



Marlborough's Freshwater Recreational Water Quality

2008-09

Prepared by:

F S Tiernan

Environmental Science and Monitoring

Marlborough District Council



EXECUTIVE SUMMARY

A number of freshwater locations in Marlborough are monitored on a weekly basis during the summer months and assessed against the Ministry for the Environment's (MfE's) bathing water guidelines. Marlborough's rivers are generally of good quality and are safe for recreational activities. However rivers that drain urban and intensive agriculture areas are more prone to poor water quality and are often not safe for recreational activities, even during dry weather. Wet weather events frequently result in exceedances of MfE's guidelines and therefore swimming following rainfall is not recommended, particularly in urban and intensive agricultural areas.

During the 2008-09 bathing water season, approximately a third of sites monitored were categorised as safe for recreational use for more than 90% of the time. The poorest performing sites were located on the Rai and the Taylor Rivers, exceedances at these sites were primarily related to rainfall events, during which contaminants are washed into the rivers.

Suitability for recreation grades (SFRG's) have been derived using MfE's methodology and are based on the most recent five years of microbiological data and sanitary inspections classes which have been re-assessed in 2009. All but one site (the Waihopai at Craiglochart) have enough samples to determine a complete Recreation Grade (SFRG). Regular monitoring of each site is recommended to allow for comparisons in freshwater quality each year and to assign complete Suitability for Recreation Grades (SFRG's) to each site.

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	OBJECTIVES	1
3.	SITES	1
4.	SAMPLING	2
4.1.	Indicator Organisms	2
4.2.	Guideline Values	3
4.2.1.	Microbiological Assessment Category (MAC)	3
4.2.2.	Sanitary Inspection Category (SIC)	4
4.2.3.	Suitability for Recreation Grades (SFRG)	4
5.	BATHING WATER QUALITY RESULTS 2008-09	5
5.1.	Rainfall Effects	7
5.2	Non-rainfall exceedances	9
5.3	Suitability For Recreation Grades (SFRG's) 2008-09	10
6.	CONCLUSIONS AND RECOMMENDATIONS	12
7.	REFERENCES	13
APPENDIX 1	Freshwater Bathing Site Locations	
APPENDIX 2	Results from the Bathing Water (Freshwaters) sampling from November 2008 to March 2009 inclusive	
APPENDIX 3	Graphed results for each Freshwater Bathing site for the Summer 2008-09 period in relation to MfE's bathing water standards (action level and alert levels)	
APPENDIX 4	Health warning sign for freshwater recreational bathing sites	
APPENDIX 5	<i>E. coli</i> numbers recorded during the heavy rainfall events during November and December 2008.	
APPENDIX 6	2008-09 Suitability for Recreation Grade (SFRG's) results	

1. INTRODUCTION

District councils are required under the Health Act 1956 to monitor environmental factors affecting public health and to abate conditions likely to be offensive or injurious to health. Water quality in our rivers and coastal areas can have an impact on public health.

Regional councils have responsibilities under the Resource Management Act 1991 for the planning and management of natural resources including fresh and coastal waters. The Marlborough District Council as a unitary authority has responsibility for both district and regional functions.

Guidelines for the safe use of recreational waters are defined by the Ministry for the Environment in the Microbiological Water Quality Guidelines (MfE, 2003). The recreational waters in Marlborough are sampled in accordance with these guidelines.

2. OBJECTIVES OF THE FRESHWATER BATHING PROGRAMME

The objectives of the bathing water programme are:

1. To provide the results of monitoring to the public as soon as they become available.
2. To assess the safety of each site in relation to the risk of contracting illness/infection at each site on a weekly basis and to inform the public as soon as possible.
3. To grade bathing water sites using MfE's 2003 guidelines for grading swimming rivers.
4. To assess the results of monitoring to allow for national comparisons between river bathing water sites and to enable long term trends in river bathing water quality to be determined.
5. To help identify sites which require additional investigation due to excessive faecal contamination.

3. SITES

During the summer of 2008-09 a total of 13 freshwater bathing sites were monitored on a weekly basis from November to March inclusive, the location of these sites are shown in Appendix 1. Table 1 details the name, location and grid reference of each site. In general the freshwaters of Marlborough are suitable for contact recreational activities, however there are areas which are more susceptible to contamination which can lead to an increased risk of illness and infection. The 13 sites that are chosen to be monitored each bathing water season are deemed high use and/or high risk sites. For example the Lower Wairau and the Rai River both have a high amenity value where kayaking, rowing and swimming are routinely undertaken during the summer months, these rivers are also deemed high risk due to land use practices which can lead to diffuse pollution within the catchments, which can impact on bathing water quality.

Table 1: Freshwater Sites 2008-09

Site name	Site ID	Grid Reference (NZTM)
Taylor @ Hutcheson Street Bridge	TYR-5	2589749, 5965963
Taylor @ Riverside	TYR-16	2590036, 5965687
Opawa @ Malthouse Reserve	OPR-40	2594039, 5964404
Opawa @ Elizabeth Street Footbridge	OPL-1	2590450, 5966000
Wairau @ Blenheim Rowing Club	WRR-1	2594332, 5968306
Wairau @ Wairau Rowing Club	WRR-9	2592398, 5969476
Wairau @ Ferry Bridge	WRR-8	2591253, 5971829
Wairau Diversion @ Neals Road	WDV-1	2594005, 5973346
Pelorus @ Totara Flat	PLR-3	2558264, 5989435
Rai @ Brown River Reserve	RAR-2	2559215, 5998566
Rai @ Rai Falls	RAR-1	2558020, 5990970
Pelorus @ Pelorus Bridge	PLR-2	2558079, 5989795
Waihopai @ Craiglochart Bridge # 2	WHR-3	2565059, 5952794

4. SAMPLING

The water quality at each site is tested for the presence of *Escherichia coli* (*E. coli*) and the results are reported in MPN/100mL (most probable number). All laboratory testing is carried out by the Cawthron Institute in Blenheim. *E. coli* is chosen as the indicator bacteria for freshwater as it is deemed to be a good indicator of recent sewage and/or faecal contamination.

4.1 Indicator Organisms

An indicator organism can be defined as an organism which is used to indicate the **potential** presence of another organism. *E. coli* is the indicator organism used when monitoring freshwater recreational sites. When monitoring freshwaters used for recreational purposes, the primary concern is the presence of organisms which can cause illness and/or infection in people. It may not always be possible to identify specific disease causing organisms due to their low numbers, difficulty and expense of analysis among other reasons; therefore the waters are tested for indicator organisms, in this case *E. coli*. The advantages of using *E. coli* as the indicator organism are 1) it is easy to sample and inexpensive to measure and 2) it can survive for several weeks in freshwater and is therefore a definite indication of recent faecal contamination. *E. coli* is present in the gut of all warm blooded animals (including humans, mammals and birds), all of which are potential carriers of disease causing organisms in humans.

The number of *E. coli* present in a water sample (100mL) denotes the potential health risk of the waters to humans, it is not a direct measurement of the actual health risks, and therefore an exceedance of the guideline value will indicate that there is an increased risk to bathers in the area. Further details on how this risk is quantified are available in Appendix 2 of the Microbiological Water Quality Guidelines (MfE, 2003).

4.2 Guideline Values

The guideline values for safe freshwater recreational sites have been determined by MfE and are as follows:

	For a <i>single</i> sample		Requirement	
Acceptable 'Green Mode'	< 260 <i>E.coli</i> / 100mL	Highly likely to be uncontaminated	Routine monitoring	Safe 😊
Alert 'Amber Mode'	> 260 < 550 <i>E.coli</i> / 100mL	Potentially contaminated	Investigate likely causes	OK 😐
Action 'Red Mode'	> 550 <i>E.coli</i> / 100mL	Highly likely to be contaminated	Further investigation, inform relevant interested parties	Unsafe 😞

These levels are based on an estimate that approximately 5% of *Campylobacter* infections could be attributable to freshwater contact recreation (MfE, 2003). In addition, the Ministry of the Environment has developed Suitability for Recreation Grades (SFRG's). These are defined using the Microbiological Assessment Category (MAC) and the Sanitary Inspection Category (SIC).

4.2.1 Microbiological Assessment Category (MAC)

The Microbiological Assessment Category is assessed using data from the previous 5 years. A minimum of 100 samples over five bathing water seasons (November to March inclusive) is required in order to establish a complete MAC, if there are less than 100 samples over this 5 year period then the MAC status is defined as being incomplete. Marlborough District Council has been carrying out monitoring of freshwater bathing sites since 1996, however in order to obtain a completed MAC grade a minimum of 20 samples for each bathing water season for a period of 5 years is required. For the 13 sites sampled this year the number of samples per year (over the last 5 years) ranges from 96 to over 100. Table 2 below defines the MAC grades.

Table 2: Microbiological Assessment Category (MAC) definitions

Grade	95 th Percentile (Hazen method)
A	≤ 130 <i>E.coli</i> / 100mL
B	131 - 260 <i>E.coli</i> / 100mL
C	260 - 550 <i>E.coli</i> / 100mL
D	> 550 <i>E.coli</i> / 100mL

The MAC grade is assessed each year based on the previous 5 years of data. The MAC is used in conjunction with the Sanitary Inspection Category (SIC) to obtain Suitability for Recreation Grades (SFRGs) for each site. There are between 21 and 22 weeks in the bathing water season so it is important to ensure each site is consistently monitored over the bathing water season to ensure accurate reporting of MAC grades and Suitability for Recreation Grades (SFRGs).

4.2.2 Sanitary Inspection Category (SIC)

The SIC assigns a category to the site based on the risk of contamination associated with faecal sources in the vicinity. Figure 1 details this risk. Marlborough District Council assigned SIC classes to the freshwater bathing sites in 2004 (MDC, 2004), these have been reassessed in 2009.

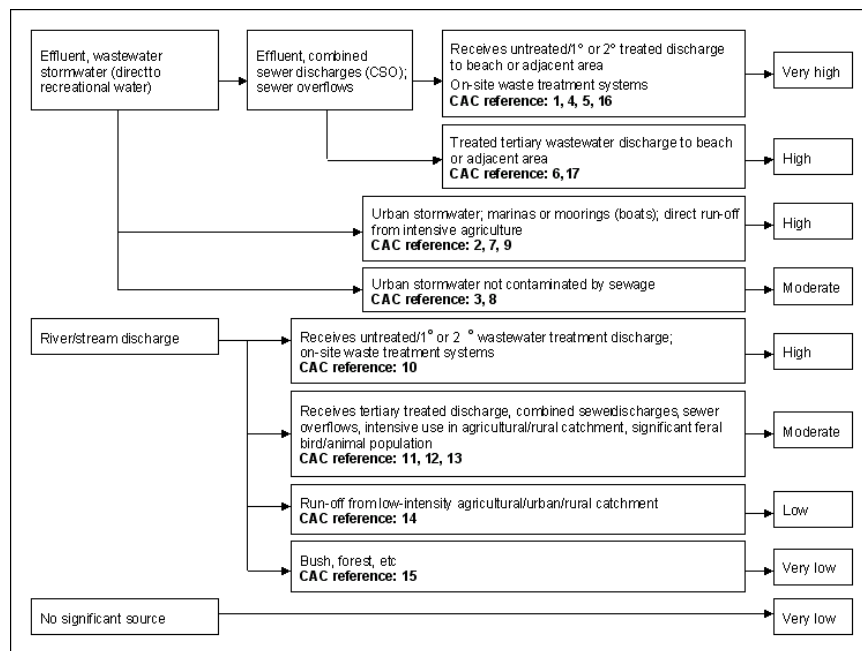


Figure 1: Sanitary Inspection Category for freshwater sites (MfE, 2003)

4.2.3 Suitability for Recreation Grade (SFRG)

Bathing water sites are graded according to the SFRGs, as follows:

- Very Good,
- Good,
- Fair,
- Poor and
- Very Poor.

Suitability for Recreation Grades (SFRGs) are obtained using the MAC in conjunction with the SICs (figure 2) and are calculated using MfE's Recreational Water Quality Assessment software called 'Bathewatch'.

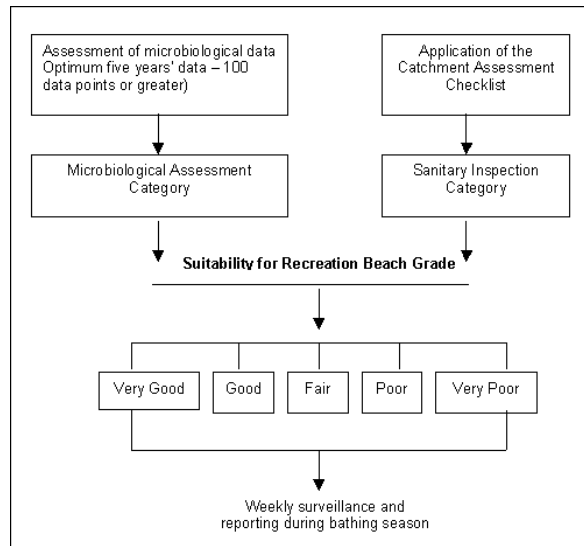


Figure 2: Requirements for grading swimming rivers (MfE, 2003)

5. BATHING WATER QUALITY RESULTS 2008-09

The results of the summer 2008-09 sampling are shown in Appendix 2. These results are graphed for each site and are shown in Appendix 3. The results show the *E. coli* numbers alongside rainfall (72 hour total) and are plotted against both the alert and action level bathing water guideline standards.

Figure 3 shows the percentage of time the sites were deemed safe or otherwise for swimming and are ranked accordingly. The Rai the Taylor sites had the poorest water quality during the summer 2008-09 season and the Waihopai and the Upper Pelorus (at the state highway bridge) had the best.

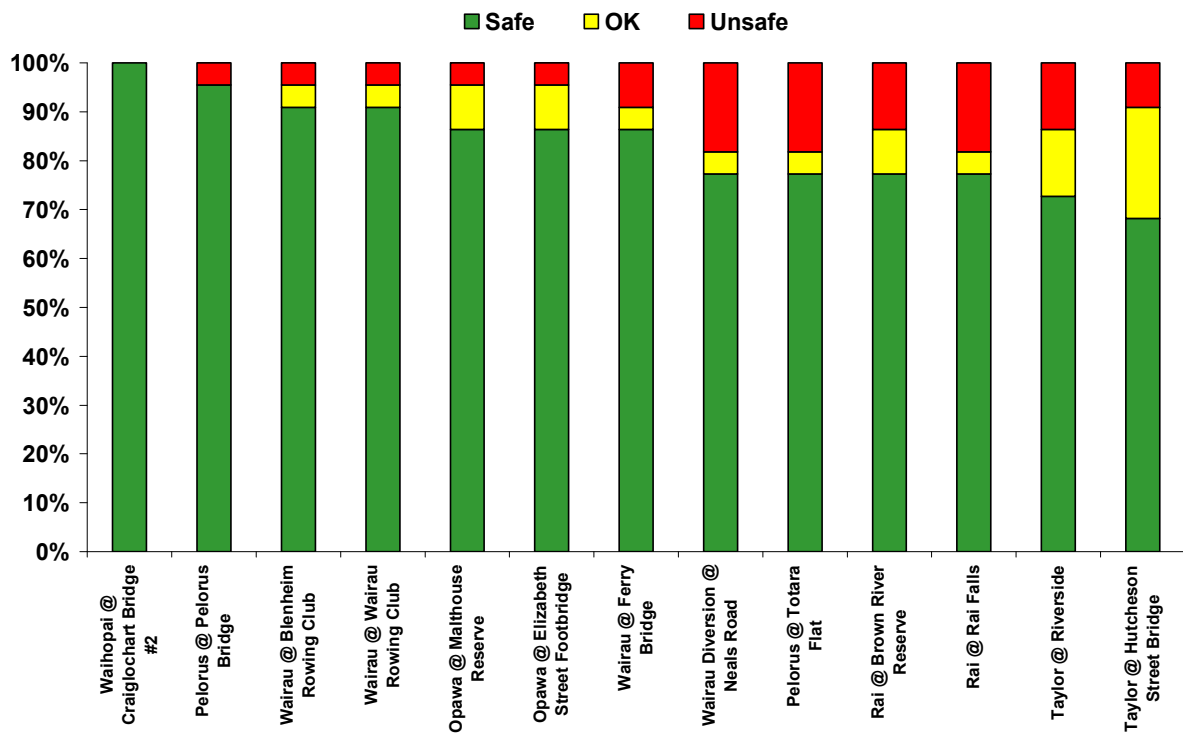


Figure 3: Freshwater bathing sites ranked according to the percentage of time they were suitable for contact recreation.

Figure 4 shows the median *E. coli* count for each of the sites. The sites are ranked from highest to lowest. The best water quality is recorded at the Wairau sites and at the Upper Pelorus. The poorest water quality is recorded at the Taylor River sites. The Rai sites, in contrast to the results from figure 3 above, are ranked midway between poor and good water quality. The Rai has historically recorded poor water quality but results from this years' sampling shows that during dry weather water quality is generally good to very good. This may in part be a reflection of improvements in the catchment as part of the Clean Streams Accord whereby farmers are required to install bridges on all river crossings used by dairy herds. The latest report shows that 41% of crossings have been eliminated since work began in 2003, of these 79% of the high priority crossings have been eliminated (MDC, 2009). A median guideline of 126 *E.coli* /100mL is sometimes quoted as an acceptable number for lowland rivers (McBride *et al.* 1991). A survey in 2004 of 410 river sites in New Zealand showed that 14% of sites exceeded the median guideline value of 126

E.coli /100mL (Scarsbrook and McBride, 2004). This is similar for Marlboroughs freshwater recreation sites where approximately 15% of sites exceed this guideline (figure 4).

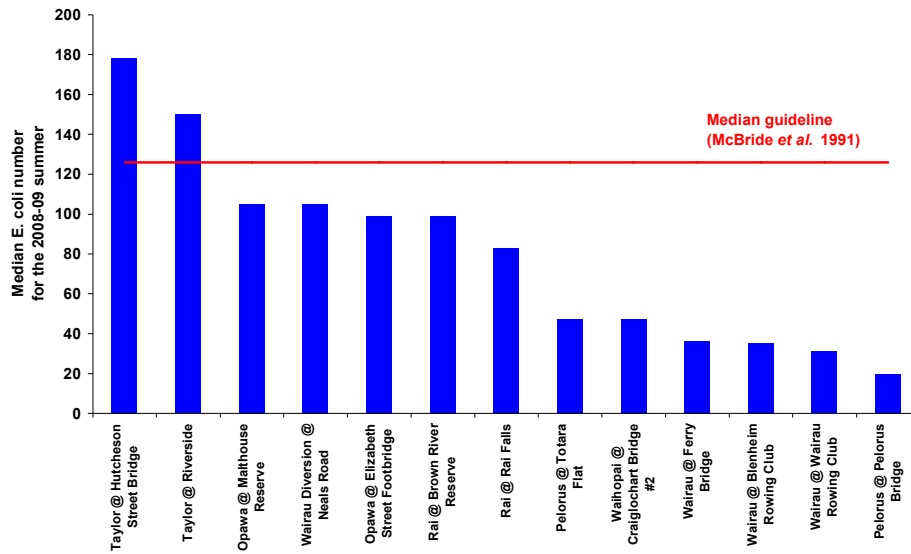


Figure 4: Freshwater bathing sites ranked according to the median *E. coli* count recorded during the 2008-09 bathing water season.

5.1 Rainfall Effects

E. coli numbers have been shown to be highly correlated with turbidity (Davies-Colley *et al.*, 2004) and in many instances turbidity can be used as a surrogate for *E. coli* numbers, both in large and small agricultural catchments (Collins 2002, Nagels *et al.*, 2002, Muirhead *et al.*, 2004). High turbidity results in poor water clarity, thus swimming in areas which appear dirty or murky should be avoided.

Heavy rainfall was responsible for many of the exceedances recorded at the bathing water sites. In addition heavy rainfall in the Rai Valley during November and December led to vast areas of land being flooded (Photos 1-3) and resulted in some of the highest bacteria numbers recorded in the catchment.



Photo 1



Photo 2

It is likely that due to the flooding, effluent ponds would have overflowed and entered the waterways. Warning signs (Appendix 4) were put up at three sites; the Rai at Brown River Reserve, the Rai at Rai Falls and the Pelorus at Totara Flat.



Photo 3: The Rai Valley floods (Maike van der Heide, The Marlborough Express).

Intensive monitoring was carried out to determine the relationship between *E. coli* numbers and rainfall. The results from this monitoring are excluded from the results of routine monitoring used for calculating Recreation Grades for the sites. The Rai and Pelorus sites were monitored on a daily basis until two consecutive clear results showed that faecal contamination no longer posed a risk to the public. The warning signs were then subsequently removed.

Figure 5 shows the *E. coli* numbers recorded at the Rai and Pelorus sites during the heavy rain in November and December. Routine monitoring of the bathing water sites have a maximum detection limit of 2,000 *E. coli* /100mL, however for the wet weather survey of the Rai and Pelorus, separate laboratory analysis with a maximum detection limit of 20,000 was used for the samples. The highest *E. coli* number (20,000 *E. coli* /100mL) recorded during this time was from the Pelorus at Totara Flat on the 25 November 2008. Illegal dumping of animal effluent was discovered approximately 800m upstream of Pelorus Flat. It is likely that during heavy rainfall, such as took place in November and December 2008, this effluent would have had a significant impact on water quality downstream. This effluent would not have had an effect on water quality at the Rai Falls or at the Pelorus Bridge.

Appendix 5 shows the results for the wet weather survey, alongside 24 hour rainfall totals. For clarity the maximum *E. coli* number included in figure 4 is 2,000 *E. coli* /100mL.

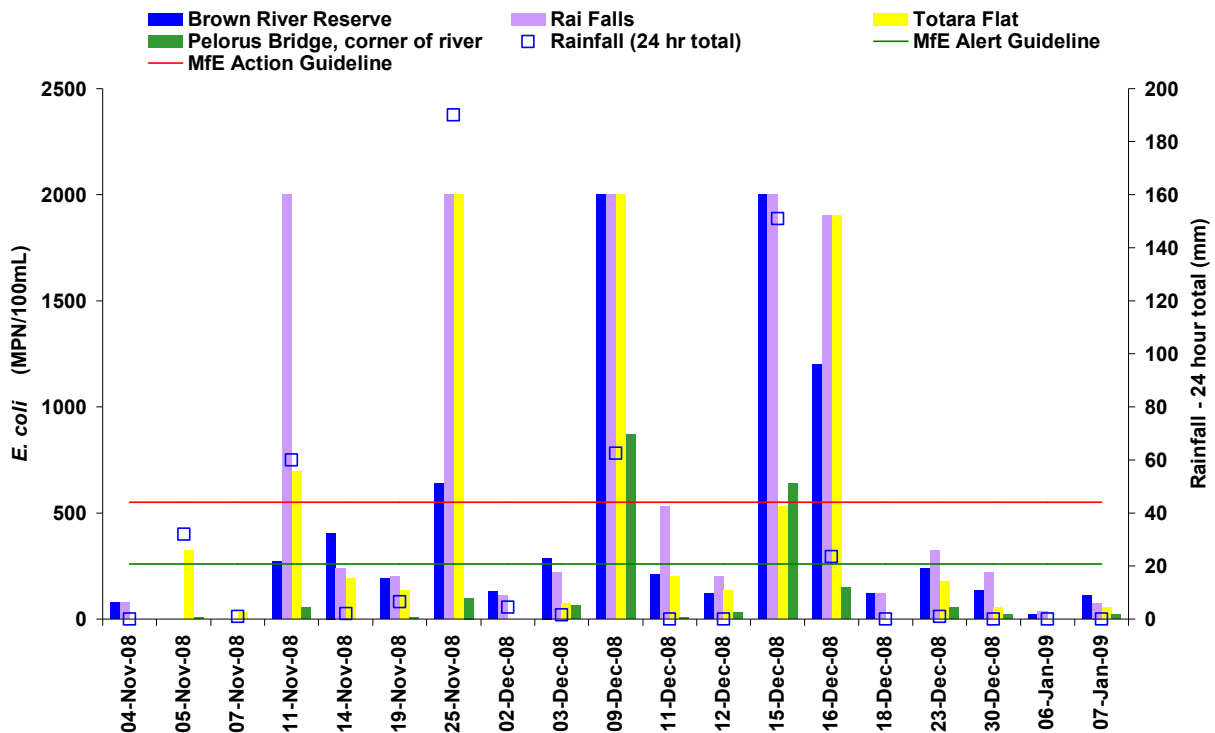


Figure 5: *E. coli* numbers recorded at the Rai and Pelorus sites from November to January. Heavy flooding in November and December led to warning signs being put up at 3 of the 4 sites.

During the survey it was found that *E. coli* numbers are more highly correlated with rainfall from the previous 24 hours than with rainfall over the longer term.

5.2 Non-rainfall exceedances

Of the 47 exceedances of the MfE guidelines (i.e. >260 *E. coli* /100mL) only 4 were during dry weather. These were:

- Opawa at Malthouse Reserve 31 December 2008 (week 9) 478 *E. coli* /100mL
- Wairau Diversion at Neals Road 7 January 2009 (week 10) 324 *E. coli* /100mL
- Wairau at Ferry Road Bridge 14 January 2009 (week 11) 306 *E. coli* /100mL
- Taylor at Hutcheson 18 March 2009 (week 20) 324 *E. coli* /100mL

None of the above exceeded the MfE action guideline of 550 *E. coli* /100mL (figure 6).

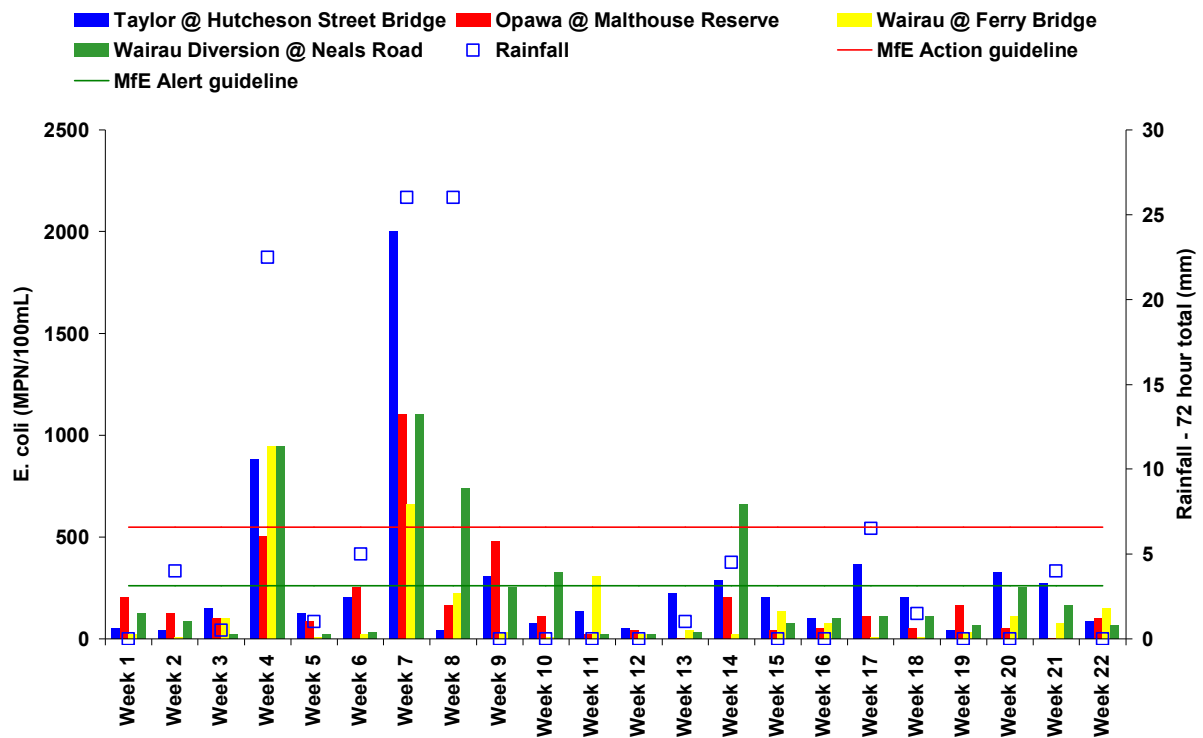


Figure 6: Dry weather exceedances of MfE’s alert level guideline.

Of the four the exceedance from the Wairau at Ferry Road Bridge is the most unusual as the median *E. coli* number at this site is low. Median numbers at the 3 other sites are amongst the highest and thereby the exceedances could be explained by the high background numbers of *E. coli*.

5.3 Suitability for Recreation Grades (SFRGs) 2008-09

The Suitability for Recreation Grades were calculated using monitoring data collected over the last five years and from the results of the sanitary inspection categories (SIC). The results are shown in Appendix 6 and are summarised in Table 3. Due to the number of incomplete beach grades in previous years the sanitary inspection categories, which were originally calculated in 2004 (MDC, 2004), have been recalculated in 2009.

Table 3: Suitability for Recreation Grades for Marlboroughs Freshwater Bathing sites

Site	MAC Grade* Summer season 2008-09	MAC Grade** long term (5 years)	Trend	SFRG	Status of SFRG grade
Opawa at Elizabeth St Footbridge	C	C	↔	Fair	Complete
Opawa at Malthouse Reserve	D	D	↔	Poor	Complete
Pelorus Bridge	C	D	↑	Poor	Complete
Pelorus at Totara Flat	D	D	↔	Very Poor	Complete

Rai at Brown River Reserve	D	D	↔	Very Poor	Complete
Rai at Rai Falls	D	D	↔	Very Poor	Complete
Taylor at Hutcheson	D	D	↔	Very Poor	Complete
Taylor at Riverside	D	D	↔	Very Poor	Complete
Waihopai at Craiglochchart	B	D	↑	Poor	Complete
Wairau at Blenheim Rowing Club	D	C	↓	Fair	Complete
Wairau at Ferry Bridge	D	C	↓	Fair	Complete
Wairau at Wairau Rowing Club	D	C	↓	Fair	Complete
Wairau Diversion at Neals Road	D	D	↔	Poor	Complete

* Based on the 95th percentile for the 2008-09 Bathing Water season.

** Calculated using MfEs' Bathewatch programme, includes the latest 5 years of microbiological data

All but the Waihopai at Craiglochchart have in excess of the minimum number of samples (>100) required to calculate a complete microbiological assessment grade (MAC grade). The Waihopai has a total of 96 samples over 5 years. Where there are apparent inconsistencies in the recorded microbiological data and the SIC, Bathewatch calculates the most conservative grade for the site and flags the grade as a 'Follow-up Grade'. All of the sites assessed in 2009 had complete SFRG's.

Based on the above grades the best freshwater bathing sites are only classed as Fair, approximately a third of sites fall into the Fair, Poor and Very Poor classes respectively (figure 7), with 69% being graded as Poor or Very Poor. Scarsbrook and McBride (2004) showed that from 410 river sites in New Zealand 69% were rated as Poor or Very Poor according to MfE's methodology for grading sites.

Twelve of the thirteen sites have enough data over five years to determine complete MAC grades. None of the sites had inconsistencies between the monitoring data and the sanitary inspection categories and therefore the confidence in the final grades is high. Most sites had similar water quality to that recorded in the long term (over a five year period). The Waihopai at Craiglochchart showed the most significant improvement over the long term whilst the Wairau sites showed a deterioration in water quality over the long term (table 3).

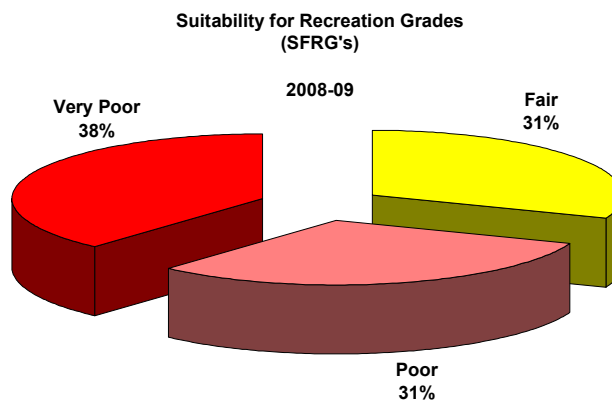


Figure 7: Pie-chart of SFRG's for the freshwater bathing sites for the 2008-09 summer.

6. CONCLUSIONS AND RECOMMENDATIONS

River and stream systems are highly valued in the Marlborough region and there is a perception/demand that the water quality is of a high enough standard that water-based recreational activities are safe, especially during the warmer summer months. Water quality monitoring during the 2008-09 period showed that approximately a third of the sites monitored were safe for swimming for 90% or more of the time. Nearly 70% of sites are classed as poor or very poor according to MfE's recreational water quality grading system.

There are few point source discharges to rivers and streams in the Marlborough region, with the exception of stormwater discharges in urban areas. The high correlation between *E. coli* numbers and rainfall demonstrates the impact land-use has on water quality, with urban areas and areas of intensive pastoral farming having the poorest water quality. This is not inconsistent with what has been reported on a national level (Larned *et al.*, 2004). Therefore in order to improve water quality for recreational use management strategies need to focus on diffuse sources of pollution. There are initiatives already in place e.g. Marlborough District Councils 'Stormwater Strategy' and the 'Clean Streams Accord', which focus on water quality in Blenheim's urban area and in the Rai catchment respectively. Ongoing monitoring of recreational freshwaters will assess the effectiveness of these and other programmes.

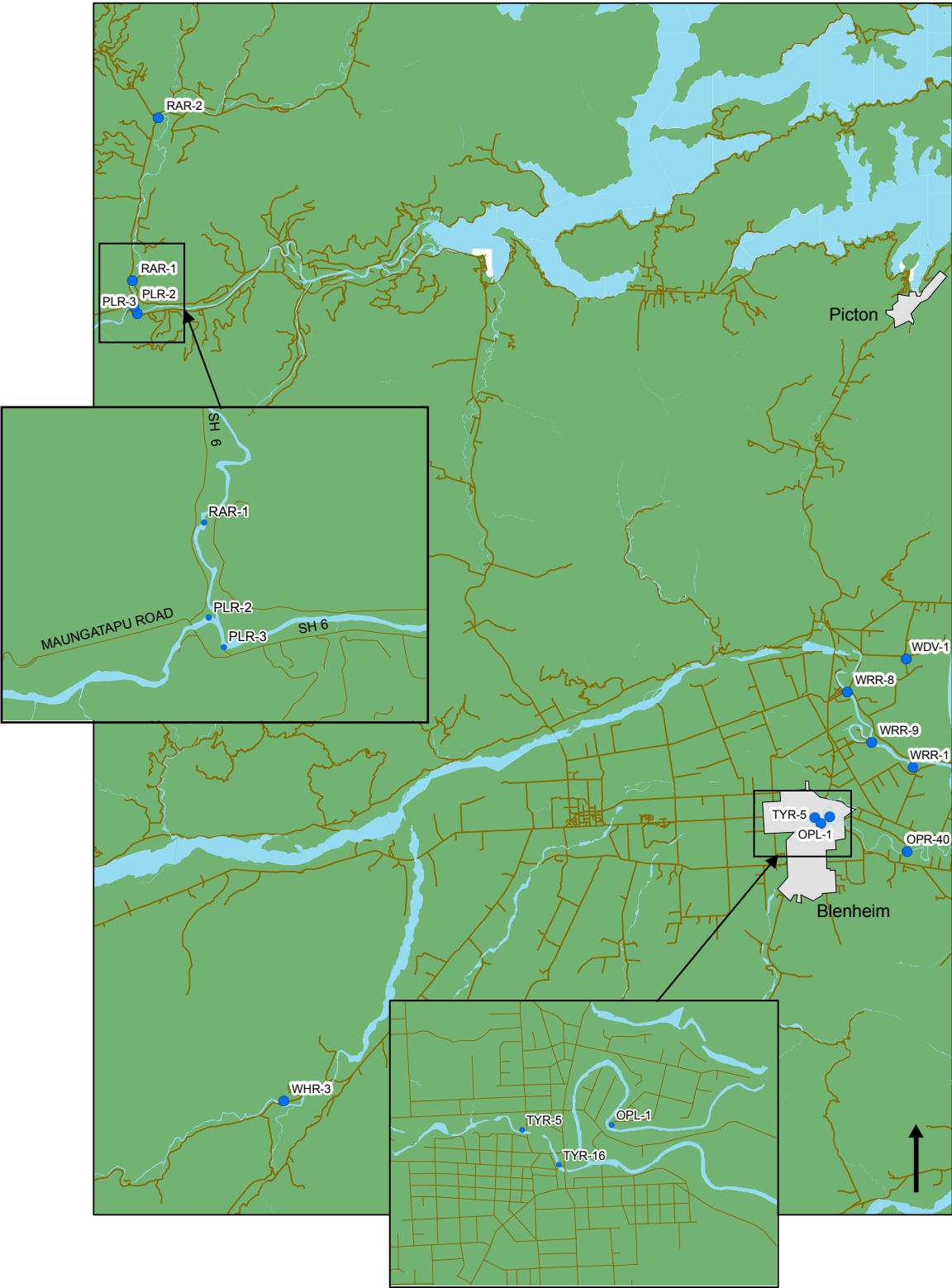
Regular monitoring of each site is recommended to allow for comparisons in freshwater quality each year and to assign complete SFRG grades to each site. Wet weather can result in very high *E. coli* numbers (up to 20,000 /100mL), however the current methods of analysis only allow for the detection of a maximum of 2,000 /100mL. It is recommended that the method of analysis be changed to allow for upper detection limits to be extended to up to 20,000 /100mL to allow for a more accurate detection of trends in *E. coli* numbers over time.

7. REFERENCES

- Collins, R. (2002) *Management strategies to mitigate faecal contamination inferred from analysis of data from the Waikato Region*. MAF Technical Publication Paper No: 2002/15.
- Davies-Colley, R., Nagels, J., Donnison, A. and Muirhead, R. (2004) *Flood flushing of bugs in agricultural streams*. Water and Atmosphere. Vol. 12 (2) 18-20.
- Larned, S. T., Scarsbrook, M. R., Snelder, T. H., Norton, N. J. and Biggs, B. J. F. (2004) *Water quality in low-elevation streams and rivers of New Zealand: recent state and trends in contrasting land-cover classes*. New Zealand Journal of Marine and Freshwater Research. Vol 38: 347-366.
- McBride, G.B, Cooper, A. B. and Till, D. G. (1991) *Microbial water quality guidelines for recreation and shellfish gathering waters in New Zealand*. NZ Department of Health, Wellington.
- MDC (2009) *Dairyshed Effluent and Stream Crossing Surveys*. Marlborough District Council.
- MDC (2004) *Freshwater Contact Recreational Monitoring Programme Summary Report 2003/2004*. Marlborough District Council.
- MfE (2003) *Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas*. Ministry for the Environment <http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03/microbiological-quality-jun03.pdf>
- Muirhead, R. W., Davies-Colley, R. J., Donnison, A. M. and Nagels, J. W. (2004) *Faecal bacteria yields in artificial flood events: quantifying in-stream stores*. Water Research. Vol 38: (5), 1215-1224.
- Nagels, J. W., Davies-Colley, R. J., Donnison, A. M. and Muirhead, R. W. (2002) *Faecal contamination over flood events in a pastoral agricultural stream in New Zealand*. Water and Science Technology. Vol. 45, 45-52.
- Scarsbrook, M. and McBride, G. (2004) *Levels of E. coli in New Zealand's rivers*. NIWA Client Report: HAM2004-157. December 2004.

APPENDIX 1

Freshwater Bathing Site Locations



APPENDIX 2

Results from the weekly Bathing Water (Freshwater) sampling beginning 1st November 2008 to 31st March 2009

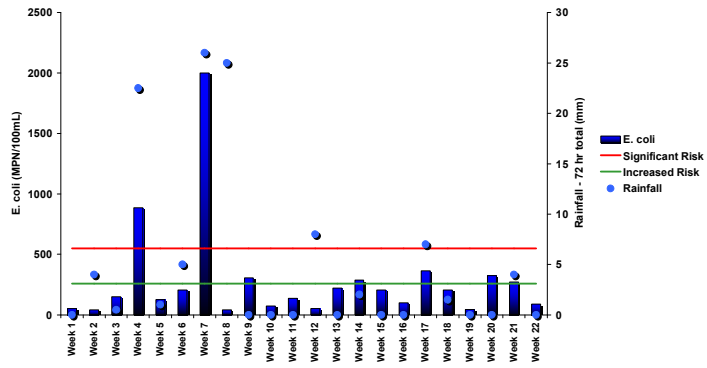
	TYR-5	TYR-16	OPR-40	OPL-1	WRR-1	WRR-9	WRR-8	WDV-1	PLR-3	RAR-2	RAR-1	PLR-2	WHR-3		
	Taylor @ Hutcheson Street Bridge	Taylor @ Riverside	Opawa @ Malthouse Reserve	Opawa @ Elizabeth Street Footbridge	Wairau @ Blenheim Rowing Club	Wairau @ Wairau Rowing Club	Wairau @ Ferry Bridge	Wairau Diversion @ Neals Road	Pelorus @ Totara Flat	Rai @ Brown River Reserve	Rai @ Rai Falls	Pelorus @ Pelorus Bridge	Waihopai @ Craiglochart Bridge #2	Increased Risk	Significant Risk
Week 1	53	64	207	164	20	5	20	124	324	79	79	10	30	260	550
Week 2	40	75	124	10	20	10	10	87	697	271	2000	53	30	260	550
Week 3	150	87	99	99	10	30	99	20	137	190	200	5	40	260	550
Week 4	885	1400	504	164	384	478	945	945	2000	640	2000	100	164	260	550
Week 5	124	111	87	99	40	40	10	20	75	288	222	64	20	260	550
Week 6	207	75	254	75	30	30	20	30	2000	2000	2000	870	87	260	550
Week 7	2000	2000	1100	504	1000	738	659	1100	1900	1200	1900	150	238	260	550
Week 8	40	124	164	560	164	75	222	738	178	238	324	53	87	260	550
Week 9	306	254	478	164	53	64	30	254	53	137	222	20	5	260	550
Week 10	75	659	111	40	30	5	10	324	53	111	75	20	53	260	550
Week 11	137	137	20	222	10	254	306	20	10	53	64	42	42	260	550
Week 12	53	344	42	75	42	20	20	20	31	64	64	87	31	260	550
Week 13	222	150	5	178	99	20	42	31	31	87	5	20	42	260	550
Week 14	288	429	207	87	5	222	20	659	10	10	20	10	150	260	550
Week 15	207	238	42	254	111	53	137	75	31	5	31	20	31	260	550
Week 16	99	99	53	99	75	20	75	99	42	20	87	10	87	260	550
Week 17	364	406	111	238	53	31	10	111	111	238	222	87	150	260	550
Week 18	207	150	53	306	5	42	10	111	42	137	150	10	99	260	550
Week 19	42	10	164	5	10	20	31	64	5	5	5	5	31	260	550
Week 20	324	150	53	53	31	20	111	254	20	31	53	10	64	260	550
Week 21	271	254	5	99	20	42	75	164	20	53	5	10	64	260	550
Week 22	87	164	99	31	111	31	150	64	5	64	42	20	31	260	550

Less than values are halved i.e. <10 MPN/100mL becomes 5.
An upper detection limit of 2000 *E. coli* /100mL applies to all samples

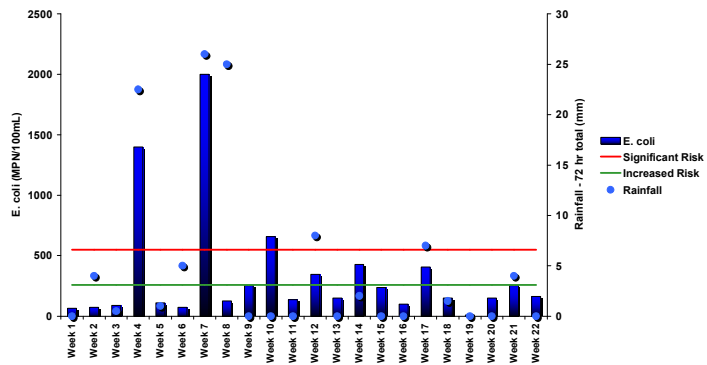
APPENDIX 3

Graphed results for each Freshwater Bathing site for the Summer 2008-09 period in relation to MfE's bathing water standards (action level and alert levels).

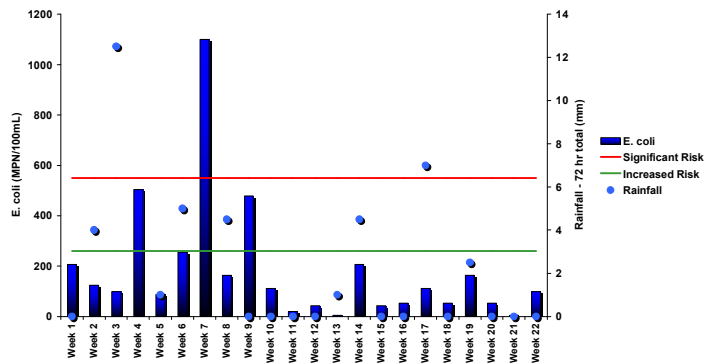
Taylor @ Hutcheson Street Bridge



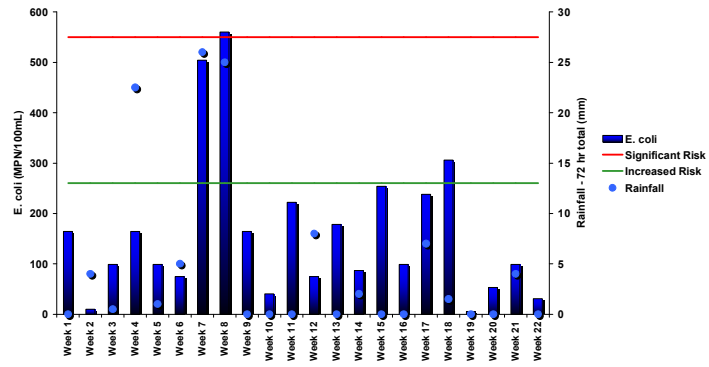
Taylor @ Riverside



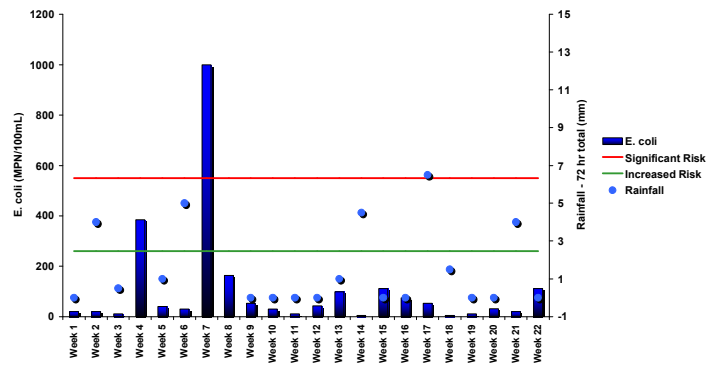
Opawa @ Malthouse Reserve



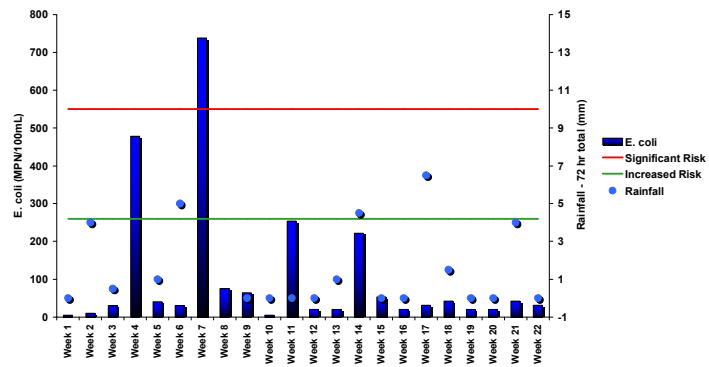
Opawa @ Elizabeth Street Footbridge



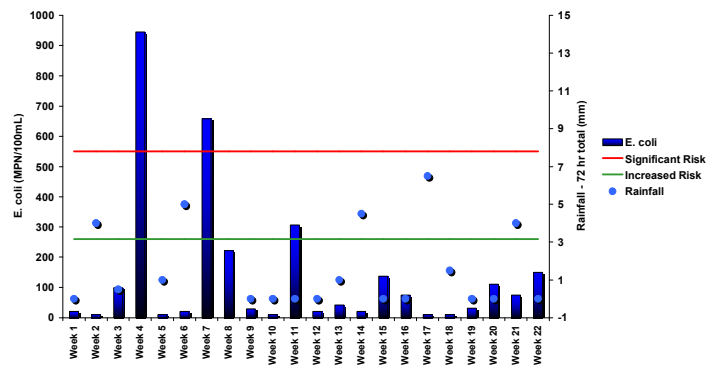
Wairau @ Blenheim Rowing Club



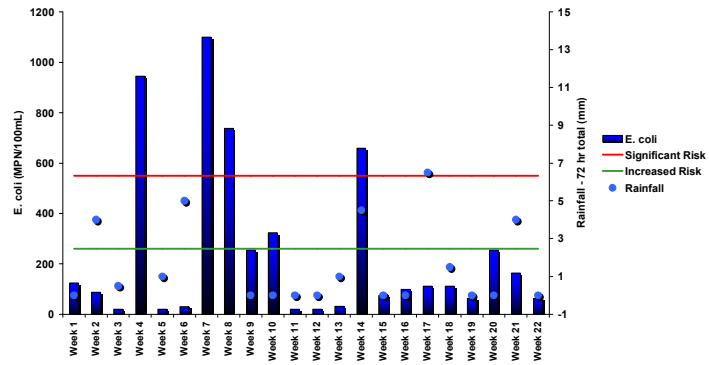
Wairau @ Wairau Rowing Club



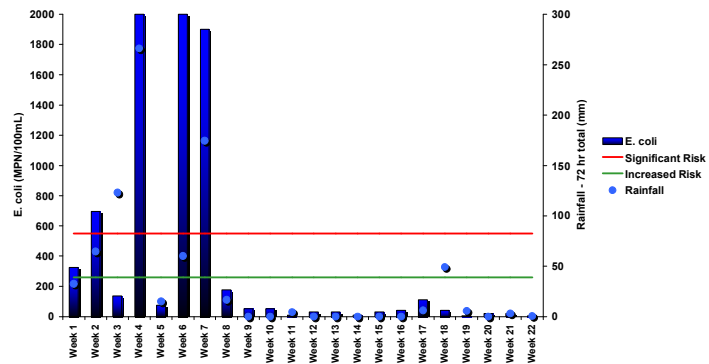
Wairau @ Ferry Bridge



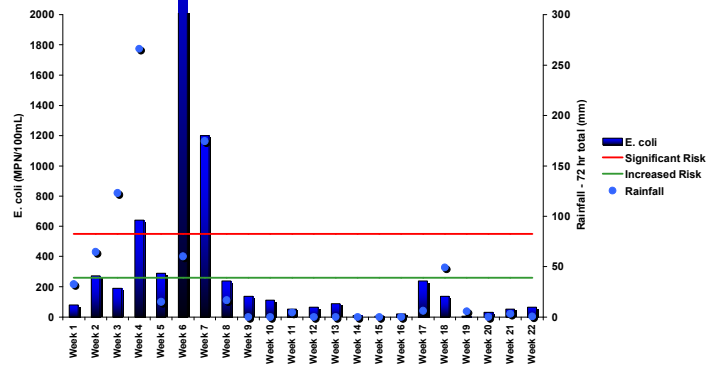
Wairau Diversion @ Neals Road



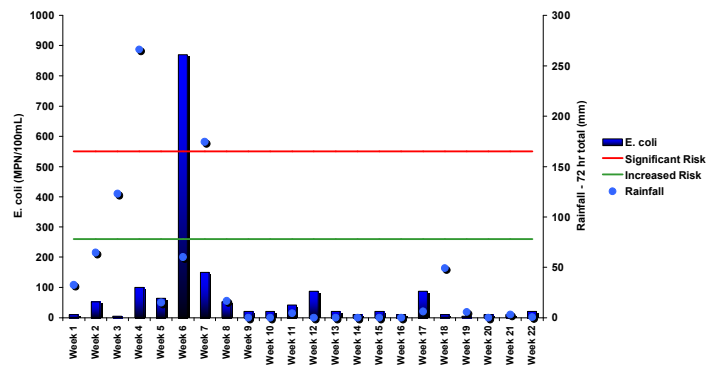
Pelorus @ Totara Flat



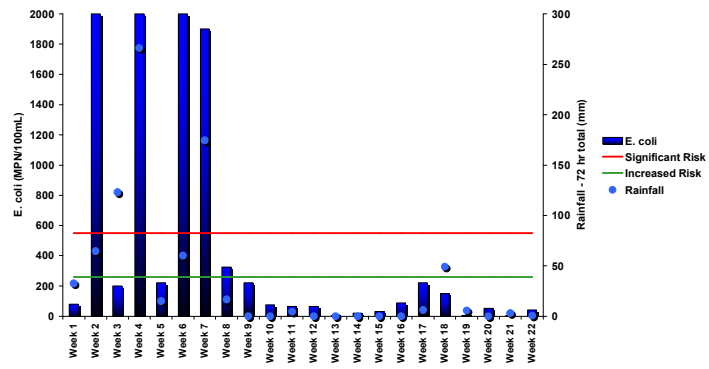
Rai @ Brown River Reserve



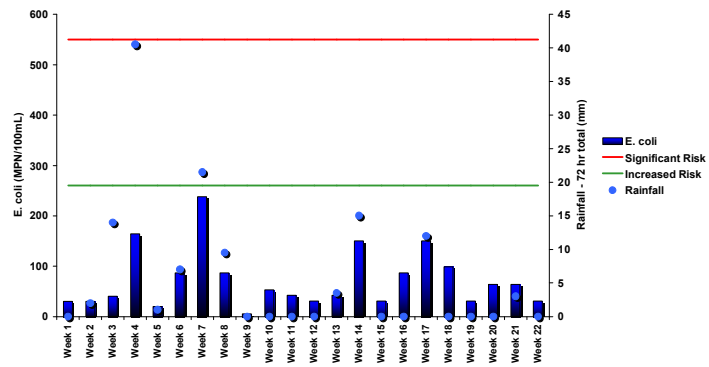
Pelorus @ Pelorus Bridge



Rai @ Rai Falls



Waihopai @ Craiglochart Bridge #2



APPENDIX 4

Health warning sign for freshwater recreational bathing sites

**Temporary
Health Warning
12 December 2008**



Water testing has shown high bacterial levels in the river.

Swimming or contact with water in the river is not recommended

The sign will be removed when water quality has been shown to improve.

For more information contact Marlborough District Council on 03 520 7400.



APPENDIX 5

E. coli numbers recorded during the heavy rainfall events during November and December 2008.

DATE	Brown River Reserve RAR-2	Rai Falls RAR-1	Totara Flat PLR-3	Pelorus Bridge, corner of river PLR-2	Rainfall (24 hr total)
04-Nov-08	79	79			0
05-Nov-08			324	10	32
07-Nov-08			30		1
11-Nov-08	271	2000	697	53	60
14-Nov-08	406	238	192		2
19-Nov-08	190	200	137	10	6.5
25-Nov-08	640	8900	20000	100	190
02-Dec-08	130	110			4.5
03-Dec-08	288	222	75	64	1.5
09-Dec-08	3800	4100	2000	870	62.5
11-Dec-08	207	530	200	10	0
12-Dec-08	124	200	137	30	0
15-Dec-08	4500	2000	530	640	151
16-Dec-08	1200	1900	1900	150	23.5
18-Dec-08	120	120			0
23-Dec-08	238	324	178	53	1
30-Dec-08	137	222	53	20	0
06-Jan-09	24	35			0
07-Jan-09	111	75	53	20	0

APPENDIX 6

2008-09 Suitability for Recreation Grade (SFRG's) results

OPAWA AT ELIZABETH ST FOOTBRIDGE						
***** Microbiological Assessment Category *****						
Annual exceedance information (for water year 01 November to 31 October)						
	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	99	2	1	95
Year	2007	21	178	2	0	100
Year	2006	18	130.5	0	1	94
Year	2005	22	178	5	1	95
Year	2004	20	111.5	1	0	100
Total	0	103	124	10	3	97
Assessment Results						
Microbiological Assessment Grade - C						
Hazen Percentile Result - 406						
Data Set Extent - Complete Data Set (5 years with at least 100 samples)						
***** Suitability for Recreation Class *****						
Suitability Assessment Results						
SFRC Assessment Grade - Fair						
Primary Impact - ,5: Primary or secondary treatment facilities						
Complete						
***** Sanitary Inspection Category *****						
Catchment Assessment Checklist Results						
SIC Assessment Grade - Moderate						
Primary Impact:						
3: Urban stormwater						

OPAWA AT MALTHOUSE RESERVE

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	105	2	1	95
Year	2007	21	87	2	1	95
Year	2006	19	64	1	2	89
Year	2005	21	53	0	0	100
Year	2004	20	215	2	7	65
Total	0	103	99	7	11	89

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1205

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

***** Suitability for Recreation Class *****

Suitability Assessment Results

SFRC Assessment Grade - Poor

Primary Impact - ,5: Primary or secondary treatment facilities Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - Moderate

Primary Impact:

8: Run-off from low intensity agriculture

PELORUS AT PELORUS BRIDGE						
***** Microbiological Assessment Category *****						
Annual exceedance information (for water year 01 November to 31 October)						
	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	20	0	1	95
Year	2007	21	20	1	1	95
Year	2006	19	20	2	1	94
Year	2005	22	30	0	2	90
Year	2004	19	30	0	1	94
Total	0	103	30	3	6	94
Assessment Results						
Microbiological Assessment Grade - D						
Hazen Percentile Result - 688.65						
Data Set Extent - Complete Data Set (5 years with at least 100 samples)						
***** Suitability for Recreation Class *****						
Suitability Assessment Results						
SFRC Assessment Grade - Poor						
Primary Impact - ,5: Primary or secondary treatment facilities Complete						
***** Sanitary Inspection Category *****						
Catchment Assessment Checklist Results						
SIC Assessment Grade - Moderate						
Primary Impact:						
8: Run-off from low intensity agriculture						

PELORUS AT TOTARA FLAT

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	47.5	1	4	81
Year	2007	21	75	3	2	90
Year	2006	19	40	1	2	89
Year	2005	24	20	2	1	95
Year	2004	19	111	2	2	89
Total	0	105	42	9	11	89

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1325

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - Very Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - High

Primary Impact:

7: Intensive agricultural use

RAI AT BROWN RIVER RESERVE

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	99	2	3	86
Year	2007	21	271	8	3	85
Year	2006	19	87	3	2	89
Year	2005	23	207	4	2	91
Year	2004	40	157	8	4	90
Total	0	125	150	25	14	88

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1300

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - Very Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - High

Primary Impact:

7: Intensive agricultural use

RAI AT RAI FALLS

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	83	1	4	81

Year	2007	21	99	3	3	85
Year	2006	19	53	1	4	78
Year	2005	26	87	1	4	84
Year	2004	43	137	9	5	88
Total	0	131	111	15	20	84

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 1995

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - Very Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - High

Primary Impact:

7: Intensive agricultural use

TAYLOR AT HUTCHESON BRIDGE

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	178.5	5	2	90
Year	2007	21	137	2	1	95
Year	2006	19	192	5	0	100
Year	2005	21	207	4	4	80
Year	2004	20	171	3	1	95
Total	0	103	178	19	8	92

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 925.25

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - Very Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - High

Primary Impact:

2: Stormwater outlets

TAYLOR AT RIVERSIDE

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	150	3	3	86
Year	2007	21	164	6	2	90
Year	2006	19	178	6	0	100
Year	2005	21	192	4	3	85
Year	2004	20	137	2	1	95
Total	0	103	164	21	9	91

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 998.3

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

***** Suitability for Recreation Class *****

Suitability Assessment Results

SFRC Assessment Grade - Very Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

***** Sanitary Inspection Category *****

Catchment Assessment Checklist Results

SIC Assessment Grade - High

Primary Impact:

2: Stormwater outlets

WAIHOPAI AT CRAIGLOCHART

***** Microbiological Assessment Category *****

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	47.5	0	0	100
Year	2007	21	75	0	4	80
Year	2006	19	20	0	1	94
Year	2005	14	35	0	1	92
Year	2004	20	46.5	1	1	95
Total	0	96	40	1	7	92

Assessment Results

Microbiological Assessment Grade - D

Hazen Percentile Result - 868.8

Data Set Extent - Interim Data Set (< 5 years or < 100 samples used)

***** Suitability for Recreation Class *****

Suitability Assessment Results

SFRC Assessment Grade - Poor

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

***** Sanitary Inspection Category *****

Catchment Assessment Checklist Results					
SIC Assessment Grade - Moderate					
Primary Impact:					
8: Run-off from low intensity agriculture					

WAIRAU AT BLENHEIM ROWING CLUB

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	35.5	1	1	95
Year	2007	21	30	1	1	95
Year	2006	18	30	0	0	100
Year	2005	21	40	0	1	95
Year	2004	20	25	2	0	100
Total	0	102	30	4	3	97

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 316.2

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - Fair

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - Moderate

Primary Impact:

8: Run-off from low intensity agriculture

WAIRAU AT FERRY BRIDGE						
***** Microbiological Assessment Category *****						
Annual exceedance information (for water year 01 November to 31 October)						
	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	36.5	1	2	90
Year	2007	21	75	2	1	95
Year	2006	18	40	1	0	100
Year	2005	21	75	0	0	100
Year	2004	20	64	3	0	100
Total	0	102	64	7	3	97
Assessment Results						
Microbiological Assessment Grade - C						
Hazen Percentile Result - 321.2						
Data Set Extent - Complete Data Set (5 years with at least 100 samples)						
***** Suitability for Recreation Class *****						

Suitability Assessment Results			
SFRC Assessment Grade - Fair			
Primary Impact - ,5: Primary or secondary treatment facilities			
Complete			
***** Sanitary Inspection Category *****			
Catchment Assessment Checklist Results			
SIC Assessment Grade - Moderate			
Primary Impact:			
8: Run-off from low intensity agriculture			

WAIRAU AT WAIRAU ROWING CLUB

******* Microbiological Assessment Category *******

Annual exceedance information (for water year 01 November to 31 October)

	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	31	1	1	95
Year	2007	21	40	3	0	100
Year	2006	17	40	0	0	100
Year	2005	22	30	0	1	95
Year	2004	20	58.5	2	0	100
Total	0	102	40	6	2	98

Assessment Results

Microbiological Assessment Grade - C

Hazen Percentile Result - 415.2

Data Set Extent - Complete Data Set (5 years with at least 100 samples)

******* Suitability for Recreation Class *******

Suitability Assessment Results

SFRC Assessment Grade - ,Fair

Primary Impact - ,5: Primary or secondary treatment facilities

Complete

******* Sanitary Inspection Category *******

Catchment Assessment Checklist Results

SIC Assessment Grade - Moderate

Primary Impact:

8: Run-off from low intensity agriculture

WAIRAU DIVERSION AT NEALS RD BRIDGE						
***** Microbiological Assessment Category *****						
Annual exceedance information (for water year 01 November to 31 October)						
	sample season	sample size	median	exceed 260 to 550	exceed >550	%days <550
Year	2008	22	105	1	4	81
Year	2007	21	40	1	1	95
Year	2006	18	64	2	0	100
Year	2005	21	75	0	0	100
Year	2004	20	81	3	1	95
Total	0	102	75	7	6	94

Assessment Results			
Microbiological Assessment Grade - D			
Hazen Percentile Result - 674.2			
Data Set Extent - Complete Data Set (5 years with at least 100 samples)			
***** Suitability for Recreation Class *****			
Suitability Assessment Results			
SFRC Assessment Grade - ,Poor			
Primary Impact - ,5: Primary or secondary treatment facilities Complete			
***** Sanitary Inspection Category *****			
Catchment Assessment Checklist Results			
SIC Assessment Grade - Moderate			
Primary Impact:			
16: Indirect influences - High intensity agriculture or feral animals/birds			