

Recreational Waters of Southland



2012/13



Te Taiaro Tonga

Recreational Waters of Southland 2012/13

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Executive Summary

This report summarises the results of Environment Southland's 2012/13 microbial monitoring programme. The programme monitors the public health risk from contact recreation at 11 marine beaches, 13 rivers and lakes, and 8 shellfish gathering sites in the region.

The 2012/13 freshwater bathing season was slightly better than long-term average for Southland but the number of national bathing guideline breaches was up on the previous summer. However, the marine bathing season was the best recorded since 2003/04, though three sites were rated as poor according to Ministry for the Environment guidelines. The stable river flows due to limited rainfall account for the reduced number of national guideline breaches.

Key findings of the 2012/13 bathing season were:

- Ø lowland river sites recorded a low number of guideline breaches compared to long term averages;
- Ø the Oreti River at Wallacetown did not breach the national guidelines, a first since 2004;
- Ø the mid and upper catchment sites still recorded average levels of bacterial contamination;
- Ø the “best” sites to swim at were Lakes Manapouri and Te Anau, and the upper Mararoa and Waikaia Rivers;
- Ø the “worst” freshwater sites to swim at were the Waikaia River at Waikaia, Maitai River at Gore and Riversdale, and the Aparima River at Thornbury;
- Ø the analysis done showed the dominant bacteria sources at some freshwater sites were wild fowl, plant decay and ruminants;
- Ø no human sourced bacteria were recorded at any freshwater bathing site;
- Ø the marine bathing sites only recorded two guideline breaches after widespread rainfall in mid-January 2013;
- Ø all subsequent re-samples recorded very low bacterial counts, highlighting the well-flushed nature of the marine sites where only periodic contamination exists;
- Ø the “best” marine bathing sites were at Porpoise Bay, Awarua Bay and Oreti Beach;
- Ø the “worst” marine bathing sites were in the Jacobs and New River Estuaries.

The report also presents the latest Ministry for the Environment Suitability for Recreation Grades (SFRGs) for Southland marine and freshwater bathing sites. The SFRG is a combination of monitoring data and a risk based assessment to identify bacterial sources in each catchment. The SFRG assessment describes the general condition of water quality at the site, other than just at the time of sampling to give an overall suitability for contact recreation.

The Southland SFRGs suggest monitoring is still required at both freshwater and marine sites, as bacteria levels were often elevated and the sites were still well used. The key findings from the SFRGs were:

- Ø of the 13 Southland marine bathing sites, six are rated as “good” and “very good”, and the remaining sites rated as “fair” to “poor”;
- Ø the sites rated “good” and “very good” are well-flushed beaches away from large freshwater inputs;
- Ø of the 11 freshwater sites, three are rated as “very good”, but the remaining sites are rated as “poor” or “very poor”;
- Ø this result does not mean the public will always get sick from swimming at these sites, but it does suggest the public health risk is elevated.

The report also summarised the results of the eight shellfish monitoring sites. The 2012/13 shellfish-monitoring results were consistent with the long-term results previously reported in *Water 2010: Our Health*. Shellfish gathering sites with rivers discharging nearby often recorded elevated bacterial contamination. Sites in the New and Jacobs River Estuaries and Toetoes Harbour usually breached national guidelines. These results reinforce the recommendation of no shellfish harvesting after elevated river flows for up to five days. It is recommended that “weekly results posters” be maintained in western Southland and be extended into northern Southland to improve the communication of monitoring results.

A short review of the Environment Southland microbial bathing programme was also undertaken. Key points from the review were:

- Ø investigate the feasibility of adding of several freshwater monitoring sites and one marine bathing site;
- Ø improve the linkage between the freshwater and marine bacterial contamination by ensuring marine sampling is undertaken after freshwater sampling;
- Ø increase monitoring effort at several freshwater and marine bathing sites, but undertake shellfish contaminant source investigations at Colac Bay and Toetoes Harbour.

1.0 Introduction

Environment Southland's bathing and shellfish monitoring programme

Why we monitor

Water contaminated by faecal matter can contain a range of disease-causing microorganisms, such as viruses, bacteria and protozoa. These organisms pose a health hazard when the water is used for recreational activities such as contact water sports and shellfish gathering.

Regional and Local Councils have responsibilities under the Resource Management Act (RMA 1991) and the Health Act to monitor and assess the human health risk from recreational bathing and shellfish gathering. This involves routine monitoring of bacterial concentrations at popular bathing sites around the country. As outlined in the RMA, regional councils and the Ministry for the Environment also have obligations to report on the State of the Environment at bathing sites.

Recreational water quality monitoring objectives

Recreational bathing and shellfish water quality is assessed according to national microbiological guidelines set by the Ministry for the Environment (MfE 2003) and the Ministry of Health (MoH). Southland's microbial programme is undertaken by Environment Southland in collaboration with local Iwi, other Southland councils, and public health representatives. Environment Southland routinely monitors the health of the region's waterways for bathing and shellfish gathering, using these guidelines as a framework. The monitoring sites are well-used by swimmers, kayakers, kite-boarders, surfers, kai moana gathers and fishers.

Consistent with other regional councils and the objectives set out by the MfE (2003), the monitoring programme aims to do the following:

1. determine the suitability of freshwater and marine bathing sites for contact recreation, including shellfish gathering, to safeguard public health and the environmental and cultural values of the sites;
2. provide the Southland community with information, and report on the state of the region's bathing sites;
3. where poor water quality exists, provide information to determine where mitigation steps could be undertaken.

Environment Southland has previously reported on the state of the bathing and shellfish sites across Southland in the *Water 2010: Our Health* report. *Water 2010* detailed the state and trends in water quality for marine and freshwater bathing and popular shellfish gathering sites. Overall, Southland's bathing water quality was excellent at most of the marine bathing sites. However, freshwater bathing quality often breached regional and national bathing guidelines and standards. The *Water 2010: Our Health* report highlighted that in the last 10 years, 2/11 freshwater bathing sites had improved, 1/11 had declined

and 8/11 sites recorded no change. The report also stated that although two sites had improved, the same sites were still well above the recommended guidelines for freshwater bathing. Shellfish water quality between 1995-2009 showed half the monitoring sites were improving in faecal bacteria concentrations. However, the two sites with the most frequently elevated bacterial counts, Jacobs River Estuary and Toetoes Harbour, showed no sign of improvement. In general, the report clearly highlighted the risk to contact recreation and shellfish gathering values from faecal bacteria, with special focus on the impact the freshwater environment had on the coastal environment.

Aims

The current report summarises Environment Southland's monitoring for the 2012/13 summer bathing season. The report compares recorded contamination against national microbiological guidelines (MfE 2003) and Regional Water Plan (RWP 2010) recreational bathing standards. A secondary aim of the summary report was to update the Suitability for Recreation Grades (SFRG) for the 24 Southland bathing sites.

The current report also gives a brief review of Environment Southland's monitoring programme. Specific objectives of the review were to:

- Ø identify areas of the Southland region which do not have monitoring sites;
- Ø determine bathing site representativeness so that well-used reference, impacted and slight impacted sites are included in the monitoring programme;
- Ø determine any future requirements and recommendations to improve the monitoring programme's effectiveness, such as sampling logistics.

This report is not a comprehensive review of the whole bathing program, but rather short overview at identifying possible gaps in the monitoring. It is recommended a full review be undertaken after the MfE (2003) microbiological guidelines are revised.

2.0 Background

2.1 Microbiological guidelines and indicators

For a full explanation to the approach, water quality indicators, triggers and microbiological guidelines, readers are directed to:

<http://www.mfe.govt.nz/publications/water/microbiological-quality-jun03>.

In brief, the MfE (2003) and Ministry of Health have set out the national recreational bathing and shellfish gathering guidelines for New Zealand, including water quality indicators and microbiological trigger levels. These guidelines use a “risk of exposure” to humans from contaminated water with animal faeces. The chosen indicators represent the likely presence of harmful pathogens but are not a measurement of the pathogens themselves. It reflects a precautionary approach to managing public health risks and does not represent an accurate picture of water quality in the catchment.

The indicators used are:

1. for freshwater bathing sites: *Escherichia coli* (*E. coli*);
2. for marine (coastal) bathing sites, including estuarine waters: *Enterococci*;
3. for shellfish gathering waters: *Faecal coliforms*.

The MfE (2003) guidelines provide a framework which is recommended as international best practice by the World Health Organization (WHO) from which to assess site compliance. Guideline compliance is assessed against a three-tier management framework which is spread across several organisations. The three-tier framework is required as multiple agencies have differing statutory responsibilities, depending on the outcome of the monitoring results.

Table 1: The three-tier management framework

Mode	Management response	Roles/Responsibilities
Green/Surveillance	Normal routine monitoring	Regional Councils
Amber/Alert	Increased monitoring/investigations	Regional Councils, in conjunction with Public Health Officials and Territorial Authorities
Red/Action	Public notification, source investigation	Public Health Officials and Territorial Authorities supported by Regional Councils

2.2 Bathing trigger values and shellfish gathering guidelines

The three-tier monitoring and management framework above is divided into marine and freshwater bathing trigger values, and guidelines for recreational shellfish gathering.

Table 2: Marine bathing waters trigger values

Mode	Guideline: <i>Enterococci</i> (MPN/100mls)	Management response
Green/Surveillance	Single sample < 140	Normal routine monitoring
Amber/Alert	Single sample >140	Increased monitoring/investigation
Red/Action	Two consecutive samples >280	Public notification, source investigation

Table 3: Freshwater bathing waters trigger values

Mode	Guideline: <i>Ecoli</i> (MPN/100mls)	Management response
Green/Surveillance	Single sample <260	Normal routine monitoring
Amber/Alert	Single sample >260 and <550	Increased monitoring/investigation
Red/Action	Single sample >550	Public notification, source investigation

2.3 The recreational shellfish gathering water guidelines

A three-tier framework does not yet exist for recreational shellfish gathering water. However, the guidelines are as follows:

The median faecal coliform of samples over a shellfish gathering season shall not exceed 14 mpn/100ml, and no more than 10 % of samples shall exceed 43 mpn/100 ml (using the five tube decimal dilution test).

The guidelines for shellfish waters do not specify alert or action conditions or response protocols. In Southland, an arbitrary trigger of 400 faecal coliforms has been applied as “action” mode.

The MfE (2003) guidelines do not account for the presence of other harmful organisms, such as heavy metals, viruses or biotoxins in shellfish. Therefore, the applicability of the guidelines to determine the health risk from consuming contaminated shellfish flesh is limited. Shellfish flesh monitoring is not routinely undertaken by Environment Southland. However, site specific shellfish flesh investigations such as the “Fit for Consumption” study are currently undertaken by Environment Southland (Ward, N. Personal Communication with Author, 2013).

Historically, under the three-tier monitoring framework, when action levels are reached, the public notification process is enacted. However, it is widely accepted that elevated rainfall and river flows are correlated with high bacteria counts in rivers (*Water 2010: Our Health & Our Ecosystem*). Therefore, the only time warning signs are not routinely put up at bathing sites is after rainfall. In Southland, Public Health Officials and Environment Southland now recommend to avoid bathing and shellfish gathering between 2-5 days after rainfall.

2.4 Suitability for recreation grades: Risk-based assessments

As well as routine sampling over the bathing season, risk-based assessments for Southland's bathing sites are also undertaken. The "risk-based" approach aims to determine the bacterial risk of the water at any given time, and not just at the time of sampling.

The Suitability for Recreation Grade (SFRG) is a combination of two separate assessments. The first assessment is the Microbiological Assessment Category (MAC), which grades a bathing site on the last five years of monitoring data. The second assessment is a "Sanitary Inspection Category" (SIC), which identifies all likely bacterial sources in the catchment upstream of the bathing site. The bacterial risk factors range from feral animal populations to intensive agriculture and industrial discharges. The SFRG is not a substitute for routine monitoring but rather a general grade for a bathing site, highlighting the likely human health risk from contact recreation. In Southland, all freshwater and marine bathing sites have SFRGs assigned, however, all the assessments are categorised as interim due to insufficient monitoring data points per bathing season.

A full breakdown of the SFRG, SIC and MAC can be accessed at the MfE website:

<http://www.mfe.govt.nz/environmental-reporting/fresh-water/suitability-for-swimming-indicator/suitability-swimming-indicator.html>.

3.0 Methodology

3.1 Marine bathing sites

Water quality monitoring was undertaken at 13 marine bathing sites (Figure 1) in Southland over the 2012/13 summer. Ten of the sites were sampled weekly and three sites fortnightly. The fortnightly sampled sites have been deemed low risk to recreational bathers by historically having 'very good' SFRGs. However, as these sites are still well used by swimmers, surfers and kayakers, monitoring continues.

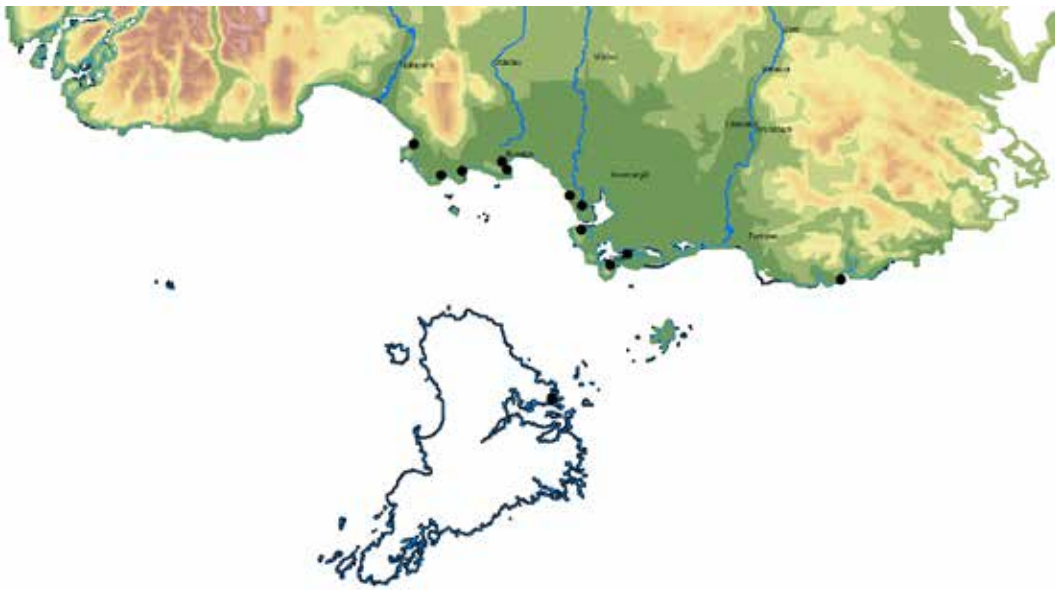


Figure 1: Southland's marine bathing sites

3.2 Freshwater bathing sites

Water quality monitoring was undertaken at 11 freshwater bathing sites (Figure 2) in Southland over the 2012/13 summer. Seven of the 11 sites were river sites sampled weekly over the summer. The remaining sites were two lake sites and two high country river sites. These four sites have been deemed lower risk to bathers, and therefore sampled monthly.



Figure 2: Southland's freshwater bathing sites

3.3 Shellfish monitoring sites

Water quality monitoring at shellfish gathering sites was undertaken at eight sites in Southland over the 2012/13 season (Figure 3). Each of the sites was sampled monthly from 1 July 2012 to 30 June 2013. Water samples were collected on the second Tuesday and Wednesday of each month.

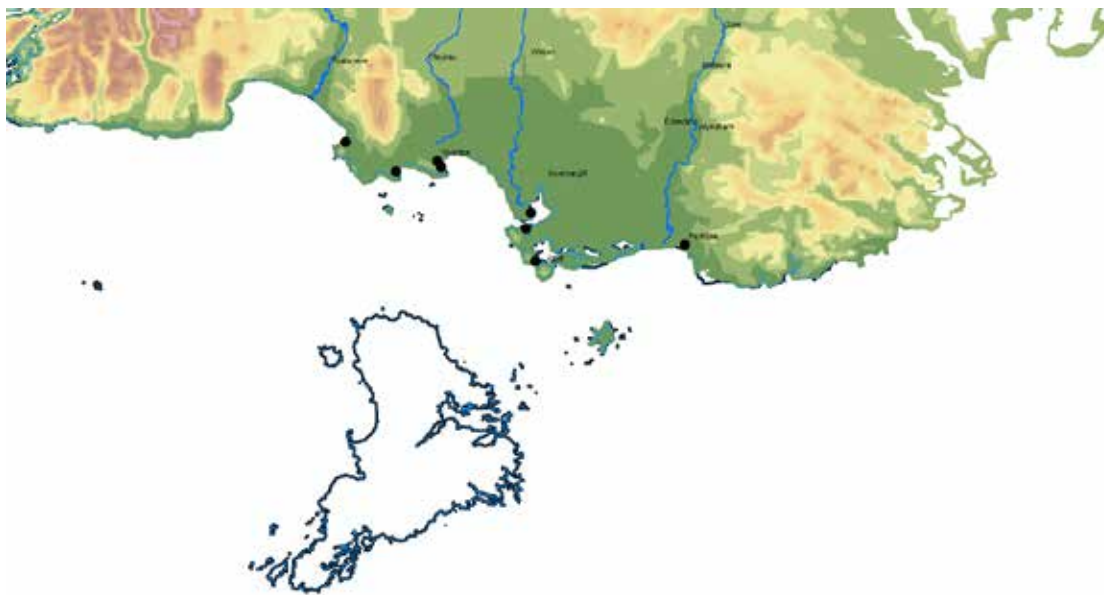


Figure 3: Southland's recreational shellfish sites

3.4 Monitoring procedure

All water samples were taken in 0.5 m water depth, with the sample container plunged into the flow at approximately 0.2 m below the water surface. Water temperature and conductivity measurements were undertaken using a hand held calibrated YSI meter. All water samples were taken in accordance with Environment Southland's internal water sampling protocol (McKenzie and Thomsen, 1995). Trained field staff noted weather and river conditions and recorded obvious bacterial sources such as livestock, visible discharges, bird populations and freedom campers adjacent to the sampling area. Chain of custody was maintained throughout sample collections, with appropriate documentation taking place before delivery to the IANZ accredited Hills Laboratory in Christchurch.

3.5 River flow and rainfall

Elevated rainfall and increased river flows were accounted for in the analysis as they can impact on water quality due to bacterial runoff. River flows three times the median (Freq 3 flow) were deemed to be "elevated". River flows were estimated at the time of sampling using the nearest Environment Southland automatic flow recorder immediately upstream of the bathing site. Rainfall totals in the 12 hours prior to sampling were also calculated using data collected from the closest rain gauge to each bathing site.

3.6 Faecal source testing

Upon detecting elevated *E. coli* results at freshwater sites over the 2012/13 summer, samples were stored frozen and sent to ESR Laboratories in Christchurch for faecal sterol analysis to determine the sources of faecal bacteria (Appendix C for sites and date of sampling).

To read a full synopsis of the sampling techniques and analysis used please visit: <http://www.waterquality.org.nz/>.

4.0 Results

4.1 Marine bathing: National guideline compliance

In the Southland 2012/13 season, only two samples out of 195 (1.03 %) breached the red “action” levels (Table 4). However, all re-samples were within green ‘surveillance’ trigger levels, which results in no MfE (2003) guideline breaches.

Table 4: Southland marine bathing site compliance

Site Name	Min	Max	Median	Samples	% <140	% 140-280	% >280	Flow/rainfall related event
Bluff Harbour at Morrison Beach	5	134	10	17	100	0	0	n/a
Colac Bay at Colac Bay Road opp marae	5	10	5	17	100	0	0	n/a
Halfmoon Bay at bathing beach	5	43	5	17	100	0	0	n/a
Halfmoon Bay at Elgin Terrace	5	52	5	16	100	0	0	n/a
Jacobs River Estuary d/s Railway Br East	5	426	5	17	94	0	6	1/1=100%
Kawakaputa Bay at Wakapatu Road	5	20	5	17	100	0	0	n/a
Monkey Island at Frenztz Road	5	156	5	17	94	6	0	1/1=100%
New River Estuary at Omaui	5	30	5	17	100	0	0	n/a
New River Estuary at Water Ski Club	5	594	5	17	94	0	6	1/1=100%
Riverton Rocks at Mitchells Bay North	5	146	5	16	94	6	0	1/1=100%
Awarua Bay at Tiwai pumphouse	5	5	5	9	100	0	0	n/a
Porpoise Bay at camping ground	5	5	5	9	100	0	0	n/a
Oreti Beach at Dunns Road	5	74	5	9	100	0	0	n/a

n=195 samples, event driven breaches only relate to Enterococci over 140/100 ml

Bathing site compliance over the 2012/13 summer was the best recorded since 2003/04 (Table 5). Bacterial counts were so low over the 2012/13 season that 12/13 sites recorded sample medians of 5 *Enterococci*/100 ml. The lowest bacterial levels were recorded at Awarua Bay, Porpoise Bay and Colac Bay. These three sites recorded sample maximums of ≤10 *Enterococci*/100 ml. The highest bacterial concentrations were recorded in the New River Estuary at the Water Ski Club (594/100 ml) and Jacobs River Estuary downstream of the Railway Bridge (426/100 ml). These bacteria counts were far below those previously recorded at marine bathing sites throughout Southland (Wilson et al., 2012).

Both the season’s action level samples occurred after rainfall and increased river flows in mid-January 2012. The pattern of periodic bacterial contamination after rainfall and higher river flows is consistent with previous results (*Water 2010: Our Health & Our Ecosystems*). Rainfall can result in a catchment-wide “runoff of bacteria” being delivered to the coast by elevated river flows. However, at Southland marine bathing sites contamination is usually localised to 2-3 days after peak river flows.

Table 5: Southland marine bathing breaches 2003-2013

Year	MfE (2003) breaches
2003/04	2
2004/05	18
2005/06	9
2006/07	5
2007/08	5
2008/09	3
2009/10	3
2010/11	7
2011/12	3
2012/13	2
Average	5.7

4.2 Marine SFRGs

Southland’s marine bathing sites have a range of suitability for recreation (Table 6). Six of the 13 sites were rated “good” or “very good”. However, five sites were rated as “poor” for recreation. These sites have a range of land use in their upstream catchment, with agriculture on high producing grasslands dominating (LDCB 3). Since 2011/12 none of the bathing sites have recorded an improvement in their Suitability for Recreation Grades (SFRG). In 2012/13, one site (Colac Bay) still has a “follow-up” grade, suggesting more sampling and data is required before a definitive grade can be determined.

Table 6: Southland’s marine bathing sites SFRGs

Site Name	5 yr hazen	SIC	MAC	2011/12 grade	2012/13 SFRG	Bacterial Risk/Source
Bluff Harbour at Morrison’s Beach	142	High	C	Poor	Poor	Stormwater/feral animals
Colac Bay at Colac Bay Road opposite marae	13	Moderate	A	Follow up	Follow up	Septic tanks/agriculture
Halfmoon Bay at bathing beach	41	Very Low	B	Very Good	Very Good	None identified
Halfmoon Bay at Elgin Terrace	226	Moderate	C	Follow up	Fair	Septic tanks/feral animals
Jacobs River Estuary downstream Railway Br East	188	High	B	Poor	Poor	Intensive agriculture, septic tanks
Kawakaputa Bay at Wakaputa Road	55	High	B	Good	Good	Agriculture/feral animals
Monkey Island at Frenzt Road	117	High	B	Poor	Poor	Intensive agriculture
New River Estuary at Omaui	91	High	B	Good	Poor	Focal point of drainage, Multiple Sources (WWTP, Industrial Discharges, Intensive Agriculture)
New River Estuary at Water Ski Club	112	High	B	Good	Poor	Focal point of drainage, Multiple Sources (industrial discharges, intensive agriculture)
Riverton Rocks at Mitchells Bay North	30	Moderate	A	Good	Good	Intensive agriculture, septic tanks
Awarua Bay at Tiwai Pumphouse	21	Very Low	A	Very Good	Very Good	None identified
Porpoise Bay at camping ground	5	Low	A	Very Good	Very Good	None identified
Oreti Beach at Dunns Road	58	Very Low	B	Very Good	Very Good	None identified

4.3 Freshwater bathing

4.3.1 Southland RWP (2010) bathing compliance

Compliance with the Regional Water Plan (RWP 2010) bathing standard (130 *E.coli*/100 ml) was highly variable (Table 7). Four sites recorded 100% compliance with the RWP (2010) freshwater bathing standard. Two sites were river sites, namely Waikaia River at Piano Flat and the Mararoa River Outlet at the South Mavoura Lake, and two were lake sites, Lake Manapouri and Lake Te Anau.

The remaining river sites recorded between 13% and 67% compliance with the Southland RWP (2010) bathing standard. The sites which breached the RWP (2010) standards most often were the Waikaia River at Waikaia, the two sites on the Maitai River, and the Aparima River at Thornbury. All four sites recorded season medians over the RWP (2010) bathing standard of 130 *E.coli*/100 ml, with the Waikaia River recording a median of 319 *E.coli*/100 ml.

Table 7: Southland's freshwater bathing site compliance

Site Name	Min	Max	Median	Samples	% < 130	% 130-260	% 260-550	% > 550	Flow/rainfall related event
Waikaia River at Waikaia	73	2421	319	16	13	19	31	37	3/6= 50 %
Waikaia River u/s Piano Flat	5	40	17.5	4	100	0	0	0	n/a
Waiau River at Tuatapere	10	816	119	16	56	19	19	6	1/1= 100 %
Oreti River at Winton Bridge	10	613	126	16	50	31	13	6	0/1= 0%
Oreti River at Wallacetown	13	525	80	15	67	20	13	0	n/a
Maitai River at Riversdale	26	3450	304	16	25	19	25	31	2/5=40 %
Maitai River at Gore	40	1414	194.5	16	25	38	19	18	2/3=66%
Aparima River at Thornbury	39	2421	166	16	38	25	19	18	2/3=66%
Mararoa River at South Mavoura Lake	5	10	5	4	100	0	0	0	n/a
Lake Te Anau at Boat Harbour Beach	1	10	3	5	100	0	0	0	n/a
Lake Manapouri at Frazers Beach	1	20	4	5	100	0	0	0	n/a

4.3.2 MfE (2003) freshwater bathing compliance

Compliance with the MfE (2003) bathing guideline was highly variable (Table 7). Five of the 11 sites recorded no breaches of the guidelines, with another two sites only recording a single breach of the guideline each. The Oreti River at Wallacetown was the only lowland site where no guideline breach was recorded – this has not occurred at Wallacetown since 2003/04. Four sites breached the MfE (2003) guidelines between 19% and 38% of all samples. These sites were the Waikaia River at Waikaia, the two sites on the Maitai River, and the Aparima River at Thornbury.

During the 2012/13 season 19 out of 129 samples (14.7%) breached the MfE (2003) guidelines (Table 8). The number of breaches was up slightly from last year but well below the 2010/11 season and the long-term average.

Table 8: Southland MfE (2003) breaches

Year	MfE (2003) breaches
2003/4	25
2004/5	42
2005/6	27
2006/7	21
2007/8	22
2008/9	19
2009/10	22
2010/11	39
2011/12	15
2012/13	19
Average	25.1

4.4 Event driven breaches

Unlike the marine bathing sites where all MfE (2003) guideline breaches were event driven, the freshwater bathing sites recorded a different pattern. Ten of the 19 breaches were a result of event driven contamination (Table 7). The remaining nine guideline breaches (47%) were not event driven. Two sites with reduced event driven faecal contamination were the Waikaia River and the Mataura River at Riversdale. These two sites recorded only 40% and 50% of the guideline breaches as a result of elevated river flows. A consistent pattern of non-event driven contamination has previously been reported for the Waikaia River (*Water 2010: Our Health*). As most bathing occurs in settled weather and low river flows, this is concerning as bathers are still subjected to elevated faecal levels.

4.5 Freshwater SFRGs

Southland's freshwater bathing sites SFRGs range from "very good" to "very poor" (Table 9). Three of the 11 sites are rated as "very good". These sites are situated in less developed parts of the region and adjacent to large "natural state" lakes. The MAC grades at these sites were rated as "high", further supporting the lack of recorded contamination. Although the bathing sites on Lakes Manapouri and Te Anau are adjacent to urban areas, the SIC grade for both sites is still rated as "very low". This is because no specific bacterial source has been identified or deemed to have caused an impact.

The remaining eight river sites have SFRGs rated as "poor" or "very poor". The low SFRG grades reflect bacteria from a range of sources including agricultural animals and wild fowl excreta (Rusinol & Moriarty, 2013). This results in all eight sites recording "D" MAC grades (based on historic data), and 5yr Hazen values well into the thousands (Table 9).

Table 9: Southland freshwater bathing grades

Site Name	5 yr Hazen	SIC Grade	MAC Grade	2011/12 SFRG	2012/13 SFRG	Dominant bacterial risk
Waikaia River at Waikaia	4,050	High	D	Very Poor	Very Poor	Intensive Agriculture
Waikaia River u/s Piano Flat	1,091	Low	D	Follow up	Poor	Feral Animals/Extensive Agriculture
Waiau River at Tuatapere	3,228	High	D	Very Poor	Very Poor	Intensive Agriculture
Oreti River at Winton Bridge	993	High	D	Very Poor	Very Poor	Intensive Agriculture
Oreti River at Wallacetown	1,762	High	D	Very Poor	Very Poor	Intensive Agriculture. WWTP
Mataura River at Riversdale	3,540	High	D	Very Poor	Very Poor	Intensive Agriculture
Mataura River at Gore	2,389	High	D	Very Poor	Very Poor	Intensive Agriculture, Industrial Discharges
Aparima River at Thornbury	7,270	High	D	Very Poor	Very Poor	Intensive Agriculture, WWTP, Industrial discharges
Mararoa River at South Mavora Lake	21	Very Low	A	Very Good	Very Good	None Identified
Lake Te Anau at Boat Harbour Beach	221	Very Low	B	Very Good	Very Good	No specific source identified but possible stormwater ingress
Lake Manapouri at Frazers Beach	28	Very Low	A	Very Good	Very Good	None Identified

4.6 Shellfish waters

Three shellfish monitoring sites (Table 10) did not breach the MfE (2003) guidelines, with Bluff, Riverton and Monkey Island sites all recording very low levels of bacterial contamination. The remaining five sites recorded between 36% and 75% of all samples breaching the MfE (2003) guidelines. The two sites with the highest levels of bacteria were the cockle beds in Toetoes Harbour and the Jacobs River Estuary. Both sites recorded season medians well in excess of 14 fc/100 ml and breached MfE (2003) guidelines in 75% of all samples.

Table 10: Southland's shellfish monitoring site compliance 2012/13

Site	median (<14 fc/100ml)	% of samples over 43 Note: MfE threshold 10%)	MfE pass	Southland 'action' level (% over 400 fc/100ml)
Bluff Harbour at Ocean Beach	1	9	Yes	0
New River Estuary at Whalers Bay	10	36	No	18
New River Estuary at Mokomoko Inlet	35	45	No	9
Toetoes Harbour at Fortrose	200	75	No	25
Jacobs River Estuary d/s Fish Co-op	110	75	No	8
Riverton Rocks at Mitchells Bay	3	0	Yes	0
Colac Bay at Bungalow Hill Road	25	42	No	8
Monkey Island at Frenztz Road	4	0	Yes	0

All faecal coliforms concentrations above 400/100 ml (the Southland action level) were event driven, highlighting the close linkage between freshwater contamination and bacterial levels at the shellfish gathering sites.

4.7 Faecal sources

Microbial source tracking of freshwater samples taken over the 2012/13 bathing season recorded three sources (Table 11). At all sites, wild fowl and plant decay faecal sterols dominated. The other dominant source was ruminant in origin, especially in the Waikaia River. Human sourced bacteria were not recorded at any of the bathing sites.

The samples were largely undertaken in low flows except those in early to mid-January 2013, where ruminant sourced bacteria were more prevalent at several sites. Caution should be applied as several of the samples had low levels of sterols present, which decreased the accuracy of source identification.

Table 11: Faecal source results for freshwater bathing sites

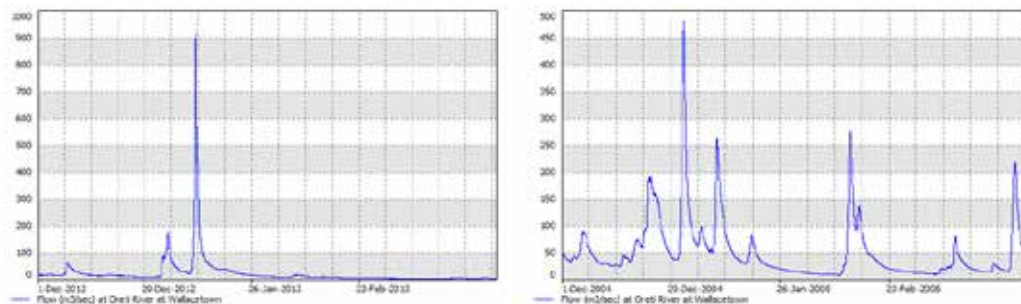
Location	Date	<i>E. coli</i> MPN/100ml	Source
Waikaia River at Waikaia	8 January 2013	2,421	Wild fowl/plant decay
Waikaia River at Waikaia	15 January 2013	2,420	Ruminant/wildfowl
Waikaia River at Waikaia	7 February 2013	727	Ruminant/wildfowl
Waikaia River at Waikaia	26 February 2013	2,420	Ruminant
Waikaia River at Waikaia	18 March 2013	1,333	Ruminant/plant decay
Mataura at Gore	15 January 2013	N/A	Wild fowl/plant decay
Mataura at Gore	7 February 2013	184	Wild fowl/plant decay
Mataura at Gore	18 March 2013	884	Wild fowl/plant decay
Mataura at Riversdale	15 January 2013	687	Wild fowl/plant decay
Mataura at Riversdale	26 February 2013	727	Wild fowl/plant decay
Mataura at Riversdale	18 March 2013	3,450	Wild fowl/plant decay
Mataura at Riversdale	25 March 2013	683	Wild fowl/plant decay
Aparima at Thornbury	8 January 2013	770	Ruminant
Aparima at Thornbury	10 January 2013	46,111	Ruminant/wildfowl
Aparima at Thornbury	12 February 2013	866	Wild fowl/plant decay
Aparima at Thornbury	18 March 2013	480	Wild fowl/plant decay
Oreti River at Winton Bridge	18 March 2013	450	Wild fowl/plant decay
Oreti River at Winton Bridge	25 March 2013	520	Wild fowl/plant decay

5.0 Discussion

5.1 Marine bathing summary

The marine bathing season in Southland over the summer of 2012/13 was very good compared with the MfE (2003) bathing guidelines. The season recorded the lowest levels of bacterial contamination since 2003/04, with only two out of 195 samples (1.02%) reaching red “action” levels. By comparison, the Otago region recorded 10.07% over the 2012/13 summer, and the Taranaki region recorded 3% of marine samples reaching action levels.

Not only was the number of breaches very low compared to previous summers, but the level of bacterial contamination was lower than previous years. All marine bathing sites recorded median values close to the detection limit for the *Enterococci* test. *Water 2010: Our Health* reported maximum values at most marine bathing sites well in the thousands from 1995-2010. However, over the 2012/13 summer the maximum value recorded was 594 *Enterococci*/100 ml (New River Estuary at the Water Ski Club). This value is far below the maximum of 6,900 *Enterococci* previously recorded at this site during elevated river flows.



Figures 3 and 4: Oreti River at Wallacetown Hydrograph, 2012/13 (left) and 2004/05 (right) bathing season
(*Environment Southland hydrological data, Hilltop Software*)

Southland’s marine bathing sites are usually only prone to bacterial contamination after sustained catchment rainfall. Both guideline breaches last summer occurred in early January 2013, after widespread rainfall was recorded across the region. The “event driven” pattern is consistent with that previously recorded for bathing sites in Southland and in New Zealand (*Water 2010: Our Health* report, Greenley et al, 2012). Following high river flows in mid-January 2013, river levels decreased to median flow at most sites for the remainder of the bathing season (Figure 3). This accounts for the low levels of bacteria recorded over the rest of the summer as no flushing events occurred. By contrast, the worst bathing season occurred in 2004/05 with 18 recorded guideline breaches - the Oreti River recorded over a dozen flushing events and spent little time at median flow (Figure 4).

5.2 Marine SFRGs site summary

Southland’s marine bathing sites range from near pristine sites to partial impacted sites in terms of their SFRG assessments. The majority of the sites have recorded no change in the SFRG assessments in the last two years. However, both sites in the New River

Estuary have recorded a decline in their SFRG, and two sites (Halfmoon Bay at Elgin Terrace and Colac Bay) require “follow up” assessments.

New River Estuary sites

The two sites in the New River Estuary (at the Water Ski Club and Omaui) have seen reductions in their respective SFRG grades, from “good” to “poor”. Both sites have a “high” SIC grade, which is related to the microbiological “risk” from untreated animal excreta in their intensively farmed catchments. The New River Estuary has previously been described as a partially degraded estuarine system, in terms of both microbiological status and ecological health (Robertson & Ryder 1995/96, Robertson & Steven, 2007-2012, *Water 2010: Our Health & Our Ecosystem*).



Figure 5: New River Estuary (1 km north of Water Ski-Club)

The lower Oreti River and the New River Estuary are exposed to multiple industrial discharges and untreated stormwater, and also receive treated wastewater from Invercargill City. The influence of the industrial discharges and diffuse source pollution to both bathing sites was uncertain at varying river flows, hence the high SIC grade. The “poor” SFRG does not mean that bathing at either site will always be poor, however, it does highlight the increased risk to bathers, especially after rainfall in the Oreti and Waihopai Catchments.

A focus on determining the faecal source and hydrological influences on each site in the estuary should be considered; this may provide justification in the future to undertake dry weather SFRGs for these bathing sites, which would likely see an improvement in their respective SFRG assessments.

Halfmoon Bay

The previous SFRG for Halfmoon Bay at Elgin Terrace (2011/12) suggested a “follow up” was required. In 2009, the site recorded a 95th Hazen number of 106, with a MAC grade of B. However, by 2012 the Hazen had doubled to 230 *Enterococci* with a MAC grade of C.

Preliminary site investigations by Environment Southland staff and representatives in 2011 and 2012 identified the site as a point of drainage for multiple onsite septic tanks; and where a local population of seabirds resides. No evidential sampling was undertaken as subsequent re-sampling in the bathing season recorded low bacterial levels. However, until bacterial source identification is undertaken in the catchment, it is unknown what bacterial inputs are related to the township’s septic tank network and/or the seabird population. It is recommended in the coming bathing season that duplicate water samples be collected to allow source identification if bacterial levels spike again.

Colac Bay

Although the marine bathing site at Colac Bay recorded low levels of bacteria in 2012/13, its SFRG assessment still requires a “follow up”. Colac Bay has historically been prone to moderate bacterial levels, especially toward the shellfish gathering site adjacent Huraki Creek. A Southland Regional Council investigation (1999) found both animal and human faecal bacteria contaminating the bathing and shellfish gathering sites, but the contamination was sporadic and often localised. Subsequent work by the territorial authorities identified and made improvements to several septic tanks deemed to be causing concern.

Long-term data (1995-2010) for the shellfish gathering site shows 93% of all samples breach the MfE (2003) recreational shellfish gathering guidelines. Over the 2012/13 season, Colac Bay again failed to meet the MfE (2003) recreational shellfish harvest guideline, with a median of 24 fc/100 ml. All faecal counts above 43/100 ml in 2012/13 were recorded after rainfall (Environment Southland hydrological data, 2013). This highlights the close linkage between bacterial sources, hydrological factors and coastal water contamination in the catchment.



Figure 6: Huraki Creek mouth at Colac Bay

In the last 10 years, the Colac Bay catchment has undergone further development for housing and agriculture (Environment Southland Aerial Images, 1995-2012). Therefore, identifying and discriminating faecal sources and their influences on the bathing and shellfish gathering sites at Colac Bay requires verification. It is recommended duplicate water samples be collected in the coming bathing season to allow microbial source tracking.

5.3 Freshwater bathing summary

The 2012/13 freshwater bathing season was good compared to the long-term average for Southland. Only 14.7% of all samples breached the national guidelines over summer, which was similar to the Otago region with 13.6% and the Taranaki region with 14% of samples breaching national guidelines.

The percentage of “event driven” breaches was consistent with that previously reported, whereby 40-60% of ‘action’ levels were a result of high river flows (*Water 2010: Our Health*). However, in the 2012/13 season the distribution of breaches across the region was slightly different with a reduced number of breaches in lowland river sites. Freshwater bathing sites in lowland Southland have a close association to river discharge and are therefore focal points for bacterial contamination (*Water 2010: Our Health and Our Ecosystem*). The reduced number of flushing events in the 2012/13 summer account for the reduced lowland faecal contamination. The settled low river flows resulted in reduced breaches at the Waiau River at Tuatapere, the Mataura River at Gore and the Oreti River at Wallacetown. The Oreti River recorded the least number of breaches

Key

Red	High producing grasslands
Yellow	Low producing grasslands
Orange	Tall tussock grasslands
Green	Indigenous forest

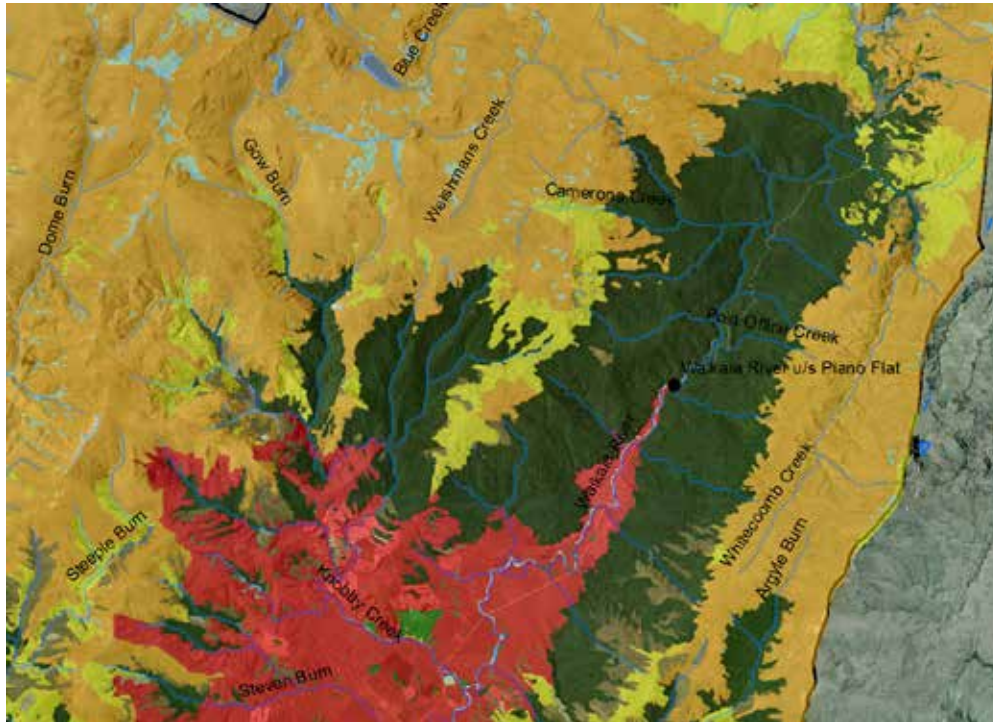


Figure 8: Gow Burn land cover (LDCB 3) Black dot indicates bathing site

Bacterial sources over the 2012/13 summer were dominated by wild fowl/plant decay. River flows across the region were low for most of the summer, with only one flood recorded. This result suggests wild fowl and plant decay sourced bacteria are consistent with calm settled river flows. Ruminant sourced bacteria still featured at several freshwater bathing sites, but did not dominate all the sampling sites. However, it should be noted that this sampling only acts as a snapshot in time and was conducted over a relatively dry period.

Mongahan et al (2010) state that for beef and sheep farms, direct faecal deposition accounts for 10% of total faecal input, whereas overland flow accounts for 60% of total input. The lack of rainfall across the region would have restricted overland flow, hence the recorded ruminant source partition is more likely direct deposition. In years where rainfall is closer to long-term averages, overland flow and therefore ruminant source bacteria are likely to be more prominent. Significantly more investigation is required before the health risk to bathers and shellfish gatherers can be determined from each of these faecal source signatures. Emphasis should be then be placed on increasing knowledge around source contribution for each bathing site through a range of environmental conditions.

5.4 SFRGs summary

Southland's freshwater bathing sites are largely divided between sites exposed to bacteria from agricultural activities and those in undeveloped catchments. This is reflected in the SFRGs assessment with three sites recording 'very good' SFRGs. These sites are the two pristine "natural state" lakes Te Anau and Manapouri, and the Mararoa River at South Mavora Lake. All three of these sites have no significant bacterial risk identified and correspondingly have bacterial counts well below national guidelines. The remaining eight bathing sites are located in agriculturally farmed catchments and are exposed to increased faecal bacterial levels.

Several other regional councils have undertaken SFRG assessments using two datasets - one with rainfall/flow events included, and two with rainfall/flow events removed. This approach may benefit several Southland lowland bathing sites and marine/estuarine sites by improving their SFRG assessments, such as the lower Waiau and Oreti River/New River Estuary sites. However, for the remaining sites it is unlikely to alter their SFRGs if the conditions were dry or wet, due to the high percentages of non-event driven contamination there.

5.5 Shellfish waters summary

The shellfish monitoring season in 2012/13 was typical for Southland with similar sites breaching the MfE (2003) recreational harvesting guidelines. Consistent with the findings of *Water 2010: Our Health*, the lowest levels of bacteria were recorded at Bluff Harbour, Monkey Island and Riverton Rocks. All three sites recorded medians between 1 and 3 fc/100 ml, highlighting the well-flushed nature of the sites. The sites also lacked large freshwater discharges directly adjacent to the shellfish gathering site.

Shellfish gathering sites which consistently breach national guidelines were the sites with rivers discharging in the immediate vicinity. These sites were the cockle beds in Toetoes Harbour, the two sites in the New River Estuary and the Jacobs River Estuary. All of four sites drain well-developed agricultural catchments and include several industrial discharges. This recorded pattern of riverine/event driven bacterial contamination in shellfish-gathering areas is well documented around New Zealand (Greenley et al, 2012; TRC 2013; MfE, 2013). In Southland, these results again clearly show the impact which freshwater quality has on coastal water quality and the increased risk to public health.

5.6 Communication of results and public awareness

Increasing the public awareness around the health risks from contact recreation is important for Environment Southland and its partners in the Bathing programme. In Southland where river records show both persistent and sporadic bacterial contamination, careful management is required. A “one size fits all” approach is unlikely to work, as bacterial contamination fluctuates and depends on locality and hydrological influence.



In other regions throughout New Zealand, the use of permanent bathing sites has been adopted. However, in Southland where bathing sites are spread across a large geographic area, this approach can be costly. The use of temporary signage across the region has historically been problematic in terms of sign management, vandalism, effectiveness and the perceived “poor public image”.

Figure 9: Southland’s contact recreation bathing sign



The use of posters with weekly results, updated via electronic communication, has been trialed for several years throughout Southland at Riverton/Aparima with good success (PHS survey, 2011). The posters are placed at selected community sites, such as schools, campgrounds, shops and community information centers. It is therefore recommended this approach be extended in Northern Southland to cover the towns of Gore, Riversdale, Waikaia, Balfour, Lumsden and Mossburn.

Results are published immediately upon being received, and are processed for quality assurance. These results are made available on the Environment Southland website:

<http://gis.es.govt.nz/bathing-waters/index.aspx>

Figure 10: Western Southland’s monitoring results poster

5.7 Monitoring review

A primary aim of State of the Environment (SOE) monitoring and reporting is to regularly update the local community and nation on the state of the region's environment. An SOE monitoring programme should therefore be representative of the region and provide adequate coverage of the monitoring sites. For example, are the monitored bathing sites well used by the public, and where rivers, lakes, estuaries and beaches are represented? Furthermore, are pristine and impacted bathing sites well represented by the sites monitored, in relation to known or suspected bacterial risk?

Environment Southland's other SOE monitoring programmes (groundwater and surface water) are represented by sites spread across RWP (2010) water classification zones. However, the bathing site selection and representativeness has historically been chosen using staff discretion using little protocol. Therefore bathing sites have been selected where areas are perceived to be well used by public and are predominantly located in populated and agriculturally developed catchments, as opposed to unpopulated, undeveloped areas. This skews the bathing programme to be more focused on impacted sites rather than pristine or non-impacted sites (Table 12).

5.7.1 Freshwater site coverage

Table 12: Freshwater bathing site coverage

RWP zone	Site	Catchment	Type	Status
Mountain	Mararoa River at South Mavora Lake	Upper Mararoa	Lake Outlet	Pristine
Lake Fed	Waiau River at Tuatapere	Lower Waiau	River	Impacted
Natural State	Lake Manapouri at Frasers Beach	Waiau	Lake	Pristine
	Lake Te Anau at Boat Harbour Beach	Waiau	Lake	Pristine
Mataura 3	Waikaia River at Piano Flat	Upper Waikaia	River	Partial impacted
	Waikaia River at Waikaia	Lower Waikaia	River	Impacted
	Mataura River at Gore	Mid Mataura	River	Impacted
Lowland hard bed	Mataura River at Riversdale	Mid Mataura	River	Impacted
	Oreti River at Wallacetown	Lower Oreti	River	Impacted
	Oreti River at Winton Bridge	Mid Oreti	River	Impacted
	Aparima River at Thornbury	Lower Aparima	River	Impacted
Hill	None	n/a	n/a	n/a
Spring fed	None	n/a	n/a	n/a
Other Mataura Classes	None	n/a	n/a	n/a

Coverage of Southland freshwater bathing sites has focused on the main catchments that drain to the Southern coast. However, there are several other sub-catchments, which are not covered by monitoring sites. These include the following:

- Ø the upper Oreti Catchment between Dipton and including Mossburn (hill zone);
- Ø the upper Mataura Catchment between Nokomai and Garston (Mataura 3);
- Ø the lower Mataura Catchment below Wydham (Mataura 3);
- Ø the mid to upper Aparima River above Otatau/Wreys Bush (lowland hard bed);
- Ø the mid to upper Waiau River below the Lake Gates and Alton Burn (lake fed);
- Ø the Whitestone River (hill/spring fed zone);
- Ø the Mavora Lake campground (mountain zone);
- Ø the whole of the Makarewa sub-catchment (lowland soft bed);
- Ø the Coastal Catlins/Waikawa catchment (lowland soft bed).

5.7.2 Recommendations for freshwater bathing

1. Gauging of usage in the coming 2013/14 bathing season the public usage of the above sub-catchments which are not represented in the monitoring programme.
2. Development of site selection criteria to assist in the above process.

5.8 Marine bathing sites coverage

The Southland coastline is generally sparsely populated with a large percentage of the coastline in undeveloped conservation estate. The placement of bathing sites in the sparsely populated areas is impractical as bathing is sporadic.

Currently, no coastal water quality zones exist in the Southland Coastal Plan (2007), which makes site representativeness and spatial coverage more qualitative. Marine bathing site selection has historically been based on public usage and sites which are physically safe for bathing/swimming on the southern coast.

Table 13: Marine bathing site coverage and description

Site	Catchment	Type	Status
Monkey Island at Frenzt Road	Kenny Creek Catchment	Sandy open coast	Partially Impacted
Kawakaputa Beach at Wakaputa Bay	Oue Creek Catchment	Sandy open coast	Partially Impacted
Colac Bay at Colac Bay Road opp Marae	Huraki Creek Catchment	Sandy open coast	Partially Impacted
Riverton Rocks at Mitchell Bay	Aparima Catchment	Pebble/sand Bay	Partially Impacted
Jacobs River Estuary at Railway Bridge East	Aparima Catchment	Estuarine beach	Partially Impacted
Oreti Beach at Dunns Road	Open Coast	Sandy open coast	Reference?
New River Estuary at Water Ski Club	Oreti Catchment	Estuarine beach	Partially Impacted
New River Estuary at Omaui	Oreti Catchment	Sandy open coast	Partially Impacted
Bluff Harbour at Morrison Beach	Creek/Stormwater system	Enclosed harbour beach	Partially Impacted
Awarua Bay at Tiwai Pumphouse	Bluff Harbour/Awarua Bay Catchments	Enclosed Bay	Reference?
Porpoise Bay at Campground	Cooks Creek Catchment/Open Coast	Sandy open coast	Reference?
Halfmoon Bay at Elgin Terrace	Creek/Stormwater System	Enclosed Bay	Partially Impacted
Halfmoon Bay at Bathing Beach	Mill Creek Catchment	Enclosed Bay	Partially Impacted

All bathing site types are represented (Table 13), but sandy beaches dominant, as these are more favourable and safer for bathing and swimming. As the majority of the marine sites are periodically impacted by faecal bacteria, there is no pristine or reference site in the programme. However, the well-used low risk sites (Halfmoon Bay at Bathing Beach, Awarua Bay, Oreti Beach and Porpoise Bay) can be used as proxy reference sites, eliminating the need to sample “true” reference sites.

Spatial coverage of marine bathing sites in Southland is generally good, given the size of the region and population. Most of Southland’s human population is represented by at least one bathing site. However, there are two sub-catchments, which are not covered by monitoring sites.

These include the following:

- Ø **Toetoes Harbour/Fortrose:** the nearest marine bathing sites are located at Bluff Harbour (34 km to the west) and Porpoise Bay (25 km to the east);

- Ø **Waikawa/Coastal Catlins:** this is another well-used area by the public for bathing, swimming, surfing and shellfish gathering. The area has very important cultural and environmental values and is Environment Southland’s latest Living Streams catchment (Tarbutt, personal communication with the author, 2013). The area only has one bathing site at Porpoise Bay, which is sampled fortnightly as it is deemed lower risk. However, the Waikawa Estuary is another well-used location for all contact recreation activities, such as shellfish gathering, swimming, fishing and paddling.

5.8.1 Recommendations for marine bathing

- Ø The placement of marine bathing sites in the Toetoes and Waikawa Harbours should be investigated to ascertain public usage of the area.
- Ø The survey in the Catlins could be run in conjunction with the Living Streams programme.

5.9 Shellfish gathering sites coverage

The freshwater and marine bathing microbiological guidelines have direct application to the health risk for bathers. However, the shellfish monitoring does not quantify the health risk from consuming contaminated shellfish flesh. This is because only the water surrounding shellfish is sampled and not the flesh, which means caution should be applied in interpreting the MfE (2003) guidelines. Furthermore, the MfE (2003) guidelines do not account for other variable such as hydrological inputs, which can greatly influence shellfish contamination in Southland (*Water 2010: Our Health*, 2010, Lovett, 2009).

Therefore, instead of increasing the monitoring effort in Southland by the addition of more monitoring sites, it may be more advantageous to undertake small investigations. Focus should be given to provide information on shellfish contamination and the clearance time periods after high-river flows. This will assist in increasing the predictive ability of the programme, as opposed to the reactive monitoring which is currently undertaken. Consideration should also be given to other pathogenic organisms, which can persist in shellfish flesh longer than the faecal bacteria indicators, such as viruses.

Table 14: Southland recreational shellfish gathering sites

Site	Shellfish type	Site description	Catchment
Monkey Island	Mussel/Kutai	Open coast	Kenny Creek
Colac Bay at Bungalow Hill Road	Mussel/Kutai	Open coast	Huraki Creek
Jacobs River Estuary d/s Fish Co-op	Cockle/Tuaki	Estuary	Aparima
Riverton Rocks at Mitchells Bay	Mussel/Kutai	Coastal Bay	Aparima
New River Estuary at Mokomoko Inlet	Cockle/Tuaki	Estuary	Oreti
New River Estuary at Whalers Bay	Cockle/Tuaki	Estuary	Oreti
Bluff Harbour at Ocean Beach	Cockle/Tuaki	Harbour	Bluff Harbour
Toetoes Harbour at Fortrose	Cockle/Tuaki	Estuary	Mataura

Southland’s main catchments are represented by the monitoring programme (Table 14); however, the following shellfish gathering areas are not represented:

- Ø Waikawa Harbour (tuaki/tuangi/cockle);
- Ø New River Estuary Entrance/Oreti Beach (toheroa);
- Ø Awarua Bay (tuaki/tuangi/cockle).

5.9.1 Recommendations for shellfish monitoring

- Ø Survey local marae, known shellfish collectors and the general public to ascertain the usage of the above locations.
- Ø Do not increase monitoring effort but undertake shellfish flesh investigations to determine risk from consuming contaminated flesh.
- Ø Increase the predictive ability of the monitoring programme by investigating the use of river flow-faecal relationships to forecast high faecal loads and clearance times.

5.10 Monitoring site summary

The spatial coverage of Environment Southland's marine and shellfish monitoring programme is generally adequate. However, there are several spatial gaps in the freshwater bathing programme. It is recommended that Environment Southland investigate the feasibility of adding several freshwater and two marine bathing sites to the current monitoring programme. This investigation could incorporate a recreational bathing survey as to determine the most up-to-date usability of Southland bathing sites. The survey should coincide with a review of the Environment Southland microbial monitoring plan in 2014/15, and after the MfE (2003) national microbiological guidelines are reviewed. It is also recommended that a bathing site selection criteria be formalized, as to quantify any future additions to the Environment Southland bathing programme.

6.0 Recommendations for improved monitoring

The recommendations for future work and improving the monitoring programme are described below:

Ø *Monitoring programme effectiveness*

1. Determine the effectiveness of the monitoring programme in terms of meeting its RWP (2010) requirements. Undertake this in the review of the Environment Southland microbial programme (due in 2014/15).
2. Determine the likely effectiveness of Environment Southland's microbial monitoring program meeting its NPS (2011) freshwater objectives and requirements (Appendix 2).
3. Amend Appendix K in the RWP (2010) to include all the freshwater bathing sites, with the addition of Mataura River at Riversdale, and the two lake sites on Lakes Te Anau and Manapouri to the Appendix.
4. Quantify the RWP (2010) objective 11 "*Freshwater quality does not have an adverse effect on coastal water quality*" by increasing the linkages between the freshwater, marine and shellfish gathering programmes. This should include all three parts of the current programme but also extend to Environment Southland's State of the Environment surface water monitoring programme.
5. Undertake trend analysis on all sites in the bathing programme in 2014/15 to 'track' changes since the *Water 2010: Our Health* analysis.

Ø *Monitoring frequency, sampling days, sample parameters, extra monitoring tools*

6. Determine any extra requirements to the monitoring program after the MfE (2003) revised microbiological guidelines are completed.
7. To improve the linkages between the freshwater and marine water quality, investigate the feasibility of the following:
 - ® reversing the freshwater and marine sampling days to better understand faecal contamination attenuation in each catchment;
 - ® include *Enterococci* (marine bacteria indicator) on the terminal SOE water quality site, as previously recommended by Ausseil (2010). Sites should include the Aparima River at Thornbury, the Oreti River at Wallacetown and the Mataura River at Gorge Road.
8. Based on the results of the 2013 SFRGs, maintain the weekly sample frequency at higher risk sites and fortnightly frequency at low risk sites.
9. Investigate the use of "dry weather SFRGs" for lowland river sites and marine sites with "event driven" faecal contamination. (*Note: This approach is unlikely to yield different SFRGs for mid and upper catchment sites as contamination is still prevalent at lower flows.*)
10. Investigate the public usage of the region's bathing and shellfish sites, with special focus on catchments, beaches and shellfish gathering areas, which are under-represented by monitoring sites.

11. Until the revised MfE (2003) microbiological guidelines are completed, continue to sample during periods of rainfall and elevated river flows. This is because contact recreation activities often occur on the coast.
12. For sites with event driven contamination, investigate the possibility of adding visual clarity or turbidity measurements to the sampling tests. This may enable a faecal-bacteria-to-turbidity relationship to be developed, to increase the “prediction” of likely faecal levels with turbid river flows.
13. Undertaking sanitary inspections and investigation is costly in terms of laboratory cost and logistics. For example, the use of Microbial Source Tracking (MST) as a routine monitoring tool is still limited, as it has reduced temporal variability due to being cost prohibitive along with a lengthy processing period. This slightly reduces the long-term application and value of MST techniques to recreational bathing sites. A more cost effective option may be to increase the monitoring capacity during the bathing season. It is recommended that at sites where bacterial sources require identification, duplicate samples be collected in the future to allow MST analysis.

Ø *Education and Extension of Programme*

1. Extend the weekly results posters into Northern Southland to include the townships of Lumsden, Mossburn, Riversdale, Balfour, Waikaia & Gore.
2. Explore the usage of advertising for weekly results in the local media, such as papers, radio programmes and TV stations.

7.0 Conclusion

The current report summarises the results from the Environment Southland microbial monitoring programme in 2012/13. The key findings were:

- Ø the marine bathing season was the best recorded since 2003, with only 1% of samples breaching the “action” level;
- Ø recorded levels of marine bacteria were greatly reduced compared to previous seasons;
- Ø the number of freshwater occasions for an “action” level was up slightly on 2011/12 but still well below long term averages for Southland;
- Ø the number of lowland rivers breaching national bathing guidelines was reduced;
- Ø the summer low river flows and limited rainfall account for the improved bathing season;
- Ø shellfish gathering sites recorded similar levels of bacterial contamination as long-term records;
- Ø Those sites away from large freshwater inputs recorded little contamination;
- Ø by comparison those sites adjacent to river inputs were usually above national guidelines;
- Ø SFRGs for Southland bathing sites suggest monitoring is still required at most freshwater and marine sites, as bacterial contamination is often prevalent;
- Ø of the 11 freshwater sites, three are rated as very good, but the remaining sites are rated as poor or very poor for their suitability for recreation;
- Ø of the 13 Southland marine bathing sites, six are rated at good and very good, and the remaining sites rated as fair to poor;
- Ø there is a need to:
 - ® investigate the feasibility of adding several new freshwater and marine monitoring sites;
 - ® increase the linkage between the freshwater, marine and shellfish sampling;
 - ® increase the linkage between the bathing programme and the surface water quality programme;
- Ø understanding faecal contamination across Southland and its temporal variability is critical for Environment Southland. Where possible, emphasis should be placed on quantifying hydrological influences on Southland bathing and shellfish sites, using more predicative than reactive techniques;
- Ø it is recommended the Environment Southland bathing programme be comprehensively reviewed after the release of the MfE (2003) microbiological guidelines.

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Glossary

95 % Hazen percentile

A percentile is the value of a variable below which a certain percent of observations exist. So using the Hazen method adopted by MfE (2003) means that 95 % of all observations fall below that value.

Compliance

The state or fact of according with or meeting rules or standards as set out in Southland's Regional Water Plan (2010) and the MfE (2003) microbiological guidelines.

E.coli - Escherichia coli

An anaerobic bacterium commonly found in the lower intestine of warm-blooded organisms. It is the bacterial indicator used for freshwater.

Enterococci

A bacterium which forms pairs and is commonly found in the gut of humans. It is the bacterial indicator used for marine water.

Event driven

Elevated faecal bacteria levels associated with increased rainfall and river flows.

Faecal coliforms

A group of bacteria which includes *E.coli*. It is the bacterial indicator used for shellfish waters.

Freq 3

River flow measured past a fixed point which is three times the median flow.

MfE (2003)

Ministry of the Environment microbiological guidelines 2003.

Appendix A - Southland Regional Water Plan (2010) surface water quality objectives

Section 3.1 of the Proposed Regional Freshwater Plan defines the water quality outcomes the plan sets to achieve within the next 10 years, including:

- (2) There will be no reduction of water quality in the Southland Region beyond the zone of reasonable mixing for discharges;
- (3) Water quality will be maintained in Natural State Waters;
- (4) The water quality of surface water bodies will be maintained and enhanced so that it is suitable for bathing in popular bathing sites, trout and native fish, stock drinking water and Ngāi Tahu cultural values, including mahinga kai;
- (5) An improvement in the water quality and in particular a minimum 10 percent reduction in levels of microbiological contaminants, nitrate and phosphorus and a minimum 10 percent improvement in water clarity will be achieved in hill, lowland and spring-fed surface water bodies over 10 years from the date this Plan becomes operative;
- (6) Discharges to water bodies will not result in levels of toxic substances that harm humans, domestic animals including stock or aquatic life;
- (8) The significant adverse effects of discharging during low flows are avoided;
- (10) Storm-water discharges will meet water quality standards and current ANZECC sediment guidelines by 2010;
- (11) Freshwater quality does not have an adverse effect on coastal water quality.

Appendix B - NPS (2011) objectives

Objective 3 – Improving the quality of fresh water

To ensure the progressive enhancement of the overall quality of Freshwater Resources, including actions to ensure appropriate Freshwater Resources can reach or exceed a swimmable standard.

Objective 5 – Addressing freshwater degradation

To control the effects of Land-use Development and discharges of contaminants to avoid further degradation of Freshwater Resources.

Objective 8 – Iwi and hapū roles and Tangata Whenua Values and Interests

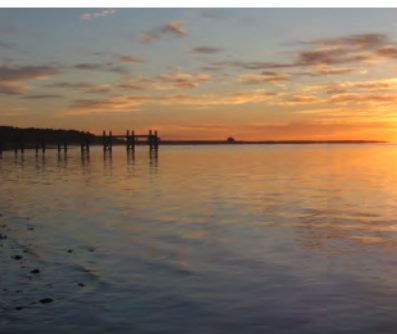
To ensure that iwi and hapū are involved, and Tangata Whenua Values and Interests are identified and reflected, in the management of Freshwater Resources including the matters specified in Objectives 1–7.

Objective 9 – Ensuring effective monitoring and reporting

To ensure that regional councils and territorial authorities undertake effective monitoring and reporting of the matters specified in Objectives 1–8.

Appendix C – Faecal Sources Samples

Location	Date	Result <i>E. coli</i> MPN/100ml	Source from results	Comments	Sample #
Waikaia River at Waikaia	8 January 2013	>2420	Wild fowl/plant decay		20127654
Waikaia River at Waikaia	15 January 2013	2420	Ruminant/wildfowl		20130121
Waikaia River at Waikaia	7 February 2013	727	Ruminant/wildfowl	low level of sterols	20130707
Waikaia River at Waikaia	26 February 2013	2420	Ruminant	low level of sterols	20130940
Waikaia River at Waikaia	18 March 2013	1333	Ruminant/plant decay		20131201
Mataura at Gore	15 January 2013		Wild fowl/plant decay		20130120
Mataura at Gore	7 February 2013	184	Wild fowl/plant decay		20130708
Mataura at Gore	18 March 2013	884	Wild fowl/plant decay		20131199
Mataura at Riversdale	15 January 2013	687	Wild fowl/plant decay		20130122
Mataura at Riversdale	26 February 2013	727	Wild fowl/plant decay		20130941
Mataura at Riversdale	18 March 2013	3450	Wild fowl/plant decay		20131200
Mataura at Riversdale	25 March 2013	683	Wild fowl/plant decay		20131338
Aparima at Thornbury	8 January 2013	770	Ruminant		20127652
Aparima at Thornbury	10 January 2013	46111	Ruminant/wildfowl		20130066
Aparima at Thornbury	12 February 2013	866	Wild fowl/plant decay		20130768
Aparima at Thornbury	18 March 2013	480	Wild fowl/plant decay		20131203
Oreti River at Winton Bridge	18 March 2013	450	Wild fowl/plant decay	not enough sterol to get results	20131202
Oreti River at Winton Bridge	25 March 2013	520	Wild fowl/plant decay	not enough sterol to get results	20131340



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