

Development of Drinking- water Management in New Zealand since 1992

MEU Taylor

Ministry of Health, Wellington

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Overview

In 1992 the public health oversight of drinking-water management in New Zealand was in disarray after seven years of central and local government restructuring and retrenchment. The (then) Department of Health was receiving little information about the quality of public drinking-water supplies (Taylor 1993a). However, an independent survey in 1989 (New Zealand Water and Wastes Association) had shown that at least 45 to 50 percent of water supplies did not monitor their chlorine dosage satisfactorily, 28 percent never tested the bacteriological quality of water after it entered the reticulation and another 30 percent tested only four times per year.

After the Department of Health was restructured into the Ministry of Health in 1993, an initial appraisal of the public health safety management of the drinking-water industry was carried out (Taylor 1993a, 1993b). The opportunity was taken to fundamentally review and restructure the process of public health management of drinking-water. There were also a number of major governance and structural issues surrounding the water industry that might benefit from review, but responsibility for these lies outside the health portfolio. The Ministry of Health therefore concentrated on the public health infrastructure, although it has contributed where possible to various governance and structural reviews carried out by other agencies.

In New Zealand in 2000 some 82 percent of the total population was serviced by a mere 114 drinking-water supplies. Each of these is a medium-to-large supply providing for more than 5000 people. The remaining 18 percent of the population is serviced by over 1900 supplies that each provide for fewer than 5000 people. In 1998, 98.7 percent of the supplies that failed to comply with the bacteriological requirements of the Drinking-Water Standards for New Zealand 1995 (Ministry of Health 1995a) fell into this lower 18 percentile (Ministry of Health 2000b, 2000c, 2001). Many of these are in poor, dispersed rural communities that not only do not have ready access to laboratory facilities but also have relatively high per capita costs for both treatment and monitoring compared to their larger urban counterparts.

The existing legislative framework for drinking-water is fragmentary and outdated reflecting its roots in English legislation from the 1800s and the redistribution of portions of the health portfolio among numerous agencies between 1987 and 1993. Consequently the Ministry of Health has had to develop management procedures based on non-regulatory intervention.

The management approach

To improve the public health management of drinking-water supplies, the Ministry has developed an integrated management system in which the various components not only complement but mutually reinforce each other. The management programmes are designed to promote maximum interaction and mutual support between the various stakeholders, the public and the media, the drinking-water supplier, and the public health officer. Emphasis is on using risk management planning techniques to promote a quality assurance approach. This is complemented by a monitoring programme used as a final quality control which also acts as a feedback loop and provides a trigger for remedial action where this is necessary.

The principal public health management tools used are:

- the Ministry of Health Drinking-Water Standards for New Zealand 2000 (2000a)
- monitoring by water suppliers of compliance with the Drinking-Water Standards for New Zealand (DWSNZ), with surveillance by health protection officers designated by the Ministry of Health
- public health grading of community drinking-water supplies (Department of Health 1993)
- the Register of Community Drinking-Water Supplies in New Zealand (Ministry of Health 2000c) which lists the location of all drinking-water supplies in New Zealand, the population served, the public health grading of the drinking-water supply and the presence of any determinands whose concentration exceeds 50 percent of the maximum accepted value (MAV)
- an Annual Report on the Microbiological Quality of Drinking-Water Supplies in New Zealand (Ministry of Health 2001) which advises the public of how well their supply has complied with the microbiological requirements of the DWSNZ, the likelihood that their water supply has been contaminated by faeces, and analyses the causes of problems
- the Guidelines for Drinking-Water Quality Management in New Zealand (Ministry of Health 1995b) which provides information and advice on managing drinking-water supplies
- the requirement that only laboratories recognised for the purpose by the Ministry of Health may carry out compliance testing for the DWSNZ
- Water Information New Zealand (WINZ) which is a national electronic drinking-water information base, operated by public health services and drinking-water supply authorities. WINZ collates compliance and quality assurance data, automatically checks that sampling and analytical protocols have been complied with, and is used in the verification of compliance and the public health grading of drinking-water supplies
- a suite of guides for the preparation of public health risk management plans for drinking-water supplies and a 30 minute video to introduce risk management concepts to small drinking-water suppliers.

The public health grading of drinking-water supplies

The principal driver of improvement in the quality of drinking-water in New Zealand since 1993 has been the public health grading of drinking-water supplies by public health officers. This provides an impartial assessment of the performance of a supply and is published so that the public can evaluate the service they are receiving. The resulting improvements have been gratifying.

The purpose of grading a drinking-water supply is to provide a public statement of the extent to which the supply achieves, and can ensure, a consistently safe product.

The protection of the source and the adequacy of the treatment are graded on a scale of 'A' to 'E' ('good' to 'completely unsatisfactory' respectively) based on the competence of the operators, the extent of treatment (eg, coagulation, filtration, disinfection) and the degree to which the supply complies with the DWSNZ. Similarly, each distribution zone in the network reticulation is graded on a scale of 'a' to 'e' scale for the condition and management of the distribution system.

The 1993 grading protocols have been revised in 2002 to incorporate the changes from the DWSNZ 1995 to the DWSNZ 2000.

The public awareness stimulated by the grading is supplemented by the publication of the Annual Report on the Microbiological Quality of Drinking-Water Supplies, which often arouses considerable local media interest in districts where the drinking-water supplies are unsatisfactory.

Drinking-water standards

The DWSNZ 1995 prescribe MAVs for determinands of public health significance and provide a yardstick against which drinking-water quality is measured.

The DWSNZ specify minimum frequencies of monitoring that will give 95 percent confidence that a drinking-water supply is complying with the Standards for at least 95 percent of the time. The larger supplies are required to monitor more frequently. In 2000 the DWSNZ 1995 were revised to produce the Drinking-Water Standards for New Zealand 2000 that came into effect on 1 January 2001. The DWSNZ 1995 used 'classical' statistics to derive the necessary monitoring frequencies, but the DWSNZ 2000 take advantage of recent advances in the use of statistics in which monitoring frequencies are derived using the Bayesian approach (McBride and Ellis 2000). This requires fewer samples for the same degree of confidence and has the potential to enable the performance record of the supply to be taken into account in determining the appropriate sampling protocols (McBride 2000).

The DWSNZ also:

- specify referee methods against which the methods used by individual laboratories have to be calibrated
- require that laboratories carrying out compliance testing be approved for the purpose by the Ministry of Health
- specify minimum remedial action that has to be taken in the event of the DWSNZ being breached.

The purpose of the referee methods is to overcome the problem of different analytical methods giving differing results. The referee method provides a benchmark in case of disagreements. Laboratories can use any method that has sufficient precision and sensitivity, but the conformance assessment agency that accredits them is required to certify that the methods the laboratory is accredited for have been calibrated against the referee method.

The DWSNZ specify MAVs for more than 140 determinands. To minimise the number of determinands that have to be monitored routinely in any specific drinking-water supply but still maintain adequate safeguards to public health, the DWSNZ have grouped the determinands of public health concern into four priority classes.

Priority 1 is given to indicators of faecal contamination and indicators of the efficacy of treatment processes in inactivating protozoa. Rapid response and remedial action are required for all determinands that indicate the potential presence of pathogens. All drinking-water suppliers are required to monitor Priority 1 determinands.

Priority 2 determinands are chemicals that have been shown to be present at more than 50 percent of the MAV in a particular supply or, in the case of pathogenic micro-organisms, where the Medical Officer of Health considers that the circumstances require that they be monitored. The requirement to monitor Priority 2 (P2) determinands is specific to the supply concerned. The Ministry of Health has carried out a survey of all drinking-water supplies serving more than 500 people, to identify the presence of P2 determinands in order to ascertain monitoring requirements.

Priority 3 and Priority 4 determinands include all other determinands of public health concern for which there is no evidence that they are present in the water supply in significant concentrations. Monitoring for these is at the discretion of the drinking-water supplier.

It can be seen that the top priority is given to identifying potential causes of infectious disease outbreaks. In an ideal world a screening test would be used that provides instant identification of the presence of pathogenic organisms in drinking-water. At present no such test exists. Until better tests have been developed, New Zealand, like the rest of the world, has to fall back on the use of indicator organisms to identify the probability that the water has been contaminated by excrement and, therefore, the possibility that pathogenic bacteria or viruses are present. Because of the practical difficulties in routinely enumerating infectious protozoa in drinking-water, surrogate methods have had to be used, based on checking that the water is from a safe source or has received a level of treatment that has a high probability of removing protozoan organisms.

Microbiological standards

In the DWSNZ 2000 *Escherichia coli* (*E. coli*) has been chosen as the indicator organism for faecal contamination instead of the faecal coliforms used in the DWSNZ 1995.

There remains the problem of achieving consistency between laboratories. To some extent this can be achieved by inter-laboratory comparison, but in most cases the inter-laboratory protocols use freeze-dried organisms and do not adequately test the considerable variance that is due to sample handling procedures. This problem has not yet been satisfactorily resolved.

No supplementary monitoring of other organisms is required by the DWSNZ 2000. Any further development of microbiological surveillance is intended to arise from the use of public health risk management plans. The extent of risk management and the level of surveillance are linked to the degree of risk to the public health from the supply. Thus the greater the number of barriers to infection that exist, the lower the frequency of compliance monitoring that is required. For example, for drinking-water supplies derived from secure aquifers or with a demonstrated adequate disinfection residual, the frequency of *E. coli* monitoring required is less than it is for a surface water without residual disinfection.

Public health risk management plans

The development of public health risk management plans by drinking-water suppliers is encouraged by the Ministry and is proposed to become a statutory requirement under the draft Health (Drinking Water) Amendment Bill, currently with law drafters prior to being introduced into the House.

No difficulties are anticipated with the larger suppliers, but a substantial proportion of the smaller suppliers will not have the resources to achieve this.

To assist suppliers to develop and implement public health risk management plans, the Ministry of Health has developed public health risk assessment modules guides that cover the major elements of drinking-water quality protection. These guides provide the basis for the development of specific public health risk management plans for individual supplies by selecting the components that are relevant to that supply.

A matrix approach is used which provides a set of modules for each individual stage of a generalised drinking-water supply system, These stages include:

- catchment management
- raw water storage reservoir management
- pretreatment
- coagulation and flocculation
- preliminary solid / liquid separation
- filtration
- disinfection
- final treatment
- the network reticulation
- service reservoirs.

For each process in a water supply there is information on:

- risk assessment
- risk causes
- potential preventative measures and controls
- comparative level of risk
- corrective action
- indicators of performance in preventative measure controls and corrective actions
- process management
- contingency plans.

By selecting the modules that apply to their particular circumstances, each drinking-water supplier can develop a risk management plan for the whole of their supply that identifies their specific risks and the associated controls. From this the management priorities for the supply can be established, taking into account the overall benefits and costs. Guidance for this stage of the development of the public health risk management for the supply is provided in an overview document titled *How to prepare and develop public health risk management plans for drinking-water supplies* (Ministry of Health 2001b). The 39 public health risk management plan guides were trialled by desk exercises in the four major centres and given three months' public consultation before being published. The guides are intended to be living documents and will be updated as new information becomes available.

Accredited drinking-water assessors

To promote consistent application of the new drinking-water legislation, the draft Bill provides for assessors¹ who will monitor compliance with the Act. These assessors are to be approved by the Ministry and will be accredited as verification bodies² by an internationally recognised accreditation³ body⁴. The Act will also provide that only laboratories that have been recognised for the purpose by the Ministry may issue certificates that a specified determinand⁵ is in compliance with the drinking-water standards.

The Ministry wishes to ensure that the procedures for, and implementation of, the Ministry's approval⁶ processes, and the accreditation of verification bodies and analytical laboratories, are effectively integrated. The only accreditation body in New Zealand that is internationally recognised for the accreditation of both verification bodies and analytical laboratories is International Accreditation New Zealand (IANZ).

To enable the assessors to develop appropriate competencies, a list of their functions and requirements has been agreed upon and was used by the Water Industrial Training Organisation to develop unit standards for a national New Zealand Qualifications

Authority post-graduate diploma for drinking-water supply assessors. The Ministry of Health has negotiated a memorandum of understanding with IANZ to develop accreditation protocols for assessors and laboratories that comply with ISO/IEC 17020 and 17025 respectively.

Legislative developments

The effect of the non-regulatory interventions in drinking-water management practice that have been introduced since 1993 has been to improve the situation from that reported in 1989 (New Zealand Water and Wastes Association) to the situation in 2000 where 81 percent of the population received drinking-water that is fully compliant with the DWSNZ 1995 (Ministry of Health 2000b, 2001). Compliance requirements are strict. A supply fails to comply with the DWSNZ if:

- MAVs are exceeded more frequently than is permitted by the DWSNZ
- the number of samples analysed is fewer than that required by the DWSNZ
- the laboratory used for the analyses has not been recognised for the purpose by the Ministry of Health
- the prescribed remedial action is not carried out when a MAV has been exceeded.

To consolidate this progress, Cabinet instructed the Ministry of Health in December 2000 to prepare a Health Act Amendment Bill that will provide a statutory framework for the non-regulatory interventions that are presently operating. The amendment will strengthen and improve the existing legislation by:

- placing duties on drinking-water suppliers to take all practicable steps⁷ to comply with drinking-water standards (and various other duties and powers ancillary to that)
- providing a statutory framework for the promulgation of drinking-water standards
- putting duties on the general public not to contaminate drinking-water supplies
- requiring drinking-water suppliers to introduce and implement public health risk management plans
- providing for officers designated by the Ministry to act as assessors to verify:
 - compliance with the DWSNZ
 - the standard and implementation of public health risk management plans
 - the competence of water supply staff carrying out process and field analyses
- requiring designated assessors to have their competence accredited by an internationally recognised conformance accreditation agency
- providing for appropriate record-keeping and publication of information about the compliance of the supply with the Act.

To enable the drinking-water suppliers to adjust to the requirements of the new legislation the Act will be phased in over five years. The larger water suppliers will have two years to comply and the smaller suppliers will have five years. Because it is expected that some of the smaller suppliers will have difficulties in developing the necessary resources, a working party consisting of central government, local government and small water suppliers has been formed to monitor and evaluate the impact of the legislation. This party will report back annually to the Minister on those suppliers not complying with the legislation, including the reasons for their non-compliance, and actions taken to effect compliance.

The Act will empower the Minister of Health to grant variations to the compliance requirements for a particular drinking-water supply, having regard to the potential risks to public health, the views of the local community, and the costs and benefits involved in cases where the working party set up to oversee the implementation of the Bill is satisfied that such variation is warranted.

Once the public health risk management plans are operational, the criteria currently used for public health grading of drinking-water supplies will be revised to take advantage of the new opportunities for performance assessment that the plans will provide. In conjunction with the information processing capabilities of WINZ, this will enable annual or quarterly reviews of the public health grades to be carried out for each supply. The planned reorganisation of the public health management of drinking-water in New Zealand will then have been completed.

References

- American Public Health Association. 1998. *Standard Methods for the Examination of Water and Wastewater*. 20th Edition.
- Finlay RK, Millar JA and Whyte RJ. 1995. *Detection of total coliforms and Escherichia coli in drinking-waters: comparison of a standard multiple tube fermentation method with Colilert and Colisure*. ESR contract report to Ministry of Health, FW95/20.
- Department of Health. 1993. *Water Supply Grading Explanatory Notes*. Wellington: Department of Health.
- McBride GB. 2000. *Quantifying consumer's and supplier's risks for assessing compliance with a 95 percentile drinking-water standard*. Contract report to the Ministry of Health. Wellington.
- McBride GB. *Exact MPN tables using occupancy theory*. NIWA contract report to Ministry of Health.
- McBride GB and Ellis JC. 2000. *Confidence of compliance: A Bayesian approach for percentile statistics*. Water Research.
- Ministry of Agriculture and Forestry, Ministry for the Environment and Ministry of Health. *Freshwater Microbiological Research Programme Project Design Manual*, in preparation.
- Ministry of Health. 1995a. *Drinking-Water Standards for New Zealand 1995*. Wellington: Ministry of Health.
- Ministry of Health. 1995b. *Guidelines for Drinking-Water Quality Management in New Zealand*. Wellington: Ministry of Health.
- Ministry of Health. 2000a. *Drinking-Water Standards for New Zealand 2000*. Wellington: Ministry of Health.
- Ministry of Health. 2000b. *Initiatives to Improve the Quality of Drinking-Water in New Zealand: Discussion paper for local government New Zealand*. Wellington: Ministry of Health.
- Ministry of Health. 2000c. *Register of Community Drinking-Water Supplies in New Zealand* [annual]. Wellington: Ministry of Health.
- Ministry of Health. 2001. *Annual Report on the Microbiological Quality of Drinking-Water Supplies in New Zealand* [annual]. Wellington: Ministry of Health.
- New Zealand Water and Wastes Association Newsletter, 20, 24 September 1989.
- Taylor MEU. 1993a. Review of the Management of Drinking Water Quality in New Zealand. Paper presented at the New Zealand Water and Wastes Association Annual Conference, 1993.
- Taylor MEU. 1993b. Drinking-Water for the 21st Century. Paper presented at the Second Annual AIC Water Resources Annual Conference, Auckland, 1993.
- Tillett HO and Coleman R. 1985. Estimated numbers of bacteria from non-homogeneous bodies of water. *Journal of Applied Bacteriology*, 59 381-388.

Whyte RJ. 1996. *Protocol for drinking-water monitoring programmes based on rapid test systems such as Colilert/Colisure*. ERS contract report to Ministry of Health FW95/28.

¹ *assessor* means a body or person who inspects and assesses the operation of a drinking-water supply for the purpose of verifying compliance with the provisions of the Act.

² *verification body* (also *inspection body*) is the term used by conformance assessment bodies to describe a body or person that certifies compliance of a third party with a code of practice or standard.

³ *accreditation* is the formal recognition and certification of the competence of inspection, verification and assessment bodies, or laboratory testing organisations by an agency that is internationally recognised for the purpose

⁴ *accreditation body* is a body that is internationally recognised as competent to issue certifications of accreditation to inspection, verification and assessment bodies, or laboratory testing organisations.

⁵ *determinand* means a constituent or property of the drinking-water which is can be determined, or estimated, in drinking water.

^{vi} *approval* means, for the purposes of this document, that the Ministry of Health has authorised the body or person to carry out the functions for which the approval is given.

^{vii} it is proposed to define *practicable steps* as ‘all steps to achieve the result that is reasonably practicable to take in the circumstances, having regard to:

- (a) the nature and severity of the harm that may be suffered if the result is not achieved
- (b) the current state of knowledge about the likelihood that harm of that nature and severity will be suffered if the result is not achieved
- (c) the current state of knowledge about harm of that nature
- (d) the current state of knowledge about the means available to achieve the result, and about the likely efficacy of each
- (e) the availability and cost of those means.’