

Waitara Marine Outfall  
Bacteriological  
Monitoring Programme  
Annual Report 2000

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## Executive Summary

A bacteriological monitoring programme in relation to the discharge of treated domestic sewage from Waitara township into the Waitara embayment has been conducted since May 1987. Effluent from Waitara wastewater treatment plant and a package plant at the Waitara Valley methanol plant is discharged through a 1250 metre long outfall off the Waitara River mouth. The monitoring programme was revised in 1996 and again in 1998-99 to exclude wet weather conditions and high river flows in the Waitara River during sampling.

This report summarises the results of bacteriological monitoring undertaken during the 2000-01 summer monitoring period. Sampling was undertaken on thirteen occasions during the period from mid-November 2000 to the end of March 2001. Sampling was undertaken at four coastal sites within the Waitara embayment and the Waitara River. Samples were analysed for faecal coliform, *E. coli* and enterococci bacteria, temperature and conductivity. Turbidity was also analysed for freshwater samples.

The bacteriological results collected within this 2000-01 monitoring period are lower than the previous few years, however occasional elevated bacterial counts occurred. It is concluded these were due to the wastewater discharge through the marine outfall. The Waitara River was found to have a negligible influence throughout the monitoring period.

In terms of the water quality within the Waitara embayment for contact recreation purposes, the old Water and Soil Conservation Act (1967) standard for faecal coliforms was met at all four coastal sites. According to the former 1992 DoH guideline all sites, except Waitara East Beach, met the 'light use' category identified as appropriate to the Waitara embayment, and the 1998 MfE recreational water quality guideline identified 96% of all samples collected within the embayment to be 'safe' for contact recreation purposes.

Continuation of the present monitoring programme in relation to the Waitara outfall is recommended.

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# 1 Introduction

This report is the Annual Report for the period January-December 2000 by the Taranaki Regional Council describing the bacteriological monitoring programme associated with the Waitara marine outfall.

This report covers the results and findings of the monitoring programme implemented by the Council over the 2000-01 summer period to assess the impact of the wastewater discharge on shoreline seawater quality within the Waitara embayment. This is the eighth Annual Report by the Taranaki Regional Council for the Waitara marine outfall bacteriological monitoring programme and its effects.

## 1.1 Process description

The Waitara marine outfall discharges into the Waitara embayment approximately 1250 metres offshore from the mouth of the Waitara River in approximately 10 metres of water. This outfall provides for the disposal of wastewater from the Waitara municipal sewage reticulation system, the Methanex Waitara Valley methanol plant and the Methanex Motunui methanol plant. Until September 1997, it conveyed wastewater from AFFCO's meatworks. Treated domestic wastewater from the Methanex Motunui plant is treated at the Waitara plant.

The four major users of the outfall together have formed the Waitara Outfall Management Board (WOMB) to oversee the refurbishment and maintenance of the outfall. The Board undertook to refurbish the outfall to provide for a 25 year life and to improve initial dilution. Refurbishment of the outfall was carried out between July and December 1991. An impervious plastic liner was inserted through the pipeline, the stability of the pipeline on the seabed was improved, and a new diffuser was installed.

During 1991 and 1992, the New Plymouth District Council and the meat processing company, AFFCO, constructed a wastewater treatment plant for the combined domestic and meatworks effluents which previously had been discharged through the outfall with minimal treatment. Treatment comprises screening of wastewater to 0.5 millimetres particle diameter (meatworks wastewater was screened at the works), followed by disinfection through elevation of pH with lime to pH 11 and holding for a minimum of four hours. Treated wastewater is discharged through the outfall in batches at a constant rate, the frequency depending on influent flow rates.

## 1.2 Resource consents

### 1.2.1 Water discharge permit

Section 15(1)(a) of the Resource Management Act stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations.

Each of the users of the outfall was granted a separate but contemporaneous consent to discharge through the outfall until 2008. The present holders of the four consents are:

<u>Consent holder</u>	<u>Consent</u>	<u>Discharge source</u>
New Plymouth District Council	3397	Waitara municipal domestic and minor industrial sewage
Manawatu Food & Technology Ltd	3398	Waitara meatworks
Methanex Waitara Valley	3399	Methanol plant
Methanex Motunui	3400	Methanol plant

AFFCO's consent was transferred to Manawatu Food and Technology Limited on 8 June 1999.

There are a number of special conditions attached to these consents in relation to the outfall, effluent, contingency plans and annual reports, responsibility for investigation and remedy of effects of unauthorised discharges and review of conditions. There are three special conditions specific to the marine outfall and these are as follows.

Special condition 5 stipulates that the minimum initial dilution of the effluent above the diffuser be 100:1.

Special condition 6 requires the consent holder to verify the performance of the outfall and diffuser within the first two years of exercise of this consent.

Special condition 7 requires the consent holder to undertake inspections of the outfall.

These consents were issued by the Taranaki Regional Council on 11 October 1989 as a resource consent under Section 87(e) of the Resource Management Act. They are due to expire on 12 March 2008. A copy of consent 3397 is attached in Appendix I.

## **1.3 Monitoring Programme**

### **1.3.1 Introduction**

Section 35 of the Resource Management Act sets out an obligation for the Taranaki Regional Council to gather information, monitor, and conduct research on the exercise of resource consents, and the effects arising, within the Taranaki Region.

The Taranaki Regional Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders. The bacteriological monitoring programme for the Waitara marine outfall is set out as follows.

### **1.3.1 Background**

The Waitara Bacteriological Monitoring Programme was revised in October 1989.

Previous to 1989, shoreline sites around the Waitara embayment were monitored for faecal coliforms to determine compliance with the bacteriological standard of the SB water classification under the Water and Soil Conservation Act, 1967. Sites on the Waitara River and Waiongana Stream, and the municipal effluent were also monitored in an effort to gauge the relative effects of outfall and riverine influences on shoreline water quality.

The programme was revised for two reasons. First, lime treatment is particularly effective against coliforms, reducing the usefulness of the faecal coliform as an indicator of the presence of pathogens in the treated municipal effluent. Secondly, the influence of the Waitara River was found to mask any effects of the discharge from the Waitara outfall on shoreline faecal coliform levels.

The more resistant enterococci bacteria were chosen to replace the faecal coliforms as the primary organisms to monitor in the Waitara embayment as an indicator of water quality.

The Regional Council recognised that the Waitara River may have a similar confounding influence on enterococci monitoring as for faecal coliforms, and determined to obtain some background information before the new treatment system was commissioned. *E.coli* was

also monitored, to provide data for assessment of changes in coliform levels after the new treatment system was commissioned.

The frequency of monitoring was reduced from twelve to four 30-day, five-sample periods per year, with an emphasis on the summer bathing season. The lower Waitara River sites and the Waiongana site were omitted from the programme.

From 1990 to 1993 sample collection and analysis was carried out by AFFCO staff. There was some inconsistency in the number of samples taken each year and in the time of year that sampling was undertaken. In 1994 it was agreed that the Regional Council would be responsible for all aspects of this monitoring programme including sample collection and analysis.

In 1996 the bacteriological monitoring programme was revised again. This revision was undertaken to bring the monitoring programme into line with the 'Provisional Microbiological Water Quality Guidelines for Recreational and Shellfish-Gathering Waters in New Zealand' (Department of Health, 1992) and with other marine bacteriological monitoring programmes undertaken by the Taranaki Regional Council.

The revised programme involved monitoring on at least twelve occasions during the summer bathing season (December to February). The intention was to sample on four occasions per month during each of the three summer months, however, some flexibility was allowed to take account of bad weather, tides, etc. Sampling was restricted to between 0900h and 1800h and to dry weather conditions which were considered to occur at least two days following any significant rainfall. Sampling was restricted to within two hours either side of high tide and samples were taken at approximately knee depth. The treated effluent sample site was removed from the programme due to the difficulties of co-ordinating the other requirements of the monitoring programme, particularly tides, with the intermittent batch discharge nature of the discharge from the treatment plant. The three bacterial indicators used since 1989: enterococci, *E.coli* and faecal coliforms, were retained in the revised programme. The Department of Health (DoH) provisional guidelines are based on enterococci bacteria.

The main changes introduced to the programme in the 1996 revision were a reduction in sampling frequency and the restriction of sampling to dry weather conditions. It was considered that the restriction to dry weather conditions would enable a better assessment of the effects of the outfall to be undertaken due to the reduced influence of high flow events in the Waitara River.

During the 1997-98 monitoring period, four additional sites were included in the programme (as recommended by the 1996-97 Annual Report) to investigate the potential causes of occasional elevated bacterial levels at the East Beach site recorded during the 1996-97 monitoring period. The results were not able to determine whether the occasional high counts were related to the Waitara River and adjoining tributary.

During the 1998-99 monitoring period the programme was slightly modified to further restrict sampling to beyond three days of river fresh conditions. All other aspects of sampling methodology remained unchanged.

As a result of changes to the monitoring methodology, the results obtained since the 1996-97 summer period are not directly comparable to historical monitoring results. This is mainly due to the restriction of sampling to dry weather conditions, which was not part of the sampling requirements prior to the 1996-97 season.

### 1.3.3 Monitoring methodology

#### 1.3.3.1 Sampling design

Sample collection, field measurements, transport and analyses are undertaken according to documented Taranaki Regional Council procedures. It is intended that on average, four samples be collected from each of the sites in each month when hydrological flow conditions permitted, within two hours of high tide. Bathing water samples are to be taken between the hours of 0900 and 1800 hours (NZDT) with none collected within three days of river fresh conditions. Where necessary a 2 metre sampling pole is used for bacteriological sample collection immediately beneath the water surface and at a minimum of knee depth at the sites. A minimum of twelve samples are collected from each site.

Samples are analysed for enterococci, *E. coli* and faecal coliform bacteria and conductivity. In addition, at each of the sites the following information is recorded; time, water temperature, weather condition, wind condition, surf condition, colour/appearance of water, and number of bathers and other users.

#### 1.3.3.2 Site location

Table 1 describes the beaches that were included in the monitoring programme over the 2000-01 summer period. The locations of the sites are depicted in Figure 1.

**Table 1** Waitara bacteriological monitoring sites 2000-01

Location	Description	Grid Reference	Site number
Airedale Reef	Shoreline 1000m east of Waitara River mouth	Q19:172 459	SEA 901030
East Beach	Shoreline 200m east of Waitara River mouth	Q19:167 457	SEA 901033
West Beach	Shoreline 200m west of Waitara River mouth	Q19:613 456	SEA 901037
Tuaranga Reef	Shoreline 2000m west of Waitara River mouth	Q19:154 456	SEA 901052
Bertrand Road	Waitara River at Bertrand Road bridge	Q19:187 390	WTR 000800

All sites' locations and descriptions are stored in the TRC site index card system and are recorded in the laboratory computer database (Labsys) where all analytical results were stored following standard sample registration procedures.

#### 1.3.3.3 Environmental parameters and indicators

The environmental parameters and indicators used to assess the effects of the Waitara marine outfall discharge on shoreline seawater quality in the Waitara embayment are, primarily, historical data comparisons since 1989 and the relative influence of the Waitara River on bacteriological results.

In addition, although the sites monitored within the Waitara embayment are not popular summer bathing beaches, the bacteriological results are also assessed in terms of suitability for contact recreation. The following is a summary of the water quality guidelines currently used by the Council.

##### ***Faecal coliforms***

Faecal coliform bacteria have historically been the most commonly used indicator of microbiological contamination in Taranaki and throughout New Zealand. The use of faecal coliform bacteria was based upon the SB Class for seawater in the now repealed Water and Soil Conservation Act 1967 which required a median standard of 200 faecal coliforms per 100 ml from a minimum of 5 samples collected over a 30 day period. Although there is

now no statutory basis for the use of faecal coliforms, a number of regional councils have retained faecal coliform bacteria as an indicator species, and at this time they continue to be monitored by the Taranaki Regional Council.

### **Provisional Microbiological Water Quality Guidelines**

*E. coli* and faecal coliforms have been used in the past as bacterial indicators for samples taken throughout Taranaki. The Provisional Microbiological Water Quality Guidelines published by the Department of Health in 1992 set out guidelines for seawater microbiological water quality in terms of enterococci bacteria (DOH, 1992).

These guidelines are based upon water quality criteria developed by the United States Environmental Protection Agency (EPA, 1986). Before the introduction of these guidelines enterococci bacteria were seldom used in bacteriological studies in New Zealand and the level of historical data for enterococci levels in New Zealand streams and rivers is limited. There is also a limited understanding of how these bacteria are influenced by different environmental factors and the relationship between enterococci numbers and disease incidence in the New Zealand situation. As enterococci may become the commonly used indicator bacteria in this country they are included in most Taranaki Regional Council bacteriological studies in order to establish a historical database and to establish any relationship between faecal coliforms and enterococci bacteria.

The provisional guidelines recommended for coastal water that the median of samples taken over a bathing season shall not exceed 35 enterococci per 100 ml, and that no single sample should exceed the following upper limit:

Upper limit per (nos/100 ml)	Designated bathing area	Moderate use	Light use	Infrequent use
Enterococci	104	153	275	500

Staff of the Council, when evaluating results, have concluded that the most appropriate category to compare results against is the 'moderate use' category for Taranaki beaches. By comparison with other New Zealand beaches Taranaki beaches receive occasional high usage. In the case of the Waitara embayment, the most appropriate category to compare results against is the 'light use' category and it is this category which will be referred to when assessing results.

### **Recreational Water Quality Guidelines**

These draft guidelines (MfE, 1998) which replace the provisional guidelines (DOH, 1992), were developed (by MfE and MoH) to assist water managers to implement the Resource Management Act (1991) and the Health Act (1956) for the purposes of shellfish-gathering and contact recreation. The guidelines use a combination of seasonal median and single bacteriological samples to assess the safety of contact recreational waters. The framework for safety assessment is a three tier system: clean ('safe'), potentially unclean ('potentially unsafe'), and highly likely to be unclean ('highly likely to be unsafe').

For marine water the preferred indicator is enterococci. For fresh water the preferred indicator is *Escherichia coli* (*E. coli*). Enterococci is not preferred in fresh water because enterococci-type bacteria can be derived from non-faecal sources such as the breakdown of leaf material.

The framework in these guidelines uses both medians and single sample maxima. Seasonal medians provide the basic means to assess safety. Single samples are used to help water managers determine whether it is likely that the seasonal median set out in the guidelines

will be achieved. A running median is also used to assess whether the seasonal median (set out in the guidelines) will be achieved.

The marine bathing guidelines are summarised as follows:

	Enterococci (nos/100ml)			Action
	Safe	Alert		
		Mode I	Mode II	
Running median	<35	>35	-	-
Single sample maximum	-	<137	137-277	>277

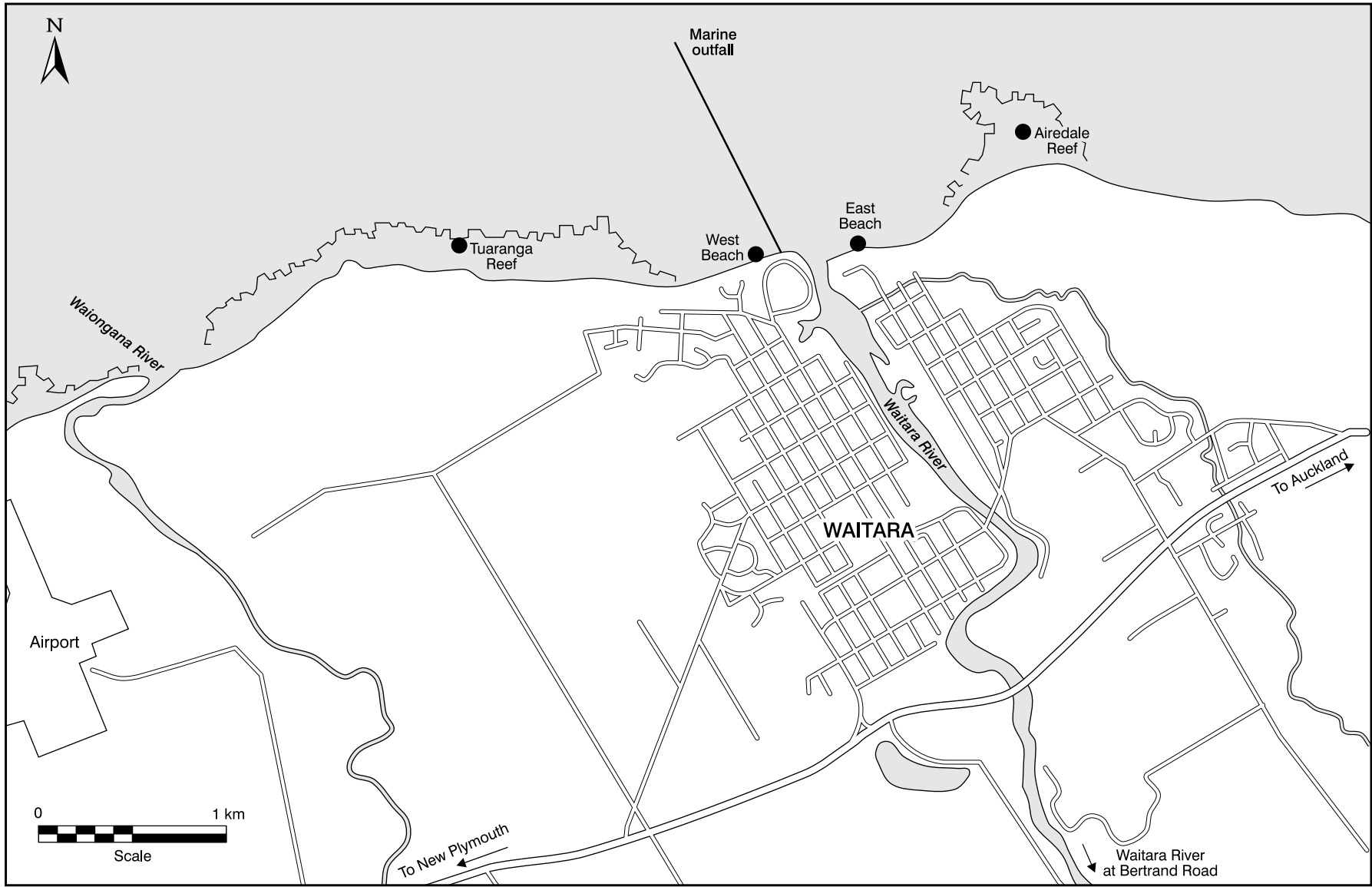
According to the 1998 MfE guidelines, when enterococci counts exceed the 'safe' category (i.e. no running median calculated throughout the season exceeds 35 enterococci per 100 ml) investigations should be initiated to determine the cause of the exceedances recorded. The response category, Alert Mode I, occurs when the running median is greater than 35/100 ml, but no single or individual sample exceeds 136 enterococci per 100 ml. When this occurs the guidelines recommend that sampling is increased to twice weekly to improve the information base. At least two samples less than 35 enterococci per 100 ml should be recorded before returning to surveillance/safe mode. Alert Mode II occurs when a single sample between 136 and 277 enterococci per 100 ml is recorded (irrespective of running median). Investigations to be undertaken include daily sampling, a sanitary survey and identification of potential management options. Action mode occurs when two consecutive single samples (collected within 24 hours of each other) exceed 277 enterococci per 100 ml (irrespective of running median). When this occurs samples are to be collected daily, a sanitary survey is to be undertaken and the public are warned that the beach is considered unsafe.

It is noted that the Taranaki Regional Council has incorporated comparison against these guidelines into existing methodology for assessing the water quality of its beaches.

#### 1.3.4 Other Waitara monitoring programmes

The Waitara bacteriological monitoring programme is one of two 'impact' monitoring programmes carried out in relation to discharges from Waitara outfall. The other programme monitors intertidal marine ecology in the Waitara embayment.

The major effluents contributing to the Waitara outfall discharge are each monitored at source in 'compliance' monitoring programmes. Annual reports are also produced on these programmes.



**Figure 1** Location of Waitara bacteriological monitoring sites

## 2. Results

### 2.1 Summer 2000-01 monitoring

#### 2.1.1 Summary statistics

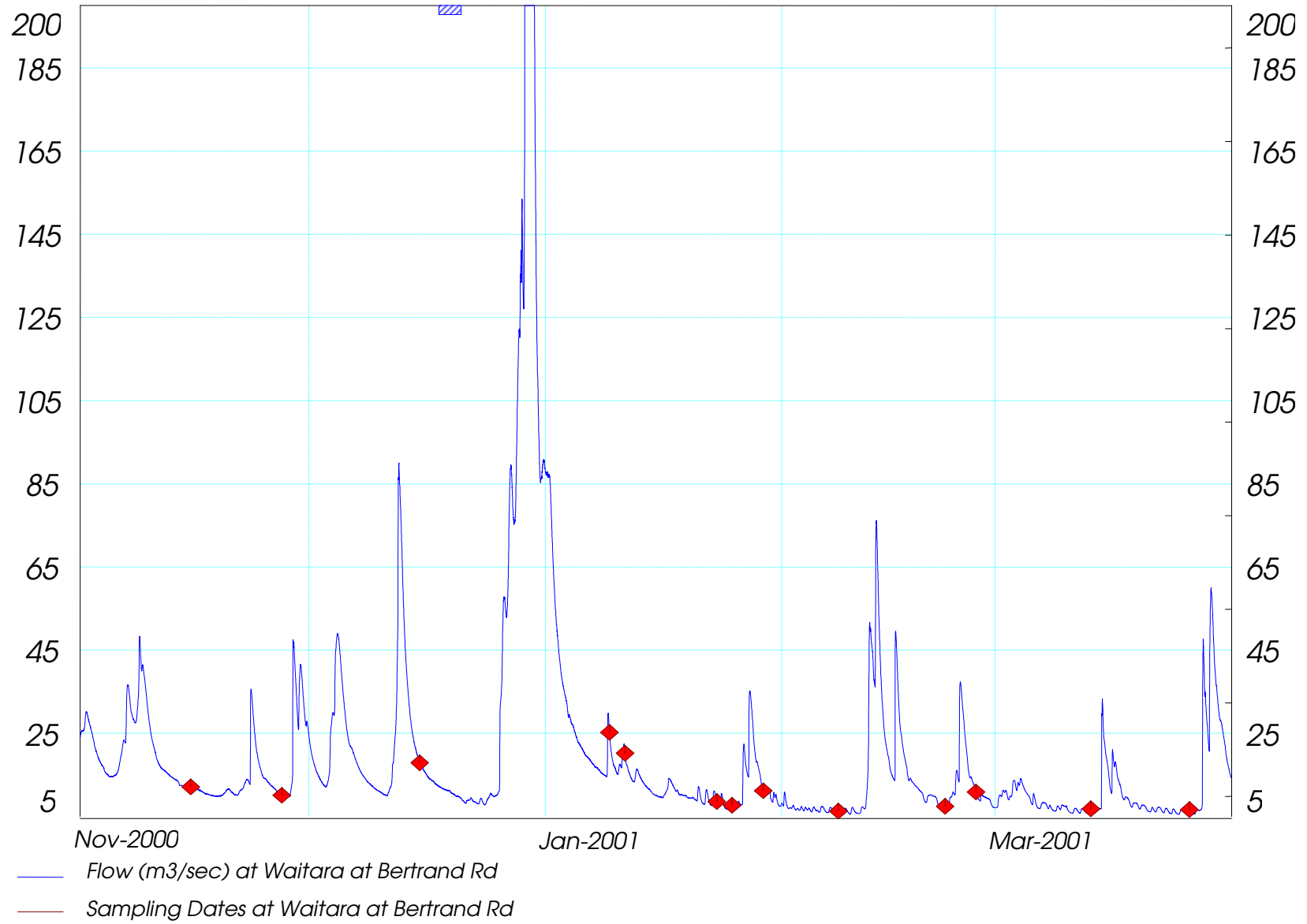
Summary statistics for the results of monitoring undertaken during the 2000-01 summer period are shown in Table 2 below. The raw data for this period are contained in Appendix II.

A hydrograph showing the stage height in the Waitara River during the sampling period (mid-November to end of March) is shown in Figure 2. The times of each of the sampling runs are also shown on the hydrograph to indicate the level of discharge from the Waitara River during each sampling run.

**Table 2** Summary of statistics for 2000-01 summer sampling period

Site	Parameter	Units	Median	Minimum	Maximum
Airedale Reef	Temperature	°C	20.2	15.4	21.4
	Conductivity	mS/m	4630	4220	4750
	Faecal coliforms	No/100ml	3	<1	44
	<i>E.coli</i>	No/100ml	3	<1	44
	Enterococci	No/100ml	7	1	50
Waitara East Beach	Temperature	°C	20	15.4	21.3
	Conductivity	mS/m	4520	4320	4700
	Faecal coliforms	No/100ml	3	<1	130
	<i>E.coli</i>	No/100ml	3	<1	130
	Enterococci	No/100ml	9	1	520
Waitara West Beach	Temperature	°C	19.9	15	21.5
	Conductivity	mS/m	4580	4170	4760
	Faecal coliforms	No/100ml	9	<1	410
	<i>E.coli</i>	No/100ml	9	<1	410
	Enterococci	No/100ml	5	<1	240
Tuaranga Reef	Temperature	°C	19.6	15.1	21.8
	Conductivity	mS/m	4560	4140	4700
	Faecal coliforms	No/100ml	5	<1	37
	<i>E.coli</i>	No/100ml	4	<1	37
	Enterococci	No/100ml	4	<1	24
Bertrand Road	Temperature	°C	21.1	17.3	22.6
	Conductivity	mS/m	10.8	8.9	11.4
	Turbidity	NTU	2	1.2	44
	Faecal coliforms	No/100ml	80	9	240
	<i>E.coli</i>	No/100ml	76	9	240
	Enterococci	No/100ml	60	11	120

The faecal coliform, *E.coli* and enterococci counts recorded at each of the sites on the thirteen sampling occasions during 2000-2001 are shown in Figures 3 to 7. The conductivity for each sampling occasion is also shown to indicate the extent of the freshwater influence at each site (the lower the conductivity, the greater the freshwater component – the conductivity of seawater without freshwater influence is about 4750 mS/m). The turbidity is also assessed for the Waitara River samples to provide a measure of the clarity of the Waitara River at the time of sampling (Figure 7).



**Figure 2** Waitara River flow recorded at Bertrand Road (November 2000-March 2001)



Figure 3 Results of bacteriological sampling at Airedale Reef

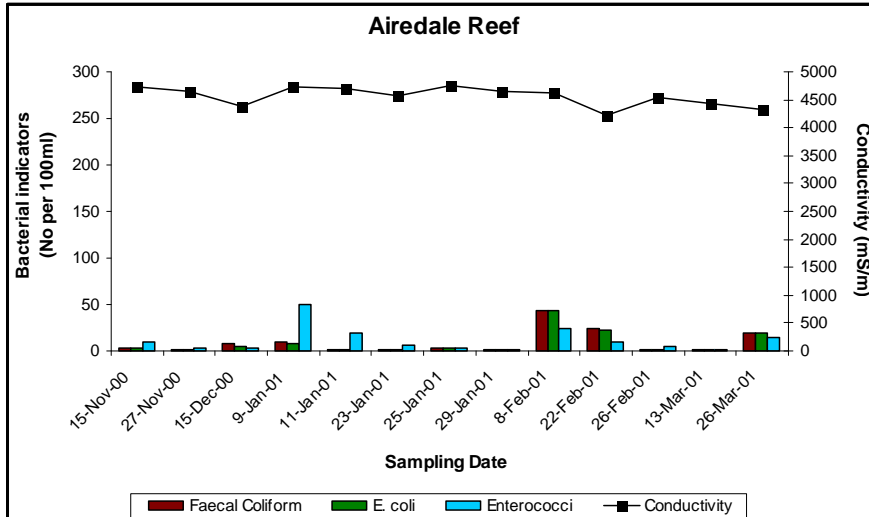


Figure 4 Results of bacteriological sampling at Waitara East Beach

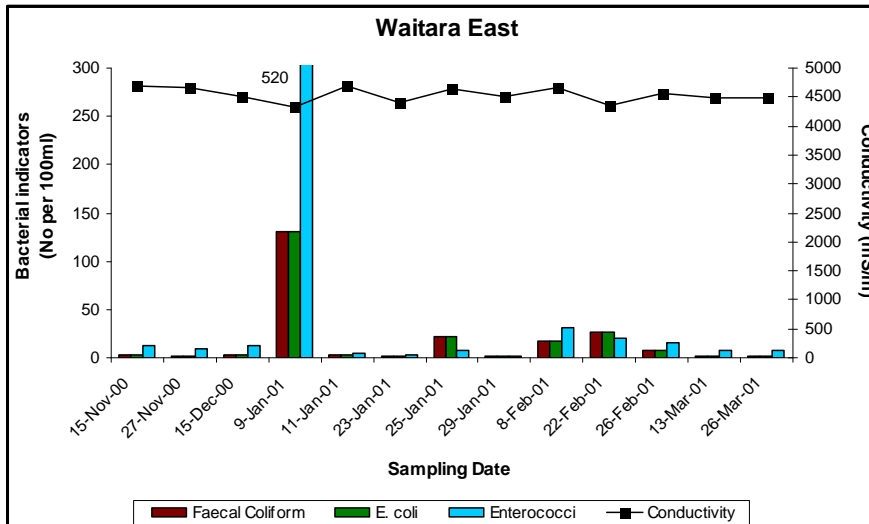
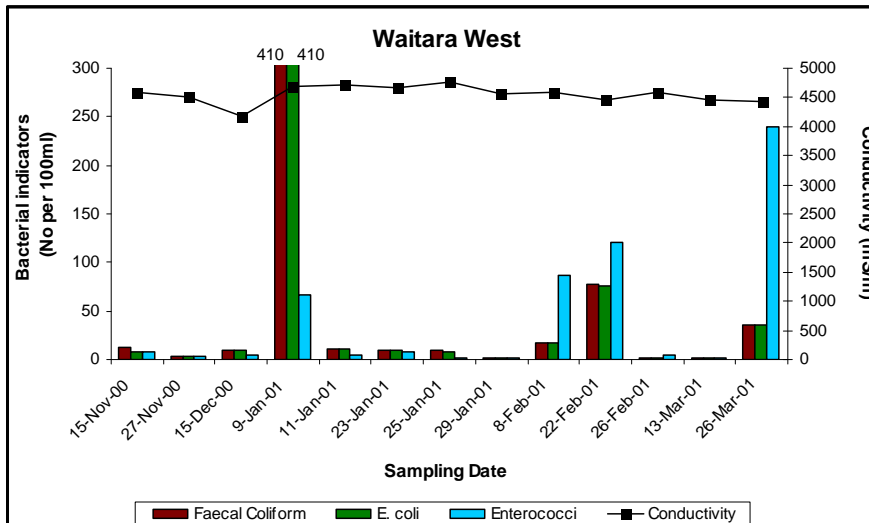
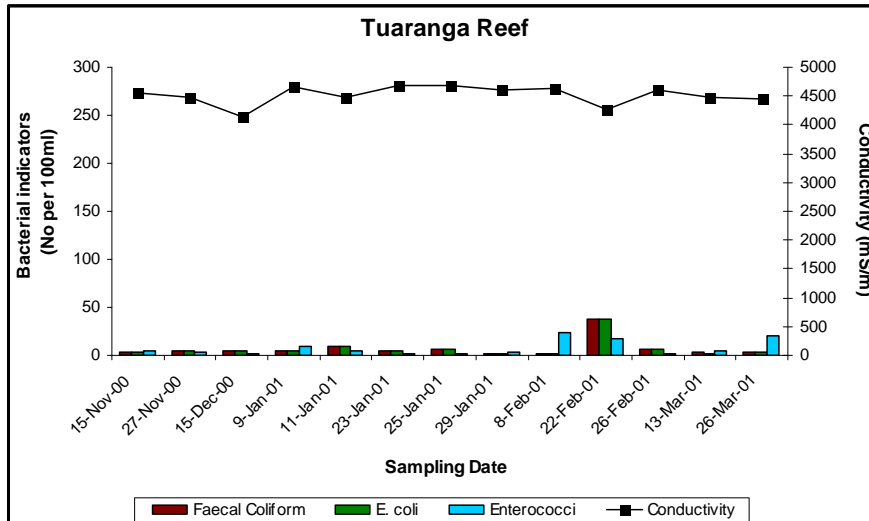


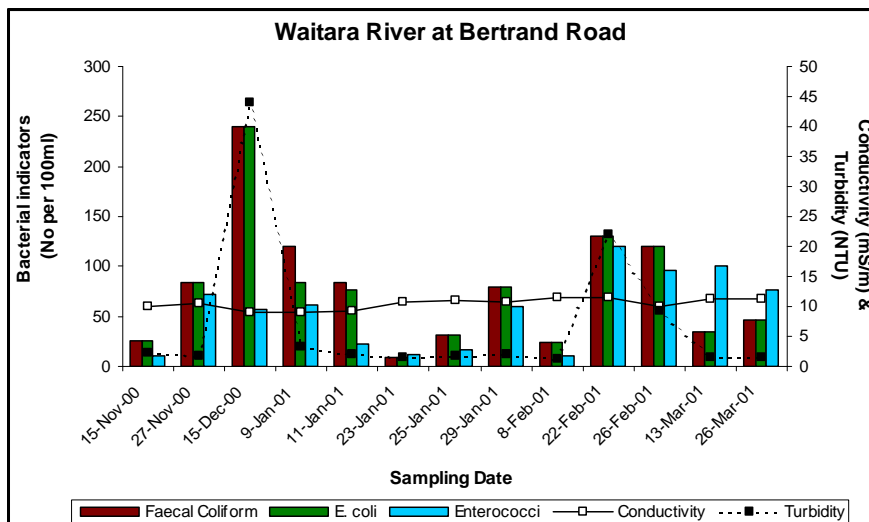
Figure 5 Results of bacteriological sampling at Waitara West Beach



**Figure 6** Results of bacteriological sampling at Tuaranga Reef



**Figure 7** Results of bacteriological sampling at Bertrand Road



The Airedale Reef site recorded consistently low bacterial counts throughout the sampling period. The maximum count recorded was 50 enterococci/100 ml on 9 January 2001 (Figure 3). Conductivity levels were relatively consistent during each sampling occasion indicating negligible freshwater influence at the site.

Similarly, the Tuaranga Reef site recorded low bacterial counts throughout the sampling period with median results similar to Airedale Reef (Table 2). The maximum count recorded during the sampling period was 37/100 ml faecal coliform and *E. coli* bacteria on 22 February 2001 (Figure 6). Conductivity levels were relatively consistent during each sampling occasion indicating negligible freshwater influence at the site.

Both the Waitara East and Waitara West Beaches recorded low median bacterial counts similar to the two coastal sites (Table 2). However, each site was subject to occasional elevated counts during the sampling period. Both beach sites recorded elevated levels on 9 January 2001. The Waitara East Beach recorded the highest enterococci count (520/100 ml) on this occasion (Figure 4) while the Waitara West Beach recorded the highest faecal coliform and *E. coli* counts (410/100 ml) (Figure 5). These elevated counts do not correspond to elevated counts in the Waitara River, or a large freshwater influence at the

site, or high river flows. This is the same sampling occasion that the Airedale Reef site recorded maximum enterococci counts.

The Waitara West Beach site experienced an additional three occasions of elevated bacterial counts, most notably of enterococci. On the 8 February 2001 a slightly elevated enterococci count of 86/100 ml was recorded which could not be attributed to the Waitara River (Figure 7; note low bacterial and turbidity levels). Bacterial counts in the Waitara River at the time of sampling on 22 February 2001 were not particularly high but the turbidity level was slightly elevated and the appearance of the river was described as 'brown' at the time of sampling. The appearance of the seawater sites was described as 'green/brown' suggesting some nearshore discolouration and associated contamination from the Waitara River. The elevated enterococci count on 26 March 2001 could not be attributed to the Waitara River which was running clear at the time of sampling and with lower enterococci counts than the beach site.

### 2.1.2 Influence of Waitara River on shoreline bacteriological results

Although conductivity results, a hydrograph and recording of bacterial counts in the Waitara River are useful, linear regression analysis is also used to assess the degree and relative influence of both the Waitara River bacteriological levels and a number of environmental parameters on shoreline bacteriological levels.

Simple linear regressions were performed on the discharge of each bacterial indicator ( $\log_{10}$  x river flow x bacterial indicator count) from the Waitara River against the three bacterial indicators at each of the shoreline sites. The  $\log_{10}$  transformation of each parameter was used for this analysis as bacteriological data are generally not normally distributed.

A summary of the results of these simple linear regressions are shown in Table 3 below. Table 3 gives the coefficient of determination ( $r^2$ ) value for each regression analysis performed. This value indicates the strength of the linear relationship between the two values (i.e. a  $r^2$  value close to 1 or -1 implies a strong relationship).

**Table 3** Summary of simple linear regression analyses for 2000-01 summer bacteriological results -  $r^2$  values

Discharge from Waitara River ( $\log_{10}$ x river flow x bacterial count)	Site ( $\log_{10}$ x bacterial count)			
	Tuaranga Reef	West Beach	East Beach	Airedale Reef
Faecal coliforms	0.0224	0.0038	0.0011	0.1230
<i>E.coli</i>	0.0213	0.0050	0.0014	0.1471
Enterococci	0.1064	0.0320	0.0028	0.0408

The results from bacteriological monitoring conducted between 1990 and 1995 were pooled to perform regression analysis and have been reported in previous reports. These analyses had shown that the Waitara River has had a major influence on bacterial indicator levels at all the coastal sites sampled during periods of high flow. Thus the sampling programme was revised in the 1996-97 monitoring period to exclude wet weather conditions and high river flows in the Waitara River.

The regression analyses undertaken using 2000-01 data indicated that the Waitara River accounted for between 0.1% and 15% of bacterial counts within the Waitara embayment during the summer survey. The greatest influence the Waitara River had was on *E. coli* counts at Airedale Reef (15%). These results do not indicate that the Waitara River had any influence on the bacterial counts recorded at the two beach sites. It could only account for influencing enterococci counts at Waitara West Beach 3% of the time.

### 2.1.3 Comparison with water quality guidelines

As the MfE 1998 guidelines are still in working draft form it is considered appropriate at this time to continue to include the use of the 1992 Department of Health (DoH) guidelines for assessing water quality in terms of enterococci bacteria. For the purpose of determining the water quality in terms of faecal coliform bacteria for which the Council still collects data, the old Water and Soil Conservation Act (1967) guidelines will also be used.

#### 2.1.3.1 Faecal coliform standard

The old Water and Soil Conservation Act requires a median standard of less than 200 faecal coliforms per 100 ml from a minimum of five samples. As shown by the results in Table 2 all sites recorded median counts of well below this median standard.

#### 2.1.3.2 1992 DoH guidelines

Tables 4 summarises enterococci monitoring data in terms of compliance with DoH 1992 guidelines.

**Table 4** DoH 1992 guidelines for seasonal enterococci median and number of single sample maxima meeting each category (13 samples at each site)

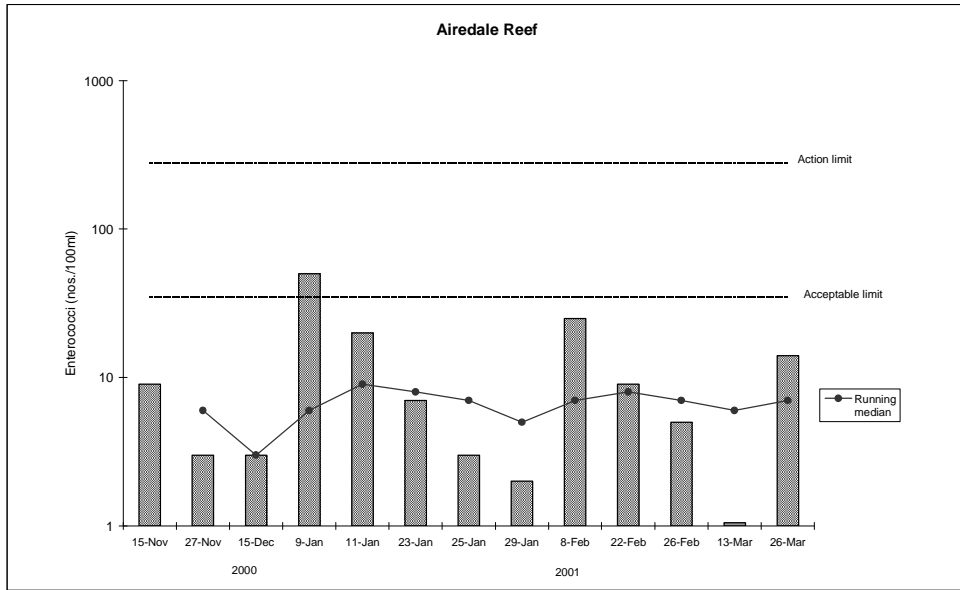
Beach	Year	Seasonal median <35	Designated bathing beach <104	Moderate use <153	Light use <275	Infrequent use <500
Tuaranga Reef	2000-01	4	13			
West Beach	2000-01	5	11	1	1	
East Beach	2000-01	9	12			1 (520)
Airedale Reef	2000-01	7	13			

Each of the sites recorded seasonal medians below the guideline value of 35 enterococci per 100 ml. According to the single sample maxima, both Tuaranga Reef and Airedale Reef met the 'designated bathing beach' category. Waitara West Beach met the 'light use' category and Waitara East Beach slightly exceeded the 'infrequent use' category due to a count of 520 enterococci/100ml on one sampling occasion.

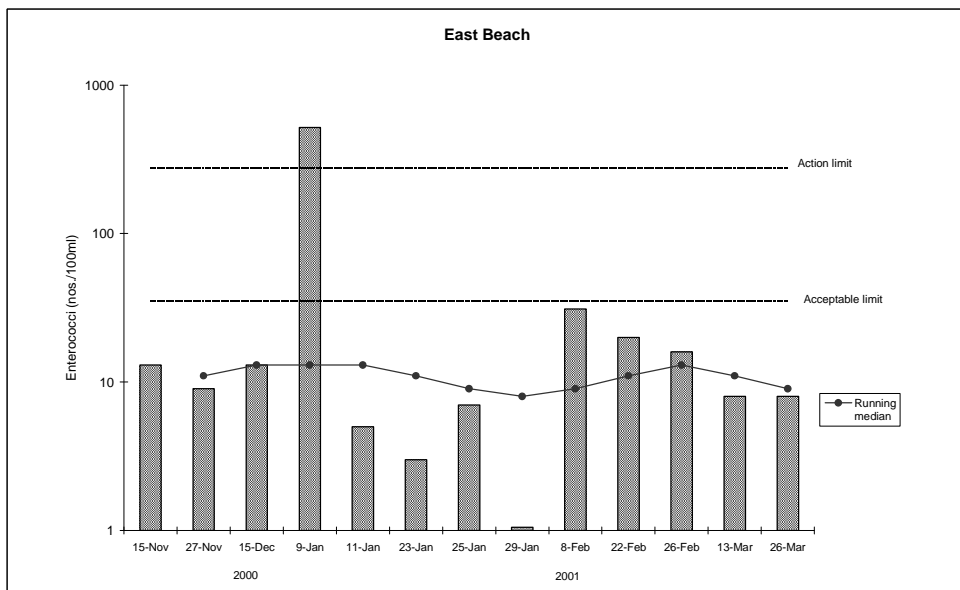
#### 2.1.3.3 1998 MfE guidelines

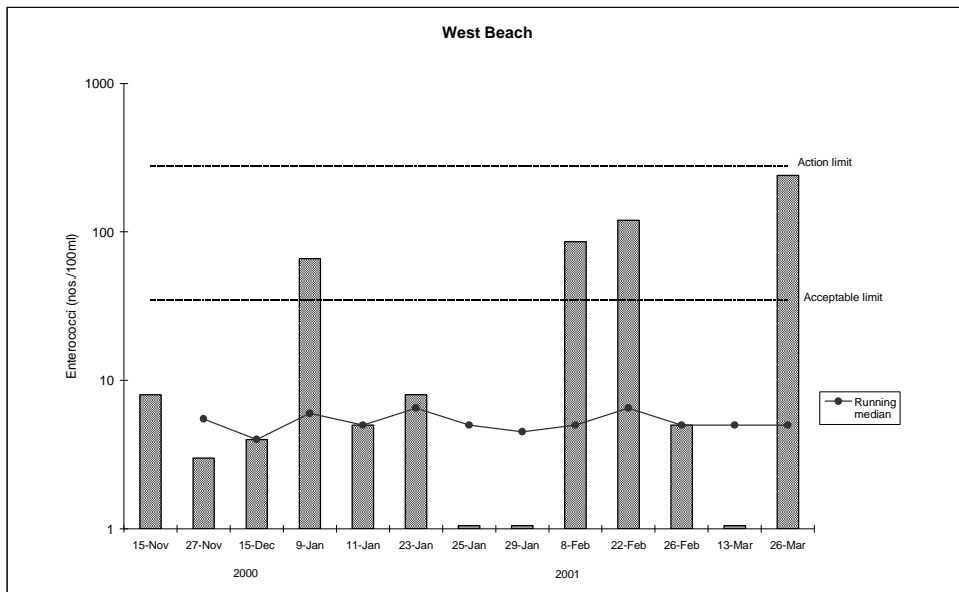
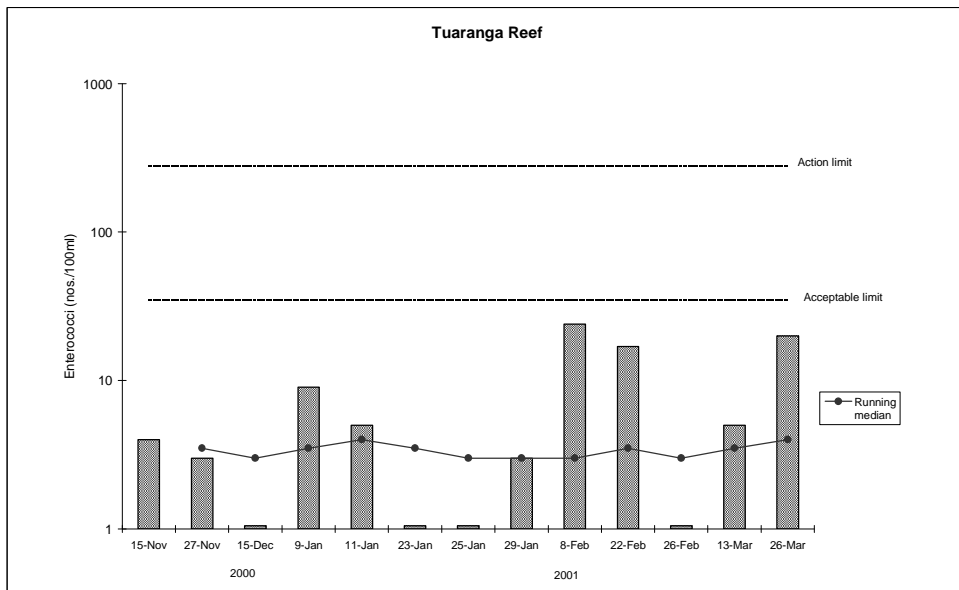
Figures 8 to 11 illustrate the enterococci monitoring data collected during the 2000-01 monitoring period in terms of compliance with MfE 1998 guidelines for each coastal site. Each plot shows the enterococci count recorded on each sampling occasion accompanied by a running median (calculated after two samples collected). Each plot also indicates the acceptable (or 'Safe') level of a running median of less than 35 enterococci per 100 ml and the 'Action' level of two consecutive single samples greater than 277 enterococci per 100 ml.

**Figure 8** Enterococci counts and running median at Airedale Reef



**Figure 9** Enterococci counts and running median at Waitara East Beach



**Figure 10** Enterococci counts and running median at Waitara West Beach**Figure 11** Enterococci counts and running median at Tuaranga Reef

The running median was well within the 'acceptable/safe' limit of the guideline value of less than 35 enterococci per 100 ml throughout the sampling period, at each of the four sites.

All samples collected at the Airedale Reef and Tuaranga Reef sites were below the single sample maxima of 136 enterococci/100 ml and were considered 'safe' throughout the sampling period. Twelve of the thirteen samples collected at the Waitara West Beach were also within this 'safe' category except for one occasion when this maxima was exceeded (240 enterococci/100 ml) and the beach fell within Alert Mode II. The Waitara East Beach was also found to be within the 'safe' category during the sampling period

except for one occasion (when the single sample of 520 enterococci/100 ml was recorded) but a second consecutive sample (collected 2 days later) recorded 'safe' levels again.

## **2.2 Comparison of 2000 results with previous summer surveys**

In this section, the results obtained during the 2000-01 summer monitoring period are compared with bacteriological results obtained at the same sites during previous summer sampling periods.

Median results for all parameters at each of the sites are shown in Table 5, for each summer sampling period.

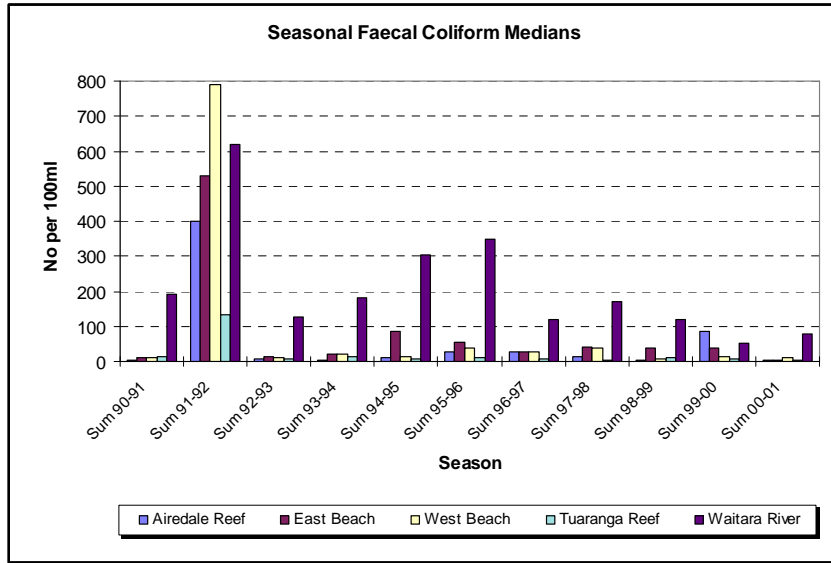
The median results per season for each of the three bacteriological indicators are shown in Figure 12 for faecal coliforms, Figure 13 for *E.coli* and Figure 14 for enterococci.

**Table 5** Medians by season at all sites since 1989/90

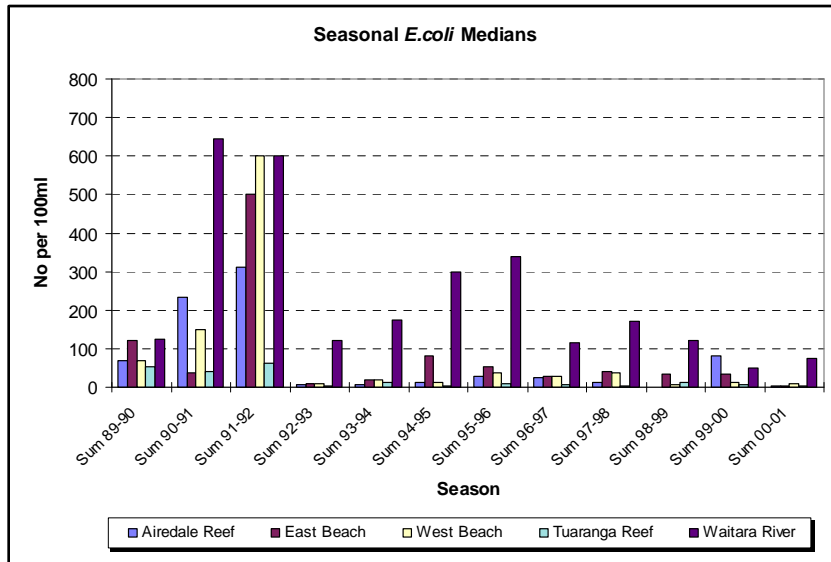
Season	Parameter	Site				
		Waitara River	Airedale Reef	East Beach	West Beach	Tuaranga Reef
Summer 1989/90 (No of samples = 5)	Temperature (°C)	20.0	20.0	19.5	19.5	20.51
	Salinity (ppt)	-	22.25	25.5	29.25	28.25
	Faecal coliforms (No/100ml)	-	-	-	-	-
	<i>E.coli</i> (No/100ml)	125	70	120	70	52
	Enterococci (No/100ml)	24	76	245	110	97
Summer 1990/91 (No of samples = 10*)	Temperature (°C)	17.5	17.25	17.5	17.75	18.25
	Salinity (ppt)	-	27.5	28.38	29.25	29.0
	Faecal coliforms (No/100ml)	193	3	10	10	13
	<i>E.coli</i> (No/100ml)	645	235	36.5	150	38.5
	Enterococci (No/100ml)	51.5	60	40	75	53.5
Summer 1991/92 (No of samples = 15)	Temperature (°C)	17	16.5	16	16.5	16
	Salinity (ppt)	-	30	28.5	32.4	32.3
	Faecal coliforms (No/100ml)	620	400	530	790	133
	<i>E.coli</i> (No/100ml)	600	310	500	600	63
	Enterococci (No/100ml)	60	60	50	133	50
Summer 1992/93 (No of samples = 10)	Temperature (°C)	17.75	17	17.25	17.25	17.25
	Salinity (ppt)	-	32	32	32	31.25
	Faecal coliforms (No/100ml)	125	8	14.5	9	6.5
	<i>E.coli</i> (No/100ml)	121.5	6	10	7.5	4
	Enterococci (No/100ml)	41.5	15.5	13	17	22.5
Summer 1993/94 (No of samples = 10)	Temperature (°C)	18.15	19.8	19.35	20	20.1
	Salinity (ppt)	-	36.3	36.5	36.35	35.95
	Faecal coliforms (No/100ml)	180	4.5	19.5	20	13
	<i>E.coli</i> (No/100ml)	175	4.5	19.5	20	13
	Enterococci (No/100ml)	47.5	6.5	12	22	22
Summer 1994/95 (No of samples = 20)	Temperature (°C)	19	20	19.3	19.8	19.85
	Salinity (ppt)	-	35	32.7	34.9	34.8
	Conductivity (mS/m)	-	4275	4150	4215	4210
	Faecal coliforms (No/100ml)	305	11	84	11.5	7
	<i>E.coli</i> (No/100ml)	300	11	82	11.5	3.5
Enterococci (No/100ml)	150	17	28.5	19	20	
Summer 1995/96 (No of samples = 20)	Temperature (°C)	20.1	20.1	19.7	19.6	19.6
	Conductivity (mS/m)	9.1	4575	4200	4390	4605
	Faecal coliforms (No/100ml)	350	27.5	53.5	38.5	9.5
	<i>E.coli</i> (No/100ml)	340	26.5	52.5	36	8
	Enterococci (No/100ml)	150	54	50	36	6.5
Summer 1996/97 (No of samples = 12)	Temperature (°C)	19.5	17.4	17.6	17.2	17.7
	Conductivity (mS/m)	9.5	4540	4490	4605	4565
	Faecal coliforms (No/100ml)	120	28	29	28	8
	<i>E.coli</i> (No/100ml)	115	24	28	28	7
	Enterococci (No/100ml)	21	9	11	16	5
Summer 1997/98 (No of samples = 12)	Temperature (°C)	18.1	19.9	19.9	19.9	20.0
	Conductivity (mS/m)	9.2	4220	4230	4430	4385
	Faecal coliforms (No/100ml)	170	14	41	36	4
	<i>E.coli</i> (No/100ml)	170	12	41	36	4
	Enterococci (No/100ml)	32	8	14	28	8
Summer 1998/99 (No of samples = 13)	Temperature (°C)	20.8	21	21	20.7	20.9
	Conductivity (mS/m)	10.3	4530	4360	4530	4580
	Faecal coliforms (No/100ml)	120	39	7	11	3
	<i>E.coli</i> (No/100ml)	120	35	7	11	1
	Enterococci (No/100ml)	42	20	5	23	8
Summer 1999/2000 (No of samples = 13)	Temperature (°C)	19.3	19.1	19.1	19.1	18.8
	Conductivity (mS/m)	9.0	4455	4090	4550	4640
	Faecal coliforms (No/100ml)	50	84	37	13	7
	<i>E.coli</i> (No/100ml)	50	80	34	13	7
	Enterococci (No/100ml)	21	43	40	19	8
Summer 2000/01 (No of samples = 13)	Temperature (°C)	21.1	20.2	20	19.9	19.6
	Conductivity (mS/m)	10.8	4630	4520	4580	4560
	Faecal coliforms (No/100ml)	80	3	3	9	5
	<i>E.coli</i> (No/100ml)	76	3	3	9	4
	Enterococci (No/100ml)	60	7	9	5	4

\* faecal coliforms recorded for 5 samples only

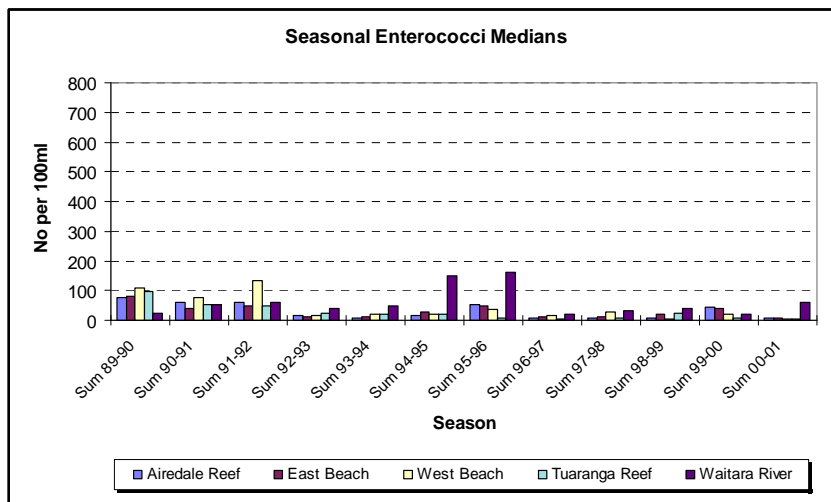
**Figure 12** Seasonal median faecal coliform levels at seawater sites and the Waitara River



**Figure 13** Seasonal median *E.coli* levels at seawater sites and the Waitara River



**Figure 14** Seasonal median enterococci levels at seawater sites and the Waitara River



The high bacterial counts recorded during the 1989-90, 1990-91 and 1991-92 were the result of untreated domestic sewage and meatworks effluent being discharged through the marine outfall. During 1991 and 1992 a wastewater treatment plant was constructed to treat the combined domestic and meatworks effluents via milliscreening and pH disinfection. The lowered bacterial counts at the coastal sites from the 1992-93 summer monitoring period clearly shows the bacterial contamination experienced at coastal sites prior to treatment and the improvement in water quality since the treatment of the wastewater.

The median bacterial counts at each of the four coastal sites have remained relatively unchanged since 1992-93, as illustrated in each of the above plots. Slightly elevated bacterial counts were recorded during the 1995-96 sampling period at each of the sites when higher median bacterial counts also occurred in the Waitara River. It was found that samples collected from 1992-93 to 1995-96 were largely influenced by the Waitara River during periods of high river flow and that these events masked any effects of the outfall on bacterial indicator levels. The monitoring programme was therefore revised in 1996 to exclude wet weather conditions and high river flows by not sampling within two days of fresh events. The lowered faecal coliform, *E. coli* and enterococci levels discharged from the Waitara River after this change are clearly seen in each of the above plots. The sampling programme was again slightly revised during the 1998-99 monitoring period to exclude sampling within *three* days of fresh events, as it was found sampling within two days of a fresh continued to have some influence on shoreline bacterial levels. As a consequence of modifications to the monitoring programme, results collected since 1996-97 are not directly comparable to results collected prior to this.

The most notable feature of the 2000-01 median bacterial results was that all four coastal sites recorded the lowest counts since 1996 when monitoring excluded wet weather conditions (although the Tuaranga Reef site has recorded similarly low bacterial counts previously). It is also noted that the Waitara River bacterial counts were slightly above the low median counts recorded during the last 1999-2000 monitoring period.

## 3. Discussion

### 3.1 The Resource Management Act (1991)

The Resource Management Act primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

- (a) the neighbourhood or the wider community around a discharger, and may include cultural and socio-economic effects;
- (b) physical effects on the locality, including landscape, amenity and visual effects;
- (c) ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
- (d) natural and physical resources having special significance (eg, recreational, cultural, or aesthetic);
- (e) risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Taranaki Regional Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each discharge source. Monitoring programmes are therefore not only based on existing permit conditions, but also on the obligations of the Resource Management Act to assess the effects of the exercise of consents.

### 3.2 Discussion of bacteriological monitoring

The Waitara marine outfall bacteriological monitoring programme is undertaken to assess the effect of the Waitara outfall discharge on shoreline bacteriological water quality. The nearby Waitara River is also acknowledged as a significant potential source of shoreline bacteriological contamination and therefore sampling of the Waitara River is also undertaken.

The sampling procedure is undertaken according to documented Taranaki Regional Council procedures. At least twelve bathing water samples are to be taken between the hours of 0900 and 1800 hours (NZDT) with none collected within three days of river fresh conditions. Samples are analysed for enterococci, *E. coli* and faecal coliform bacteria and conductivity. All sites' locations and descriptions are stored in the Taranaki Regional Council site index card system and are recorded in the laboratory computer database (Labsys) where all analytical results were stored following standard sample registration procedures.

This report examines the results of bacteriological monitoring obtained during the 2000-01 summer monitoring period and investigates the level of influence the Waitara River had on bacterial counts at the four coastal sites. The report also compares results with previous results obtained at the same sites since 1989. Although the Waitara beaches monitored as part of this programme are not popular summer bathing beaches, the bacteriological results are also assessed in terms of recreational bathing water quality. These guidelines can provide some guidance as to what is an acceptable, safe bacteriological level at these beaches.

Bacteriological water quality at the four coastal sites was good during the sampling period. Occasional higher bacterial counts were recorded at each of the two coastal sites adjacent the Waitara River, Waitara East Beach and Waitara West Beach. Airedale Reef and Tuaranga Reef recorded low bacterial counts throughout the sampling period.

The Waitara River has been found to influence shoreline bacterial levels for several days after fresh events. This is due to the large size of the river (it is the largest north Taranaki river) and as it drains not only the eastern slopes of Mount Taranaki but also drains the eastern hill country, it can carry high sediment loads that take several days to subside. Oceanographic studies performed within the Waitara embayment during the early 1980's had found that the embayment extends for some kilometres offshore, a complex circulation pattern exists within the embayment, and that the marine outfall effluent plume is effected by stratification and onshore current patterns, indicating poor freshwater flushing within the embayment. It is for these reasons that it may take more than a week before sampling can be resumed. During this 2000-01 sampling period the Waitara River was found to have negligible influence on shoreline bacterial results according to bacterial counts in the Waitara River, the hydrograph and linear regression results. It appears to have been the cause of only one elevated count at the Waitara West Beach on 22 February 2001.

In terms of the water quality within the Waitara embayment for contact recreation purposes, each of the guidelines are discussed below.

The median faecal coliform level over the bathing season was well within the old Water and Soil standard of 200 per 100 ml at all four coastal sites.

The DoH guideline of a seasonal median for enterococci bacteria of 35 per 100 ml for seawater used for bathing was met at all four sites. The single sample maxima of a designated bathing beach of 104 enterococci per 100 ml was met at the Airedale Reef and Tuaranga Reef sites. The Waitara West Beach site met the light use category and the Waitara East Beach slightly exceeded the infrequent use category. None of the four coastal sites would be considered a designated bathing beach site as these sites receive relatively light use in terms of recreational bathing. The light use category would probably be the most relevant for these sites and this single sample maximum was met by all sites except at Waitara East Beach on one occasion.

According to the MfE running median guideline of less than 35 enterococci per 100 ml, all sites were considered 'safe' throughout the sampling period. Of the fifty-two samples collected throughout the sampling period at the coastal sites, fifty (96%) were below the single sample maxima of 136 enterococci/100 ml. The two Waitara beach sites each recorded an elevated count above the single sample maxima of 136 enterococci/100 ml. Subsequent sampling showed bacterial counts return to 'safe' levels.

The MfE guidelines recommend that when enterococci counts exceed the 'safe' category investigations should be initiated to determine the cause of the exceedances recorded. With respect to the Taranaki Regional Council initiating additional work to determine the cause of the exceedances recorded, it should be noted that on almost all sampling occasions when enterococci counts exceeded guideline values, these elevated counts could be attributed to most notably river and fresh conditions or the marine outfall hence additional sampling was not considered to be necessary. It is also noted that additional work has been carried in relation to this programme in 1997-98 to help determine the cause of occasional high counts at coastal sites within the Waitara embayment.

During the 2000-01 monitoring period all four coastal sites recorded the lowest median bacterial counts since 1996 when monitoring was designed to exclude wet weather conditions. It is also noted that the Waitara River bacterial counts were slightly above the low median counts recorded during the last 1999-2000 monitoring period.

### 3.3 Evaluation of performance

During the year, the Waitara River was found to have a minor influence on shoreline bacteriological levels. This is a pleasing result as it has been the goal of the monitoring programme to remove as much influence from the Waitara River as possible by excluding wet weather conditions and periods of high flow in the river. This then allows any contamination from the marine outfall to be evident.

The bacteriological results collected during this 2000-01 monitoring period were notably lower than the previous few years. This is thought to be a consequence of avoiding sampling after high river flows and bacterial counts in the Waitara River. Only one of the four elevated counts recorded could be attributed to the Waitara River. It is concluded that the remaining three elevated counts (all occurring at the Waitara West Beach) are attributed to contamination from the Waitara marine outfall.

Despite the few elevated counts recorded during the sampling period the recreational bathing water quality within the Waitara embayment is considered good for all sites. The standard for faecal coliforms was met at all four coastal sites. The DoH guideline found that all sites, except the Waitara East Beach due to a single high count, meet the 'light use' category identified as appropriate to the Waitara embayment. The MfE guideline found all sites to be considered 'safe' for contact recreational purposes according to most (96%) of the samples collected. Only two samples collected during the sampling period exceeded the single sample maxima.

The results of this bacteriological monitoring programme indicate that although the wastewater discharge through the Waitara marine outfall did appear to influence bacterial levels occasionally at one site during the monitoring period, the bacterial levels recorded at this site are not considered unsafe according to bathing water quality guidelines, and the end of season median bacterial level was comparable to the other coastal sites monitored.

Therefore, it is concluded that the wastewater discharge resulted in a good level of environmental performance and compliance with resource consents.

### 3.4 Recommendations from the 1999 Annual Report

Based on the results of monitoring conducted during the 1999 monitoring years in relation to the Waitara marine outfall bacteriological monitoring programme, it was recommended:

1. THAT the microbiological monitoring programme in relation to the Waitara marine outfall in the 2000-2001 year continue at the same level as in 1999-2000
2. THAT should the Waitara River be found to influence bacteriological results on any sampling occasion then an additional sample at each of the coastal sites should be collected.

These recommendations have been complied with by the completion of the Waitara outfall bacteriological monitoring programme in 2000.

### 3.5 Alterations to monitoring programmes for 2001

In designing and implementing the monitoring programmes for water discharges in the region, the Taranaki Regional Council has taken into account the extent of information made available by previous authorities, its relevance under the Resource Management Act, the obligations of the Act in terms of monitoring discharges and effects, and subsequently reporting to the regional community, the scope of assessments required at the time of

renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki discharging to the environment.

In the case of the Waitara marine outfall, the programme for 2001 was not altered from that for 2000. It is proposed that for 2001, as for in 2000, an additional sample at each of the coastal sites should be collected if it is found that the Waitara River had a large influence on bacteriological results at the time of sampling. A recommendation to this effect is attached to this report.

## **4. Recommendations**

Based on the results of monitoring conducted during the 2000 monitoring year in relation to the Waitara marine outfall bacteriological monitoring programme, it is recommended:

1. THAT the microbiological monitoring programme in relation to the Waitara marine outfall in the 2001 year continue at the same level as in 2000
2. THAT should the Waitara River be found to influence bacteriological results on any sampling occasion then an additional sample at each of the coastal sites should be collected.

## References

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**Appendix I**  
Consent 3397

## **Appendix II**

2000-01 Monitoring Data