MARLBOROUGH DISTRICT COUNCIL

Recreational Water Quality Report 2018-2019

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Executive Summary

Ten coastal beaches and seven river sites were sampled weekly from the beginning of November 2018 until the end of March 2019.

Samples were analysed for the concentration of indicator bacteria – E.coli for river samples and Enterococci for coastal samples. These bacteria are an indicator for faecal contamination, which has the potential to affect the health of recreational water users, such as swimmers and surfers.

The majority of samples had indicator bacteria concentrations at safe levels. Occasional samples with unsafe bacteria concentrations were usually taken during or shortly after rainfall had fallen in the catchment.

The Taylor River at Riverside was the main exception with high E. coli levels due to earthquake-damaged sewerage and stormwater infrastructure. Permanent warning signs were in place at the site for the entire season. The damaged pipes are currently being repaired.

Of the coastal sites, Momorangi Bay had the best water quality following significant upgrades to the campground sewerage infrastructure in recent years. The most samples with unsafe Enterococci concentrations were taken from Picton Foreshore, but all exceedances were rainfall related.

A grading system was applied to provide an overall assessment of recreational water quality (SFR Grades). A review of the grades showed that there were no changes compared to grades published in the previous report.

Most sites have a SFR Grade of ‘Fair’ and a number of sites have recreational water quality graded as ‘Good’. The Taylor River at Riverside and Momorangi Bay have SFR Grades of ‘Very Poor’ and ‘Poor’, respectively, but grades for both sites are expected to improve in the near future.

The National Policy Statement for Freshwater Management (NPS-FM) contains limits for E. coli levels for determining the state of river water quality. The statistics used by the NPS-FM can be modified by utilising the guideline levels for Enterococci to allow application to coastal sites as well. Comparison of the NPS-FM states and the SFR Grades shows that the NPS-FM is generally more lenient.

Additional samples need to be collected next season to provide data for the development of predictive models. However, models will require testing for at least another season before outputs can be made publicly available.

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1. Introduction

Marlborough has many beautiful beaches and rivers that are popular with visitors and local residents. Swimming, boating, surfing and fishing are only a few of the many water based recreational activities that take place in the region.

Accidental ingestion of water can result in illness when faecal bacteria concentrations in the water are high. The risk of infection is highest for activities such as swimming and surfing. In New Zealand, Campylobacteriosis is the most common illness associated with water use [2]. Other, less common diseases are Cryptosporidiosis and Giardiasis. All three illnesses can cause vomiting, stomach cramps and diarrhoea. It can take up to ten days before symptoms occur. This means that the source of infection is often difficult to determine. In 2016, recreational water contact was identified as a risk factor for 26% of Cryotosporidiosis cases and over 30% of Giardiasis cases in New Zealand [2].

The microorganisms causing these diseases can only multiply in a warm, dark and moist environment, such as the gut of warm-blooded animals. Thus, the most common reason for their presence in water is contamination with faecal matter[1].

To determine the risk to water users, council takes weekly water samples from the most popular beaches during the summer months. Measuring the concentrations of all harmful microorganisms (pathogens) in these samples is both difficult and expensive. Instead, the samples are analysed for indicator bacteria. These are easier to measure and generally occur together with harmful microorganisms. E. coli are the indicator bacteria used for freshwater samples, while Enterococci are preferred for coastal waters.

This report presents the results for the samples taken during the summer season of 2018/2019. It is important to note, that the report is only focused on health risks associated with faecal contamination. The results presented are not reflective of general water quality. The presence of toxic algae or other health risks, such as high water flows or strong currents are also not covered.

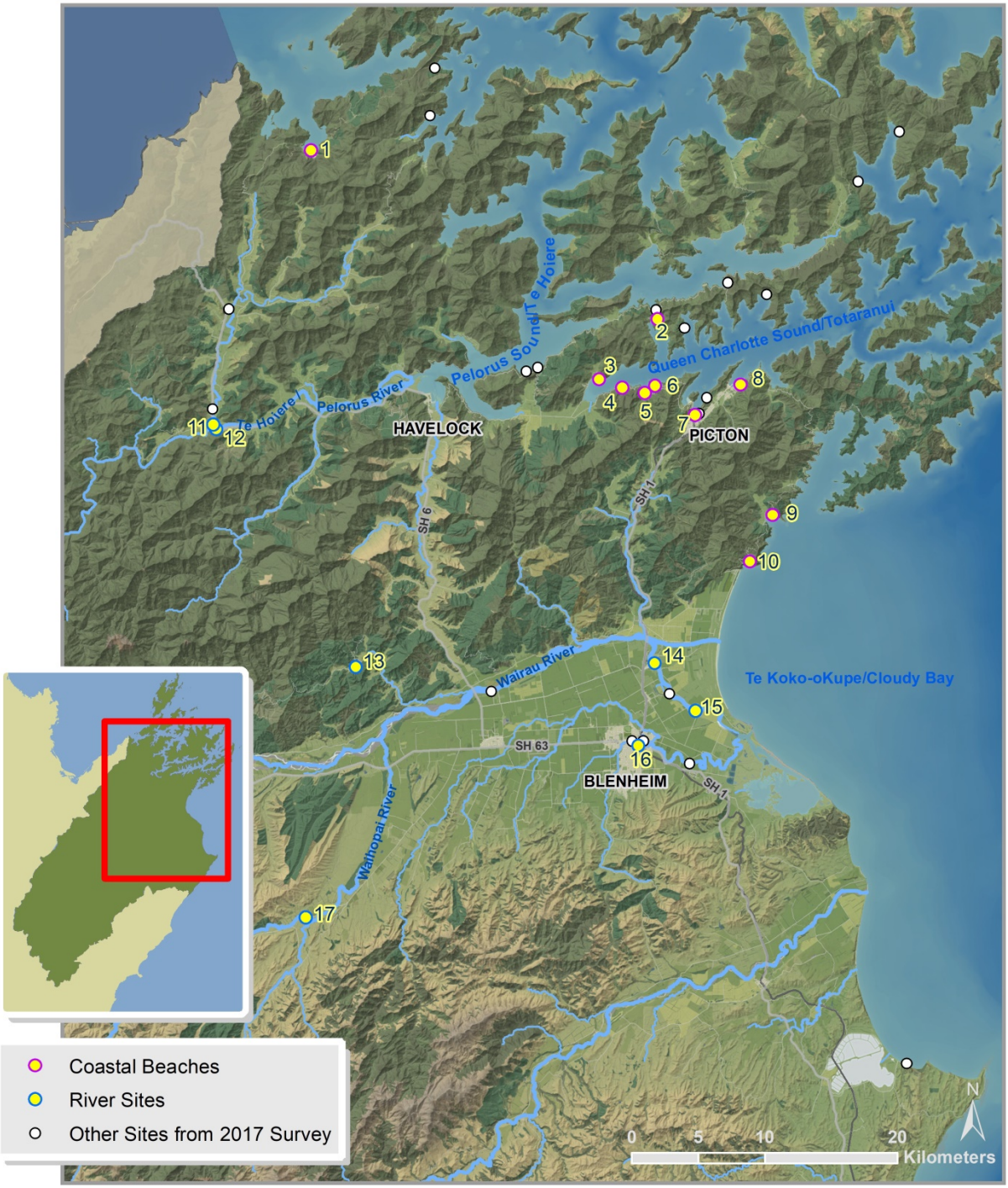
2. Recreational Water Quality Monitoring

During the 2018/2019 summer season, council monitored ten coastal beaches and seven river sites (Figure 1). These sites were the most popular swimming locations in a site usage survey carried out in 2017 [5].

The 17 sites were monitored weekly from the beginning of November until the end of March. This is the time when water temperatures are highest and most swimming occurs. Monitoring consists of field measurements (water temperature and conductivity) and the taking of water samples. The water samples are analysed for faecal indicator bacteria by Hill Laboratories in Blenheim. Bacteria levels are measured using the Enteroalert method for Enterococci and Colilert method for E. coli. For both methods, the samples need to be incubated for 18 to 24 hours. This means that there is a delay of at least one day before sampling results are available. Once council has received the analysis results, they can be viewed on the LAWA website (www.lawa.org.nz). LAWA is a viewing platform for environmental information collected by councils across New Zealand. Recreational water quality is presented in the "Can I Swim Here" module of the website. Other environmental information that can be found on LAWA, includes general water quality, water quantity and air quality data.

The following sections provide a short introduction to the guidelines used to assess the analysis results for recreational water quality samples.

[1] Mainly droppings from domestic or native animals, but also human sewage.



	No.	Site	Easting	Northing
Coastal Beaches	1	Okiwi Bay	1655355	5448685
	2	Mistletoe Bay	1681470	5436007
	3	Anakiwa	1677073	5431495
	4	Momorangi Bay	1678817	5430879
	5	Ngakuta Bay	1680514	5430489
	6	Governors Bay	1681310	5431030
	7	Picton Foreshore	1684298	5428815
	8	Waikawa Bay	1687695	5431090
	9	Waikutakuta/Robin Hood Bay East	1690115	5421285
	10	Pukatea/Whites Bay	1688425	5417793

	No.	Site	Easting	Northing
River Sites	11	Te Hoiere/Pelorus Rv at Pelorus Bridge	1648077	5428091
	12	Te Hoiere/Pelorus Rv at Totara Flat	1648262	5427731
	13	Ohinemahuta Rv at Onamalutu Domain	1658791	5409896
	14	Wairau Rv at Ferry Bridge	1681274	5410163
	15	Wairau Rv at Blenheim Rowing Club	1684319	5406605
	16	Taylor River at Riverside	1680023	5403987
	17	Waihopai River at Craiglochart #2	1655029	5391098

Figure 1: Monitoring Sites of the Recreational Water Quality Programme (numbered). The map also shows sites that were part of the 2017 Site Usage Survey, but are not currently monitored.

3. Assessment of monitoring results

Our immune system can deal with small concentrations of most pathogens. However, if concentrations are too high, we become sick. There are many factors that influence the number of pathogens that are required to make us sick. One of these factors is the type of pathogen. In New Zealand, the most commonly notified disease that can be caused by recreational water uses is Campylobacteriosis [2]. For this reason, guideline levels are based on the concentration of indicator bacteria (E. coli and Enterococci) that are present when persons contract Campylobacteriosis. However, some persons are more susceptible than others. So, the guideline values are chosen to protect roughly 99% of all users.

The most well studied indicator bacterium used is E. coli and guideline values for rivers are based on this bacterium. However, E. coli die quickly in saltwater, which means a more robust indicator organism is needed for coastal beaches. Therefore, Enterococci are used as an indicator for the risk to human health in coastal waters.

3.1. Guideline values for individual samples

The 2003 Guideline document [7] provides two guideline values for each of the two indicator bacteria. Using the guidelines values, sample results are categorised into three “Modes”. Bacteria concentrations within the “Green Mode” indicate that the health risk to swimmers is low. If bacteria levels reach the “Alert mode”, the infection risk is slightly increased. Although it is still safe for swimmers to take a dip, it is a flag for council to investigate the sources of increased faecal pollution. Once bacteria concentrations exceed the Action Guideline, the health risk is considered unacceptable. Table 1 shows the range of indicator bacteria concentrations for the “Modes” and the associated guidelines.

Mode	Freshwater	Coastal	Meaning
	E. coli/100mL	Enterococci/100mL	
Green Mode	<260	<140	**Safe** for contact recreation
Alert Guideline	260	140	
Alert Mode	260 - 550	140 - 280	**Increased risk** for health
Action Guideline	550	280	
Action Mode	>550	>280	**Unsafe** for conctact recreation

Table 1: Modes in the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas [7].

If indicator bacteria concentrations are above the Alert or Action Guideline, possible causes are considered and the District Health Board (DHB) is informed. Council and DHB then make a joint decision on how to proceed. A flow-chart outlining the decision process can be found in Appendix 2.

In Marlborough, most exceedances of the Action Guideline are caused by rainfall. Rainfall water that is not absorbed by the ground, flows over the surface and into the nearest stream or coastal area. This is referred to as surface run-off. If the water flows over animal droppings, it becomes contaminated with microorganisms and other pollutants. For this reason streams that flow through pasture usually have high faecal bacteria concentrations during rainfall. Riparian buffer vegetation on stream banks can stop some of the pollution. However, even streams flowing through native bush will contain some faecal bacteria during rainfall, because of birds and other wild animal droppings.

In urban areas, the majority of surfaces will not allow rainfall to infiltrate into the ground. Therefore, the portion of rainfall forming surface run-off is greater. The run-off collects in stormwater pipes that often discharge directly into streams and coastal areas. In addition to animal droppings, the main sources of contamination in urban areas are sewer overflows and damage to the sewerage pipe system.

In small rural and coastal residential areas, private sewage treatment can also be a source of pathogens in water bodies. These private systems require regular checks and maintenance. However, in Marlborough, there is currently no requirement to have this carried out.

The District Health Board and council have released a general recommendation to not swim in waterways for up to 48 hours following heavy rainfall or if the water is discoloured. The message is usually reinforced with a media release at the beginning of each summer season.

3.2. Suitability for Contact Recreation Grades (SFR Grades)

To determine the concentration of indicator bacteria, a sub-sample is injected into a growing medium and the medium is then placed into an incubator. This creates ideal conditions for the indicator bacteria to multiply. After 18 – 24 hours of incubation, the bacterial colonies can be counted and a concentration is calculated.

Unfortunately, this causes a delay of at least one day before the bacterial concentration is determined. This means by the time analysis results are received, the concentration of indicator bacteria has likely changes. Particularly, rainfall can cause significant changes in water quality within minutes. This means that the latest sampling results cannot be used to decide on whether it is safe to swim or not. To overcome this problem, a grading system, the SFR Grades, was developed. SFR Grades range from 'Very Good' to 'Very Poor' and provide an overall assessment of recreational water quality. Table 2 lists the five SFR Grades and what they mean.

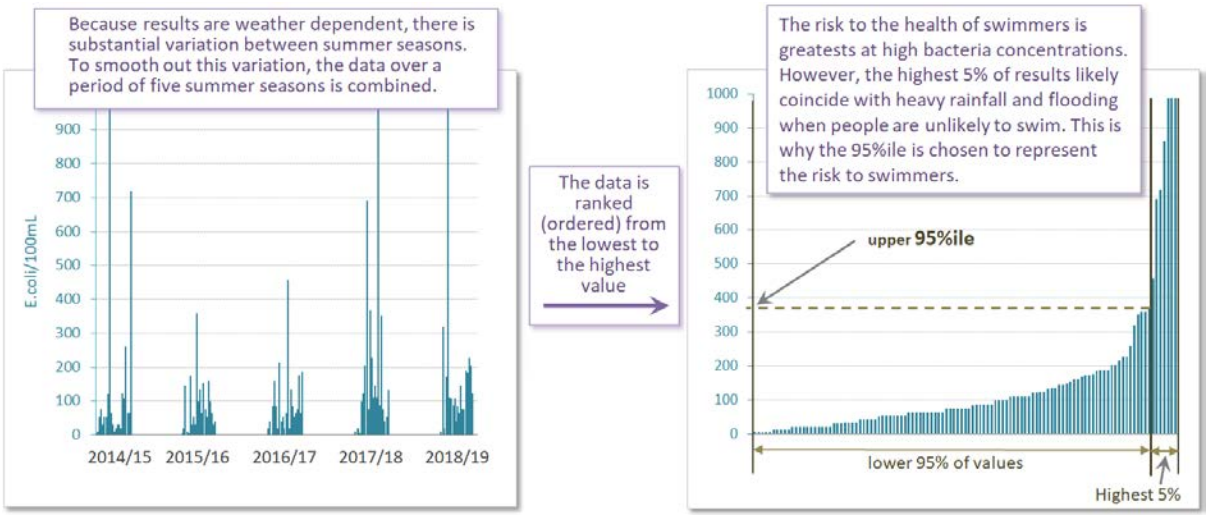
SFR Grade	Meaning
Very Good	Considered satisfactory for swimming at all times.
Good	Satisfactory for swimming most of the time with exceptions following rainfall.
Fair	Generally satisfactory for swimming. Caution should be taken during periods of high rainfall and swimming avoided if water is discoloured.
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 2: Suitability for Contact Recreation Grades (SFR Grades) and their meaning.

The grading consists of two parts. The first part is an assessment of the health risk from all potential faecal sources within the catchment[2] of a swimming site. Based on the assessment, sites are assigned one of five **Sanitary Inspection Categories, SICs**. These categories range from 'Very Low' to 'Very High' (Risk). Direct discharges into rivers and coastal areas are the most obvious sources of faecal contamination, but faecal material can enter water bodies also from a variety of land use activities. If a swimming spot is surrounded by native bush, the health risk from waterborne diseases is considered to be minimal and the site is given a SIC of 'Very Low'. Extensive sheep and beef farms cause a slightly greater risk of faecal contamination, particularly if livestock can access streams. This results in a SIC of 'Low' or 'Moderate'. The highest health risk is generally associated with human sewage. Swimming spots influenced by residential and urban development are therefore assigned a SIC of 'Moderate' to 'Very High'.

The second part of the SFR grading is the **Microbiological Assessment Category, MAC.** The MAC is calculated from bacteria concentrations in samples taken at a site. MACs range from A to D and are based on the upper 95th percentile (95%ile) calculated with the Hazen method (Figure 2).

[2] A catchment is the land area from which all rainfall that falls onto it eventually flows to a river sampling site or into a coastal bay. It is also called drainage basin or watershed.



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

Figure 2: Calculation of the upper 95%ile, which is used to assign the Microbiological Assessment Category (MAC) based on the table shown.

The calculation of the MAC requires a minimum of 20 sample results per season over a period of five consecutive summers. This means that it will take several years before new sites can be graded. To provide some information for beach users, an interim grade can be calculated using the data over a shorter period. On the LAWA website, the MAC is calculated using data from a shorter, three year period, for all sites. This provides the advantage that changes to water quality are reflected in the grading earlier. The LAWA team have gone a step further, basing their grading on the MAC calculation only. In the national guidelines [7] the SFR Grade combines the results from the SIC and MAC analysis (Table 3). The SIC allows adjustment of the grade based on the health risk from different sources of faecal contamination. For example, contamination from human sources generally presents a greater risk to swimmers than animal droppings. The MAC grading alone does not provide for this. The main argument against the inclusion of the SIC into the grading is that it introduces some subjectivity to the process. However, the use of genetic source tracking methods and site investigations allow the SIC category to be determined with greater certainty.

In this report the grading of sites is based on the national guidelines using the MAC and SIC categories to determine the SFR Grade. The SFR Grades are updated after every summer season as new data becomes available.

SFR Grade (Suitability for Contact Recreation Grade)		MAC (Microbiological Assessment Category) A	B	C	D
SIC (Sanitary Inspection Category)	Very Low	Very Good	Very Good	*	*
	Low	Very Good	Good	Fair	*
	Moderate	*	Good	Fair	Poor
	High	*	*	Poor	Very Poor
	Very High	*	*	*	Very Poor

* unexpected result (further investigation is necessary)

Table 3: Assignment of a SFR Grade from MAC and SIC results.

4. Results and Discussion

4.1. Results for the 2018/2019 summer season

This section presents a summary of the monitoring results for the 2018/2019 summer season. The individual results for all samples taken this season can be found in Appendix 1.

Figure 3 shows the percentage of results in the different modes set out in Section 3.1 for all routine samples taken this season.

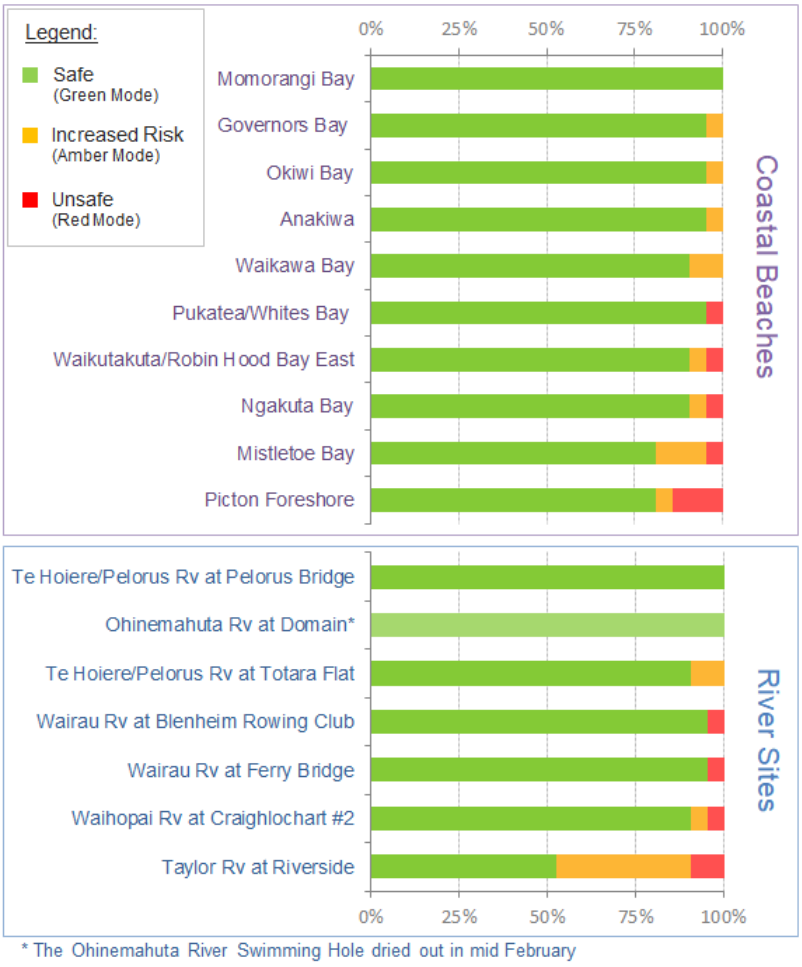


Figure 3: Percentage of routine samples within the different Guideline modes, for all sites sampled during the 2018/2019 summer season.

The majority of samples had indicator bacteria concentrations at safe levels. Occasional unsafe bacteria concentrations were almost exclusively related to rainfall. Additional sampling following guideline exceedances, showed a return to safe bacteria levels within a day or two after rainfall subsided.

The most notable exception was the Taylor River at Riverside. Warning signs were placed at the site for the entire season. Earlier sampling of stormwater pipes had revealed that very high E. coli concentrations were being discharged into the river, particularly from pipes near the Riverside sampling site. Use of genetic marker analysis revealed that human sewage was one of the sources of faecal contamination. Subsequent investigation of the stormwater infrastructure showed that recent earthquakes had caused significant damage to both sewerage and stormwater pipes. This results in cross-contamination of stormwater with sewage. The first stage of pipe repairs was completed in April this year and changes in river water quality should be noticeable next season.

The map in Figure 4 shows the extent of the Taylor River affected. Sampling of additional Taylor River sites in earlier seasons had shown that indicator bacteria concentrations in the upstream and downstream reaches are generally at safe levels [4].

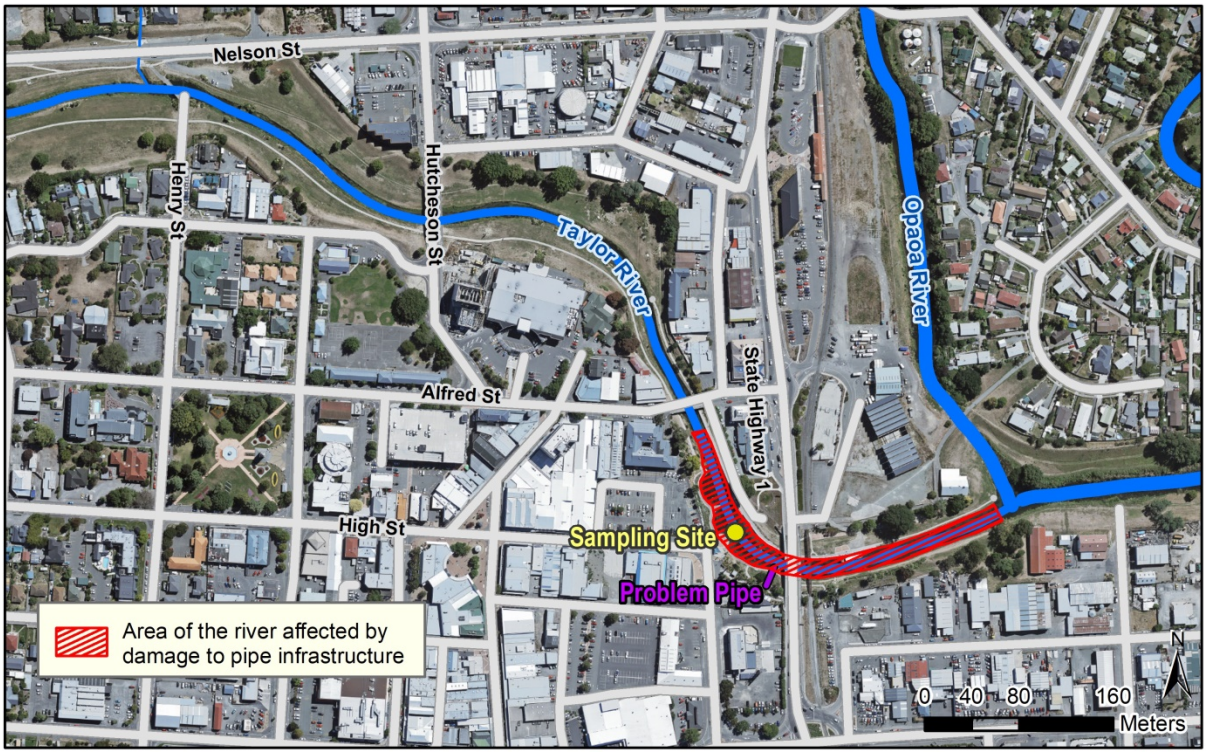


Figure 4: Area of the Taylor River affected by damage to stormwater and sewerage infrastructure.

Monitoring of the Ohinemahuta River stopped in mid-February as the lack of rain resulted in the river drying up. For the remainder of the season, the swimming hole was either completely dry or only consisted of shallow pools. During the previous summer, the river was flowing for the entire season [6]. This site is a recent addition to the Programme and has only been sampled for two summer seasons. Regular drying up of the swimming hole will result in insufficient data for SFR grading of this site.

Okiwi Bay is another site that has only recently been added to the Programme. Being a coastal site, lack of water is not a problem. However, the site is remote and is currently sampled by a contractor living in the bay. Samples are couriered to Nelson and there is a greater delay before sample results are known. Fortunately, indicator bacteria concentrations in Okiwi Bay are generally low. In February users of Okiwi Bay reported very bright green algae accumulating at the tide line. A sample was sent to Cawthron and the algae were identified as non-toxic small flagellates.

There has been an emerging pattern in Governors Bay with higher Enterococci concentrations towards the end of the season (Figure 5). The catchment of the bay is covered in native vegetation with no residential development. A possible reason for the elevated Enterococci levels is the observed greater use of the bay in the latter part of the season. Governors Bay is one of the few beaches monitored where dogs are permitted. Therefore, it is possible, that dog faeces left on the beach at lower tide are submerged when the water level rises during the incoming tide.

Another possible source of faecal contamination in Governors Bay are discharges from boats visiting the bay. Fortunately, Enterococci concentrations rarely exceed unsafe levels. However, this also means that genetic source tracking methods to identify the sources of faecal contamination cannot be applied.

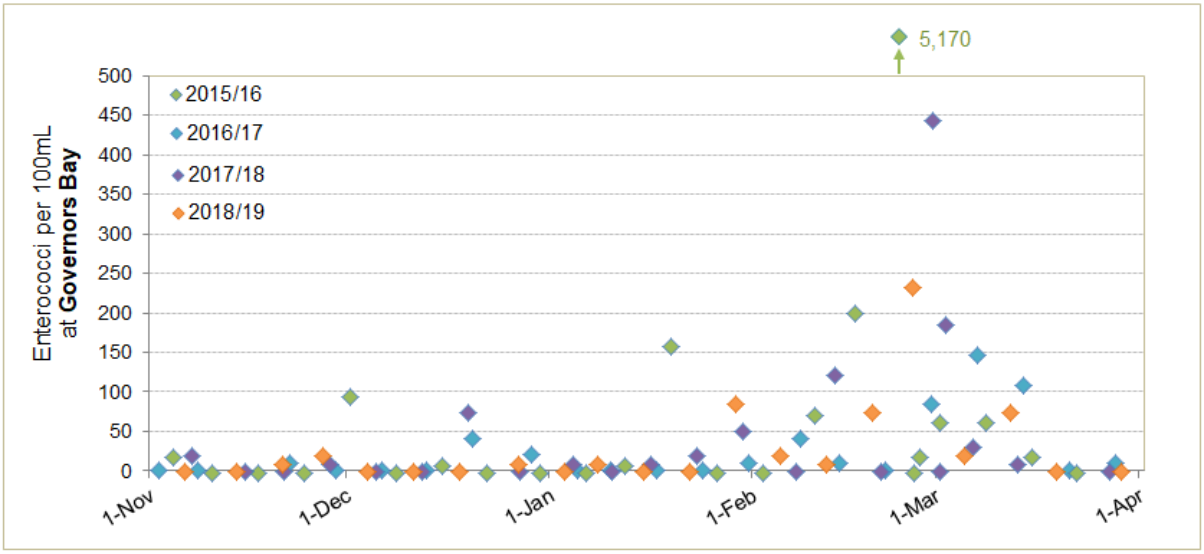


Figure 5: Enterococci concentrations in Governors Bay over the last four summer seasons.

Unusually high Enterococci concentrations in neighbouring Ngakuta Bay, observed last season [6] were not seen this season. Unlike Governors Bay, Ngakuta Bay is the home to a small community living in nearly 100 homes and holiday batches. Therefore, the most likely cause of high faecal bacteria concentrations in the bay are private sewage treatment systems. It is possible that last season's results have prompted some residents of Ngakuta Bay to check and maintain their sewage system, which lead to the lower Enterococci levels observed this summer.

There are many bays in the Marlborough Sounds that are the home to small communities with private sewage systems. Often, these sewage systems are forgotten about once installed and rarely inspected or maintained. There have been a number of confirmed cases of malfunctioning systems causing poor coastal water quality in Marlborough and other regions. Only a limited number of bays can be monitored as part of the Recreational Water Quality Programme. This means another mechanism is needed to assess and manage the health risk from malfunctioning systems. One option is to make regular checks and maintenance compulsory. Some councils actively monitor the performance of private systems in their region.

Mistletoe Bay was one example, of an old septic tank causing high faecal bacteria concentrations in the bay [4]. This has since been remediated and the bay had the best recreational water quality during the 2017/2018 season. However, during the recent (2018/2019) summer a number of samples had elevated Enterococci concentrations that could not be linked to rainfall. Data analysis showed no clear relationship with other parameters such as tide level or conductivity that might assist source identification. Additional sampling will need to be carried out, should unexplained guideline exceedances continue to occur in the future.

Of the coastal sites, Picton Foreshore had the highest Enterococci concentrations. This is not surprising as Picton, the largest residential area in the Sounds, heavily influences the water quality at the site. However, all three occasions of unsafe Enterococci concentrations were caused by recent rainfall in the catchment. This means that if the general advice to avoid swimming after rainfall is followed, the risk to the health of recreational users is relatively low.

Momorangi Bay had the best recreational water quality of the coastal sites this summer season. This is good news after the bay had two seasons of poor water quality as result of problems with the campground sewage system. The system has since undergone major upgrades, which means that visitors to one of the most popular bays can again enjoy good water quality.

4.2. SFR Grades

SFR Grades, including both, the SIC and MAC categories, were reviewed for each site sampled this summer. There were no changes to the SFR Grades compared to those published last year [6].

The majority of sites have a SFR Grade of 'Fair' (see Figure 6), with an equal number of coastal and river sites in this category. A grade of 'Fair' means that water quality is generally satisfactory, but swimming should be avoided following rainfall (see Section 3.2). This is consistent with our monitoring data, which show that high indicator bacteria concentrations at these sites are mostly linked to rainfall events.

There are also a number of sites with a SFR Grade of 'Good', most of them coastal beaches. Generally, coastal waters have better SFR Grades than river sites. This is partly due to greater dilution of contaminants in a much larger water body. Also, there is generally less land-use pressure in the Marlborough Sounds, where most coastal monitoring sites are located.

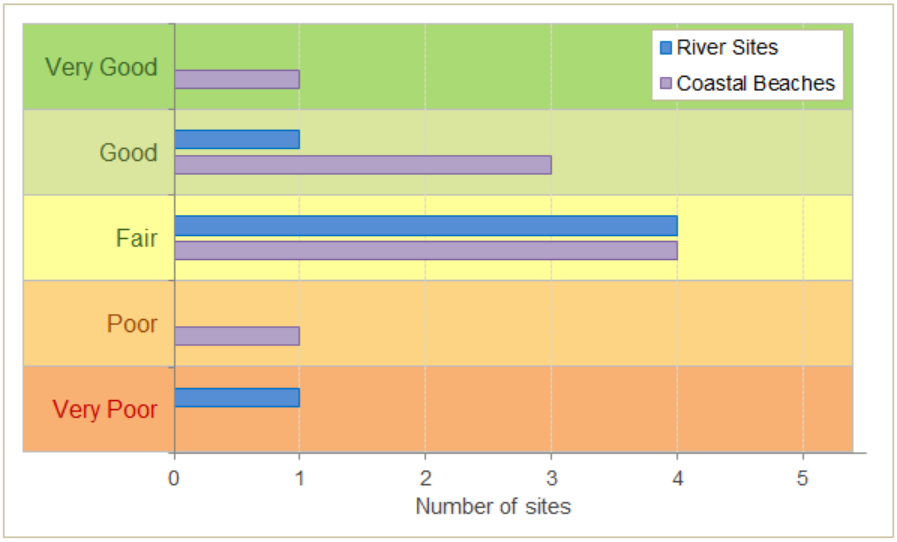


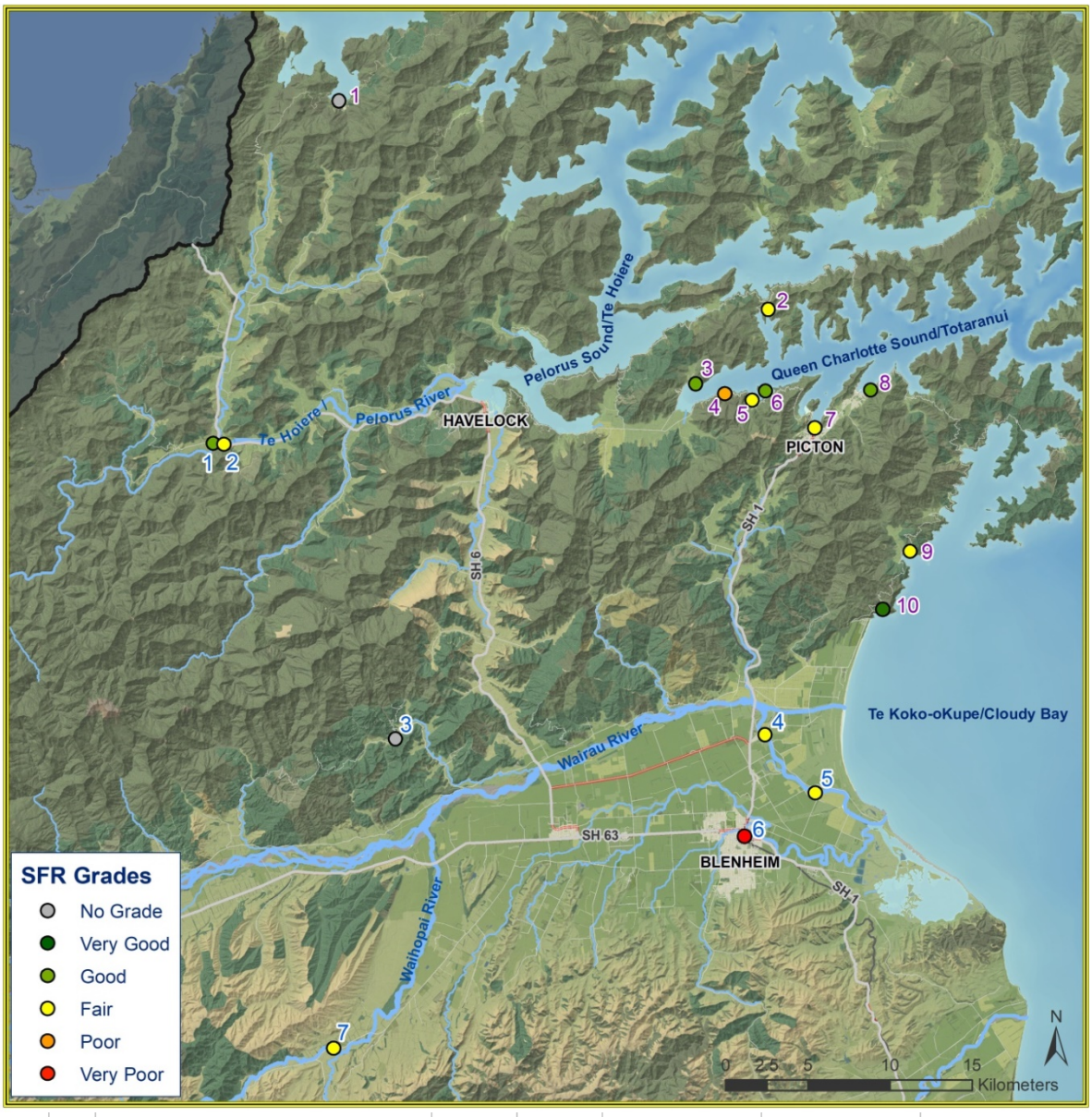
Figure 6: Number of sites in the different SFR Grades.

The map and table in Figure 7 show the SFR Grades, including the SIC and MAC categories for the individual sites. Momorangi Bay still has a SFR Grade of 'Poor', despite having the best water quality this season. This is due high Enterococci concentrations in 2014 and 2015 which were caused by problems with the campground sewage system. Because the SFR Grade is based on data over five summers, these earlier results are still influencing the current SFR Grade. An interim grade using the data over the last three summers would put Momorangi into the 'Fair' category.

The only site with a SFR Grade of 'Very Poor' is the Taylor River, but work is underway to improve this (see Section 4.1).

The site with the best SFR Grade of 'Very Good" is also the most popular. There are several factors that lead to the good water quality in Pukatea/Whites Bay. The site is surrounded by bush and a DoC campground is the only human influence present. Additionally, the bay is relatively open, which provides for good flushing with the vast amount of water from the wider Te Koko-o-Kupe/Cloudy Bay.

There is still insufficient data to grade the two recently added sites, Okiwi Bay and Ohinemahuta River at Onamalutu Domain, but following the next season, an interim grade can be calculated. Fortunately, indicator bacteria concentrations have been low, which should result in SFR Grades of 'Good' or 'Fair' for these sites.



Type	No.	Site	Easting	Northing	SIC (Sanitary Inspection Category)	MAC (Microbiological Assessment	SFR Grade (Suitability for Contact Recreation Grade)
Coastal Sites	1	Okiwi Bay	1655355	5448685	insufficiant data		
	2	Mistletoe Bay	1681470	5436007	Low	C	Fair
	3	Anakiwa	1677073	5431495	Moderate	B	Good
	4	Momorangi Bay	1678817	5430879	Moderate	D	Poor
	5	Ngakuta Bay	1680514	5430489	Moderate	C	Fair
	6	Governors Bay	1681310	5431030	Low	B	Good
	7	Picton Foreshore	1684298	5428815	Moderate	C	Fair
	8	Waikawa Bay	1687695	5431090	Low	B	Good
	9	Waikutakuta/Robin Hood Bay East	1690115	5421285	Low	C	Fair
	10	Pukatea/Whites Bay	1688425	5417793	Very Low	B	Very Good
	1	Te Hoiere/Pelorus Rv at Pelorus Bridge	1648077	5428091	Low	B	Good
	2	Te Hoiere/Pelorus Rv at Totara Flat	1648262	5427731	Moderate	C	Fair
	3	Ohinemahuta Rv at Onamalutu Domain	1658791	5409896	insufficiant data		
	4	Wairau Rv at Ferry Bridge	1681274	5410163	Moderate	C	Fair
	5	Wairau Rv at Blenheim Rowing Club	1684319	5406605	Moderate	C	Fair
	6	Taylor River at Riverside	1680023	5403987	High	D	Very Poor
	7	Waihopai River at Craiglochart #2	1655029	5391098	Moderate	C	Fair

Figure 7: SFR Grades for the sites currently monitored.

4.3. The National Policy Statement for Freshwater Management (NPS-FM)

In 2017 an updated National Policy Statement for Freshwater Management (NPS-FM) was released [8]. This document includes value bands for a number of parameters that are used to characterise the state of water quality in rivers and lakes. The bands range from A, which represent best water quality, to D/E, which is referred to as the 'National Bottom Line'. Water quality within the D or E band is considered unacceptable and measures need to be taken to improve it. One of the parameters for which the NPS-FM provides value bands is the concentration of E. coli. Four separate statistics are used to determine the E. coli state for waterways (Table 4).

There is a close relationship with the guidelines for the assessment of recreational water quality. Although, the NPS-FM only applies to river sites, the same statistics could be applied to assess coastal sites by modifying the limits using the guideline values for Enterococci concentrations[3]. The grey values in Table 4 were derived using this method.

Attribube State (Band)	I Percentage of samples above 540 E.coli/100mL (280 Enterococci/100mL)	II Percentage of samples above 260 E.coli/100mL (140 Enterococci/100mL)	III Median [E. coli/100mL]	IV 95th Percentile [E. coli/100mL]	**Narrative Attribute State** (Description of risk of Campylobacter infection based on E. coli/Enterococci indicator)
A (Blue)	< 5%	< 20%	≤ 130 ≤ 67	≤ 540 ≤ 280	For at least half the time, the estimated risk is <1 in 1000 (0.1% risk). The predicted average infection risk is 1%.
B (Green)	5% - 10%	20% - 30%	≤ 130 ≤ 67	≤ 1000 ≤ 520	For at least half the time, the estimated risk is <1 in 1000 (0.1% risk). The predicted average infection risk is 2%.
C (Yellow)	10% - 20%	20% - 34%	≤ 130 ≤ 67	≤ 1200 ≤ 620	For at least half the time, the estimated risk is <1 in 1000 (0.1% risk). The predicted average infection risk is 3%.
D (Orange)	20% - 30%	> 34%	> 130 > 67	> 1200 > 620	20-30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >3%.
E (Red)	> 30%	> 50%	> 260 > 135	> 1200 > 620	For more than 30% of the time the estimated risk is ≥50 in 1000 (>5% risk). The predicted average infection risk is >7%.

Table 4: E. coli bands as defined by the NPS-FM 2017 (black). Additional values used for this report to apply a similar approach to coastal results are shown in grey and are not part of the NPS-FM.

A minimum of 60 samples collected regularly over a maximum of five years are required for the calculation of the NPS-FM attribute state. Using the data from the recreational water quality programme, a period over three summer seasons will provide sufficient data for the calculation of NPS-FM states. However, for better comparison, data over a period of five years is used. This ensures that NPS-FM state and SFR Grades are assigned using the same dataset.

Table 5 shows a comparison of the SFR Grades and the NPS-FM state bands for the sites currently sampled as part of the Recreational Water Quality Programme.

Overall, the NPS grading is more lenient, placing most sites into the A band, which represents the best water quality state achievable. In contrast, the SFR-Grading assigns the best grade of 'Very Good' to one site only. Most other sites have a SFR Grade in the mid-range, represented by 'Fair' water quality.

[3] For statistics I and II, the E. coli exceedance levels were replaced with the Enterococci exceedance levels from the national recreational water quality guidelines. The limits for statistics III and IV are simple ratios of the E. coli and Enterococci guideline values for recreational water quality.

Looking at the coastal sites, the NPS-FM assessment method results in a B band for Picton Foreshore and Momorangi Bay. These two sites had indeed poorer water quality when compared to other coastal beaches. This appears to be reflected in the SFR Grade for Momorangi Bay, but not in the grade for Picton Foreshore. However, all coastal sites with a SFR Grade of 'Fair' have had at least one season during which local conditions resulted in unusually high Enterococci concentrations.

	Site	SFR Grade	2017 NPS-FM*				
			Overall	I	II	III	IV
River Sites	Pelorus Rv at Pelorus Bridge	Good	A	A	A-C	A	A
	Pelorus Rv at Totara Flat	Fair	A	A	A-C	A	A
	Wairau Rv at Ferry Bridge	Fair	A	A	A-C	A	A
	Wairau Rv at Blenheim Rowing Club	Fair	A	A	A-C	A	A
	Waihopai Rv at Craighlochart #2	Fair	A	A	A-C	A	A
	Taylor Rv at Riverside	Very Poor	E	D	E	E	D
Coastal Beaches	Pukatea/Whites Bay	Very Good	A	A	A-C	A	A
	Waikawa Bay	Good	A	A	A-C	A	A
	Governors Bay	Good	A	A	A-C	A	A
	Anakiwa	Good	A	A	A-C	A	A
	Mistletoe Bay	Fair	A	A	A-C	A	A
	Waikutakuta/Robin Hood Bay East	Fair	A	A	A-C	A	A
	Ngakuta Bay	Fair	A	A	A-C	A	A
	Picton Foreshore	Fair	B	B	A-C	A	B
	Momorangi Bay	Poor	B	B	A-C	A	B

* Note that the NPS-FM limits strictly apply to river sites only, however, the same statistics can be used to determine a state for coastal sites by adjusting the limits using national guideline values

Table 5: Comparison of SFR Grade and NPS-FM states for the sites monitored as part of the Recreational Water Quality Programme.

There is strong agreement between the methods in regard to water quality in the Taylor River. Both assign the lowest possible state to this site.

Overall, the SFR-Grading system provides a better reflection of recreational water quality when compared to the assessment method in the NPS-FM.

5. Next Season

There will be no changes to the routine monitoring programme for the next summer season. Sampling sites for the Recreational Water Quality Programme are reviewed every five years. An earlier review is unadvisable, because the SRF grading requires data over a minimum period of five summers. The Programme was last reviewed following a site usage survey in early 2017. The next Programme review is planned for 2022.

Nationally, a move to develop models that predict feacal indicator bacteria is gaining momentum. Until cost-effective continious monitoring techniques for feacal bacteria are developed, modelling could provide much needed real-time information for recreational users. In Marlborough, high indicator bacteria concentrations are predominantly a result of rainfall events. This means relatively simple models can be developed to predict if water quality is safe for swimming.

Water quality is sites specific, therefore different models need to be developed for each site. The main aim of the models will be the prediction of guidelines exceedances. This means sample results with high bacteria concentrations are of most interest for model development. However, the results presented in Section 4.1 show that most samples have very low bacteria levels. This means, for most sites we do not have sufficient data to develop models. Targeted sampling during rainfall can provide the data required. This is planned for a selected number of sites next summer season. Using the additional data, initial models can then be developed. However, the models will need to be tested and refined using monitoring data from a subsequent season. Only when the models allow prediction of unsafe faecal contamination with sufficient certainty, will the outputs be made available to recreational users.

6. References

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7. Appendices

7.1. Appendix 1: Results for the 2018/2019 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	Momorangi Bay	Ngakuta Bay	Governors Bay	Picton Foreshore	Waikawa Bay	Whites Bay	Robin Hood Bay East	Okiwi Bay
Coastal	1	05/06 Nov 2018	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
	2	13/14/16 Nov 2018	<10	<10	10	10	<10	<10	<10	<10	<10	<10
	3	19/20/21 Nov 2018	20	<10	<10	20	10	41	<10	<10	<10	10
	4	26/27 Nov 2018	74	160	109	96	20	4,110	272	744	830	<10
	Follow-up	28 Nov 2018								121	171	
	Follow-up	29 Nov 2018						10				
	Follow-up	30 Nov 2018						31		121	171	
	5	03/04 Dec 2018	52	10	<10	31	<10	336	<10	<10	<10	53
	Follow-up	05 Dec 2018						10				
	Follow-up	06 Dec 2018						31				
	Follow-up	07 Dec 2018										
	6	10/11 Dec 2018	<10	<10	<10	<10	<10	10	<10	<10	<10	<10
	7	17/18 Dec 2018	41	<10	10	<10	<10	<10	<10	<10	<10	<10
	8	27 Dec 2018	<10	20	10	175	10	10	41	<10	<10	34
	9	03 Jan 2019	<10	<10	20	<10	<10	20	<10	<10	<10	>201
	10	07/08 Jan 2019	161	<10	52	282	10	<10	10	10	<10	<10
	Follow-up	11 Jan 2019				<10		10				
	11	14/15/16 Jan 2019	10	<10	20	<10	<10	31	<10	30	<10	<10
	12	21/22 Jan 2019	10	397	<10	10	<10	<10	10	<10	<10	<10
	Follow-up	25 Jan 2019		<10				31				
	13	28/29 Jan 2019	<10	<10	10	<10	86	<10	10	<10	<10	<10
	14	04/05 Feb 2019	<10	<10	<10	10	20	<10	10	<10	<10	10
	15	11/12 Feb 2019	<10	173	31	<10	10	158	10	<10	<10	<10
	16	18/19/20 Feb 2019	10	145	10	<10	74	20	<10	<10	<10	<10
	17	25/26/27 Feb 2019	<10	<10	<10	10	231	52	10	108	<10	<10
	18	04/05 Mar 2019	<10	41	<10	20	20	10	<10	10	<10	<10
	19	11/12 Mar 2019	<10	<10	10	10	74	31	<10	<10	<10	10
	20	18/19 Mar 2019	20	<10	10	<10	<10	31	<10	<10	<10	10
	21	26/27/29 Mar 2019	10	<10	<10	<10	<10	464	272	20	173	<10

Site Type	Week	Sample Date	Pelorus Rv at Pelorus Bridge	Pelorus Rv at Totara Flat	Waihopai Rv at Craiglochart #2	Ohinemahuta Rv at Onamalutu Domain	Wairau Rv at Ferry Bridge	Wairau Rv at Blenheim Rowing Club	Taylor Rv at Riverside
River	1	05/06 Nov 2018	<10	<10	10	20	20	10	209
	2	13/14 Nov 2018	<10	31	318	10	20	31	74
	3	19/21 Nov 2018	20	31	20	<10	85	20	135
	4	26/27 Nov 2018	63	295	171	197	3,260	3,450	1,274
	Follow-up	28 Nov 2018					958	379	10,460
	Follow-up	30 Nov 2018					134	160	327
	5	03/04 Dec 2018	132	520	860	63	52	30	213
	Follow-up	05 Dec 2018			1,246				
	Follow-up	06 Dec 2018			359				
	Follow-up	07 Dec 2018			98				
	6	10/11 Dec 2018	10	84	110	63	74	31	228
	7	17 Dec 2018	<10	31	108	41	10	31	146
	8	27 Dec 2018	<10	<10	86	31	108	119	988 / 420
	9	03 Jan 2019	10	10	109	74	41	84	373
	10	07/08 Jan 2019	<10	<10	41	20	74	52	292
	11	14/15 Jan 2019	41	41	84	107	211	10	480
	12	21/22 Jan 2019	<10	20	63	<10	72	20	399
	13	28/29 Jan 2019	<10	30	145	110	41	<10	426
	14	04/05 Feb 2019	<10	10	74	10	31	10	189
	15	11 Feb 2019	10	74	74		10	74	246
	16	18/20 Feb 2019	<10	<10	187		10	51	249
	17	26/27 Feb 2019	<10	<10	183		86	<10	288
	18	04/05 Mar 2019	10	20	226		63	30	355
	19	11/12 Mar 2019	<10	52	203		122	41	226 / 9210
	20	18/19 Mar 2019	31	52	122		122	74	135
	21	27/29 Mar 2019	146	146	187		213	131	318

7.2. Appendix 2: Management procedure for exceedances of bathing water guidelines