# Proposed National Environmental Standard for Sources of Human Drinking-water

# Resource Management Act Section 32

Analysis of the costs and benefits

Ministry for the Environment

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# **Executive Summary**

Drinking-water quality in New Zealand is generally very good. However, disease-causing micro-organisms are present in many of New Zealand's water sources. These enter our water from a range of sources, including animal and human waste. This places drinking-water supplies at risk.

Effective management of drinking-water requires reducing the risk of contamination at all steps of the process, from source water through to the treatment plant and distribution system. The principle is that if the risk of contamination is minimised at every step, a failure in one step of the process will not lead to catastrophic consequences.

Internationally, lack of recognition of the importance of protecting drinking-water sources has resulted in severe outbreaks of water-borne disease in developed countries, leading to serious illness and deaths. Contamination of water sources is often the cause of these events.

Although New Zealand has been fortunate in avoiding large-scale outbreaks of disease caused by contaminated drinking-water, water-borne disease events have occurred. The largest of these was in Queenstown in 1984, when an estimated 3500 people became ill. Studies by economists indicate that water-borne disease costs New Zealand \$25 million per year.

At present there is no explicit legislative requirement for council decision-making processes to consider the effects of activities on sources of human drinking-water. This is a gap that potentially leaves community water sources vulnerable to contamination.

Currently, the degree of protection for drinking-water sources in New Zealand varies greatly across the country. Only three of the country's 16 regional authorities comprehensively address protection of drinking-water sources in their plans. There is no clear requirement for regional councils to consider effects on drinking-water sources when making decisions on resource consents and regional plans.

The proposed national environmental standard (NES) will require regional councils to ensure that effects on drinking-water sources are considered in decisions on resource consents and regional plans. The exact wording of the standard will be finalised in legal drafting, but councils will be required to:

- decline discharge or water permits that are likely to result in community drinking-water becoming unsafe for consumption following existing treatment
- be satisfied that permitted activities in regional plans will not result in community drinking-water supplies being unsafe for consumption following existing treatment
- place conditions on relevant resource consents requiring notification of drinking-water suppliers if significant unintended events occur that may adversely affect sources of human drinking-water.

Total costs associated with the NES have been estimated at \$24.4 million over 20 years, with the majority of costs being borne by consent applicants.

It is difficult to quantify the benefits directly attributable to the NES. However, calculations show that if the NES resulted in a 15 percent improvement in water quality over time, this would result in an estimated health benefit of \$27 million over 20 years. In practice, the regulation will deliver much broader benefits, which make the NES highly efficient. These include avoiding the need for future treatment plant upgrades, and maintaining New Zealand's image as a safe tourist destination and a source of healthy, environmentally sound produce.

It is considered that the proposed NES is the most appropriate, effective and efficient means of achieving the objective of reducing the risk of contaminating drinking-water sources.

# **1** Introduction

## 1.1 Overview

The Minister for the Environment proposes to introduce a national environmental standard (NES) for sources of human drinking-water. This document presents an analysis of the proposed standard, as required by section 32 of the Resource Management Act 1991 (RMA).

#### 1.1.1 National environmental standards

The RMA enables the Minister for the Environment to prepare national environmental standards. These standards have the force of regulation and are binding on local authorities. A NES can:

- prohibit an activity
- allow an activity subject to compliance with plan rules
- restrict the making of rules and granting of resource consents
- require certification of compliance with the regulations
- specify the effect of the regulations on existing rules, and require local authorities to review existing resource consents within particular timeframes.

Standards can be established for a range of matters, such as air quality, noise, or specifying monitoring requirements. Full details of matters that a NES can regulate are provided in Appendix 8.

The first national environment standards in New Zealand were the suite of air quality standards, which were introduced in 2004.

#### 1.1.2 A proposed NES for sources of human drinking-water

The proposed NES is intended to provide certainty in decision-making and a bottom line for protecting drinking-water sources throughout New Zealand. The proposed NES applies to activities that can affect the quality of sources of human drinking-water. It is intended to ensure that activities in drinking-water catchments do not result in water becoming polluted to the extent that it will be unsafe to drink following the existing treatment process. It provides a clear signal to councils that they need to consider the effects on human drinking-water quality in their statutory decision-making processes.

There are three components to the proposed standard. These apply to:

- decisions on regional **resource consents** that could affect the quality of community drinking-water sources
- **permitted activity rules** in regional plans
- **conditions on resource consents** for activities that have the potential to affect downstream water supplies.

This standard will complement Ministry of Health standards and proposed legislation for improving drinking-water supply and delivery, and ensure a comprehensive approach to managing drinking-water from source to tap.

#### 1.1.3 Developing the NES

In late September 2005 the Ministry for the Environment notified the NES for human drinkingwater sources. Details of the original proposal were described in a discussion document which was distributed during the submission period, *Proposed National Environmental Standard for Human Drinking-water Sources* (Ministry for the Environment, 2005).

Four workshops on the proposed drinking-water source NES were held in early October 2005 in Wellington, Dunedin, Christchurch and Hamilton. In addition, a number of separate meetings were held with local government, drinking-water assessors and other stakeholder groups. The Ministry for the Environment's Road Show travelled throughout New Zealand, holding over 30 meetings in 16 regions and talking to over 2700 people. The proposed NES was one of the key topics discussed at the Road Show meetings. During the submission period a combination of technical workshops and the Talk Environment Road Show delivered this proposal to over 3100 people.

During the submission period, which closed on 28 November 2005, 82 submissions were received. An overview of these submissions is contained in the report *Proposed National Environmental Standard for Sources of Human Drinking-water: Report on Submissions* (Ministry for the Environment, 2006).

## 1.2 The section 32 evaluation and report

Section 32 of the RMA requires the Minister for the Environment to evaluate the objectives and policies of any proposed national environmental standards, and to prepare a report summarising the evaluation. The requirements contained within section 32 of the RMA are:

- (3) An evaluation must examine:
  - (a) the extent to which each objective is the most appropriate way to achieve the purpose of this Act; and
  - (b) whether, having regard to their efficiency and effectiveness, the policies, rules, or other methods are the most appropriate for achieving the objectives.

[...]

- (4) For the purposes of this examination, an evaluation must take into account:
  - (a) the benefits and costs of policies, rules, or other methods; and
  - (b) the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the policies, rules, or other methods.

There are two main aspects to the test of appropriateness:

- weighing up alternative objectives to determine which one will provide environmental outcomes that will best meet the purpose of the Act
- being satisfied that the objective chosen can best be achieved through the Act, rather than through some other mechanism.

Getting a measure of *effectiveness* involves assessing how well something might work.

Determining the relative *efficiency* of various alternatives is more difficult, and involves an examination of costs and benefits. A measure of efficiency is the extent to which the proposed method achieves the purpose of the Act, compared to the magnitude of what is foregone as a result of using this method. Assessing this involves calculating and comparing the net environmental benefits against the net costs (environmental, social and economic). The more the net benefits exceed the net costs, the more efficient the option is (Ministry for the Environment, 2000).

In evaluating the efficiency of the proposed NES, some assumptions have had to be made about how the policies might be put into practice by local government.

## 2 Statement of the Issue

### 2.1 The need for a NES

Most of the New Zealand population receives safe drinking-water (Ministry of Health, 2005a). However, we do have problems with nutrient and microbiological contamination of water, partly as a result of our large primary industry base. The greatest risks are from microbiological contamination of water by viruses, bacteria and protozoa.

New Zealand rates of gastroenteritis from food- and water-borne sources are double those of comparable OECD countries (Till and McBride, 2004). For example, the incidence of campylobacteriosis in New Zealand is two to three times higher than in other developed countries and more than 10 times higher than that in the United States (Baker et al, 2002; see Table 1). The proportion of disease resulting from contaminated water compared with food and other sources is unknown, but at least some of this disease is considered to be water-borne.

Country	Period	Rate /100,000
New Zealand	12 months to December 2001	279.8
USA	2000	20.1
Canada	1986–1998	39–54
Denmark	1999	78
Australia*	2000	107
England and Wales	1998	111

Table 1: Comparison of campylobacteriosis incidence between countries

Source: Baker et al, 2002.

\* Excludes New South Wales, which does not report campylobacteriosis.

Internationally, there is increasing recognition of the importance of protecting source waters as part of the process of ensuring the delivery of safe drinking-water. Drinking-water experts recognise that relying on treatment alone is not sufficient to manage the risk posed by drinking-water contamination to public health. A number of major outbreaks of water-borne disease in developed countries resulting in serious illness and death have shown that risks to health need to be reduced at every step of the way – not just in the treatment plant and distribution network, but by reducing the amount of contamination that enters water sources in the first place.

Reducing the loading of contaminants not only decreases the loading on treatment plants, but also decreases the risk of large amounts of contaminants entering community water supplies if a treatment plant fails. In addition, there are a number of disease-causing organisms and chemicals that can only be removed with sophisticated and expensive treatment. Preventing these contaminants from entering water in the first place is preferable to investing large amounts of money in sophisticated plants that are not only expensive to run but may break down, exposing communities to health risks. This 'multiple barrier' approach is recommended by the World Health Organisation as a key principle in preventing or reducing drinking-water contamination (WHO, 2006).

#### The multiple-barrier approach

'Safety is increased if multiple barriers are in place, including protection of water resources, proper selection and operation of a series of treatment steps and management of distribution systems (piped or otherwise) to maintain and protect treated water quality. The preferred strategy is a management approach that places the primary emphasis on preventing or reducing the entry of pathogens into water sources and reducing reliance on treatment processes for removal of pathogens' [emphasis added].

'Identification and implementation of control measures should be based on the multiplebarrier principle. The strength of this approach is that a failure of one barrier may be compensated by effective operation of the remaining barriers, thus minimising the likelihood of contaminants passing through the entire system and being present in sufficient amounts to cause harm to consumers'. (WHO, 2006)

To improve how drinking-water is managed at source, the Ministry for the Environment is proposing a national environmental standard for the management of human drinking-water sources. This will complement proposed Ministry of Health legislation and standards for improving drinking-water supply and delivery, and will ensure a comprehensive source-to-tap approach to the management of drinking-water. This is in keeping with the multiple-barrier approach to managing human drinking-water advocated by the World Health Organization. Specifically, the NES will ensure there is a catchment component to managing human drinking-water.

## 2.2 International context

Major outbreaks of water-borne disease in developed countries have led to increased awareness of the importance of drinking-water quality for health. Two of the most notable outbreaks have occurred in North America.

In the small rural town of Walkerton, Canada, contamination of the drinking-water supplies by the toxin-producing bacterium *Escherichia coli* O157:H7 resulted in more than 2300 people becoming ill (out of a population of 4800) and caused seven deaths. Twenty-seven people require dialysis for the rest of their lives. Costs were estimated at CAN \$155 million (Livernois, 2001). The contamination that caused this event entered the water supply from effluent run-off.

In another well-known case in Milwaukee, United States, 400,000 people are estimated to have become ill with cryptosporidiosis, and over 100 people died, as a result of contaminated drinking-water (MacKenzie et al, 1994). This event resulted from contamination of the water source by cattle feed lots.

The contribution of source water problems to water supply contamination events is documented in a paper summarising the causes of 19 outbreaks in six developed countries (Hrudey et al, 2002). This paper concluded that 14 of the 19 outbreaks studied resulted from source water problems.

#### 2.2.1 International approaches to catchment protection

The importance of catchment protection in ensuring good quality drinking-water is recognised by a number of developed countries.

In the US, Williams and Fenske (2003) estimated the benefits of wellhead protection programmes at between US\$4.4 million (for a population of 13,000) and US \$200 million (for a population of 2.3 million) in saved capital and operating costs. They found avoided benefit-to-cost ratios of between 2.3 and 13.4. Studies in the US have found that every \$US1 invested in watershed protection can save from US \$7.50 to US \$200 in costs for new water treatment and filtration facilities (Emerton and Bos, 2004). Protection of the catchments that supply New York city's drinking-water are estimated to have resulted in savings of US \$3 to \$4 billion by avoiding the need for further treatment (filtration), and a further US \$300 million/annum for operating costs.<sup>1</sup>

In Australia, catchment protection for Melbourne's water supply has avoided the need to build a treatment plant to filter Melbourne's water. This has saved approximately A\$400 million, plus annual operating costs of \$50 million.<sup>2</sup> In addition, Melbourne's good water quality means that residents have confidence in the public water supply. This has both social and economic benefits, as so-called "avoidance behaviour" (eg, buying bottled water) does not occur. For example, when *Cryptosporidium* and *Giardia* were detected in Sydney's water supply in 1998, citizens were warned not to drink the water for weeks on end. The cost of avoidance behaviour during this incident was estimated at A \$308 million.<sup>3</sup>

In the UK, costs from different agricultural contaminant contributions (pesticides, nitrates, phosphates and soil, and zoonoses) are estimated to contribute to the requirement for additional water treatment by £260 million every year (Pretty et al, 2000).

## 2.3 New Zealand context

Most of the New Zealand population receives safe drinking-water. Only three percent of the population receives water from registered supplies with unacceptable levels of the faecal indicator bacterium *Escherichia coli* (Ministry of Health, 2005a; see Table 2). However, it should be noted that compliance cannot be assured for another 26 percent of the population, either because they receive water from unregistered supplies or because monitoring data is insufficient to ensure compliance.

<sup>&</sup>lt;sup>1</sup> D Smith, personal communication, Presentation to New Zealand Treasury, 2006.

<sup>&</sup>lt;sup>2</sup> T Priestly, CRC for Water Quality and Treatment, personal communication, 2006.

<sup>&</sup>lt;sup>3</sup> T Priestly, CRC for Water Quality and Treatment, personal communication, 2006.

Tahla 2.	Bacteriological com	liance with drinkin	n-water standards	in New Zealand	2004
i able z.	Dacteriological com		iy-waler slanuarus	III New Zealanu	, 2004

Drinking-water supply compliance with bacteriological criteria <sup>a</sup>	Number of people <sup>b</sup>	Percentage of New Zealand population (%)
Complies with <i>E. coli</i> criteria	3,019,970	74
Population served by registered supplies not compliant with <i>E. coli</i> requirements	595,146	15
Unacceptable levels of E. coli	104,000	3
E. coli monitoring not performed or monitoring data unavailable	66,000	2
Water suppliers did not take appropriate corrective action after detection of <i>E. coli</i>	57,000	1.4
Insufficient number of samples to demonstrate compliance	564,000	14
Laboratory not registered by the Ministry of Health for drinking- water compliance testing	5,000	0.1
Supplied with drinking-water from unregistered supplies	446,000	11

Source: Ministry of Health, 2005a.

a Compliance with criteria specified in Drinking-Water Standards for New Zealand 2000.

b Some people are included in more than one category.

#### 2.3.1 Water-borne disease in New Zealand

New Zealand is fortunate in having had few large outbreaks of water-borne disease in recent times. However, there have been a number of documented outbreaks, both in towns and at camps. Between 1986 and 2003 the Ministry of Health recorded at least 16 outbreaks of water-borne disease in towns around New Zealand, and 13 at camps, ski fields and tramping huts. Details of these incidents are provided in Appendix 2.

The largest recorded water-borne disease outbreak in New Zealand occurred in Queenstown in 1984, affecting an estimated 3500 people (Taylor and Ball, 2005). A number of people were hospitalised and almost half the population's school pupils were absent at the height of the outbreak. The cause of the outbreak was thought to be a sewer overflow close to the town's water supply intake. Most recently, in July 2006 contamination of a drinking-water source at Cardrona skifield resulted in at least 120 cases of gastroenteritis.<sup>4</sup>

A study for the Ministry of Health estimated the annual background burden of water-borne disease (Outcome Management Services Ltd, 2004). The study estimated that there are over 18,000 cases of water-borne disease in New Zealand every year. The annual cost of this is estimated to be \$25 million (Harris Consulting Ltd et al, 2006). However, it is important to note that it is very difficult to accurately quantify the amount of disease caused by contaminated drinking-water, because many infectious diseases carried in water can also be transmitted by food or person-to-person contact. Water-borne disease is known to be substantially underreported, both in New Zealand and internationally (see section 5.6 for more detail).

<sup>&</sup>lt;sup>4</sup> Ministry of Health, personal communication, 2006.

## 2.4 Legislative framework

Both local government and health agencies have responsibilities for drinking-water quality at different stages, from the catchment to the consumer's tap. Regional councils and unitary authorities (collectively known as regional authorities) have the primary responsibility for managing water quality in the environment. From the point of abstraction from source water, drinking-water quality comes under the jurisdiction of health legislation, implemented by health agencies and local government (see Figure 1).



Figure 1: Key legislation and agencies involved in drinking-water management

Note: This figure shows only the key legislation associated with the management of drinking-water. Other associated legislation includes the Local Government Act and the Civil Defence and the Emergency Management Act. The Local Government Act 2002 requires local authorities to undertake a specific assessment of the quality and adequacy of drinking-water supplies (Part 7, section 126). However, there is no mandated requirement to manage source water quality.

Note: PHRMP means Public Health Risk Management Plan.

#### 2.4.1 Water in catchments

Activities regulated by regional councils (eg, discharges, damming, diversion, some land uses) can have adverse effects on drinking-water sources. However, there is currently no specific requirement for councils to consider the effects of activities on the quality of water sources used for human drinking when making decisions under the RMA, other than a general duty to consider effects of activities on the environment. Consequently, there is the potential for activities or discharges to be consented that reduce water quality at the point of abstraction to below what the plant is designed to treat. This presents potential health risks to the community and may result in significant costs to the supplier in upgrading treatment facilities.

There is also the potential for unintended events (often accidental and unpredictable) to contaminate water supplies. For example, failure of a waste-water treatment process upstream of a water treatment plant could threaten the safety of a drinking-water supply.

Regulatory protection mechanisms for water supply catchments vary throughout the country. An assessment of regional plans found that only three out of 16 regional plans were considered to provide comprehensively<sup>5</sup> for drinking-water supplies (Ministry for the Environment, 2004). The extent to which a regional council considers water supplies also depends on the knowledge it has about the catchment and the location of community water supply. While many councils will be aware of the location of larger supplies, and refer consent applications to suppliers for comment on the effects of the activity on source water quality, there is no specific requirement for this to occur.

Health, local government, building and civil defence legislation applies only after water is taken from its source for treatment and/or delivery to the consumer. To achieve integrated management of water from source to tap, and thus achieve the objective of implementing the multiple-barrier approach, controls are needed under both the RMA and health legislation. Currently there can be some ambiguity about the responsibility of local government compared with health agencies for drinking-water quality, including source water protection. Part of the reason for these discrepancies is an uncertainty at the local government level about how potential effects on human health should be considered in environmental decision-making. Some councils may also consider that controls on activities in drinking-water catchments are not needed because treatment processes can make almost any water potable (wholesome).

#### 2.4.2 Water after abstraction

The Health Act 1956 applies to drinking-water from the point of abstraction to the property boundary (see Figure 1). Proposals are currently before Parliament to amend health legislation to improve the management of drinking-water in the form of the Health (Drinking-water) Amendment Bill. This Bill focuses on improving the management of drinking-water after abstraction, in treatment plants and throughout the distribution network. It includes a requirement to comply with national monitoring and best practice guidelines (the Drinking-water Standards for New Zealand 2005), which is currently voluntary.

However, health agency jurisdiction does not extend into catchments to the extent needed to assess and manage risks to human drinking-water. Managing and regulating activities that can affect water quality in drinking-water catchments are the responsibility of local government, primarily regional councils, under the RMA.

<sup>&</sup>lt;sup>5</sup> "Comprehensive" was defined as including specific policies and rules for drinking-water supplies, numeric water supply quality objectives, and identifying or classifying water supply catchments.

# 3 What are the options?

To improve the management of sources of human drinking-water, a number of national policy options could be considered, including:

- do nothing (status quo)
- non-regulatory measures (eg, partnership with regional councils, production of voluntary guidelines and providing information on the locations of water supplies)
- amend the RMA
- a national policy statement
- a national environmental standard.

This section explains these options and assesses their appropriateness for achieving the policy objectives.

## 3.1 Policy objective

The policy objective is to reduce the risk of contamination of drinking-water sources by:

- contributing to a multi-barrier approach to managing human drinking-water
- ensuring there is a catchment component to managing human drinking-water, by making certain there are controls within drinking-water supply catchments.

Each of the options was compared against the policy objective to determine which would be the most effective way to meet the objective.

## 3.2 Status quo

The status quo in relation to the management of sources of human drinking-water is variable. Some regional councils' approaches are comprehensive, while others do not include any reference to drinking-water supplies (Ministry for the Environment, 2004). (For a more detailed assessment of the status quo, see chapter 2 under 'New Zealand context'.)

Without any central government support or regulation, regional council plans and practices may slowly tend towards improving protection of sources of drinking-water. However, there is no guarantee that this will occur. Without government intervention, the extent to which drinking-water sources are taken into consideration is likely to continue to be nationally inconsistent.

## 3.3 Non-regulatory approach

In this approach the Ministry for the Environment could, through the use of voluntary measures, encourage and support regional councils, treatment plant operators, drinking-water assessors and district health boards to improve the management of drinking-water sources. There would be a range of measures to support local government, but no compulsion for regions to improve practice or implement guidance. These measures could include:

- recommended protocols for consulting with treatment plant operators on relevant resource consents
- partnership models to improve communication between regional councils, water treatment plant operators, public health units (particularly drinking-water assessors) and consent applicants
- providing accurate information on the locations of drinking-water treatment plants and abstraction points (eg, using the geo-referenced Water Information New Zealand database)
- issuing best practice guidelines on how to assess the potential effects of various activities on drinking-water source quality, and how to develop appropriate consent conditions or regional plan rules.

This approach could well lead to improvements in how councils manage the effects of activities on drinking-water sources. However, without regulatory compulsion there is no guarantee that councils would explicitly include consideration of drinking-water sources in their decisions (although some of these measures could usefully complement and support regulatory options).

## 3.4 RMA amendment

The RMA could be amended to make it clear that councils need to explicitly consider effects on drinking-water sources when preparing plans and making decisions on resource consents. However, the RMA is an enabling and broad-scale piece of legislation. Amending the head statute to accommodate specific matters as they arise would make the legislation unnecessarily complex. The RMA provides for more specific matters to be addressed through regulation-making powers (such as national environmental standards) for individual environmental management issues.

Legislative amendments are also often more expensive and time-consuming than other options. In addition, it is more difficult to amend legislation if changes are needed at a later date (eg, if amendments are made to the Drinking-water Standards for New Zealand).

## 3.5 National policy statement

Part 5 of the RMA provides for the Minister of the Environment to issue national policy statements "to state objectives and policies on matters of national significance that are relevant to achieving the purpose of this Act".<sup>6</sup>

These take effect in one of four ways. Local authorities must:

- give effect to the national policy statement (NPS) by amending a regional policy statement or plan (in line with the timeframe specified in the NPS, or "as soon as practicable")
- when making a decision on a resource consent application, have regard to a NPS
- when making a recommendation on a notice of requirement, have particular regard to a NPS
- take any other action specified in a NPS.

For example, a NPS could be prepared stating that protection of drinking-water sources is a matter of national significance. This would give clear guidance to consent authorities that they need to have regard to effects on sources of human drinking-water when making decisions on resource consents, and when preparing plans and regional policy statements.

However, there are limitations to the certainty about decision-making that could be achieved by a NPS alone. National environment standards establish objectives and policies; they do not establish methods or rules (ie, they do not establish how the objectives and policies are to be achieved). Therefore, there could be a wide variation of interpretation of the NPS requirements at the individual council level. This may not achieve sufficient consistency to ensure the protection of drinking-water sources around the country.

A NPS could also be viewed as elevating the status of drinking-water above other values. This is not the policy objective. The policy objective is to ensure there is a catchment component to drinking-water management, rather than elevating it above all other potential uses or values.

### 3.6 National environmental standard

The RMA enables the Minister for the Environment to prepare national environmental standards. These have the force of regulation and are binding on local authorities. Standards can prescribe methods or requirements and be either quantitative or qualitative. Section 43 of the RMA outlines the matters that can be covered by a NES (see Appendix 8).

National environmental standards can be more prescriptive instruments than national policy statements and legislation. This provides some key benefits over other options. A NES would fulfil the policy objectives by providing certainty about the outcomes of decision-making on resource consents and policy provisions. The NES requirements would also remove any remaining ambiguity over whether to consider effects on human health when making decisions on these matters.

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<sup>&</sup>lt;sup>6</sup> To date, no national policy statements, other than the mandatory New Zealand Coastal Policy Statement, have been issued in New Zealand. However, several are under consideration at the time of writing.

## 3.7 Comparison of alternatives

Of the options considered, the only two that are appropriate to meet the policy objectives are:

- RMA amendment
- national environmental standard.

These options can compel by legislation or regulation. None of the other options are appropriate, because they would not satisfy the policy objectives of *ensuring* a catchment component to managing human drinking-water, and *making certain* there are controls within drinking-water supply catchments. A national policy statement will not ensure there is a catchment component to managing human drinking-water, or make certain there are controls within drinking-water catchments. This is because it can only state objectives and policies, not how to achieve them. As a result, a NPS alone cannot be sufficiently specific to ensure that necessary controls are applied in drinking-water catchments.

A NES was considered a more appropriate instrument than a RMA amendment for the following reasons.

- A NES is a more specific instrument. It allows for more prescriptive requirements than the legislative amendments suggested (eg, notification of water treatment plant operators). It is less open to interpretation, providing more direction and certainty to practitioners. This means there is a decreased likelihood of the intention of the policy being diluted.
- A NES can be more readily and quickly amended than legislation if later changes are required.
- Alterations to legislation are likely to be more expensive and take longer than the promulgation of a NES, since the steps to be followed are more numerous and arduous than for implementing a NES. There may also be regulatory inconsistency between regions, depending on how councils interpret instructions such as "recognise and provide for". Implementation is likely to be protracted, so changes may not be made until the time of scheduled plan reviews.

Having considered the available alternatives, a national environmental standard was considered the most appropriate means of achieving the policy objective.

# 4 Proposed Standard for Sources of Human Drinking-water

The proposed NES is a narrative standard that describes how decisions should be made for activities that may affect sources of human drinking-water. It is best viewed as an additional consideration in existing processes for (i) assessing consent applications and (ii) developing regional plans.

There are three components to the proposed standard. These relate to:

- decisions on resource consents
- permitted activity rules in plans
- emergency notification.

It was not practical to set a numerical standard for source water because of the wide variations throughout the country in source water types and quality, and types of treatment plants. For example, some communities obtain their drinking-water from secure aquifers,<sup>7</sup> and it is so clean that it does not require treatment. Others obtain their water from unprotected surface water (eg, rivers), which can require sophisticated treatment before it is safe to drink. Therefore, it is not practical to specify a single set of water quality criteria that will be suitable for all of these situations. An approach is needed that is flexible enough to be suitable for a wide variety of source waters and treatment plant capabilities, but is sufficiently protective to achieve the objective of reducing the risk of source water contamination.

The original wording of the proposed standard, as notified in the discussion document (Ministry of the Environment, 2005), is provided in each section and also in Appendix 4. Some changes have been made to the original proposal in response to submissions. The reasons for these changes are outlined in this chapter.

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<sup>&</sup>lt;sup>7</sup> In secure aquifers, water has been demonstrated to be greater than one year old and hence unlikely to be contaminated by pathogens (DWSNZ 2005).

## 4.1 Decisions on resource consents

The first part of the proposed standard affects decisions on resource consents (specifically, discharge permits, or permits to take, use, dam or divert water).

#### The policy intent for the first part of the standard is:

Consent authorities are required to decline discharge permits, and permits to take, use, dam or divert water, that are likely to result in community drinking-water becoming non-potable or unwholesome following existing treatment.

This part of the standard will only apply to communities of 500 people or more.

Alternative requirement for plants that do not comply with the *Drinking-water Standards for New Zealand* (DWSNZ 2000):

In situations where existing drinking-water treatment facilities are inadequate (ie, do not currently provide potable or wholesome water), discharge permits, or permits to take, use, dam or divert water, shall not be granted if they will (or are likely to) make the water quality worse at the point where water is taken for a drinking-water supply.

In effect, this adds another consideration to existing consent application processes. When considering an application for a discharge permit, regional councils are already required to assess the effects of the proposed activity on water quality, including effects on aquatic ecosystems. Section 107 of the RMA states that a regional council cannot grant a discharge permit if the contaminant or water discharged is likely to result in freshwater becoming unsuitable for consumption by farm animals, or to have significant adverse effects on aquatic life. Also, permits cannot be granted if they are likely to result in the formation of foams or scums, changes in clarity or emission of objectionable odours.

The proposed NES clarifies that regional councils need to consider the potential effects of activities on the suitability of water for human drinking purposes (after existing treatment), in addition to existing requirements under the RMA. In many situations, existing RMA requirements for aquatic ecosystems and stock drinking are likely to be more stringent than those required for water that will be treated before human consumption, particularly for surface water. The concentrations of many chemical contaminants that aquatic organisms can tolerate are likely to be much lower than those that a drinking-water treatment plant can deal with. Similarly, for microbial pathogens, guideline levels of bacteria for animal consumption are much lower than most treatment plants can deal with.

Likely significant exceptions are pathogens, particularly protozoa, that are not easily removed by existing treatment (eg, protozoa). The other major exception is groundwater, where suitability for drinking may be the major consideration in consent and regional plan decisionmaking.

Note that the standard will not apply retrospectively (ie, it applies only to new consents. This includes existing consents when they expire and new consents are sought.)

Section 14 activities are included if the take/diversion will increase concentrations of contaminants in source water.

The alternative requirement (see box above) is intended to achieve a balance between preventing ongoing increases in contamination of source waters, while allowing some development in catchments with inadequate drinking-water treatment plants.

#### 4.1.1 Response to submissions

The original proposal was for this part of the standard to apply to all consents in drinking-water catchments. This would have included all types of consents issued by both territorial local authorities and regional councils.

**Original proposal:** New consents in drinking-water catchments shall only be granted if the proposed activity does not result in drinking-water being non-potable or unwholesome following treatment.

However, some submitters said that territorial authorities should not be required to consider the effects of activities on water quality because this is outside their function. Regional councils have the function of controlling discharge to land and water, and controlling the use of land for the purpose of maintaining and enhancing water quality (section 30, RMA).

In response, this part of the standard was modified so that it applies only to activities regulated under sections 14 and 15 of the RMA (discharge and water permits). These are controlled by regional councils and unitary authorities, not territorial authorities.

The revised proposal does not address some submitters' concerns about the effects of land use on water quality. However, many of the land-use activities regulated by territorial authorities are unlikely to result in significant effects on water quality on an individual consent basis.

There are also legal restrictions about how regulations can be written for land use compared with discharges. The RMA takes a more prescriptive approach to regulating activities that affect water: discharges are not allowed unless specifically authorised by a rule in a plan. Conversely, land uses are allowed unless a rule in a plan specifies otherwise. As a result, it would be harder to achieve certainty with land-use regulation because it would need to specify all activities that could not be undertaken. This would be a much more prescriptive approach, which could limit the flexibility of local government approaches to implementing the standard. (For example, it could require the development of detailed schedules, which would be very difficult to develop on a national basis given the wide variation of source water types and treatment plants.)

After discussion with stakeholders about the practical difficulties associated with such a regulation, the Ministry decided to restrict this part of the regulation to discharge permits and permits to take, use, dam and divert water. This restriction also addresses the concerns of some submitters that if the NES were interpreted conservatively it may restrict development in communities, particularly land uses.

The explicit reference to drinking-water catchments was also removed from the wording of the proposed NES in response to submissions. This was done to address concerns about the costs of delineating catchments, and to emphasise that decisions on consent applications should be based on a case-by-case assessment of potential effects at the abstraction point for a drinking-water treatment plant, not a mechanistic assessment based on whether or not a proposed activity is located within the boundary of a drinking-water catchment (whose boundaries could be a considerable distance from the abstraction point).

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#### 4.1.2 Population threshold

Submissions showed a range of opinions on the population threshold for the NES. Originally it was proposed that the NES should apply to community drinking-water supplies serving more than 25 people for at least 60 days of the year. However, many submitters were concerned that this threshold would lead to considerable additional work for councils. They also considered that this would mean that substantially greater areas of catchments and activities would be affected by the NES, which would result in costs being incurred for a greater number of consent applicants. They were particularly concerned about a disproportionate amount of the costs falling on small communities, and about the possible economic effects of additional regulatory requirements for small populations.

On the other hand, some submitters considered that the 25-person population threshold was appropriate in order to provide sufficient public health protection. Small water treatment plants often have the most difficulty complying with the Drinking-water Standards for New Zealand. Some submitters therefore considered that it was particularly important for the source water for these supplies to be protected, as treatment at these plants is often more basic than for larger communities.

Close to 95 percent of the New Zealand population on a reticulated water supply live in communities of 500 people or more (see Table 3). Full details on the number of community water supplies for different population bands are provided in Appendix 5.

Population	Population		Zones		Number	% of zones	
Danu	N	%	n	%	Complying with DWSNZ 2000	Not complying with DWSNZ 2000	with DWSNZ 2000
< 25	3,085*	0.1	246	11.1	9	237	4
25–199	92,478	2.6	1281	58	164	1117	13
200–499	92,990	2.6	298	13.5	119	179	40
Total: 25–499 ≥ 500	185,468 3,426,263	5.2 94.8	1579 386	71.4 17.5	283 238	1296 148	18 62

 Table 3:
 Distribution of New Zealand population, by community drinking-water supply zone

Source: Ministry of Health, Register of Drinking-Water Supplies in New Zealand, 2004.

\* Figures for populations and distribution zones of less than 25 people are likely to be substantial underestimates because of a lack of information about these small community supplies.

#### Costs for different population thresholds

The estimated cost of applying the NES to communities of 500 people and above is \$24.2 million over 20 years (see chapter 5 for further details). Setting the population threshold at 200 would mean that sources for another 298 supply zones would be included. This would extend the benefits of the NES to an additional 92,990 people. Only 40 percent of these zones currently comply with the Drinking-water Standards for New Zealand 2000 (DWSNZ 2000), so it could be argued that extending the NES to these communities would result in reducing risks to a more vulnerable sector of the population. However, it would also increase the workload for councils, and increase the national compliance costs of the NES to \$54.4 million over 20 years.

For a threshold of 25 people and above, as originally proposed, the estimated cost is \$200.4 million over 20 years. This is over eight times the cost of applying the standard to

communities of 500 and above. Therefore, recommendations will be made to set the population threshold for the proposed NES at 500. However, proposed health drinking-water legislation would require compliance with the DWSNZ 2005 for progressively smaller populations over time, down to communities of 25 people or more. If this Bill is passed, amendments to progressively lower the population threshold for the NES may be suggested to align with the health legislation requirements.

#### 4.1.3 Non-compliant plants

Different conditions are proposed for decisions on consent applications upstream of treatment plants that do not comply with the DWSNZ. The threshold used for assessing consent applications cannot be used for non-compliant plants, because these are currently not delivering water that is potable or wholesome.

A balance needs to be achieved between protecting source water in the catchments of plants with inadequate treatment in order to reduce the risk to public health (since these communities will be more vulnerable to contaminated source water than those with adequately functioning plants), and excessively restricting development in the catchments of water bodies with inadequate treatment plants. The test for decisions in these situations is that the proposed activity should not result in water quality becoming worse at the point of abstraction than it is at the time of the consent application.

When it comes to contaminants for which the plant is currently non-compliant (ie, levels of those determinants exceed the criteria for potability or wholesomeness after existing treatment), consents will not be granted if the activity is likely to result in the concentration of that contaminant increasing at the abstraction point. In keeping with the approach of the RMA, this means increases in concentration of contaminants at the abstraction point must be no more than minor.

For contaminants the plant is currently treating adequately, consent will not be granted for activities that will result in water becoming non-potable or unwholesome after treatment *in respect of those contaminants*.

#### 4.1.4 Response to submissions

The special condition for communities with substandard drinking-water treatment plants reflects councils' concerns about inequitable restrictions on development in catchments with inadequate treatment infrastructure. It is also intended to address council concerns that treatment plant operators may seek to prevent development in drinking-water catchments rather than spending money on upgrading their treatment facilities.

The Health (Drinking-water) Amendment Bill, if enacted, will provide an independent mechanism for upgrading inadequate treatment plants. If this legislation were in place, the special condition for communities with inadequate treatment plants could be phased out over time. This is because the health legislation would result in increased compliance with the DWSNZ for smaller communities over time. In the meantime, inclusion of the special condition is proposed to provide councils with discretion on how to manage consent applications in situations where existing drinking-water treatment facilities are inadequate.

## 4.2 Permitted activities

This part of the proposed standard requires regional councils to assess how permitted activities are affecting the quality of drinking-water sources. This could apply to any activity regulated by a regional council, such as discharges, water abstraction and land uses that could affect water quality.

Before including permitted activity rules in a regional plan, regional councils must:

- undertake an assessment that considers the nature of the drinking-water sources and the nature of permitted activities in their catchments
- be satisfied that permitted activities will not result in community drinking-water supplies being non-potable or unwholesome after existing treatment.

This part of the regulation will apply when any regional plan or part of a regional plan is prepared or reviewed.

This part of the standard will only apply to communities of 500 people or more.

#### 4.2.1 Assessment

The proposed NES does not specify the level of detail required for the assessment. This is to be decided by individual councils at their discretion, in line with the local solutions approach of the RMA. Councils may choose to conduct assessments at a desktop level. This could be done by assessing factors such as land-use changes in a catchment over the past five to 10 years, discussing any challenges treatment plant operators may be facing with source water quality, and reviewing any existing water quality monitoring data (eg, from existing state of the environment monitoring networks). Councils could also choose to add sites to their existing monitoring networks to better characterise water sources.

Councils will not be undertaking this review in isolation. Regional councils are already required to monitor the efficiency and effectiveness of their rules (section 35(2)(b) of the RMA).

The intention is for the level of assessment to be risk-based, rather than requiring a blanket monitoring requirement for all situations.

#### 4.2.2 Permitted activity rules

Section 70 of the RMA already requires councils to be satisfied that permitted activities will not result in specified adverse environmental effects before including these rules as permitted activities in regional plans. These effects include rendering water unsuitable for consumption by farm animals, and having significant adverse effects on aquatic life. The NES simply extends this requirement to include the effects of permitted activities on drinking-water sources.

To allow flexibility for councils and communities, the NES deliberately does not prescribe how councils should meet this requirement. Introducing or changing permitted activity rules is one possibility. Non-regulatory methods, such as riparian protection programmes, is another.

The NES also does not specify the nature of the action(s) a council must undertake if the assessment indicates that permitted activities are adversely affecting (or are likely to adversely affect) human drinking-water sources. If a council's assessment shows that water will (or is likely to) become non-potable or unwholesome after treatment as a result of permitted activities, the council has a range of options, including:

- tightening the conditions of the existing permitted activity rules or
- reclassifying the relevant activity as controlled, restricted discretionary, discretionary, or prohibited or
- increasing compliance monitoring and enforcement with existing permitted activity conditions or
- non-regulatory tools the council's assessment may show that currently permitted activities are likely to degrade water quality. However, if the council can be satisfied that non-regulatory methods will prevent this degradation, or improve water quality, this could be an alternative to changing the permitted activity rule. For example, the council could support additional riparian retirement or farm management plans.

This part of the standard will not require councils to undertake a separate plan review. It is intended to be done as part of plan preparation or scheduled plan review to minimise additional work for regional councils. Councils are required to review their regional plans every 10 years (section 79(1) of the RMA). Councils are also required to monitor the efficiency and effectiveness of policies, rules or other methods in their plans at least every five years (section 35(2)(b) and (2A) of the RMA).

#### 4.2.3 Response to submissions

**Original proposal:** Consent authorities will periodically assess the risks within drinkingwater catchments to ensure that permitted and unregulated activities do not cause impacts beyond the performance of the affected treatment facilities.

The original notified version of the proposed standard required this action to be taken by both territorial and regional authorities. Several submitters questioned whether this was a function territorial authorities should undertake, or whether it should be performed by regional councils only. This has now been revised in response to submissions. As for the first part of the standard, this part now applies only to regional councils, in keeping with RMA responsibilities for water quality. It was considered that the majority of decisions likely to have major effects on water quality were those regulated by regional councils.

A number of submitters were concerned that this part of the standard would result in onerous monitoring requirements.

To clarify that this part of the proposed NES is not intended to require intensive monitoring, some changes to the wording were made. The phrase "drinking-water catchment" was removed, as in the first part of the NES, to make it clear that the focus of the NES is not simply whether an activity is located in a drinking-water catchment, but what effects that activity may have on a drinking-water source.

Assessments are only required before including a permitted activity rule in a plan. If plans are reviewed at the minimum of once every 10 years, then an assessment is only required once

every 10 years. However, it is likely that assessments would happen at least once every five years under section 35 of the RMA.

The population threshold for this part of the standard was also changed to 500, in keeping with the reasons set out in 4.1.2 above.

## 4.3 Consent conditions

#### Consent authorities are required to:

Place conditions on consents for activities that have the potential to adversely affect the quality of a drinking-water source. These conditions will require consent holders to notify downstream water treatment plant operators and the consent authority of significant unintended events that have the potential to adversely affect water quality at the point where water is taken for a drinking-water supply.

This part of the standard applies to activities with the potential to affect community drinking-water supplies for populations of 25 people or more.

The intention of this part of the standard is to ensure that drinking-water suppliers are notified of incidents that may adversely affect their supplies, so that suppliers can take appropriate steps to ensure that safe drinking-water continues to be supplied (eg, optimising treatment processes, or shutting off intake points).

This requirement applies to all types of consents issued by both territorial authorities and regional councils. However, conditions will only need to be attached to consents that have the potential to adversely affect water quality at the abstraction point as a result of a significant unintended event. Breaches to be notified are only those with the potential to affect water quality. The judgement about whether this condition needs to be added to a consent will be made on a case-by-case basis by consent authorities, in consultation with treatment plant operators and applicants.

This part of the standard is proposed to apply to activities that could affect community drinking water supplies for 25 people or more, rather than the population threshold of 500 that applies to the rest of the standard. This is because notification of incidents is considered to be a much less onerous requirement for consent authorities and applicants than the actions required by other parts of the proposed NES, so should not impose major costs on any stakeholder group.

#### 4.3.1 Response to submissions

**Original proposal:** Resource consents within drinking-water catchments will have a condition that any unauthorised activity be notified to the water supplier immediately.

Resource consents to take water for drinking will have a condition that requires appropriate action, including turning off the supply, if notified of events or activities that make the drinking-water non-potable.

The original proposal included an additional clause requiring resource consents for drinkingwater takes to include a requirement to take appropriate action – including turning off the water supply – if notified of events or activities that would make drinking-water non-potable. Submitters noted that even if water is non-potable, water supplies are still required for sanitary purposes (eg, toilet flushing) and fire fighting. It would be extremely rare to require a water supply to be turned off for public health reasons. In addition, submitters pointed out that the clause duplicates the requirements of existing legislation, including those of the Health Act and Civil Defence and Emergency Management Act.

Therefore, this requirement has been removed from the revised proposal.

## 4.4 **Provision for more stringent conditions**

For a council to be more stringent than a NES, the NES must explicitly allow for this (section 43B(1) of the RMA).

Given feedback from a number of councils about the need for the NES to allow for flexibility in council approaches, it is recommended that councils be able to set more stringent conditions for protection of drinking-water sources in their region if they wish. This is seen to be particularly important for those regions where water quality is currently high.

# 5 Efficiency and Effectiveness of the NES

An economic appraisal was undertaken by an independent consulting team to assess the costs and benefits associated with the proposed NES. The team comprised a resource management consultant, an economist and a water scientist.

The potential costs and benefits of the NES are very specific to individual situations. Regional planning frameworks, the nature of individual catchments, the types of activities that affect water quality, the nature of treatment plants and the size of communities all determine the balance of costs and benefits from the NES. As a result, a fully quantified national cost–benefit analysis was not possible because of the high degree of variability in individual situations. Instead, a case study approach was used, which looked at specific drinking-water supplies in their context. This was then scaled up to provide a national estimate.

Nine case study catchments from five regions were selected (see Appendix 6 for a description of the methodology used). The case study catchments were selected to reflect a wide range of circumstances, in consultation with regional council representatives and based on analysis by a drinking-water scientist. Potential case studies were stratified by the nature of their sources and the quality of water supplied to consumers.

## 5.1 Overview of impact

Five stakeholder groups are likely to be affected by the proposed NES:

- central government development and guidance on implementation
- regional councils implementation, administration, monitoring and review of permitted activities
- resource consent applicants application and mitigation costs
- drinking-water suppliers implementation, consultation, avoidance of upgrade costs
- general public health benefits.

Total costs associated with the NES were estimated at 24.4 million over 20 years (see Table 4),<sup>8</sup> with the majority of costs borne by consent applicants.

<sup>&</sup>lt;sup>8</sup> This is considered to be an upper estimate as conservative assumptions were applied by the consulting team when conducting the assessment of compliance costs.

It is difficult to quantify the benefits directly attributable to the NES. However, a range of scenarios have been run to indicate the magnitude of the possible quantified benefits. Economic valuation, based on the incidence of water-borne disease in New Zealand, estimates that the cost of disease associated with contaminated drinking-water is approximately \$25 million per annum. Improving the quality of the source of drinking-water will reduce this ill health and provide a benefit to society through increased productivity and a reduced burden on the health system. Analysis shows that at a 10 percent discount rate the NES would need to deliver a 15 percent improvement in drinking-water source quality in order for the benefits to outweigh the costs. If the improvements were higher than this (say 30 percent), then the cost–benefit equation is very favourable, with a net present value (NPV) of \$27 million. At lower discount rates (appropriate for long-term health benefits), the "tipping point" is approximately a 10 percent improvement in the quality of drinking-water at its source.

The costings above are based on a single benefit – improvements in health. However, the NES will deliver much broader benefits, which should make it highly efficient. For example, protecting drinking-water sources will also lead to improved recreational opportunities such as swimming, kayaking and fishing. It will also complement initiatives to protect water sources for ecological reasons. By reducing the risk of disease outbreaks from drinking-water, protecting source water contributes to maintaining New Zealand's image as a safe tourist destination. It will also assist with maintaining New Zealand's clean green image as a source of healthy, environmentally sound agricultural produce for export markets.

The NES is also likely to result in substantial cost savings over time in terms of reducing the need to upgrade drinking-water treatment plants, through maintaining source water quality at a level at which existing water treatment plants can deliver safe drinking-water. The quantified benefits should therefore be viewed as a minimum. The NES will deliver a range of favourable outcomes that will improve health, the environment and the overall quality of life for New Zealanders.

Stakeholder	Category	PV costs of NES	Proportion
Central government costs	Preparing guidance material	\$300,000	1.2%
Regional councils (all)	Identifying drinking-water sources	\$75,000	0.3%
	Defining drinking-water management area	\$88,000	0.4%
	Administering changes to consent processes	\$70,000	0.3%
	Monitoring for permitted activity impact	\$1,020,000	4.2%
	Permitted activity review	\$680,000	2.8%
Drinking-water suppliers (all)	Consultation with regional council	\$70,000	0.3%
	Consultation with applicant	\$1,260,000	5.2%
	Upgrade costs (negative = costs avoided)	-\$1,900,000	-7.8%
Resource consent applicants	Application costs	\$16,100,000	66.0%
(all)	Mitigation costs	\$6,700,000	27.5%
Total		\$24,400,000	100.0%

Table 4: Present value (PV) costs: national impact of NES over 20 years

Source: Harris et al, 2006

The impact of the NES on each group of stakeholders is discussed in more detail in the following sections.

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## 5.2 Central government

Costs to central government were estimated at \$300,000<sup>9</sup> over the first three years of implementation of the NES.<sup>10</sup> The major likely costs for central government will be incurred through producing guidance materials to help councils implement the NES. The likely costs were estimated based on experience implementing the existing national environmental standards for air quality.

## 5.3 Regional councils

The total cost to all regional councils was estimated at \$1.9 million over 20 years. This translates to an average cost per council of \$120,813.<sup>11</sup> However, it should be noted that costs are likely to vary between regions depending on factors such as councils' existing practice, the nature of water sources and the number of drinking-water supplies in each region.

Costs to regional councils were considered to arise from:

- coordinating information on drinking-water sources and catchments
- consent processing
- monitoring for the impact of existing permitted activities
- reviewing permitted activity rules as part of scheduled plan reviews.

These are summarised in Table 5. More detail is provided below.

Table 5: Tasks included when estimating costs for regional cour	ncils
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Task*	Cost		
Information on drinking-water sources and catchments			
Importing geo-referenced Ministry of Health data on drinking-water sources	\$5000 per council		
Defining drinking-water management areas (catchment boundaries)	\$240 per drinking-water source (> 500 people) in region		
Consent processing			
Changing consent templates (includes check for drinking-water)	\$5,000 per council		
Checking consultation has occurred	\$20/application		
Assessing impact of permitted activities			
Monitoring sensitive sources	\$1200 per source (average: six sources/council = \$7200)		
Permitted activity review			
Assessing data, policy review, plan change if required	\$50,000/council		

Many of these actions are not specifically required by the NES, but have been included as estimates for procedures councils may choose to undertake.

<sup>&</sup>lt;sup>9</sup> Present value.

<sup>&</sup>lt;sup>10</sup> There are not expected to be any substantial costs to central government beyond this time, because the majority of implementation guidance will be required in the first two or three years after the standard comes into place.

<sup>&</sup>lt;sup>11</sup> Average cost per regional authority was calculated by dividing the total cost by the number of regional authorities in New Zealand (16).

#### 5.3.1 Information on drinking-water sources and catchments

The Ministry of Health have geo-referenced water supply take points in the Water Information New Zealand database, and this data is being updated and checked. The data would be supplied to regional councils, with only small costs incurred by councils to import the data into their systems. A one-off cost of \$5000 per council was assigned for this task based on discussions with councils.

Defining drinking-water management areas is not compulsory under the NES. However, councils may choose to define key areas to improve the efficiency of administering resource consents.

The Ministry for the Environment will develop an implementation package, including guidance on defining drinking-water catchments. This is a relatively simple task for surface water. The consulting team considered it unlikely that councils would need to undertake full modelling of groundwater catchments, and that a guideline approach should suffice to ensure that water management issues were adequately addressed. It is likely that more complete modelling will be required if consents are contested, but these costs have not been included in the estimate.

Consultants costed this component by allowing for geographic information system (GIS) programmers' time per water source to define and map the drinking-water catchments. This is a cost of \$240 per drinking-water source, and has been multiplied by the number of drinking-water sources in each region to provide the national estimates in Table 4.

#### 5.3.2 Administering changes to consent processes

Some costs will increase for local government in administering the consent component of the proposed NES. When any application is processed for a discharge permit, or a permit to take, use, dam or divert water, there will be an additional step required to check whether the activity could adversely affect a drinking-water source, and, where this is the case, to ensure that the necessary impacts have been included in the assessment of environmental effects. The consulting team considered that the costs councils would incur from this would be relatively small, and that most costs would be incurred by applicants. Thus \$5000 was allowed per council to implement changes to their consenting processes to:

- include drinking-water as a check item
- change the template for consents to include a condition whereby the consent holder must notify the drinking-water supplier in the event of an incident that may adversely affect a drinking-water source.

A further 10 minutes was allocated per application ( $$20^{12}$ ) to check that the appropriate consultations have been carried out.

There may be isolated instances where a resource consent application that would otherwise be processed as non-notified has to be notified because of the NES. However, feedback from councils suggests that this will be relatively uncommon, so it has not been included as an additional cost.

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<sup>&</sup>lt;sup>12</sup> At a charge-out rate of \$120/hour.

#### 5.3.3 Assessing the impact of permitted activities

The proposed NES does not require any specific monitoring. The extent of assessment undertaken to assess the impact of permitted activities is at each council's discretion. However, in order to review permitted activities more thoroughly, councils may choose to increase their monitoring programmes.

The consulting team considered it was unlikely that every drinking-water source would need to be monitored. Rather, they considered that monitoring would be undertaken in a limited number of key pressure catchments in order to allow the council to do some case studies of how permitted activity rules were affecting drinking-water sources.

In order to match the permitted activity review costs outlined below, the consulting team assumed that each council would monitor six of its most sensitive catchments. Cost estimates by Environment Canterbury (\$1200 per source) were used to estimate the total cost of monitoring for other regional councils. This \$1200 per source, multiplied by six sources per council, gives an estimate of \$7200 per council for monitoring costs. These costs have been aggregated by the total number of councils to provide the figures in Table 5.

#### 5.3.4 Permitted activity review

The costs of undertaking a review of permitted activity rules to comply with the second part of the NES were assessed after discussion with regional council staff. Permitted activity rule reviews will be undertaken in conjunction with scheduled regional plan reviews. The additional costs of reviewing relevant permitted activity rules for compliance with the NES were not considered to be very large, and to vary greatly depending on the level of detail a council decided was necessary to implement this part of the NES in their region.

Costs could include a review of monitoring data, assessment of land-use change, and assessment of the effects of activities on source water quality. Based on the results of these findings, the need for policy review would be considered. If a change to a permitted activity rule was considered necessary based on this assessment, costs would also be incurred for preparing a report and input to council decision-making.

Indicative figures of \$30,000 to \$100,000 were provided by council staff for undertaking a review of their permitted activity rules in relation to the NES requirements. An estimate of \$50,000 per council was allocated to review permitted activity status once in the period of analysis. As noted, this will vary greatly depending on how many activities need to be reviewed, and whether such reviews need to be region-wide or restricted to specified supply catchment areas.

## 5.4 Resource consent applicants

The total estimated costs for resource consent applicants resulting from the NES are \$22.8 million over 20 years. These costs are associated with:

- information supporting applications for resource consents
- mitigation required to comply with the NES
- possible changes of activity status.

In many cases the additional costs associated with the NES are likely to be minimal for individual consent applicants. This is because existing RMA requirements for receptors such as aquatic ecosystems or farm animals are often more stringent than for water that will undergo treatment before consumption. Also, a number of councils already require applicants to consider the effects of activities on drinking-water sources. In these situations, the NES will introduce few – if any – additional requirements for consent applicants.

The major difference to the status quo is likely to occur in situations where communities are supplied by untreated groundwater. In these cases, the drinking-water supply may be the most sensitive receptor that needs to be considered. The requirements of the NES may lead to additional application and mitigation costs in these situations.

Costs for consent applicants were assessed by commissioning an environmental engineering consulting firm to determine the likely increase in costs associated with considering effects on drinking-water sources for different consent application types. The same firm also provided cost estimates of upgrading discharges in the key categories they had identified as likely to require changes to consent conditions in order to comply with the NES.

#### 5.4.1 Application costs

The additional costs of applications associated with the NES were estimated at \$16.1 million over 20 years (for all of New Zealand). This was based on an analysis of the types of consent applications for which additional assessment (eg, groundwater modelling) would be required to comply with the NES.

It should be noted that actual costs of assessment to accompany a consent application in order to comply with the NES will vary widely depending on a range of factors, including:

- available chemical/microbiological drinking-water supply compliance information (including groundwater supply security)
- catchment type and surface water and groundwater quality
- catchment land-use patterns
- existing knowledge of catchment hydrology and hydrogeology
- existing knowledge of surface and groundwater quality
- the scale and risk profile of the discharge activity
- existing knowledge of the proposed discharge activity
- the scale of the water supply take
- the distance between the discharge and the water supply intake.

#### 5.4.2 Mitigation costs

The total costs of mitigation measures required by consent applicants in order to comply with the NES were estimated at \$6.7 million over 20 years (for all of New Zealand).

Where an activity may adversely affect drinking-water sources, consent applicants are likely to incur some mitigation costs to avoid or reduce source water contamination (eg, increasing the level of treatment of wastewater). The size and scope of these costs are difficult to determine. They may vary from very significant (if major engineering works are needed to mitigate the effects of an activity)<sup>13</sup> to low (where only minor mitigation measures are required).

#### 5.4.3 Cost of changes to permitted activity rules

Consent applicants may incur extra costs if the review of permitted activity rules results in a change in activity status in the regional plan (eg, a lower threshold for a permitted activity, or reclassifying an activity so that it becomes discretionary).<sup>14</sup>

It was not possible to quantify what these costs might be because of the wide variation of possible outcomes of permitted activity review. It should also be noted that even if a council decides that a change to a permitted activity rule is required, this will not necessarily result in any extra costs for consent applications. For example, councils may decide to manage effects on catchments through non-regulatory methods (eg, riparian vegetation) rather than by changing permitted activity rules.

## 5.5 Drinking-water suppliers

Drinking-water suppliers will experience some increased costs as a result of implementation of the NES. However, this may be offset by a reduction in the need for future treatment plant upgrades if the NES prevents or reduces source water deterioration.

During initial implementation, cost increases are likely to be minor and associated with increased consultation with regional councils. Discussions with treatment plant operators indicated considerable variability in their level of knowledge of the NES and interaction with regional council staff. A one-off cost of two days' time (\$1900) was estimated per district council for liaison and consultation during the implementation phase.

<sup>&</sup>lt;sup>13</sup> It is considered that such instances would be rare, as in most cases existing requirements to protect ecological receptors or stock drinking-water will be more stringent than those required for a drinking-water source that undergoes treatment prior to human consumption.

<sup>&</sup>lt;sup>14</sup> Additional costs may also be incurred (eg, by land users) if an activity that was previously not regulated under the regional plan is given permitted activity status in order to comply with the NES. Due to the high level of uncertainty involved in predicting possible changes in activities over the next 20 years, the economic analysis was not able to quantify the possible costs associated with changes to permitted activity rules for land uses and other activities.

During ongoing implementation of the NES, drinking-water suppliers can expect greater referral of consents as affected parties. This will greatly depend on the location and type of drinking-water source, the activities in the catchment, and current practice with consultation on consent applications.

- Where drinking-water catchments are protected, or are limited in size, the impacts are not likely to be significant.
- In some cases, referral of resource consents to drinking-water suppliers already occurs, and so the cost increase will not be large.
- In some cases where referral is not routine, but where drinking-water suppliers have been vigilant in protecting their catchment, there may be a decrease in costs because the assessments of environmental effects will now be required to include issues of concern which may otherwise have required a submission on the water supplier's part.
- Where consents have not routinely included impacts on drinking-water sources, the costs for suppliers may increase in dealing with a larger number of consents as a potentially affected party.

Costs during this phase were estimated in discussion with water treatment plant staff in the case study catchments. Again there was a wide range of views, from those who already actively participate in consent hearings in their catchments (costs of \$10,000 to \$15,000<sup>15</sup> where the consent was contested), down to those who currently appear to take little interest in activities in the supply zone. One hour of consultation (\$120) per application was allowed to cover the costs of treatment plant operators' involvement in the consenting process. This was multiplied by the number of consents in each catchment to provide the figure in Table 4.

Where consents are notified, these costs are likely to be higher. The consultants did not consider the number of notified consents would increase significantly as a result of the NES. They considered it likely that most major discharges would be notified anyway, and that proposals with more minor or less contentious discharges would be resolved through consultation with the drinking-water supplier.

#### 5.5.1 Notification of consent breaches

The NES requires any consent holder who breaches the condition of their consent<sup>16</sup> to notify the drinking-water supplier (for events that could have adverse effects on drinking-water sources). The consultants did not identify any costs associated with unauthorised discharges from consented activities causing problems for treatment plant operators. They stated that it would be very difficult to quantify costs because typically plant operators were currently not made aware of the occurrence of such events. Equally, the consultants were unable to quantify a benefit to this component of the NES because of the lack of data on existing events in the case study catchments.

<sup>&</sup>lt;sup>15</sup> These costs include preparing the assessment of environmental effects (AEE), council costs in processing, costs of hearing commissioners, costs of those appearing for the applicant at the hearing, and writing up the decision (Jenny Ridgen, Christchurch City Council, personal communication).

<sup>&</sup>lt;sup>16</sup> Note: the wording in the final regulation will be done in a way that makes it clear that self-incrimination by the consent holder is not required.

However, the consultants considered it likely increased notification would result in benefits for treatment plant operation and water quality, as it would allow treatment plant operators to take action if necessary. The consultants also considered this provision likely to prevent costs for water treatment plants and public health in the event of consent breaches.

#### 5.5.2 Protecting treatment plant infrastructure

#### Reducing the need for treatment plant upgrade

In some cases the increased protection offered by specifically considering the impacts on drinking-water sources will result in savings in treatment costs, particularly for drinking-water suppliers with low or minimal treatment in place. International research shows that these savings can be considerable (see section 2.2.1).

Because the situation will vary so much from catchment to catchment in terms of whether an activity will result in source water deteriorating to the point where the existing treatment plant can no longer deliver potable water, it was not possible to determine the benefit of the NES in reducing the need for treatment plant upgrade in future. However, the consulting team's case studies found at least one situation in which the NES could prevent the need for additional upgrade, at Cambridge, in the Waikato region (depending on the nature and timing of regional council actions).

Cambridge currently has compliant treatment processes, but is at risk from further blue-green algal blooms in Lake Karapiro, which is the main source of supply. If the NES prevented an increase in these blooms, a capital cost of \$600,000 for upgrade to activated carbon filtration would be avoided. The case study also found that the NES could delay the need for an upgrade at Amberley in the Canterbury region.

The consulting team was unable to estimate how widespread these benefits from avoiding a treatment plant upgrade were likely to be nationally because of the case study approach used.<sup>17</sup> However, some examples of possible cost savings from maintaining the current quality of drinking-water sources are provided below.

#### Generic upgrade cost estimates

Depending on the degree of deterioration of source water, an additional level of treatment may be required for a plant to continue to comply with the DWSNZ 2000.<sup>18</sup> The costs of this will vary depending on the level of treatment already in place.

<sup>&</sup>lt;sup>17</sup> The case study included nine communities with varying source water types, different levels of treatment and different degrees of compliance with DWSNZ 2000. Given the small sample size and the wide variation in existing regional plan provisions, source water types and compliance with DWSNZ 2000 around the country, it was not possible to extrapolate from the case study to a national estimate.

<sup>&</sup>lt;sup>18</sup> In the example given, the district council engineer estimated that an additional log credit of treatment would be required. Log credit is a measure of the efficacy of a treatment plant in removing or inactivating protozoa (eg, *Giardia*).

- Plants that currently comply with the DWSNZ 2000 and use conventional treatment (including coagulation): if source water quality deteriorates, the cost of additional treatment to deliver safe drinking-water would be approximately \$300,000 for a plant supplying a community of 2000 to 5000 people (this is the cost of adding an ultraviolet disinfection process).
- Plants that previously had sufficiently good source water quality (in particular, low turbidity) so that disinfection was the primary means of treatment (ie, did not have coagulation/filtration processes): the estimated cost is approximately \$3 million, as more advanced treatment processes would need to be installed.<sup>19</sup>

In addition to avoiding the need to upgrade treatment plants, protecting drinking-water source quality has financial benefits through reducing the need for additional chemical use in existing coagulation and disinfection.

#### 5.5.3 Protecting existing sources

In situations where there is currently little or no treatment of drinking-water, deterioration of source water could lead to a situation where either new treatment needs to be put in place, or a new water source needs to be found. This can be very costly.

Christchurch City Council has assessed the cost of providing alternative water supplies should part or all of the Christchurch aquifer become non-potable. If the aquifers supplying Christchurch became contaminated, Christchurch would need to either find a new supply of potable water, or install treatment plants. The cost of this has been estimated at \$118 million (MWH, 2005).

#### 5.5.4 Improved communication

The NES will result in improved communication between consent holders, drinking-water suppliers and regional councils. While it is not possible to quantify the extent of the benefit, there are certainly situations in which this will result in improved outcomes for the drinking-water supply – either in terms of reduced health impacts or savings in treatment upgrade costs. These were not able to be identified in the case study approach used for the economic appraisal. However, the consultants note that these unquantified benefits should be set against the costs quantified here.

<sup>&</sup>lt;sup>19</sup> Cost estimates provided by Timaru District Council water supply engineer, 2006, personal communication.

## 5.6 Health benefits

Health benefits from the NES are likely to derive from:

- reducing the background burden of water-borne disease (compared with the status quo)
- reducing the risk of outbreaks of water-borne disease from major contamination events.

#### 5.6.1 Estimates of reduced disease burden

Water-borne disease is estimated to cost New Zealand \$25 million a year (Harris Consulting et al, 2006; see Appendix 3). Advice from national and international health experts and authorities was sought to determine whether it is possible to quantify a reduction in disease burden associated with the proposed NES. Their advice was that it is extremely difficult, if not impossible, to quantify the health benefits associated with source protection independently of other steps in the multiple-barrier approach to drinking-water protection.

A health and drinking-water expert group was convened to assess this question. They confirmed that it is not possible to quantitatively assess the health impacts of the NES, even within a specific catchment, because the nature of the relationships between activities, source water, treatment and health are too uncertain. However, using a linear dose-response relationship (which assumes a linear relationship between the amount of drinking-water contamination and disease burden<sup>20</sup>) it is possible to provide an indication of the change in health status associated with a change in final drinking-water quality.

Table 6 shows estimates of the cost-benefit ratio for different levels of reduction of water-borne pathogens. This was developed using a simple model based on health cost data. A range of national scenarios was then run to determine the cost-benefit ratio at varying percentage reductions in pathogen loading due to the NES (from 5 percent to 50 percent). This has been done for a range of discount rates (including Treasury's recommended 10 percent rate).

Dark shading indicates where the NES is not economically justified; light shading indicates where the NES is economically justified. The break-even point varies by discount rate, but it is estimated that the NES would be economically justified if it resulted in a 15 percent reduction in water-borne pathogens. At lower discount rates (appropriate for long-term health benefits), the tipping point is approximately a 10 percent improvement in the quality of drinking-water source. If the improvements were greater than this (say 30 percent), then the cost–benefit equation is very favourable (with a NPV of \$27 million).

Note that this analysis focuses purely on health impacts. Other benefits (eg, aesthetic, environmental, recreational) are all additional.

<sup>&</sup>lt;sup>20</sup> Graham McBride, NIWA, personal communication, July 2006.

Discount	Reduction in waterborne pathogens due to NES								
rate		5%	10%	20%	30%	40%	50%		
0.0%	B/C	0.73	1.47	2.94	4.41	5.88	7.35		
	NPV	-\$6,630,936	\$11,738,128	\$48,476,255	\$85,214,383	\$121,952,510	\$158,690,638		
3.5%	B/C	0.54	1.08	2.16	3.24	4.32	5.40		
	NPV	-\$11,489,703	\$2,020,594	\$29,041,188	\$56,061,782	\$83,082,377	\$110,102,971		
5.0%	B/C	0.48	0.96	1.92	2.88	3.85	4.81		
	NPV	-\$12,981,745	-\$963,491	\$23,073,019	\$47,109,528	\$71,146,037	\$95,182,547		
10.0%	B/C	0.34	0.69	1.38	2.06	2.75	3.44		
	NPV	-\$16,398,759	-\$7,797,519	\$9,404,963	\$26,607,444	\$43,809,926	\$61,012,407		

Table 6:	Indicative quantification of health outcomes
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Note: Sensitivity test: present value of impact under different assumptions of the proportion of disease attributable to populations over 500, and different levels of impact from the NES

Notes: (B/C = benefit-cost ratio; NPV = net present value).

#### Quantifying the disease burden

It is important to stress that quantifying the improvement the NES would contribute to drinkingwater quality is an assumption made for comparative purposes. It is very difficult to quantify a level of drinking-water quality improvement that is attributable to the NES because there are many steps in the causal pathway for water-borne disease. It is very difficult to numerically attribute the health benefit of reducing contamination at any one of these points. Measuring an improvement also assumes the ability to measure a baseline level of the disease burden, which is also extremely difficult.

It is difficult to quantify the total burden of water-borne disease, including both outbreaks and background rates of disease in the community. Water-borne disease is substantially under-reported, both in New Zealand and internationally. There are several reasons for this.

- Many people with gastroenteric disease the most common form of water-borne illness do not report it to the doctor. If illness lasts just a few days, many people will wait for it to pass without seeking any medical assistance. International studies suggest that for every case of infectious intestinal disease reported to a general practitioner, there are almost five other cases undetected in the wider community (Wheeler et al, 1999).
- Even when people do go to doctors, only some of these cases will be verified by laboratory samples. Without taking such a sample it is almost impossible to confirm which disease the patient has, since most gastroenteric illnesses have very similar symptoms.
- Not all cases of water-borne diseases are reported to the appropriate authorities as notifiable diseases. This means they do not appear on national registers as cases of disease, so comprehensive statistics cannot be obtained.
- It can be difficult to determine if a case of disease has arisen from drinking-water or from another pathway (eg, from food, or contact with an infected person).

#### 5.6.2 Reducing the risk of a contamination event

The drinking-water source is often the origin of drinking-water contamination events.<sup>21</sup> The effective protection of a community's drinking-water from contamination, and thus from disease outbreaks, relies on a multi-barrier approach (previously described). Source protection is one of several barriers that contribute to this approach.

The objective of the NES is to increase the protection of source water by reducing the risk of drinking-water source contamination. Therefore, the NES requirements are likely to contribute towards reducing the frequency of contamination events and associated outbreaks.

New Zealand has been fortunate to have had only relatively minor contamination events and outbreaks, but international examples provide some indication of the costs associated with more major events. The most notable and well documented are the Walkerton and Milwaukee outbreaks in North America, already referred to in discussing the international context for the NES (see section 2.2).

- In the small rural town of Walkerton, Canada, an outbreak of the toxin-producing bacteria *E. coli O157* in 2000 led to 2000 cases of illness and seven deaths. The total costs of the outbreak were estimated at CAN \$155 million (NZ \$205 million<sup>22</sup>). The contamination that caused this event entered the water supply from effluent run-off (Livernois, 2001).
- In Milwaukee, United States, an outbreak of cryptosporidiosis resulted in an estimated 403,000 people becoming ill and led to the death of 120 people. The total cost of the outbreak (Corso, 2003) is estimated at US \$96.2 million (NZ \$140 million<sup>23</sup>).

If the NES contributed to avoiding one Walkerton-scale disease outbreak in New Zealand, the cost savings are likely to be in excess of \$200 million.

#### 5.6.3 Health impact assessment

A health impact assessment of the proposed NES was also conducted. Health impact assessment is an integrated approach to addressing the social, economic, health and environmental consequences of policies, programmes and projects. Its aim is to deliver evidence-based recommendations that inform the decision-making process, maximise gains in health and well-being, and reduce or remove negative impacts or inequalities. It is largely a qualitative multi-disciplinary approach that investigates the potential public health and well-being outcomes of a proposal.

A multi-disciplinary group of stakeholders was convened to conduct a screening (high-level) health impact assessment of the proposed NES. The group comprised public health experts, drinking-water managers and community representatives, and was facilitated by a health impact assessment practitioner.

<sup>&</sup>lt;sup>21</sup> The contribution of source water problems to water supply contamination events is documented in a 2002 paper (Hrudey et al, 2002) summarising the causes of 19 outbreaks in six developed countries. This paper concluded that 14 of the 19 outbreaks resulted from source water problems.

<sup>&</sup>lt;sup>22</sup> Canadian dollars converted to New Zealand dollars at an indicative rate of 0.7558 on 30 August 2006.

<sup>&</sup>lt;sup>23</sup> US dollars converted to New Zealand dollars at an indicative rate of 0.6821 on 30 August 2006.

In addition to the key benefits of reducing the burden of water-borne disease and decreasing risks of outbreaks, the group identified the following specific public health benefits:

- increased protection for sectors of the community at greater risk from drinking-water contamination (the immuno-compromised, children and the elderly)
- increased protection and decreased vulnerability for urban dwellers or tourists (who are accustomed to a higher level of water quality) when visiting smaller towns or rural areas that currently have greater potential for water contamination.

Additional benefits to society from improved protection of drinking-water sources identified by the health impact assessment screening included:

- protection or improvement of waterways for recreational purposes
- improved recognition of the cultural and spiritual importance of water
- improved public confidence in the water supply (potentially leading to increased consumption of drinking-water compared with less healthy alternatives such as soft drinks, and decreased reliance on bottled water, home filters or boiling water)
- improved public valuation of waterways (including intangibles such as a greater sense of place and connectivity to water bodies).

## 5.7 Other benefits

#### 5.7.1 Environmental, recreational and aesthetic benefits

There are likely to be additional environmental benefits from requiring tighter controls on some contaminants in water bodies. Contaminants that are of concern to drinking-water are often of concern to other in-stream values, including ecosystem values, contact recreation and aesthetic values. Capping or reducing contaminants in the source water for a drinking-water supply would also result in benefits to these other in-stream values.<sup>24</sup>

Although a monetary value could not be provided for these benefits, the co-benefits should be acknowledged when considering the overall value of the standard.

#### 5.7.2 Maintaining New Zealand's international reputation

To attract tourism and trade, New Zealand markets itself internationally as "100% Pure".<sup>25</sup> A Walkerton-scale outbreak has significant potential to affect the credibility of this brand and negatively impact on tourism and trade. New Zealand's international reputation would be particularly vulnerable if an outbreak were to occur at a tourist centre (eg, Queenstown, Wanaka or Kaikoura).

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<sup>&</sup>lt;sup>24</sup> If these are not adequately provided for already by existing mechanisms.

<sup>&</sup>lt;sup>25</sup> Tourism New Zealand runs a "100% Pure" marketing campaign (see www.newzealand.com).

## 5.8 Summary: efficiency and effectiveness

As stated in Chapter 1, efficiency is a measure of whether the benefits of an option outweigh the costs. It is considered that the proposed NES will deliver substantial benefits. These include the public health benefits of reducing the risk of drinking-water contamination, decreasing the need for future upgrades of water treatment plants, and wider environmental benefits. The net environmental and public health benefits are considered to exceed the net economic costs of the proposed NES.

Effectiveness is an assessment of how well an option will work. The proposed standard was considered to be an effective method of reducing the risk of drinking-water source contamination compared with the available alternatives. In particular, it is considered that it would be a consistent method of ensuring effective drinking-water source management at a national level.

In summary, it is considered that the proposed national environmental standard is the most appropriate, effective and efficient means of achieving the objective of reducing the risk of contaminating drinking-water sources.

# Appendix 1: Compliance with Drinking-water Standards

#### Table A1: Compliance with Drinking-water Standards for New Zealand 2000

E. coli compliance	
Percentage of New Zealand population served by registered reticulated drinking-water supplies known to comply with the distribution zone <i>E. coli</i> requirements of the DWSNZ: 2000. [These are generally located in towns with populations in excess of 5000 people.]	74%
Percentage of New Zealand population served by reticulated drinking-water supplies <u>not</u> compliant with the distribution zone <i>E. coli</i> requirements of the DWSNZ: 2000. [These are generally located in towns with populations of less than 5000 people.]	15%
Percentage of New Zealand population not served by registered reticulated drinking-water supplies. [In most instances these people are in buildings that are self-supplied with drinking-water, eg, from a roof tank or bore.]	11%
Protozoal compliance	
Percentage of New Zealand population served by registered reticulated drinking-water supplies known to comply with the protozoan requirements of the DWSNZ: 2000. [These are generally located in towns with populations in excess of 5000 people.]	71%
Percentage of New Zealand population served by reticulated drinking-water supplies <u>not</u> compliant with the protozoan requirements of the DWSNZ: 2000. [These are generally located in towns with populations of less than 5000 people.]	18%
Percentage of New Zealand population not served by registered reticulated drinking-water supplies. [In most instances these people are in buildings that are self-supplied with drinking-water, eg, from a roof tank or bore.]	11%

Source: Analysis of data for 2004; Ministry of Health 2005a.

# Appendix 2: Outbreaks of Water-borne Disease in New Zealand

Following is a list of outbreaks of water-borne disease in New Zealand identified by the Ministry of Health (Taylor and Ball, 2005). Note that this is not a comprehensive list of all outbreaks or cases of water-borne disease in New Zealand. For example, analysis performed for the Ministry of Health reports 27 outbreaks of water-borne disease in 2005 alone (Perera, 2006).

#### Towns

- Queenstown, 1984: New Zealand's largest recorded water-borne disease outbreak, affecting 3500 people (Thorstensen, 1985, cited in Taylor and Ball, 2005).
- Ashburton, 1986: 19 cases of campylobacteriosis (Briesman, MA, 1987 cited in Taylor and Ball 2005).
- Whangarei, 1990: increased incidence of giardiasis in that part of the city with unfiltered water (Sloan, 1990, cited in Taylor and Ball, 2005).
- Havelock North, 1991: 12 cases of campylobacteriosis (suspected from water).
- Dunedin, 1991: a study found that drinking unfiltered water significantly increased the risk of giardiasis (Fraser and Cooke, 1991, cited in Taylor and Ball, 2005).
- Waimate, 1992: campylobacteriosis, increased use of anti-diarrhoeal medication, absence from kindergarten.
- Auckland, 1993: 34 cases of giardiasis.
- Lyttelton, 1994: one case of *Aeromonas* (hospitalised with gastroenteritis).
- Fairlie, 1994: six cases of campylobacteriosis.
- Tauranga, 1995: one notification of cryptosporidiosis at a school.
- Ashburton, 1996: 33 cases of campylobacteriosis.
- Buller District (Denniston), 1996: four cases of giardiasis.
- Waikato (Ohinemuri, Morrinsville), 1996/97: 14 cases of giardiasis.
- Peketa (Kaikoura District) 1996: three cases of giardiasis.
- Waikato, 1997: 170 cases of cryptosporidiosis.
- Masterton, 2003: *Cryptosporidium* detected in water supply, but few cases of disease.

#### Camps, schools, etc

- Lake Hawea, 1989: camp ground, one case of salmonellosis.
- Canterbury, 1990: camp, 42 cases of campylobacteriosis (Stehr-Green et al, 1991, cited in Taylor and Ball, 2005).
- Northland, 1992: tangi, 30 cases of hepatitis A (Calder and Collision, 1992, cited in Taylor and Ball, 2005).
- Northland, 1992: camp, 14 cases of campylobacteriosis (Jarman and Henneveld, 1993, cited in Taylor and Ball, 2005).
- Hawke's Bay, 1992: camp, 97 cases of campylobacteriosis.
- Raurimu, 1994: private supply, 16 cases of campylobacteriosis.
- Northland, 1995: camp, 34 cases of salmonellosis.
- Hutt Valley, 1995, camp, 100 cases of gastroenteritis .
- Mt Hutt skifield, 1996: 36+ cases of gastroenteritis (five confirmed cases of norovirus).
- Mt Arthur Hut, 1996: six cases of gastroenteritis.
- Roof water tank: salmonellosis in four family members (Simmons and Smith, 1997, cited in Taylor and Ball, 2005).
- Wainui, Akaroa Peninsula, 1997: 67 cases of campylobacteriosis (Bohmer, 1997, cited in Taylor and Ball, 2005).
- Hawke's Bay, 2001: 95–185 people with campylobacteriosis at a boarding school.

## Appendix 3: Estimate of Water-borne Disease Burden in New Zealand

Source: Outcome Management Services Ltd, 2004

The following table represents best estimates of the annual background burden of disease due to drinking-water. It is based on the number of cases reported annually to the notifiable disease system operated by ESR for the Ministry of Health.

The process used to develop the table was as follows.

- 1. Each pathogen known to be carried by drinking-water was separately analysed.
- 2. The number of cases reported each year was extracted from the notifiable disease system.
- 3. Under-reporting was estimated using expert advice and published literature, and the total incidence of disease nationwide was calculated.
- 4. Drinking-water as a known cause was estimated using expert advice and information from outbreaks where causal agents have been more reliably established from scientific analysis.
- 5. Costs per case were taken from the published literature. Protozoa and *E. coli* O157 costs were estimated using estimates for time off work, hospitalisations, long-term morbidity and mortality data from US data (US EPA) and the Centers for Disease Control and Prevention (CDC).
- 6. Quality assurance of the process was performed by public health physicians and economists working in this area.

Waterborne illness in New Zealand													
Pathogen	Total incidence per 100,000 (corrected for under- reporting)	Reported incidence per 100,000 (ESR 2004)	% reported ( <i>NZ Med</i> <i>J</i> , 2000)	Cases per annum	Cost per case (1999 \$)	Proportion waterborne	% hospitalised	% mortality (based on EPA data)	Average days off work	Time off work (\$000)	Mortality (\$000)	Medical (\$000)	Total (\$000)
Campylobacteriosis	3040	400	13%	121,600	\$533	10%	0.3%	0.005%	5	\$5,046	\$1,216	\$219	\$6,481
E. coli O157 (VTEC)	9	3	35%	343	\$60,000	20%	12.0%	0.4%	6	\$34	\$549	\$3,532	\$4,114
Cryptosporidiosis	200	20	10%	8,000	\$978	30%	4.0%	0.02%	6	\$1,195	\$960	\$192	\$2,347
Giardiosis	250	25	10%	10,000	\$855	20%	2.0%	0.02%	5	\$830	\$800	\$80	\$1,710
Salmonellosis	112	35	31%	4,480	\$526	5%	1.0%	0.02%	3.5	\$65	\$90	\$0	\$118
Yersiniosis	62	12	20%	2,480	\$891	10%	0.5%		9	\$185	\$0	\$36	\$221
Toxins (algae)	414	207	50%	16,560	\$221	5%	0.3%		2	\$137	\$0	\$46	\$183
Virus (including hepatitis A)	478	72	15%	19,120	\$204	2%	0.0%	0.002%	2	\$63	\$15	\$0	\$78
										\$7,557	\$3,629	\$4,104	\$15,253

#### Table A2: Estimates of the annual background burden of water-borne disease in New Zealand

Source: Adapted from Outcome Management Services Ltd, 2004.

Notes: This data is based on work published in the NZ Med J, 2000, V113 pp.278-84, Economic Cost to New Zealand of Food-borne Infectious Disease (Lake, Baker, Garrett, Scott, Scott) augmented with data from other sources as required:

- 1 Annual Summary of Outbreaks in New Zealand, 2002, by ESR
- 2 New Zealand Public Health surveillance Report Summer 2004
- 3 www.cdc.gov (US Communicable Disease Unit)

4 Information reviewed via personal communication with the Medical Officer of Health in MidCentral (Dr Donald Campbell)

Data modified from the above source is: Cryptosporidiosis Time off-work estim

S Time off-work estimated using Netherlands study: http://www.eurosurveillance.org/em/v01n02/0102-222.asp Cost per case estimated six days off work/7 x \$581/week income + \$2 million x 0.0002(fatality risk) + \$2000 x 0.04 (hospital risk mainly applies to children)

Giarida	As above using five days off work since it is a less aggressive organism
E. coli 0157	% water-borne calculated using CDC reported outbreaks ex US (30%), modified for New Zealand. Under-reporting is estimated ONLY \$60,000/case is highly dependant on number of children with kidney failure needing long-term dialysis. Costs using Walkerton data = (seven deaths @ \$2 million/case + 27 dialysis cases costing \$150,000/annum for 30 years).
Salmonella	Risk associated with roof-collection systems where poultry have access to roof collection systems or other vectors (animal or wind) are involved.
Under-reporting	Derived from the study above based on an English infectious intestinal study. Protozoa values derived from US CDC experience.

# Appendix 4: Original Wording of NES as Notified in Discussion Document

The proposed standard, as notified for consultation, was worded as follows.

- **Part 1** New consents in drinking-water catchments shall only be granted if the proposed activity does not result in drinking-water being non-potable or unwholesome following treatment.
- **Part 2** Consent authorities will periodically assess the risks within drinking-water catchments to ensure that permitted and unregulated activities do not cause impacts beyond the performance of the affected treatment facilities.
- **Part 3** Resource consents within drinking-water catchments will have a condition that any unauthorised activity be notified to the water supplier immediately.
- **Part 4** Resource consents to take water for drinking will have a condition that requires appropriate action, including turning off the supply, if notified of events or activities that make the drinking-water non-potable.

The discussion document noted that the exact wording of any standard will be legally drafted after government decisions.

Source: Ministry for the Environment, 2005.

# Appendix 5: Drinking-water Supplies, by Population

Table A3 shows the distribution of drinking-water supplies throughout New Zealand based on population size. Data is taken from the *Register of Community Drinking-water Supplies in New Zealand* (Ministry of Health, 2005b). Figures for 2004 have been used as the 2005 statistics had not been compiled at the time of writing.

Population		Distribution	zones		Complying distribution zones				Number of zones		
band	Zone po	Zones		Zone population		Zones		Comply	Non-comply		
	Population	% population	Number	% zones	Population	% population	Number	% zones			
< 25	3,085	0.1	246	11.1	89	0.0	9	1.7	9	237	
25–99	49,490	1.4	957	43.3	4,666	0.2	87	16.4	87	870	
100–199	42,988	1.2	324	14.7	10,604	0.4	77	14.5	77	247	
200–499	92,990	2.6	298	13.5	38,871	1.3	119	22.5	119	179	
500–999	70,821	2.0	108	4.9	35,383	1.2	53	10.0	53	55	
1,000–4,999	369,359	10.2	163	7.4	219,923	7.3	94	17.7	94	69	
5,000–19,999	673,213	18.6	73	3.3	521,652	17.3	53	10.0	53	20	
20,000–49,999	943,055	26.1	30	1.4	818,967	27.1	26	4.9	26	4	
50,000–99,999	445,656	12.3	7	0.3	445,656	14.8	7	1.3	7	0	
100,000+	924,159	25.6	5	0.2	924,159	30.6	5	0.9	5	0	
Total	3,614,816	100	2211	100	3,019,970	100	530	100	530	1681	

 Table A3:
 Drinking-water supplies on the Ministry of Health Register of Drinking-Water

 Supplies in New Zealand, 2004
 2004

## **Appendix 6: Case Study Methodology**

Case study catchments were selected to reflect a range of circumstances. Case studies included large communities with very secure supplies, such as Christchurch, and much smaller communities with poor quality supplies, such as Te Karaka (Gisborne District), Lumsden and Winton (Southland District). Sources of supplies included surface water and both deep and shallow groundwater sources. Knowledge of the source catchments varied from extremely well characterised (Christchurch and Hastings groundwater and the Waikato River), to only poorly known (Winton and Lumsden).

Region	Drinking-water catchments	Population supplied	Source type	Assessment against DWSNZ 2000
Southland	Winton 2,100 Shallow groundwater. surface water		Shallow groundwater/ surface water	Not E. coli or protozoan compliant
	Lumsden	657	Shallow groundwater/ surface water	Not E. coli or protozoan compliant Elevated nitrates
Canterbury	Ashburton	15,000	Groundwater (unsecure); surface water	Not E. coli or protozoan compliant
	Christchurch	300,000	Groundwater (secure)	Compliant; one bore with elevated nitrate level
	Amberley	1,200	Surface water	Not protozoan compliant
Hawke's Bay	Frimley Park, West Hastings	58,000	Groundwater (unsecure)	Not E. coli or protozoan compliant
Gisborne	Te Karaka	600	Surface water	Not E. coli or protozoan compliant
Waikato	Te Kauwhata	1,700	Surface water	Fully compliant
	Cambridge	13,000	Surface water	Fully compliant; borderline for cyanobacteria

Table A4: Case study regions and catchments

The methodologies used to determine the costs to regional councils and drinking-water suppliers are explained in chapter 5. The methodology for determining the costs for consent applicants is set out below.

#### Consent applicants' costs

The costs to consent applicants were estimated from the case study catchments using the following steps.

#### Step 1: Determining numbers and types of consents

Data on catchments was collected from regional council visits. Other stakeholders were contacted for personal or telephone interviews. Data was collected on the number and type of consents in each of the drinking-water catchments, and this data was extrapolated into the future using a variety of trend information on past development in the catchment to estimate the number of consents likely to occur in the catchments over the next 20 years.

#### Step 2: Application and mitigation costs

Consent application and mitigation costs imposed as a direct requirement of the NES were estimated for each of these catchments. Costs relate to the potential for *additional* consent requirements or additional refusals likely to result from the NES.

Application and mitigation costs for consent applicants were estimated by an environmental consulting firm. Two categories of costs were estimated:

- 1. increased costs associated with considering effects on drinking-water sources for different consent application types
- 2. the cost of upgrading discharge controls (ie, avoidance, remedying or mitigation) in the key categories identified by the consultants as likely to require changes to consent conditions to comply with the NES.

#### Step 3: Extrapolation to national level

The national costs for resource consent applicants were calculated by extrapolating costs estimated in the case study catchments to a national level. The case study cost estimates were multiplied by the number of catchments in New Zealand with drinking-water sources supplying communities of over 500 people.

## **Appendix 7: Health Benefit Methods**

The health benefits that can be ascribed to the NES are recognised as extremely difficult to quantify. The reasons for this are outlined in chapter 5. Nevertheless, several different methods were used to attempt to quantify the health benefits of the NES for the purpose of this analysis. Qualitative approaches were also used.

Quantitative health benefits were estimated using the following methods:

- an expert group
- a linear health effect model.

The methodologies used to determine the health benefits are explained in chapter 5. The expert group methodology is set out below.

#### **Expert group**

A group of experts – including microbiologists, a water treatment engineer, a biostatistician and an expert in drinking-water management – was convened with the task of determining: "Can a health benefit be quantified for the proposed NES for sources of human drinking-water?"

The group discussed how activities were likely to be affected by the NES, and in a case study situation assessed the likely impact on drinking-water and public health. The expert group was asked:

- 1. whether it was possible to numerically estimate the health benefit associated with the NES on a national basis for all of New Zealand and, if not
- 2. whether the health benefit could be quantified for a case study catchment.

The group indicated that it was not possible to quantify health benefits nationally. Therefore the group was provided with a case study example to determine whether health benefits of the NES could be estimated on a local basis.

The group used the Ashburton drinking-water supply and its source catchments<sup>26</sup> as its case study. Information was provided to the group on the nature of water sources, drinking-water treatment, land uses, permitted activities and consents in the supply catchment, together with the consulting team's assessment of the likely outcome of consent applications and permitted activity reviews under the NES.

The expert group reached the conclusion that it is not possible to quantitatively assess the health impacts of the NES, even within a specific catchment, because the nature of the relationships between activities, source water, treatment and health are too uncertain.

<sup>&</sup>lt;sup>26</sup> This source was chosen because it included both ground and surface water, and because we had reasonably good information on the consents in both source catchments from the Environment Canterbury (ECan) database. It is somewhat historical because the supply has recently been upgraded to a secure groundwater source, and because the ECan Proposed Natural Resources Regional Plan (NRRP) introduces a number of controls in drinking-water catchments. We addressed the plant as it was prior to its recent upgrade, and used the ECan NRRP as a likely outcome following a review of permitted activities in accordance with the NES.

## Appendix 8: Section 43 of the Resource Management Act 1991

# 43. Regulations prescribing national environmental standards

- (1) The Governor-General may, by Order in Council, make regulations, to be known as national environmental standards, that prescribe any or all of the following technical standards, methods, or requirements:
  - (a) standards for the matters referred to in section 9, section 11, section 12, section 13, section 14, or section 15, including, but not limited to
    - (i) contaminants:
    - (ii) water quality, level, or flow:
    - (iii) air quality:
    - (iv) soil quality in relation to the discharge of contaminants:
  - (b) standards for noise:
  - (c) standards, methods, or requirements for monitoring.
- (2) The regulations may include:
  - (a) qualitative or quantitative standards:
  - (b) standards for any discharge or the ambient environment:
  - (c) methods for classifying a natural or physical resource:
  - (d) methods, processes, or technology to implement standards:
  - (e) exemptions from standards:
  - (f) transitional provisions for standards, methods, or requirements.
- (3) Section 360(2) applies to all regulations made under this section.

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