

Topic: New Zealand Colilert[®] and Enterolert[®] approval for Bathing Water testing

Title: *Recreational Water Quality Guidelines: Guidelines for the Management of Waters used for Marine and Fresh Water Recreation and Recreational Shellfish-Gathering*

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Report Highlights:

- For marine water samples the preferred indicator is enterococci and Enterolert is the ‘method of choice’
- For fresh water samples the preferred indicator is *Escherichia coli (E coli)* and Colilert is the ‘method of choice’



Ministry for the
Environment
Manatū Mō Te Taiao



RECREATIONAL WATER QUALITY GUIDELINES

**Guidelines for the Management of Waters used for
Marine and Fresh Water Recreation and Recreational
Shellfish-Gathering.**

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1. Introduction

1.1 Purpose of the guidelines

These guidelines are to assist water managers to implement the Resource Management Act (RMA) 1991 and the Health Act 1956 for shellfish gathering or contact recreation. They replace the Department of Health's *Provisional Microbiological Water Quality Guidelines for Recreational and Shellfish-Gathering Waters in New Zealand* (January 1992) and the Environment and Health Ministries' *Bacteriological Water Quality Guidelines for Marine and Fresh Water* (December 1998). The guideline values set out in this document take into account the recently reported marine bathing health effects study (McBride *et al.* 1998).

The Ministry for the Environment and the Ministry of Health developed these guidelines in consultation with a small group of regional councils and representatives from health authorities.

These guidelines cover three categories of water use:

- = Marine bathing and other contact recreation activities.
- = Fresh water bathing and other contact recreation activities.
- = Recreational shellfish-gathering in marine waters (but not commercial shellfish harvesting).

They cover the interpretation of monitoring results from surveys of bacteriological indicators of faecal contamination. They do not cover other impacts on the above water uses, such as water clarity or marine biotoxins from algal blooms. Documents that may be of interest to water managers managing water for contact recreation include:

- = The Ministry for the Environment's *Water Quality Guidelines No 1*, which covers the management of biological growths in rivers used for swimming.
- = Ministry's *Water Quality Guidelines No 2*, which covers the management of water clarity for bathing in fresh waters.

NOTE: This document is an uncluttered "quick reference" style of guideline. Therefore, very little supporting technical information has been included. Further information can be found in a separate volume, *Bacteriological Water Quality Guidelines for Marine and Fresh Water - Supporting Manual*. This is available from the Ministry for the Environment, Publications, PO Box 10 362, Wellington, phone (04) 917 7493, fax (04) 917 7523, and on the Ministry's web site (www.mfe.govt.nz).

1.2 Overall approach

The framework used in these guidelines is a three tier system, analogous to traffic lights:

- = **Clean:** "Safe" for bathing (green), requiring water managers to continue surveillance (eg routine monitoring).
- = **Potentially contaminated:** "Potentially unsafe" (amber), requiring water managers to undertake further investigation to assess the safety. The water manager reaches the amber condition through two mechanisms, each requiring a slightly different response. These two mechanisms are discussed in subsequent sections of this document.
- = **Highly likely to be contaminated:** "Highly likely to be unsafe" (red), requiring urgent action from water managers, such as closing a beach.

The guidelines use a combination of annual (seasonal) median values and single samples to assess safety.

1.3 The 1994/95 Marine Bathing Study

The previous provisional marine bathing guidelines were developed using the results of international studies. New Zealand water managers were concerned that the overseas studies might not be applicable to New Zealand because of our different environmental conditions, such as a much higher proportion of contamination from animal sources compared to that from human sources. The New Zealand Marine Bathing Study (1994/95) clarified many of the issues raised by water managers.

The key findings of the New Zealand Study are:

- = The relationships in New Zealand between indicator bacteria and health effects are consistent with those found overseas.
- = There is no noteworthy difference between the health risks associated with animal and human sources of contamination. Therefore, the guideline values should apply irrespective of location and time. For example, there is no justification, from a health perspective, for not sampling after heavy rainfall if people are swimming or likely to be swimming. That is, sampling programmes should be based on the number of people (likely to be) swimming, whether or not there has been a heavy rainfall event.
- = Of the easily measured bacteriological indicators, enterococci are the preferred indicator to show a relationship to health risks in marine waters.
- = Bacteriological levels in shallow water correlate well with health risks. Therefore, *sampling can take place at 0.5 m depth* rather than at chest depth, as proposed in previous guidelines. Sampling at chest depth can also be a hazard to those collecting samples.

1.4 Guidelines for fresh water bathing: A lack of research

The fresh water numerical guideline values have been developed on the basis of only a few international studies and their suitability for use as fresh water guidelines in New Zealand requires further evaluation. The Ministry for the Environment with the Ministries of Agriculture and Forestry and Health are undertaking a Fresh Water Microbiological Research Programme that aims to develop more robust fresh water guidelines, but this will not be complete until the year 2002.

Because the Environment and Health Ministries believe that some guidance for fresh water bathing is however required and better than none at all, this document includes guideline values for fresh water bathing. The fresh water guidelines are *interim and must be used with caution*, because although they are internationally accepted they are based on a very small number of studies. Until the Fresh Water Microbiological Research Programme is complete, the numerical guidelines in this document are the best that are available.

2. Health risks and acceptable risks

1.12.1 Health risks

Water contaminated by human or animal excreta may contain a diverse range of pathogenic (disease causing) microorganisms such as viruses, bacteria and protozoa. These organisms may pose a health hazard when the water is used for recreational activities such as swimming and other "high contact" water sports. In these activities there is a reasonable risk that water could be swallowed, inhaled (Harrington *et al.* 1993), or come in contact with ears, nasal passages, mucous membranes and cuts in the skin; allowing pathogens to enter the body.

Research is continuing into the health risks associated with contamination of water by sewage and excreta. Until recently scientists believed that gastro-enteritis was the main health effect from contact with polluted water, but now it is becoming clear that respiratory health effects also occur, and may be more prevalent than gastro-enteritis.

In most cases, the ill-health effects from exposure to contaminated water are minor and short-lived. However, the potential for more serious diseases such as Hepatitis A, Giardiasis, Cryptosporidiosis, Campylobacteriosis and Salmonellosis cannot be discounted (Philip 1991).

1.22.2 "Acceptable" risks of illness associated with swimming

The guidelines use "maximum acceptable" swimming-associated illness risks of 8 and 19 per 1,000 bathers for fresh water and for marine water respectively, as was used in the 1992 guidelines. These risk values have been adopted by the US Environmental Protection Agency. The adoption of these risk levels recognises that these guidelines are consistent with international practice.

3. Applying the guidelines

1-13.1 Bacteriological indicators, medians and single samples

These guidelines use bacteriological indicators to indicate the risk of faecal contamination with the potential for the presence of pathogens. For marine water the preferred indicator is enterococci. For fresh water, the preferred indicator is *Escherichia coli* (*E. coli*).

In marine waters, adherence to the guideline values and use of the framework set out in these guidelines should ensure that people using the water for recreation or the collection of shellfish for eating are not exposed to significant health risks. For fresh water, we are less certain that the guidelines will protect public health. The Fresh Water Microbiological Research Programme will enable the Environment and Health Ministries to develop more reliable guidelines.

The guidelines were developed from studies relating bacteriological indicators to illness in the general public. Water conforming to the guideline values may still pose a potential health risk to high-risk user groups such as the very young, the elderly and those with impaired immune systems.

The framework in these guidelines uses both medians and single sample maxima. Seasonal medians provide the basic means to assess safety status over time. Single samples are used to help water managers determine when management intervention is required and whether it is likely that the seasonal median set out in these guidelines will be achieved.

1-23.2 Roles and responsibilities of agencies

Regional councils, territorial local authorities and health authorities all have an involvement in the management of recreational water. Sometimes there are overlaps in responsibility, which can create tensions between agencies. The Supporting Manual provides a recommended framework for allocation of roles and responsibilities.

1-33.3 Designation of a contact recreation area

Designation of beaches according to the level of use (as suggested in the previous guidelines) is now considered impractical for application in New Zealand. Beaches are either "contact recreation areas", ie well used, or are not considered "contact recreation areas", ie not well used. Which beaches are monitored will be a local decision, and guidance on this is given in the Supporting Manual. This is a significant shift from the previous guidelines, which had four categories of bather usage. These guidelines therefore refer to the single category of use.

This approach does not mean water quality can be allowed to deteriorate at non-designated contact recreation areas, but these guidelines are expected to be rigorously

applied at designated beaches. The monitoring required in these guidelines and associated costs may not be justified at non-designated beaches.

1.43.4 Monitored beaches: Surveillance, alert and action

As outlined in the introduction, these guidelines propose a three-tier management framework, using bacteriological indicator values:

1. **Surveillance**, which involves routine (eg weekly) sampling of bacteriological levels.
2. **Alert**, requiring investigations into the causes of the elevated levels and increased sampling to enable the risks to bathers to be more accurately assessed.
3. **Action**, requiring the local authority and health authorities to warn the public that the beach is considered to be unsafe.

1.1.13.4.1 Surveillance (routine monitoring)

The surveillance condition occurs when the running median (ie the median calculated during the bathing season) is below the guideline median value. Under the surveillance condition, the beach is considered "safe", but routine monitoring (eg weekly sampling) must continue. Guidance on when and where to sample can be found in the technical background document.

Surveillance mode = running median less than guideline median value.

Under surveillance conditions, routine monitoring should continue.

1.1.23.4.2 Alert/Amber Mode

There are two ways in which an "Alert Mode" is triggered. The two situations require different management responses

Alert Mode I: Running Medians

If the running median is above the guideline median value, sampling should be increased, for example from weekly to twice weekly. The increased sampling will increase the database available for making decisions on the safety of the beach.

In addition to increased sampling, the sources of contamination should be identified, and the safety of the beach assessed. Technical officers should recommend actions to be taken, such as moving to action mode or further investigations into contamination sources, or increasing the sampling regime.

Alert Mode I: If the running median is greater than the guideline median value:

- = Increase sampling (eg. from weekly to twice weekly).
- = Identify the likely sources of contamination and the actions needed to ensure the public is not exposed to excessive health risk.

Alert/Amber Mode II: Single Samples

Alert Mode II is triggered when a single bacteriological sample exceeds a pre-determined level. The Supporting Manual to these guidelines explains how the guideline values for Alert Mode II were derived.

Under Alert Mode II, sampling frequency should be increased to daily and a sanitary survey should be undertaken to identify the sources of contamination and potential management options. The Supporting Manual explains what a sanitary survey is and how to conduct one.

Alert Mode II: If a single sample exceeds the Alert Mode II level:

- = Increase sampling frequency to daily.
- = Undertake a full sanitary survey.
- = Identify options for reducing contamination levels and develop recommendations.

Action/Red Mode: Consecutive Samples

The Action Mode is triggered when two consecutive single samples (within 24 hours) exceed a certain value. Under the Action Mode the local authority and health authorities warn the public through the media that the beach is unsafe and arrange for the local authority to erect signs at the beach warning the public of a health danger.

Action Mode: If two consecutive single samples exceed the action level:

- = Inform the public that the beach is unsafe.
- = Undertake detailed investigations into the causes and remedies.

3.5 Caveats

- = These guidelines must not be used as a measure of suitability for bathing when there is a major outbreak of a potentially waterborne disease in the community and that community's sewage contributes to the microbiological contamination to the water. The guidelines do not apply then because the relationship between indicator organisms and disease was derived when there were no known outbreaks of waterborne diseases in the community. When there is an outbreak of disease in the community, health risks may be increased because of a higher-than-usual ratio of pathogen concentration to indicators in the water.

- = Implementing the guidelines in no way reduces the need and importance for traditional sanitary surveys.
- = Compliance with the guidelines does not guarantee that a beach is "safe". For example, effluent may be treated to the level where the indicator bacterial levels are very low, but other pathogens such as viruses or protozoa may still be present at high levels. It is important that water managers use these guidelines judiciously and carefully consider where they can be applied. Therefore in some circumstances, where for example discharges of highly treated effluent could reduce indicator bacteria levels, these guidelines may not apply and water managers will need to undertake a specific risk assessment.

4. Marine recreational waters

4.1 Enterococci: The preferred indicator for marine environments

The New Zealand Marine Bathing Study showed that enterococci are the indicator most closely correlated with health effects in New Zealand marine waters. Faecal coliforms and *E. coli* were not as well correlated with health risks. Importantly, the study found that health risks from water contaminated with animal and human faecal material were not significantly different, and enterococci is a good indicator for health risks associated with both these sources of contamination.

The results of the Marine Bathing Study do not suggest that a change is needed to the guideline values used in the previous Ministry of Health guidelines (a seasonal median of 35 enterococci per 100 mL). This value was set in relation to an "acceptable" gastro-intestinal illness and is supported when respiratory illnesses are also included.

4.2 Sampling depth

The study found similar patterns of association between illness rate and indicator density in shallow water sample results and those of deeper water sample results (adult-chest depth). This finding means that samples can be collected from shallow water. Samples should be collected at 0.5m depth (based on data in McBride *et al.* 1998).

4.3 Sampling after wet weather

The guidelines relate to the median of samples taken throughout the total bathing season irrespective of weather conditions. This is a significant change from the previous guidelines. The exclusion of results that are influenced by rainfall does not reflect the actual risks to bathers. People do swim shortly after a rainfall event. It is important to sample when people are likely to be swimming.

The separation of dry-weather and wet-weather data is also impractical because the definition of the two is problematical. For example, coastal water can be less polluted in the early stages of a wet spell but more polluted when the weather has become fine just after a substantial rainfall; the reverse can be true in estuaries. The essential factor is to sample when people are likely to want to swim or are swimming.

4.4 Marine bathing guidelines

The marine bathing guidelines are set out in the box below. They are based on an acceptable swimming-related illness risk of 19 cases per 1,000 bathers (a level of risk that has been used internationally and in New Zealand for years and is generally accepted.).

Marine bathing guidelines

SURVEILLANCE/GREEN MODE: Running median less than 35 enterococci/100 mL.

- = Continue routine (eg. weekly) monitoring.

ALLERT/AMBER MODE I: Running median greater than 35 enterococci/100 mL and no single sample greater than 136 enterococci/100 mL.

- = Increase sampling to at least twice weekly to improve the information base.
- = Prepare a report on potential health risks and causes of elevated bacteriological levels.

ALLERT/AMBER MODE II: Single sample greater than 136 enterococci/100 mL (irrespective of running median).

- = Increase sampling to daily (Initial samples will be used to confirm if a problem exists.)
- = Undertake a sanitary survey, identify sources of contamination.

ACTION/RED MODE: Two consecutive single samples (within 24 hours) greater than 277 enterococci/100 mL (irrespective of running median).

- = Increase sampling to daily (Initial samples will be used to confirm if a problem exists.)
- = Undertake a sanitary survey, identify sources of contamination.
- = Erect warning signs.
- = Inform public through the media that a public health problem exists.

Note:

- = Enterolert™ is the method of choice to enumerate enterococci or EPA Method 1600: Membrane Filter Test for Enterococci in Water (this 1998 modification gives a result in 24 hours) as described in Document No. EPA-821-C-97-004.* These methods must be used to enumerate enterococci unless an alternative method is validated to give equivalent results for the waters being tested.
 - = Samples should be collected during the "bathing season", or when the water body is used for contact recreation. The bathing season will vary according to location, but will generally extend from 1 November to 31 March. Sampling should take place between 0800 hours and 1800 hours. Samples should be taken at 0.5 m depth, below the surface of the water.
 - = A sufficient number of samples should be gathered over the bathing season to enable reasonable statistical analysis of testing for compliance. The Supporting Manual will provide information on sample numbers.
- * United States Environmental Protection Agency, National Centre for Environmental Publications and Information, 11029 Kenwood Road, Cincinnati, OH, 45242, USA

5. Fresh water bathing - interim guidelines

There has been little work in New Zealand or overseas on developing microbiological indicators for fresh water recreation. The Ministries of Health and the Environment together with the Ministry of Agriculture and Fisheries are studying fresh water microbiological quality to develop more defensible bathing guidelines. The results of this study will be available in 2002.

The fresh water bathing guidelines set out below are the best that can be developed at this time.

5.1 *E. coli*: The preferred indicator for fresh water at this stage

The pathogens occurring in contaminated fresh water are the same as those occurring in marine waters, except that survival times in fresh water are likely to be longer especially for protozoan cysts (e.g. *Giardia* and *Cryptosporidium*) and viruses. *E. coli* is the preferred indicator organism for fresh waters. Enterococci should not be used in fresh waters, because some enterococci in fresh waters can arise from natural sources, such as the decay of leaf material. Thus, in pristine waters, enterococci levels can be very high, but these high levels may not necessarily indicate high levels of pathogens.

The guidelines for fresh water bathing are derived for "maximum acceptable swimming-associated illness risk" of 8 per 1,000 bathers, based on US studies and guidelines. As mentioned earlier in this document, this 8/1,000 value has been accepted internationally for some years.

5.2 The fresh water interim guidelines

The fresh water bathing guidelines are set out in the box below.

Fresh water bathing guidelines

ACCEPTABLE/GREEN MODE: Running median (estimated monthly) less than 126 *E. coli*/100mL.

- Continue routine (eg. weekly) monitoring.

ALERT/AMBER MODE I: Running median between 126 and 273 *E. coli*/100mL.

- Increase sampling to at least twice weekly, in order to improve the information base.
- Prepare a report on potential health risks and causes of elevated bacteriological levels.

ALERT/AMBER MODE II: Single sample greater than 273 *E. coli*/100mL (irrespective of the running median).

- Increase sampling to daily. (Initial samples will be used to confirm if a problem exists.)
- Undertake a sanitary survey, report on sources of contamination.

ACTION/RED MODE: Single sample greater than 410 *E. coli*/100mL (irrespective of running median).

- Increase sampling to daily. (Initial samples will be used to confirm if a problem exists.)
- Undertake a sanitary survey, report on sources of contamination.
- Erect warning signs.
- Inform public through the media that a public health problem exists.

Note:

- = Colilert™ is the method of choice to enumerate *Escherichia coli* or EPA Method 1103.1, 1985 Membrane Filter Method for *E. coli* (this method gives a result for *E. coli* within 24 hours) ,), as in Section X. USEPA ICR Microbial Laboratory Manual*. This method and the MPN Method for *E. coli* which is also acceptable (but gives a result in 48 hours) is also described in the 20th. Ed. of *Standard Methods for the Examination of Water and Waste Water, American Public Health Association*. These methods must be used to enumerate *E. coli* unless an alternative method is validated to give equivalent results for the waters being tested.
- = Samples to test compliance should be over the bathing season appropriate to that locality (at least 1 November to 31 March) and sampling times should be restricted to between 0800 hours and 1800 hours.
- * USEPA National Centre for Environmental Publications and Information (NCEPI)
11029 Kenwood Road
Cincinnati, OH 45242, USA
Document No. EPA-821-C-97-004

A sufficient number of samples should be gathered over the bathing season to provide reasonable statistical power in testing for compliance.

6. Waters used for recreational shellfish-gathering

The microbiological water quality guidelines for recreational shellfish gathering are as defined in the Ministry of Agriculture and Fisheries *Shellfish Quality Assurance Circular* 1995 for areas of approved shellfish-growing waters. Such guidelines are used by the shellfish export sector and are internationally accepted as indicating that shellfish grown in such classified waters under given conditions of sanitary safety are expected to have suitable microbiological quality for public consumption.

Note: These recreational shellfish-gathering water quality guidelines only cover microbiological contamination. They do not cover marine biotoxins, which in certain places and locations can pose a significant risk to recreational shellfish gatherers.

The guidelines use "faecal coliform" indicator organism values to denote the potential presence of pathogenic bacteria, viruses and protozoa. Research commissioned by the US Food and Drug Agency suggests that faecal coliforms are more closely correlated with health risks associated with eating shell fish than are enterococci.

Compliance with these guidelines alone does not guarantee that shellfish grown in waters of this microbiological quality will be safe. The guidelines apply to waters in a catchment where a prior sanitary survey has shown that there are no point sources of pollution of public health concern. The guidelines are solely a management tool to measure any change from those conditions prevailing at the time of assessment.

The guidelines are also useful in assessing the impact of pollution from surface run-off after rainfall, and of tidal movement under storm conditions. Such factors are used to decide when gathering should be curtailed in commercial shellfish-growing areas when weather conditions cause pollution. They are equally applicable for recreational shellfish growing waters.

The guidelines are set out in the box below.

Recreational shellfish-gathering bacteriological guidelines

The median faecal coliform content of samples taken over a shellfish-gathering season shall not exceed a Most Probable Number (MPN) of 14 per 100 mL, and not more than ten percent of samples should exceed an MPN of 43 per 100 mL (using a five-tube decimal dilution test).

These guidelines should be applied in conjunction with a sanitary survey. There may be situations where bacteriological levels suggest that waters are "safe", but a sanitary survey may indicate that there is an unacceptable level of risk.

✓ Note:

- = The MPN method as described in *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association (current edition) must be used to enumerate faecal coliforms unless an alternative method is validated to give equivalent results for the waters being tested.
- = Sampling to test compliance shall be over the whole shellfish-gathering season.
- = A sufficient number of samples should be gathered throughout the gathering season to provide reasonable statistical power in testing for compliance for both the median limit and the 90 percent samples limit.

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About the Ministry for the Environment

Our mission – Making a difference through environmental leadership

The Ministry for the Environment is working to achieve effective management of the New Zealand environment. That includes reporting to the Government on the state of our environment and the way that environmental laws and policies work in practice. It also includes developing proposals and tools for improving environmental management. Councils, particularly regional councils, deal with most day-to-day environmental management.

We are responsible for government policies covering:

- = resource management
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We provide an environmental viewpoint on government policies such as Treaty of Waitangi settlements, and the energy sector and transport sector reforms. We work with other government agencies on matters where we do not have the main responsibility, such as biological diversity, marine environmental issues and the relationship between trade and environmental issues.

We know that aspects of our work are important to councils, iwi, businesses, professional and environmental organisations and many others in the community. We want to understand their concerns and how any changes in policy or laws will affect them. Our work, therefore, includes a strong element of consultation with those interested in environmental policy, both through submissions on proposals and through regular information meetings with key groups. We seek to provide the information and advice that councils, businesses and the wider community need to make environmental policy work in practice.

The Ministry acts on behalf of the Minister for the Environment in carrying out his duties under the Resource Management Act 1991. This includes reporting to him about local government performance on environmental matters. We will also report on the work of the new Environmental Risk Management Authority.

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