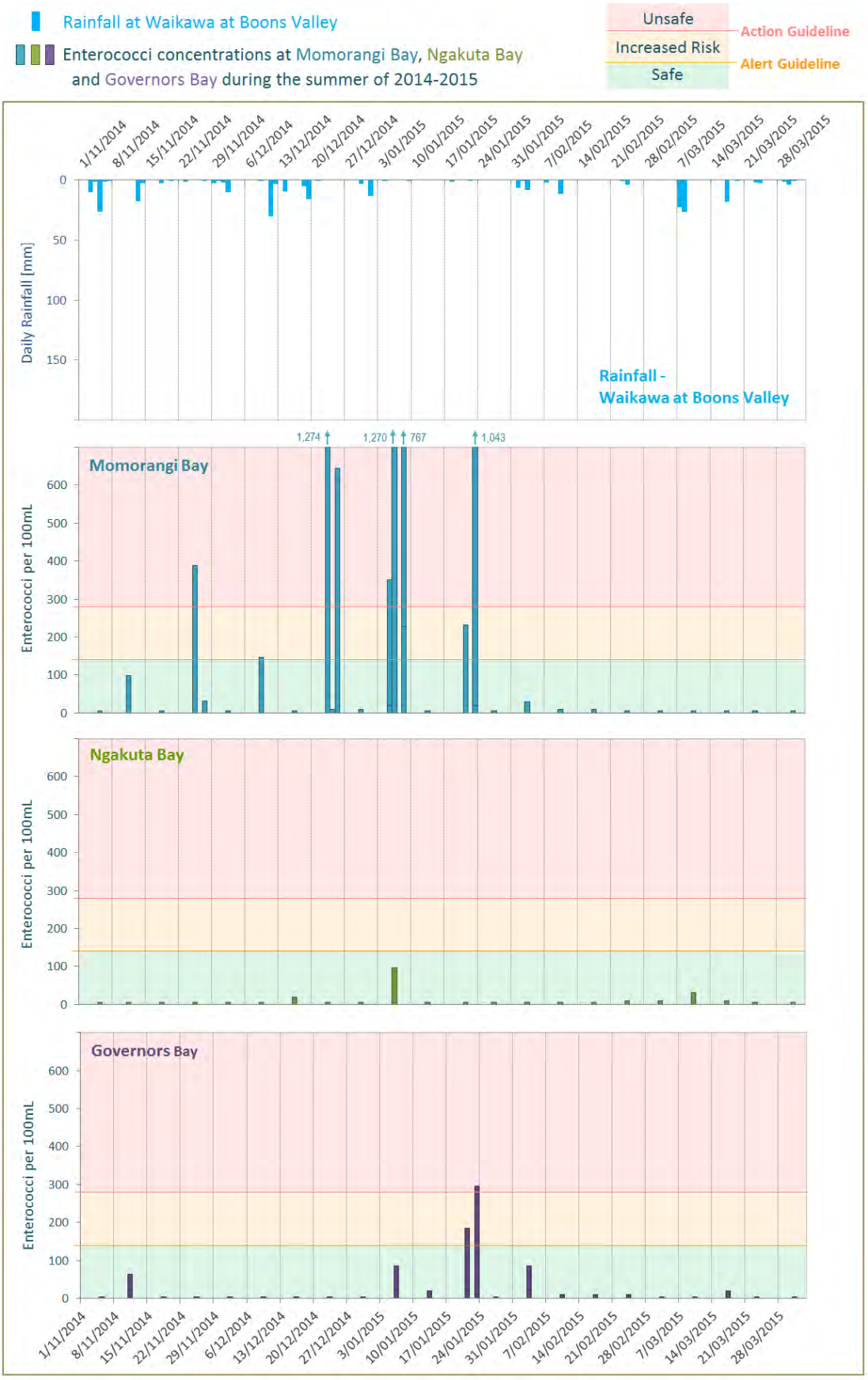


Figure 10: Monitoring results for Momorangi Bay, Ngakuta Bay and Governors Bay for the summer season of 2014/15.

The investigations revealed that faecal contamination was confined to an area on the eastern side of the central beach and was possibly linked to upgrades of the toilet and shower facilities carried out the winter before. In response to the high Enterococci concentrations, DoC upgraded the facilities on the eastern side of the bay as well as a sewage pipe close to the area with the highest Enterococci concentrations. It was agreed that further upgrades of the part of the sewage system located on the foreshore will be carried out once the camp was closed for the season. It is unclear whether the improved water quality in Momorangi Bay towards the end of the season can be attributed to the sewage system upgrades or was due to continuing lack of substantial rainfall, which lowered the groundwater table, reducing the underground transport of contaminants.

Unfortunately, the high levels of Enterococci bacteria in Momorangi Bay observed this summer caused a reverse in the positive long-term trend of recent years (Figure 11).

In Governors Bay, elevated Enterococci concentrations in samples also taken during dry weather conditions are unlikely to be related to the faecal contamination in Momorangi Bay. Apart from the 2.5km distance, there are two facts pointing to this conclusion. Firstly, the investigative sampling in Momorangi Bay showed that the lowest Enterococci concentrations were observed along the eastern end of the bay. Secondly, Ngakuta Bay, located between Momorangi and Governors Bay did not have elevated Enterococci concentrations unrelated to rainfall. The high faecal bacteria concentrations in Governors Bay are therefore linked to localised sources. However, there is no residential development in the catchment. The only building in the bay is a toilet facility, but the sporadic nature of faecal contamination during dry weather conditions makes this an implausible source. Instead, irresponsible behaviour by either boat owners or dog owners accessing the bay is a more likely cause. This is a potentially high-risk source of faecal contamination as there are no indicators, i.e. rainfall, that could alert users to a potential contamination. For example, field notes indicate the water had a clear appearance during all of the occasions when samples with elevated Enterococci concentrations were taken.

Ngakuta Bay was the only site in this group where Enterococci concentrations did not exceed guideline level during the whole of the summer season. This is reflected in an improved long-term trend, indicating that Enterococci concentrations are returning to levels observed several years ago. It still is unclear, why faecal bacteria concentrations in Ngakuta Bay were substantially higher during a short period between 2010 and 2013.

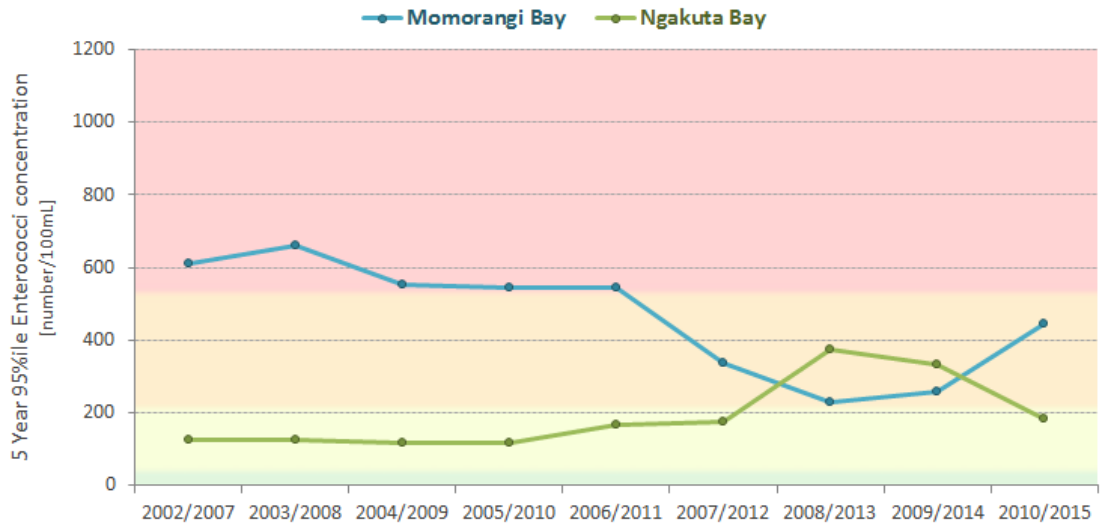


Figure 11: The 5-year-95%ile Enterococci concentrations in Momorangi Bay and Ngakuta Bay for all of the summer seasons monitored.

5.4. Picton Foreshore and Waikawa Bay

Sites

The water quality of Picton Foreshore and Waikawa Bay are both influenced by the urban environment that surrounds these sites. The substantially greater amount of residential development of the Picton Township is reflected in the generally poorer water quality at the Picton Foreshore.

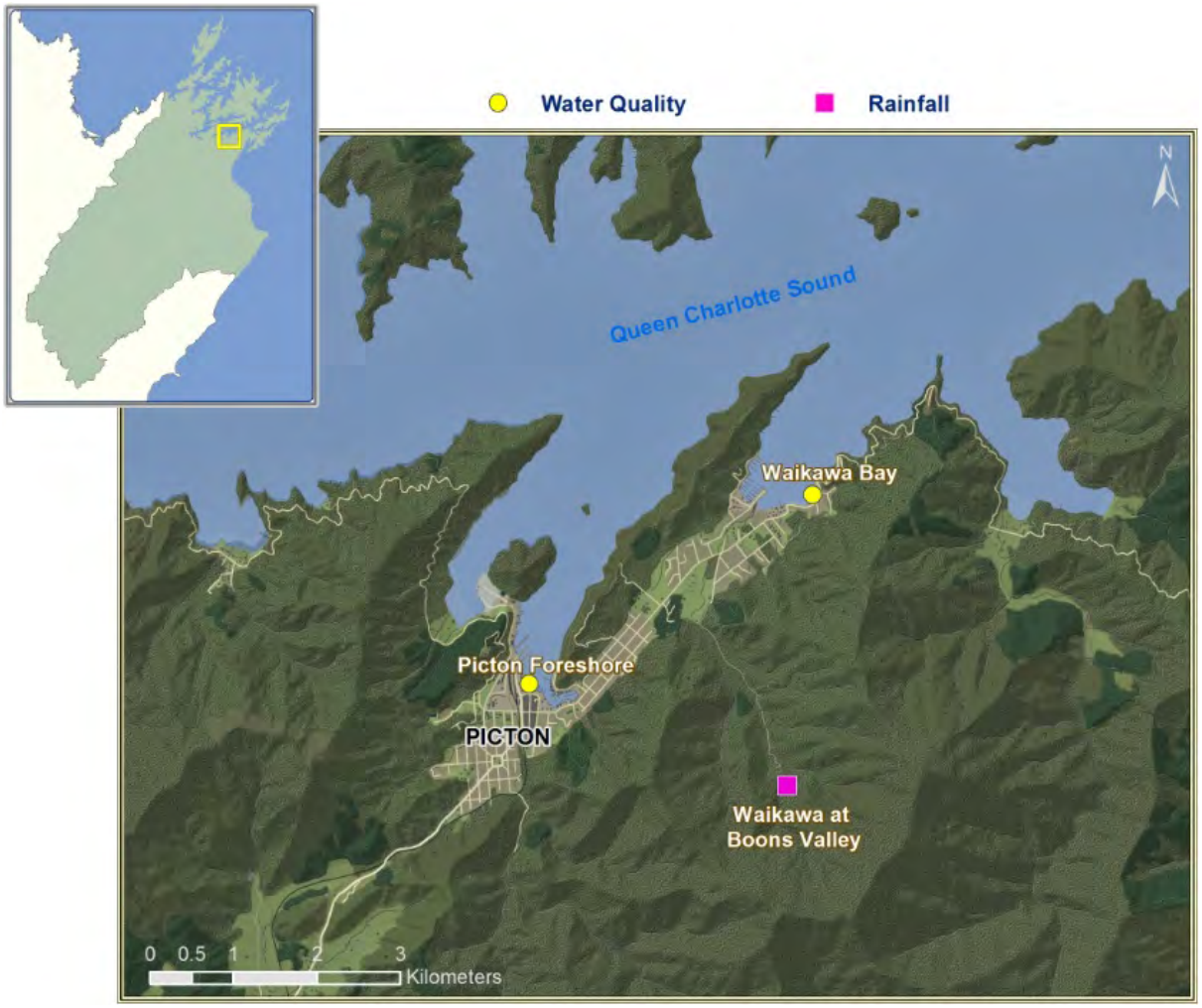


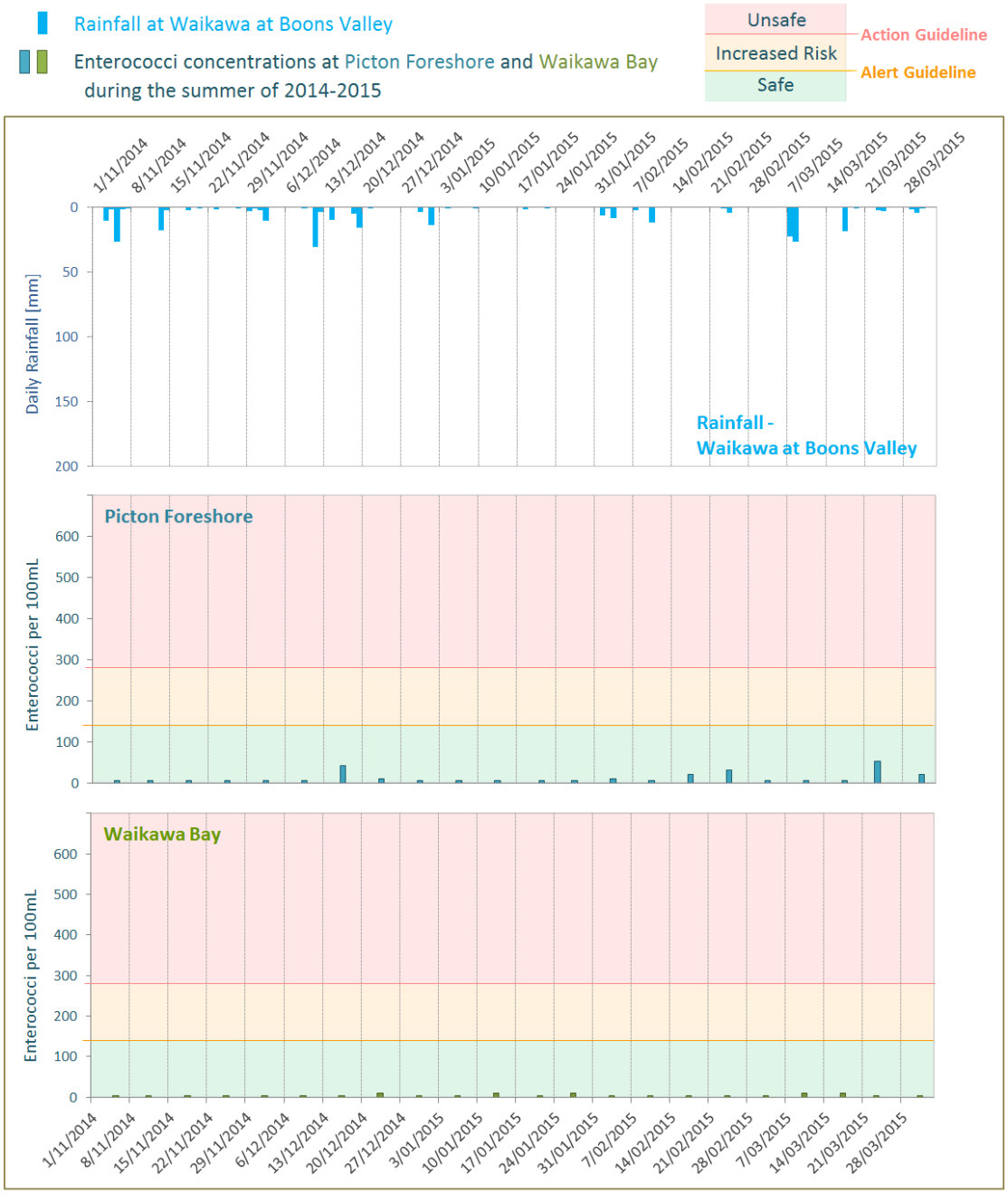
Figure 12: Map showing the locations of the Picton Foreshore and Waikawa Bay sampling sites as well as the rainfall recorder at Boons Valley.

Results

During last summer, Enterococci concentrations in Waikawa Bay and the Picton Foreshore were consistently low. On three occasions following small rainfall events, slightly elevated Enterococci concentrations were observed at Picton Foreshore, but levels remained well below guideline values (Figure 13).

Continued efforts by the Assets and Services team of the Council to eliminate cross-connections between sewage and stormwater pipes as well as ongoing upgrades to the sewer system have resulted in significant improvements of the water quality at the Picton Foreshore (Figure 13). Nevertheless, due to the higher health risk associated with human sewage contamination, the site has a SFR Grade of ‘Poor’.

Waikawa Bay is graded as ‘Good’ and the long-term trend shows very little change since regular monitoring began in 2002.



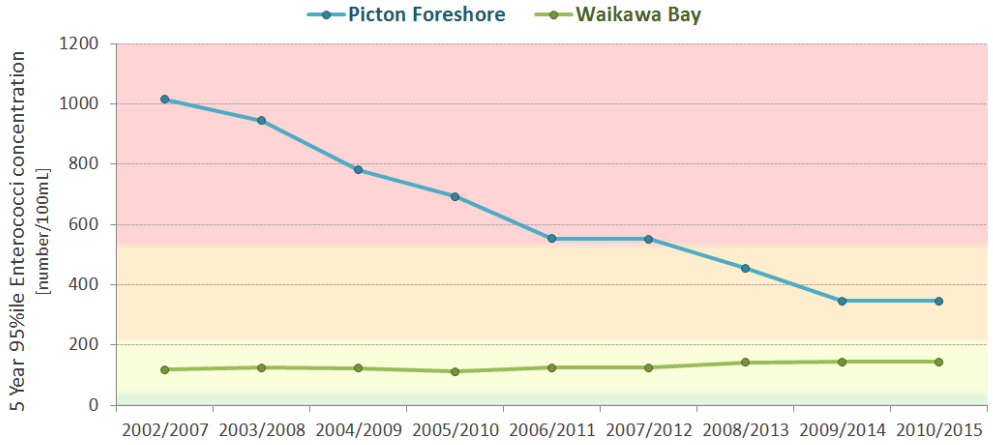


Figure 13: 2014/15 summer season results and trends for Picton Foreshore and Waikawa Bay.

5.5. Whites Bay and Robin Hood Bay

Sites

Whites Bay and Robin Hood Bay are located on the upper East Coast of the region. Whites Bay is one of the most popular beaches in Marlborough. A DoC campground is the only human impact in the bay and consequently water quality is generally very good. Robin Hood Bay, located only a few kilometres north of Whites Bay also offers a campground, but has agricultural land use in the catchment, which potentially affects the water quality in the bay. Robin Hood Bay is sampled at two sites, a surf beach on the Southwest side of the Bay and a swimming beach on the Northeast side that is also used for launching boats.

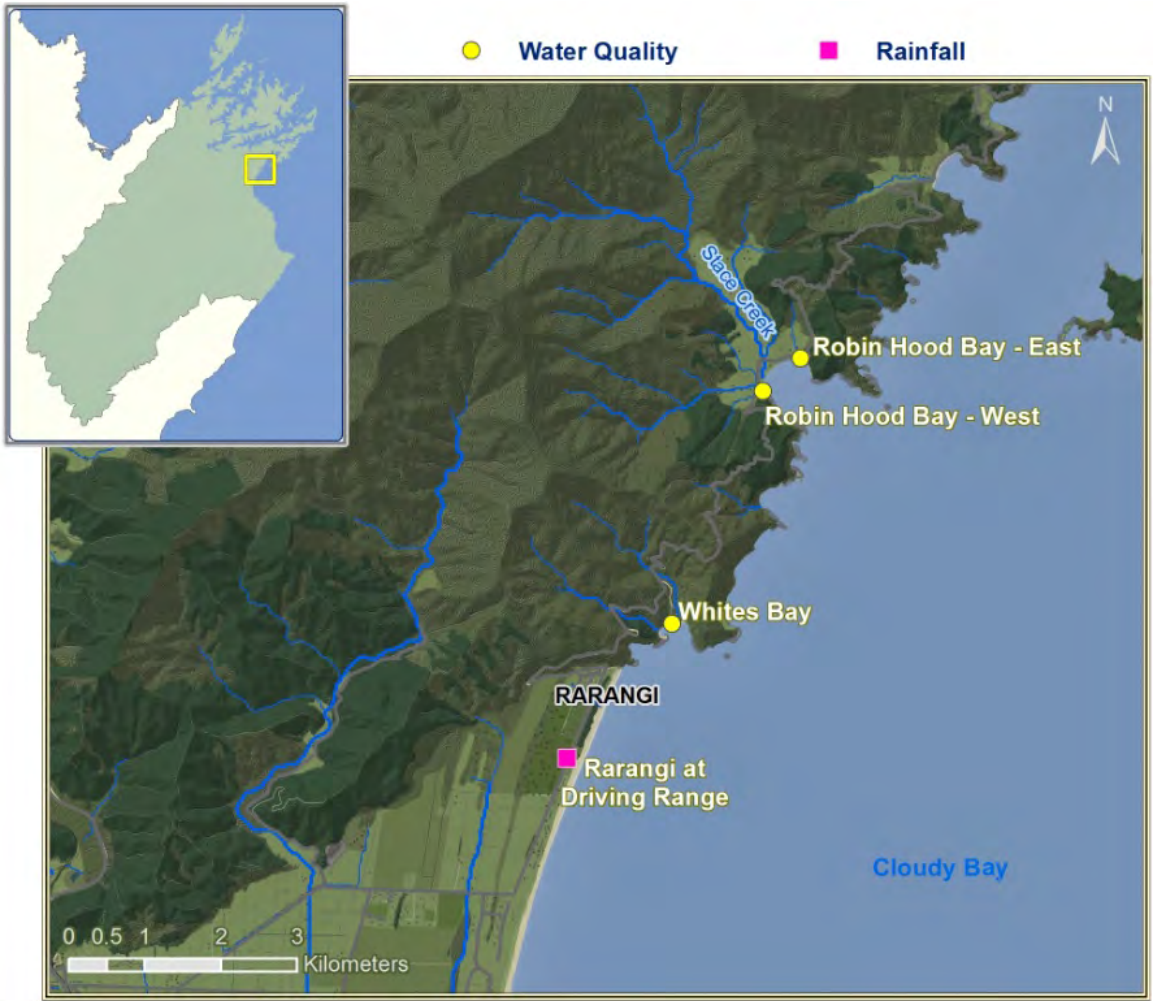


Figure 14: Map showing the locations of the Whites Bay and the two Robin Hood Bay sampling sites, as well as the location of the Rarangi rainfall recorder.

Results

Little rainfall for most of the summer meant that Enterococci concentrations at all three sites in this group were very low throughout the summer. During previous summers, occasionally high faecal bacteria concentrations were observed in both of the sites located in Robin Hood Bay, but elevated levels were not always observed at the same time at the two sites. While water quality of the western bay is influence by Stace Creek, freshwater inflows into the eastern bay are significantly smaller. Nevertheless, Enterococci concentrations were occasionally higher at Robin Hood Bay - East. An investigation into potential sources of the faecal contamination as well as water quality of Stacy Creek and other freshwater inflows was planned for the summer, but could not be carried out as the very dry conditions resulted in the creeks being dry for most of the sampling period. The investigation is therefore planned to be undertaken in the next summer season.

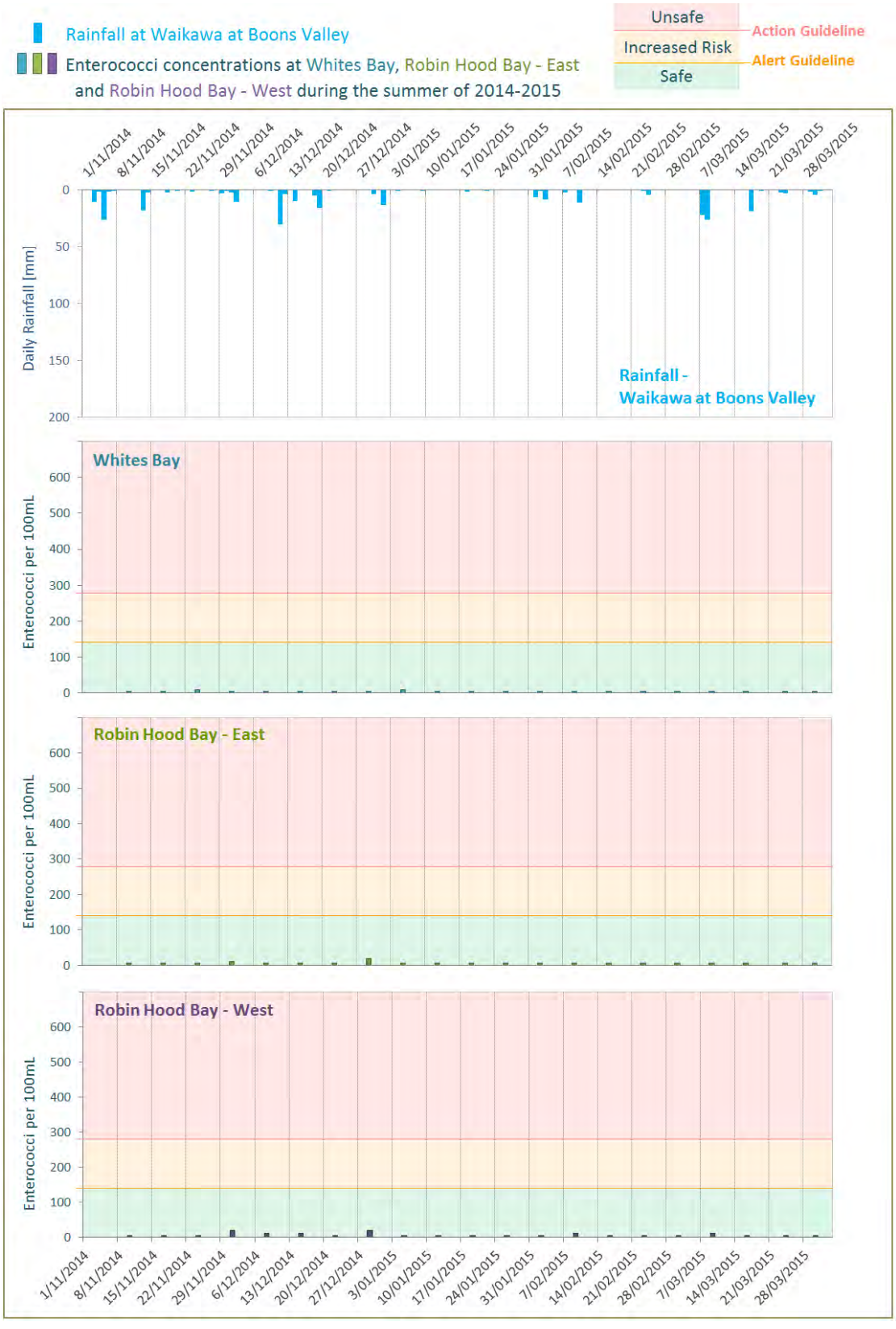


Figure 15: Monitoring results for Whites Bay and Robin Hood Bay for the summer season of 2014/15.

Of the three sites in this group, only Whites Bay has been sampled for a sufficiently long time to analyse long-term trends. The 5-year-95%ile Enterococci concentrations show that bacteria levels have been consistently very low over the years. This is reflected in the 'Very Good' SFR Grade for this bay.

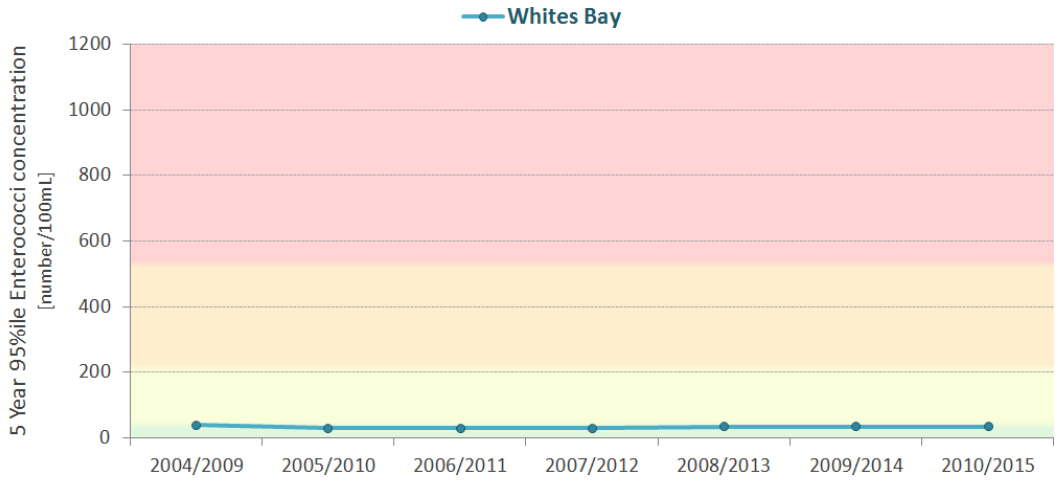


Figure 16: The 5-year-95%ile Enterococci concentrations in Whites Bay for all of the summer seasons monitored.

Figure 17: Whites Bay on a quiet day.

5.6. Marfells Beach

Site

Marfells Beach is the most southern sampling site, located on the lower East Coast of the region. There are no large rivers or streams flowing into the sea close to the site, which means that the surrounding low intensity pastoral farming has little effect on the water quality. A popular DoC campground is located next to the beach and there are usually more than 100 seagulls on the beach.

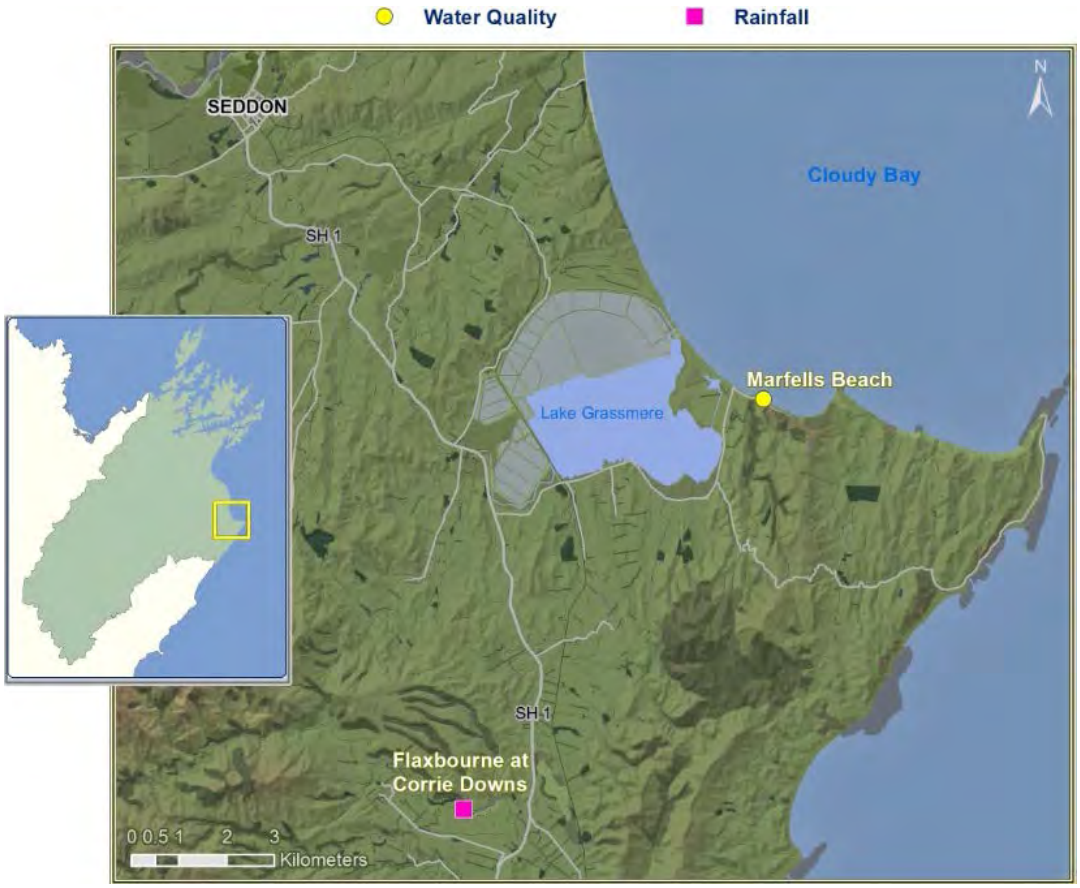


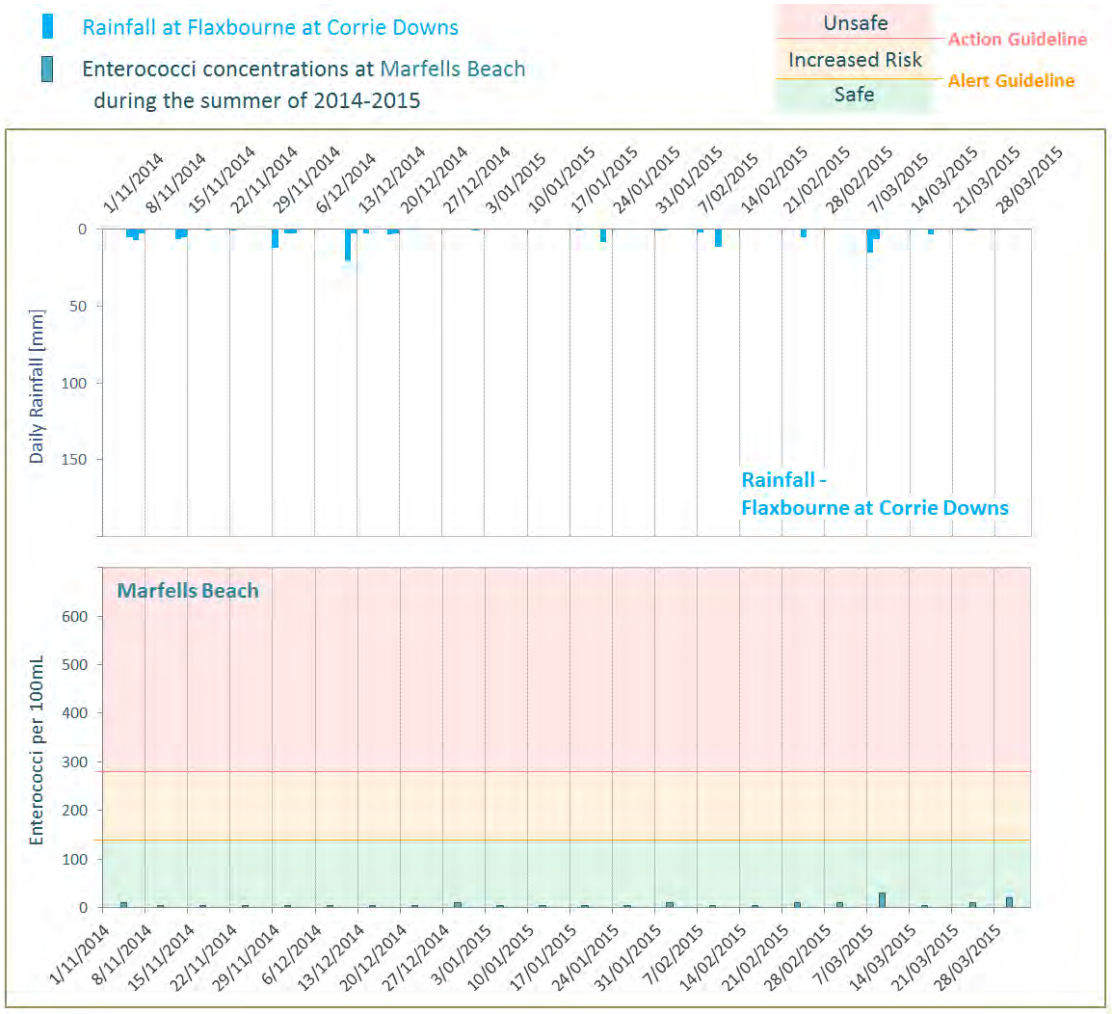
Figure 18: Map showing the location of the Marfells Beach sampling site and Flaxbourne rainfall recorder.

Results

Since 2009 there have been no exceedances of any of the guidelines at this site and this summer Enterococci concentrations have again been very low in all samples taken (Figure 19). Marfells Beach has the best water quality of all sites sampled as part of the Recreational Water Quality Program.

In a monitoring and site review in 2012, Marfells Beach was identified as a site that should be regularly monitored. Robust site and monitoring reviews have a substantial cost associated with them (i.e. survey of recreational users and site usage) and therefore cannot be carried out frequently. Additionally, long term records are required for a robust analysis of water quality at a site. In 2012 it was proposed to conduct another site review after 5 years[3]. Subsequently, a review is planned for 2017. Considering the consistently good recreational water quality at Marfells Beach, the sampling frequency for this site could potentially be reduced, for example to a one in five year summer monitoring schedule.

[3] Mainly due to the minimum requirement of 5 years of monitoring data for the assignment of SFR Grades to new sites.



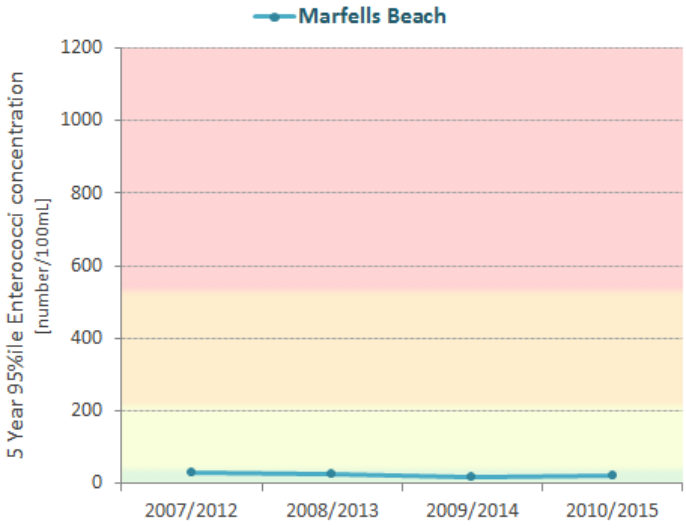


Figure 19: 2014/15 summer season results and the 5-year-95%ile Enterococci concentrations for Marfells Beach.

5.7. Rai River and Pelorus River

Sites

The Pelorus River has two popular swimming sites that are sampled as part of the Recreational Water Quality program, the Pelorus Bridge and Totara Flat. The Rai River, which is sampled at the Rai Falls, flows into the Pelorus River between the two sites, approximately 300m upstream of Totara Flat. Consequently, water quality at Totara Flat is strongly influenced by the water quality in the Rai River.

Figure 20: Map showing the location of the Pelorus and Rai River sampling site and the Pelorus River flow recorder.

Results

E. coli concentrations were consistently elevated in the Rai River during the first three months of the summer, but guideline values were exceeded on only two occasions shortly after small amounts of rain had fallen (Figure 21). Following the second exceedance, E. coli concentrations were generally lower, which might indicate that the faecal bacteria source causing the previously elevated level was either washed out or removed. Both exceedances of E. coli guidelines in the Rai River were caused by relatively small rainfall events[4], and the water remained clear during the first event and was only slightly turbid on the second occasion. This means potential recreational users had no visual clues pointing to the faecal contamination at the site. This emphasises that the appearance of water is not always a reliable indicator for water quality.

The two exceedances in the Rai River also resulted in elevated E. coli concentrations at Totara Flat, but concentrations did not reach levels of concern to human health there. An earlier exceedance of the Alert guideline at the Totara Flat was caused by a localised rainfall event in the upper Pelorus catchment, which also caused the only exceedance of a guideline at the Pelorus Bridge site.

[4] the first sample was taken before the large flood event at the end of December

Figure 21: 2014/15 summer season monitoring results for the Rai and Pelorus River sites.

The long-term trend shows a significant reduction in E. coli concentration in the Rai River at Rai Falls in recent years (Figure 22). This is reflected in improvements in recreational water quality in the Pelorus River downstream of the confluence with the Rai River, at Totara Flat. However, further improvement of water quality in the Rai River is necessary to achieve a SFR Grade better than the current 'Very Poor' Grade. This would also result in a better SFR Grade for Totara Flat, which is currently graded as 'Poor'.

Water quality in the Pelorus River at the Pelorus Bridge, upstream of the Rai River, also improved between 2003 and 2012, and has remained of good quality since. The site has an SFR Grade of 'Good'.

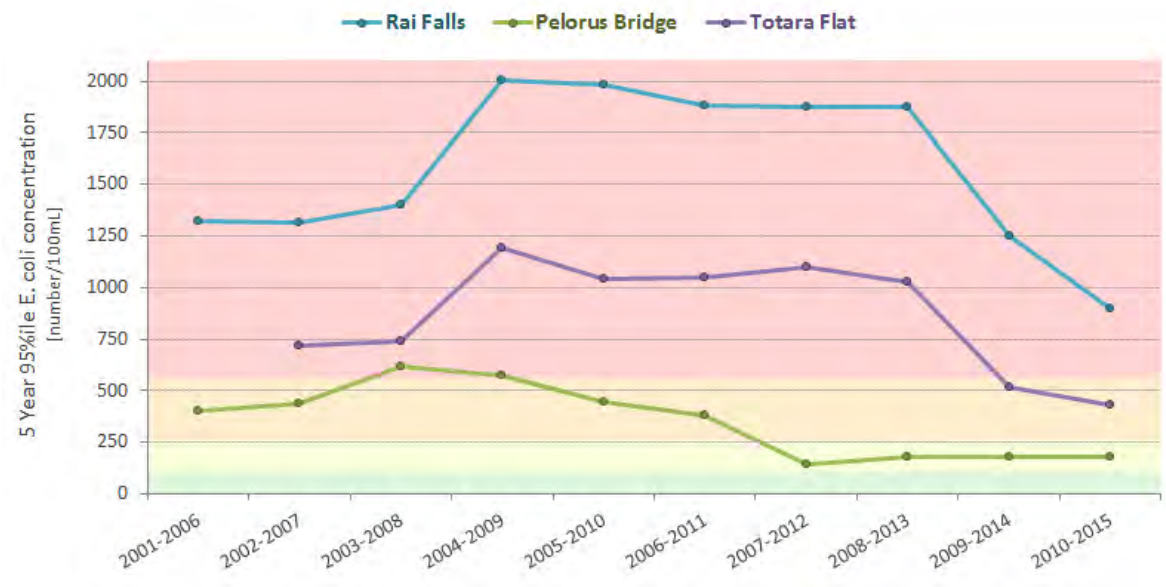


Figure 22: The 5-year-95%ile E. coli concentrations in the Rai River at Rai Falls and the two Pelorus River sampling sites for all of the summer seasons monitored.

Figure 23: Pelorus River at Pelorus Bridge.

5.8. Waihopai River

Site

The Waihopai River swimming hole at the Craiglochart #2 Bridge is particularly popular with local residents. Often there will be nobody at the site when samples are taken, but it is known that school groups and families are using the site frequently, especially in the weekends. Over a quarter of the catchment area has been converted to pasture, but grazing is mostly of low intensity.

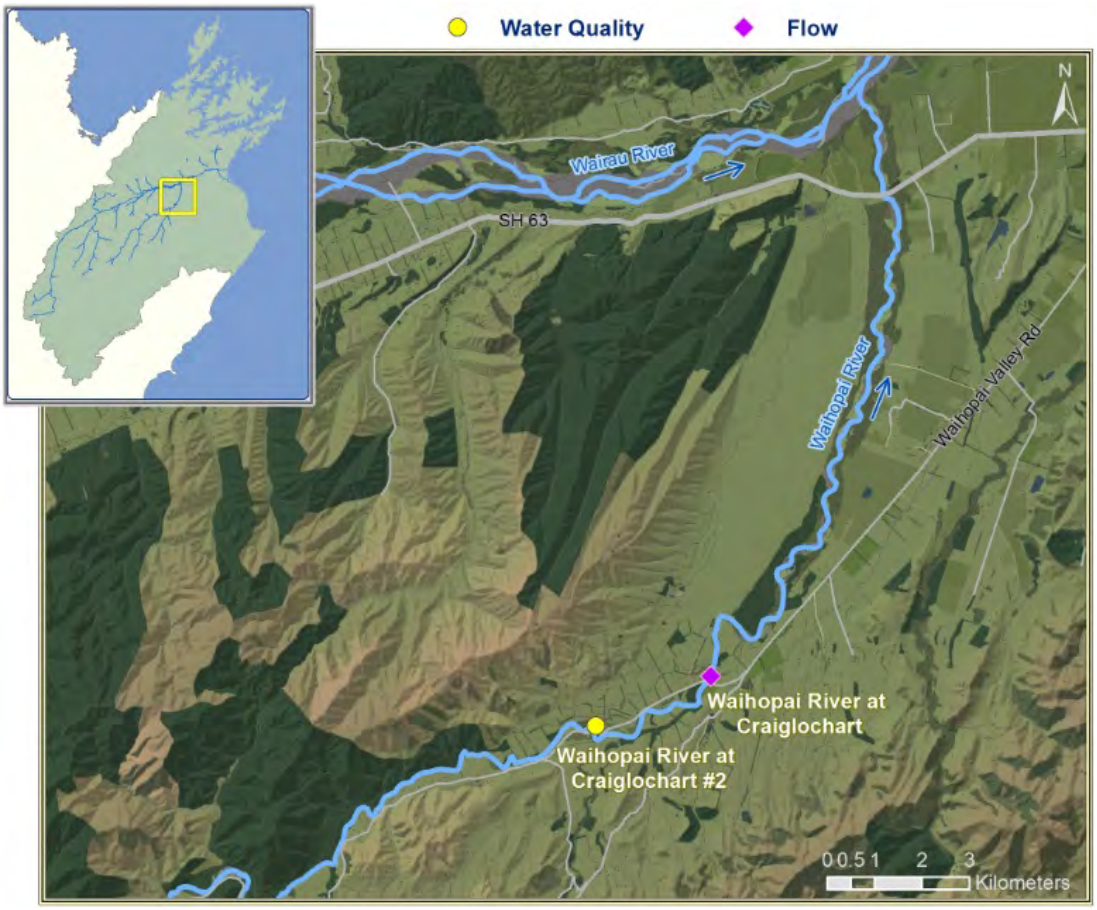


Figure 24: Map showing the location of the Waihopai River sampling site and the flow recorder.

Results

Two samples taken from the Waihopai at Craiglochart #2 had E. coli concentrations above the levels considered safe for contact recreation (Figure 25). Both samples were taken at only slightly elevated flows that were caused by heavy rainfall restricted to small areas in the catchment.

A very intense rainfall event in early March resulted in the largest flood of this season and caused significant erosion in the upper Waihopai catchment. As a result the river was discoloured for the remaining summer period. Subsequently, the high E. coli concentrations in late March were unlikely to have resulted in a significant health risk to the public.

The long-term trend shows increasing E. coli concentrations after a steady reduction in the first years of continuous monitoring. It is unclear what is causing the reversed trend. Field notes show that dog faeces and rubbish, including nappies, are frequently found at the site. This is very unfortunate as it is not only potentially increasing the risk to recreational users in regard to infection with pathogens, but also diminishes the aesthetic value of the site and therefore the recreational enjoyment for the visitors.

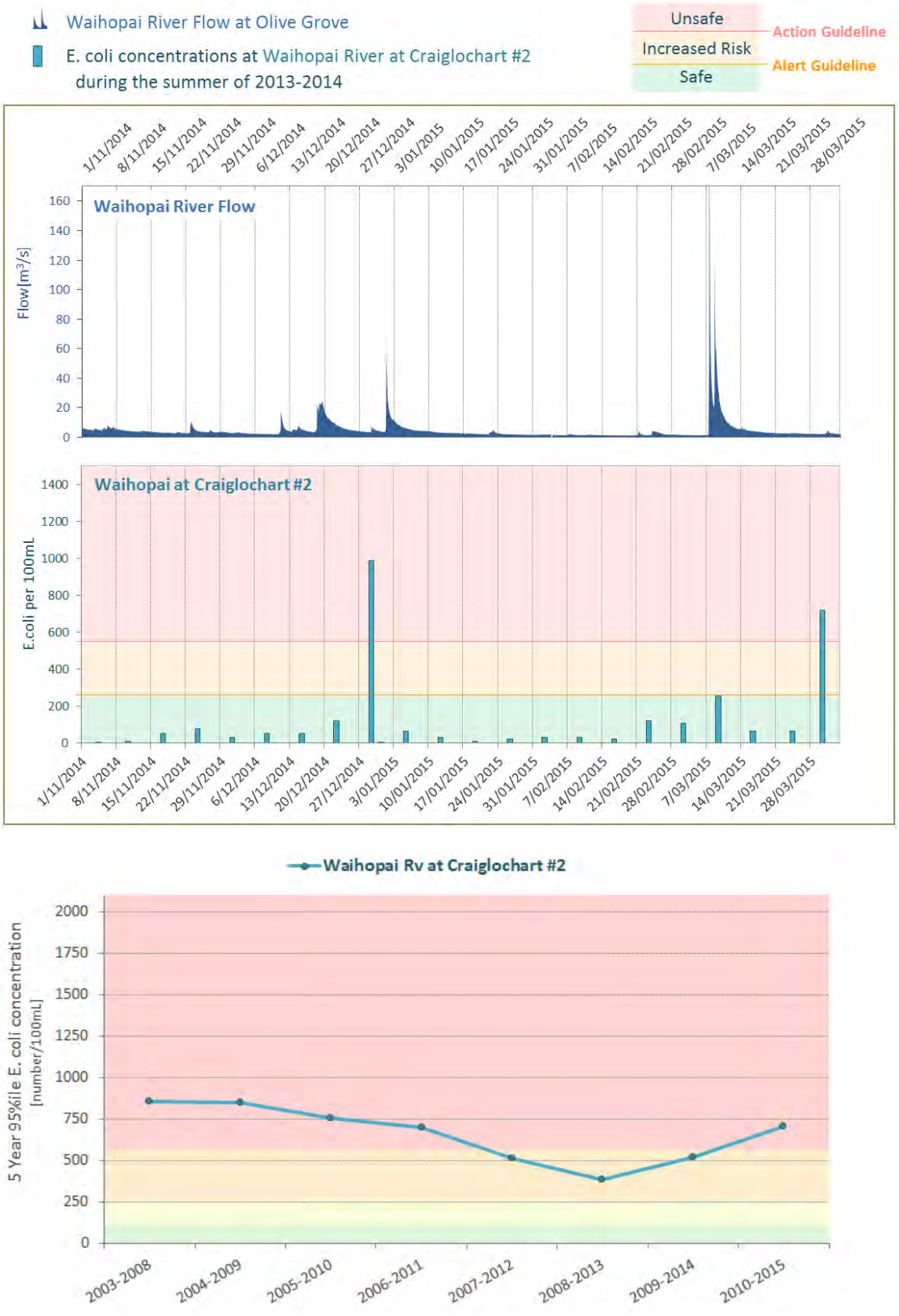


Figure 25: Results for the 2014/15 summer season and 5-year-95%iles for the Waihopai River at Craiglochart #2.

5.9. Wairau River

Sites

There are three sites along the Wairau River that are sampled as part of the Recreational Water Quality program. The two sites located furthest downstream, Ferry Bridge and Blenheim Rowing Club, have been part of the program for some time, while the site at the State Highway Six Bridge was added recently as a result of a beach usage survey carried out in 2011 [MDC, 2012].

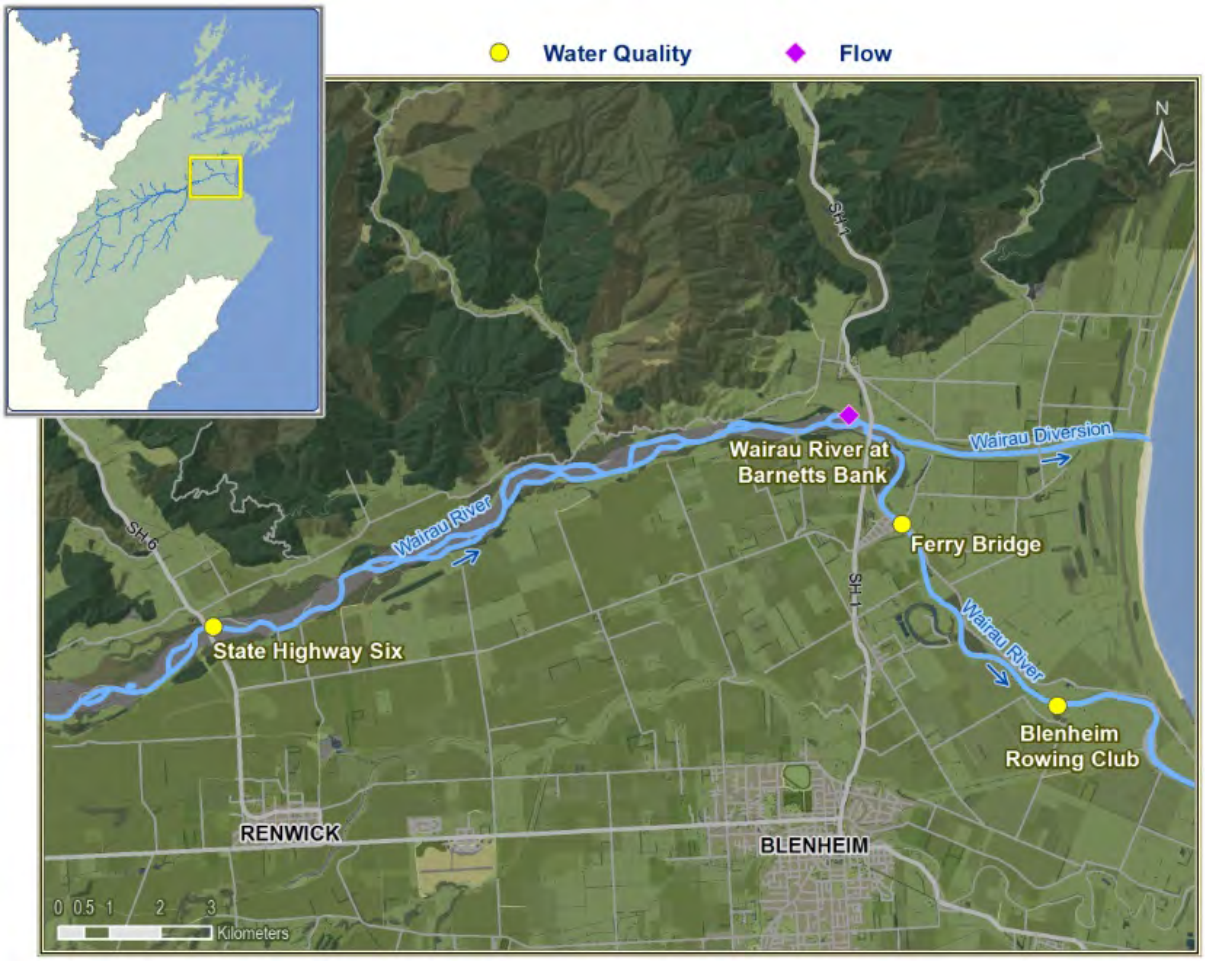


Figure 26: Map showing the location of the three Wairau River sampling sites and the Wairau River flow recorder.

Results

None of the samples taken from the three sites this season had E. coli concentrations above levels considered unsafe in regard to human health (Figure 27).

The largest flood of the summer, in early March, only caused E. coli concentrations at the Blenheim Rowing Club to slightly exceed the Alert Guideline. Another sample with similar E. coli concentrations was taken from the Ferry Bridge during light rainfall. There is often a significant amount of rubbish, including nappies, left at this site, which most likely explains the elevated E. coli concentration on that occasion.

All three sites are located downstream of the confluence with the Waihopai River. Subsequently, following the flood event in early March, which caused significant erosion in the upper Waihopai catchment, both the Waihopai River and Wairau River were turbid for the rest of the season.

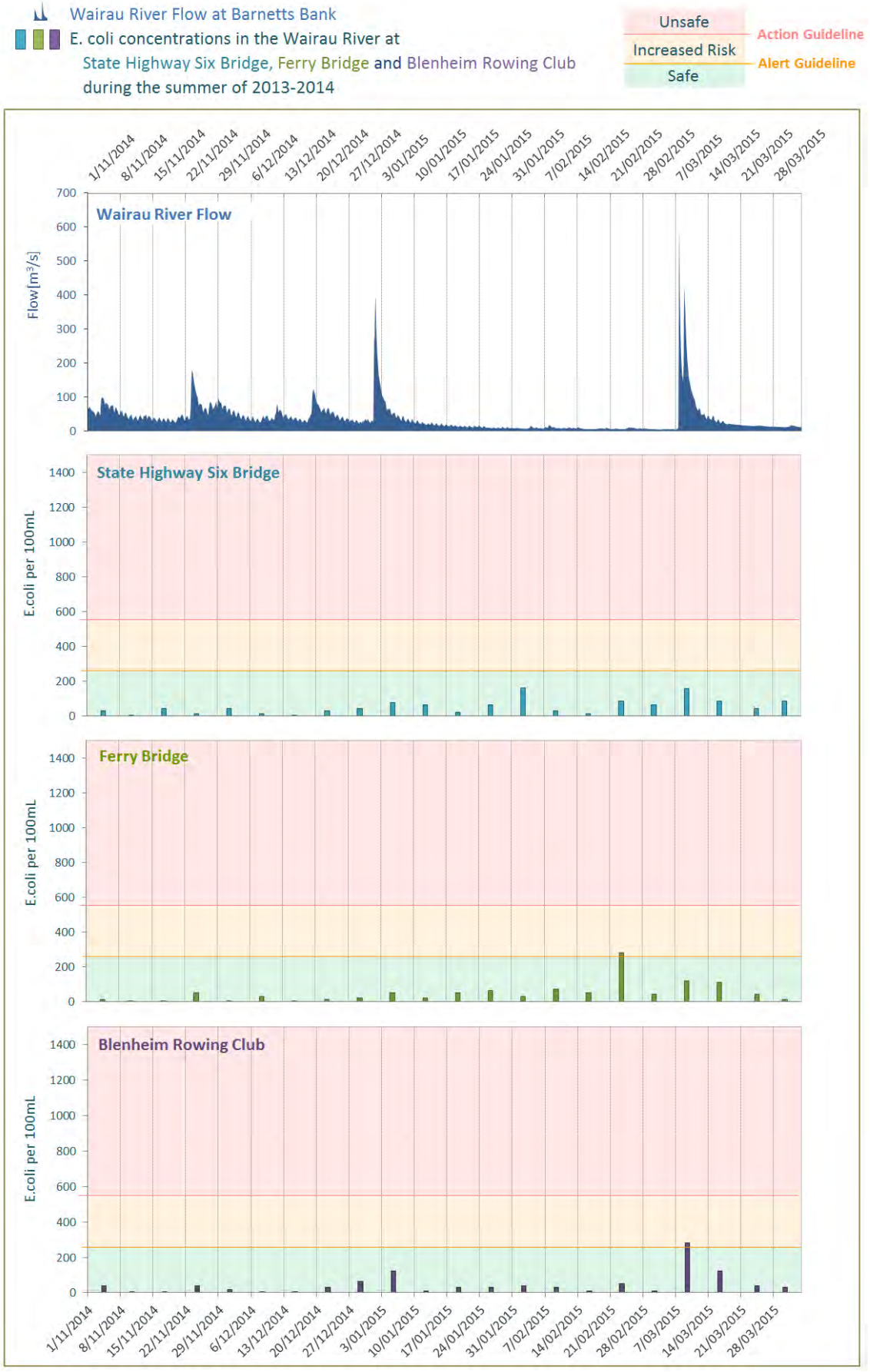


Figure 27: 2014/15 summer season monitoring results for the Wairau River sites.

The long-term trend shows a small improvement in recreational water quality for the site at the Blenheim Rowing Club, but very little change for the site at the Ferry Bridge (Figure 28). The Blenheim Rowing Club site has an SFR Grade of 'Good', while the slightly poorer water quality at the Ferry Bridge is reflected in a SFR Grade of 'Fair'. The site at State Highway Six has not been monitored for a sufficiently long period, to allow the assignment of a SFR Grade.

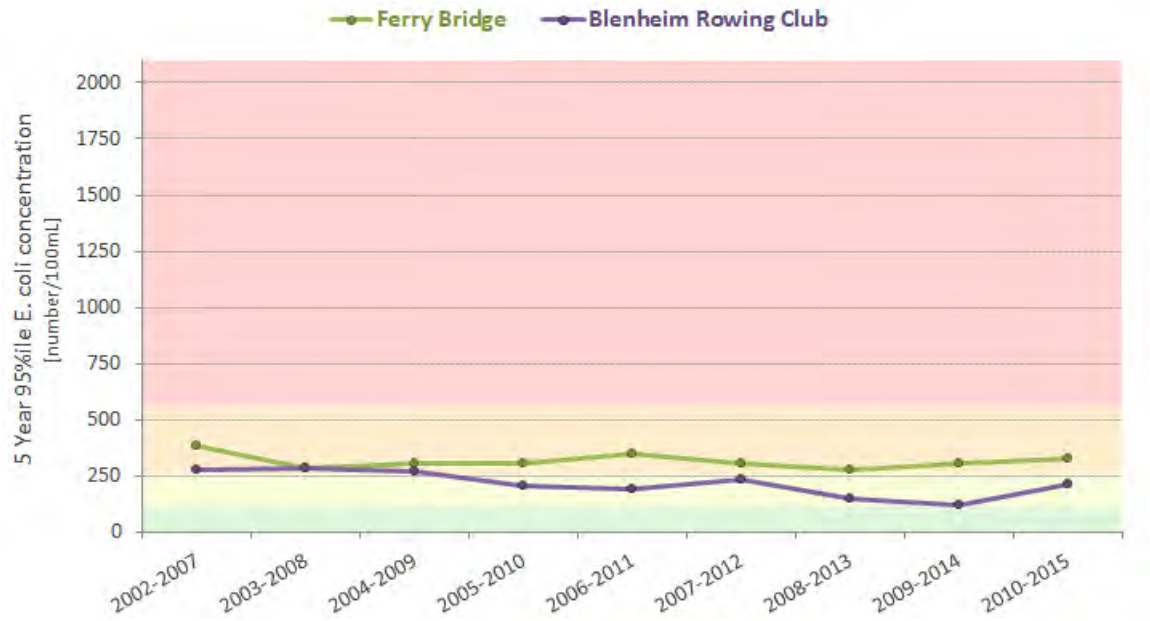


Figure 28: The 5-year-95%ile E. coli concentrations in the Wairau River at Ferry Bridge and the Blenheim Rowing Club for all of the summer seasons monitored.

Figure 29: Rowers on the Wairau River at the Blenheim Rowing Club.

5.10. Taylor River and Opawa River

Sites

The Taylor River at Riverside and Opawa River at Elizabeth St Bridge are both located in Blenheim and are therefore heavily influenced by their urban environment. Although both rivers also flow through rural areas, the agricultural land use in the catchment appears to have limited impact on the microbial water quality at the sampling sites.

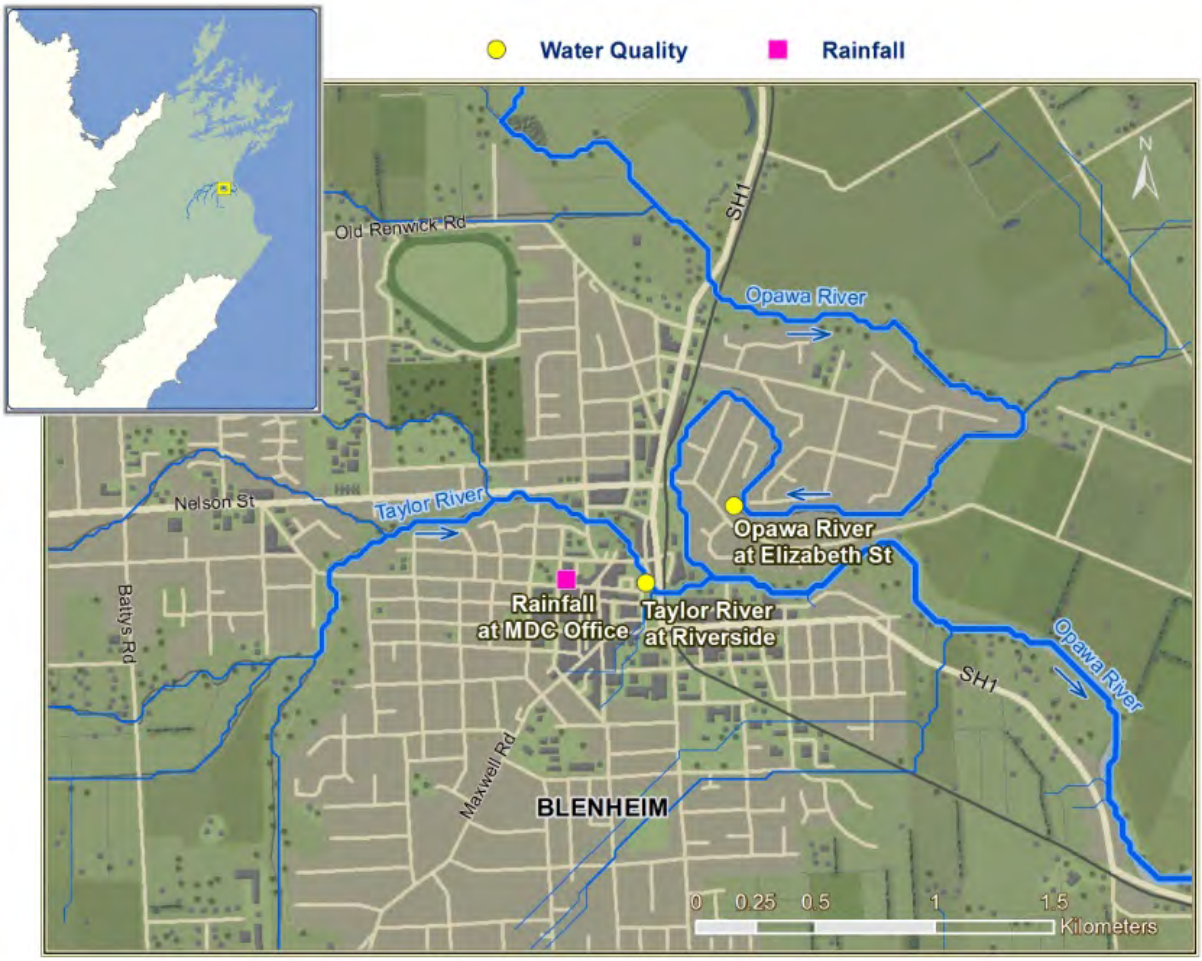


Figure 30: Map showing the location of the Taylor River and Opawa River sampling sites as well as the Blenheim MDC rainfall recorder.

Results

Unlike other sites sampled as part of the Recreational Water Quality program, the Taylor River contains the highest concentrations of faecal bacteria during low flows. Faecal source tracking carried out in 2013 showed that ducks and dogs were the main sources of contamination [MDC 2013b]. During low flow conditions the smaller amount of water in the river results in a reduced dilution of faecal material from these sources. Consequently, higher E. coli concentrations are observed during very dry periods. However, the flow is not the only factor influencing E. coli concentrations as bacteria levels fluctuate significantly during relatively stable flows. In 2013 and 2014 a number of stormwater inputs were sampled in order to assess their impact on the water quality of the Taylor River. A report summarising the findings of this investigation is expected soon and may point to an additional source of faecal contamination that might have to be closely managed. The sporadic nature of very high E. coli concentrations in the Taylor makes investigation into the sources difficult. Nevertheless, recreational water quality in the Taylor River is the worst of all sites monitored in the program and the

long-term trend shows that E. coli concentrations have remained at highs level in recent years (Figure 32). Therefore, efforts to improve water quality are of high priority.

E. coli concentrations in the Opawa River at Elizabeth St Bridge are generally elevated, but seldom reach unsafe levels. The only sample with faecal bacteria concentrations above the Action Guideline was taken after a significant amount of rain had fallen, resulting in increased flows and visible discolouration of the water. The long-term trend for this site shows that recreational water quality has not changed considerably in recent years. The site has a SFR Grade of 'Fair'.

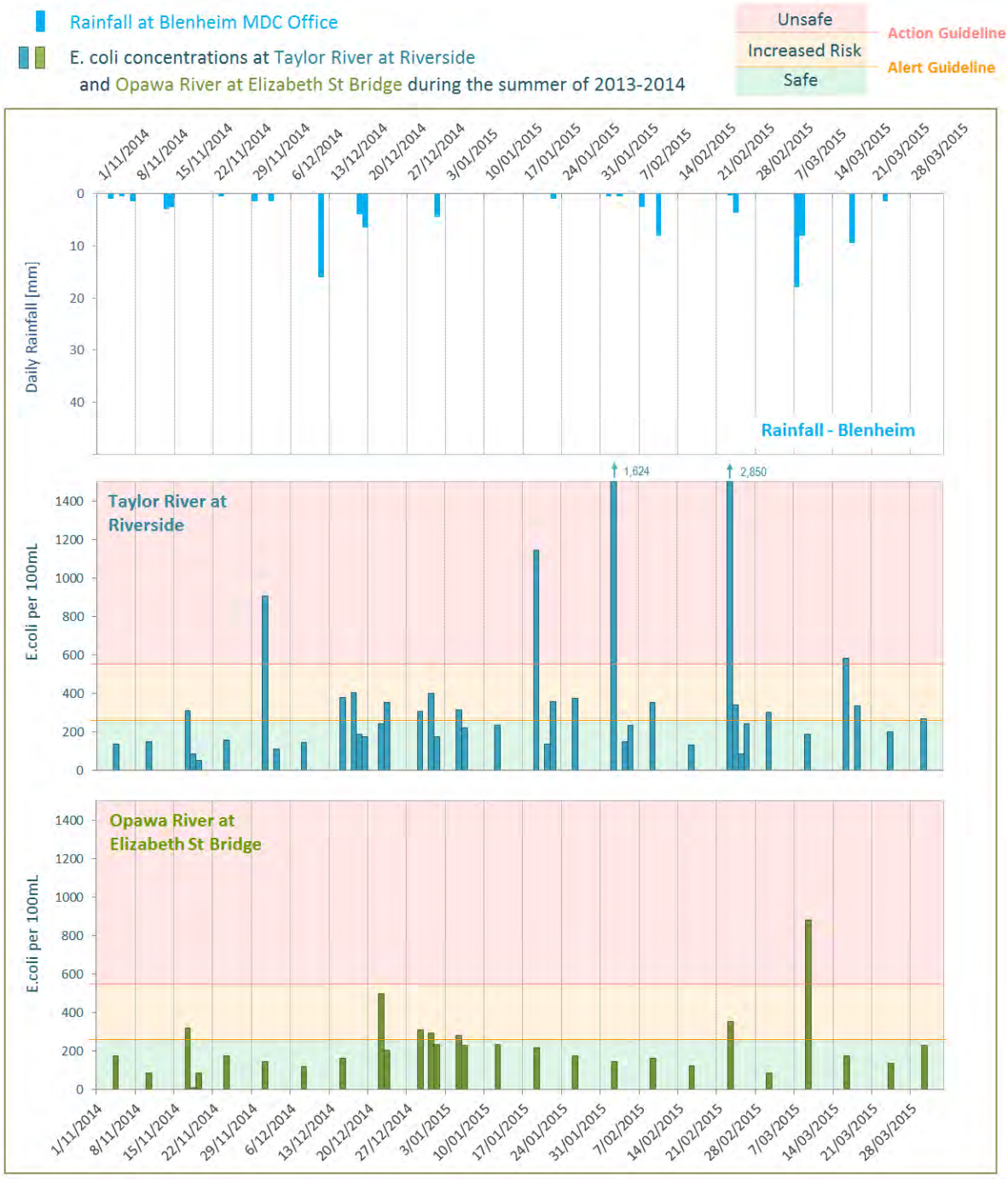


Figure 31: Monitoring results for the Taylor River at Riverside and the Opawa River at Elizabeth St for the summer season of 2014/15.

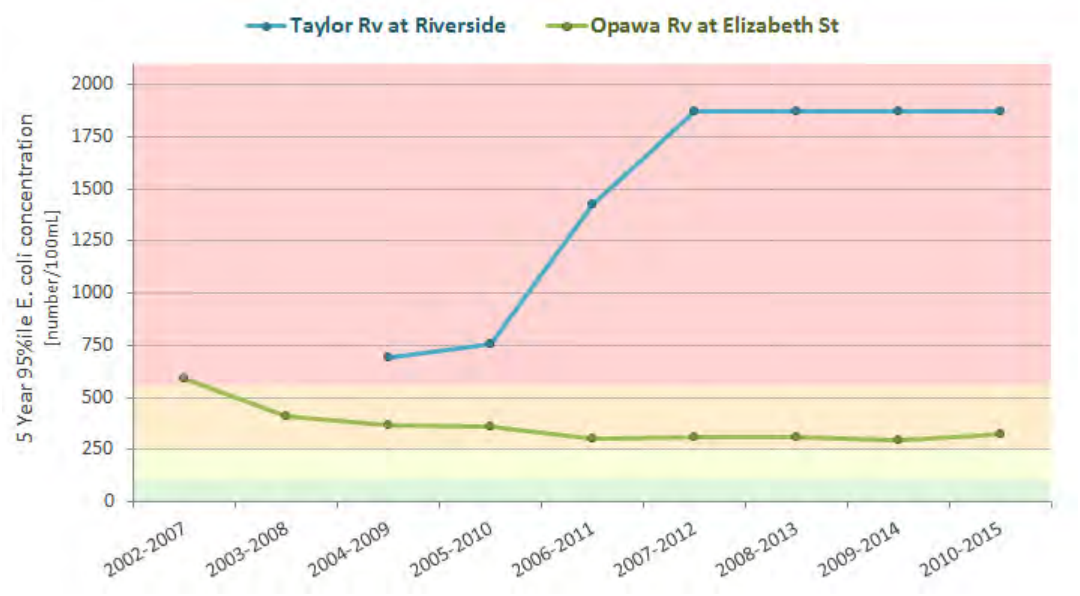


Figure 32: The 5-year-95%ile E. coli concentrations in the Taylor River at Riverside and the Opawa River at Elizabeth St of all of the summer seasons monitored.

Figure 33: Taylor River at Riverside

6. Result Summary

Most of the region had below average rainfall during this summer. Therefore, as the majority of faecal contamination enters waterways as a result of surface run-off during rainfall events, recreational water quality was generally very good.

The combination of low rainfall and upgrades to the Picton sewage system meant the recreational water quality at the Picton Foreshore was significantly better than in previous years. Of the coastal sites, only Mistletoe Bay had unsafe Enterococci concentrations attributed to localised rainfall.

Unusually high Enterococci concentrations at Momorangi Bay were most likely caused by leakage of the campground sewage system and warning signs were placed around the bay for most of the summer. Repairs to the system are ongoing and should result in a return to the relatively good recreational water quality observed in the bay in recent years.

Governors Bay also had occasionally elevated Enterococci concentrations unrelated to rainfall, but faecal bacteria concentrations exceeded safe levels in one follow-up sample only. Although Governors Bay is located in the vicinity of Momorangi Bay, the faecal contamination is not thought to be related to the high Enterococci concentrations in Momorangi Bay. Similar occasional exceedances of the recreational water quality guidelines were observed in Governors Bay in previous years and are likely caused by irresponsible behaviour of individual users.

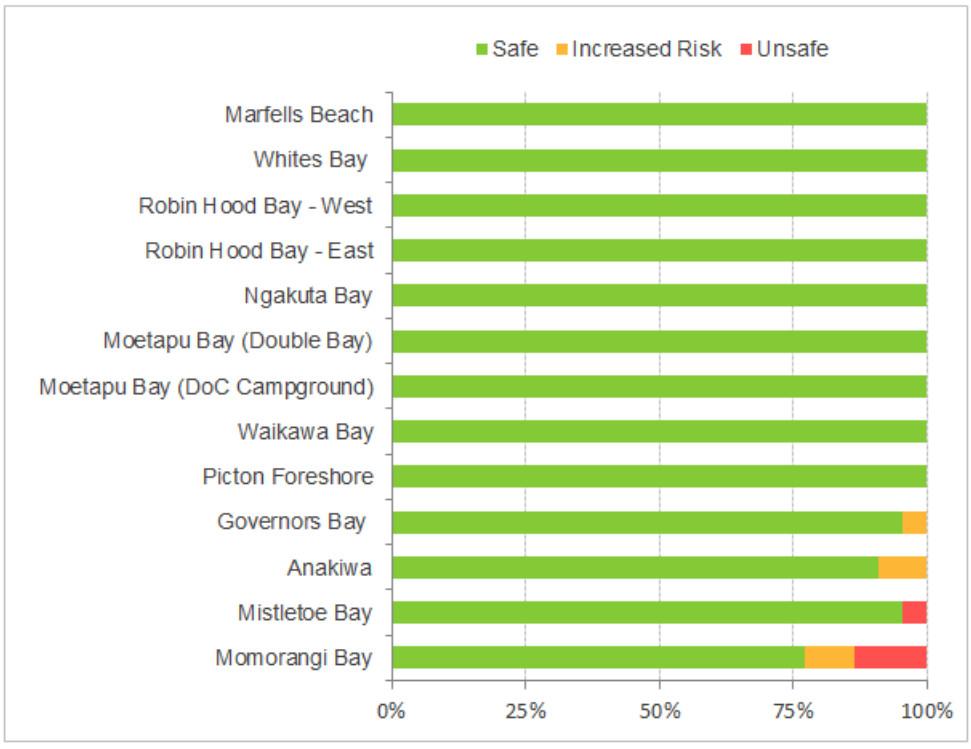


Figure 34: Compliance of coastal beaches with the Recreational Water Quality Guidelines (Routine samples only).

The lack of significant rainfall and subsequent flooding also resulted in consistently good recreational water quality for most of the freshwater sites (Figure 35). However, comparatively small rainfall events resulted in two occasions with unsafe faecal contamination for both, the Rai River and the Waihopai River.

Efforts by local dairy farmers have resulted in significant improvement in the recreational water quality of the Rai River. This has a follow-on effect on the water quality in the Pelorus River at Totara Flat. E. coli concentrations in the Waihopai River at Craiglochart #2, on the other hand, show an increasing trend for the recent years. The causes for this are unknown and should be further investigated.

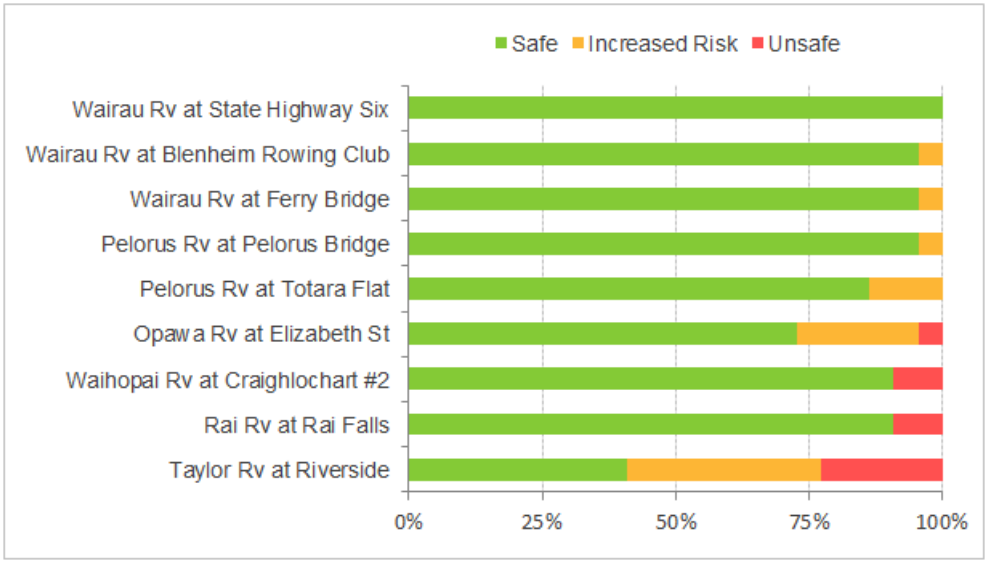
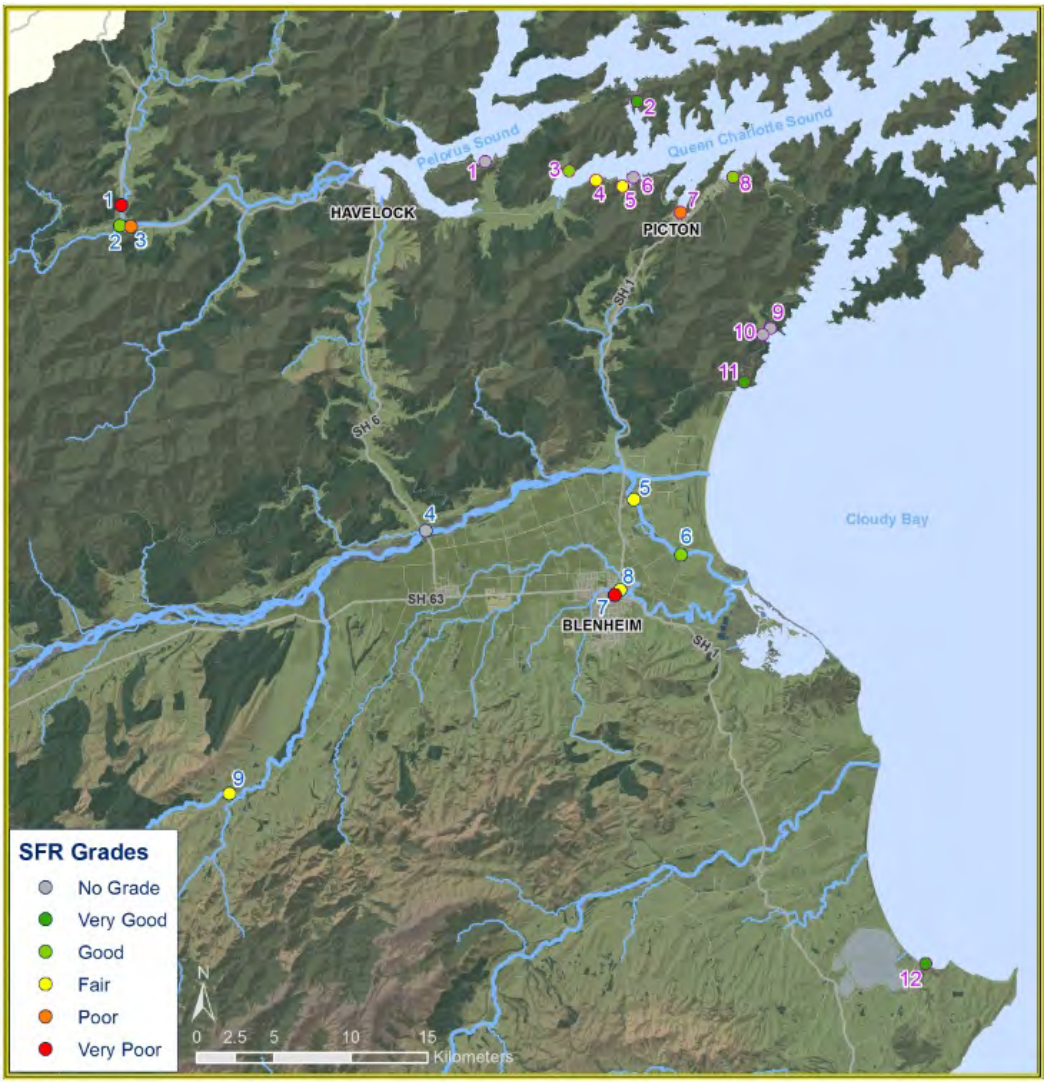


Figure 35: Compliance of river sites with the Recreational Water Quality Guidelines (Routine samples only.

The Taylor River at Riverside had the worst water quality of all freshwater sites monitored. High E. coli concentrations at this site are a result of reduced dilution of faecal contamination during low flows. Previous investigations identified wildfowl and dogs as the main sources, but other sources could contribute to the sporadically very high E. coli concentrations observed.

The Suitability for Contact Recreation (SFR) Grades are an indicator of the overall recreational water quality at a site. Figure 36 shows the current SFR Grades for the sites monitored. The Grades were not review as part of this document. Although there have been changes of faecal bacteria concentrations at some of the sites that could result in a change of the SFR Grade, a review should only be done if it is clear that these changes are persistent. Also, sites that were added to the program in 2012 will have sufficient data in another two seasons to have SFR Grades assigned to them. Therefore, it is recommended that the SFR Grades are reviewed after the 2016/17 summer season.



Type	No.	Site	Easting	Northing	SIC (Sanitary Inspection Category)	MAC (Microbiological Assessment	SFR Grade (Suitability for Contact Recreation
Coastal Sites	1	Moetapu Bay	1671600	5432100	new site (insufficiant data)		
	2	Mistletoe Bay	1681470	5436007	Very Low	B	Very Good
	3	Anakiwa	1677073	5431495	Moderate	B	Good
	4	Momorangi Bay	1678817	5430879	Moderate	C	Fair
	5	Ngakuta Bay	1680514	5430489	Moderate	C	Fair
	6	Governors Bay	1681310	5431030	new site (insufficiant data)		
	7	Picton Foreshore	1684298	5428815	High	C	Poor
	8	Waikawa Bay	1687695	5431090	Low	B	Good
	9	Robin Hood Bay East	1690115	5421285	new site (insufficiant data)		
	10	Robin Hood Bay West	1689595	5420930	new site (insufficiant data)		
	11	Whites Bay	1688425	5417793	Very Low	A	Very Good
	12	Marfells Beach	1700194	5380089	Very Low	A	Very Good
River Sites	1	Rai Rv at Rai Falls	1648018	5429266	High	D	Very Poor
	2	Pelorus Rv at Pelorus Bridge	1648077	5428091	Low	B	Good
	3	Pelorus Rv at Totara Flat	1648262	5427731	Moderate	D	Poor
	4	Wairau Rv at State Highway Six	1667780	5408150	new site (insufficiant data)		
	5	Wairau Rv at Ferry Bridge	1681274	5410163	Moderate	C	Fair
	6	Wairau Rv at Blenheim Rowing Clu	1684319	5406605	Moderate	B	Good
	7	Taylor River at Riverside	1680023	5403987	High	D	Very Poor
	8	Opawa River at Elizabeth St Bridge	1680393	5404310	Moderate	C	Fair
	9	Waihopai River at Craiglochart #2	1655029	5391098	Moderate	C	Fair

Figure 36: Suitability for Contact Recreation (SFR) Grades for the all sites monitored.

7. References

MDC (2012) *Recreational Water Quality Report 2011-12*. Marlborough District Council, Technical Report 12-013

MDC (2013a) *Recreational Water Quality Report 2012-13*. Marlborough District Council, Technical Report 13-006

MDC (2013b) *Investigation into High E. coli Concentrations in the Taylor River during Low Flows*. Marlborough District Council, Technical Report 13-007

MDC (2014) State of the Environment Surface Water Quality Monitoring Report. Marlborough District Council, Technical Report 14-006

MfE (2003) *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas.* Ministry for the Environment

Table of Contents

1. Appendices

Appendix 1: Results for the 2014/2015 summer season

Results are Enterococci concentrations for coastal sites and E. coli concentrations for river sites, both in MPN/100mL

Site Type	Week	Sample Date	Anakiwa	Mistletoe Bay	Moetapu Bay (DoC)	Moetapu - Doubel Bay	Momorangi Bay	Ngakuta Bay	Governors Bay	Picton Foreshore	Waikawa Bay	Whites Bay	Robin Hood Bay East	Robin Hood Bay West	Marfells Beach
Coastal	1	04/05 Nov 2014	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
	2	10/11 Nov 2014	<10	<10	<10	<10	98	<10	63	<10	<10	<10	<10	<10	<10
	3	17/18 Nov 2014	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	4	24/25 Nov 2014	<10	<10	<10	<10	389	<10	<10	<10	<10	10	<10	<10	<10
	Follow-up	27 Nov 2014					31								
	5	01/02 Dec 2014	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	20	<10
	6	08/09 Dec 2014	<10	<10	<10	31	146	<10	<10	<10	<10	<10	<10	10	<10
	7	15/16 Dec 2014	<10	<10	<10	<10	<10	20	<10	41	<10	<10	<10	10	<10
	8	22/23 Dec 2014	10	<10	20	<10	1274	<10	<10	10	10	<10	<10	<10	<10
	Follow-up	24 Dec 2014					10								
	Follow-up	25 Dec 2014					644								
	9	29/30 Dec 2014	<10	<10	10	<10	10	<10	<10	<10	<10	<10	20	20	10
	10	05/06 Jan 2015	20	10	<10	<10	<10 - 350*	96	86	<10	<10	10	<10	<10	<10
	Follow-up	08 Jan 2015					228 - 767*								
	11	12/13 Jan 2015	<10	<10	<10	<10	<10	<10	20	<10	10	<10	<10	<10	<10
	12	19/21 Jan 2015	31	<10	31	<10	231	<10	185	<10	<10	<10	<10	<10	<10
	Follow-up	23 Jan 2015		<10			10 - 1043*		295						
	13	26/27 Jan 2015	<10		<10	<10	<10	<10	<10	<10	10	<10	<10	<10	<10
	14	02/03 Feb 2015	20	465	<10	135	30	<10	85	10	<10	<10	<10	<10	10
	Follow-up	05 Feb 2015		20											
	15	09/10 Feb 2015	20	<10	<10	<10	10	<10	10	<10	<10	<10	<10	10	<10
	16	16/17 Feb 2015	20	<10	<10	<10	10	<10	10	20	<10	<10	<10	<10	<10
	17	23/24 Feb 2015	20	<10	<10	<10	<10	10	10	31	<10	<10	<10	<10	10
	18	02/03 Mar 2015	<10	<10	20	10	<10	10	<10	<10	<10	<10	<10	<10	10
	19	09/10 Mar 2015	189	<10	<10	<10	<10	31	<10	<10	10	<10	<10	10	30
	20	16/17 Mar 2015	226	<10	<10	<10	<10	10	20	<10	10	<10	<10	<10	<10
	21	23/24 Mar 2015	<10	10	<10	10	<10	<10	<10	52	<10	<10	<10	<10	10
	22	30/31 Mar 2015	31	<10	<10	<10	<10	<10	<10	20	<10	<10	<10	<10	20

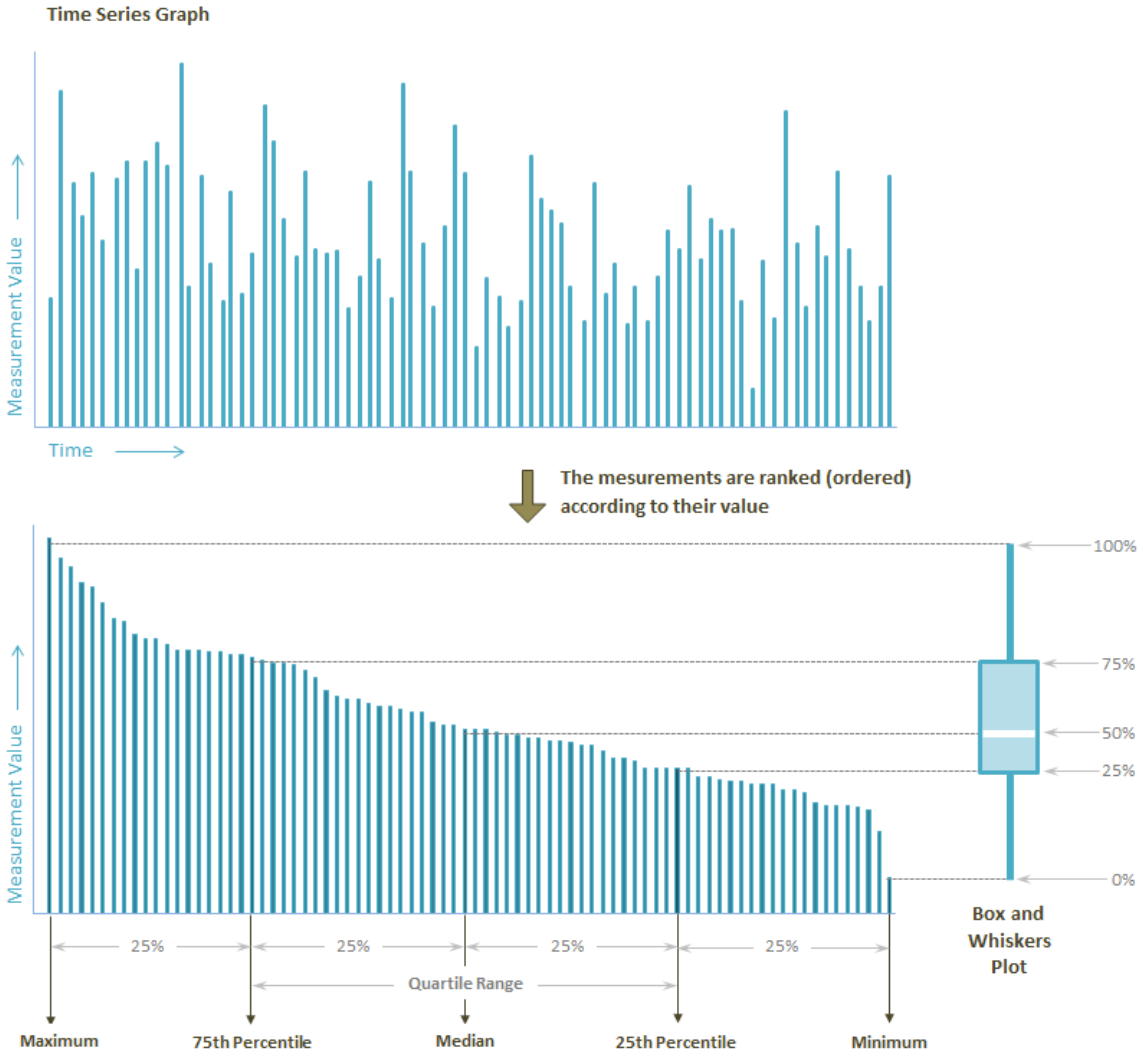
* several samples taken

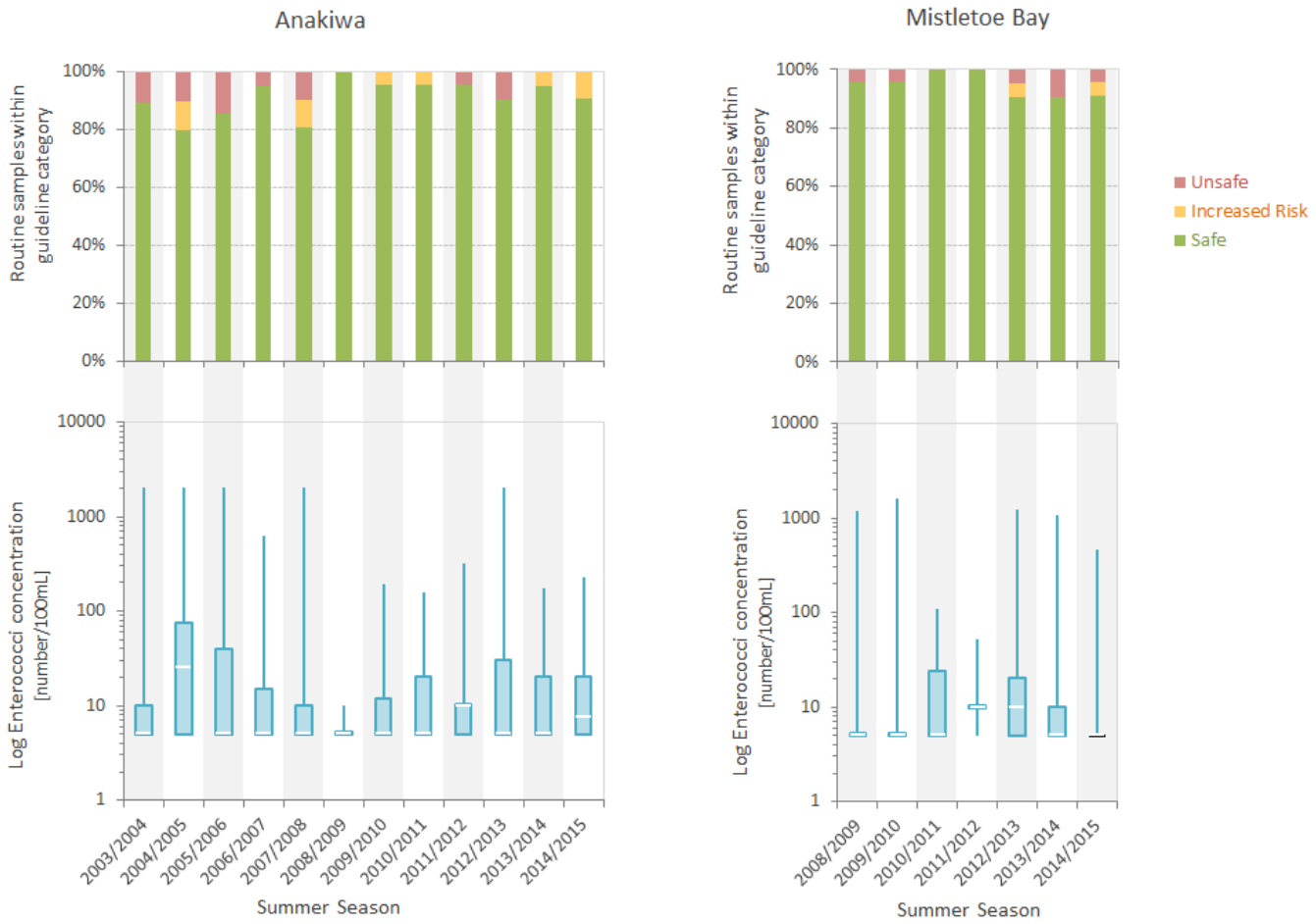
Site Type	Week	Sample Date	Rai Falls	Pelorus Rv at Pelorus Bridge	Pelorus Rv at Totara Flat	Waihopai Rv at Craiglochart #2	Wairau Rv at State Highway Six	Wairau Rv at Ferry Bridge	Wairau Rv at Blenheim Rowing Club	Taylor Rv at Riverside	Opawa Rv at Elizabeth St
River	1	04/05 Nov 2014	98	31	52	<10	30	10	41	173	135
	2	10/11 Nov 2014	20	10	41	10	<10	<10	<10	86	146
	3	17/18 Nov 2014	98	20	41	52	41	<10	<10	318	309
	Follow-up	18-19 Nov 2014								10-86*	52-85*
	4	24/25 Nov 2014	62	52	<10	75	10	52	41	173	155
	5	01/02 Dec 2014	135	450	432	30	41	<10	20	144	905
	Follow-up	04 Dec 2014		31	31						109
	6	08/09 Dec 2014	122	31	52	52	10	31	<10	120	142
	7	15/16 Dec 2014	130	98	73	52	<10	<10	<10	160	379
	Follow-up	17-19 Dec 2014									173-404*
	8	22/23 Dec 2014	158	10	96	120	31	10	31	496	243
	Follow-up	23 Dec 2014								203	350
	9	29/30 Dec 2014	836	97	313	985	41	20	63	309	305
	Follow-up	31 Dec 2014				<10				295	399
	Follow-up	01 Jan 2015								233	173
	10	05/06 Jan 2015	98	41	85	63	75	52	121	279	313
	Follow-up	06 Jan 2015								228	221
	11	12/13 Jan 2015	110	31	20	31	63	20	10	233	233
	12	19/21 Jan 2015	75	10	31	10	20	52	31	218	1145
	Follow-up	21-22 Jan 2015									134-355*
	13	26/27 Jan 2015	109	63	20	20	63	62	31	173	373
	14	02/03 Feb 2015	767	134	318	31	161	31	41	146	1624
	Follow-up	04/05 Feb 2015	85		41						148-231*
	15	09/10 Feb 2015	30	31	31	31	31	72	31	160	350
	16	16/17 Feb 2015	30	41	63	20	10	52	10	122	132
	17	23/24 Feb 2015	86	98	75	121	86	279	52	355	2850
	Follow-up	24-26 Feb 2015									86-341*
	18	02/03 Mar 2015	31	30	20	108	63	41	10	86	301
	19	09/10 Mar 2015	97	109	109	259	158	119	282	882	187
	20	16/17 Mar 2015	20	31	20	63	85	110	122	173	583
	Follow-up	18 Mar 2015									336
	21	23/24 Mar 2015	41	85	63	63	41	41	41	135	199
	22	30/31 Mar 2015	31	74	31	717	85	10	30	228	269

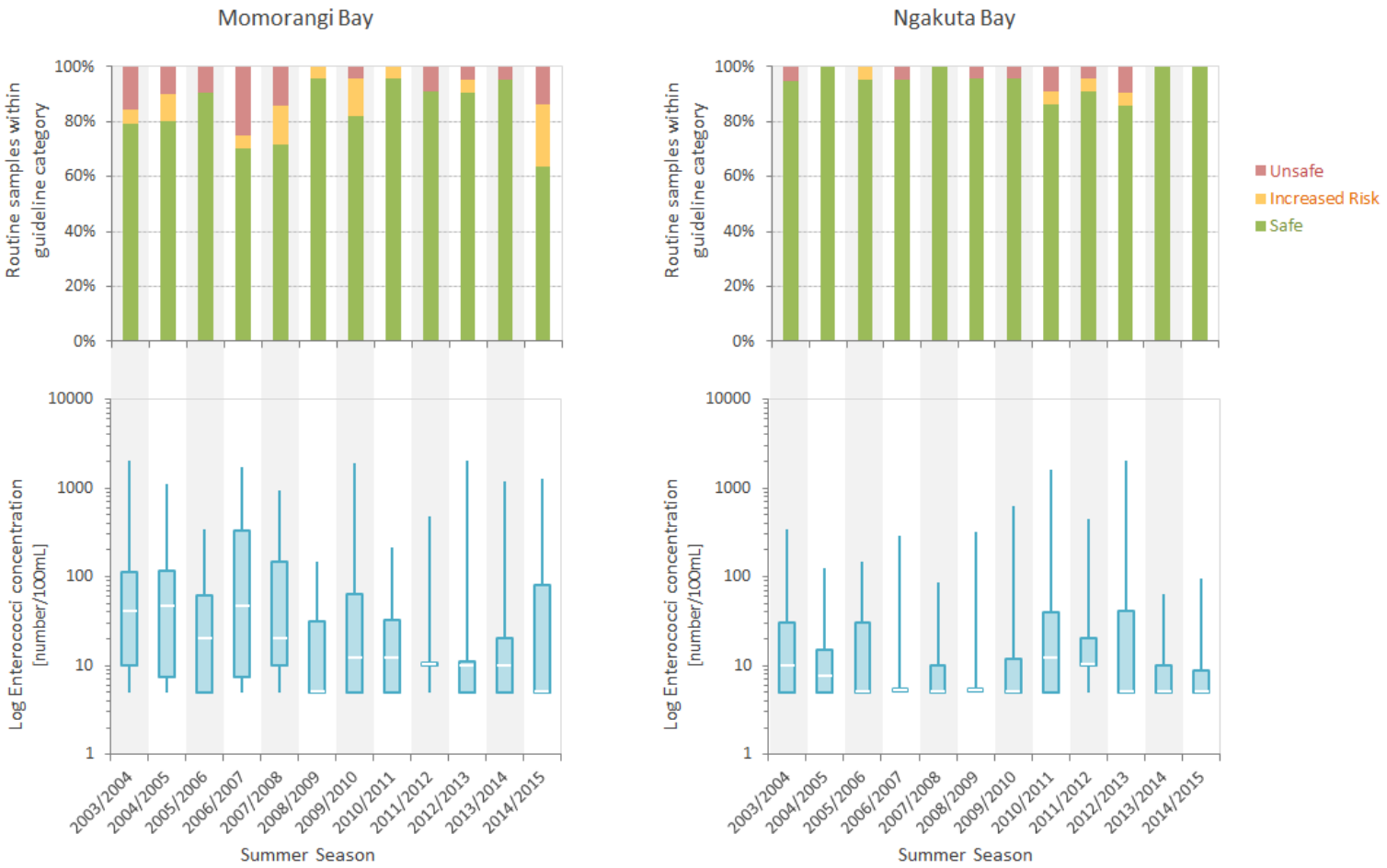
* several samples taken

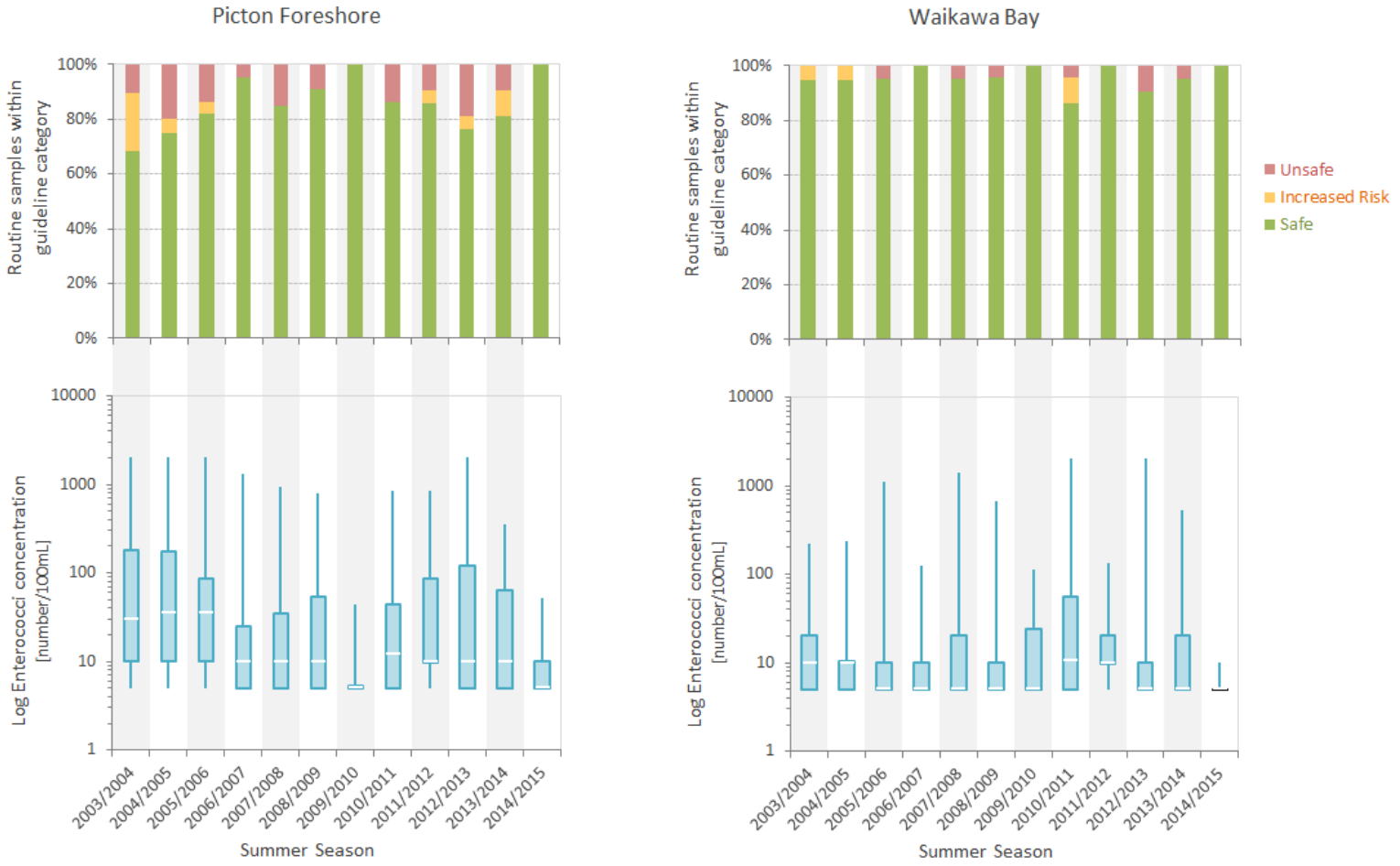
Appendix 2: Levels of compliance and Box and Whiskers plots

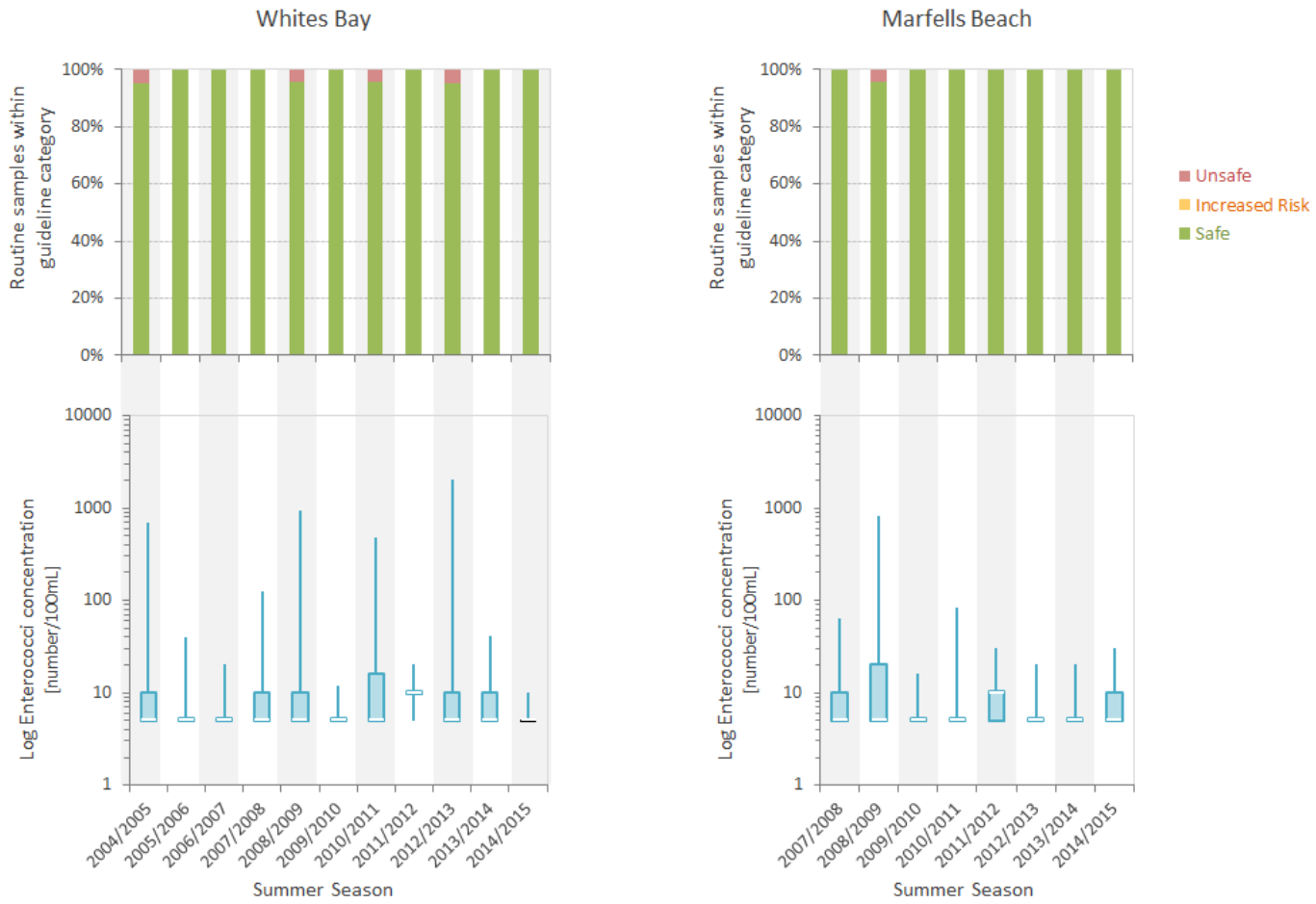
The Plots were created from the results of the routine sampling only. The first figure shows how Box and Whiskers Plots are created. Note that concentrations in the Box and Whiskers Plots for the actual sample results are on a logarithmic scale and only sites with a minimum of 3 years of record are shown.


Time Series Graph
Measurement Value
Time
The mesurements are ranked (ordered) according to their value
Measurement Value
100%
75%
50%
25%
0%
Box and Whiskers Plot
25%
25%
25%
25%
Quartile Range
Maximum
75th Percentile
Median
25th Percentile
Minimum

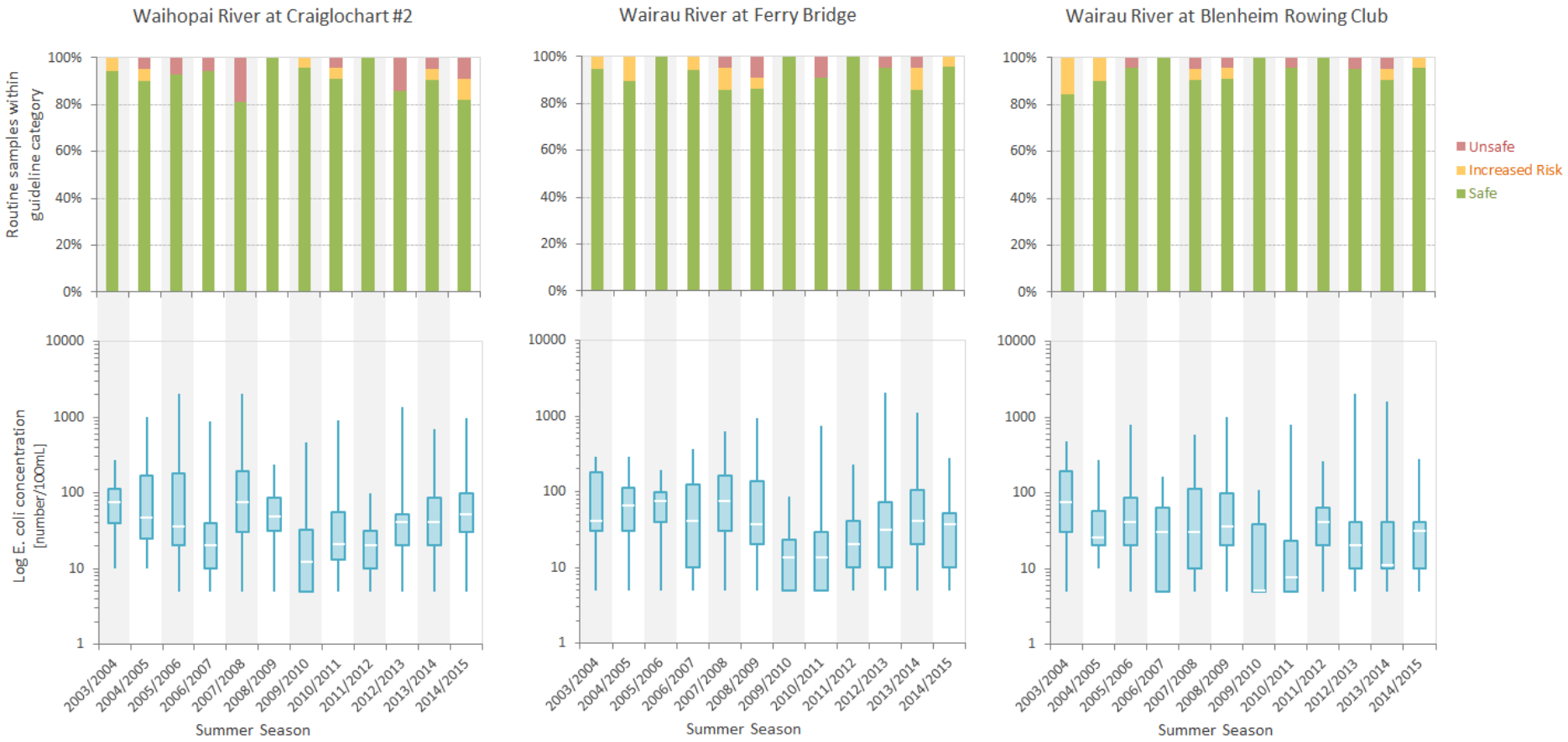

Anakiwa
Mistletoe Bay
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log Enterococci concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Momorangi Bay
Ngakuta Bay
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log Enterococci concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season

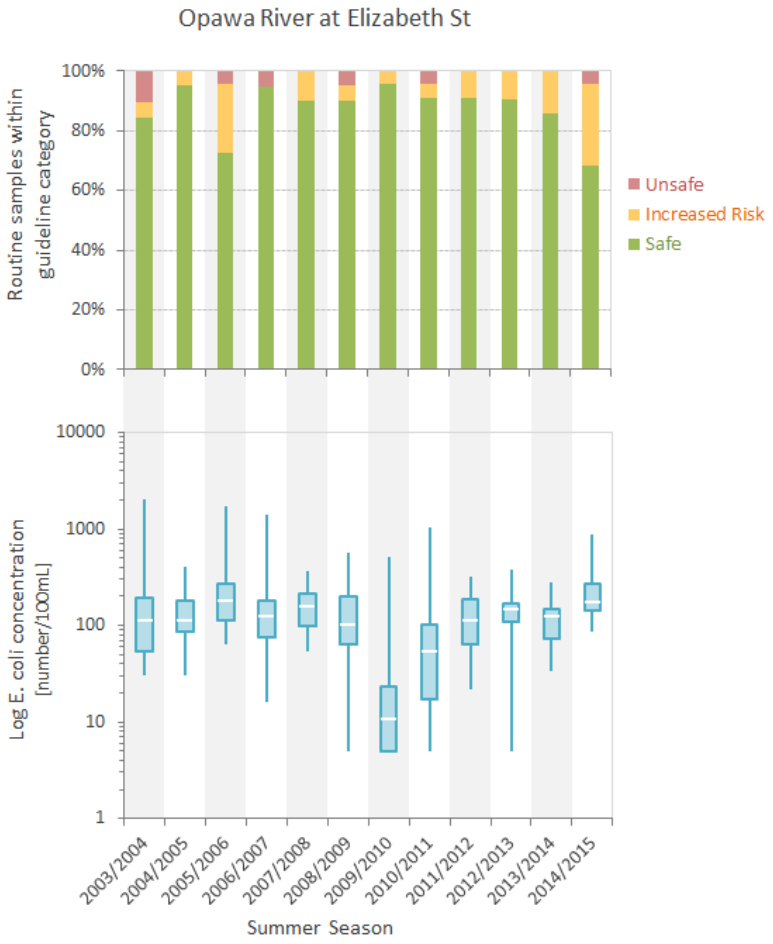

Picton Foreshore
Waikawa Bay
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log Enterococci concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Whites Bay
Marfells Beach
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log Enterococci concentration [number/100mL]
10000
1000
100
10
1
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Rai Falls
Pelorus River at Pelorus Bridge
Pelorus River at Totara Flat
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log E. coli concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Waihopai River at Craiglochart #2
Wairau River at Ferry Bridge
Wairau River at Blenheim Rowing Club
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Unsafe
Increased Risk
Safe
Log E. coli concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Taylor River at Riverside
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Log E. coli concentration [number/100mL]
10000
1000
100
10
1
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season


Opawa River at Elizabeth St
Routine samples within guideline category
100%
80%
60%
40%
20%
0%
Log E. coli concentration [number/100mL]
10000
1000
100
10
1
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
2010/2011
2011/2012
2012/2013
2013/2014
2014/2015
Summer Season
Unsafe
Increased Risk
Safe

Appendix 3: Management procedure for exceedances of bathing water guidelines