SURVEILLANCE OF RURAL DRINKING WATER QUALITY IN NSW

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INTRODUCTION

The sampling and analysis of our drinking water supplies is fundamental to safeguarding public health. In rural NSW, water supply authorities - Local or County Councils, or the Public Works Department (PWD) - are responsible for the provision of drinking water which meets agreed microbiological, chemical and physical criteria. Compliance with National Health and Medical Research Council (NHMRC) water quality guidelines should protect the public from waterborne illness. However, it is not uncommon for these recommended criteria to be exceeded in rural NSW, and some supplies are tested irregularly.

This review has two aims:

- to evaluate the current system of water quality surveillance in NSW; and
- to gauge the public health significance of these results.

BACKGROUND

Legal situation

There is no statutory requirement for any authority to monitor drinking water quality. However, legislation allows for closure of a drinking water supply if it is suspected to be unfit for drinking (Public Health Act, 1991); creates offences relating to the discharge of prohibited matter into sewers and drains, unauthorised drainage work, wasting or misusing water, and polluting a public water supply (Local Government Act, 1993); and confers powers to classify waters, inspect and impose standards and direct action in relation to pollution of a waterway (Clean Waters Act, 1970); as well as dealing with the mechanics of water supply and commercial standards for use.

To safeguard public health, the NHMRC and the Australian Water Resources Council (AWRC) have developed guidelines for the microbiological, physical, chemical and radiological characteristics of drinking water in Australia. The guideline values are not standards but achievement of the guidelines ensure that drinking water will not present a significant health risk to the public. The NSW Health Department, the PWD and local councils have adopted these guidelines as a basis for assessing water quality in NSW. The guidelines, adopted in 1987, are being revised and propose:

- more stringent values for some parameters;
- more frequent microbiological sampling; and
- a framework for the evaluation of a supply's water quality.

The draft guidelines advocate that water authorities provide event reports and annual reports of water quality to health authorities and the public. Although having no legislative status, the guidelines imply there is a duty of care on the water supply and health authorities to ensure safe drinking water is provided to the public. The draft guidelines state that they provide a "needed reference to ensure the accountability both of water authorities, as managers, and of state health authorities, as auditors of water supplies".

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Rural drinking water surveillance

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Water supply authorities

In NSW the following government authorities are responsible for drinking water supplies:

- Water Boards (consisting of the Sydney, Hunter and Broken Hill water boards);
- NSW Public Works Department; and
- Local and County Councils which service most of the rural areas.

The PWD, through the Country Towns Water Supply and Sewerage Subsidy Program (CTWSSP), has delegated responsibility for the provision of water services to rural councils. The program includes areas not covered by the Sydney and the Hunter Water Board and incorporates 128 councils and 200 water supply schemes.

In rural NSW towns about 82 per cent of the water supply comes from surface sources while the remainder originates from groundwater sources which include deep bores and shallow wells. Almost all the supplies in rural towns use chlorination for disinfection, with chloramination being used in only two supplies where long disinfection residual times are required. A small number of councils has decided not to disinfect water supplies.

Costs

The 1987 water quality guidelines state that to achieve compliance with all water quality guidelines throughout Australia would cost around $2,000 million in 1984 dollars. Although small towns have a limited capacity to meet these costs, the goal of the PWD is to improve the quality of all water supplies in rural towns to meet the 1987 guidelines as a minimum.

The Division of Analytical Laboratories (DAL) carries out microbiological, physical, chemical and pesticide analysis of drinking water samples for rural NSW supplies. The water samples are submitted by the water supply authorities and are analysed free of charge. Results are fed back to councils and the Public Health Units (PHUs).

Some councils use alternative laboratories for the analysis of water samples. Councils in the South West Region and two councils in the South East Region send samples to Wagga Wagga Base Hospital for microbiological analysis only, and a few councils in the New England Region carry out analysis in their own laboratories or send samples elsewhere.

The cost incurred by DAL for microbiological, chemical and physical analysis of both public and private drinking water samples for the period 1988-89 was $528,400 (excluding pesticide analysis), and $664,630 for 1989-1990 (including pesticide analysis). These figures incorporate costs for salaries, maintenance, working expenses, laboratory equipment and equipment replacement. Councils also incur significant costs in the collection of samples.

Sampling and analysis of drinking water supplies in rural NSW

The NHMRC states that local conditions and a knowledge of the water supply system will help to determine where and how frequently monitoring should be carried out. Nevertheless, the guidelines also define a minimum frequency for water sampling and state that the samples must be representative of the water supply. The guideline values relate to quality of the water which is delivered to the consumer. The guidelines stress that exceeding the standards occasionally is not necessarily a public health threat, but that authorities should consider the degree and duration when taking remedial action.

In addition to monitoring the treated drinking water supply, some authorities also test raw water sources and storages to assemble information on the quality of the water before treatment.

- Microbiological sampling and analysis
  It is not feasible to test for all materials or organisms which may be present in water. Instead, the coliform group of organisms, and in particular *E. coli*, are used as indicator bacteria of faecal contamination. The NSW Health Department, including DAL, has adopted the sampling frequency for microbiological analysis as recommended in the guidelines. The major determinant of sampling frequency is population size – for example, a minimum of one sample a month for the smallest supplies, and weekly sampling in supplies servicing areas with large seasonal increases in population such as holiday resorts.

  When faecal contamination occurs, the water and health authorities should take appropriate remedial action and where necessary issue a public warning. This action has been carried out by the Regional PHUs and Local Councils. In the event of a gastroenteritis outbreak, a full microbiological investigation is conducted, although no tests for the presence of viruses are done.

  The draft guidelines present a framework for the annual assessment and reporting of non-compliance with water quality standards. At present this is not often conducted.

- Chemical, physical and pesticides analysis

  The NHMRC guidelines stipulate that supplies serving more than 50,000 people be sampled monthly, and those serving smaller populations be sampled twice annually. In addition, the pattern and types of pesticides used in the area should be considered.

  DAL has developed a water sampling program in which supply authorities are requested to submit two samples a year for chemical and physical analyses. Submission of water samples for pesticide analysis usually occurs at this time.

METHODS

The results of water quality surveillance were obtained from the following available DAL reports: bi-monthly microbiological reports, record sheets for annual chemical and physical results by Region, annual pesticide results by Region, and the 1988-1989 and 1990 annual reports. The results presented in this review are for treated water samples only.

The PWD has been receiving water quality data from DAL for more than 20 years, and has computerised the information up to 1990. In addition, the PWD recruits councils on a voluntary basis to report annually on the performance of their water and sewerage systems. In the 1991 NSW Water Supply and Sewerage Performance Comparisons, water quality results have been compiled...
from information collected on 86 water supply schemes
(100 councils). A table from this report summarises the
compliance of a sample of rural water supply authorities
with current guidelines.
DAL results of water testing and compliance with current
water quality guidelines are presented in terms of locations
tested, supplies tested or total samples tested. A water
supply scheme may serve one or more locations, and
locations can be towns, villages or any other settlements.

RESULTS

Microbiological analysis
Between July 1991 and June 1992 DAL received specimens
from 352 (73 per cent) of the 481 water supplies throughout
NSW (Table 1). Some of the 27 per cent of supplies not
tested serve populations greater than 15,000 people.
In addition, many samples failed microbiological standards.
In Table 2 the water samples submitted to DAL between
1988-90 and in 1992-93 are summarised by type of analysis
and failure rate.
A total of 753 samples (10 per cent) from 313 locations failed
during 1992-1990. Of these locations, 195 failed at least
once throughout the year; 65 failed twice and 58 failed three
or more times. Similar information is not available for 1988-
90, due to incompleteness of record cards by the submitting
water authorities.

Chemical and physical analysis
The proportion of locations tested for chemical and physical
analysis has increased from 58 per cent in 1988-89 to 89 per
cent in 1992. During 1992, 39 per cent of samples
submitted for chemical/physical analysis failed on at least
one parameter. The most common parameters for which
samples failed were colour, turbidity, iron, manganese, pH
and conductivity. During 1989-90 and 1988-89, the failure
rates for chemical and physical analysis were 38 per cent
and 51 per cent respectively (Table 2).

Pesticides analysis
The number of locations sampled for pesticide residues
and the detection rates are shown in Table 3. In addition to the
routine pesticide samples submitted, some PHUs and
councils have carried out specific surveys. These survey
results are not included in this table.

PWD surveillance
The results obtained from the NSW Water Supply and
Sewerage Performance Comparisons from the PWD are
presented in Table 4.

DISCUSSION

Microbiology
The results of this review clearly illustrate that a significant
number of water supply authorities in rural NSW do not
regularly submit samples for water analysis, and that a
number of locations fail existing health criteria on a
continual basis.

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### TABLE 1

<table>
<thead>
<tr>
<th>Areas or Regions</th>
<th>Total Number of Locations</th>
<th>Number of Locations not tested (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Coast Region</td>
<td>32</td>
<td>6 (19%)</td>
</tr>
<tr>
<td>Hunter Area</td>
<td>11</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>Illawarra Area</td>
<td>34</td>
<td>4 (12%)</td>
</tr>
<tr>
<td>Central West Region</td>
<td>70</td>
<td>20 (29%)</td>
</tr>
<tr>
<td>South East Region</td>
<td>100</td>
<td>12 (12%)</td>
</tr>
<tr>
<td>North Coast Region</td>
<td>80</td>
<td>21 (26%)</td>
</tr>
<tr>
<td>New England Region</td>
<td>68</td>
<td>13 (19%)</td>
</tr>
<tr>
<td>Orana and Far West Region</td>
<td>86</td>
<td>49 (57%)</td>
</tr>
<tr>
<td>Total</td>
<td>481</td>
<td>129 (27%)</td>
</tr>
</tbody>
</table>

Source: DAL, microbiology results.

a. Locations known to DAL.
b. Two councils from the South East Region send water samples
to Wagga Wagga Base Hospital for microbiological analysis.
c. Several councils in the New England Region have alternative
arrangements for analysis of water samples.

### TABLE 2

<table>
<thead>
<tr>
<th>Type of sample</th>
<th>1988-89</th>
<th>1989-90</th>
<th>1992-1993</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of samples tested</td>
<td>Failure rate</td>
<td>No. of samples tested</td>
</tr>
<tr>
<td>Microbiological (coliforms, faecal</td>
<td>Public supplies</td>
<td>5,476</td>
<td>31% of samples</td>
</tr>
<tr>
<td>coliforms and E. coli)</td>
<td>Private supplies</td>
<td>324</td>
<td>41% of samples</td>
</tr>
<tr>
<td></td>
<td>Food processing</td>
<td>374</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>(TPC, coliforms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and E. coli)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical analysis</td>
<td>Public supplies</td>
<td>2,499</td>
<td>51%</td>
</tr>
<tr>
<td></td>
<td>Private supplies</td>
<td>453</td>
<td>67%</td>
</tr>
</tbody>
</table>

Sources: Annual reports: 1988-89; 1990. DAL

a. Failure is defined by DAL as: > 10 coliforms/100 ml of water or any faecal coliforms/100 ml of water.
b. Results obtained from DAL annual reports.
c. Results obtained from bimonthly microbiological reports.

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PESTICIDE MONITORING IN NSW 1990-1992

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of locations</th>
<th>Locations for which samples were not submitted</th>
<th>Locations tested twice during the 12-month period</th>
<th>Locations in which pesticides were detected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1990 1991 1992</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>538 542 533</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40% (215)</td>
<td>2.8% (15)</td>
<td>1 location Found in trace amounts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.4% (154)</td>
<td>2.8% (15)</td>
<td>1.1% (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34.7% (185)</td>
<td></td>
<td>2.2% (12) Found in trace amounts</td>
</tr>
</tbody>
</table>

Source: DAL Pesticides laboratory
1. Locations may vary due to water supplies becoming operational/non-operational.

Rural drinking water surveillance

The PWD and DAL use different reporting periods and criteria and so the information is not directly comparable. The PWD program relies on self-reporting of supplies by local councils which may introduce bias. For instance, the PWD compiled data on 55 schemes from the 200 in NSW for 1988.

Failure to comply with microbiological standards for drinking water may have important implications for public health. In the US more waterborne disease outbreaks were reported for the period 1971-1985 than in any 15-year period since 1920, although the incidence of waterborne disease has declined from eight cases per 100,000 during 1920-40 to four cases per 100,000 during 1971-85. The US Centers for Disease Control and Prevention estimates that in the US 900,000 people become sick each year from drinking contaminated water.

Despite improvements in epidemiological and microbiological methods, an aetiological agent has not been identified in about half the recent US outbreaks. Since 1971, outbreaks in surface water systems occurred primarily because of inadequate disinfection (13 per cent) or interrupted disinfection (14 per cent), especially in systems that provide disinfection as the only treatment. However, a recent Canadian study showed that even with drinking water which met current guidelines, the rates of gastrointestinal symptoms in people drinking the unfiltered compared with filtered tap water were significantly higher. The supply of water was sourced from sewage-contaminated surface waters. The authors concluded that there is a "non-trivial endemic level of unreported gastrointestinal disease due to the consumption of tap water". The almost complete absence of pesticide residues in tested water should be viewed with some caution. The monitoring program, which tests only once or twice a year, is not specifically tailored to the timing or the type of pesticide used in each area.

Furthermore, this evidence stands in contrast to a NSW Water Resources study which found pesticide contamination at all sites tested in the Barwon, Gwydir, Namoi and Macquarie valleys, albeit at extremely low levels. The DAL pesticides laboratory does not have the technology or the resources to screen for all pesticides in use in NSW, but efforts are being made to widen this range.

RECOMMENDATIONS

The following recommendations are proposed in response to the issues presented in this review:

- The establishment of a formal avenue for annual reporting of water quality in NSW by the Health

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**TABLE 3**

<table>
<thead>
<tr>
<th>PESTICIDE MONITORING IN NSW 1990-1992</th>
</tr>
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<tbody>
<tr>
<td>Year</td>
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<tr>
<td>------</td>
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<tr>
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<tr>
<td></td>
</tr>
</tbody>
</table>

Source: DAL Pesticides laboratory
1. Locations may vary due to water supplies becoming operational/non-operational.

**TABLE 4**

<table>
<thead>
<tr>
<th>NSW PERFORMANCE INDICATORS FOR 82 WATER SUPPLY SCHEMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbiological water quality</td>
</tr>
<tr>
<td>Physical water quality</td>
</tr>
<tr>
<td>Chemical water quality</td>
</tr>
</tbody>
</table>

* 1988 figures include information from 55 rural water supply schemes

Source: 1991 NSW Water Supply and Sewerage Performance Comparisons

Chemical and physical agents

For chemical analysis, excesses of iron and manganese, and for physical criteria, excesses of colour, turbidity, pH and conductivity, were the most common reasons for failure. These characteristics are generally not a public health risk but do affect the aesthetic quality of water and may cause people to seek drinking water from alternative sources, which may not be as safe.

Manganese and iron contamination stain clothes, and low pH causes corrosion and encrustation to pipework and plumbing fixtures. Turbidity, due to particulate matter in the water, can protect microorganisms from disinfection and promote bacterial growth.

Pesticides

The almost complete absence of pesticide residues in tested water should be viewed with some caution. The monitoring program, which tests only once or twice a year, is not specifically tailored to the timing or the type of pesticide used in each area.

Furthermore, this evidence stands in contrast to a NSW Water Resources study which found pesticide contamination at all sites tested in the Barwon, Gwydir, Namoi and Macquarie valleys, albeit at extremely low levels. The DAL pesticides laboratory does not have the technology or the resources to screen for all pesticides in use in NSW, but efforts are being made to widen this range.

RECOMMENDATIONS

The following recommendations are proposed in response to the issues presented in this review:

- The establishment of a formal avenue for annual reporting of water quality in NSW by the Health
That computerisation of data by DAL be given high priority.

A Health Department circular be distributed to water supply authorities, outlining their responsibility to conduct periodic water sampling as a basic public health preventive measure. Emphasis be placed on proper completion of the water sample record cards to ensure all relevant data are collected.

Water supply authorities be required to assess the long-term performance of their water supplies. This should be conducted on an annual basis in accordance with the guidelines, and the information should be provided to the PHUs.

Non-compliance of water supplies either on a short-term or long-term basis, requires follow-up investigation by the PHUs.

Consideration be given by the Public Health Network to the need for gastrointestinal symptom surveys in areas with supplies which regularly fail current microbiological criteria for water quality.

Enhance communication between DAL, the PHUs and the Public Health Section of the NSW Health Department. PHUs, local councils, PWD and the Department of Agriculture should be requested to provide DAL with an annually updated list of:

- supplies in each Region, and the number of locations requiring sampling. This will aid DAL in the programming of samples;
- pesticides used in each Area/Region, giving priority to those most widely used and of greatest toxicity; and
- annual patterns of pesticide use.

The pesticide monitoring program be structured to suit patterns of Statewide pesticide use. Another suggestion is to concentrate on Regions supporting the most intense agriculture and to sample these areas more frequently.

That Environmental Health Officers and/or Food Surveyors investigate the high degree of microbiological non-compliance of water used by food processing manufacturers.

Review of the water monitoring program take place when the new guidelines are adopted.

13. DAL. Chemical and physical data.
14. DAL. Pesticide data.