NORTHLAND FRESHWATER BATHING SITES

WATER QUALITY MONITORING SUMMER 2004-05

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EXECUTIVE SUMMARY

- Twenty popular swimming sites at eighteen of Northland's rivers, lakes and streams were sampled over a twelve week period, from the start of December 2004 through to the end of February 2005.

- Pollution indicator bacteria (*Escherichia coli*) counts were carried out on the samples, and the results were compared with the Ministry for the Environment and Ministry of Health's **Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas**.

- Results are forwarded on to the relevant district councils, as well as Northland Health, as they become available, for action when levels of *E. coli* are elevated above the MfE guidelines.

- The water quality of the three lakes sampled, Ngatu on the Aupouri Peninsula, Waro in Hikurangi and Taharoa in the Kai iwi lakes group, were generally excellent over the entire 2004-05 survey.

- Results for the rivers and streams were variable. The Omamari Beach Stream and the Kaihu River met the guidelines for most of the sampling period, however samples taken from the Langs Beach, Otiria and Wairoa Stream sites consistently contained *E. coli* well in excess of the recommended levels.

- Interim grades, based on the MfE guidelines, have been produced for sites with data stretching back over at least five summers. Grades for other sites have been postponed until a long enough record is collated. The process has tended to be conservative and have overstated the health risks at some sites.

- For the summer of 2005-06, it is recommended that monitoring of all the sites be continued and that sampling is extended from 10 to 12 weeks.

- Faecal sterol or whitening agent sampling is carried out at ongoing problematic sites to assist with identifying the source of contamination.

- An integrated education campaign should be developed, targeting schools in order to make people more aware of the health and environmental issues concerning freshwater bathing.

- That a protocol between all the relevant authorities regarding warning signs be drafted and implemented before the beginning of next summers' survey.

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1 INTRODUCTION

The Northland Regional Council, in conjunction with Northland Health and Northland's district councils, conducts a survey of the water quality at a number of the region's most popular freshwater bathing sites. Freshwater sites are not always safe for recreational activities, as waterways can sometimes become contaminated with human or animal effluent, effluent that contains large numbers of organisms capable of causing illness. These organisms, called pathogens, include such "bugs" as giardia (*Giardia lamblia),* and campylobacter *(Campylobacter jejuni)*.

The most common sources of pathogenic contamination are human sewage, stormwater and rural run-off (Jarman, 2002a). Human sewage is perhaps of most concern, particularly because it should be the easiest to remedy, by fixing broken or leaking pipes, maintaining septic tanks and minimising sewage system overflows. The effects stormwater and rural run-off are not as easy to mitigate. No matter what the source is though, the potential for causing illness is the same (Jarman, 2002a).

The purpose of the annual survey is to determine the relative environmental health of each site. The Northland Regional Council can then use this data to identify problem areas and, with the co-operation of Northland Health and the relevant district councils, work towards providing solutions.

1.1 ILLNESS

Swimming in contaminated water can lead to skin, eye or ear infections, or gastrointestinal or respiratory illnesses (Jarman, 2002a). Ingestion is the most common pathway for pathogens, but inhalation has been identified as a major route as well, particularly for activities such as water-skiing (MfE 2002).

The effects of recreational-bathing related illnesses can be quite unpleasant. Campylobacteriosis, for example, can cause fever, severe abdominal pain, nausea and diarrhoea, with symptoms lasting up to ten days (Jarman, 2002b). Depending on the type of disease and the severity of the infection, hospitalisation may be necessary. In 2001, 26 % of patients infected with shigellosis required some time in hospital (Jarman, 2002b)[1].

[1] Both Campylobacteriosis and Shigellosis, along with a host of other bathing-related illnesses, are common in Northland (Jarman, 2002b).

1.2 ACCEPTABLE RISKS

The amount of pathogens a person needs to ingest before becoming sick varies from many thousands to a single pathogen, and depends on a number of factors. When you consider how small bacteria and viruses are, and how big lakes and rivers can get, it makes it impossible to ever guarantee that any waterway is safe to swim in. This uncertainty is the reason that health authorities always recommend you boil untreated water before consuming it.

Instead, when determining how safe a body of water is for recreation, it is better to consider things in terms of maximum acceptable risk. If only one person in a million became ill after swimming somewhere, it is unlikely that anyone would be overly worried. On the other hand, if every swimmer got sick, the risks become unacceptable. The maximum acceptable risk falls somewhere in between; some people may get sick, but not so many as to become a strain on health resources or present a threat to peoples' lives.

For freshwater recreation in New Zealand, the Ministry for the Environment and the Ministry of Health has set the maximum acceptable risk at 8 in every 1000 users falling ill as a result of freshwater recreation (MfE, 2002; MfE 2003). This number is based on a combination of local and international studies.

2 WHEN TO AVOID CONTACT RECREATION

In order to minimise the risk when using our waterways for contact recreation, a number of simple steps should be followed:

CLARITY

It may seem to be stating the obvious, but stagnant and murky water tends to contain many more pathogens than crystal clear and flowing water. There is a loose correlation between suspended solids (which reduce clarity) and agricultural run-off (high in potential pathogens), and a good way to reduce your risk is to only swim[2] in water in which you can see your feet when you are knee deep.

DISCOLOURATION, FOAMS AND ODOUR

Water can be unsafe for swimming in if it has an unpleasant or unusual smell, or if there is foam or slicks on the water's surface. Even if the water is relatively clear, foams and odour are often signs of upstream sewage discharges.

RAINFALL

Rainfall has a big impact on waterways. When it rains, run-off from farmland and urban areas can be washed into rivers, streams and lakes, carrying potentially substantial loads of pathogens into the water. After heavy rainfall, it is recommended to wait several days, to allow for any run-off to pass through, even if water passes the other tests.

[2] It is unwieldy to continually use the term "freshwater recreational contact use", so for the sake of brevity and clarity, swimming will be assumed to be synonymous, and any recommendations equally applicable to any other use, from jet skiing to diving.

3 RECREATIONAL CONTACT GUIDELINES

The Ministry for the Environment and Ministry of Health released national Microbiological Water Quality Guidelines in June 2003. The Northland Regional Council's monitoring programme has incorporated the recommendations presented in the guidelines where possible, and the NRC can therefore determine the quality of Northland's freshwater bathing sites using national standards. This section provides an outline and discussion of the key aspects of the Ministry's guidelines, available online at:

www.mfe.govt.nz/publications/water/microbiological-quality-jun03/

3.1 THE MICROBIOLOGICAL ASSESSMENT CATEGORY (MAC)

The Ministry for the Environment has grouped the possible range of microbiological results into four categories, ranging from A to D as presented in Table 1. These categories are determined using the 95th percentiles[3] of datasets with at least 100 data points stretching over 5 years. Where there is not enough data, all grading using the MfE guidelines should only be considered provisional.

Table 1: Microbiological Assessment Category (MAC) definitions (MfE 2003)

A	Sample 95th percentile ≤ 130 Escherichia coli per 100 mL
B	Sample 95th percentile 131-260 Escherichia coli per 100 mL
C	Sample 95th percentile 261-550 Escherichia coli per 100 mL
D	Sample 95th percentile > 550 Escherichia coli per 100 mL

3.2 THE SANITARY INSPECTION CATEGORY (SIC)

The **sanitary inspection category** is used to classify the likely dominant source of faecal contamination of a given water body. In order to determine the SIC for a river, stream or lake, the potential and probable suppliers of faecal bacteria are listed. In most cases, one source will dominate, such as run-off in agricultural catchments or stormwater in urban catchments. The Ministry for the Environment has grouped the most commonly occurring sources into five categories as shown in Table 2. Once the major source of faecal contamination into a body of water has been identified, a **sanitary inspection category** can be chosen.

[3] Calculated using the hazen method.

Table 2: Sanitary Inspection Category (SIC) Definitions (MfE 2003)

SANITARY INSPECTION CATEGORY	EXAMPLES OF SOURCE
VERY LOW	No significant source, indirect run-off from forests.
LOW	Indirect run-off horticulture or low-intensity agriculture, direct run-off from forests.
MODERATE	Stormwater (free of sewage), direct run-off from horticulture or low-intensity agriculture, indirect run-off from high-intensity agriculture, marina, or boat moorings, unrestricted access of stock to tributaries.
HIGH	Indirect discharge of untreated sewage or on-site waste treatment systems, urban stormwater, unrestricted access of stock to waterway, direct run-off from intensive agriculture, dense bird populations.
VERY HIGH	Direct discharge of untreated sewage or on-site waste treatment systems (including leaking septic tanks).

3.3 THE SUITABILITY FOR RECREATION GRADE (SFRG)

The **suitability for recreation grade** is determined by combining the MAC and SIC of a recreational bathing site. There are five grades, ranging from very good to very poor. As mentioned previously, if there is insufficient data to fulfil the basic assumptions of the MAC determination (100 data points over 5 years of sampling), then these grades should be considered interim grades rather than absolute ones. Table 3 show how the MAC and SIC categories combine, and an explanation of the various grade follows.

Table 3: Suitability for Recreation Grade Guidelines (MfE 2003)

SUSCEPTIBILITY TO FAECAL INFLUENCE		MICROBIOLOGICAL ASSESSMENT CATEGORY			
		A	B	C	D
SANITARY INSPECTION CATEGORY	VERY LOW	Very Good	Very Good	Follow Up♠	Follow Up♠
	LOW	Very Good	Good	Fair	Follow Up♠
	MODERATE	Follow Up♣	Good	Fair	Poor
	HIGH	Follow Up♣	Follow Up♣	Poor	Very Poor
	VERY HIGH	Follow Up♣	Follow Up♣	Follow Up♣	Very Poor

♣ Unexpected results, which require further investigation (either SIC or MAC needs to be reassessed).

♠ Implies non-sewage source of faecal contamination, and this needs to be verified.

SFRG = VERY GOOD
Without any significant sources of faecal contamination, a site with a "Very Good" SFRG may be considered suitable for contact recreation at all times. A site with a "Very Good" SFRG may not require regular sampling in the future.

SFRG = GOOD
While water quality is generally good at a "Good" site, potential sources of faecal contamination such as indirect agricultural run-off or non-sewage stormwater can make the site unsuitable for contact recreation during and after periods of significant rainfall. Regular monitoring of such sites is necessary as there is the possibility that the water quality could deteriorate with future development of the upstream catchment.

SFRG = FAIR
At sites with a "Fair" grade, water is usually suitable for contact recreation, but sources of contamination such as direct discharges from low-intensity agriculture and stormwater drains or indirect discharges from intensive agriculture mean that these sites should not be used during or immediately after rain events. The MfE recommends that such sites should be monitored weekly over loading periods (such as the summer school holidays).

SFRG = POOR
The water at sites with a "Poor" grade tends to breach alert guidelines (> 260 *E. coli* per 100 mL) more often than not. Because of direct discharges from intensive agriculture and tertiary treated sewage, or indirect discharges from leaking septic tanks and other untreated wastes, the site is generally unsuitable for swimming or other recreational activities, and that infants, the elderly, or the sick in particular should avoid using such sites for recreational contact. This recommendation applies even during dry periods, and territorial authorities may choose to erect permanent warning signs, especially if weekly sampling is discontinued at such sites.

SFRG = VERY POOR
Sites that receive a grade of "Very Poor" should not be used for recreational activities. Direct discharges of faecal material from sources such as leaking septic tanks or untreated wastewater mean that local authorities should erect permanent warning signs at such sites, advising that the water is categorically unsuitable for use.

3.4 SINGLE SAMPLE GUIDELINES

In addition to providing guidelines on how to handle information at the conclusion of freshwater contact surveys, the Ministry for the Environment has also set a recommended course of action for the treatment of data during surveys. Under the current guidelines, each sample will fall into one of three categories: Acceptable (green), Alert (yellow), or Action (red), as shown in Table 4.

Table 4: Single sample guidelines for contact recreational surveys (MfE 2003)

E. coli COUNT	CATEGORY	SUGGESTED RESPONSE
Sample < 260 per 100 mL	Acceptable	▪ No response necessary – Continue weekly sampling
260 < Sample > 550 per 100 mL	Alert	▪ Increase sampling to daily ▪ Undertake sanitary survey to isolate source of faecal contamination
Sample > 550 per 100 mL	Action	▪ Increase sampling to daily ▪ Undertake sanitary survey ▪ Erect warning signs ▪ Inform public through the media that a public health risk exists

In practise, the Northland Regional Council undertakes the regular weekly sampling, and passes the results onto Northland Health, who in turn alert the relevant District Council (Far North, Whangarei or Kaipara), if results from a site are above the 260 *E. coli* per 100 mL threshold and further sampling is required. Sanitary surveys may be undertaken as solo or co-operative efforts between the relevant local bodies.

4 METHODS

4.1 TECHNIQUE

It is an expensive and difficult procedure to identify and count pathogens in water. Instead, the Council uses an indicator bacteria called *Escherichia coli*, which is much easier to measure. *E. coli* are the faecal pollution indicator recommended in the MfE guidelines, as scientific studies have shown that when we find *E. coli* in a river, we can safely assume that there will be pathogens in the water as well (MfE, 2002).

4.2 SITES

The Northland Regional Council does not have the resources to monitor every swimming hole in Northland, nor would it be practical to do so. The Council reviews the number of sites used in the annual surveys at the beginning of each summer, chooses sites based on popularity, and/or because of a specific request from the public.

The locations of sites monitored in the 2004-05 freshwater recreational contact survey are shown overleaf as Figure 1 and in Table 5. Four new sites were added to the programme in the 2004-05 season: Otaua Stream in Kaikohe, Lake Waro in Hikurangi, Langs Beach Stream and Ocean Beach Stream.

4.3 PROTOCOLS

The Northland Regional Council collected 10 samples per site over the course of the summer of 2004-05, with the exception of a few sites, which had the odd sampling occasion missed due to staff availability. Sampling was conducted approximately once per week, except no samples could be collected over the Christmas/New Years period.

For each visit, three replicate samples were taken on site, which were later mixed into one composite sample. This composite sample was analysed for *E. coli* and total coliforms using Colilert™. Temperature was noted at each site using handheld YSI meters and turbidity was measured in the Laboratory.

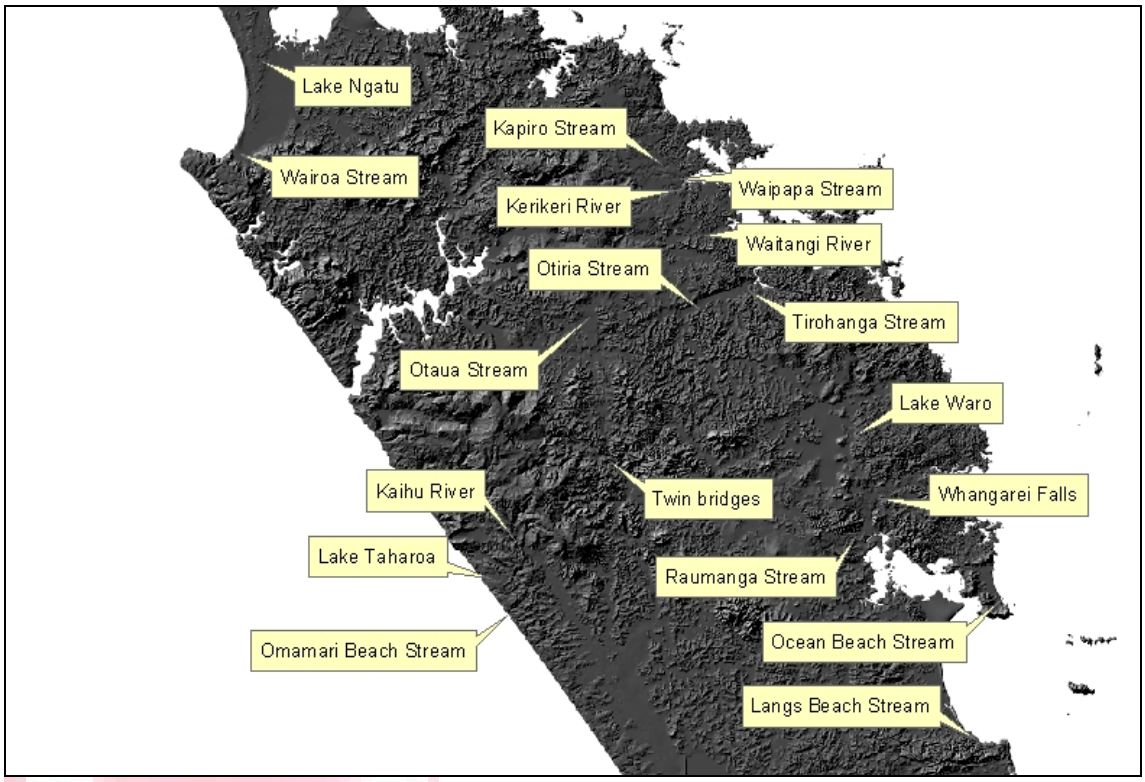


Figure 1: Sites sampled during the 2004-05 Freshwater Recreational Contact Survey

Table 5: Details of the sites used in the 2004-05 Survey

WATER BODY	LOCATION	DISTRICT
Lake Ngatu	DoC Reserve	Far North
	South End	
Wairoa Stream	Ahipara Bridge	
Kapiro Stream	Parerua Swimming Hole	
Waipapa River	Waipapa Landing	
Kerikeri River	Kerikeri Basin	
Waitangi River	Lily Pond Reserve	
Tirohanga Stream	Tirohanga Road	
Otaua Stream	Kaikohe	
Otiria Stream	Otiria Falls	
Ocean Beach Stream	Ocean beach	
Mangakahia River	Twin Bridges Reserve	Whangarei
Waitaua Stream	Whangarei Falls	
Lake Waro	Hikurangi	
Raumanga Stream	Raumanga Valley Reserve	
Langs Beach stream	Langs Beach	
Kaihu River	Motor Camp	
Lake Taharoa	Promenade Point	Kaipara
	Camp Ground	
Omamari Beach Stream	Omamari	

5 RESULTS & INTERPRETATIONS

5.1 LAKE NGATU

SIC: LOW **MAC: C** **SFRG: FAIR**

Lake Ngatu lies within the Aupouri Peninsula, north of Kaitaia. With no permanent streams flowing into or out of Lake Ngatu, rainfall is the predominant input. Seepage and evaporation are the major outputs. There are very few potential sources of *E. coli* to the lake, although with heavy use over summer, the occasional contamination event has occurred.

Table 6: Collated results for the two Lake Ngatu sites

	2004-05 SURVEY	ALL SURVEYS
Median	< 10 *E. coli* per 100 mL	10 *E. coli* per 100 mL
95th Percentile	421 *E. coli* per 100 mL	393 *E. coli* per 100 mL
Alert Compliance	94 %	93 %
Action Compliance	94 %	98 %

As is obvious from Table 6 (above), and Figure 2 (below), the bacteriological water quality of Lake Ngatu was excellent for the bulk of the sampling period. There was only one spike in *E. coli* on 10 February, where it exceeded the action level at the South end of the lake. Overall the lake was generally suitable for contact recreational use.

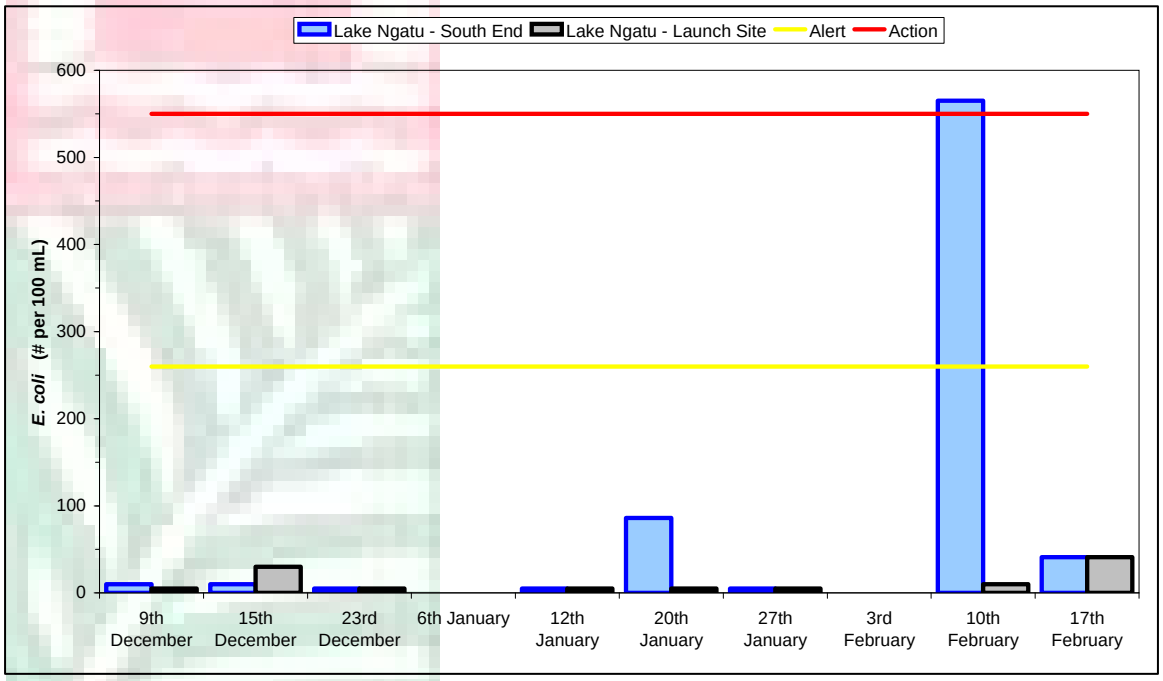


Figure 2: Results from the 2004-05 freshwater recreational contact sampling for the two Lake Ngatu sites

After a comparison between *E. coli* results and rainfall data (Figure 3), it is possible that surface run-off (as a result of the rainfall in the week prior to sampling) is the source of the elevated *E. coli* levels detected in February at the South end of the lake. However this is unlikely as *E. coli* levels were not elevated at the other sampling site on the lake and rain did not have an impact on bacterial levels at other times within the 2004-05 bathing season.

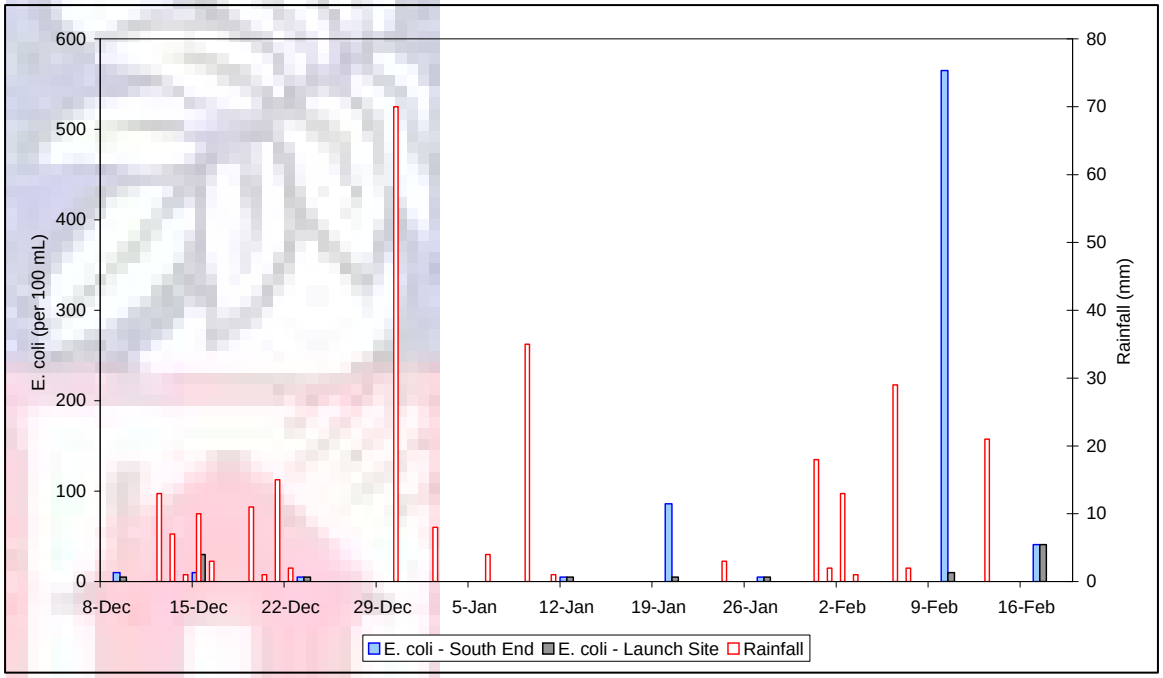


Figure 3: Rainfall and *E. coli* levels at the two Lake Ngatu sites over the 2004-05 summer

The Northland Regional Council has collected 85 samples from Lake Ngatu over the last six years, so the SFRG grade is only an interim one. The alert compliance is fluctuating around 93 to 95% with the SFRG grade remaining as "Fair". There have only been two results since sampling began in Lake Ngatu that have exceeded the action threshold, and overall the lake is generally safe for contact recreation. Therefore it is expected that the SFRG grade will rise from "Fair" to "Good" as the data set increases.

5.2 WAIROA STREAM

SIC: HIGH MAC: D SFRG: VERY POOR

Wairoa Stream is located just east of the Ahipara Township at the southern end of Ninety-Mile Beach. Intensive agriculture in the catchment means that the Wairoa Stream's water quality is historically poor, nonetheless, many people continue to swim at the site.

Table 7: Collated results for the Wairoa Stream

	2004-05 SURVEY	ALL SURVEYS
Median	729 *E. coli* per 100 mL	686 *E. coli* per 100 mL
95th Percentile	Insufficient data	1658 *E. coli* per 100 mL
Alert Compliance	13 %	21 %
Action Compliance	13 %	42 %

The results presented as Figure 4 show that the Wairoa Stream's water quality over the summer was generally poor, exceeding the action level of 550 *E. coli* per 100 mL on 7 of the 8 sampling occasions. As summarised in Table 7, the median, alert and action compliance during 2004-05 were worse than previous years. 95th percentiles using the hazen method require at least 10 data points, and therefore could not be calculated for the Wairoa Stream for the 2004-05 season.

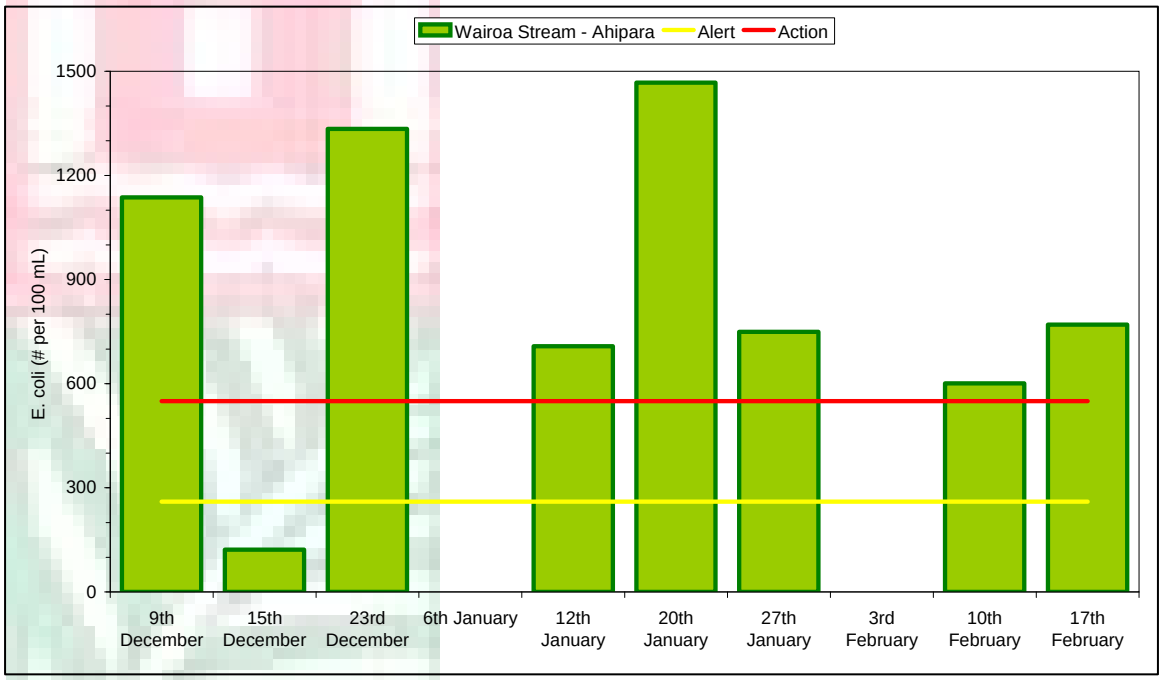


Figure 4: Results from the 2004-05 freshwater recreational contact sampling of Wairoa Stream, Ahipara

Figure 5 shows a comparison between rainfall and *E. coli* over the 2004-05 summer. It is likely that some of the high *E. coli* populations in the Wairoa Stream are associated with rainfall events prior to sampling. However this is not always the case such as on the 20th and 27th of January when there was high *E. coli* levels without any significant rainfall in the week prior to sampling. Therefore there is a source or sources of contamination within the catchment that is causing elevated bacterial levels, which is not related to run off during rainfall events.

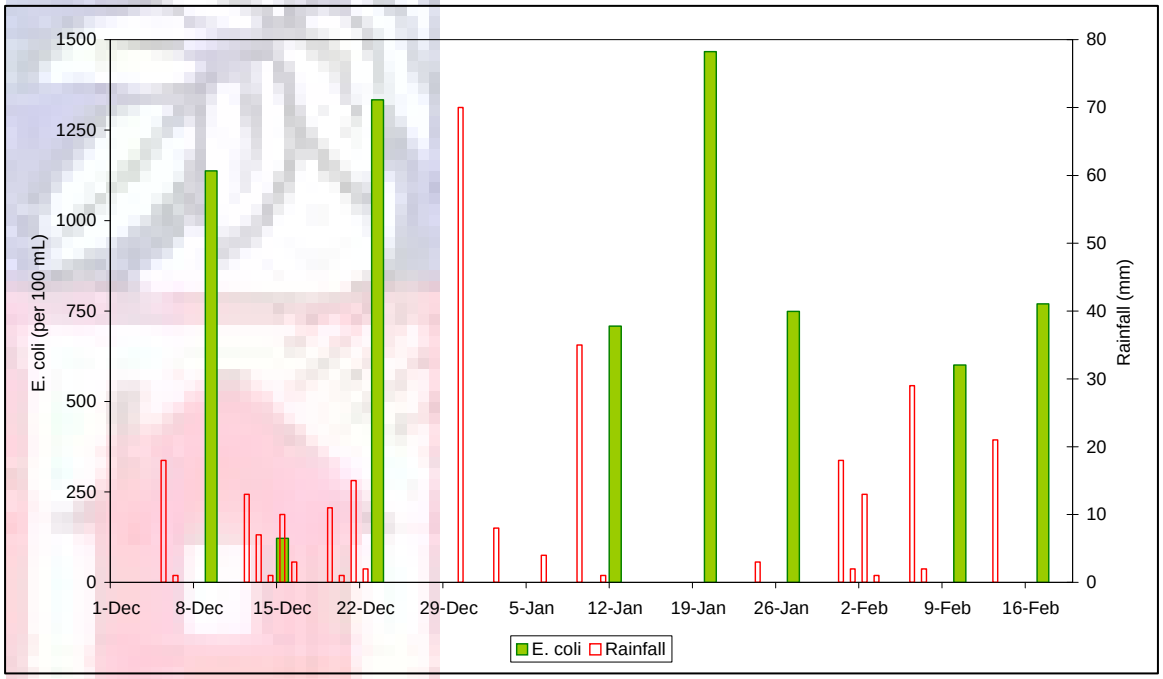


Figure 5: Rainfall and *E. coli* levels in Wairoa Stream over the 2004-05 summer

The Wairoa Stream has had 38 samples collected from it since the summer of 2000-01, so there is now enough data to calculate an interim SFRG. The SFRG is "Very Poor" with a consistently low alert compliance of 21 to 23%.

There are several potential sources of faecal contamination some of which are associated with rainfall events and others, which can occur at anytime. There are a few dairy farms within the catchment but recent results suggest that they have effective treatment systems and have minimal impact on the stream. There is potential for contamination from ineffective onsite treatment systems (septic tanks) in the rural areas upstream of the sampling site. Other potential sources include access to the stream by stock and feral animals including birdlife within the catchment and high *E. coli* results have also been associated with two large natural wetland areas within the catchment (Prangley, pers. comm.).

5.3 TIROHANGA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Tirohanga Stream is located east of the Kawakawa Township, and drains into the Bay of Islands. The sampling site is located 50 m downstream of the Far North District Council's water take for Kawakawa. Recreational users are a common sight at the sample area.

Table 8: Collated results for the Tirohanga Stream

	2004-05 SURVEY	ALL SURVEYS
Median	214 *E. coli* per 100 mL	259 *E. coli* per 100 mL
95th Percentile	309 *E. coli* per 100 mL	1484 *E. coli* per 100 mL
Alert Compliance	80 %	52 %
Action Compliance	100 %	86 %

In general, the bacteriological quality of the water in Tirohanga Stream was good in the 2004-05 summer, with exceptions on 13 January and 3 February where *E. coli* levels were generally unacceptable for recreational use (in terms of health risks). Compared to the complete set of data for the Tirohanga Stream, the median, 95th percentile and compliance levels were better in the 2004-05 summer than previous years.

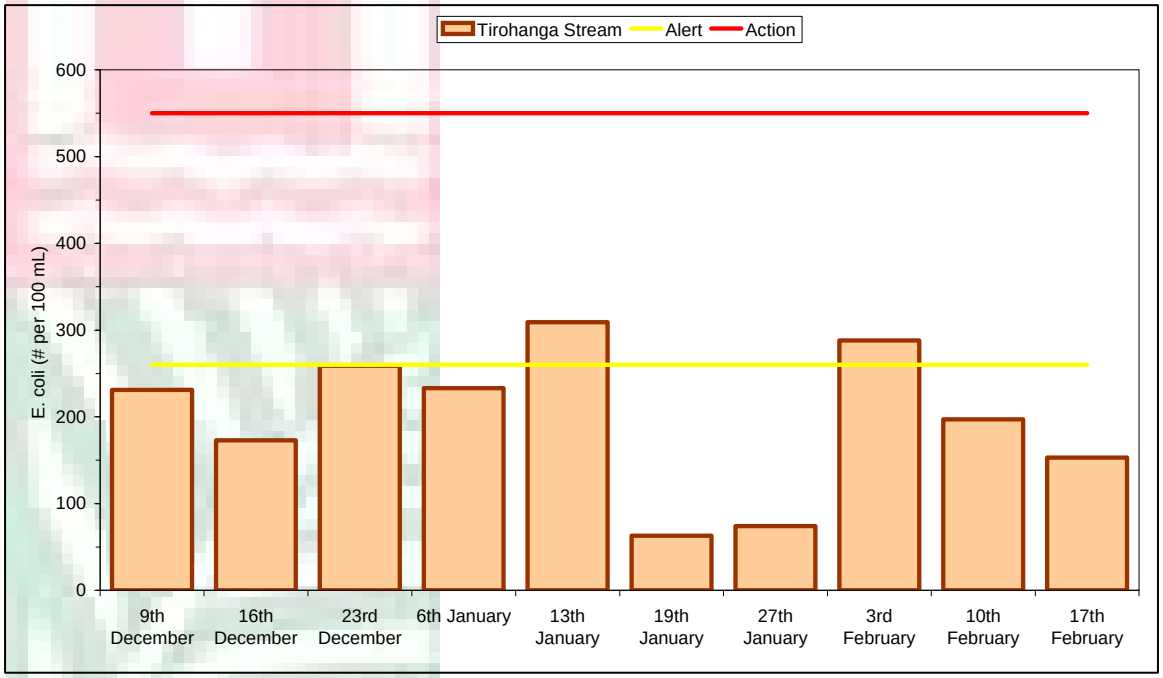


Figure 6: Results from the 2004-05 freshwater recreational contact sampling for Tirohanga Stream

Moderate to low intensity beef farming is the predominant land-use in the upstream catchment, but it is unlikely that runoff from those farms is the sole source of faecal contamination into the Tirohanga. As shown in Figure 7, there is the possibility of a relationship between rainfall and elevated E. coli levels as levels were much lower during the dry period in January.

Septic tanks, stock access to the stream and feral animals from the areas of remnant bush within the catchment may also be influencing factors. Poorly maintained septic tanks could provide small amounts of contamination during dry periods, and a greater part in wetter conditions when soils are wet and seepage volumes are higher.

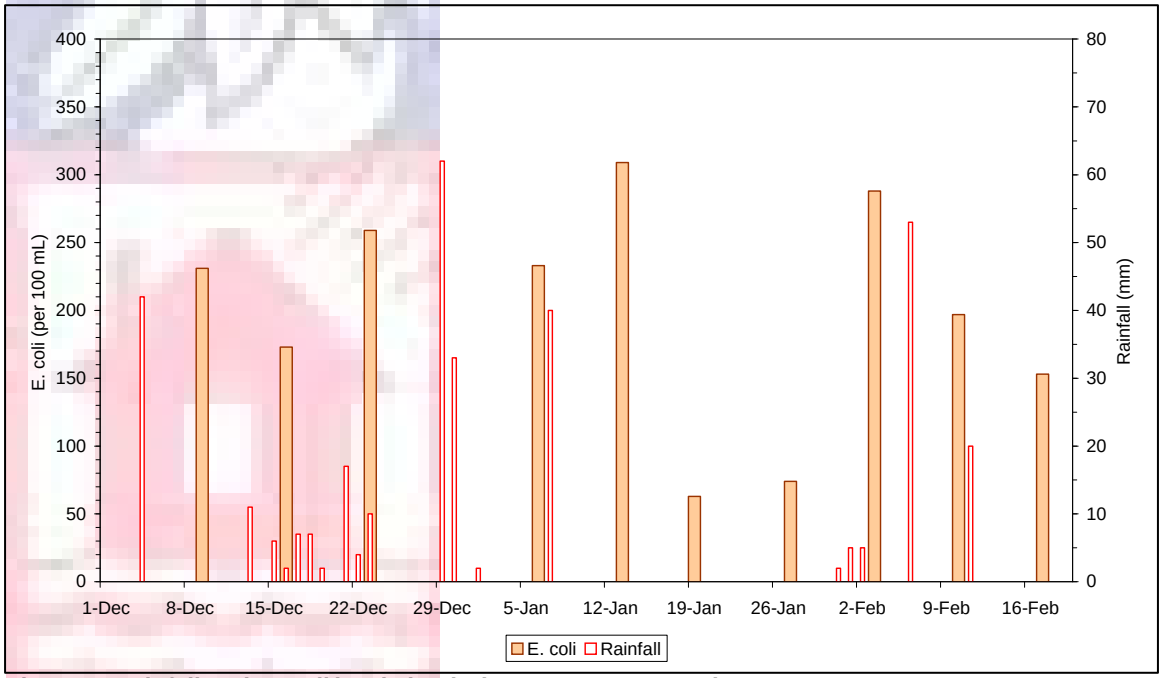


Figure 7: Rainfall and *E. coli* levels in Tirohanga Stream over the 2004-05 summer.

The Tirohanga Stream, stream appeared to be suitable for swimming for the bulk of the sampling period, but the SFRG interim grading for the site is still "Poor". However this is only an interim grading calculated from 42 sampling events over the last 5 years and it is likely that the grading will improve to "Fair" as the size of the data set increases.

5.4 WAITANGI RIVER

SIC: HIGH MAC: D SFRG: VERY POOR

The Waitangi River flows from the middle of Northland (just to the east of Lake Omapere) through into the Bay of Islands, just north of Paihia. The sampling site is located in the middle reaches of the river catchment and at a popular swimming hole, situated immediately below a waterfall. Upstream agricultural land use and increasing lifestyle block developments significantly impact upon this stony bottomed and fast flowing river.

Table 9: Collated results for the Waitangi River

	2004-05 SURVEY	ALL SURVEYS
Median	193 *E. coli* per 100 mL	172 *E. coli* per 100 mL
95th Percentile	327 *E. coli* per 100 mL	2419 *E. coli* per 100 mL
Alert Compliance	70 %	66 %
Action Compliance	100 %	82 %

The bacterial water quality of the Waitangi River was generally better this season than in past ones with a lower 95% percentile and higher compliance rates (Table 9). The *E. coli* results over the 2004-05 summer in the Waitangi River exceeded the alert level slightly on only 3 occasions (Figure 8).

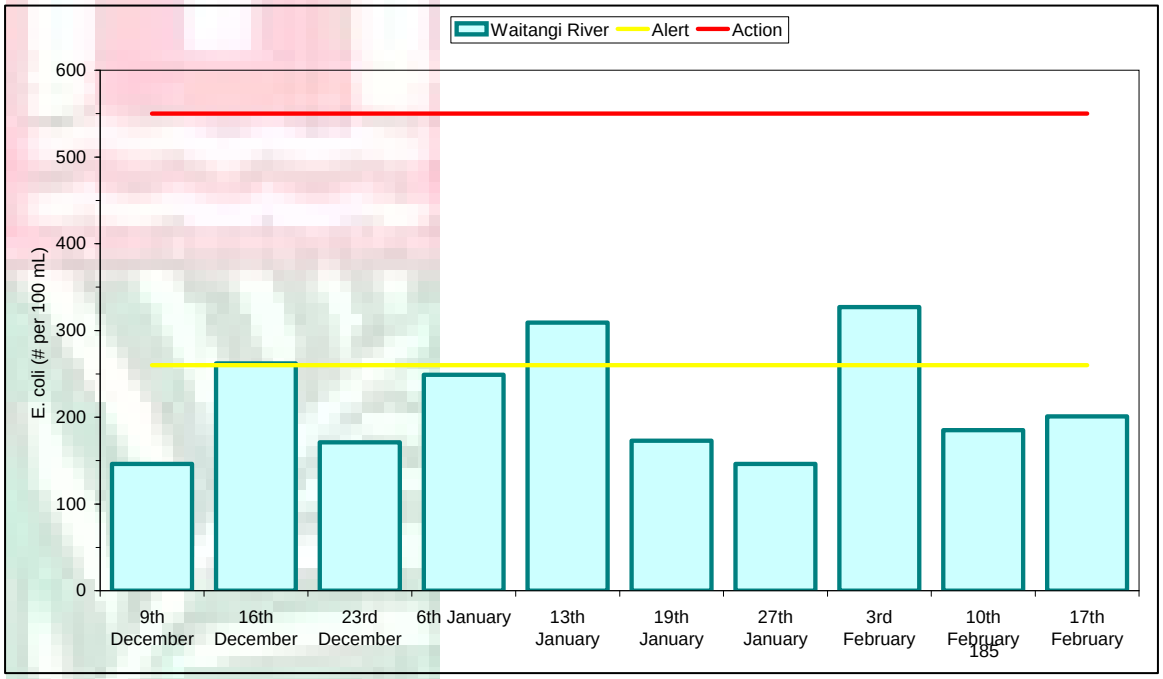


Figure 8: Results from the 2004-05 freshwater recreational contact sampling for Waitangi River

Sustained rainfall appears to be causing elevated *E. coli* levels, as breaches of the 260 *E. coli* per 100 mL alert threshold occurred after consecutive days of rain (Figure 9). However rainfall cannot be the only factor influencing *E. coli* levels in the river, as *E. coli* levels appear to be slightly elevated even during dry periods (such as that observed during mid-January).

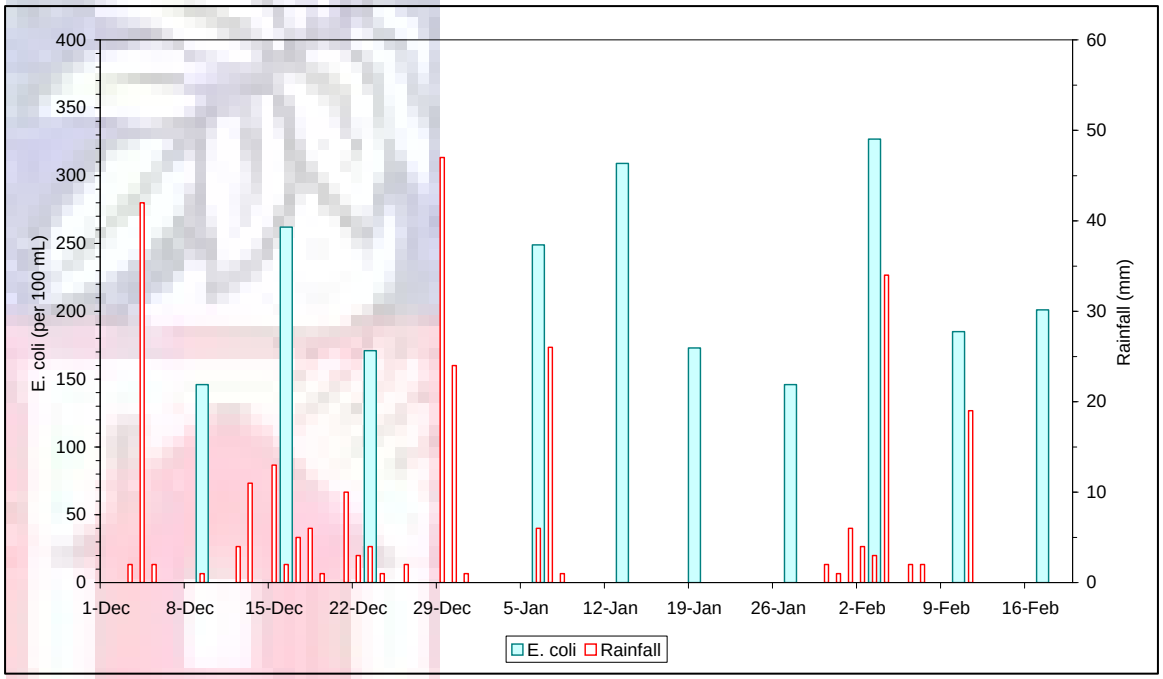


Figure 9: Rainfall and *E. coli* levels for Waitangi River over the 2004-05 summer

The Council used 44 samples, collected over five summers, to develop the interim SFRG for the Waitangi River. A grading of "Very Poor" is unfair, given a relatively low historic median (172 *E. coli* per 100 mL) and a historic alert compliance at about 66 %. There were no breaches of the 550 "action" threshold over the 2004-05 summer and the three exceedances of the alert threshold were slight. With this in mind, a grading of "Poor" is probably more accurate, taking into account the Sanitary Inspection Category of "High".

5.5 KERIKERI RIVER

SIC: HIGH MAC: D SFRG: VERY POOR

The Kerikeri Basin lies at the base of the Kerikeri River, a river that drains from an intensive horticultural and agricultural catchment through a predominantly urban area. Some parts of the Kerikeri township remain on septic tanks, and these along with agricultural run-off and feral animals in bush remnants are the main potential sources of pathogenic bacteria into the basin. Stormwater discharges and sewage reticulation system failures may also have a significant influence.

Table 10: Collated Results for the Kerikeri River

	2004-05 SURVEY	ALL SURVEYS
Median	168 *E. coli* per 100 mL	275 *E. coli* per 100 mL
95th Percentile	754 *E. coli* per 100 mL	7451 *E. coli* per 100 mL
Alert Compliance	70 %	49 %
Action Compliance	90 %	71 %

Bacteriological counts for the Kerikeri River were much lower and the compliance rates higher over the 2004-05 summer compared to previous years (Table 10). As shown in Figure 10, there were three breaches of the alert level with one of these exceeding the action threshold in early February.

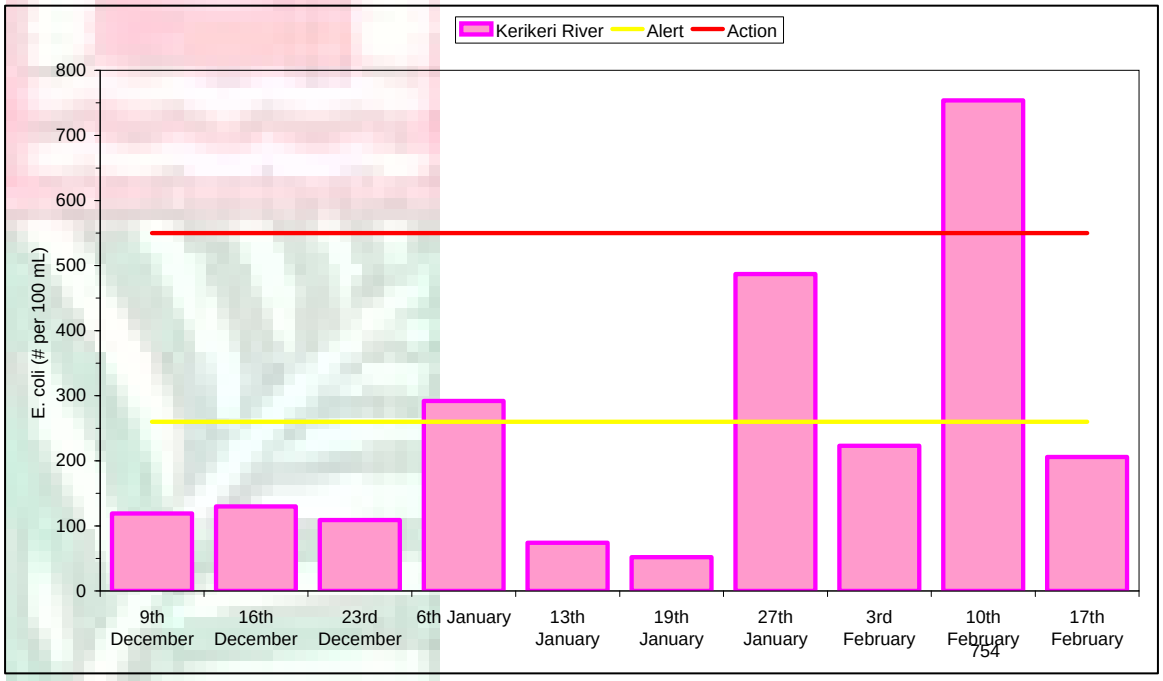


Figure 10: Results from the 2004-05 freshwater recreational contact sampling for Kerikeri River

There is no obvious correlation between rainfall and *E. coli* in the Kerikeri River (Figure 11), at least at the river basin. Prolonged rainfall is most likely the principle cause of the

extremely high levels observed on 10th February but the high levels recorded on the 27th January cannot be related to run-off or stormwater as it occurred during an extended dry period.

Septic tank or reticulated system failures and stock access upstream of the sampling site are all possible sources for high *E. coli* levels during drier periods. Both NRC and FNDC sampling officers have noticed consistently high densities of waterfowl in the Kerikeri basin. It is possible that their excrement is an uncontrollable source of pathogens into the water. However, when samples were taken from both upstream and downstream of a group of ducks, there were no significant differences in *E. coli* populations (Wilson 2004).

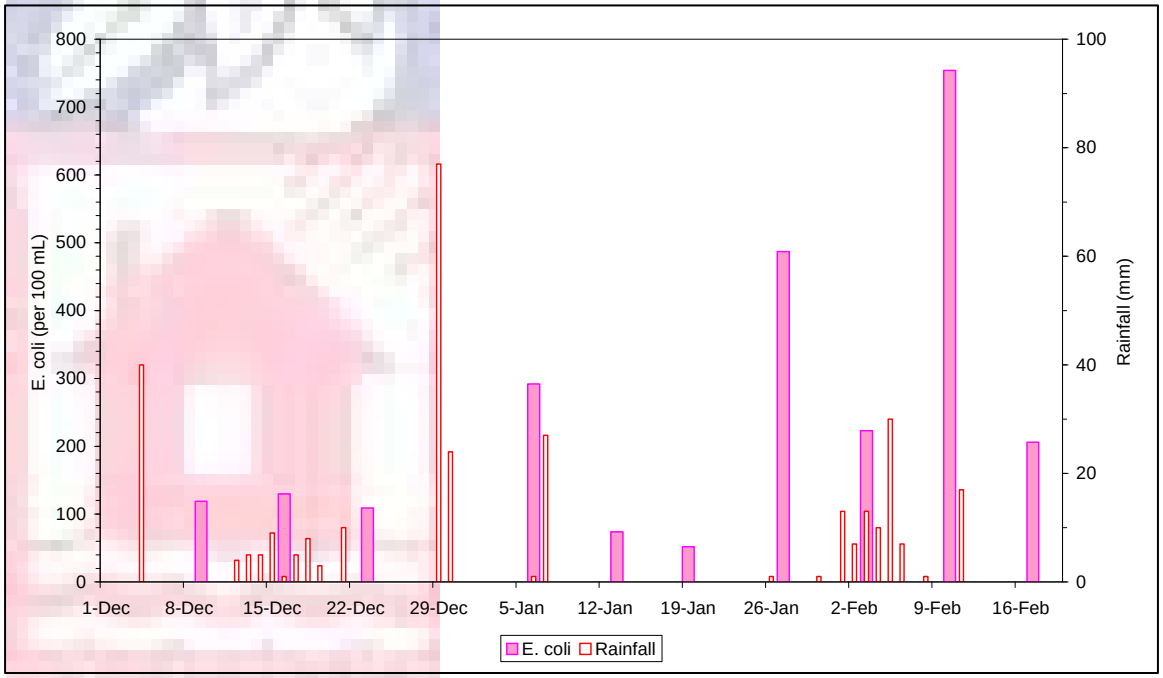


Figure 11: Rainfall and *E. coli* levels for the Kerikeri River over the 2004-05 summer

Results from 35 samples collected from the popular swimming spot in the Kerikeri basin over the last four bathing seasons were used to calculate an interim SFRG. Like Waitangi River the interim grade of "Very Poor" seems inappropriate for the Kerikeri basin with its relatively low median and high compliance rates. Therefore it is likely the grading will improve from "Very Poor" to "Poor" as the size of the data set increases.

5.6 KAPIRO STREAM

SIC: MODERATE MAC: INSUFFICIENT DATA SFRG: N/A

Kapiro Stream drains north of Kerikeri into the Bay of Islands through a predominantly agricultural and horticultural catchment. Local children frequently use the swimming hole at the Parerua Road Bridge in particular during the summer, and the site was added to the programme after public request was made to Northland Health in the middle of January 2004. There is no historical bacteriological data for this site.

Table 11: Collated results for the Kapiro Stream

	2004-05 SURVEY	ALL SURVEYS
Median	265 *E. coli* per 100 mL	252 *E. coli* per 100 mL
95th Percentile	521 *E. coli* per 100 mL	809 *E. coli* per 100 mL
Alert Compliance	50 %	50 %
Action Compliance	100 %	94 %

As this is only the second season of sampling at this site, it is premature to read too much from the results. However bacteriological results were slightly better in the 2004-05 season with a lower 95% percentile and higher compliance rate for the action threshold than the 2003-04 summer (Table 11). No samples exceeded the action threshold of 550 *E. coli* per 100 mL, however five samples contained *E. coli* above the alert threshold of 260 *E. coli* per 100 mL (Figure 12).

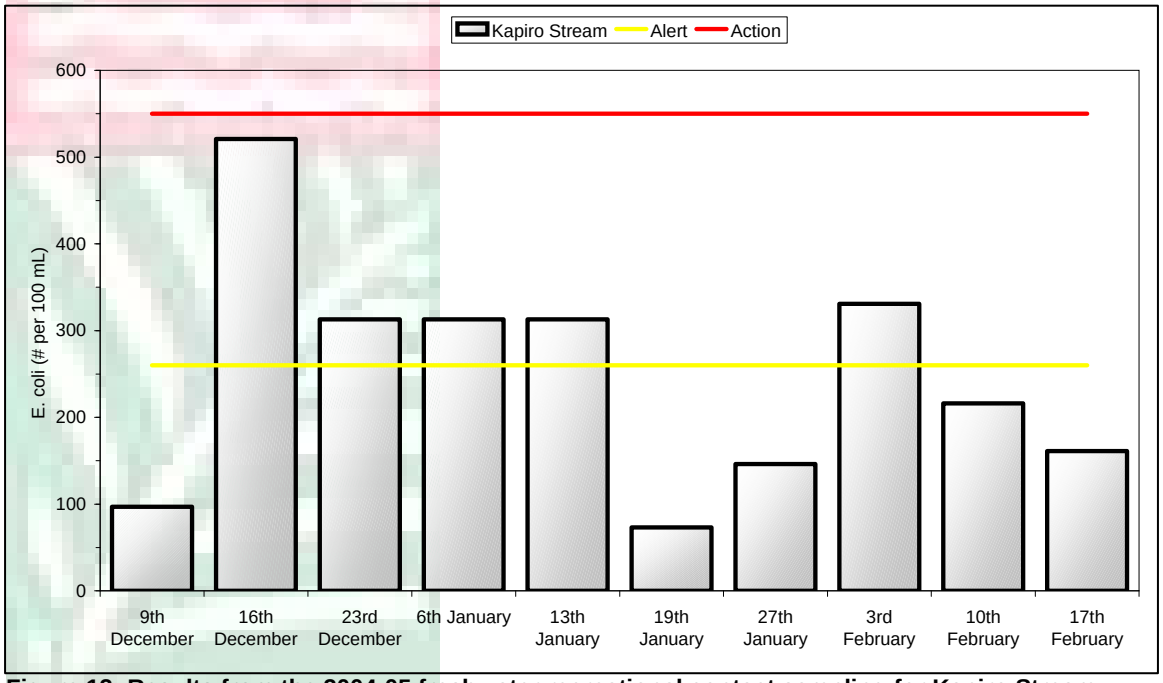


Figure 12: Results from the 2004-05 freshwater recreational contact sampling for Kapiro Stream

There does not appear to be any clear-cut relationship between rainfall and *E. coli* populations in the Parerua swimming hole on Kapiro Stream (Figure 13). The elevated *E.*

coli result on the 16th December could be linked to surface run off as a result of the rainfall, however it is not likely as only about 24 mm fell over the 4 days prior.

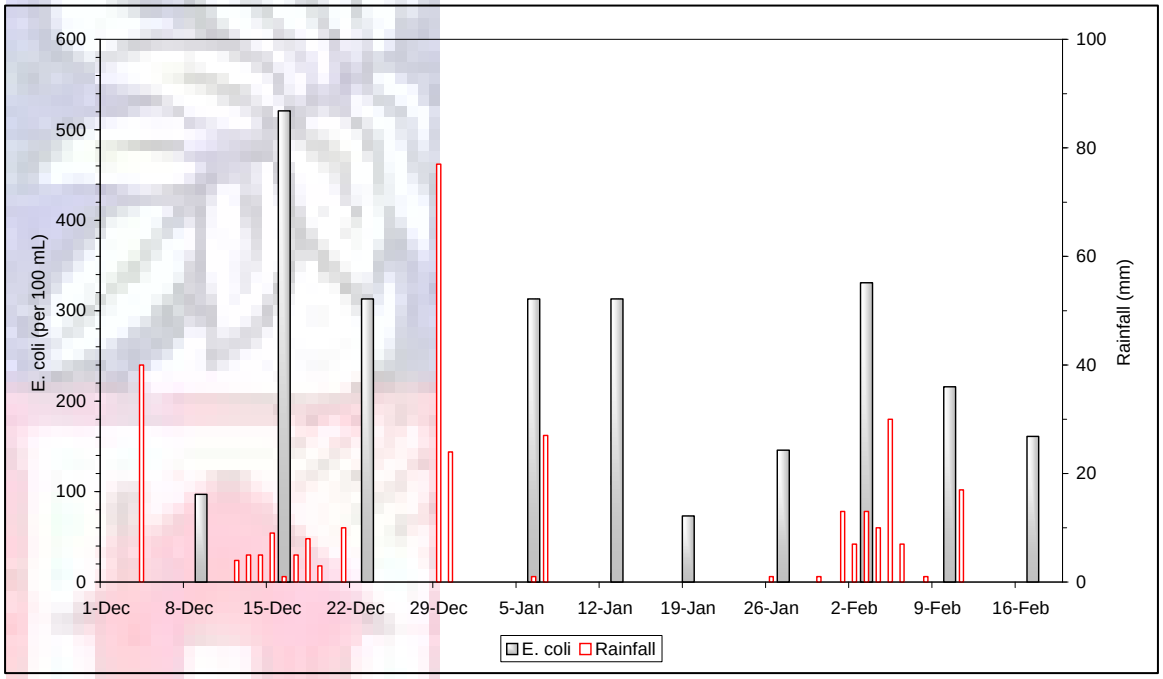


Figure 13: Rainfall and *E. coli* data for Kapiro Stream over the 2004-05 summer

As mentioned previously the data for the Kapiro Stream site is limited and is insufficient for calculating the MAC and the SFRG for this site. It is recommended that the Kapiro Stream be monitored as part of future surveys, at least until any direct link between rainfall and *E. coli* population spikes can be tested or an interim guideline can be obtained. With a SIC assessment of "moderate" susceptibility to faecal influence and a 95% percentile of 809 *E. coli* per 100ml after 16 sampling events, it is likely that this bathing site will be graded as "Poor" in the future.

5.7 OTIRIA STREAM

SIC: VERY HIGH **MAC: D** **SFRG: VERY POOR**

The Otiria Waterfall is a popular swimming hole for people from Moerewa, but the water quality at the site is particularly poor. The Far North District Council has done some investigative sampling in the area, and agricultural effluent appears to be a major contributor, as well as some influence from a large natural wetland and lake (Andrew Prangley, pers. comm.). A combination of this intensive agricultural land use, along with the possibility of leaking septic tanks have made the Otiria Stream unfit for swimming all year round, regardless of weather conditions or water clarity for several years.

In light of the findings, local authorities have erected a permanent sign at the falls warning people of the elevated health risk. Northland Health and local community groups continue to work on improving the stream's health.

Table 12: Collated results for the Otiria Stream

	2004-05 SURVEY	ALL SURVEYS
Median	1581 *E. coli* per 100 mL	933 *E. coli* per 100 mL
95th Percentile	3076 *E. coli* per 100 mL	3448 *E. coli* per 100 mL
Alert Compliance	0 %	6 %
Action Compliance	10 %	20 %

Water quality at the Otiria Falls site was still extremely poor over the entire summer (Figure 14). All collected samples exceeded the action threshold, except the 23rd of December, which was still high with 479 *E. coli* per 100mL breaching the alert threshold, (Table 12). The median and compliance rates were worse in the 2004-05 summer compared to previous surveys, suggesting that water quality at the site has deteriorated compared to historical records.

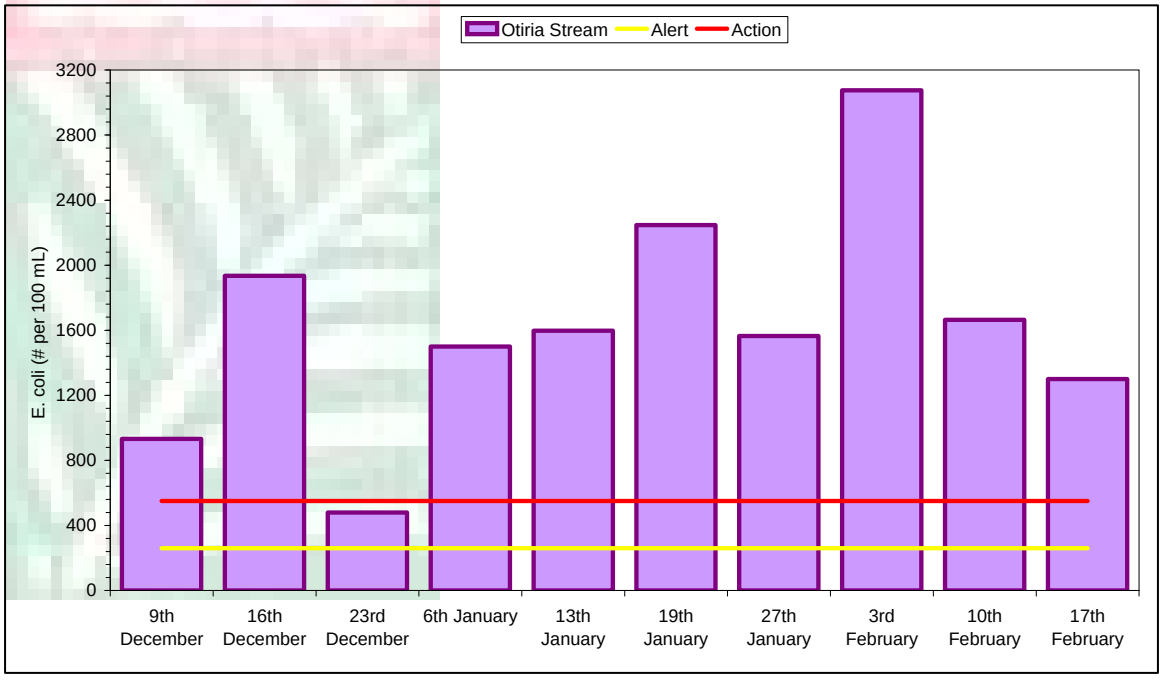


Figure 14: Results from the 2004-05 freshwater recreational contact sampling for Otiria

The most disturbing aspect of a comparison between rainfall and *E. coli* information for the Otiria Falls swimming hole is that rain and therefore surface run-off appears to have no effect upon the situation (Figure 15). There was no particular sampling occasion that was clearly influenced by rainfall prior to sampling and therefore all the high *E. coli* results occurred irrelevant of rain.

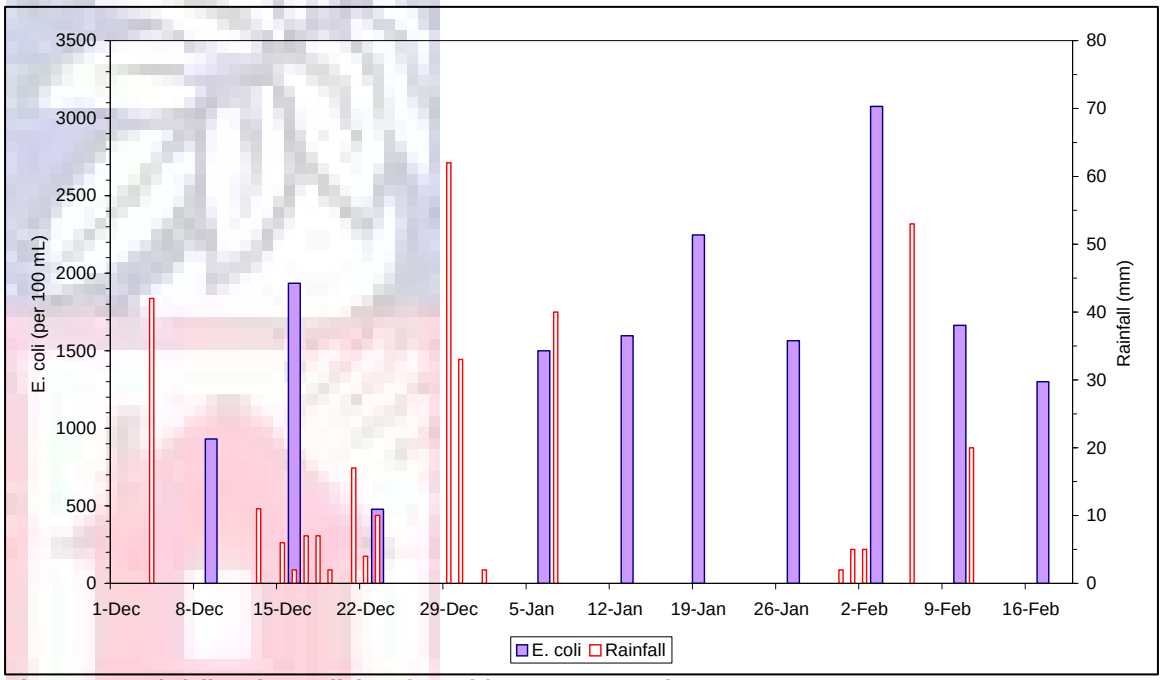


Figure 15: Rainfall and *E. coli* data for Otiria Stream over the 2004-05 summer

The interim SFRG grade of "Very Poor" is built on 44 samples collected over the last five bathing seasons. This is an acceptable grade for this site considering over the last 2 years it has consistently exceeded the alert threshold on all sampling occasions. Unless the mitigating circumstances improve dramatically, Otiria Stream will remain in extremely poor health, and should not be used for contact recreation until further notice. There is potential to carry out faecal sterol analysis on samples with high *E. coli* results to investigate further the likely source of the contamination i.e. humans, stock or birds.

5.8 WAIPAPA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

Lake Manuwai, one of the Kerikeri irrigation dams, is the major source of water into the Waipapa River. From the lake, the river winds through an agricultural and horticultural catchment. Historically, the Waipapa landing on the Waipapa Stream has been a popular site for water users and picnickers.

Table 13: Collated results for the Waipapa Stream

	2004-05 SURVEY	ALL SURVEYS
Median	179 E. coli per 100 mL	154 E. coli per 100 mL
95th Percentile	328 E. coli per 100 mL	1498 E. coli per 100 mL
Alert Compliance	70 %	72 %
Action Compliance	100 %	89 %

While, for the most part the Waipapa Stream was suitable for recreational contact use over the 2004-05 summer (Table 13), it did exceed the alert threshold of 260 E. coli per 100ml on 3 occasions (Figure 16). The 95th percentile and action compliance rate were better in the 2004-05 summer compared to previous surveys.

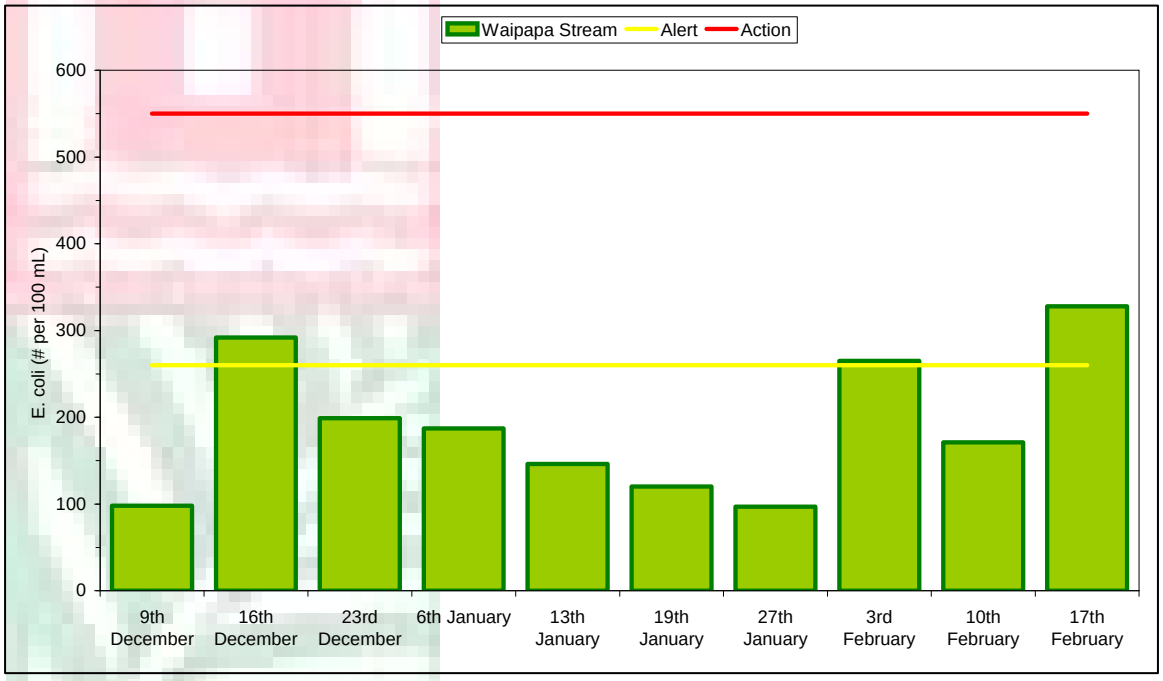


Figure 16: Results from the 2004-05 freshwater recreational contact sampling for Waipapa Stream

It is likely that bacteriological levels in Waipapa Stream are quite strongly related to rainfall (Figure 17), with two of the breaches of the alert threshold occurring during periods of rain and during a dry period from the 12th January the number of *E. coli* steadily declines for 3 weeks.

The sightly elevated levels of E. coli on the 17th February are not so easy to explain, but a one-off point source, such as excrement from transient birds, stock or perhaps people could be a possible explanation for the spike.

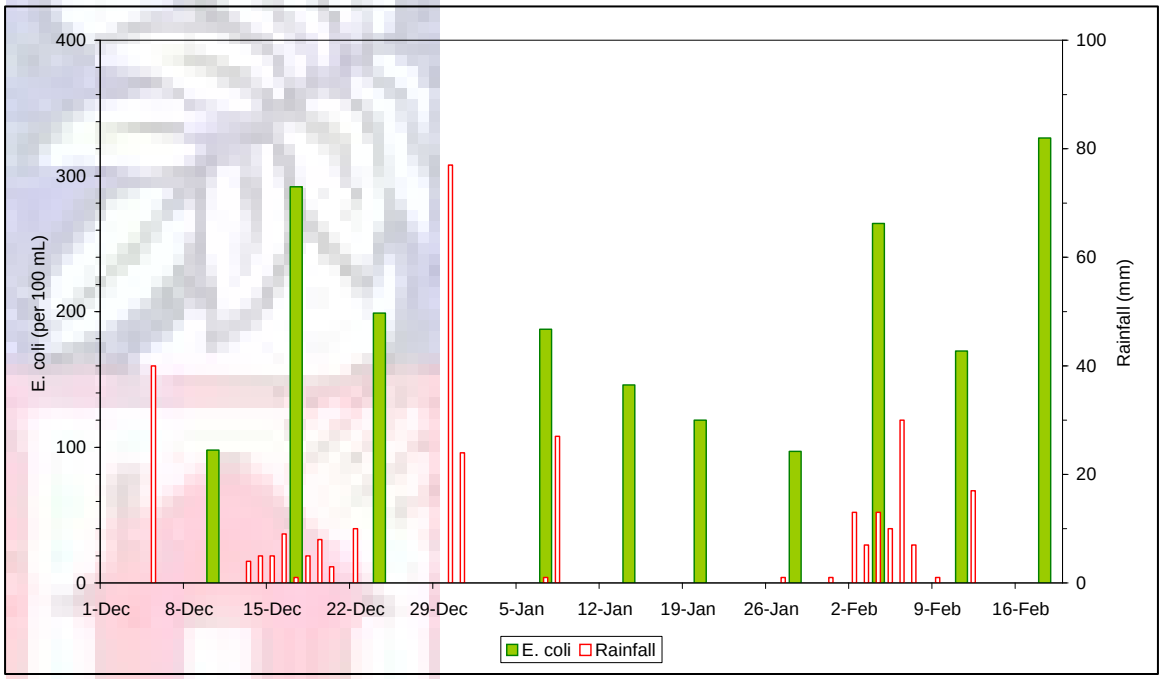


Figure 17: Rainfall and *E. coli* data for the Waipapa Stream over the 2004-05 summer

An interim SFRG of "Poor" is not an accurate reflection of the state of the Waipapa Stream (grading based on 40 samples over five summers). Spikes after heavy rainfall have created a D MAC, but for the bulk of the summer the stream's water quality is good and with a SIC assessment of "Moderate", a grading of "Fair" would be a better assessment of the situation at Waipapa Landing. Therefore it is recommended that any public description of the site should explain this particular discrepancy. Such a site is a good example of where the MfE guidelines are perhaps too rigid, as any site that has significant rain for more than 5% of the time can potentially fail (i.e. be categorised as poor or very poor), even if for the rest of the time water quality is very good.

5.9 WAITAUA STREAM

SIC: HIGH MAC: D SFRG: VERY POOR

Waitaua Stream originates North of Whangarei, flows around the edge of an urban area on the East of Whangarei and eventually becomes the Hatea (Hotea) River. Unlike most of the sites sampled during the recreational bathing surveys, the Whangarei Falls site is largely unaffected by agriculture. While the upper catchment does contain some mixed beef farming, the catchment is predominately a mix of lifestyle blocks and urban areas. The mostly urban lower catchment has the potential for bacterial contamination if septic tanks are not well maintained or if problems arise with the reticulated sewage system.

Historically, *E. coli* populations have been consistently elevated, high enough that a permanent warning sign has been erected. In spite of the warning sign, children are frequently observed swimming at the site during sampling, and it can be assumed that usage is heavy throughout summer.

Table 14: Collated data for the Waitaua Stream

	2004-05 SURVEY	ALL SURVEYS
Median	357 E. coli per 100 mL	345 E. coli per 100 mL
95th Percentile	880 E. coli per 100 mL	4526 E. coli per 100 mL
Alert Compliance	20 %	37 %
Action Compliance	70 %	80 %

According to Table 14, the water quality of the Waitaua Stream at the Whangarei Falls was worse over the 2004-05 summer than previous summers, with three breaches of the 550 *E. coli* per 100 mL action threshold, a higher median and lower compliance rates. Overall, *E. coli* populations were higher in the Waitaua Stream than at most sites around Northland, with a median above the 260 *E. coli* per 100 mL alert guideline. As shown in Figure 18, water quality at the site was variable throughout the summer, but generally very poor for the entire summer, with it only being suitable for bathing on two occasions (less than the alert threshold).

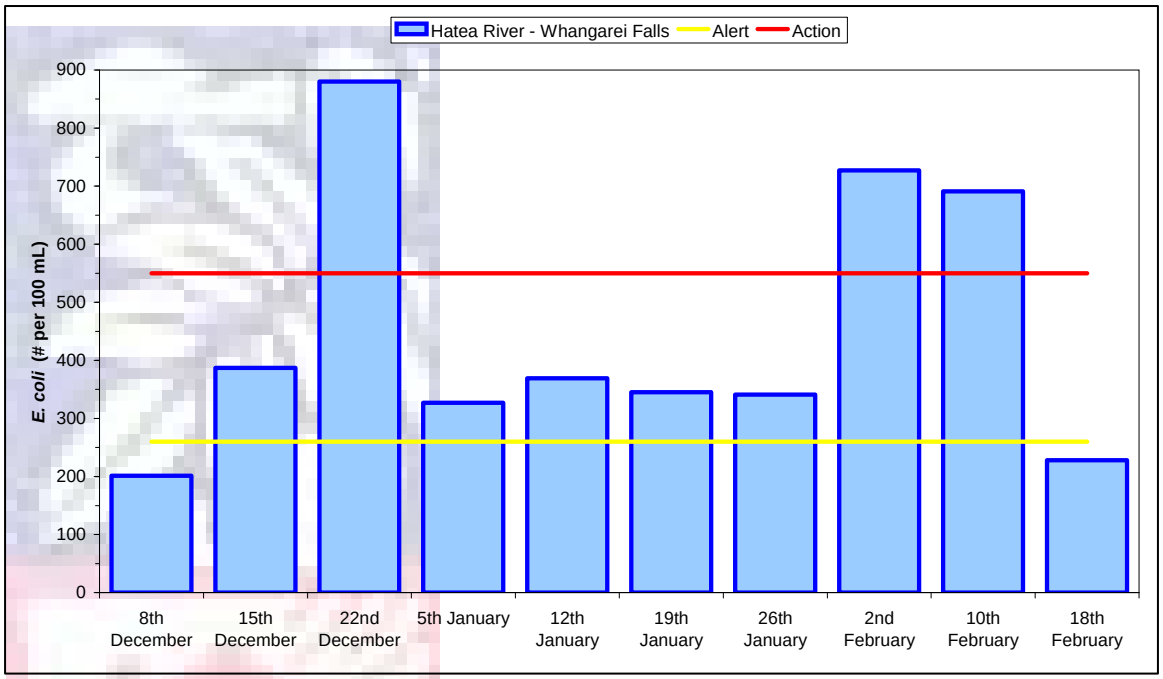


Figure 18: Results from the 2004-05 freshwater recreational contact sampling for Waitaua Stream at Whangarei Falls

Although in general bacterial water quality is consistently poor in Waitaua Stream irrelevant of rainfall, it seems that rainfall causes bacterial levels to rise even further, such as the three breaches of the action level which coincided with periods of rain (Figure 19). This is consistent with last season's bathing results, where the only breach of the action level proceeded a period of sustained heavy rainfall (Wilson 2004).

This indicates that there could be several factors influencing water quality in Waitaua Stream, including those that are not related to rainfall such as leakage from poorly maintained septic tanks, stock access or waterfowl and those that are such as stormwater discharges and agricultural run-off.

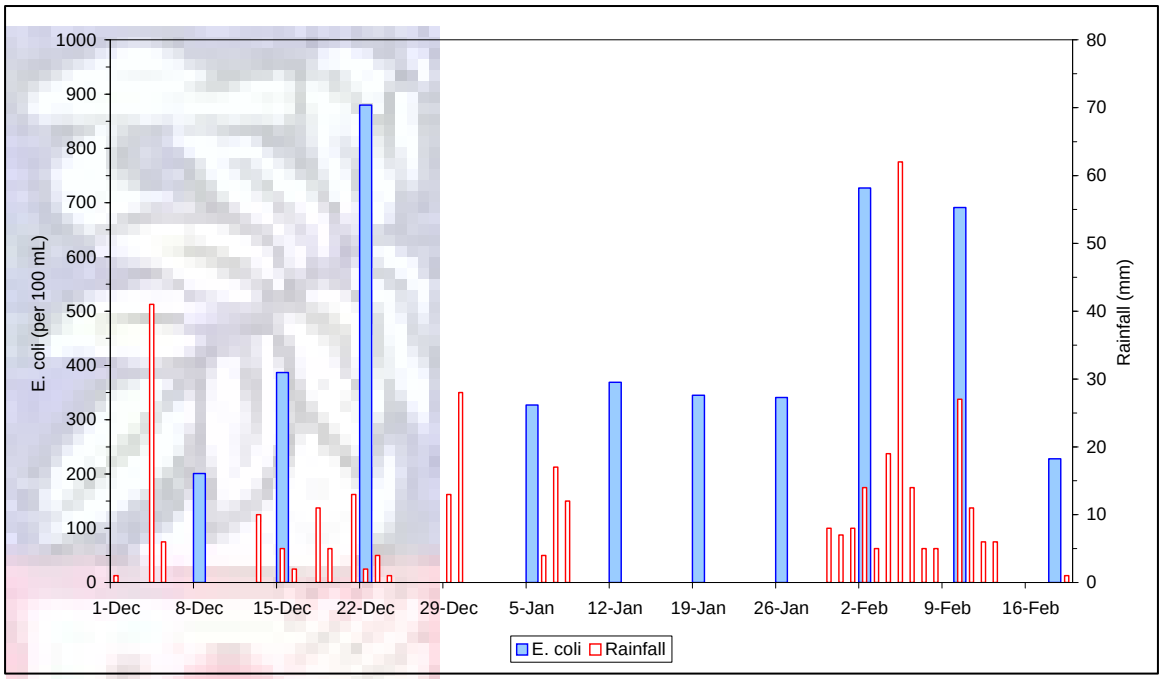


Figure 19: Rainfall and *E. coli* data for the Waitaua Stream at Whangarei Falls over the 2004-05 summer

The interim Suitability for Recreation Grade for Waitaua Stream has been calculated as "Poor" from 42 samples collected over 5 bathing seasons. This is a realistic grading for Waitaua Stream when compared to other Northland freshwater bathing sites because although Waitaua Stream has reasonably good percentage of compliance rates, it also has a relatively high median, greater than the alert threshold of 260 *E. coli* per 100 mL.

5.10 RAUMANGA STREAM

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Raumanga Stream flows through a similar catchment to the Waitaua Stream. The land use is chiefly urban so any problems with reticulated sewage will impact upon the stream, while lifestyle blocks and low-intensity agriculture in the upper catchment also present possible sources of contamination.

The Raumanga Stream is sampled at a swimming hole in the Raumanga Valley Reserve, a particularly popular park over summer. Water quality is variable, reflected in low compliances historically. Nonetheless, the swimming hole is very popular, especially for children. Stormwater is the likely source of most of the bacteriological contamination into the river.

Table 15: Collated results for the Raumanga Stream

	2004-05 SURVEY	ALL SURVEYS
Median	299 *E. coli* per 100 mL	300 *E. coli* per 100 mL
95th Percentile	3873 *E. coli* per 100 mL	3655 *E. coli* per 100 mL
Alert Compliance	50 %	42 %
Action Compliance	70 %	72 %

The results from the Raumanga Stream swimming hole did not deviate far in the 2004-05 summer from pervious summers and similarly to the Waitaua Stream site, median *E. coli* values have remained quite high at the Raumanga Stream site (Table 15). As shown in Figure 20, the *E. coli* results breached the action threshold three times over the summer months, and exceeded the alert levels on a further two occasions.

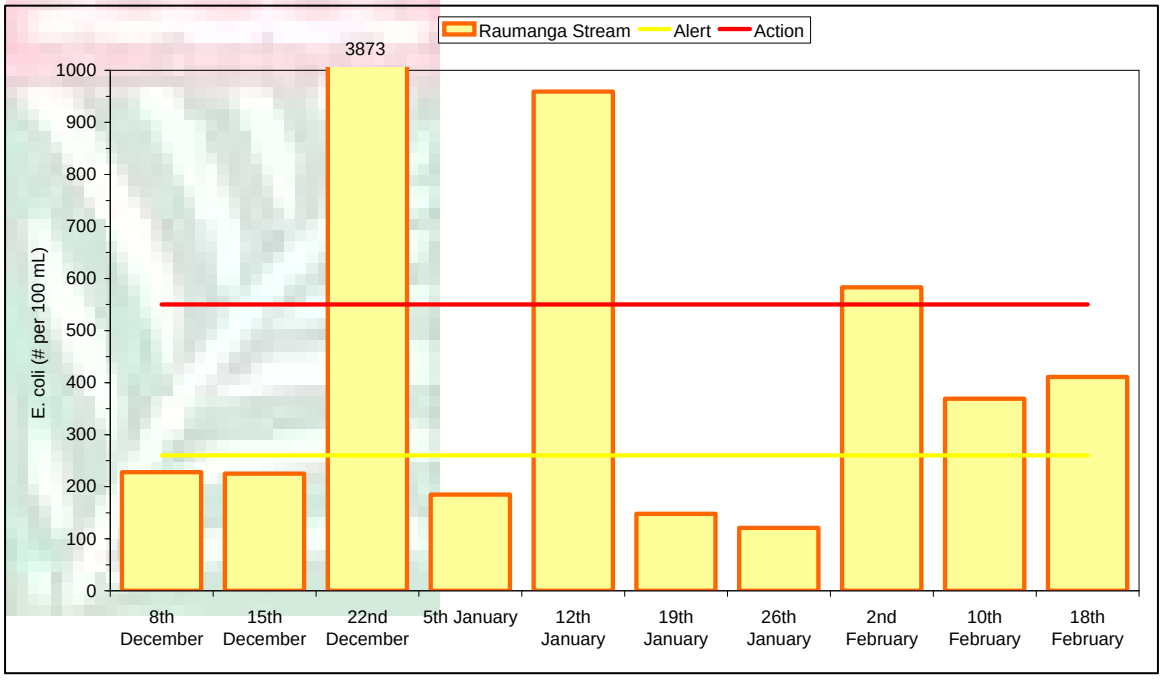


Figure 20: Results from the 2004-05 freshwater recreational contact sampling for Raumanga Stream

In the 2003-04 survey it was found that elevated *E. coli* results was related to rainfall, where more than 10mm of rain in the day preceding sampling appeared to flush high numbers of *E. coli* into the Raumanga Stream, and the greater the rainfall, the greater the number of *E. coli* (Wlson 2004). In the 2004-05 survey, rainfall 4 days prior to sampling it appeared to cause elevated *E. coli* results in Raumanga Stream, however there were also sampling events that had rainfall prior that did not have elevated *E. coli* results such as on the 8th and 15th of December.

Therefore the majority of the bacterial contamination is most likely related to sources associated with rainfall events such as agricultural runoff and stormwater.

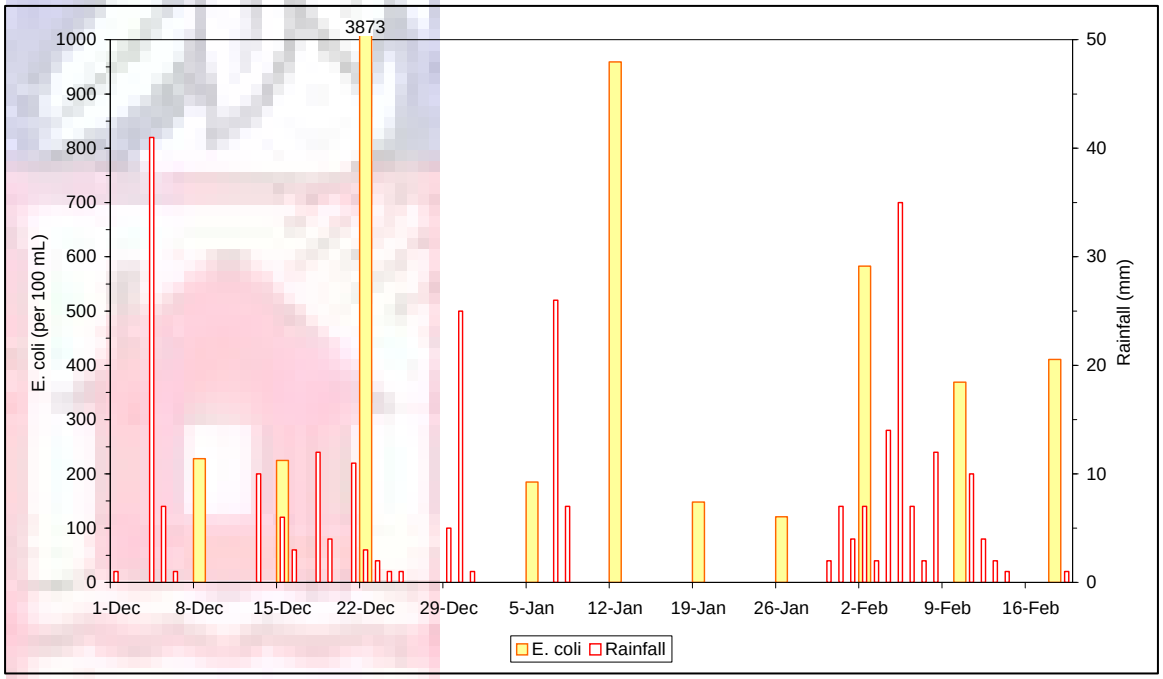


Figure 21: Rainfall and *E. coli* results for the Raumanga Stream over the 2004-05 summer

The probable relationship between rainfall and *E. coli* levels in the Raumanga Stream that causes extremely high *E. coli* spikes during rainfall events such as the 3873 *E. coli* per 100 ml that occurred on the 22nd December is causing the 95th percentile to be very high. This suggests that an interim SFRG of "Poor" calculated from 43 samples over the last 5 years is perhaps too conservative. In dry periods, the water quality is generally suitable for recreational bathing, and therefore a "Fair" grading may be more warranted. However, a historic alert compliance of only 42% and an action compliance of 72% suggests that realistically the grade probably lies somewhere between "Fair" and "Poor" and should continue to be reported as "Poor" until these compliance rates improve.

Whether or not a sign should be erected at this site is not clear-cut, and it may be that education, especially at local schools, about the basic rules of swimming[4] in rivers is the best way to minimise the occurrence of bathing-related illnesses.

[4] As outlined in the introduction of this document.

5.11 OTAUA STREAM

SIC: MODERATE **MAC: INSUFFICIENT DATA** **SFRG: N/A**

The Otaua Stream swimming hole on Otaua Road west of Kaikohe was sampled for the first time this year due to its popularity and concerns over water quality after an outbreak of gastroenteritis in the community in November 2004 (Tahi Morton pers. comm.). The site is located just up the road from a marae and has predominantly agricultural land use in its upstream catchment.

There would be contamination risks associated with agricultural runoff and poorly maintained septic tanks in the rural areas upstream of the swimming hole. There is no historical *E. coli* data for this site.

Table 16: Collated results for Otaua Stream, Kaikohe

	2004-05 SURVEY
Median	202 *E. coli* per 100 mL
95th Percentile	4352 *E. coli* per 100 mL
Alert Compliance	80 %
Action Compliance	90 %

Water quality at the Otaua Stream swimming hole was generally good until February when there was an extreme spike of 4352 *E. coli* per 100 mL (Figure 22). Compared to the other river and stream bathing sites in Northland the results were relatively good at the Otaua Stream swimming hole with a low median, only one breach of the action threshold and one further breach of the alert threshold (Table 16).

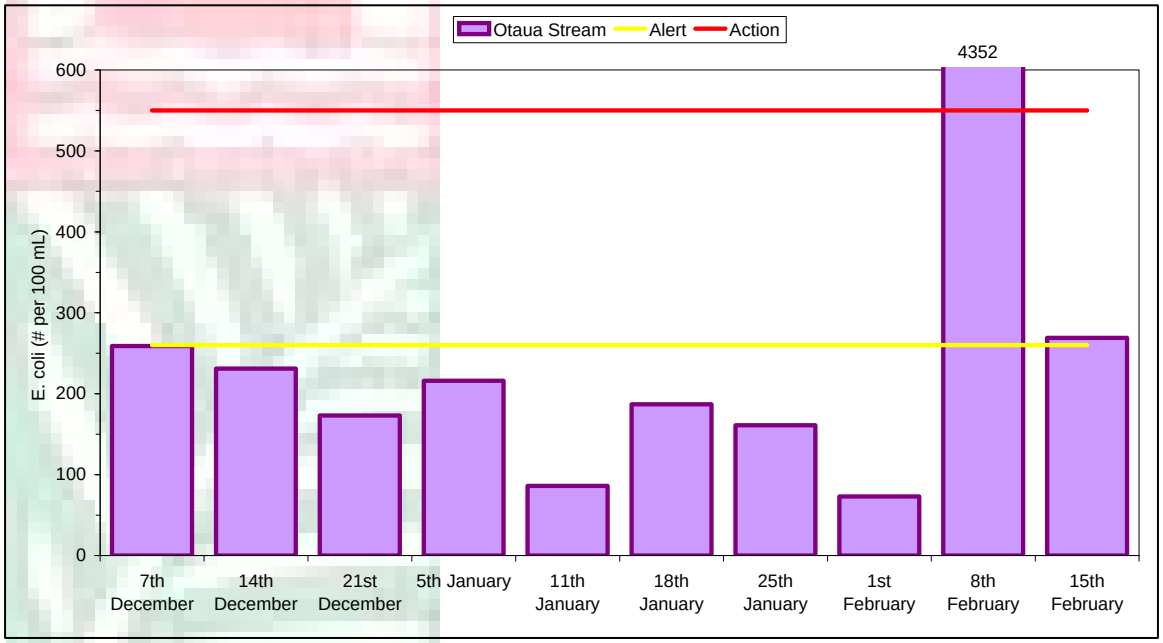


Figure 22: Results from the 2004-05 freshwater recreational contact sampling for Otaua Stream swimming hole

It is quite clear from Figure 23 that the extreme spike on the 8th of February is related to the heavy rain preceding sampling. However smaller volumes of rain do not appear to cause *E. coli* counts to become elevated beyond the alert threshold and in fact do not appear to

increase counts far above the background level found in Otaua Stream of 100 – 200 *E. coli* per 100 ml. This background level persisted through the dry period in mid to late January and therefore is most likely as a result of stock access to the stream and its tributaries and leakage from poorly maintained septic tanks within the catchment.

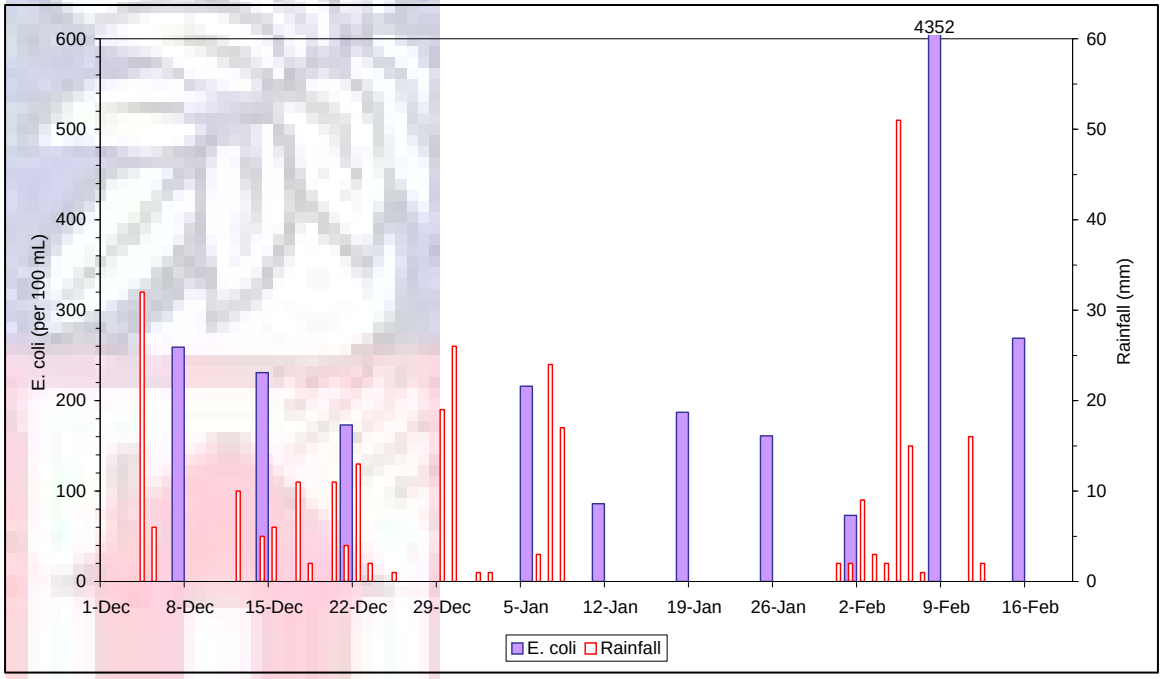


Figure 23: Rainfall and *E. coli* levels for Otaua Stream over the 2004-05 summer

One summer's worth of data is inadequate for any MAC or SFRG calculations. However with the low *E. coli* results that have been recorded through the summer even during periods of rainfall, as long as people obey the basic rules of clarity, discolouration, and rainfall, the health risks associated with recreational use will be relatively low at the site.

5.12 MANGAKAHIA RIVER @ TWIN BRIDGES

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Mangakahia River catchment upstream of the Twin Bridges is a mix of native forest, exotic forestry and moderately intensive sheep and beef farming. The Twin Bridges is a popular spot for picnics, camping and swimming, however there are no public toilets available.

Table 17: Collated results for Mangakahia River at Twin Bridges

	2004-05 SURVEY	ALL SURVEYS
Median	274 *E. coli* per 100 mL	230 *E. coli* per 100 mL
95th Percentile	798 *E. coli* per 100 mL	6785 *E. coli* per 100 mL
Alert Compliance	50 %	60 %
Action Compliance	80 %	76 %

The Twin Bridges site is one of the more pleasant sites to sample over summer, however water quality was relatively poor over the 2004-05 survey, with an alert compliance rate of only 50%. As listed in Table 17, bacterial water quality was worse in general compared to previous years except the 95th percentile was significantly lower this summer. The highest peak this summer was 798 *E. coli* per 100 ml (Figure 24), which is much lower than the spikes that have occurred in previous years such as January 2004 where *E. coli* were measured in the tens of thousands (Wilson 2004).

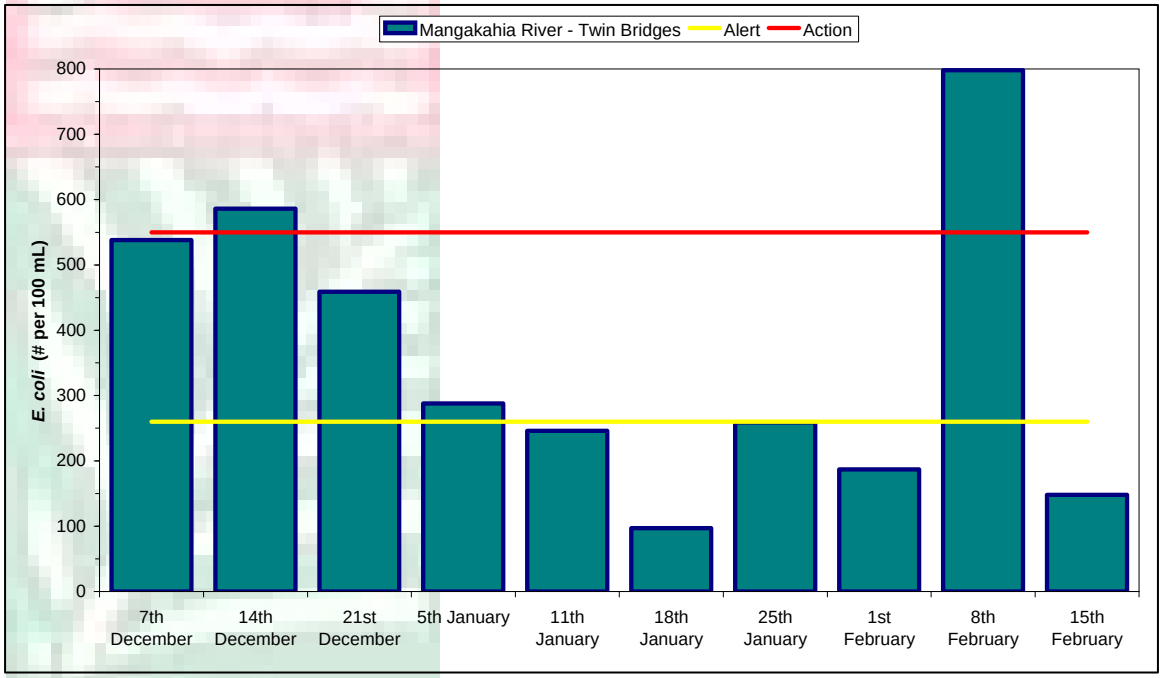


Figure 24: Results from the 2004-05 freshwater recreational contact sampling for Mangakahia River at Twin Bridges

Figure 25 suggests that there is a link between runoff as a result of rainfall and *E. coli* at the Twin Bridges. The more rainfall prior to sampling tended to lead to higher *E. coli* levels and the lowest *E. coli* result was recorded after a week of no rain. Given the upstream land use of the catchment it is likely that agricultural or forestry run-off is the most likely source of the contamination.

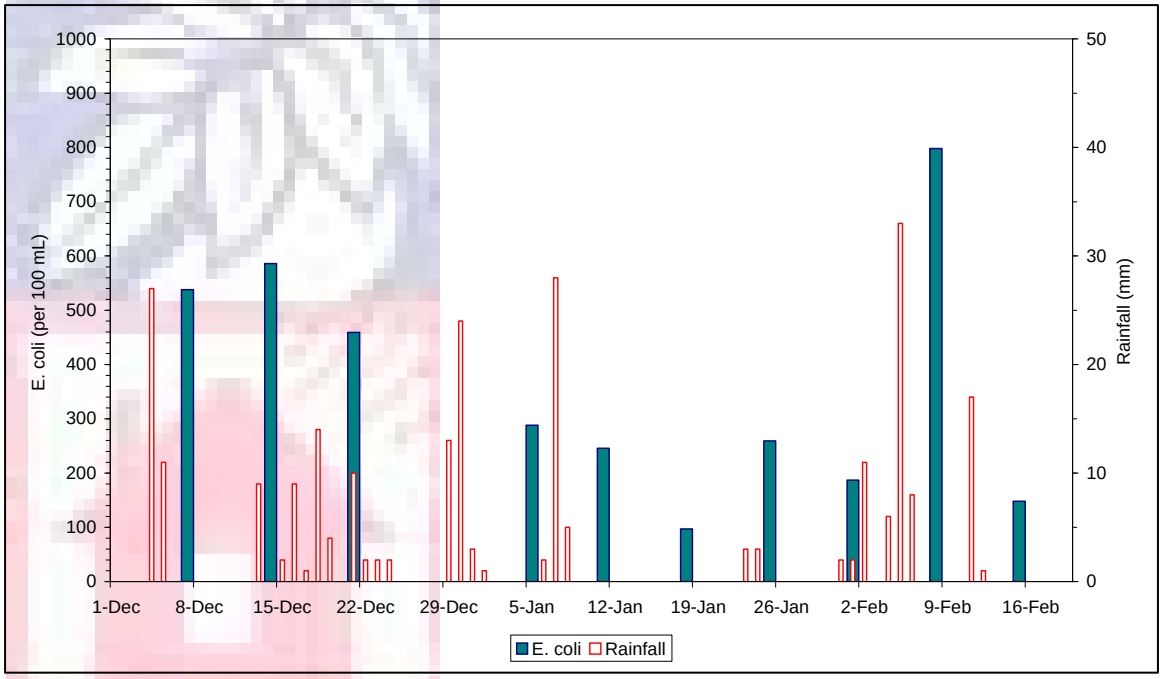


Figure 25 Rainfall and *E. coli* levels at the twin bridges (Mangakahia River) over the 2004-05 summer

A SFRG of "poor", calculated from 43 samples over the last 5 years, is perhaps overly harsh, given the strong correlation with rainfall at the site. However, until the causes of the spikes are isolated and remedied, it is unlikely that the 95th percentile for the site (and therefore the MAC) will improve in the near future.

5.13 KAIHU RIVER

SIC: MODERATE **MAC: D** **SFRG: POOR**

The Kaihu River drains from a catchment that is a mix of native bush and agricultural farmland, with a number of dairy farms upstream of the sampling site. The NRC takes samples below a camping ground, which is extremely popular over the summer months. By the time the Kaihu River reaches the motor camp, the river includes both the Waima River and Mangatu Stream.

Table 18: Collated results for the Kaihu River

	2004-05 SURVEY	ALL SURVEYS
Median	84 *E. coli* per 100 mL	85 *E. coli* per 100 mL
95th Percentile	6488 *E. coli* per 100 mL	5686 *E. coli* per 100 mL
Alert Compliance	89 %	75 %
Action Compliance	89 %	78 %

The compliance rates for the 2004-05 survey for the Kaihu River swimming hole were slightly better compared to previous years, however the 95th percentile was higher (Table 18). The Kaihu River site had very good water quality over the 2004-05 summer except for one extremely high spike of E. coli on the 22nd of December (Figure 26). In fact it had the lowest median of all the river bathing sites surveyed in the 2004/05 survey. Results tended to be extreme at the site, with samples usually containing less than 150 *E. coli* per 100 mL other than extreme spikes where counts reached several thousand, which is consistent with last years results (Wilson 2004).

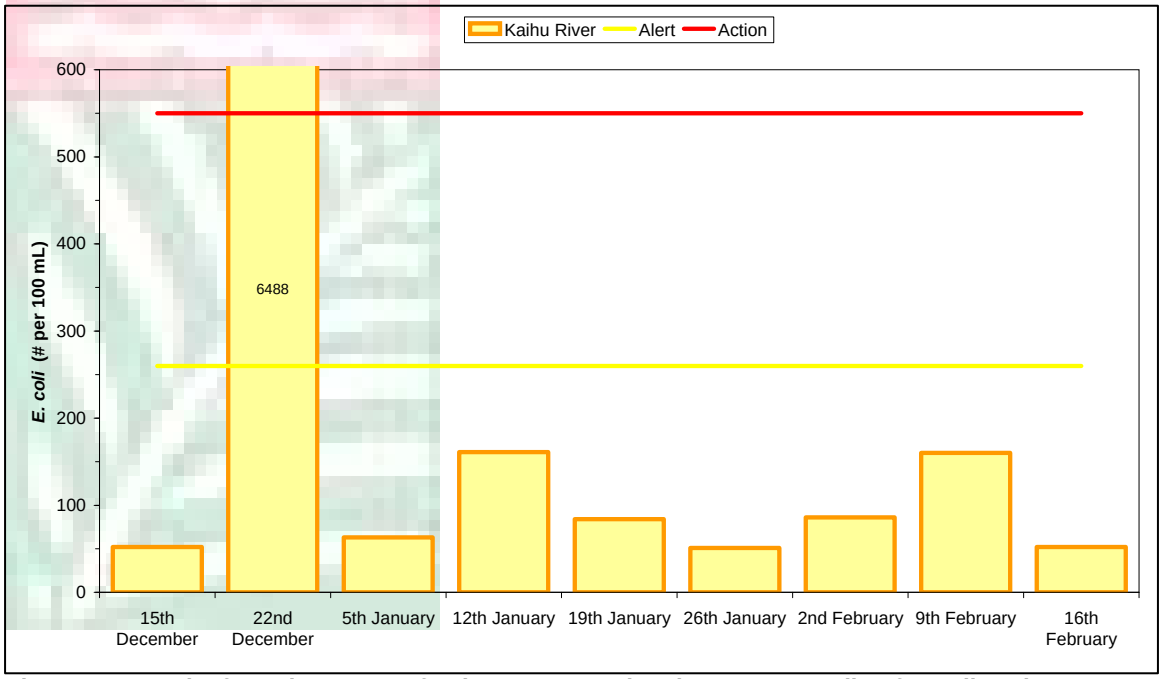


Figure 26: Results from the 2004-05 freshwater recreational contact sampling for Kaihu River

The data collected for the 2004-05 summer (Figure 27) suggests that the Kaihu River site is excellent for swimming in dry periods, but after heavy or prolonged periods of rain it may become extremely unsuitable. However it is unclear why the site can still have relatively low *E. coli* counts after moderate amounts of rainfall such as on the 15th of December and than have a huge spike only a week later on the 22nd.

It was thought that it could be that the catchment requires a set amount of rainfall before the bacteriological by-products of agricultural farming are washed into the river or that consistent rainfall over previous months meant that no build up of effluent occurred, and therefore there was nothing to flush in early December (Wilson 2004). However neither of these explanations are consistent with the spike that occurred on the 22nd of December and it is more likely that it is a once of contamination event that has occurred just prior to sampling such as stock crossing the stream.

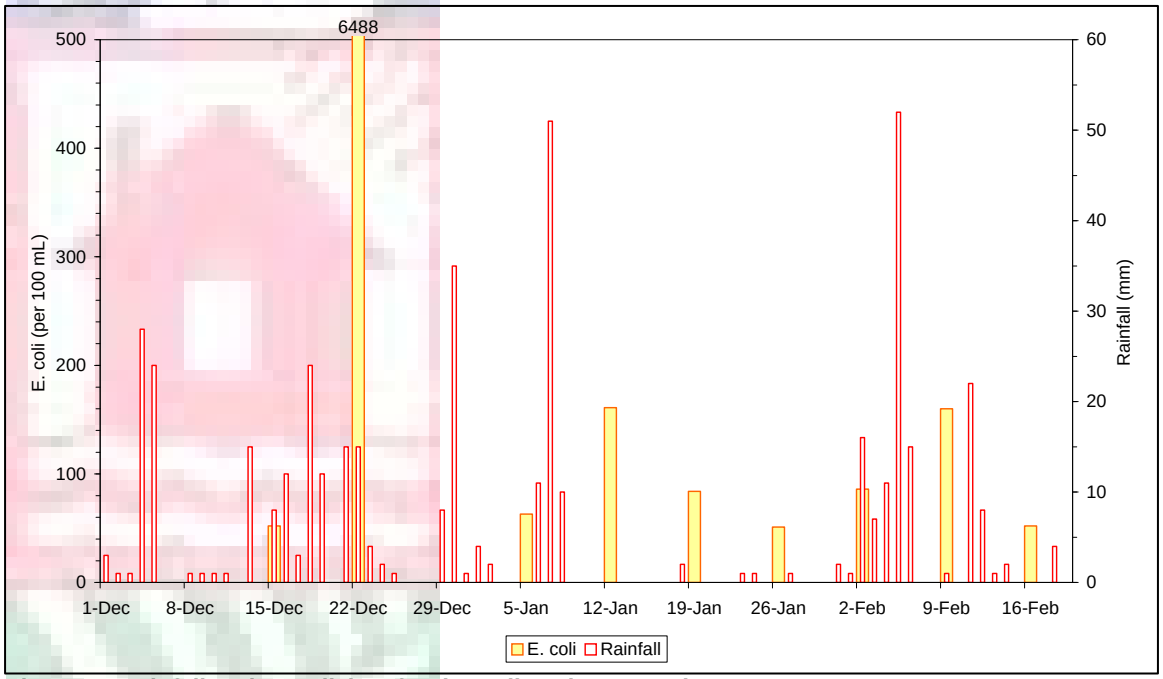


Figure 27 Rainfall and *E. coli* data for the Kaihu River over the 2004-05 summer

The interim SFRG, based on a MAC of "D" due to the high 95th percentile of 40 samples over the last 5 summers and a SIC assessment of "High" due to the intensive agricultural use in the immediate catchment, calculates to be "very poor". However the median and compliance rates suggest that water quality is suitable for swimming the majority of the time and that a grading of either "poor" or "fair" is probably more accurate of the situation at the Kaihu River swimming hole, as long as the basic rules discussed in section 2 of this report are followed.

5.14 OMAMARI BEACH STREAM

SIC: LOW **MAC: D** **SFRG: POOR**

The Omamari Beach Stream is a small stream created by the meeting of two tributaries, one derived from indigenous wetlands, the other from a mixed sheep and beef farming and exotic forestry catchment. The Omamari Beach Stream is only a small stream but a lot of local children swim in the stream and the Omamari Rate Payers Association have been concerned about the quality of the water for some time. There is a risk of contamination from poorly maintained septic tanks, however the risk would be low as there are not many houses in Omamari.

Table 19: Collated results for the Omamari Beach Stream

	2004-05 SURVEY	ALL SURVEYS
Median	134 *E. coli* per 100 mL	128 *E. coli* per 100 mL
95th Percentile	1259 *E. coli* per 100 mL	882 *E. coli* per 100 mL
Alert Compliance	89 %	85 %
Action Compliance	89 %	95 %

The results presented in Table 19 show that water quality was generally very good during the 2004-05 summer at the Omamari Stream site and consistent with previous summers. Only one of the nine sampling occasions exceeded the action threshold of 550 *E. coli* per 100 mL on the 5th of January (Figure 28).

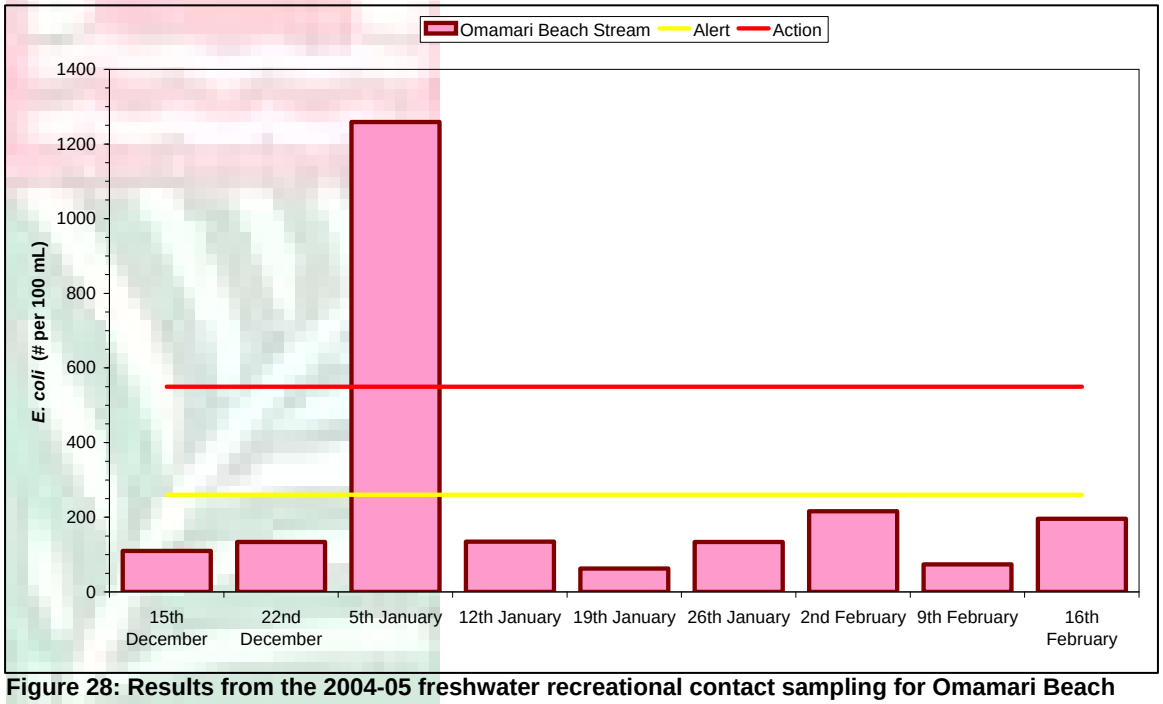


Figure 28: Results from the 2004-05 freshwater recreational contact sampling for Omamari Beach Stream

The comparison between rainfall and *E. coli* in Figure 29 shows no clear relationship between rainfall and elevated *E. coli* counts and in fact there was very little rain prior to the spike that occurred on the 5th of January. This spike could be caused by overloaded septic tanks as a result of the extra people in Omamari for the public holidays.

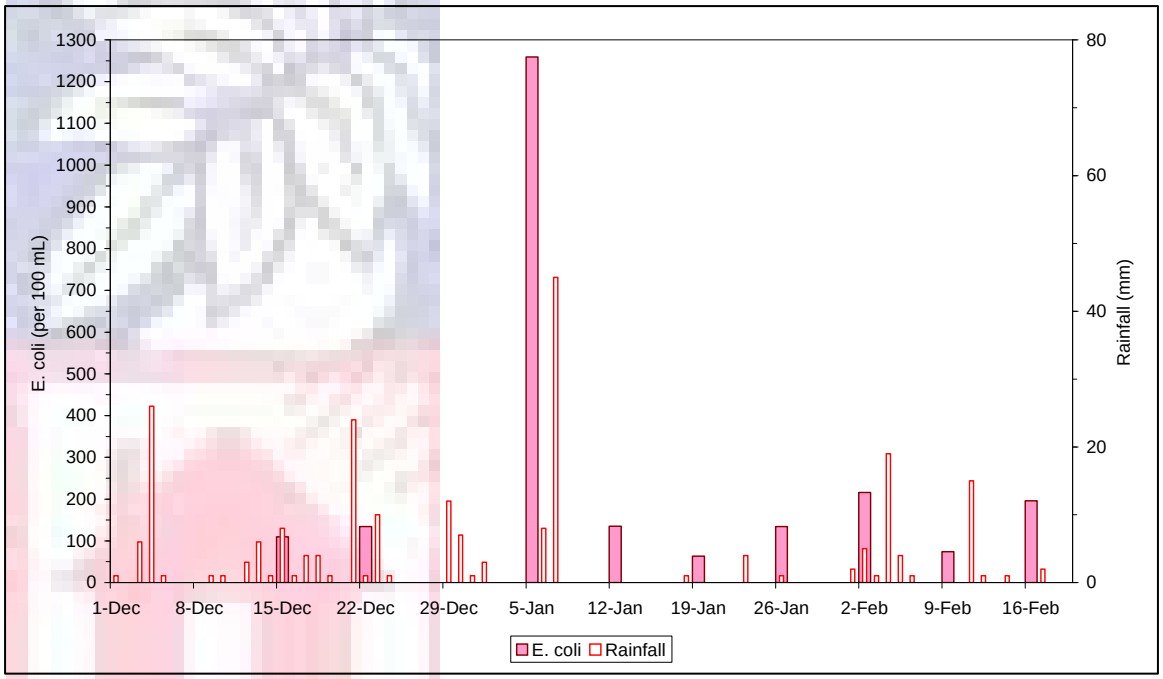


Figure 29 Rainfall and *E. coli* levels in Omamari Beach Stream over the 2004-05 summer

The interim SFRG for Omamari Beach Stream could not be calculated because the SIC assessment of "low" contradicts with the MAC of "D". However as this is only based on 20 samples over 2 summers and in general water quality is good it is likely that the 95th percentile will decrease, improving the MAC assessment to "C" and in turn giving an interim grade of "fair". This would be in line with what we would expect for this stream. Future surveys will confirm whether this is the case and therefore it is recommended that sampling continues at this site, with a view to make an interim grading after the conclusion of the 2007-08 summer.

5.15 LAKE TAHAROA

SIC: VERY LOW **MAC: B** **SFRG: VERY GOOD**

Lake Taharoa is the biggest of the four Kai iwi lakes, an extremely popular area for both locals and tourists alike, situated approximately 25 km northwest of Dargaville. Thousands of people flock to the lake during summer and there are regularly enough tents in the camping grounds to accommodate 500 people. Like Lake Ngatu in the Far North, Lake Taharoa has no significant inputs or outputs with a predominately native and exotic forestry catchment. Without any major inputs, bacteriological contamination should be rare, even given the lake's heavy usage.

Table 20: Collated results for the two Lake Taharoa sites

	2004-05 SURVEY	ALL SURVEYS
Median	10 *E. coli* per 100 mL	5 *E. coli* per 100 mL
95th Percentile	140 *E. coli* per 100 mL	139 *E. coli* per 100 mL
Alert Compliance	100 %	97 %
Action Compliance	100 %	99 %

Results for the 2004-05 summer for the two sites sampled in Lake Taharoa were excellent with an extremely low median and 95th percentile as in the past (Table 20). The highest result was only 158 *E. coli* per 100 mL at pine beach on the 8th of Decmeber, as shown on Figure 30, and therefore the lake achieved 100 % compliance with the MfE guidelines, consistent with the last 2 years.

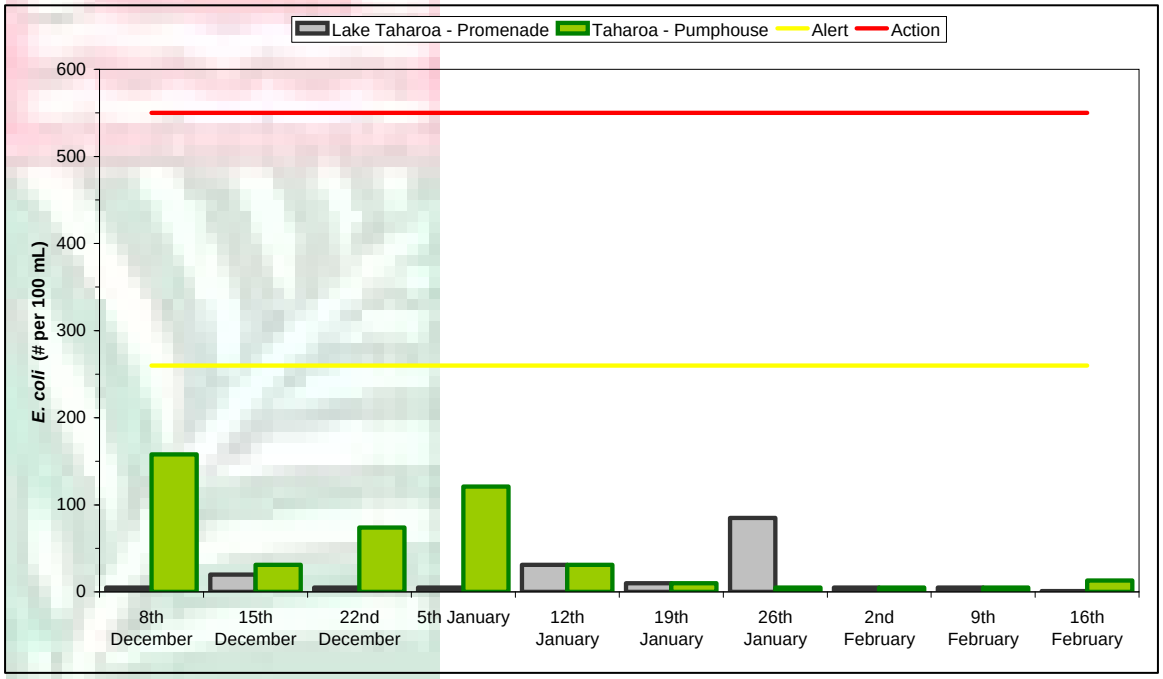


Figure 30: Results from the 2004-05 freshwater recreational contact sampling for the two Lake Taharoa sites

There is no obvious link between rainfall and *E. coli* levels in Lake Taharoa (Figure 31).

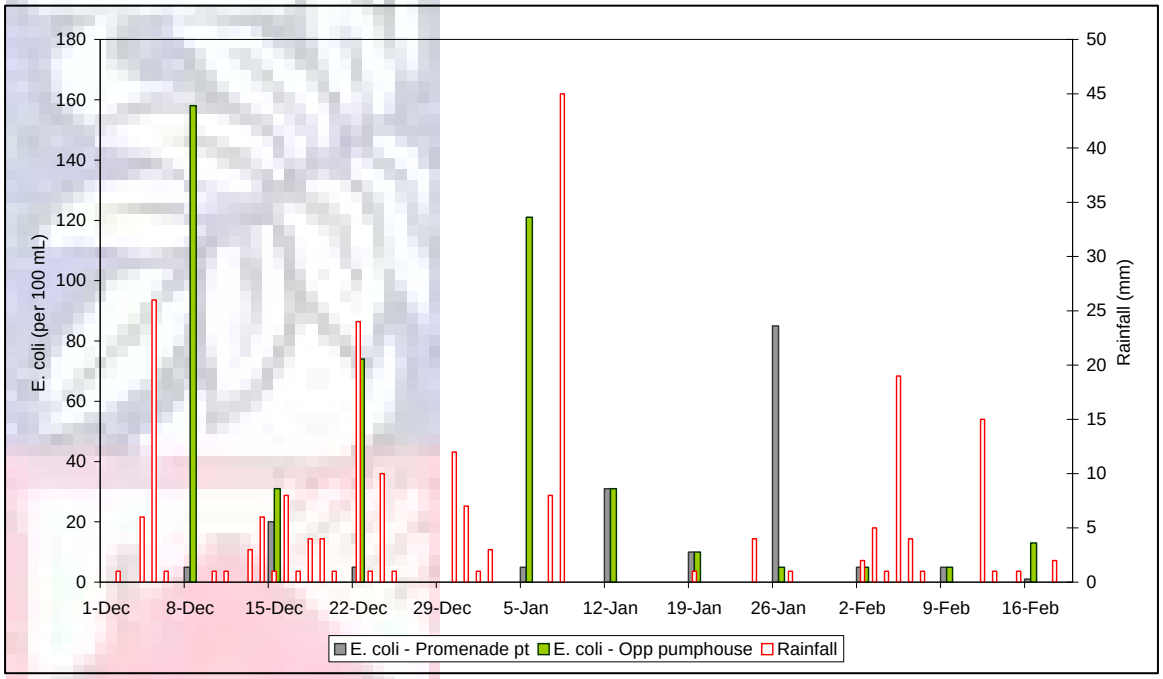


Figure 31 Rainfall and *E. coli* data for the two Lake Taharoa sites over the 2004-05 summer

The interim SFRG grade based on 83 samples from the two sites over the last 5 summers is "Very Good", and therefore may not require sampling in the future, so long as the surrounding catchment is not drastically changed. However, it is envisaged that Lake Taharoa, along with Lake Ngatu, will be able to be properly graded within the next few years if sampling remains weekly. Such a feat is unlikely for any other site unless the sampling frequency is increased, and therefore it is recommended that sampling continues at Lake Taharoa until a dataset of 100 points collected over 5 years is achieved.

5.16 LAKE WARO @ HIKURANGI

SIC: LOW **MAC: INSUFFICIENT DATA** **SFRG: N/A**

Lake Waro is a small manmade lake with a small catchment area, located north of Hikurangi, it is a popular swimming spot for local children in summer months. It has no contributing permanent flowing streams or drains. The catchment is predominately low intensity beef farming, with a few houses that have septic tanks. Waterfowl are commonly seen on the lake, so there is a risk of bacteriological contamination from birds excreting into the water. Lake Waro was sampled for the first time in the 2004-05 summer and was added to the freshwater bathing monitoring programme due to concerns over water quality for recreational users.

Table 21: Collated results for the Lake Waro site

	2004-05 SURVEY
Median	52 *E. coli* per 100 mL
95th Percentile	175 *E. coli* per 100 mL
Alert Compliance	100 %
Action Compliance	100 %

As shown in Table 21 and Figure 32 bacteriological water quality in Lake Waro was excellent over the 2004-05 summer, with all results below 180 *E. coli* per 100ml and therefore 100% compliance with the MfE guidelines.

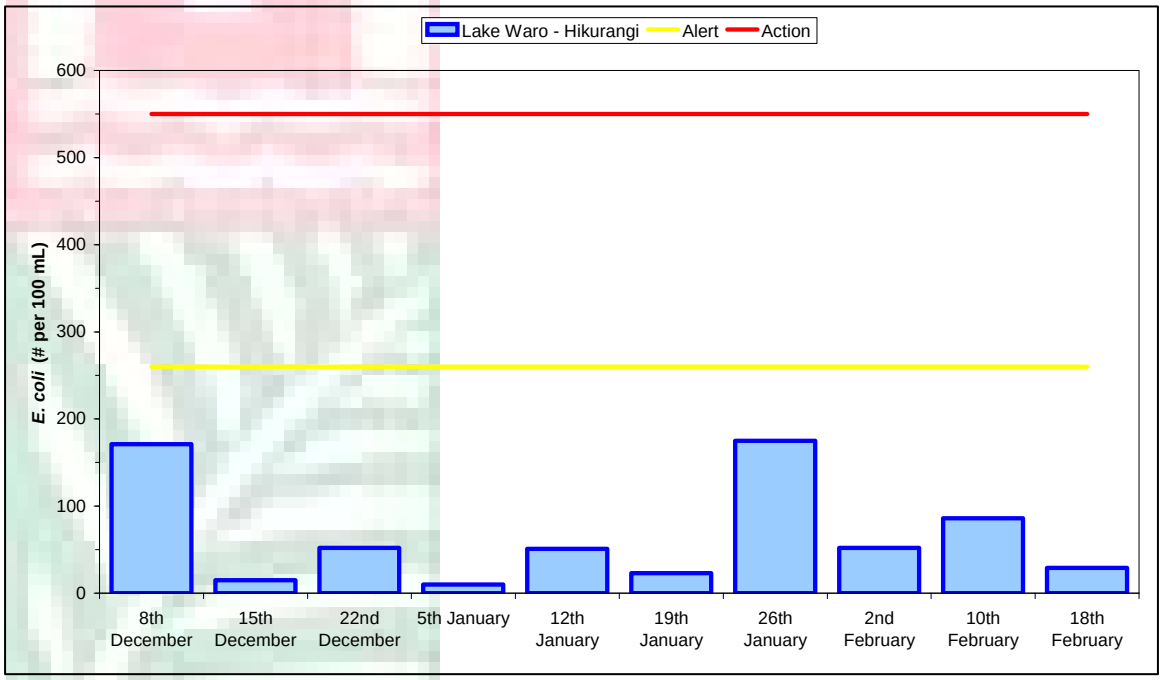


Figure 32: Results from the 2004-05 freshwater recreational contact sampling for Lake Waro, Hikurangi

A comparison of rainfall and *E. coli* showed no clear relationship between rainfall and bacteriological water quality in Lake Waro (Figure 33), which is consistent with Lakes Taharoa and Ngatu.

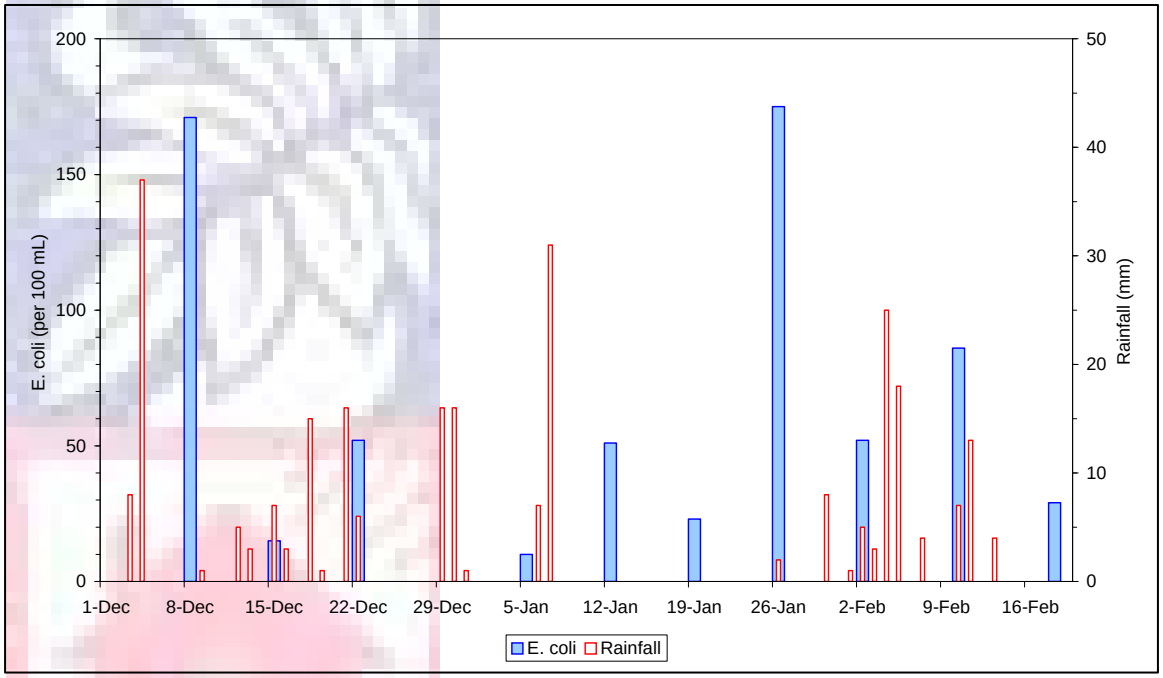


Figure 32: Rainfall and *E. coli* data for Lake Waro over the 2004-05 summer

There is insufficient data to calculate a MAC and therefore the SFRG grade for Lake Waro. It is likely if the excellent bacteriological water quality persists next summer that the MAC will be either "A" or "B". However this may not be the case as there are three historical *E. coli* results from the 2002-03 summer for Lake Waro of which two were elevated above the action threshold of 550 per 100 mL. It is recommended that sampling of Lake Waro is continued at least until an interim SFRG grade can be calculated.

5.17 OCEAN BEACH STREAM

SIC: VERY HIGH **MAC: INSUFFICIENT DATA** **SFRG: N/A**

Ocean beach stream is only small, flowing out onto Ocean Beach on the coastal side of Whangarei Heads, with a predominately sheep and beef farming catchment and some native forest in the headwaters. It is a popular stream for children to paddle in and therefore was added to the recreational monitoring programme for the 2004-05 summer. The most likely sources of bacteriological contamination include agricultural runoff and poorly maintained septic tanks.

Table 22: Collated results for the Ocean Beach Stream

	2004-05 SURVEY
Median	177 *E. coli* per 100 mL
95th Percentile	3076 *E. coli* per 100 mL
Alert Compliance	60 %
Action Compliance	70 %

Bacteriological water quality results from the 2004-05 summer indicate that Ocean Beach Stream was safe for recreational use on 6 of the 10 sampling occasions (Table 22). There was one extremely high spike of *E. coli* recorded on the 13th of December (Figure 34).

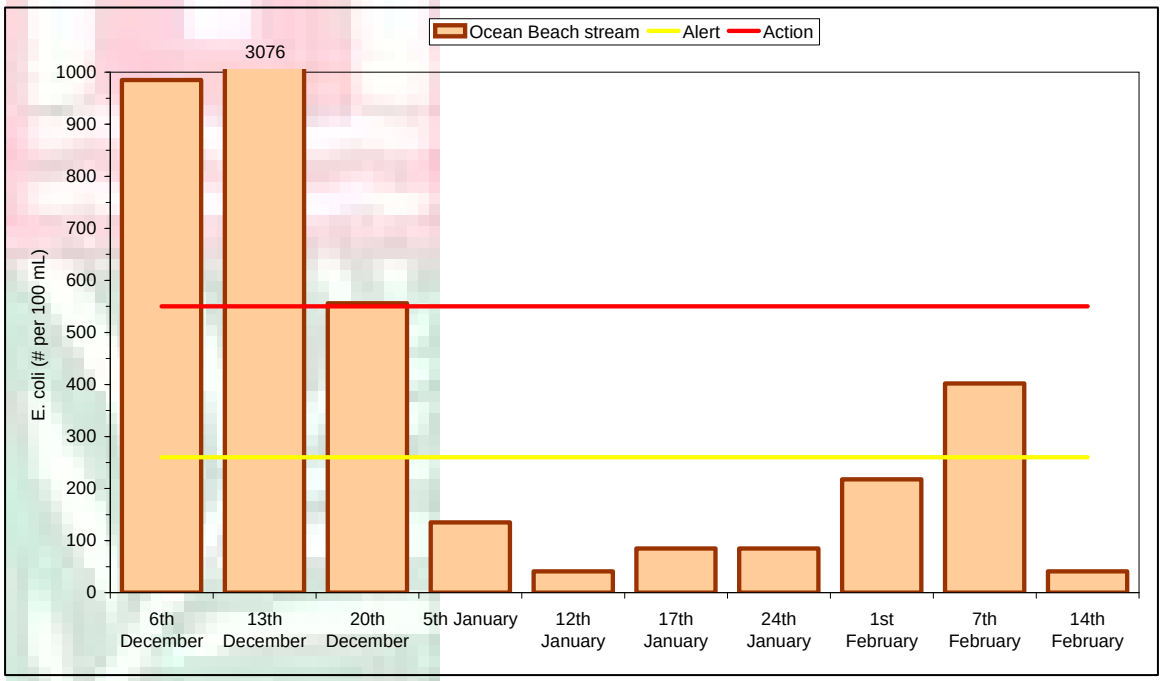


Figure 34: Results from the 2004-05 freshwater recreational contact sampling for Ocean beach stream

A comparison of rainfall and *E. coli* results suggests that there is a strong relationship between bacteriological water quality and rainfall at the Ocean Beach Stream site, particularly rain 1-2 days prior to sampling because of the short catchment (Figure 35). For example the high spike of 3076 E. coli per 100mL on the 13th of December is most likely related to the rainfall on the 12th that could be called a minor first flush event[5], which washed any agricultural and feral animal by-products accumulated on the ground into the stream. There is also potential that poorly maintained septic tanks that cannot cope with the increased ground saturation and stormwater associated with these rainfall events are contributing to these high *E. coli* results.

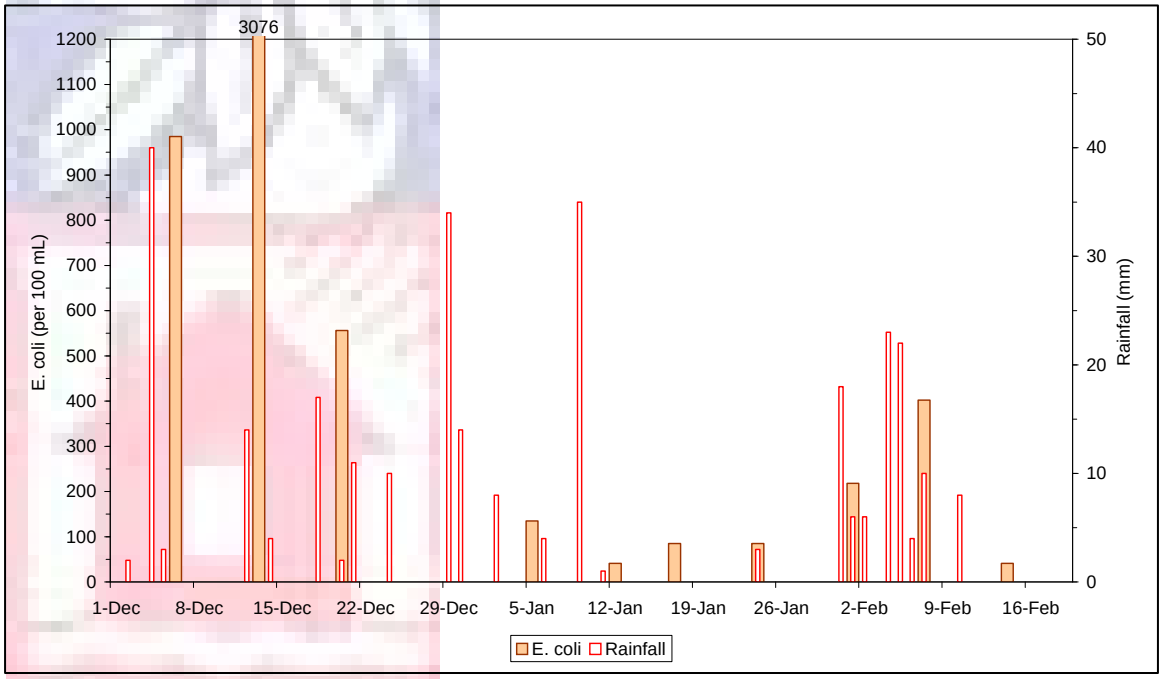


Figure 35: Rainfall and *E. coli* data at Ocean Beach Stream site over the 2004-05 summer

There is insufficient data to calculate a MAC and therefore the SFRG grade for Ocean beach stream. It is likely once enough data is obtained because of these rain influenced contamination events which are creating a high 95th percentile and the conservative approach of the SFRG system that the interim grade will be either "very poor" or "poor" for Ocean Beach Stream. It is recommended that sampling of Ocean Beach Stream is continued at least until an interim SFRG grade can be calculated.

[5] Dry for at least one week and than heavy rain directly prior to sampling

5.18 LANGS BEACH STREAM

SIC: VERY HIGH **MAC: INSUFFICIENT DATA** **SFRG: N/A**

This small stream flows on to Langs Beach and has a predominately native forest and shrub catchment with small areas of beef farming. Similarly to Ocean Beach Stream, Langs Beach stream is a popular spot for children to paddle in and therefore was added to the recreational monitoring programme in the 2004-05 summer. The most likely sources of bacteriological contamination include agricultural runoff, feral animals, poorly maintained septic tanks or a leak from the public toilets upstream of the site.

Table 23: Collated results for the Langs Beach Stream

	2004-05 SURVEY
Median	828 *E. coli* per 100 mL
95th Percentile	Insufficient data
Alert Compliance	0 %
Action Compliance	33 %

Bacteriological water quality was very poor in the Langs Beach Stream over the 2004-05 summer, consistently not suitable for recreational use with zero compliance with the alert threshold of 260 *E. coli* per 100mL (Table 23). As only 9 samples were collected over the summer a 95th percentile cannot be calculated but the median alone indicates how poor the water quality is. It is obvious from Figure 36 that *E. coli* levels steadily increase from the 23rd of December in Langs Beach Stream.

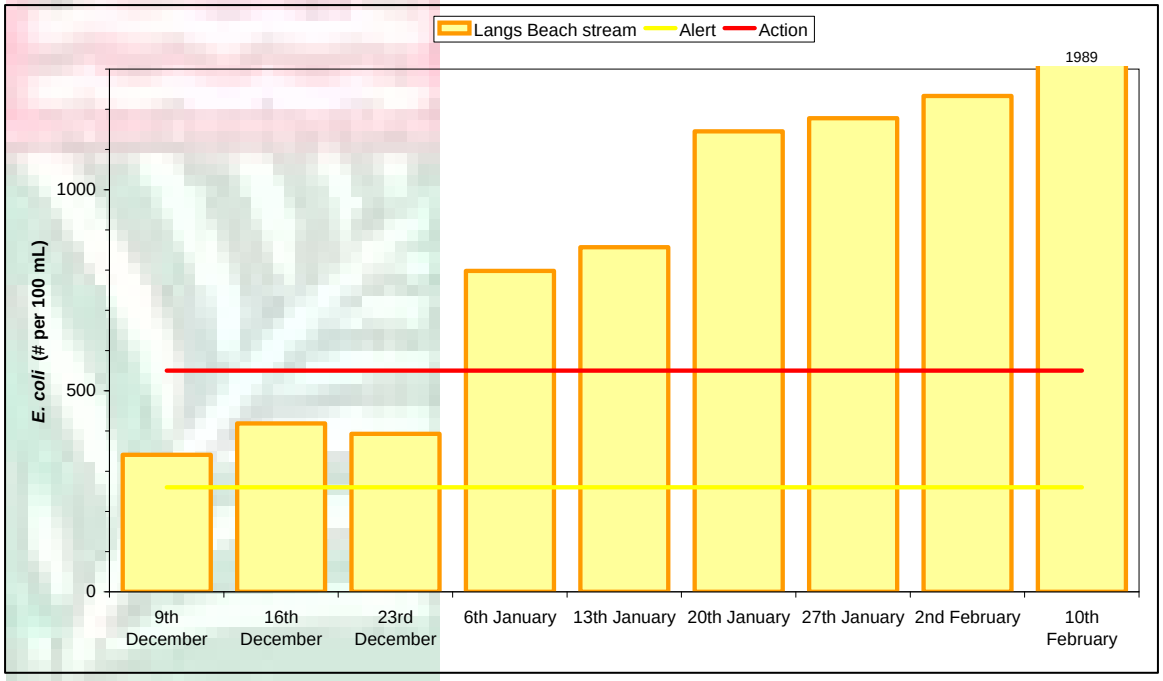


Figure 36: Results from the 2004-05 freshwater recreational contact sampling for Langs beach stream

E. coli results appear to be extremely high in Langs Beach stream irrelevant of rainfall (Figure 37) such as the 13th of January through to the 2nd of February where there was less than 10 mm of rain over 4 weeks, yet *E. coli* results were greater than 800 per 100 mL on every occasion. The steady increase, as mentioned above, most likely relates to the increased holiday population in Langs Beach from Christmas through January and suggests that poorly maintained septic tanks are the most probable source of this bacteriological contamination.

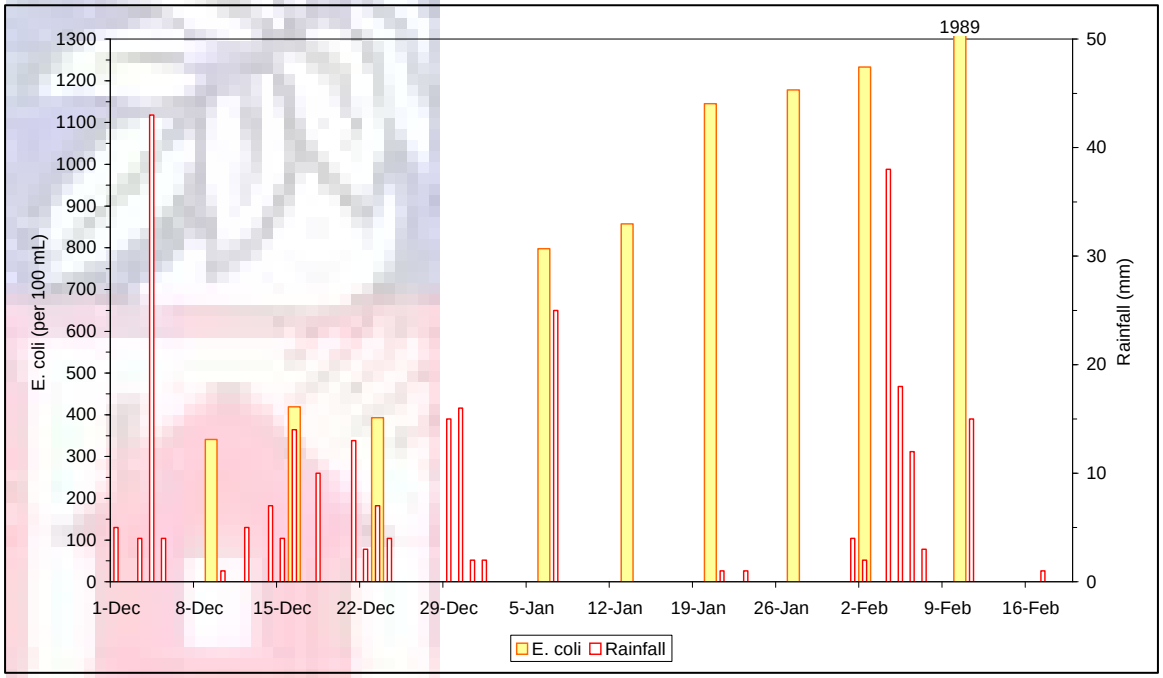


Figure 37: Rainfall and *E. coli* data for the Langs Beach Stream site over the 2004-05 summer

There is insufficient data to calculate a MAC and therefore the SFRG for Langs Beach stream. It is likely if these consistently high *E. coli* results continue for further summers that the interim SFRG grade will be either "very poor" or "poor" for Langs Beach stream. It is recommended that sampling of Langs Beach stream is continued at least for one more summer to see if the same pattern of increasing *E. coli* results after Christmas is observed. If *E. coli* levels are elevated again next year, it is recommended that faecal sterols or whitening agents are used to identify the source of contamination, i.e. human versus other animals.

At this stage Northland Health and Whangarei District Council are happy to address the potential health risks associated with the poor water quality in Langs Beach stream by educating people rather than warning signage.

6 SUMMARY TABLE

When looking at a summary of the freshwater bathing sites ranked by their median *E. coli* results over all surveys, a few things become clear (Table 24):

- Firstly, where new sites may fall within the SFRG grading system can be hypothesised such as Lake Waro, which will most likely be graded as "good" or "fair" when comparing its bacteriological water quality with other sites. In general, bacteriological water quality is very good in the three lakes monitored and is consistently suitable for contact recreational use. On the other hand, Langs Beach stream will most likely be graded as "very poor".

- Secondly, it becomes apparent which sites are probably unrealistically graded using the MfE guidelines to be worse than what they actually are such as Waitangi River, which has bacteriological water quality more similar to sites graded as "poor" rather than "very poor".

- Finally, it highlights how restrictive the MfE guidelines can be and possibly how they are not realistic for Northland with our semi-tropical weather conditions and therefore unpredictable rainfall in summer months. As the MAC assessment is based on the hazen 95th percentile, it typically only takes one elevated *E. coli* result caused by rainfall to give a 95th percentile above 550 *E. coli* per 100 mL and therefore a MAC assessment of "D". As shown in Table 24 all the sites, except the three lakes, have percentiles exceeding the 550 *E. coli* per 100 mL threshold, which immediately means they can only be graded as "poor" or "very poor" (Refer to Table 1 and 3).

Table 24: Table showing median and 95th percentile for *E. coli* per 100 mL based on all surveys at all sites monitored in the 2004-05 summer with their interim SFRG grade where available. Note: Sites are ranked by their median *E. coli* counts.

Location	Median	95th percentile	Interim SFRG
Lake Taharoa	5	139	Very good
Lake Ngatu	10	393	Fair
Lake Waro*	52	175	N/A
Kaihu River	85	5686	Poor
Omamari Beach Stream*	128	882	Follow up
Waipapa River	154	1498	Poor
Waitangi River	172	2419	Very poor
Ocean Beach Stream*	177	3076	N/A
Otaua Stream*	202	4352	N/A
Mangakahia River	230	6785	Poor
Kapiro Stream*	252	809	N/A
Tirohanga Stream	259	1484	Poor
Kerikeri River	275	7451	Very poor
Raumanga Stream	300	3655	Poor
Waitaua Stream	345	4526	Very poor
Wairoa Stream	686	1658	Very Poor
Langs Beach Stream*	828	N/A	N/A
Otiria Stream	933	3448	Very poor

*** Insufficient data to calculate interim SFRG**

7 CONCLUSIONS FROM THE SURVEY

The 2004-05 freshwater recreational contact survey was the most comprehensive the NRC has conducted since the programme began in 1999. The regime still falls short of the prescribed MfE guidelines (that recommend 20 samples per site per summer), but with weekly sampling at least enough data is being collected where results can be compared with rainfall data and problem sites identified.

The overall findings from the 2004-05 summer survey were that most of the rivers throughout Northland were generally acceptable for swimming and other freshwater recreational activities during the dry periods, but after heavy and/or prolonged rain, the waterways became unsuitable for days afterwards. In a region such as Northland with a semi-tropical climate and a high annual rainfall, using 95th percentiles for grading sites results in grades that do not necessarily reflect the "true" state of Northland's freshwaters.

Exceptions were Wairoa, Otiria and Langs Beach streams, which were all generally unsuitable for freshwater contact in all conditions. Otiria and Langs Beach streams are of the most concern as *E. coli* levels were consistently above the alert threshold over the entire summer.

On the other hand the three lakes sampled have consistently good water quality. Lakes are not as susceptible to rainfall as rivers and streams are, particularly the dune lakes of Northland which do not have any significant surface inflows. However, as results collected at Lake Ngatu in the Aupouri peninsula showed, even these lakes can be subject to occasional faecal contamination, and therefore sampling of Lakes Waro, Ngatu and Taharoa should continue.

Finally, it must be stressed that any findings presented in this document cannot be taken as absolute conclusions. In all likelihood the Langs Beach, Otiria and Wairoa sites are not the only unsafe sites in Northland and just because many of the sites were relatively good over the summer months does not necessarily make them suitable all year round, let alone from year to year. The impact that human activities have had on the health of our waterways should not be underestimated and it is probably best that, if you are unsure of the quality of a given swimming site, then that site should be considered potentially unsafe until you know otherwise.

8 RECOMMENDATIONS

Before each summer survey begins, it is customary for the NRC to meet with Northland's District Councils and Northland Health to discuss any amendments or changes from previous years. Reports such as this one typically provide the foundation for these discussions and it is therefore important to present several recommendations here, most of which were documented in the 2003-04 report but are yet to be addressed:

8.1 FURTHER SAMPLING

The NRC has not collected enough data to make formal SFRGs for any of the 18 swimming spots currently monitored. Therefore, it is recommended that none of the sites be dropped from future surveys and, in fact, that the sampling period is extended for at least another two weeks at the end of the season to the end of February.

As highlighted for Langs Beach stream where the *E. coli* results clearly suggest that human waste is a likely factor with the increased population at Langs Beach in January, there would be significant value in carrying out investigation into the source of contamination such as Faecal sterols or whitening agents. This would also be of value for investigating source at sites consistently performing poorly in the freshwater recreational surveys including Wairoa and Otiria streams and possibly also Waitaua, Raumanga streams and Kerikeri River sites.

Key Recommendation: All sites monitored in the 2004-05 survey remain for next summer's programme and sampling is extended to 12 weeks.

Key Recommendation: Faecal sterol or whitening agent sampling be carried out on at least Langs Beach, Wairoa and Otiria streams, and possibly others.

8.2 EDUCATION

The main purpose of these summer surveys is to determine what the potential risk is to those who indulge in freshwater recreation. This programme is now six years old and it may now be worthwhile to investigate setting some additional goals. In essence it is recommended that the NRC, in partnership with Northland Health and Northland's District Councils, begin to become more proactive.

People's health is inextricably linked to the health of their environment. In other words, and in very broad terms, if our waters are healthy then we as a people will be as well. The Regional and District Councils have developed, or are in the process of developing plans which, among other things, address water quality issues. However, this does not mean that the authorities involved need not take further action. By developing and promoting a region-wide health campaign, there is a real possibility that local authorities can make a massive, positive impact on the health and wellbeing of Northland's people and its environment.

Northland Health has distributed brochures detailing the simple ways in which people can determine how safe a body of water is for swimming (attached as Appendix One), but whether their message is getting across remains to be seen. Northland Health's campaign would be greatly aided if the Regional and District Councils became more

involved by also making the pamphlets available and discussing the principles of safe bathing as part of their own educational programmes. Individually, each organisation can only do so much and an integrated approach could make a real difference. It is therefore recommended that all of Northland's TLAs should become involved in disseminating the pamphlets by having them available with their other pamphlets and handing them out to schools when representatives make visits.

Schools need to be the primary target in any education campaign because children are both the most numerous users of inland swimming holes, plus one of the more at-risk groups. It may also be necessary to begin to erect more signs at Northland's most popular sites, not necessarily warning of the dangers of contact recreation, but instead providing advice on when it is best to swim and when the swimming holes should be avoided.

As well as warning people of the potential dangers, an education campaign should make people more aware of their own actions; "Am I or my family part of the problem?" is a question that, when linked to something as dear to people's hearts as water quality, can have a major impact. It is common knowledge that children are impressionable, that it is important for adults to set the "right" examples, but what is often forgotten is that children can also be extremely influential and that teaching our children is often the best way to get the message through to adults as well. Therefore an education programme, particularly targeted at schools, should aid in the dual goals of improving people's health and reducing the impact we, as a species, have on the environment (by improving stream health). The NRC, for example, is currently involved in making school children (and their teachers) aware of water quality issues and therefore it should not be too difficult to include some discussion of the causes and effects of bacteriological contamination as well.

In this regard it may be beneficial for policy-makers and those involved in the monitoring of Northland's bathing sites alike to perhaps set some long-term goals, especially in terms of awareness. Local bodies can lead the way on issues such as health and the environment, but it is up to the community as a whole if any substantial change is to occur.

Key Recommendation: That TLAs become involved with the distribution of the pamphlets attached as Appendix One of this document.

Key Recommendation: That the issues relating to freshwater contact recreation be integrated into all relevant agencies' education programmes.

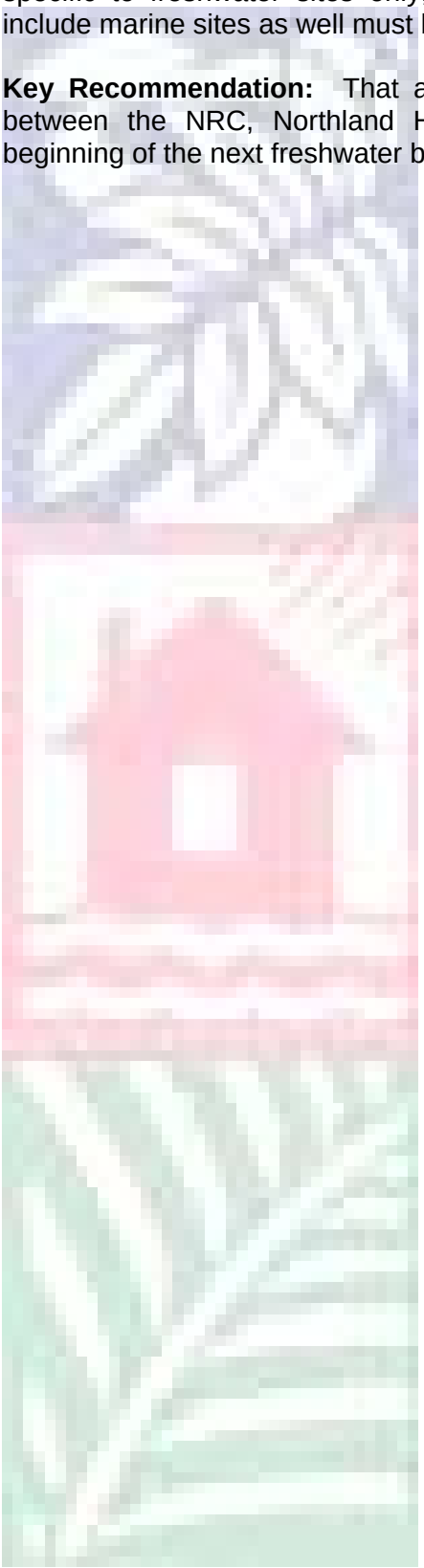
8.3 IMPROVING SIGNAGE

At present, it is not always clear which territorial authority should be responsible for the maintenance of warning signs at any given site. In conjunction with an expanding educational programme, another key step towards safer recreational-contact behaviour would be if all the authorities involved (NRC, Northland Health, and the three District Councils), developed a formal protocol for signage. This could be as simple as designing one sign for the entire region with the only variation being which District Council the site was in, or more complicated in which the signs become quite varied.

Details aside, a clear protocol would allow signage to be put up promptly without the need for any inter-agency discussions and thus better enable all involved in getting the risks associated with recreation contact out to the public. The development of such a protocol should be a top priority and, as such, should be drawn up before the start of

the next bathing survey (the summer of 2004-05). This protocol may have to be specific to freshwater sites only, although the option of expanding the protocol to include marine sites as well must be considered.

Key Recommendation: That a protocol for signage be drawn up and agreed to between the NRC, Northland Health and the three District Councils before the beginning of the next freshwater bathing survey.



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10 APPENDIX ONE

Public Health Unit
NORTHLAND

FRESHWATER SWIMMING AND AVOIDING GETTING SICK

A large number of disease-causing pathogens ("bugs") are found in the faeces ("poos") of humans and animals. Sadly many rivers in Northland are at times polluted by human and/or animal faeces.

What sort of sickness is caused by swimming in polluted rivers?

It used to be thought that only "tummy bugs" were caught from swimming in water polluted by faeces (poos). Recent studies show that other illnesses such as "colds", influenza, skin, eye and ear infections can also be caught through contact with water polluted by faeces.

Where does the human and animal faecal pollution come from?

There are three main sources of faecal pollution of waterways:

- Human sewage – one of the main sources of human sewage pollution in Northland is failing septic tanks. It is estimated that over 50% of septic tanks are not working properly in Northland. Other sources of human sewage pollution include broken or leaky pipes and sewage overflows.

- Stormwater - rainwater collected from roofs, driveways, roads, and other sealed surfaces is piped directly into waterways without treatment. It can contain waste from domestic animals.

- Farm animals - farm run-off, especially that from dairy farms, can add significantly to the contamination of waterways. Farm run-off has the same potential for causing illness in swimmers as contamination by human sewage. Wild birds can also pollute waterways with bird droppings.

How can you tell if a river is polluted by human or animal sewage?

One of the main ways is to consider how the land is used upstream. It is much more likely that a river has faecal pollution if there is a lot of farming or there is a community with septic tanks upstream.

Please see overleaf for a quick easy way for checking out water quality. The Northland Regional Council (0800 002 004) also has information on some of the rivers in Northland.

Checking out swimming water quality

Here is a quick checklist you can use to help you decide whether to swim in a river or not. Circle the score box of the statement that best describes the river or lagoon that you are considering swimming in. Add up the score at the end.

RAINFALL

score		
5	There has been heavy rain in the last 3 days	DO NOT SWIM HERE
4	There has been heavy rain in the last 7 days	
2	There has been some rain in the last 3 days	
0	There has been no recent rain	

WHAT IS THE LAND USE UPSTREAM FROM THE SWIMMING SITE?

score		
5	Town/city area, communities with septic tanks or intensive dairy farming	DO NOT SWIM HERE
4	Country area with sheep or cattle farming	
2	Forestry	
0	Native bush	

ARE THERE ANY STOCK OR BIRDS (20 PLUS) AT THE SWIMMING SITE?

score		
4	Yes, they have access to the waterway	DO NOT SWIM HERE
2	Yes, they are close to the edge of the waterway but do not have access	
2	No, but there are fresh droppings near the waterway	
0	No, there are no animals present	

AT WHAT DEPTH CAN YOU SEE YOUR FOOT CLEARLY

score	
4	Ankle depth (10cm)
3	Calf depth (35cm)
2	Knee depth (50cm)
1	Greater than knee depth

WHAT IS THE RIVER BOTTOM LIKE?

score	
3	Muddy
2	Sandy
1	Stony

WHAT IS THE SCORE?

11+	Poor water quality – the risk of catching a disease is high
7 to 10	Medium water quality – there is medium risk of catching a disease
1 to 6	Good water quality – the risk of catching a disease is low

Acknowledgment: Hawkes Bay Regional Council