

**PROPOSED STANDARDS FOR  
DRINKING WATER QUALITY  
IN VICTORIA**

***DISCUSSION PAPER***

**November 2001**

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## **MAIN REPORT**

### **1. Introduction**

The regulatory framework for drinking water quality in Victoria is presently under review. The review results from a number of previous investigations and reports which identified a need to improve the existing regulatory structure for drinking water quality and variation in the quality of drinking water supplied around Victoria.

This paper summarises the technical issues involved in the selection of new standards for the quality of drinking water, including information on the standards that presently apply in Victoria. The information in this paper has been prepared as part of the ongoing regulatory reform process for drinking water quality, to inform and facilitate the process by which standards for drinking water quality will ultimately be selected for Victoria.

The regulatory context, including the roles and responsibilities of the various stakeholders, is discussed in more detail in the Consultation Paper, entitled “*A New Regulatory Framework For Drinking Water Quality In Victoria - Consultation Paper*”, jointly published by DHS and DNRE in August 2000, as well as the *Safe Drinking Water Proposal Paper* distributed with this discussion paper. The Consultation Paper can be downloaded from the Department of Natural Resources and Environment’s web site [www.nre.vic.gov.au](http://www.nre.vic.gov.au) (under Land and Water Management).

In this context, standards will be set by Regulations subordinate to a proposed new Act covering the quality of drinking water in Victoria. The standards will therefore be subject to an independent Regulatory Impact Statement, as per the process by which regulations are made in Victoria. The Regulatory Impact Statement will examine amongst other things the expected costs and benefits of the standards. Information derived from the consultation process for the standards will be used in developing economic impact assessments of the legislative framework and the Regulatory Impact Statement for the proposed Regulations.

Dispute resolution and related customer service issues have not been examined as part of this project. These issues are beyond the scope of this paper.

## **2. Background**

The quality of drinking water is crucial for public health and for environmentally sustainable development. Regardless of its source or where it is used, drinking water should be safe to consume, pleasant to drink, free of objectionable taste and odour and not be corrosive to plumbing or appliances.

### **2.1 Existing Standards in Victoria**

There are at present no legislated standards for drinking water quality that apply statewide in Victoria. The regulatory mechanisms and the required standards for the quality of drinking water in Victoria presently vary between the Melbourne metropolitan supply and the non-metropolitan urban sector. This has resulted largely from historic institutional arrangements as well as some differing local conditions affecting the quality of drinking water around Victoria. Detailed information about the various existing regulatory instruments can be found in the Consultation Paper referred to above.

The standards for drinking water quality presently applying to the non-metropolitan urban sector were established in 1994. They are set out in the 1997 Memoranda of Understanding, between the non-metropolitan urban water authorities and the then portfolio Minister, and the more recent Water Services Agreements, between the authorities and the portfolio Minister. The standards are based on the World Health Organization's "*Guidelines for Drinking-Water Quality*" (1984 edition, commonly known as WHO 1984). Although the 1984 guidelines were revised by the World Health Organization in 1993, the revised guidelines are generally similar to those in the 1984 edition. The specified standards are reproduced in Appendix A.

A small number of remote non-potable (non-drinking) water supplies managed by these authorities have been exempted from these standards. These exempted water supplies are not intended for drinking. A very small proportion of Victoria's non-metropolitan water supplies are not presently managed by the non-metropolitan urban water authorities and do not fall under the regulatory arrangements covering those authorities. They are managed by a number of bodies, such as Parks Victoria and the alpine resorts, and include a small number of local and municipal schemes. Water quality standards are not presently set for these systems.

The drinking water quality standards presently applying to the Melbourne metropolitan supply are set out in the current Operating Licences and the associated Customer Contracts for Yarra Valley Water, City West Water and South East Water. Standards are set for microbiological indicators (faecal coliform bacteria and total coliform bacteria), with a related requirement in the Customer Contracts to comply with a range of health-related chemical criteria. The standards are reproduced in Appendix A.

These standards and criteria are based on the "*Guidelines for Drinking Water Quality in Australia*" (NHMRC 1987), because these guidelines applied to the metropolitan water supply system at the time the licences were originally prepared (in 1994). The guidelines,

commonly known as NHMRC 1987, were published by the National Health and Medical Research Council (NHMRC) and the Australian Water Resources Council. NHMRC 1987 has been scientifically superseded by “*Australian Drinking Water Guidelines 1996*” (ADWG 1996).

## **2.2 Australian Drinking Water Guidelines 1996**

ADWG 1996 was published by the NHMRC and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) in 1996. It was based on the World Health Organization’s “*Guidelines for Drinking-Water Quality*” (1993 revision). The WHO 1993 guidelines were framed as a document from which a national or local set of guidelines can evolve, taking economics, health risk and other local factors into account. ADWG 1996 was supported by all Australian State Ministers for health and water supply, but has not yet been formally adopted by the Victorian Government.

ADWG 1996 is consistent with other guidelines and practices applying internationally. It has been prepared with extensive co-operation by the Australian water industry and represents the most appropriate source of information at the present time for drinking water quality in this country. It provides a comprehensive and informative base for setting performance standards for individual parameters, defining the characteristics of good quality drinking water and procedures for managing water supply systems so that consumers continually receive good quality drinking water. Further information about the relationship between ADWG 1996 and World Health Organization documents can be found in ADWG 1996 itself.

ADWG 1996 also incorporates an in-built mechanism for continual review, when new scientific or environmental information becomes available. For example, the Fact Sheets for the protozoa *Cryptosporidium* and *Giardia* were revised in 1999, widely circulated in draft form for public comment and review, then incorporated in 2000. Similarly, NHMRC has identified risk management frameworks as a significant focus of managing drinking water quality, with the draft “*Framework for Management of Drinking Water Quality: A Preventive Strategy from Catchment to Consumer*” being circulated for public comment earlier in 2001.

It should be noted that ADWG 1996 is not intended to be a prescriptive standard in its own right. The information within it needs to be adapted for each jurisdiction, to ensure that appropriate standards are intelligently applied.

The working group recommends that the “*Australian Drinking Water Guidelines 1996*” (ADWG 1996) be adopted as the basis for defining good quality drinking water for all urban drinking water supplies in Victoria and the basis of the scientific information used for setting standards for key parameters. All water suppliers should strive to supply drinking water that satisfies the criteria and principles set out in ADWG 1996. The WHO 1984 and NHMRC 1987 guideline documents should be regarded as obsolete.

This recommendation forms the basis for adapting ADWG 1996 for Victoria.

### 2.3 Drinking Water Standards in Context

The regulatory framework for drinking water quality in Victoria is designed to require water suppliers to develop and implement an integrated risk management framework for drinking water quality, comply with standards for water quality that are based on national guidelines, communicate effectively with all stakeholders and publicly disclose relevant water quality information.

Standards for the quality of water supplied to consumers are essential because the supply of drinking water is an essential public health measure over which consumers can not readily exercise individual control. Further, drinking water is generally supplied in Victoria by capital intensive natural monopolies subject to significant information asymmetry on quality issues. For these reasons, clear standards set by Government set appropriate drivers for investment decisions by water suppliers and provide confidence to consumers. Standards also enable regulatory agencies to monitor and benchmark the quality of water supplied, the performance of water suppliers and the appropriate price of drinking water.

The integrated risk management framework for drinking water quality and public disclosure requirements are also essential components of the regulatory framework. In particular, they address the quality of the management activities of the water supplier concerned and address issues that do not readily lend themselves to being assessed by standards set at consumer supplies, such as catchment management issues. Since it is not feasible to sample all the water supplied, or capture or anticipate all possible intermittent events that may affect water quality, flexible risk management strategies need to be developed and implemented.

In particular, risk management includes, but is not limited to, determining the degree to which particular water supplies are exposed to risks from such matters as pesticide residues, environmental hazards, blue-green algae toxins and pathogenic (disease causing) organisms such as *Giardia*, *Campylobacter*, *Salmonella* and *Cryptosporidium*.

For remote supplies in Victoria where the reticulated water is not intended for drinking (i.e. non-potable supplies), the water supplier concerned would need to take all reasonable steps to ensure that the water supplied under these circumstances was not inadvertently consumed and was also suitable for its intended purpose. This again forms an essential component of a water supplier's risk management framework. Standards will not apply to these zones.

If complied with, the standards, risk management requirements and public disclosure requirements can together be expected to provide sufficient transparent evidence to consumers, regulatory agencies and Government that drinking water supplies in Victoria are aesthetically satisfactory and unlikely to pose a risk to public health.
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Risk management frameworks are described in more detail in the Consultation Paper, the Proposals Paper and the NHMRC risk management framework document referred to in Section 2.2 above.

### **3. Proposed Drinking Water Standards**

This Chapter summarises the performance standards proposed for drinking water quality for Victoria and explains the detailed information in the Table in Appendix B. In this context, the term standard means a benchmark or degree of quality against which some thing (in this case, the quality of drinking water supplied to consumers) can be measured or assessed.

Two further requirements that complement the drinking water standards are also proposed under the regulatory framework. Firstly, drinking water supplied to consumers should not contain any pathogen, substance, object, chemical or blue-green algae toxin, whether alone or in combination, at levels which may at any time pose or be suspected to pose a risk to human health.

Secondly, drinking water supplied to consumers must at all times be fit for human consumption. In this context the concept of ‘fit for human consumption’ describes, in general terms, potential gross failure of the drinking water supply or localised very poor quality water. For supplies intended for drinking, every litre of water supplied to consumers must be fit for human consumption.

The standards and monitoring proposed are intended for annual assessment of the quality of drinking water supplied to consumers. They are not intended for designated non-potable supplies, nor are they intended to be the sole controls on drinking water quality in Victoria.

#### **3.1 Categorisation of Drinking Water Standards**

The parameters listed in ADWG 1996 have been evaluated with regard to their likely relevance to the quality of drinking water in Victoria, the level of information currently available about them, the degree to which they are controllable in a well managed system and the degree to which setting performance standards would be beneficial to consumers.

The 38 parameters for which standards are proposed generally coincide with the existing criteria for non-metropolitan urban water authorities (except a small number of organic chemicals) and parameters traditionally monitored in the Melbourne metropolitan supply. Parameters and standards used interstate and in legislatively comparable jurisdictions such as the United Kingdom have also been assessed.

This selection process is consistent with the principles underlying ADWG 1996. It recognises a hierarchy of parameters, in which effort should be focussed on those which have key public health or consumer significance. As previously stated, all parameters in ADWG 1996, whether proposed to be directly assessed as standards or not, need to be considered by water suppliers in compiling their risk management frameworks for drinking water.

The proposed compliance criteria for the selected microbiological parameters, inorganic chemicals, organic chemicals, radiological and physical parameters (including some aesthetic criteria) are set out in Appendix B. These criteria consist of specified monitoring locations and a minimum monitoring frequency, as well as a statistically valid measure of annual compliance. The actual performance standard is based on the ADWG 1996 guideline value for that parameter. The proposed standards are designed to be applied for each individual water quality zone, based on rolling annual assessment of routine data.

Appendix B also compares the individual guideline values for each parameter, for ADWG 1996, WHO 1984 and NHMRC 1987. Further technical detail about the individual parameters can be found in ADWG 1996. Some of the parameters listed in Appendix B, including conductivity, chloroform and a range of pesticides, are only described briefly in ADWG 1996.

The statistical measures follow the principles set out in ADWG 1996 (Section 6.3, Long-term Evaluation of Results). In brief, health-related chemical criteria are proposed to be assessed against the 95th (or upper) percentile of the annual data for that zone, while non health-related criteria are most suitably assessed against the mean (average) of the annual data for that zone.

The key feature of Appendix B is that each of the parameters listed in ADWG 1996 have been assigned to one of ten categories, as summarised in Table 1.

Table 1 **Categorisation of drinking water quality parameters**

	<b>Category</b>	<b>Number of parameters</b>
(a)	Proposed Microbiological Standards	2
(b)	Proposed Physical and Chemical Standards	23
(c)	Additional Standards for Supplies Disinfected with Chlorine based Chemicals	5
(d)	Additional Standards for Supplies Disinfected with Ozone	2
(e)	Additional Standards for Supplies Treated with Alum	1
(f)	Parameters for which Community Based Standards are proposed	5
	<b>TOTAL PROPOSED STANDARDS</b>	<b>38</b>
(g)	General Parameters for which Standards are not proposed	47
(h)	Other parameters for which ADWG 1996 sets no guideline value	30
(j)	Pesticides listed in ADWG 1996 for which Standards are not proposed	114
(k)	Pathogenic and Nuisance micro-organisms	25
	<b>GRAND TOTAL</b>	<b>254</b>

Categories (a) to (f) set out the 38 key parameters for which standards are proposed. The standards for the parameters in Categories (a) and (b) are intended to apply universally across Victoria, whereas the standards for parameters in Categories (c) to (e) apply only to a selected set of zones, based on the treatment process employed. The standards for the parameters in Category (f) are non-health related criteria that are intended to be based on local community agreements rather than necessarily being uniform across Victoria. Suggested default standards, based on ADWG 1996 guideline values, are provided for the parameters in this category.

Categories (g) to (j) list the remaining parameters from ADWG 1996 or WHO 1984 for which performance standards are not, at this time, likely to be useful. Most of these parameters are uncommon chemicals which are not ordinarily likely to be detected or pose a health risk in drinking water in Victoria. Category (k) comprises microbiological or environmental hazards which may pose a waterborne risk to health from time to time but for which, at present, ADWG 1996 does not establish health-related guideline values (principally due to poor or incomplete scientific data).

Developing performance standards for the parameters in Categories (g) to (k) is inappropriate and also impracticable. The levels of these parameters in water supplies, as with others, are best controlled by each water supplier employing suitable risk management systems tailored for each supply, in accordance with the general advice in ADWG 1996 and their professional duty of care. For this to be effective, risk management systems need to incorporate appropriate monitoring, disclosure and incident response for each parameter, based on the most likely level of risk posed in that supply.

More detailed information about the categorisation of parameters is provided below.

### 3.2 Details of Proposed Drinking Water Standards

The following information outlines the features of the categories of the Table in Appendix B.

<b>Category (a)</b>	<b><i>Proposed Microbiological Standards</i></b>
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Category (a) comprises microbiological parameters, represented by *E. coli* and total coliform bacteria, which are the most significant and commonly employed bacteriological indicators. Although the significance of total coliforms is presently being debated, under the NHMRC public review process, they remain at present key indicator organisms and a key element of any water supplier's risk management strategy. Nevertheless, it remains prudent to examine options and cost implications for standards for total coliforms in Victoria, in order to assist Government and policy makers to make informed choices.

The analytical tests for these parameters are based on statistically determining the number of organisms in a 100 mL sample. Expressions such as 'X% < Y' are commonly used to summarise data from microbiological monitoring results. This expression means that X% of routine samples had a result of less than Y organisms/100 mL. For example, < 1 (= zero) means no organisms were detected in that 100 mL sample. Further information about analytical tests for these indicator organisms can be found in scientific literature, ADWG 1996 and the British document Report 71 (1994).

In all cases, each individual sample should satisfy the applicable standard, which in the case of *E. coli* is 0 orgs/100 mL. The proposed annual performance standard for *E. coli* is 98% < 1 orgs/100 mL.

The proposed annual performance standard for total coliforms is either 95% < 1 orgs/100 mL, or an alternative standard for zones with a reduced risk profile, again based on annual assessment. Options presently being examined for an alternative annual performance standard for total coliforms are 95% ≤ 10 orgs/100 mL and 95% ≤ 20 orgs/100 mL. Details of the performance standards are shown in Table 5.

If an alternative performance standard for total coliforms was adopted, it would generally be restricted to those individual zones in the metropolitan supply, or selected non-metropolitan supplies with a similar risk profile, where the water supplier can continually demonstrate that a reduced level of microbiological risk applies all the way from protected catchment to consumer taps. Those zones for which a reduced level of microbiological risk from catchment to tap could not be demonstrated would be required to comply with the general performance standard of 95% < 1 orgs/100 mL for total coliforms that would apply across Victoria.

Application of an alternative performance standard, if approved by the Minister for Health on advice of the Department of Human Services, is consistent with the criteria set out in ADWG 1996 (Section 2.8, System Performance) and the Department's policy position on risk management and total coliforms for supplies such as the Melbourne metropolitan supply.

<b>Category (b)</b>	<b><i>Proposed Physical and Chemical Standards</i></b>
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Category (b) comprises key physical and chemical parameters for which universal standards are proposed. These include selected inorganic chemicals, organic chemicals, pesticides and radiological and physical parameters. Although most criteria are health-related, key non health-related criteria, such as pH, turbidity, iron and manganese, have been included, due to their aesthetic impact. These parameters are identified by the letter 'N' in Appendix B. Details of the individual parameters and the derivation of the guideline values and health risk assessment can be found in the relevant Fact Sheets in ADWG 1996.

The most notable chemical standard which varies from the current standard is that for arsenic. The new standard, based on the ADWG 1996 guideline value of 0.007 mg/L, is stricter than the existing standard, which is based on the WHO 1984 (and NHMRC 1987) guideline value of 0.050 mg/L. This should be noted particularly by water authorities supplying those towns in western Victoria drawing water from ground water supplies. Stricter standards for lead and cadmium may also be significant for a small number of Victorian towns. Standards for metals in this category are based on analysis for the total metal rather than particular species.

The standard proposed for manganese is based on the non health-related guideline value of 0.1 mg/L rather than the health-related guideline value of 0.5 mg/L. This is because the

acceptable concentration of manganese in drinking water, in particular, is limited by aesthetic considerations. If the concentration exceeds 0.02 mg/L black water problems may occur. If the concentration exceeds 0.1 mg/L, there is a high potential for black water problems.

The proposed standard for pH requires 95% of samples in each zone to be in the range 6.5 to 9.2 inclusive. Although a more restricted range of 6.5 to 8.5 is preferred in ADWG 1996, an upper limit of 9.2 is permitted for zones where some leaching from cement lined pipes and tanks may be expected in the short term. The upper limit of 9.2 is also suitable for chloraminated supplies (common in Victoria), where optimum disinfection occurs in the range 8.0 to 8.4. A universal upper limit of 9.2 has accordingly been proposed as more suitable for Victoria than the stricter limit of 8.5.

Turbidity relates to the cloudiness of water and measures the amount of fine suspended or colloidal material in the water. High or variable turbidity can shield micro-organisms and enteric pathogens from disinfection, thereby significantly affecting the microbiological safety of drinking water in a manner that indicator organisms may be unable to detect.

Water with a turbidity above 5 NTU is unlikely to be of acceptable appearance to consumers and also tends to have higher oxygen demand and chlorine demand. Filtered water supplies should be readily able to achieve turbidity below 1 NTU and preferably below 0.5 NTU. The standard proposed for turbidity is therefore 1 NTU for filtered supplies and 5 NTU for all other supplies.

The maximum concentration of fluoride in fluoridated supplies is independently governed by the requirements of the *Health (Fluoridation) Act 1973*. Water authorities will need to ensure that levels of naturally occurring fluoride in non-fluoridated systems do not exceed 1.5 mg/L. The remaining heavy metals, organic chemicals and radiological indicators listed in Category (b) have been well established in all guideline documents previously used in Victoria.

<i>Categories (c), (d) and (e)</i>	<p><i>Additional Standards for Supplies Disinfected with Chlorine based Chemicals</i></p> <p><i>Additional Standards for Supplies Disinfected with Ozone</i></p> <p><i>Additional Standards for Supplies Treated with Alum</i></p>
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These categories follow the same format as Category (b), but are only proposed as additional standards for those water supplies where the treatment or disinfection process in question is used. For all supplies in Victoria, water suppliers still need to consider these parameters and treatment plant performance as part of their integrated risk management framework.

Although disinfection employing chlorine based chemicals is by far the most common form of disinfection applied in Victoria, it is not universal. Therefore, by-products relating to chlorine-based disinfection (including chlorine dioxide) have been placed in Category (c).

Total trihalomethanes, for example, are a group of chemicals that can be generated as a by-product by high or unsuitable doses of chlorine in coloured surface water supplies containing organic matter. Some individual compounds of this group, such as chloroform, which is presently monitored in non-metropolitan systems, may be carcinogenic in humans. They can also affect the taste and odour of drinking water. The performance standard for total trihalomethanes will require water suppliers to think very carefully about acceptable levels of disinfectants in water supply systems and consumer perceptions of water taste and odour.

Acid-soluble aluminium is presently regarded as the best available indicator for the level of bio-available aluminium in water. The standard for acid-soluble aluminium would only apply to those zones where treatment using aluminium salts has been used for chemical coagulation (i.e. those zones where the water supplier significantly controls the level of aluminium in the water). Applicability of the performance standard for aluminium to zones receiving water from blended supplies would be determined on a case-by-case basis, depending on the proportion of the zone's supply originating from treatment plants using aluminium.

Bromate and formaldehyde can potentially be generated as a by-product of disinfecting water by ozonation, but would be very unlikely in systems not using this process. This process, employing ozone rather than chlorine as the disinfectant, is relatively uncommon in Victoria.

<i>Category (f)</i>	<i>Parameters for which Community Based Standards are proposed</i>
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The parameters listed here are those for which community based variations may be suitable around the State, depending on local community wishes. They include total dissolved solids, hardness, true colour, sodium and chloride. These parameters principally affect the taste, appearance or palatability of the water supplied and derive from the nature of the source water used for that supply. Other non health-related criteria, over which all water suppliers can be expected to exhibit effective operational control, have been placed in Categories (b) and (e) and are therefore not proposed to be variable.

None of the parameters in Category (f) affect health, in concentrations likely to be found in drinking water in Victoria. The water supplier would be expected to negotiate with local consumers and key industrial customers, by a set process, and agree with them on a preferred standard which could apply locally. Once a local community standard has been approved by the Minister for Health, on the recommendation of the Department of Human Services, it would then be regulated as any other standard.

This flexibility is intended to ensure that local communities, especially in north western Victoria, where these parameters may be a significant issue, do not pay for unnecessary aesthetic improvement works. In the event that agreement on an alternative community based standard can not be reached, the ADWG 1996 guideline values shown in the table could be adopted as performance standards for these parameters. For consumers in most large supplies in Victoria the ADWG 1996 default guideline value would be expected to be acceptable and easily met. The standards for these parameters would then be based on the guideline values.

<b>Categories (g), (h) and (j)</b>	<b>General parameters for which Standards are not proposed</b> <b>Other parameters for which ADWG 1996 sets no guideline value</b> <b>Pesticides listed in ADWG 1996 for which Standards are not proposed</b>
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Categories (g) to (j) list the large number of remaining parameters from ADWG 1996 for which performance standards are not, at this time, proposed. These include a wide range of pesticides, organic chemicals and inorganic chemicals (including some heavy metals) which ADWG 1996 usually describes as being unlikely to be detected or have not been detected in drinking water supplies in Australia. The parameters in Category (h) are those for which it is not possible to derive meaningful guideline values at present. The pesticides listed in Category (j) are drawn from an extensive list provided in ADWG 1996 (page GL – 13), mainly for use in the event of an environmental hazard or spill.

Chlorine and a small number of disinfection by-products are included in these categories. ADWG 1996 advises that the level at which the by-products (or related chemicals) may pose a health risk is significantly above the level at which they would be likely to generate an unpleasant taste or odour in the water. Therefore, a generic taste and odour requirement can be expected to ensure that levels of these by-products are controlled effectively.

However, taste and odour are not readily measurable as chemical components of the water. Accordingly, they have usually been worded in guideline documents as being ‘acceptable’ or ‘inoffensive’. A suitable protocol for measuring this parameter, acceptable both to consumers and to the regulator, will need to be developed by each water supplier. Although a number of models for assessing consumer satisfaction in this area are available, ranging from surveys to chemical odour tests, acceptability will depend on the needs and expectations of consumers.

The disinfection by-product chloroform has also been placed in this category, although it is presently regulated under the Memoranda of Understanding and Water Service Agreements. Chloroform is a component of the chemical group identified in ADWG 1996 as ‘total trihalomethanes’. Total trihalomethanes as a group have been placed in Category (c).

No specific requirement is proposed for the small number of uncommon physical or chemical parameters in these categories with no known health effect in drinking water supplies. These are identified by the letter ‘N’ in Appendix B, and include ammonia, dissolved oxygen, zinc, hydrogen sulfide, temperature, electrical conductivity and tin.

<b>Category (k)</b>	<b>Pathogenic and Nuisance micro-organisms</b>
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This category lists a range of key pathogenic (disease-causing) bacteria, viruses, protozoa and blue-green algae toxins, such as *Campylobacter*, *Salmonella*, *Giardia* and *Cryptosporidium*. These micro-organisms and toxins should not be present in drinking water.

Meaningful guideline values, and hence performance standards, can not readily be derived at present for parameters in this category, principally due to poor or incomplete scientific data. Monitoring techniques are still largely experimental, unreliable and costly. As with the chemicals listed in Categories (g) to (j), parameters in Category (k) are suitably addressed by integrated risk management strategies that particularly consider the intermittent nature of contamination events in each specific catchment or water source, as well as the general requirement that drinking water is at all times fit for human consumption.

## **4. Monitoring Requirements**

This Chapter outlines the importance of sampling location, monitoring frequency, method of monitoring and statistical analysis that would accompany the proposed performance standards for drinking water quality. Monitoring of non-potable supplies would be at the discretion of the supplier concerned, pursuant to the disclosure and risk management framework suitable for supplies of this nature.

### **4.1 Water Quality Zones**

A water sample collected at a particular time and place only represents the composition of the water at that time and place. The sample can only be considered to represent the general condition of that water supply if the supply is of fairly constant composition over a substantial period of time. In order for monitoring to be as meaningful as possible, water supply systems are normally subdivided into areas or ‘zones’, each with fairly consistent water quality.

Sampling for performance assessment would then take place at locations in each water quality zone that represent supplies to consumers. A Water Quality Zone can be defined as follows:

*“A town, or other geographically distinct area, served by a distribution system, in which the water supplied to consumers could reasonably be expected to be of similar quality throughout all parts of the zone.”*

The population breakup for water quality zones across Victoria is shown in Table 2 below.

Table 2 **Population breakup of towns and zones throughout Victoria**

<b>Population range</b>	<b>Number of towns or zones in this range #</b>	<b>Total population in this range</b>	<b>% of statewide non-metro population</b>
Towns over 10,000:	27	609,950	54 %
Towns 5,000 - 10,000:	23	169,270	15 %
Towns 2,000 - 5,000:	56	169,090	15 %
Towns 1,000 - 2,000:	68	93,600	8 %
Towns 500 - 1,000:	74	49,250	4 %
Towns 200 - 500:	117	34,530	3 %
Towns below 200:	104	11,030	1 %
<b>NON-METRO TOTAL:</b>	469	1,136,720	100 %
<b>Metropolitan system:</b>	68 zones	3,061,486	---

Notes: # Population data from water authorities as in DHS statutory water quality database, 2000.

The Table shows that a small proportion (4%) of Victoria's non-metropolitan population is dispersed over a large number of very small towns (221 towns with population below 500). Most of Victoria's non-metropolitan population (54%) reside in zones with a population over 10,000. Supplies not managed by water authorities have been excluded from the Table.

Standards designated as 'Zone' in Appendix B are for parameters whose levels may change within the water supply distribution system or result from applied treatment processes (such as disinfection by-products). Accordingly, they will need to be sampled as close as reasonably possible to the supply to the consumer. This means at or near consumer properties or mains, rather than service reservoirs, basins, tanks, standpipes, treatment plants, transfer mains or water sources. Monitoring at these other locations would be considered separately by the water supplier as part of its catchment to tap risk management strategy. Such operational monitoring would not be used for assessing compliance with performance standards.

The zones refer to the existing water quality zones reported to the Department of Human Services and established in the metropolitan licences, or zones otherwise set by the Department as part of the monitoring process for the non-metropolitan urban authorities. In future, zone boundaries and layout may be reviewed by the Regulator.

The designation 'System' in Appendix B means that the sample may be taken from entry points representing water from each source, after treatment and/or disinfection. This designation applies to those parameters whose level is likely to remain unchanged in the water supply system after initial treatment. Where a number of zones are supplied from one system or treatment process, the same system sample results may be used for reporting water quality in the corresponding individual zones. This flexibility is essentially a geographical convenience. Sampling these parameters from representative zones rather than upstream entry points is equally applicable, if the water supplier finds this more operationally convenient.

Although standards are designed to be measured at or near supplies to consumers, water suppliers would normally, under their risk management and public disclosure obligations, inform their customers where the water supplied may affect the serviceability of domestic plumbing, equipment or appliances, or where water quality may change downstream of the point where the standards are measured.

Special purpose sample taps constructed just upstream of the water supply meters at the front of consumer supplies are recommended for monitoring the quality of water at those locations. They should not be within buildings or homes. The taps should be sealed from contamination, materially identical to each other, and used solely for monitoring drinking water quality. This is similar to the existing arrangements for the Melbourne metropolitan supply.

The distribution of such sampling points throughout each zone would normally be based on a prescribed protocol. Briefly, this would consider the age and state of the reticulation mains, variations in flow patterns, population (including variations due to tourism), residence time of water in the distribution system, location of dead-end mains and location of key industrial and

commercial customers. All sample sites would have a defined location and be registered on a database with a unique sitecode. Each water quality zone would also be uniquely identified.

For statewide comparability of data, it is essential that sampling is performed by personnel fully trained in field procedures and quality control processes and samples are analysed at approved laboratories in accordance with Department of Human Services requirements as to analytical methodology and accreditation. Field-based determination of results should not be used for compliance assessment. For quality control, sampling itself would also be audited.

The statistically valid compliance monitoring that is proposed will provide a higher degree of assurance that the results reflect the actual quality of drinking water received by consumers. This allows water suppliers to readily demonstrate to their customers that the quality of water satisfies regulatory requirements. Nevertheless, compliance monitoring programs designed to measure water at consumer supplies normally form only a small component of a water supplier's overall water quality monitoring program. All monitoring programs should allow for any significant seasonal variation in water quality.

#### 4.2 Microbiological Monitoring Frequency

The proposed monitoring frequency for the microbiological parameters in Category (a) is shown in Table 3. It is based on sampling each Water Quality Zone in a manner that represents the quality of water supplied to consumers, at a frequency determined by the zone population (generally based on ADWG 1996 Table 2.3). The frequencies shown are minima, in that water suppliers may choose to monitor more frequently for their monitoring schedules or risk management strategies. Table 3 is drawn from Table 5.

The sampling set out in Table 3 is more frequent than the minimum currently specified in the Health (Quality of Drinking Water) Regulations, whose Schedule was partially derived from information in NHMRC 1987. The most significant differences are for zones from 200 to 2,000 in population, where weekly monitoring is proposed to replace the present minimum of monthly monitoring. For zones larger than 10,000 in population, the change in minimum monitoring from the existing Regulations to the proposed system is minor.

Table 3 Proposed minimum microbiological sampling frequency

Zone population	Minimum number of microbiological samples to be taken at consumer supplies in each zone for assessment
below 200	one per week, unless the water supplier can demonstrate a reduced level of microbiological risk, in which case one per month
200 - 5,000	one per week
5,000 - 100,000	one per week plus one additional sample per month for each 5,000 above 5,000
above 100,000	six per week plus one additional sample per month for each 10,000 above 100,000

Monitoring for assessment at consumer supplies would normally follow a random or substantially random schedule, with sampling taking place through the day, including summer evenings when water use is highest, and also weekends. If zone population seasonally varied due to tourism, the monitoring frequency for the months with the higher population would also need to be adjusted accordingly. Otherwise, zone population means the permanent population of a zone.

For this Table, calculated fractions would normally be rounded up at monthly level if  $> 0.20$  or rounded down at monthly level if  $\leq 0.20$  to form a whole number of monthly samples, then multiplied by twelve (or pro rata for zones with seasonal population changes) to arrive at an annual total number of samples. The figure 0.20 is based on a reasonable interpolation of the population intervals in the table and allows for uncertainty in the zone population estimates (i.e. it allows a relative 20% uncertainty over the intervals of 5,000 or 10,000). Calculated monitoring frequencies for a range of zone populations are shown in Table 4.

For practical purposes, an optional minimum of monthly rather than weekly monitoring is proposed for those towns with a population below 200 where the water supplier can demonstrate a reduced level of microbiological risk. This differs slightly to ADWG 1996, which permits a reduced monitoring frequency for towns below 1,000 population provided other effective barriers to contamination are in place (details in Section 7.5 of ADWG 1996).

The more frequent monitoring (i.e. at least weekly) is proposed for as many towns or zones as possible in Victoria, to provide statistically valid assurance that the microbiological quality of water supplied to consumers is being accurately assessed. ADWG 1996 points out that “*from a statistical viewpoint, if the water is sampled less than once a week, then even if all samples are free of contamination, there is only a low degree of confidence that the supply is free of contamination*” (Section 2.8.1). If one or more samples taken over a year fail, or if risk management processes are ineffective, then the degree of confidence that the water supply overall is free of contamination is also reduced. Further information on the importance of statistically valid microbiological monitoring can be found in Section 2.8 of ADWG 1996.

As shown in Table 2, the smallest towns in Victoria (i.e. those below 200 population) account for no more than 1% of the overall non-metropolitan urban population. The population limit of 200 is proposed as it was already used when categorising non-potable (non-drinking) water supplies under Schedule D of the 1997 Memoranda of Understanding (and updated in Section 1 of Schedule E of the Water Services Agreements).

### **4.3 Physical and Chemical Monitoring Frequency**

The proposed monitoring frequencies for parameters in Categories (b) to (f) are shown in Appendix B. Unlike microbiological monitoring, physical and chemical monitoring schedules need not depend on zone population. The frequencies shown (i.e. fortnightly, monthly, quarterly or annually) are based on the likely variability of these parameters in water supply systems. Monitoring for parameters in Categories (g) to (k) would not be mandatory.

For some parameters, the proposed monitoring frequency differs to that shown in ADWG 1996. The frequencies shown are regarded as more suitable for compliance assessment of annual performance standards than the generic operational advice provided in ADWG 1996, which is intended for water suppliers in developing their operational monitoring strategies.

For some supplies, water authorities may be able to demonstrate, based on local conditions, that routine monitoring may not be necessary at consumer supplies for every chemical parameter for which standards are proposed. This may apply to chemicals whose levels are principally governed by catchment or source water quality rather than activities by the water supplier. For example, quarterly monitoring for herbicides and pesticides would be targeted to times of the year that spraying or agricultural application is known or most likely to occur.

In these circumstances, the water supplier may be able to obtain an exemption from the set monitoring requirement, provided they identified an alternative way in which they could demonstrate that the water complied with the annual performance standard. Water suppliers may also need to monitor more frequently in some supplies than the minimum level set out in Appendix B, to demonstrate compliance with the annual performance standard. Again, this would depend on local circumstances and risk management assessments.

#### 4.4 Statistical Measures of Compliance

As indicated previously, the proposed annual performance standard for each parameter incorporates a statistical measure of compliance. The statistical terms are shown in Figure 1.

For the microbiological criteria in Category (a), the percentage shown in the left hand side of Table 5 is the minimum percent of scheduled samples taken per annum at the specified locations that would be required to satisfy the specified criteria. An annual performance standard of  $98\% < 1$  for *E. coli* implies that at least fifty samples should be considered.

For those towns below 200 population where the microbiological monitoring frequency has been reduced from weekly to monthly due to a demonstrated reduced level of microbiological risk (i.e. towns with twelve samples per annum), the applicable standard in Table 5 is worded so that “*no more than one sample per annum to have 1 or more orgs/100 mL*”, rather than as a percentage compliance. For all zones, follow up action must be taken by the water supplier in response to any individual failure.

For non health-related criteria, other than pH, the statistical measure ‘95% UCL of mean’ is proposed to be used to assess compliance. This measure refers to the 95% Upper Confidence Limit (UCL) of the mean of data from the scheduled samples taken per annum at the specified locations. For pH, at least 95 percent of scheduled samples taken per annum at the specified locations would be required to lie within the specified range (inclusive of end points).

For health-related chemical criteria, the statistical measure ‘95% UCL of 95th percentile’ is proposed. This measure refers to the 95% Upper Confidence Limit (UCL) of the 95th

percentile of data from the scheduled samples taken per annum at the specified locations. The relationship between these terms is shown in Figure 1.

The Maximum Acceptable Level (MAL) referred to in Appendix B should be interpreted as a level above which investigations or follow-up actions are required, rather than an absolute maximum never to be exceeded. In some cases an MAL value has been nominated instead of a 95% Upper Confidence Level value because of the small number of samples expected to be tested per annum for compliance purposes.

MAL guideline values for health-related characteristics should not be exceeded in consecutive routine samples. For metals such as arsenic, chromium or mercury, an individual result above the MAL would also be expected to trigger a more detailed assessment of the significance of the contaminant, considering the form and toxicity of particular species of the metal.

For all parameters, if individual sample results fail to satisfy the performance standards or guideline values, or are otherwise of concern, immediate resampling and investigation would normally be undertaken, pursuant to the water supplier's risk management plans.

ADWG 1996 provides clear guidance on how confidence limits and percentiles can be used to assist water suppliers in compiling a risk management framework. As the principal function of compliance monitoring is to demonstrate that the water supplied to consumers meets the performance standards, water suppliers' risk management strategies and operational activities will need to rely on other information in order to be most effective.

Table 4 Proposed minimum monitoring frequency for assessing microbiological quality

Document:	Proposal based on ADWG 1996			Existing Regulations		
Population	## Weekly Minimum	## Monthly Minimum	Calculated Annual Minimum	## Weekly Minimum	## Monthly Minimum	Calculated Annual Minimum
below 200	NS	1	<b>12</b>	NS	1	<b>12</b>
500	1	NS	52	NS	1	<b>12</b>
1,000	1	NS	52	NS	1	<b>12</b>
1,500	1	NS	52	NS	1	<b>12</b>
2,000	1	NS	52	NS	1	<b>12</b>
3,000	1	NS	52	NS	1	<b>12</b>
4,000	1	NS	52	NS	2	<b>24</b>
5,000	1	NS	52	NS	2	<b>24</b>
5,000	1	0	52	NS	3	<b>36</b>
6,000	1	1	64	NS	3	<b>36</b>
7,000	1	1	64	NS	4	<b>48</b>
8,000	1	1	64	NS	4	<b>48</b>
9,000	1	1	64	NS	5	60
10,000	1	1	64	NS	5	60
15,000	1	2	76	NS	6	72
20,000	1	3	88	NS	7	84
25,000	1	4	100	NS	8	96
30,000	1	5	112	NS	9	108
35,000	1	6	124	NS	10	120
40,000	1	7	136	NS	11	132
45,000	1	8	148	NS	12	144
50,000	1	9	160	NS	13	156
55,000	1	10	172	NS	14	168
60,000	1	11	184	NS	15	180
65,000	1	12	196	NS	16	192
70,000	1	13	208	NS	17	204
75,000	1	14	220	NS	18	216
80,000	1	15	232	NS	19	228
85,000	1	16	244	NS	20	240
90,000	1	17	256	NS	21	252
95,000	1	18	268	NS	22	264
100,000	1	19	280	NS	23	276
100,000	6	0	312	NS	23	276
110,000	6	1	324	NS	24	288
120,000	6	2	336	NS	25	300
130,000	6	3	348	NS	26	312
140,000	6	4	360	NS	27	324
150,000	6	5	372	NS	28	336
160,000	6	6	384	NS	29	348
170,000	6	7	396	NS	30	360
180,000	6	8	408	NS	31	372
190,000	6	9	420	NS	32	384
200,000	6	10	432	NS	33	396

Source:	ADWG 1996	Regulations 1991
Reference:	CI 2.8.1, Table 2.3	Regulation 7 (existing)
Rules change:	5,000 & 100,000	2,000 & 10,000 & 100,000
Comments:	Smooth at 5,000 Jumps at 100,000	Smooth at 5,000 Smooth at 100,000

## Note: "Monthly Minimum" values shown exclude the weekly component listed in the previous column. For populations below 10,000, they were rounded up, if necessary, to the next whole number. The horizontal lines indicate population levels where the rules describing weekly and monthly monitoring frequencies change significantly. NS means not specified. Calculated Annual Minimum = Weekly \* 52 + Monthly \* 12.

Since performance is commonly assessed annually, a "Calculated Annual Minimum" figure has been derived from the weekly and monthly figures in the reference Clauses and Tables. Annual performance targets of 95% or 98% imply that at least fifty samples should be considered. Therefore, any Calculated Annual Minimum below fifty is shown in **Bold**.

The monitoring shown in this Table is the minimum required to assess annual performance. Refer details in Chapter 4 herein.

Table 5 Proposed performance standards for microbiological parameters

Ref. No.	Parameter	Annual performance standard for each zone #	Zone population	Minimum number of microbiological samples to be taken at consumer supplies in each zone for assessment ##
PS1	<i>E. coli</i>	no more than one sample per annum to have 1 or more orgs/100 mL	below 200	one per week, unless the water supplier can demonstrate a reduced level of microbiological risk, in which case one per month
			200 - 5,000	one per week
		at least 98% < 1 orgs/100 mL	5,000 - 100,000	one per week plus one additional sample per month for each 5,000 above 5,000
			above 100,000	six per week plus one additional sample per month for each 10,000 above 100,000
Ref. No.	Parameter	Annual performance standard for each zone #	Zone population	Minimum number of microbiological samples to be taken at consumer supplies in each zone for assessment ##
PS2	total coliforms	no more than one sample per annum to have 1 or more orgs/100 mL	below 200	one per week, unless the water supplier can demonstrate a reduced level of microbiological risk, in which case one per month
			200 – 5,000	one per week
		at least 95% < 1 orgs/100 mL, or agreed alternative standard ###	5,000 - 100,000	one per week plus one additional sample per month for each 5,000 above 5,000
			above 100,000	six per week plus one additional sample per month for each 10,000 above 100,000

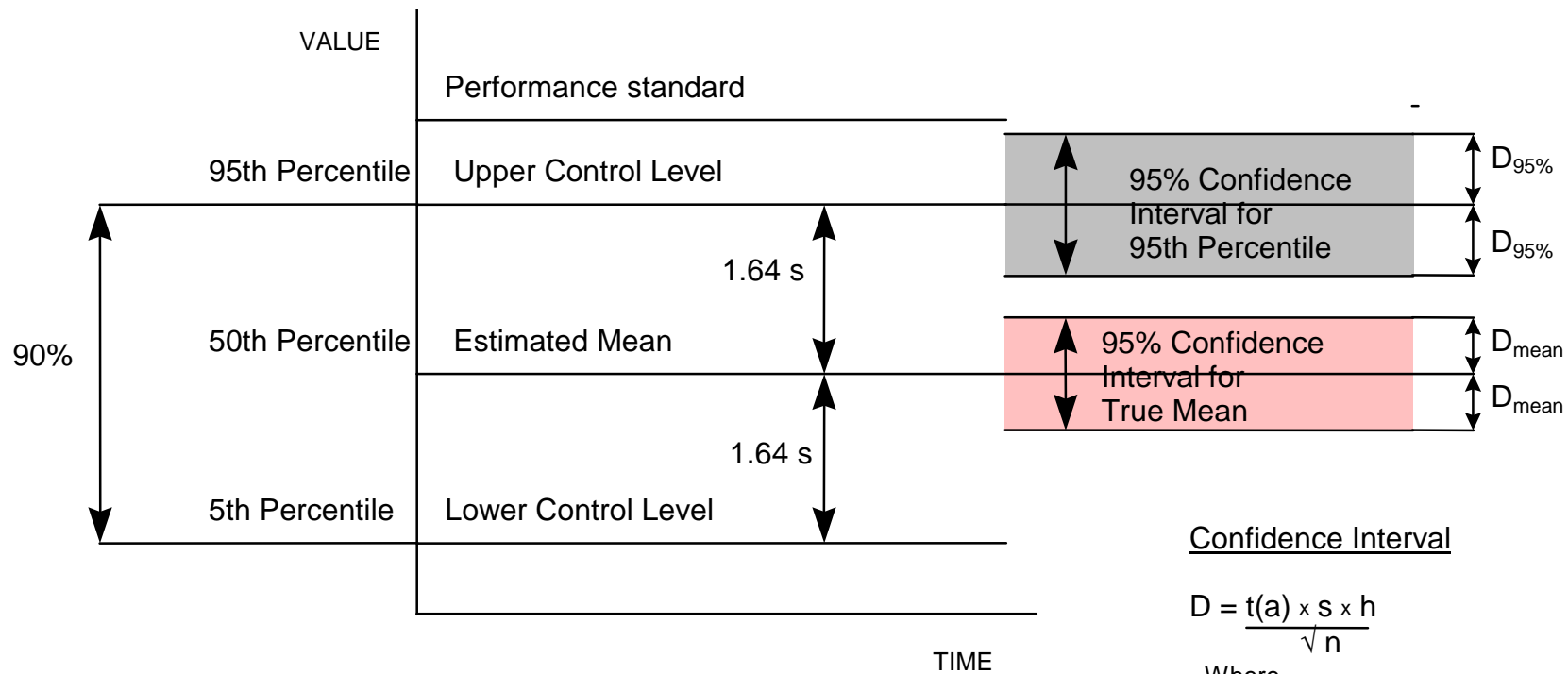
Notes: # The annual performance standards in this table do not apply to supplies that are not intended for drinking. The % in this Table refers to the minimum percent of scheduled samples taken per annum at the specified locations required to satisfy the indicated performance standards (PS1 and PS2). **In all cases, if individual sample results exceed the performance standards or are otherwise of concern, immediate resampling and investigation is required.** All microbiological analysis must be performed by approved laboratories in accordance with the NATA/DHS Memorandum of Understanding and DHS approved methodology.

## The monitoring frequencies for *E. Coli* and total coliforms are identical, but are shown separately for clarity. Zones means water quality zones as defined in Section 4.1 of this report. If zone population seasonally varies due to tourism, monitoring frequency for the months with the higher population will need to be adjusted accordingly. Otherwise, zone population means permanent population. Calculated fractions are to be rounded up at monthly level if > 0.20 and rounded down at monthly level if ≤ 0.20 to form a whole number of monthly samples, then multiplied by twelve (or pro rata for zones with seasonal population changes) to arrive at an annual total number of samples. 'At consumer supplies' means at or near consumer properties or mains, but excludes service reservoirs, basins, tanks, standpipes, treatment plants, transfer mains or water sources, which are to be considered separately by the water supplier and not to be used for assessing compliance.

### An alternative standard for total coliforms may be approved by the Minister for Health on advice of DHS, for those supplies where the water supplier can continually demonstrate a reduced level of microbiological risk all the way from catchment to consumer taps, in accordance with the principles of Section 2.8 of ADWG 1996 and to the satisfaction of DHS.

**FIGURES**

**FIGURE 1 STATISTICAL FRAMEWORK FOR PERFORMANCE ASSESSMENT**



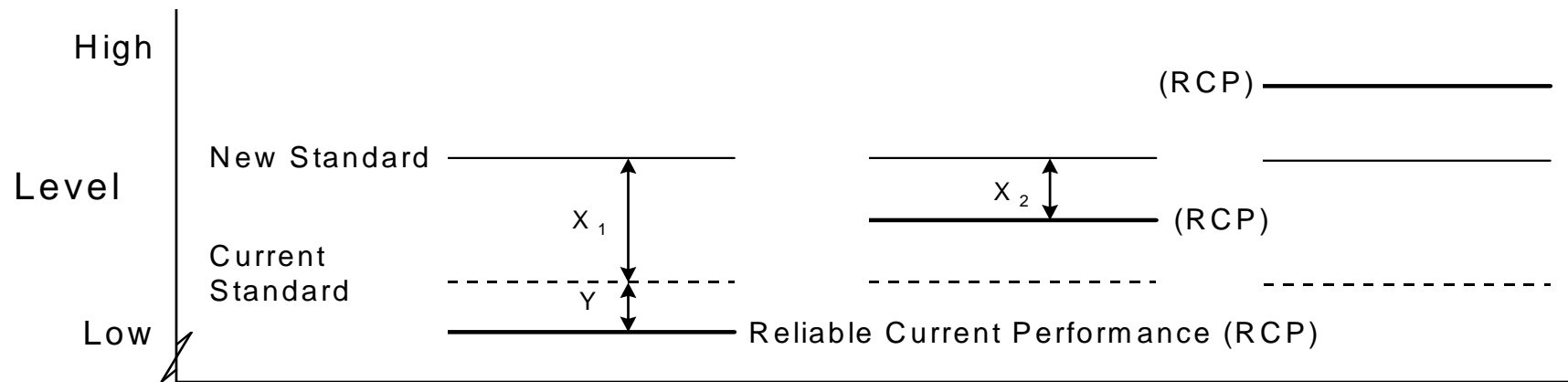
Confidence Interval

$$D = \frac{t(a) \times s \times h}{\sqrt{n}}$$

Where  
 D = half the confidence interval  
 t(a) = student 't' test statistic  
 s = standard deviation  
 h = uncertainty factor  
     mean = 1  
     95th percentile = 1.64  
 n = number of samples

Assumption: Data has a normal distribution and is unskewed;  
 refer to ADWG 1996 Section 6.3 for details.

FIGURE 2 IMPLICATIONS OF CHANGES TO PERFORMANCE REQUIREMENTS OR MONITORING REGIME



<b>Incremental Cost To Improve Performance</b>	Current Performance Under Performs Both Standards Case I	Current Performance Between Standards Case II	Current Performance Achieves Both Standards Case III
Improve to New Standard	$X_1$	$X_2$	No Cost
Improve to Current Standard	$Y$	No Cost	No Cost

## **LIST OF ABBREVIATIONS**

ADWG 1996	“ <i>Australian Drinking Water Guidelines 1996</i> ”, (National Health and Medical Research Council/Agriculture and Resource Management Council of Australia and New Zealand, 1996, Canberra)
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
DHS	Department of Human Services (Victoria)
DNRE	Department of Natural Resources and Environment (Victoria)
HU	Hazen Units (unit of measurement of colour)
MAL	Maximum Acceptable Level
mg/L	milligrams per litre
NHMRC	National Health and Medical Research Council
NHMRC 1987	“ <i>Guidelines for Drinking Water Quality in Australia</i> ”, (National Health and Medical Research Council/Australian Water Resources Council, 1987, Canberra)
NTU	Nephelometric Turbidity Units (unit of measurement of turbidity)
orgs/100 mL	unit of measurement of bacteria organisms in a 100 millilitre sample
Report 71, 1994	“ <i>The Microbiology of Water 1994 Part 1 - Drinking Water</i> ”, Report on Public Health and Medical Subjects No. 71, Methods for the Examination of Waters and Associated Materials, (HMSO, London, 1994 edition).
UCL	Upper Confidence Limit (statistical term)
WHO	World Health Organization
WHO 1984	“ <i>Guidelines for Drinking-Water Quality</i> ”, (World Health Organization, 1984, Geneva)
WHO 1993	“ <i>Guidelines for Drinking-Water Quality</i> ”, Second edition (World Health Organization, 1993, Geneva)

## **GLOSSARY OF TERMS**

Memoranda of Understanding	The “ <i>Memorandum of Understanding About Government Capital Contribution and Drinking Water Quality, Environmental and Dam Improvement Projects</i> ”, between the Government and each of the fifteen non-metropolitan urban water authorities (1997). These are being replaced in 2001 with Water Services Agreements.
Operating Licences	Water and Sewerage Licences held by Yarra Valley Water Ltd, City West Water Ltd and South East Water Ltd, pursuant to the <i>Water Industry Act 1994</i> and applying to the Melbourne metropolitan water supply system (refer extracts in Appendix A).
Consultation Paper	“ <i>A New Regulatory Framework For Drinking Water Quality In Victoria - Consultation Paper</i> ”, jointly published by DHS and DNRE in August 2000.
Drinking water (potable water)	Water that is intended for human consumption, but which may have other domestic uses. [ <i>after s1.1, ADWG 1996 – refer to Proposals Paper for full definition</i> ]
Good quality drinking water	Water that is aesthetically pleasing and which does not contain any pathogen, substance, object, chemical or blue-green algae toxin, whether alone or in combination, at levels that may at any time pose or be suspected to pose a risk to human health.
Non-potable supply	A water supply that is not intended for drinking (also known as a non-drinking supply).
Standard	A benchmark (usually numerical or quantifiable) against which some measured parameter is assessed. In the context of this report, the term water quality standard refers to a measure of the quality of water supplied to consumers.
Water Quality Zone	A town, or other geographically distinct area, served by a distribution system, in which the water supplied to consumers could reasonably be expected to be of similar quality throughout all parts of the zone.

**APPENDICES**

**APPENDIX A DETAILS OF EXISTING STANDARDS**

Extract from non-metropolitan urban water authority Memoranda of Understanding (1997) #

**SCHEDULE C****HEALTH-RELATED STANDARDS**

(based on "Guidelines for Drinking-Water Quality" issued by the World Health Organization, Geneva, in 1984)

<b>Parameter</b>	<b>Guideline Value</b>	<b>Remarks</b>
<b>Microbiological Quality</b> <i>E. coli</i> and coliform organisms	0 orgs/100 mL and 0 orgs/100 mL	in 95% of samples examined throughout the year
<b>Health-related inorganic</b> arsenic cadmium chromium cyanide fluoride  lead mercury nitrate selenium	0.05 mg/L 0.005 mg/L 0.05 mg/L 0.1 mg/L 1.5 mg/L  0.05 mg/L 0.001 mg/L 50 mg/L 0.01 mg/L	natural or deliberately added; local or climatic conditions may necessitate adaptation. Also should not exceed standards set by Department of Human Services under <b>Health (Fluoridation) Act 1973</b> .  1993 WHO guideline value
<b>Health-related organic</b> benzene benzo[a]pyrene carbon tetrachloride 1,2-dichloroethane 1,1-dichloroethene pentachlorophenol tetrachloroethene trichloroethene 2,4,6-trichlorophenol	10 µg/L 0.01 µg/L 3 µg/L 10 µg/L 0.3 µg/L 10 µg/L 10 µg/L 30 µg/L 10 µg/L	tentative guideline value     tentative guideline value tentative guideline value odour threshold concentration, 0.1 µg/L
<b>Disinfection by-products</b> chloroform	200 µg/L	1993 WHO guideline value
<b>Pesticides</b> DDT (total isomers) aldrin and dieldrin chlordane (total isomers) hexachlorobenzene heptachlor & heptachlor epoxide gamma-HCH (lindane) methoxychlor 2,4-D	1 µg/L 0.03 µg/L 0.3 µg/L 0.01 µg/L 0.1 µg/L  3 µg/L 30 µg/L 100 µg/L	
<b>Radiological</b> gross alpha activity gross beta activity	0.1 Bq/L 1 Bq/L	

# Schedule D of the Water Services Agreements is similar except that a provisional standard has been added for microcystin-LR.

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**WATER AND SEWERAGE LICENCE EXTRACT**  
**For Metropolitan Retail Water Companies**  
*Water Industry Act 1994*

**Water Quality Extract**

**8B Water quality monitoring**

- 8B.1 The licensee must conduct a water quality monitoring program in accordance with the Health (Quality of Drinking Water) Regulations 1991 and the Guidelines for Drinking Water Quality.
- 8B.2 The licensee must prepare and make publicly available a report of the results of its water quality monitoring program for the preceding financial year in accordance with Guidelines issued by the Office. The report must present the results for each supply zone described in Map A1 of Attachment 1 of the customer contract in Schedule 1 and include the number of samples taken.
- 8B.3 A copy of the report must be forwarded to the Office by 30 September each year.

**Water Quality Extract from Benchmark Customer Contract**

**4.4 Water quality**

- 4.4.1 Subject to clause 16.1.1, *Licensee Name* must ensure that the supply of drinking water to the outlet of the meter, or to the property boundary if there is no meter, is clear and free from objectionable odour and taste, and that the quality of the water:
- complies with the health-related parameters of *Guidelines for Drinking Water Quality In Australia 1987*, or any other requirement set by the Department of Human Services, except in the nominated zones listed in attachment 1 until the date shown there; and
  - is at least of equal quality to that provided by Melbourne Water Corporation before 1 January 1995.
- 4.4.2 *Licensee Name* will implement water quality improvement programs in the areas listed in attachment 1 to be completed by the dates indicated.
- 4.4.3 *Licensee Name* will conduct water quality monitoring programs.

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**SCHEDULE 2: PERFORMANCE STANDARDS**

STANDARD	CWW	SEW	YVW
<p><b>Drinking Water Quality</b></p> <p>% of samples taken over any twelve month period which comply with the requirements relating to faecal and total coliform levels contained in the <b>Guidelines for Drinking Water Quality</b>.</p> <p>For the purpose of this Standard -</p> <ul style="list-style-type: none"> <li>• the number of samples taken and the maximum interval between successive samples shall be in accordance with the Health (Quality of Drinking Water) Regulations 1991;</li> <li>• only samples representative of water at or near a customer's property shall be included;</li> <li>• samples taken within a <b>Nominated Improvement Zone</b> prior to the date by which a Water Quality Program is to be completed within that Zone shall be excluded.</li> <li>• <i>Escherichia coli</i> (<i>E. coli</i>) is to be used instead of faecal coliform.</li> <li>• Both <i>E. coli</i> and total coliforms are to be detected and enumerated using Defined Substrate Technology (DST), as specified by the Department of Human Services.</li> </ul>	<p>Faecal coliform: 95% of samples with zero faecal coliform /100ml</p> <p>Total coliform: 90% of samples with no more than 20 coliform organisms /100ml</p>	<p>Faecal coliform: 95% of samples with zero faecal coliform /100ml</p> <p>Total coliform: 90% of samples with no more than 20 coliform organisms /100ml</p>	<p>Faecal coliform: 95% of samples with zero faecal coliform /100ml</p> <p>Total coliform: 90% of samples with no more than 20 coliform organisms /100ml</p>

# APPENDIX B

# SUMMARY OF PROPOSED WATER QUALITY STANDARDS

Department of Human Services

Please refer end of table for notes and explanation of symbols, abbreviations and terminology.

PARAMETER	Group	Guideline documents				(refer notes)						Comments	Proposed Compliance Criteria			
		NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D	E	FS		Location	Frequency	Annual Performance Standard	
<b>(a) Proposed Microbiological Standards</b>														<b>2</b>		
E. coli (guideline is for individual samples)	8	H	0	0	0	orgs/100 mL						9	Indicator bacteria - or thermotolerant coliforms in ADWG 1996 Fact Sheet	Zone	Refer Table 5	Refer Table 5
Total coliforms (guideline is for individual samples)	8	H	0 or up to 10	0 or up to 3	0	orgs/100 mL						7	Indicator bacteria - subject to review	Zone	Refer Table 5	Refer Table 5
<b>(b) Proposed Physical and Chemical Standards</b>														<b>23</b>		
pH	1	N	6.5 - 8.5	6.5 - 8.5	6.5 - 9.2	--						61	Upper limit extended to 9.2	Zone	Fortnightly #	95% in range 6.5 - 9.2 inclusive
Turbidity	1	N	5	5	5	NTU						71		Zone	Fortnightly #	95% UCL of mean <= 1 NTU (filtered supplies) or <= 5 NTU (other supplies)
Arsenic	2	H	0.05	0.05	0.007	mg/L						93		System	Quarterly	MAL = 0.007 mg/L
Cadmium	2	H	0.005	0.005	0.002	mg/L						105		System	Quarterly	MAL = 0.002 mg/L
Chromium	2	H	0.05	0.05	0.05	mg/L						115	Hexavalent fraction in ADWG 1996 - refer ADWG 1996 for derivation	System	Quarterly	MAL = 0.05 mg/L
Cyanide	2	H	0.1	0.1	0.08	mg/L						119		System	Quarterly	MAL = 0.08 mg/L
Fluoride (naturally occurring)	2	H	0.5 to 1.7	1.5	1.5	mg/L						121	Fluoridated supplies must comply with separate DHS requirements	System	Quarterly	MAL = 1.5 mg/L (non-fluoridated systems)
Iron	2	N	0.3	0.3	0.3	mg/L						127		Zone	Monthly	95% UCL of mean <= 0.3 mg/L
Manganese	2	N	0.1	0.1	0.1	mg/L						131	Health guideline value is 0.5 mg/L	Zone	Monthly	95% UCL of mean <= 0.1 mg/L
Copper	2	H	1	1	2	mg/L						117	Non-health guideline value is 1 mg/L	Zone	Monthly	95% UCL of 95th %ile <= 2 mg/L
Lead	2	H	0.05	0.05	0.01	mg/L						129		Zone	Monthly	95% UCL of 95th %ile <= 0.01 mg/L
Mercury	2	H	0.001	0.001	0.001	mg/L						133		System	Quarterly	MAL = 0.001 mg/L
Nitrate (NO <sub>3</sub> )	2	H	10 (as N)	10 (as N)	50	mg/L						141	Refer Note 1	System	Quarterly	MAL = 50 mg/L (as NO <sub>3</sub> )
Selenium	2	H	0.01	0.01	0.01	mg/L						143		System	Quarterly	MAL = 0.01 mg/L
Benzo(a)pyrene	5	H	0.00001	0.00001	0.00001	mg/L						217	Refer ADWG 1996 for derivation	System	Quarterly	MAL = 0.00001 mg/L
2,4-D ^	6	H	0.1	0.1	0.03	mg/L						243		System	Quarterly	MAL = 0.03 mg/L
Aldrin and dieldrin (total) ^	6	H	0.001	0.00003	0.0003	mg/L						237	Persistent organic pollutant	System	Quarterly	MAL = 0.0003 mg/L
Chlordane ^	6	H	0.006	0.003	0.001	mg/L						241	Persistent organic pollutant	System	Quarterly	MAL = 0.001 mg/L
DDT (total isomers) ^	6	H	0.003	0.001	0.02	mg/L						245	Persistent organic pollutant	System	Quarterly	MAL = 0.02 mg/L
Heptachlor and heptachlor epoxide ^	6	H	0.003	0.0001	0.0003	mg/L						247	Persistent organic pollutant	System	Quarterly	MAL = 0.0003 mg/L
Lindane ^	6	H	0.1	0.003	0.02	mg/L						249	Also known as gamma-HCH	System	Quarterly	MAL = 0.02 mg/L
Gross Alpha	7	H	0.1	0.1	0.5	Bq/L						81	Refer Note 3	System	Annually	MAL = 0.5 Bq/L
Gross Beta (excluding Potassium-40)	7	H	0.1	1.0	0.5	Bq/L						81	Refer Note 3	System	Annually	MAL = 0.5 Bq/L
<b>(c) Additional Standards for Supplies Disinfected with Chlorine based Chemicals</b>														<b>5</b>		
Chlorite	3	H			0.3	mg/L	--	--				111		Zone	Monthly	95% UCL of 95th %ile <= 0.3 mg/L
Chloroacetic acid	4	H			0.15	mg/L	--	--				159		Zone	Monthly	95% UCL of 95th %ile <= 0.15 mg/L
Dichloroacetic acid	4	H			0.1	mg/L	--	--				159		Zone	Monthly	95% UCL of 95th %ile <= 0.1 mg/L
Trichloroacetic acid	4	H			0.1	mg/L	--	--				159		Zone	Monthly	95% UCL of 95th %ile <= 0.1 mg/L
Trihalomethanes (total THMs)	4	H	0.2	refer note >	0.25	mg/L	--	--				179	Refer Note 2	Zone	Monthly	95% UCL of 95th %ile <= 0.25 mg/L
<b>(d) Additional Standards for Supplies Disinfected with Ozone</b>														<b>2</b>		
Bromate	3	H			0.02	mg/L	--	--				103		Zone	Monthly	95% UCL of 95th %ile <= 0.02 mg/L
Formaldehyde	4	H			0.5	mg/L	--	--				173		Zone	Monthly	95% UCL of 95th %ile <= 0.5 mg/L
<b>(e) Additional Standards for Supplies Treated with Alum</b>														<b>1</b>		
Aluminium	2	N	0.2 (total)	0.2 (total)	0.2	mg/L						85	Acid-soluble fraction in ADWG 1996	Zone	Monthly	95% UCL of mean <= 0.2 mg/L (acid-soluble)
<b>(f) Parameters for which Community Based Standards are proposed</b>														<b>5</b>		
Total Dissolved Solids	1	N	1000	1000	500	mg/L						67		System	Quarterly	To be agreed with customers
Hardness	1	N	500	500	200	mg/L						69	Measured as calcium carbonate	System	Quarterly	To be agreed with customers
True Colour	1	N	15	15	15	HU						69		Zone	Monthly	To be agreed with customers
Sodium	2	N	300	200	180	mg/L						147		System	Quarterly	To be agreed with customers
Chloride	2	N	400	250	250	mg/L						107		System	Quarterly	To be agreed with customers
<b>(g) General Parameters for which Standards are not proposed</b>														<b>47</b>		

APPENDIX B

SUMMARY OF PROPOSED WATER QUALITY STANDARDS

PARAMETER	Group	Guideline documents			(refer notes)						Comments	Proposed Compliance Criteria			
		NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D	E		FS	Location	Frequency	Annual Performance Standard
Dissolved Oxygen	1 N			> 85%	% sat	--	--				57	Not health-related in ADWG 1996			(no specific requirement)
Ammonia (as NH <sub>3</sub> )	2 N			0.5	mg/L	--	--				89	Not health-related in ADWG 1996			(no specific requirement)
Antimony	2 H			0.003	mg/L	--	--				91				Refer Note 4
Barium	2 H			0.7	mg/L	--	--				97				Refer Note 4
Boron	2 H			4	mg/L	--	--				101	Revised Fact Sheet in 2001			Refer Note 4
Iodide	2 H			0.1	mg/L	--	--				125				Refer Note 4
Molybdenum	2 H			0.05	mg/L	--	--				135				Refer Note 4
Nickel	2 H			0.02	mg/L	--	--				139				Refer Note 4
Nitrite (NO <sub>2</sub> )	2 H			3	mg/L	--	--				141	Refer ADWG 1996 for derivation			Refer Note 4
Silver	2 H			0.1	mg/L	--	--				145				Refer Note 4
Sulfate	2 H	400	400	500	mg/L	--	--				149				Refer Note 4
Hydrogen Sulfide	2 N			0.05	mg/L	--	--				123	Not health-related in ADWG 1996			(no specific requirement)
Zinc	2 N	5	5	3	mg/L	--	--				153	Not health-related in ADWG 1996			(no specific requirement)
Chloramine / Monochloramine	3 H			3	mg/L	--	--				137	Refer also taste and odour requirements			Refer Note 4
Chlorine	3 H			5	mg/L	--	--				109	Refer also taste, odour, by-product and microbiological requirements	Zone	As per group (a)	Refer Note 4
Chlorine dioxide	3 H			1	mg/L	--	--				111	Refer also taste and odour requirements - systems disinfected with chlorine dioxide			Refer Note 4
2-chlorophenol	4 H			0.3	mg/L	--	--				165	Refer also taste and odour requirements			Refer Note 4
2,4-dichlorophenol	4 H			0.2	mg/L	--	--				165	Refer also taste and odour requirements			Refer Note 4
2,4,6-trichlorophenol	4 H	0.01	0.01	0.02	mg/L	--	--				165	Refer also taste and odour requirements			Refer Note 4
Cyanogen chloride	4 H			0.08	mg/L	--	--				171	Guideline value as for cyanide			Refer Note 4
Trichloroacetaldehyde (chloral hydrate)	4 H			0.02	mg/L	--	--				177				Refer Note 4
Acrylamide	5 H			0.0002	mg/L	--	--				185				Refer Note 4
Benzene	5 H	0.01	0.01	0.001	mg/L	--	--				187				Refer Note 4
Carbon tetrachloride	5 H	0.003	0.003	0.003	mg/L	--	--				189				Refer Note 4
Chlorobenzene	5 H		0.0003	0.3	mg/L	--	--				191	Refer also taste and odour requirements			Refer Note 4
1,2-dichlorobenzene	5 H			1.5	mg/L	--	--				193	Refer also taste and odour requirements			Refer Note 4
1,3-dichlorobenzene	5 N			0.02	mg/L	--	--				193	Refer also taste and odour requirements			Refer Note 4
1,4-dichlorobenzene	5 H			0.04	mg/L	--	--				193	Refer also taste and odour requirements			Refer Note 4
1,2-dichloroethane	5 H			0.003	mg/L	--	--				197				Refer Note 4
1,1-dichloroethene	5 H		0.0003	0.03	mg/L	--	--				199				Refer Note 4
1,2-dichloroethene	5 H	0.01	0.01	0.06	mg/L	--	--				199				Refer Note 4
Dichloromethane (methylene chloride)	5 H			0.004	mg/L	--	--				201				Refer Note 4
Epichlorohydrin	5 H			0.0005	mg/L	--	--				203				Refer Note 4
Ethylbenzene	5 H			0.3	mg/L	--	--				205	Refer also taste and odour requirements			Refer Note 4
Ethylenediamine tetraacetic acid (EDTA)	5 H			0.25	mg/L	--	--				207				Refer Note 4
Hexachlorobutadiene	5 H			0.0007	mg/L	--	--				209				Refer Note 4
Nitrotriacetic acid	5 H			0.2	mg/L	--	--				211				Refer Note 4
Tributyltin oxide	5 H			0.001	mg/L	--	--				213				Refer Note 4
di(2-ethylhexyl)phthalate (DEHP)	5 H			0.01	mg/L	--	--				215				Refer Note 4
Styrene	5 H			0.03	mg/L	--	--				219	Refer also taste and odour requirements			Refer Note 4
Tetrachloroethene	5 H	0.01	0.01	0.05	mg/L	--	--				221				Refer Note 4
Toluene	5 H			0.8	mg/L	--	--				223	Refer also taste and odour requirements			Refer Note 4
Trichlorobenzenes (total)	5 H			0.03	mg/L	--	--				225	Refer also taste and odour requirements			Refer Note 4
Vinyl chloride	5 H			0.0003	mg/L	--	--				231	Associated with pre-1975 UPVC pipes			Refer Note 4
Xylenes	5 H			0.6	mg/L	--	--				233	Refer also taste and odour requirements			Refer Note 4
Uranium	7 H			0.02	mg/L	--	--				79	Equivalent to 0.25 Bq/L			Refer Note 4
Radon-222	7 H			100	Bq/L	--	--				77				Refer Note 4
<b>(h) Other parameters for which ADWG 1996 sets no guideline value</b>					<b>30</b>										
Taste and Odour	1 N	acceptable	inoffensive	acceptable	--						63	May be difficult to measure	refer >	refer >	To be agreed with customers

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PARAMETER	Group		Guideline documents			(refer notes)					Comments	Proposed Compliance Criteria				
			NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D		E	FS	Location	Frequency	Annual Performance Standard
Electrical Conductivity	1	N			--	us/cm	--	--				67	Related to total dissolved solids			(no specific requirement)
Temperature	1	N			--	C	--	--				65				(no specific requirement)
Asbestos	2	*			*	fibres/mL	--	--				95				Refer Note 4
Beryllium	2	*			*	mg/L	--	--				99				Refer Note 4
Tin	2	N			*	mg/L	--	--				151				(no specific requirement)
Chlorate	3	*			*	mg/L	--	--				111				Refer Note 4
Iodine	3	*			*	mg/L	--	--				125				Refer Note 4
Ozone	3	*			--	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Chlorinated furanones (MX)	4	*			*	mg/L	--	--				157				Refer Note 4
1,1-dichloropropanone	4	*			*	mg/L	--	--				163				Refer Note 4
1,3-dichloropropanone	4	*			*	mg/L	--	--				163				Refer Note 4
1,1,1-trichloropropanone	4	*			*	mg/L	--	--				163				Refer Note 4
1,1,3-trichloropropanone	4	*			*	mg/L	--	--				163				Refer Note 4
Chloroform	4	*		0.03	refer note >	mg/L	--	--				179	Refer Note 2 and ADWG 1996 guideline value for total THMs			Refer Note 4
Chloropicrin	4	*			*	mg/L	--	--				171				Refer Note 4
dichloroacetonitrile	4	*			*	mg/L	--	--				175				Refer Note 4
trichloroacetonitrile	4	*			*	mg/L	--	--				175				Refer Note 4
dibromoacetonitrile	4	*			*	mg/L	--	--				175				Refer Note 4
Bromochloroacetonitrile	4	*			*	mg/L	--	--				175				Refer Note 4
Dialkyltins	5	*			*	mg/L	--	--				213				Refer Note 4
1,1,1-trichloroethane	5	*			*	mg/L	--	--				227				Refer Note 4
1,1-dichloroethane	5	*			*	mg/L	--	--				197				Refer Note 4
Hexachlorobenzene	5	*		0.00001	--	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
di(2-ethylhexyl)adipate (DEHA)	5	*			*	mg/L	--	--				215				Refer Note 4
Polycyclic aromatic hydrocarbons other than benzo(a)pyrene	5	*			*	mg/L	--	--				217				Refer Note 4
Trichloroethylene	5	*		0.03	*	mg/L	--	--				229	Also known as trichloroethene			Refer Note 4
Radium-226	7	*			*	Bq/L	--	--				75	Revised Fact Sheet in 2001			Refer Note 4
Radium-228	7	*			*	Bq/L	--	--				75	Revised Fact Sheet in 2001			Refer Note 4
Other beta & gamma emitting radioisotopes	7	H			*	mSv	--	--				81	Revised Fact Sheet in 2001			Refer Note 4
<b>(j) Pesticides listed in ADWG 1996 for which Standards are not proposed</b>													114			
Acephate	6	H		0.02	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Aldicarb	6	H			0.001	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Ametryn	6	H			0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Amitrole ^	6	H		0.001	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Asulam	6	H		0.1	0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Atrazine ^	6	H			0.04	mg/L	--	--				239	Revised Fact Sheet in 2001			Refer Note 4
Azinphos-methyl	6	H		0.01	0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Benomyl	6	H		0.2	0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Bentazone	6	H		0.4	0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Bioresmethrin	6	H		0.06	0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Bromacil	6	H		0.6	0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Bromophos-ethyl	6	H		0.02	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Bromoxynil	6	H		0.03	0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Carbaryl	6	H		0.06	0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Carbendazim	6	H		0.2	0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Carbofuran	6	H		0.03	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Carbophenothion	6	H		0.001	0.0005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Carboxin	6	H			0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Chlorfenvinphos	6	H		0.01	0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Chlorothalonil	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Chloroxuron	6	H		0.03	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Chlorpyrifos ^	6	H		0.002	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4

APPENDIX B

SUMMARY OF PROPOSED WATER QUALITY STANDARDS

PARAMETER	Group		Guideline documents			(refer notes)					Comments	Proposed Compliance Criteria				
			NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D		E	FS	Location	Frequency	Annual Performance Standard
Chlorsulfuron	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Clopyralid ^	6	H			1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Diazinon	6	H	0.01		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Dicamba	6	H	0.3		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Dichlobenil	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Dichlorvos	6	H	0.02		0.001	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Diclofop-methyl	6	H	0.003		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Dicofol	6	H	0.1		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Difenzoquat	6	H	0.2		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Dimethoate	6	H	0.1		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Diphenamid	6	H			0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Diquat ^	6	H	0.01		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Disulfoton	6	H	0.006		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Diuron ^	6	H	0.04		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
DPA (2,2-DPA)	6	H	0.5		0.5	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
EDB	6	H			0.001	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Endosulfan ^	6	H	0.04		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Endothall	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
EPTC	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Ethion	6	H	0.006		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Ethoprophos	6	H	0.001		0.001	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Etridiazole	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenamiphos	6	H			0.0003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenarimol	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenchlorphos	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenitrothion	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenoprop	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fensulfothion	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fenvalerate	6	H	0.04		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Flamprop-methyl	6	H	0.006		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fluometuron	6	H	0.1		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Formothion	6	H	0.1		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Fosamine	6	H	3.0		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Glyphosate	6	H	0.2		1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Hexaflurate	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Hexazinone ^	6	H	0.6		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Maldison	6	H	0.1		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Methidathion	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Methiocarb	6	H			0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Methomyl	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Methoxychlor	6	H		0.03	0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Metolachlor	6	H	0.8		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Metribuzin	6	H	0.005		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Methsulfuron methyl	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Mevinphos	6	H	0.006		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Molinatate ^	6	H	0.001		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Monocrotophos	6	H	0.002		0.001	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Napropamide	6	H			1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Nitralin	6	H	1.0		0.5	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Norflurazon	6	H			0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Oryzalin	6	H	0.06		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Oxamyl	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Paraquat ^	6	H	0.04		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Parathion	6	H	0.03		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Parathion methyl	6	H	0.006		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4

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PARAMETER	Group		Guideline documents				(refer notes)					Comments	Proposed Compliance Criteria			
			NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D	E		FS	Location	Frequency	Annual Performance Standard
Pebutate	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pendimethalin	6	H	0.6		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pentachlorophenol	6	H		0.01	0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Permethrin	6	H	0.3		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Picloram ^	6	H	0.03		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Piperonyl butoxide	6	H	0.2		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pirimicarb	6	H	0.1		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pirimiphos-ethyl	6	H	0.001		0.0005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pirimiphos-methyl	6	H	0.06		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Profenofos	6	H	0.0006		0.0003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Promecarb	6	H	0.06		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propachlor	6	H			0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propanil	6	H	1.0		0.5	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propargite	6	H	1.0		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propazine	6	H			0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propiconazole ^	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Propyzamide	6	H			0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Pyrazophos	6	H	0.006		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Quintozene	6	H	0.04		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Simazine	6	H			0.02	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Sulprofos	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Silvex (see Fenoprop)	6	H			0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
2,4,5-T	6	H	0.002		0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Temephos ^	6	H	0.03		0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Terbacil	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Terbufos	6	H			0.0005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Terbytryn	6	H			0.3	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Tetrachlorvinphos	6	H			0.1	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Thiobencarb	6	H	0.04		0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Thiometon	6	H	0.02		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Thiophanate	6	H	0.1		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Thiram	6	H	0.03		0.003	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Triadimefon	6	H			0.002	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Trichlorfon	6	H	0.01		0.005	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Trichlorpyr ^	6	H	0.02		0.01	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Trifluralin	6	H	0.5		0.05	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
Vernolate	6	H			0.03	mg/L	--	--					No Fact Sheet in ADWG 1996			Refer Note 4
<b>(k) Pathogenic and Nuisance micro-organisms</b>							<b>25</b>									
Campylobacter	8	H			absent	--	--				5	Bacteria				Refer Note 4
Klebsiella	8	H			absent	--	--				11	Bacteria				Refer Note 4
Salmonella	8	H			absent	--	--				19	Bacteria				Refer Note 4
Shigella	8	H			absent	--	--				21	Bacteria				Refer Note 4
Vibrio	8	H			absent	--	--				23	Bacteria				Refer Note 4
Yersinia	8	H			absent	--	--				25	Bacteria				Refer Note 4
Aeromonas	8	*			*	--	--				3	Bacteria				Refer Note 4
Legionella	8	*			*	--	--				13	Bacteria				Refer Note 4
Mycobacterium	8	*			*	--	--				15	Bacteria				Refer Note 4
Pseudomonas aeruginosa	8	*			*	--	--				17	Bacteria				Refer Note 4
Burkholderia Pseudomallei	8	*			*	--	--				8a	Bacteria - new Fact Sheet in 2001				Refer Note 4
Adenovirus	8	H			absent	--	--				45	Viruses				Refer Note 4
Enterovirus	8	H			absent	--	--				47	Viruses				Refer Note 4
Hepatitis viruses	8	H			absent	--	--				49	Viruses				Refer Note 4
Norwalk virus	8	H			absent	--	--				51	Viruses				Refer Note 4
Rotavirus, para-rotaviruses and reovirus (reoviridae)	8	H			absent	--	--				53	Viruses				Refer Note 4

# APPENDIX B

# SUMMARY OF PROPOSED WATER QUALITY STANDARDS

PARAMETER	Group	Guideline documents				(refer notes)					Comments	Proposed Compliance Criteria			
		NHMRC 87	WHO 1984	ADWG 1996	Units	A	B	C	D	E		FS	Location	Frequency	Annual Performance Standard
Acanthamoeba	8 *			*	--	--	--				29	Protozoa			Refer Note 4
Cryptosporidium	8 *			*	--	--					31	Protozoa - revised Fact Sheet in 2000			Refer Note 4
Giardia	8 *			*	--	--					33	Protozoa - revised Fact Sheet in 2000			Refer Note 4
Naegleria fowleri	8 H			absent	--	--					35	Protozoa			Refer Note 4
Cyanobacteria (blue-green algae)	8 *			*	--	--					39	Toxic blue-green algae			Refer Note 4
Microcystins	8 H			0.0013	mg/L	--	--				17a	As microcystin-LR toxicity equivalents			Refer Note 4
Nodularin	8 *			*	--	--					17b	Toxic blue-green algae - new FS in 2001			Refer Note 4
Saxitoxins	8 *			*	--	--					17c	Toxic blue-green algae - new FS in 2001			Refer Note 4
Cylindrospermopsin	8 *			*	--	--					17d	Toxic blue-green algae - new FS in 2001			Refer Note 4

## NOTES

This Table summarises information in selected guideline documents and describes proposed water quality standards for drinking water supplies in Victoria. ADWG 1996 means "Australian Drinking Water Guidelines 1996", originally published in 1996 by NHMRC/ARMCANZ. WHO means World Health Organization. MAL means Maximum Acceptable Level and refers to the value above which some form of action is required. MALs should not be exceeded in consecutive routine samples. NTU means Nephelometric Turbidity Unit, HU means Hazen Units, orgs means organisms, mg/L means milligrams per litre and Bq/L means Becquerel per litre. 95% UCL means 95% Upper Confidence Limit, 95th %ile means ninety fifth percentile, <= means less than or equal to (refer ADWG 1996 Section 6.3 for statistical derivation). System means at points representing the water from each source after treatment and/or disinfection. Zone means at points in each water quality zone representing supplies to consumers. DHS means the Victorian Department of Human Services. Monitoring must be performed in accordance with DHS requirements as to analytical methodology and laboratory accreditation. The monitoring frequencies shown are minima. Water authorities may need to monitor more frequently in some supplies to demonstrate compliance with the annual performance standard. # For pH and turbidity, monthly monitoring is acceptable for zones with population below 200 where the microbiological monitoring is monthly.

Column A shading means that ADWG 1996 guideline value for this parameter is stricter than that in NHMRC 1987 (dash indicates no guideline value in NHMRC 1987). Column B shading means that ADWG 1996 guideline value for this parameter is stricter than that in WHO 1984 (dash indicates no guideline value in WHO 1984). Column C shading indicates parameters listed in Schedule C of the 1997 Memoranda of Understanding between the Victorian Government and non-metropolitan urban water authorities. Column D shading indicates parameters monitored for the Melbourne metropolitan supply during the late 1990's. Column E shading indicates parameter included in United Kingdom standards. Column FS gives ADWG 1996 Fact Sheet Page Reference (as per page index in ADWG 1996).

- Note 1 DHS must also be notified and action taken when any sample exceeds 50 mg/L as NO<sub>3</sub>.
- Note 2 For trihalomethanes (THMs) in WHO 1993, the sum of the ratio of the concentration of each to its respective guideline value should not exceed 1 (includes chloroform).
- Note 3 If either of these activity concentrations is exceeded, ADWG 1996 recommends that specific radionuclides should be identified and their activity concentrations determined.
- Note 4 This parameter will principally be controlled by comprehensive audited risk management systems established by each water authority or supplier and tailored for each supply. The risk management systems must incorporate appropriate monitoring, disclosure and incident response for each parameter based on the most likely level of risk posed in that supply.

- \* Insufficient data to set a guideline value based on health considerations (refer Fact Sheets in ADWG 1996 for details).
- ^ These pesticides have either been detected, or their likely use would indicate that they may occasionally be detected in Australian drinking water (refer ADWG 1996 GL - 13).
- H Health-related guideline value in ADWG 1996
- N Non health-related guideline value in ADWG 1996

### Summary

Group (as set out in ADWG 1996)	Summary	
1 Physical Characteristics	(a) Proposed Microbiological Standards	2
2 Other Inorganic Chemicals	(b) Proposed Physical and Chemical Standards	23
3 Disinfection Agents and Inorganic By-products of Disinfection	(c) Additional Standards for Supplies Disinfected with Chlorine based Chemicals	5
4 Organic Disinfection By-Products	(d) Additional Standards for Supplies Disinfected with Ozone	2
5 Other Organic Compounds	(e) Additional Standards for Supplies Treated with Alum	1
6 Pesticides	(f) Parameters for which Community Based Standards are proposed	5
7 Radiological Parameters	(g) General Parameters for which Standards are not proposed	47
8 Micro-organisms	(h) Other parameters for which ADWG 1996 sets no guideline value	30
	(i) Pesticides listed in ADWG 1996 for which Standards are not proposed	114
	(k) Pathogenic and Nuisance micro-organisms	25
	<b>Total</b>	<b>254</b>