

Annual Report on Drinking- water Quality

2017–2018

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Citation: Ministry of Health. 2019. *Annual Report on Drinking-water Quality*. Wellington: Ministry of Health.

Published in June 2019 by the Ministry of Health
PO Box 5013, Wellington 6140, New Zealand

ISSN 1179-2604 (online)
HP 7144



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Key findings

This report describes drinking-water quality for all registered, networked drinking-water supplies that served populations of more than 100 people (the supplies) from 1 July 2017 to 30 June 2018 (the reporting period), representing 3,839,000 people (the report population). It describes the compliance of these supplies with the drinking-water requirements of the Health Act 1956 (the Act) and the extent to which they met the *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (the Standards).

In any comparison of achievement or compliance between the reporting period and the previous reporting period of 1 July 2016 to 30 June 2017, this report will refer to those periods as the reporting period and the previous period, respectively.

The Act groups drinking water supplies into supply size categories according to the population served. The four supply size categories used in this report are large (more than 10,000 people), medium (5,001 to 10,000 people), minor (501 to 5,000 people) and small (101 to 500 people).

During the reporting period, drinking-water suppliers carried out a number of actions to meet the requirements of the Act. Consequently:

- 84.7 percent of the report population (see Introduction for a definition of this term) (3,250,000 people in 329 supplies) received drinking-water that **complied with all the legislative requirements** under the Act covered in this report
- 99.3 percent (3,810,000 people in 481 supplies) received drinking-water from a supply with a **water safety plan** for which implementation had commenced
- 93.1 percent (3,576,000 people in 478 supplies) received an **adequate supply of water** with appropriate notification of any interruptions
- 99.9 percent (3,834,000 people in 470 supplies) received drinking-water from a supply for which appropriate **source protection** activities took place
- 92.0 percent (3,531,000 people in 343 supplies) received drinking-water that met all the **monitoring** requirements in the Standards
- 99.9 percent (3,835,000 people in 478 supplies) received drinking-water from a supplier that recorded and investigated all **complaints**
- 99.1 percent (3,803,000 people in 463 supplies) received drinking-water from a supplier that took adequate **remedial action** when required.

While drinking-water suppliers need only take 'all practicable' steps to comply with the Standards, achievement against the Standards was generally highest for the large suppliers, and decreased progressively through suppliers in medium, minor and small population supply size categories.

For overall achievement of the Standards, a supply must meet the bacteriological, protozoal and chemical requirements, which includes adherence to the prescribed sampling and monitoring schedule. In the reporting period, 73.7 percent of the report population (2,831,000 people) received drinking-water that achieved all the Standards. This represents a 7.4 percent decrease compared with the previous period.

97.7 percent of the report population (3,751,000 people) received drinking-water that achieved the bacteriological Standards during the reporting period, which is an increase of 1.5 percent compared with the previous period. Protozoal achievement fell by 8.3 percent, from 83.1 percent to 74.8 percent (2,870,000 people received drinking-water that achieved the protozoal Standards). The fall was driven by a number of large supplies losing their secure bore water status during the reporting period and not having appropriate protozoal treatment processes in place.

Chemical achievement increased by 1.7 percent, from 97.2 percent to 98.9 percent (3,796,000 people received drinking-water that achieved the chemical Standards).

1 Introduction

This report meets the requirement under the Health Act 1956 (the Act) for the Director-General of Health to prepare and publish a report on drinking-water each year, which includes information about the quality of drinking water, including whether that drinking water is potable; and the compliance or non-compliance of drinking-water suppliers with the Act and the *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (the Standards).

This report discusses drinking-water quality for all 493 registered networked drinking-water supplies that served populations of more than 100 people (the supplies) from 1 July 2017 to 30 June 2018 (the reporting period), representing 3,839,000 people (the report population).

The Act aims to protect public health by ensuring that communities receive a safe, wholesome and adequate supply of drinking-water. The Act uses risk management concepts to promote proactive measures, including water safety plans and appropriate monitoring of drinking-water quality.

The Act groups drinking water supplies into supply size categories according to population served. The four supply size categories used in this report are large (more than 10,000 people), medium (5001 to 10,000 people), minor (501 to 5000 people) and small (101 to 500 people).

The report is split into two parts:

- compliance with the Act
- achievement of the Standards.

The Act places requirements on drinking-water suppliers. A drinking-water supplier is a person or organisation with responsibility for the drinking-water supply. This report provides information on 155 suppliers.

The focus of drinking-water safety is risk management. The Act requires all supplies serving 501 or more people to have a water safety plan. A water safety plan is a tool to help suppliers identify, manage and minimise risks.

The Standards prescribe the maximum acceptable values of micro-organisms and chemicals that may be present in drinking-water.

Appendix 1 provides details of each individual supplier and its achievement against the Standards and the requirements of the Act.

2 Methods

Information on drinking-water quality was obtained from drinking-water suppliers and drinking-water assessors. Compliance data was extracted from the Ministry of Health's drinking-water database, Drinking Water Online (DWO).

The following caveats apply for the purposes of data interpretation.

The report includes all registered networked drinking-water supplies that served more than 100 people during the reporting period, based on the information contained in DWO as at 30 June 2018.

A supply may have one or more distribution zones. A distribution zone is part of the drinking-water supply network within which all consumers receive drinking-water of identical quality. It is possible for distribution zones within a single supply to exhibit different rates of achievement against the Standards.

The population statistics in this report are calculated from the supply populations as recorded in DWO. These figures are estimates, reassessed from time to time by each supplier.

Population figures in this report are rounded to the nearest thousand, except when they are less than 10,000. In those cases, they are rounded to the nearest hundred.

Compliance against the requirements of the Act is assessed for a whole supply based on information collected by questionnaires completed by drinking-water suppliers. Information about achievement against the Standards is entered into the database by drinking-water suppliers, laboratories and drinking-water assessors.

Water suppliers and drinking-water assessors were given an opportunity to check the data provided for this report. Information in this report reflects data collected on or before 27 August 2018.

Data quality assurance was built into the data collection and analysis stages of report preparation. In addition, drinking-water assessors and water suppliers were given the opportunity to review the assessment of individual suppliers' compliance with the Act and achievement against the Standards, with the exception of the requirements for monitoring and remedial action. Prior to data collection, drinking-water assessors were given training in the use of the annual compliance component of DWO.

3 Compliance with the Health Act 1956

3.1 Introduction

This section discusses the extent to which suppliers met the requirements of the Health Act 1956 (the Act) during the reporting period, including in regard to water safety plan preparation and use. Briefly, the requirements of the Act are as follows.

- **Water safety plans:** Every drinking-water supplier, with the exception of small suppliers, must implement an approved water safety plan for their drinking-water supplies. The supplier must review its water safety plan within five years of approval.
- **Compliance with the drinking-water standards:** Every drinking-water supplier has a duty to take all practicable steps to ensure that the drinking-water it supplies complies with the Standards.
- **Provision of drinking-water:** Every drinking-water supplier must take all practicable steps to ensure it provides an adequate supply of drinking-water to each point of supply. Interruptions may occur for planned maintenance, for improvements or for emergency repairs. However, if the interruptions are likely to exceed eight hours, the supplier must have prior approval from the medical officer of health, and must have taken all practicable steps to warn affected people. If the supply is interrupted in an emergency, the supplier has up to 24 hours to inform the medical officer of health.
- **Source protection:** Every drinking-water supplier must take reasonable steps to protect their water sources from contamination and pollution. These steps may include making submissions on district plans, resource consent applications or sanitary service assessments. They may also include contributing to catchment management.
- **Monitoring:** Every drinking-water supplier must monitor the drinking-water it supplies, to check whether it meets the Standards, or presents a public health risk.
- **Record-keeping:** Every drinking-water supplier, with the exception of small suppliers, must keep records of its drinking-water supplies, containing sufficient information to enable a drinking-water assessor to ascertain whether the supplier is meeting the requirements of the Act.
- **Complaints:** Every drinking-water supplier must record and investigate complaints about its supply.
- **Remedial actions:** Every drinking-water supplier must take appropriate remedial action to correct problems if its supply does not meet the Standards.

3.2 Overall compliance with the Health Act 1956

The Act places specific duties on drinking-water suppliers that are key to protecting the safety of drinking-water supplies. During the reporting period, 84.7 percent of the population received drinking-water from fully compliant water suppliers. This is a 2.7 percent decrease since the previous reporting period (2016/17).

Table 1 shows the proportion of population that received drinking-water from fully complying suppliers for each requirement during the current and previous reporting periods.

Table 1: Compliance with the Act in previous and current reporting periods

Requirement	2016/17	2017/18	difference
Monitoring	97.1%	92.0%	-5.1%
Water safety plans	98.5%	99.3%	0.8%
Provision of drinking-water	91.5%	93.1%	1.7%
Source protection	99.4%	99.9%	0.5%
Records	99.9%	99.5%	-0.4%
Complaints	99.9%	99.9%	0.1%
Remedial action	99.4%	99.1%	-0.4%
All requirements	87.3%	84.7%	-2.7%

3.3 Comparison by size category

The four supply size categories used in this report are large (more than 10,000 people), medium (5,001 to 10,000 people), minor (501 to 5,000 people) and small (101 to 500 people). Large supplies accounted for 3,221,000 people in 41 supplies. Medium supplies accounted for 174,000 people in 25 supplies. Minor supplies accounted for 386,000 people in 196 supplies. Small supplies accounted for 57,800 people in 231 supplies.

Overall, compliance with the Act was highest for large supplies: 86.8 percent of the large-supply population received drinking-water from suppliers that met all their legislative requirements. The equivalent figures were 80.6 percent, 71.9 percent and 61.5 percent of populations served by medium, minor and small supplies, respectively.

Generally, the lowest rates of compliance against any individual requirement in each supply band was for monitoring. The exception was large supplies, where provision of an adequate supply of drinking-water had the lowest overall rate of compliance.

Table 2: Compliance rates with the Act, by supply size

Requirement	Large	Medium	Minor	Small
Monitoring	94.7%	80.6%	78.4%	62.6%
Water safety plans	100%	96.5%	94.1%	N/A
Provision of drinking-water	92.1%	100%	98.8%	94.8%
Source protection	100%	100%	100%	92.1%
Records	100%	96.5%	97.0%	100%
Complaints	100%	100%	100%	94.0%
Remedial action	100%	100%	91.6%	93.8%
All requirements	86.8%	80.6%	71.9%	61.5%

3.4 Water safety plans

Water safety plans are a key part of the drinking-water safety system: they are fundamental to a supplier being able to produce safe drinking-water and having confidence that the drinking-water is safe. Preparing a water safety plan requires a drinking-water supplier to review the whole of its water supply chain, from raw water through the treatment processes to the pipe network that carries the drinking-water out into the community. During this review process, a supplier must identify possible causes and risks of contamination, and put measures in place to manage those risks. The plan should also state what remedial action the supplier needs to take should a contamination event occur, despite the preventive measures.

All large, medium and minor supplies must have a water safety plan. In the current period, a total of 12 supplies, serving 28,600 people, were not implementing their water safety plans as required by the Act.

Small supplies are not required to have a water safety plan unless a medical officer of health requires them to do so. They may elect to comply with section 10 of the Standards by having a water safety plan. It is encouraging to see that, in the current period, 34,300 people received drinking-water from 136 small supplies with an implemented water safety plan.

Overall, water safety plans for supplies serving 98.6 percent of the report population (80.2 percent of supplies) were being implemented in the current period.

The rate of development and implementation of water safety plans decreased with reducing supply size. All large supplies now meet the requirement. 24 of the 25 medium supplies are implementing a water safety plan; one medium supply, serving 6,000 people, has an expired plan. 185 of the 196 minor supplies are implementing a plan. Of the 11 minor supplies that are not implementing a plan (collectively serving 24,000 people), one has an approved plan that it is yet to implement, five are currently drafting plans, four have expired plans and one has not started a plan.

3.5 Duties

This part of the report covers the remaining legislative requirements under the Act.

3.5.1 Monitoring

The Act requires all drinking-water supplies covered by this report to monitor their drinking-water quality in accordance with the requirements of the Standards, since monitoring is a key verification component in managing drinking-water supplies. Monitoring allows a drinking-water supplier to determine whether drinking-water quality meets that specified by the Standards, and can indicate when remedial action is required.

Overall, supplies serving 92.0 percent of the report population, or 3,531,000 people, met the monitoring requirements during the reporting period. This was a drop of 5.1 percent from 97.1 percent in the previous reporting period.

Compliance increased with the size of the population served by a supply. Monitoring requirements in the reporting period were met for 94.7 percent of the population served by large supplies, 80.6 percent served by medium supplies, 78.4 percent served by minor supplies and 62.6 percent served by small supplies. Seven large supplies (Blenheim, Cambridge, Feilding, Napier, Oamaru, Rotorua East and Wanganui), serving a total of 169,000 people, did not meet the requirement.

3.5.2 Provision of drinking-water

Unsanitary conditions can arise when a community is without drinking-water; consumers may seek other, possibly unsafe, sources of water. To avoid such eventualities, drinking-water suppliers are required to take all practicable steps to ensure an adequate supply of drinking-water and, in the event of an interruption, planned or otherwise, to take appropriate action.

Overall, supplies serving 93.1 percent of the report population, or 3,576,000 people, met this requirement during the reporting period. This was an improvement of 1.7 percent from the previous reporting period.

One large, one minor and 13 small supplies failed to meet the provision of drinking-water requirements. Christchurch Central, serving 256,000 people, was the only large supply that failed to comply with the requirement during the current reporting period, as it failed to provide appropriate notification of interruptions.

3.5.3 Source protection

Protecting the quality of source waters is one of the most important components of the multi-barrier approach to drinking-water supply management. Protection of source waters reduces the contaminants that a water treatment system has to deal with, reducing the consequences for public health in the event of treatment failure.

Overall, supplies serving 99.9 percent of the report population, or 3,834,000 people, met the requirement to take reasonable steps to contribute to the protection of their water sources during the reporting period. This was an improvement of 0.5 percent from the previous reporting period. Twenty-three small supplies, collectively serving 4,500 people, failed to meet the source protection requirements.

3.5.4 Records

The keeping of records assists drinking-water suppliers and drinking-water assessors to determine whether a supply meets the requirements of the Act and achieves the Standards. It also helps people unfamiliar with a supply understand the way the supply should be operated and what operational parameters are typical. In the event of a waterborne disease outbreak or any other incident resulting from system failure, well-kept records may assist authorities to understand what has gone wrong and how the problem could be prevented in the future.

Overall, supplies supplying 99.5 percent of the report population (3,821,000 people) maintained records with sufficient information during the reporting period. This was a drop of 0.4 percent since the previous reporting period.

All large supplies met the record-keeping requirements. One medium and five minor supplies did not meet the requirement. Although small supplies are not required by the Act to keep records, the majority (205 out of 231) did so.

3.5.5 Complaints

Complaints about drinking-water quality most often relate to the aesthetic properties of the water (taste, odour and appearance). Drinking-water suppliers need to investigate complaints, because they may inform the supplier of a problem about which they may not otherwise be aware. Consumer concerns about the aesthetic properties of water, if sufficiently severe, may lead to the consumer seeking another source of drinking-water. While the alternative source may not have the aesthetic problems associated with the original drinking-water supply, it may contain health-significant contaminants that cannot be detected by human senses.

Overall, in the reporting period, drinking-water suppliers investigated complaints they received about the drinking-water supplied to 99.9 percent of the report population, 3,835,000 people. This was an improvement of about 0.1 percent since the previous reporting period.

All large, medium and minor supplies met this requirement. Fifteen small supplies, collectively serving 3,500 people, did not.

3.5.6 Remedial action

The Act requires drinking-water suppliers to take all practicable steps to carry out appropriate remedial action if drinking-water is contaminated. Prompt action is required when the contaminants are microbiological, because pathogens can cause acute illness. Drinking-water suppliers must seek to remedy any faults they have identified in their system that may adversely affect the safety of the supply.

Remedial action in response to transgressions was taken, when necessary, in supplies serving 99.1 percent of the report population (3,803,000 people) in the reporting period.

Water suppliers did not take prompt remedial action in 30 supplies, consisting of 16 minor supplies (collectively serving 32,400 people) and 14 small supplies (collectively serving 3,600 people).

3.6 Public health significance of not meeting the requirements of the Health Act

The significance on public health varies between the different requirements of the Health Act, and also how the water supplier failed to meet the requirements. The requirement to prepare and implement water safety plans is of the highest public health significance as this is the document where the water supplier identifies all of the risks to their supply, and how they are managing those risks, as well as other important aspects of their water supply.

The requirement to protect source water ensures that the highest quality source water is being used to provide drinking water. Any subsequent failure in treatment is less likely to cause illness if the source water is of the highest quality.

Of immediate public health significance is the requirement on the water supplier to take adequate remedial action once a problem has been identified.

A failure to meet the monitoring requirements may have minor public health significance, such as a water supplier who fails to monitor on sufficient days of the week, or who misses the collection of a single water sample. However a water supplier who fails to monitor their water supply at all could result in major public health consequences.

Failure to provide an adequate supply of drinking water may have minor public health significance such as where planned repairs take longer than expected but affected consumers are well informed. However if interruptions to supply are protracted or not well communicated and there are vulnerable consumers on the supply this may have a significant impact.

Failing to keep good records, including complaint management may not have a direct public health impact however it is an indication the water supplier does not have good historical knowledge of their supply, quality systems in place and may miss picking up on important changes in the supply through customer complaints.

4 Meeting the *Drinking-Water Standards for New Zealand 2005 (revised 2008)*

4.1 Introduction

Drinking water suppliers must take all practicable steps to meet the *Drinking-water Standards for New Zealand 2005 (Revised 2008)* (the Standards). The Standards have three main components:

- the water **quality standards**, which specify the maximum acceptable values (MAVs) of a range of microbiological, chemical and radiological properties of drinking-water (determinands). The MAVs are set at a level below which there is no significant risk to a consumer over a lifetime of drinking-water consumption
- the **compliance criteria** and **reporting requirements**, which define the checks needed to demonstrate a drinking-water supply is not exceeding the drinking-water quality standards. The stringency of these checks reflects the level of risk that the drinking-water supply poses
- the **remedial actions**, which a supplier must take in the event of a transgression. A transgression occurs when the MAV or some operational requirement of the drinking-water supply is exceeded.

In order to meet the Standards, over a 12-month period a supplier must:

- achieve the quality standards over 95 percent of the time, and
- monitor the drinking-water in accordance with the compliance criteria, and
- in the event of a transgression, take remedial actions to protect public health, and to prevent the reoccurrence of the transgression.

The Standards are the same for all supplies, because their purpose is to protect people's health. The compliance criteria depend on a number of factors; primarily the size of the population served by a supply and the nature of the determinand. The criteria balance risks to public health and costs. To manage public health risks, the more people served by a supply the more monitoring is required, to provide greater certainty that the drinking-water meets the quality standards.

In this report, the quality of drinking-water is assessed in terms of suppliers' achievement of the microbiological and chemical Standards.

Microbiological achievement of a Standard is based on the detection of indicator organisms, combined with assessment of barriers to contamination, rather than measurement of the concentrations of microorganisms in the drinking-water. Microbiological achievement is based on two main microbiological reference organisms, *Escherichia coli* (*E. coli*) and *Cryptosporidium*. **Bacteriological achievement** is determined primarily using *E. coli* monitoring; no *E. coli* should be detected in the drinking-water distribution zones. **Protozoal achievement** is based on monitoring the effectiveness of the treatment processes used to remove or inactivate *Cryptosporidium*.

The chemical Standards define water that, based on current knowledge, is able to be drunk over a lifetime with no adverse health effects. For most chemical determinands an occasional exceedance of the MAV in the Standards is not a significant risk to public health. **Chemical achievement** is assessed for those supplies that have been identified as containing chemicals that require monitoring (known as Priority 2 determinands). A drinking-water supply achieves the chemical requirements of the Standards if it has no Priority 2 determinands, or if it has been adequately monitored and any Priority 2 determinands present are shown to be within acceptable levels.

4.2 Overall achievement of the Standards

Every drinking-water supplier has a duty to take all practicable steps to ensure that the drinking-water it supplies meets the Standards. Overall achievement against the Standards requires a drinking-water supply to achieve the bacteriological, protozoal and chemical Standards. The Standards specify the drinking-water quality standards that all drinking-water supplies must achieve. It is possible to fail to meet the Standards for technical reasons, such as inadequate sampling, or for reasons that are a public health concern, such as exceeding the MAV for bacteria in the drinking-water supply.

In the reporting period:

- of the 3,839,000 people receiving drinking-water from 493 supplies serving 101 or more people, 73.7 percent (2,831,000 people) received drinking-water that fully met **all Standards**
- 97.7 percent (3,751,000 people) received drinking-water that fully met the **bacteriological Standards**
- 74.8 percent (2,870,000 people) received drinking-water that fully met the **protozoal Standards**
- 98.9 percent (3,796,000 people) received water that fully met the **chemical Standards**.

Table 3 shows the proportion of the population that received drinking-water that achieved the Standards during the current and previous reporting periods.

Table 3: Achievement of the Standards between previous and current reporting periods

Standards	2016/17	2017/18	Difference
Bacteriological	96.2%	97.7%	+1.5%
Protozoal	83.1%	74.8%	-8.3%
Chemical	97.2%	98.9%	1.7%
Overall	81.1%	73.7%	-7.4%

Compared with the previous reporting period, bacteriological achievement increased by 1.5 percent, protozoal achievement decreased by 8.3 percent and chemical achievement increased by 1.7 percent. The population receiving drinking-water with bacteriological achievement has increased by 44,000 people, the population receiving drinking-water with protozoal achievement has decreased by 301,000 people, and the population receiving drinking-water with chemical achievement has increased by 86,600 people.

4.3 Comparison by size category

On average, large supplies demonstrated a higher level of achievement than smaller supplies. Until the current reporting period, there had been a slight year-on-year increase in the proportion of the report population that received water that fully achieved the Standards.

Table 4: Achievement of Standards: large supplies

3,221,000 people in 41 supplies

Description	Population	Percentage	Supplies
Bacteriological achievement	3,060,000	95.0%	32
Protozoal achievement	2,570,000	79.8%	27
Chemical achievement	3,221,000	100%	41
Overall achievement	2,515,000	78.1%	22

Table 5: Achievement of Standards: medium supplies

174,000 people in 25 supplies

Description	Population	Percentage	Supplies
Bacteriological achievement	133,500	76.8%	18
Protozoal achievement	114,100	65.7%	16
Chemical achievement	165,300	95.1%	24
Overall achievement	99,900	57.5%	14

Table 6: Achievement of Standards: minor supplies

386,000 people in 196 supplies

Description	Population	Percentage	Supplies
Bacteriological achievement	290,000	75.1%	141
Protozoal achievement	168,000	43.4%	74
Chemical achievement	352,000	91.3%	179
Overall achievement	157,000	40.8%	70

Table 7: Achievement of Standards: small supplies

57,800 people in 231 supplies

Description	Population	Percentage	Supplies
Bacteriological achievement	33,300	57.5%	126
Protozoal achievement	17,600	30.5%	68
Chemical achievement	56,600	97.8%	226
Overall achievement	15,300	26.4%	58

4.4 Meeting the bacteriological Standards

Exceedance of a microbiological MAV is of greater immediate concern than exceedance of a chemical MAV, because of the timescales over which their adverse effects are likely to be experienced. Pathogens can cause acute illness following a single contamination event. Those most at risk of infection are infants and young children, the immune suppressed, the sick and the elderly. For this reason, immediate remedial action is of paramount importance in response to microbiological exceedances.

During the reporting period, 97.7 percent (3,751,000 people) of the report population were supplied with drinking-water that met the bacteriological Standards.

Bacteriological Standards were achieved for supplies providing water to 95.0 percent of people in large supplies, 76.8 percent in medium supplies, 75.1 percent in minor supplies and 57.5 percent in small supplies. This may reflect the increasing cost per capita of effective bacteriological treatment as supply population size decreases.

Overall, the reported bacteriological achievement rate was 1.5 percent higher than the rate for the previous reporting period.

A total of nine large supplies (Cambridge, Napier, Rotorua East, Wanganui, Feilding, Richmond/Waimea Industrial, Blenheim, Oamaru and Dunedin City) failed to meet the bacteriological Standards during the current reporting period.

In the reporting period:

- 7.5 percent (288,000 people) of the report population received drinking-water that was inadequately monitored
- 0.2 percent (8,700 people) of the report population received drinking-water that was not monitored
- 0.9 percent (34,300 people) of the report population received drinking-water with an excessive number of *E. coli* transgressions
- 0.3 percent (11,800 people) of the report population received drinking-water from a supply in which transgressions occurred that were not followed up by immediate corrective actions.

Where monitoring is inadequate or absent, the population will lack confidence that the drinking-water supplier understands the quality of the drinking-water, is aware of any changes in water quality, and knows the water supply is safe to drink.

4.5 Public health significance of bacteriological transgressions

Excessive transgressions, and/or a failure to follow up on transgressions with immediate corrective action, can put public health at risk.

The presence of *E. coli* in water indicates that the water has been contaminated with faeces and inadequately treated, or may result from contamination of the water during post-treatment distribution to the community. In either case, the presence of *E. coli* means that other faecal pathogens could be present in the water that pose a threat to public health. Although the presence of these pathogenic organisms is not monitored, their presence must be assumed; consequently, any detection of *E. coli* in the water must be regarded as a potential risk to public health.

In addition, detection of *E. coli* shows that there has been a failure in the barriers between contaminants and the community. Consequently, suppliers must immediately investigate all *E. coli* transgressions and implement remedial action. Depending on the result of the investigation, they may need to modify the supply's water safety plan.

During the reporting period, water suppliers carried out analysis of approximately 48,100 *E. coli* monitoring samples, and 137 (0.3 percent of samples) tested positive for *E. coli*. During the previous reporting period, water suppliers carried out analysis of approximately 48,500 monitoring samples, and 151 (0.3 percent) tested positive for *E. coli*.

4.6 Meeting the protozoal Standards

During the reporting period, 74.8 percent (2,870,000) of the report population were supplied with drinking-water that fully achieved the protozoal Standards (Table 8). This is a decline of 8.3 percent on the achievement rate for the previous reporting period, when 83.0 percent of people received water that fully achieved the protozoal Standards: a difference of 300,000 people.

Table 8: Protozoal achievement against the Standards between reporting periods

Type of supplier	2016/17	2017/18	Difference
Large	90.1%	79.8%	-10.3%
Medium	61.2%	65.7%	4.4%
Minor	42.4%	43.4%	1.0%
Small	27.2%	30.5%	3.2%
Overall	83.1%	74.8%	-8.3%

In interpreting the data Table 8 shows, readers should take note of the fact that, in the previous year supply sizes were based on the size of zones in a supply. For this reporting period population bands are assigned for the whole supply.

The greatest change was in the large suppliers, where there was a 10.3 percent decrease in the proportion of the population served for which suppliers met the protozoal Standards. All other size bands saw an increase. The 14 large supplies that failed to achieve the protozoal Standard were: Cambridge, Te Awamutu and Pirongia, Hastings Urban, Napier, Gisborne City, Feilding, Levin, Blenheim, Ashburton, Christchurch Central, Northwest Christchurch, Timaru City, Queenstown and Wanaka. In the previous reporting period, 11 large supplies failed: Cambridge, Feilding, Hastings Urban, Invercargill, Levin, Northwest Christchurch, Queenstown, Richmond/Waimea Industrial, Tokoroa, Wanaka and Whakatane.

All failures to achieve the protozoal standards arose from failures in providing or monitoring appropriate plant processes, since protozoa are not monitored directly.

Protozoal non-achievement does not necessarily mean that pathogenic protozoa (*Giardia* spp. and *Cryptosporidium* spp.) were present in the drinking-water. Protozoal achievement is based on the likelihood that the treatment processes in operation will adequately protect the community if pathogenic protozoa are present in the source water. To achieve this, the drinking-water supplier must meet two requirements. They must either use groundwater meeting the secure bore water criteria of the Standards, or have treatment processes in operation that can remove or inactivate an adequate percentage of any protozoa present in the raw source water. The drinking-water supplier must be able to show that they are operating the treatment processes sufficiently well to meet the target percentage protozoal removal or inactivation.

The reason that a number of large supplies, including Christchurch Central and Napier, failed to comply with the protozoal standard this year when they had done so previously was the loss of secure bore water status.

The trend of decreasing protozoal achievement with decreasing supply size is possibly a reflection of the higher cost of effective protozoal treatment, which smaller communities are less able to bear. It is also possible that the operators of treatment plants supplying smaller communities do not have the same level of expertise as those operating larger systems.

4.7 Public Health Significance of Protozoal Compliance

The majority of protozoa are fresh water organisms of no public health significance. There are however two groups of protozoa which can cause adverse health reactions.

- Enteric protozoa that live in the gut of humans and other animals such as some species of *Cryptosporidium* and *Giardia*
- Free living organisms that are opportunistic pathogens in humans and may cause serious illness such as *Naegleria fowleri* and some species of *Acanthamoeba*.

Cryptosporidium has recently been identified as one of the most important waterborne human pathogens in developed countries responsible for a large number of outbreaks. Protozoa can cause illness in people when present in very low numbers therefore any presence of any of these organisms in the drinking water supply can put public health at risk.

4.8 Meeting the chemical Standards

During the reporting period, 98.9 percent (3,796,000 people) of the report population was supplied with drinking-water that met the chemical Standards (Table 9); 1.1 percent (43,200 people) received water that did not meet the Standards.

Chemical determinands do not have to be monitored in all supplies, but are assigned as Priority 2 determinands to specific supply components (treatment plants or distribution zones) where treatment or water characteristics indicate levels of chemicals may approach MAVs. Chemicals used for disinfection or other treatment processes are not usually assigned as Priority 2 determinands, because resultant water concentrations of those chemicals generally do not approach MAVs. Nevertheless, they may require monitoring as part of assessing bacteriological or protozoal achievement. That type of

monitoring is external to the assessment of Priority 2 determinands in this chemical achievement section of the report.

For a supply to achieve the chemical Standards, it needs to achieve the Standard for all chemical determinands assigned to the supply's distribution zones, as well as for all chemical determinands assigned to any treatment plant supplying water to those zones. (Distribution zones are parts of the drinking-water supply network within which all consumers receive drinking-water of identical quality.)

Table 9 summarises comparison of chemical achievement between reporting periods. Adjustments have been made to take into account changes in the definition of supply sizes. Compared with the previous reporting period, all supply sizes, with the exception of minor supplies, showed improved achievement. Overall, there was a 1.7 percentage point increase in the population receiving drinking-water from chemically achieving supplies: a difference of 86,600 people between reporting periods.

Table 9: Chemical achievement against the Standards between reporting periods

Type of supplier	2016/17	2017/18	Difference
Large	98.0%	100%	2.0%
Medium	92.0%	95.1%	3.1%
Minor	92.6%	91.3%	-1.2%
Small	97.5%	97.8%	0.3%
Overall	97.2%	98.9%	1.7%

Note that the high level of chemical achievement for small supplies arises by default, because Priority 2 determinands are usually assigned only to zones with populations exceeding 500.

During the reporting period, 94 supplies, supplying 67.3 percent (2,585,000 people) of the report population, were assigned one or more chemical determinands. The chemical Standards were achieved for water supplied to 98.1 percent (2,535,000) of that population, and not achieved for 1.9 percent (50,400 people).

Fluoride was the most commonly assigned chemical, in terms of population served. Fluoride was assigned to supplies for 2,232,000 people; there was a 99.8 percent achievement of the chemical Standards for this determinand. The concentration of naturally occurring fluoride in drinking water sources is low in New Zealand, and does not need to be monitored; however, all fluoridated water supplies must monitor and control the level of fluoride added to the drinking water.

The next most commonly assigned chemical determinand was trihalomethanes, assigned to supplies for 120,000 people (with 96 percent achievement), and haloacetic acids, assigned to supplies for 82,100 people (with 74.3 percent achievement). Both of these are disinfection by-products.

Nitrate was assigned to supplies for 53,900 people (with 98.2 percent achievement), arsenic to supplies for 36,300 people (with 72.1 percent achievement) and lead to supplies for 25,200 people (with 96 percent achievement).

4.9 Public health significance of chemical transgressions

The chemical Standards define water that, based on current knowledge, is able to be drunk over a lifetime with no adverse health effects. In New Zealand, an adult body weight of 70 kilograms and a consumption of two litres of water per day over a lifetime is used to calculate the MAV. Short-term exceedances of the MAV rarely pose a public health risk.

Drinking-water supplied to 35,800 people (from 17 supplies), or 0.9 percent of the report population, exceeded the MAV for one or more chemical determinands during the report period. Chemicals exceeding their MAVs were trihalomethanes and haloacetic acids, fluoride and arsenic. Specifically, seven supplies had exceedances for arsenic; two supplies had exceedances for dichloroacetic acid (also a disinfection by-product); three supplies had exceedances for fluoride; six supplies had exceedances for the MAV sum ratio for haloacetic acids; and one supply had exceedances for the MAV sum ratio for trihalomethanes.

Action to reduce the concentration of disinfection by-products is encouraged, but disinfection itself must not be compromised. The risk posed by a disinfection by-product is considerably less than the risk posed by a pathogenic microorganism in water that has not been disinfected. Frequency of exceedances of disinfection by-products ranged from 8 to 100 percent of monitoring samples. The maximum exceedance was 3.5 times the MAV. The frequency of trihalomethane exceedances was 17 percent of samples, and the highest concentration measured was 1.2 times the MAV. The frequency of dichloroacetic acid exceedances was 8 to 25 percent of monitoring samples, and the highest concentration measured was 1.8 times the MAV.

The MAV for arsenic was exceeded in seven supplies (serving 11,300 people). The frequencies of exceedance reported for arsenic ranged from 16 to 100 percent of samples. The maximum arsenic concentration measured was twice the MAV. Arsenic is a naturally occurring chemical found more frequently in source waters from geothermal areas of New Zealand. Food is also an important source of arsenic, particularly from fish and shellfish.

The MAV for fluoride was exceeded in three supplies (serving 3800 people). Fluoride has been shown to prevent dental caries very effectively; however, concentrations above 1.5 mg/L may cause mottling of the teeth enamel in young children.

4.10 Monitoring

Ten supplies, serving 14,500 people, failed to meet the chemical Standards due to inadequate monitoring. Without monitoring information, water suppliers cannot make

well-informed decisions about actions they can take to meet the Standards, and the health significance of concentrations of chemicals assigned to a distribution zone cannot be readily assessed.

5 Research and project work

The Ministry supports scientific and technical investigations of drinking water issues with a range of partners.

The Institute of Environmental Science and Research (ESR) has conducted research through a series of studies that analyse the collected dataset presented in this annual report in more depth. See:

- Moriarty E, Nokes C. 2014. Public health risk assessment of sewage disposal by onsite wastewater treatment and disposal systems in the Darfield and Kirwee Communities. Auckland: ESR. URL: www.esr.cri.nz/assets/Uploads/FW14031-Darfield-public-health-risk-assessment.pdf (accessed 15 May 2019).
- Nokes C, Ritchie J. 2018. Report on a survey of New Zealand drinking-water supplies for arsenic and nitrate. Auckland: ESR. URL: www.esr.cri.nz/assets/Uploads/FW16030-As-and-NO3-Survey-FINAL.pdf (accessed 15 May 2019).

It has conducted two studies on the non-achievement of drinking water standards:

- Mattingley B, Wood D, Nokes C. 2015. Non-achievement of the Drinking-water Standards for New Zealand. Auckland: ESR. URL: www.esr.cri.nz/assets/Uploads/FW15017-FINAL.pdf (accessed 15 May 2019).
- Wood D, Mattingley B, Nokes C. 2018. Non-achievement of the Drinking-water Standards for New Zealand: E. coli transgressions. Auckland: ESR. URL: www.esr.cri.nz/assets/Uploads/FW18045-Non-achievement-of-DWSNZ-E-coli-transgressions-FINAL.pdf (accessed 15 May 2019).

Massey University conducts analysis of drinking-water quality information and how it relates to health. This is available through the Environmental Health Indicators website (see www.ehinz.ac.nz/indicators/drinking-water-quality); more detailed information is available on its Healthspace website (<http://cphronline.massey.ac.nz>).

The Massey University Protozoa Research Unit in the Molecular Epidemiology and Public Health Laboratory provides services for the Ministry of Health relating to aquatic protozoa, including advice on *Cryptosporidium* and *Giardia*, participation in relevant meetings and events (including engaging with other Ministries) and survey of targeted ground and surface water sites for *Cryptosporidium* and *Giardia*, with concurrent testing for *E. coli* and *Campylobacter*. The Unit has developed a database archive and genotyping library of characterised strains of *Cryptosporidium* and *Giardia* found in New Zealand: see <http://protozoa.org/>.

The Drinking Water Advisory Committee was established to provide high-quality, independent scientific and technical advice to the Director-General of Health on current and emerging issues related to drinking-water quality. The committee meets monthly; the first meeting was in December 2017. One of the Committee's first tasks was to look at the changes to the drinking-water Standards recommended in the final report of the Havelock North Inquiry, and provide its independent advice to the Director-General on whether those changes should be accepted.

Work on a new national database for the collection and storage of drinking-water supplier compliance information, Drinking Water Online (DWO) started in 2016. This work is a close collaboration between the Ministry of Health, BECA and ESR.

The second Havelock North Inquiry report in December 2017 made recommendations to enhance the specific functionality of DWO, to improve both national and local utility and consequently improve the drinking-water system in New Zealand.

This reporting period is the first time compliance has been assessed wholly using information from the database. Workshops were held with users after data collection to identify a programme of work for enhancements to improve usability. These improvements will be rolled out over the next five years.