



Melbourne Water

2000/01



Public Health
Review

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PUBLIC HEALTH REVIEW

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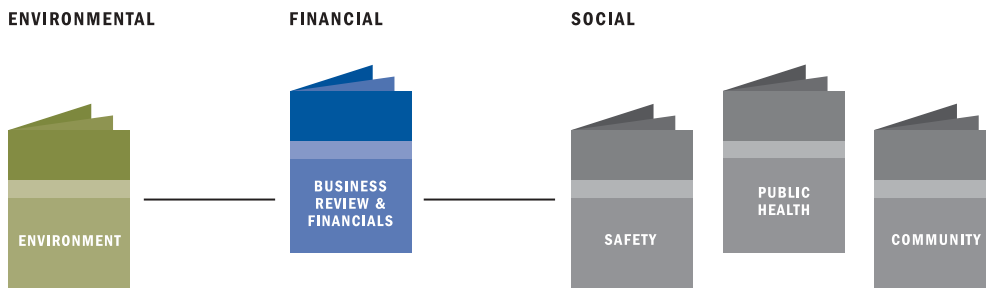
TRIPLE-BOTTOM-LINE-REPORTING

Our triple-bottom-line approach to reporting places equal emphasis on economic, environmental and social reporting. In this document we report on our public health performance. Other aspects of our social performance are addressed in our community and safety reviews.

Our financial performance, our statutory and regulatory reporting and summaries of our environmental and social performance are provided in our Melbourne Water Business Review 2000/01.

Our environmental performance is reported in greater detail in our Melbourne Water Environment Review 2000/01.

Copies of all five reports can be obtained by telephoning 131 722 or may be downloaded from our web site at www.melbournewater.com.au



Front cover:
Images from our
Upper Yarra catchment.

Right: Clouds creep down
the valley at our protected
water catchment high up
in the Yarra Ranges.

Melbourne Water Charter

Melbourne Water is owned by the Victorian Government. We manage Melbourne's water resources. Three independent retail water companies provide local water and sewerage services to consumers.

Melburnians enjoy drinking water that we believe is among the world's best—thanks primarily to the foresight more than 100 years ago of Melbourne's city planners, who set aside water catchments protected from human contamination.

The city planners also laid the foundations for a sewerage system that continues to lead in technology and environmental sustainability.

These are legacies few other cities in the world can match and Melbourne Water acknowledges that they provide a sound basis for the way we manage Melbourne's water resources both now and in the future.



In managing Melbourne’s water supply catchments, sewerage system, waterways and drains, we strive to match the foresight and innovation shown by the city’s original planners.

Our aim is to show leadership in water cycle management, through effective, sustainable and forward-looking management of the community resources we oversee.

The business objectives established to realise this aim are to:

- > protect public health
- > operate as a successful commercial business
- > manage Melbourne’s water resources and the environment in a sustainable manner
- > provide excellent service and maintain the trust and respect of the community.

At Melbourne Water we understand that partnerships with stakeholders and the community are the key to achieving our vision – Leadership in water cycle management. We also appreciate that achievements occur through the contribution of our people. At Melbourne Water we are people who:

- > recognise that we achieve more by working with others
- > feel privileged to be the custodians of our water resources
- > behave with integrity
- > attain excellence through creativity and innovation
- > celebrate our achievements and learn from our experiences

Through working successfully with others and operating as an efficient commercial business, we will be able to make Melbourne a better place to live both now and in the future.

Vision

Leadership in water cycle management



Foreword

A key responsibility the community entrusts to Melbourne Water is to protect public health. This remains one of our primary objectives. In this review we detail our public health performance for 2000/01, compare that performance against our targets and outline our targets for 2001/02.

Among our key achievements for the year was completing the Cardinia to Pearcedale pipeline, which has improved the quality of drinking water we provide to South East Water customers on the Mornington Peninsula.

We also exceeded our water quality targets, after introducing more sensitive testing procedures to meet new monitoring standards.

We take quiet pride in the work our people have done on the Hazard Assessment Critical Control Point System. Our approach is to monitor at each stage in our water supply system, rather than only when water comes out of a consumer's tap. This approach is helping Australia's water providers make major monetary savings and develop much sounder supply systems.

Our system-wide approach to monitoring, which is ahead of that undertaken anywhere else in the world, has attracted international attention. As has the technical expertise of our people. An outcome is the United Nation's World Health Organization looking to Australia as a model for global water quality guidelines.

We have also taken a lead in implementing other water quality systems and guidelines. An example is our applying World Health Organization draft guidelines to our water-monitoring program around Boags Rocks. The result is a monitoring regime that is superior to most in the world.

Another achievement during the year has been our extended public reporting in the social area, which includes public health. The 'report card' approach we introduced in our last public health report has been extended with summary tables outlining our performance against targets. We are also providing research and monitoring results on our web site as a further tangible example of our commitment to openness and transparency.



Brian Bayley
Managing Director

Melbourne Water Public Health Policy

Melbourne Water exists to add value for its customers and the community by operating a successful commercial business that supplies safe water, treats sewage and removes stormwater at an acceptable cost and in an environmentally sensitive manner.



Melbourne Water will:

Provide a low cost, reliable supply of safe, high quality drinking water that consistently meets 1987 National Health and Medical Research Council health requirements as defined in the retail water company operating licences.

Transfer and treat sewage, and ensure appropriate disposal or storage of by-products in a way that safeguards the health of the community.

Minimise the impacts of stormwater on receiving waters and thereby contribute to the improvement of waterway water quality and safe recreational opportunities for the community.

Ensure that the benefits of achieving high drinking water quality, treated effluent quality, and waterway water quality, relative to the costs, can be demonstrated.

Melbourne Water will fulfil this policy by:

Restricting public access to catchments and thereby minimising the potential for contamination and the necessity for treatment of water supplies.

Ensuring reliable water and wastewater treatment using processes tailored to Melbourne's unique conditions.

Managing the reuse of treated sewage effluent and sludge to minimise public health risks and to conform with statutory requirements while optimising business opportunities.

Providing safe and efficient stormwater services including:

- > flood warning and mitigation
- > emergency response to pollutant spills to waterways and
- > monitoring for blue-green algae in water bodies used for recreation.

Improving performance and optimising public health outcomes through:

- > remaining abreast of relevant international trends in public health policy and epidemiology studies, treatment technology, and system management and operation and
- > undertaking research on the relationship between water quality and public health.

The Yarra River is used for many recreational activities along its length from mountain catchment to its mouth at Port Phillip Bay, a short distance from Melbourne's central business district.



Developing an understanding of the public health impacts and implications of the business through:

- > regular monitoring of the quality of drinking water, treated sewage effluent, stormwater and receiving water and
- > assessing performance against corporate commitments and stakeholder expectations.

Establishing a good working relationship with public health agencies to ensure Melbourne Water contributes to and influences the debate on the setting of statutory requirements, industry standards and guidelines, and other standards relevant to public health and the water cycle.

Ensuring that management and employees are equipped to anticipate and manage public health risks and responsibilities in their day-to-day work through appropriate contingency planning and incident response capability.

Providing relevant and timely information to customers, stakeholders and the community about public health issues.

ACHIEVEMENTS

<p>Managing Melbourne's drinking water quality</p> <ul style="list-style-type: none"> > Maintaining our excellent catchment management standards and water quality throughout the year in spite of the dry conditions. > Maintaining Hazard Analysis Critical Control Point System certification. > Achieving international standard ISO9001 certification for our Water Quality Management System. > Receiving a certificate of recognition from the Australian Water Association's Water Treatment Alliance for our contribution to a scheme for optimising treatment plant performance. 	<ul style="list-style-type: none"> > Completing the Cardinia-Pearcedale pipeline which has improved the quality of the Mornington Peninsula's water supply. > Continuing our ongoing program to replace or cover open service reservoirs. During the year, we began work on lining and covering Garfield Reservoir, and replacing the open earthen Johns Hill Reservoir with a closed tank. > Continuing our progress on research into pathogens in catchments which will improve water quality. > The American Water Works Association Research Foundation agreeing to provide US\$300,000 funding for a new Australian catchment management research project in which we are involved.
<p>Managing Melbourne's sewerage system</p> <ul style="list-style-type: none"> > Implementing an expanded monitoring program of waters near Boags Rocks to demonstrate the extent of any outfall-related public health impact. 	<ul style="list-style-type: none"> > Project-managing a review of draft World Health Organization guidelines for recreational waters and their application to Australian conditions.
<p>Managing Melbourne's waterways and drains</p> <ul style="list-style-type: none"> > Involvement in a litter trap trial in stormwater drains which reduced the number of discarded syringes ending up on suburban beaches. 	<ul style="list-style-type: none"> > Water quality improvements in the Quiet Lakes (part of the Patterson Lakes development, south east of Melbourne) that have suffered persistent blooms of blue-green algae.

DISAPPOINTMENTS

<p>Managing Melbourne's drinking water quality</p> <ul style="list-style-type: none"> > Achieving limited progress in raising community understanding of public health risks from using waters in the Tarago Reservoir catchments for recreation. > Unauthorised entry into our Boronia, Hallam North and St Albans service reservoir sites. 	<ul style="list-style-type: none"> > Minor disinfection plant failures with the potential to affect supply to our customers. > The impact of additional chlorination on drinking water taste.
<p>Managing Melbourne's sewerage system</p> <ul style="list-style-type: none"> > None 	
<p>Managing Melbourne's waterways and drains</p> <ul style="list-style-type: none"> > Continual blue-green algae blooms in our Monbulk Retarding Basin. 	

KEY ISSUES

<p>Managing Melbourne's drinking water quality</p> <ul style="list-style-type: none"> > Providing Melbourne with safe and aesthetically pleasing drinking water. > Maintaining the status of protected catchments. > Preventing bushfires in the catchments. 	<ul style="list-style-type: none"> > Protecting water sources and storages against contamination. > Maintaining the reliability of our treatment, fluoridation and disinfection plants.
<p>Managing Melbourne's sewerage system</p> <ul style="list-style-type: none"> > Examining whether the discharge of treated water from our sewage treatment plants into Bass Strait and Port Phillip Bay can cause illness in people using the waters for recreational purposes. > Monitoring public health aspects of land irrigated with raw sewage. 	<ul style="list-style-type: none"> > The potential risk of beef measles in cattle grazing on sewage-irrigated land. > Managing public health risks in the use of recycled water from our sewage treatment plants for agriculture or other purposes.
<p>Managing Melbourne's waterways and drains</p> <ul style="list-style-type: none"> > Potential public health risks on suburban beaches and in Port Phillip Bay from stormwater run-off and litter washed through the drainage system. Discarded syringes are a particular problem. 	<ul style="list-style-type: none"> > Health implications for humans, animals and birds that have contact with, or consume, water contaminated with potentially toxic blue-green algae.

Water supply

Melbourne is widely regarded as having high-quality drinking water. The main reason is the purity of the water source. Approximately 90 per cent of our water is harvested from more than 140,000 hectares of uninhabited natural forest.



Melbourne Water supplies the three metropolitan water companies that service Melbourne. The water we supply has to be safe, pleasant to drink and meet:

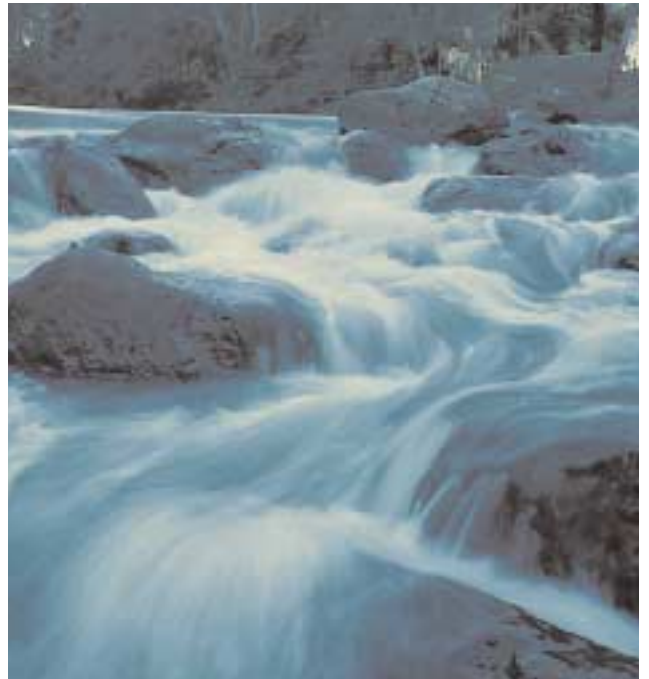
- > The National Health and Medical Research Council 1987 Guidelines for Drinking Water Quality in Australia.
- > The Victorian Government's Health (Quality of Drinking Water) Regulations 1991.
- > The requirements of the *Health (Fluoridation) Act 1973*.

Multiple barriers against contamination, which protect the quality of water supplied to Melbourne include:

- > Protected wilderness catchments for harvesting water.
- > Long retention times in major catchment reservoirs.
- > Additional retention time in seasonal storage systems.
- > Full treatment of water that is not harvested from protected catchments.
- > Disinfecting water before it enters the distribution system.
- > Closed distribution systems to avoid any possible recontamination.

Our operational supply system comprises:

- > 13 storage dams with a gross storage of 1,787,000 million litres.
- > 56 service reservoirs, tanks and basins.
- > Almost 1,400 kilometres of distribution mains, aqueducts and siphons.
- > 20 pumping stations.
- > 5 water filtration plants.
- > 68 water treatment plants (disinfection, fluoridation and pH correction plants).



Our major storage reservoirs supply water, through large transfer mains, to service reservoirs located throughout the metropolitan area. From there we transfer water to the retail companies – City West Water, South East Water and Yarra Valley Water. They operate the reticulation network that delivers water to homes, businesses and other consumers.

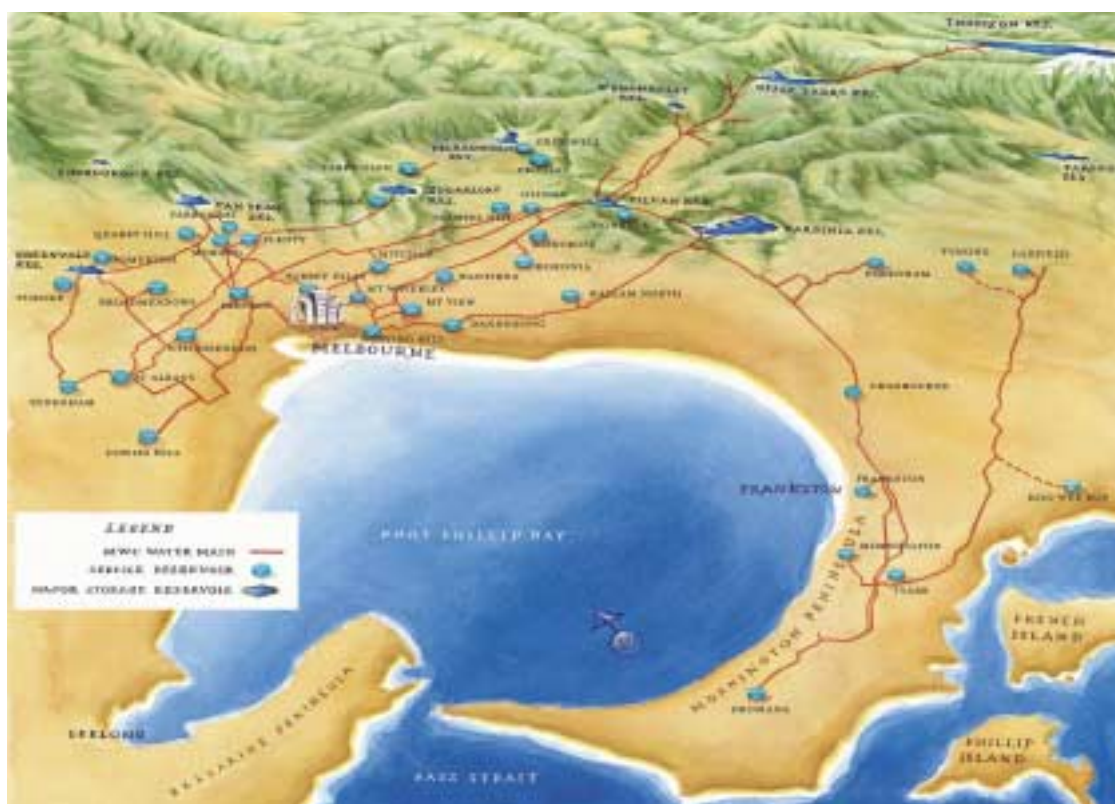
During 2000/01, we supplied 500,579 million litres of water to the three retail water companies. We also provided limited bulk-water supplies to non-metropolitan water authorities.

We take a risk-management approach to ensuring water quality. We have adapted a system used in the food industry – HACCP, or Hazard Analysis Critical Control Point System. It is a scientific, systematic process that identifies specific hazards to ensure the water we deliver is safe for consumers. The system establishes control points that focus on prevention rather than relying on end-product testing.

We also carry out extensive testing of water supplies to ensure our quality assurance systems are operating satisfactorily.

Melita Stevens, Melbourne Water Principal Scientist, about to sample our high-quality drinking water, sourced from uninhabited natural forest.





Some of our assets including water storages, service reservoirs and our water main system. These spread from the Yarra Ranges and across Melbourne.

Purity of the source is the key to Melbourne's high quality water

Managing catchments

Melbourne's water catchments, to the north and east of the city, are mostly covered in natural forest. Melbourne Water manages its catchments, and works closely with Parks Victoria in managing catchments in the Kinglake and Yarra Ranges national parks.

Most of the city's water comes from areas that have been closed to humans and farm animals for generations. It requires minimal treatment.

However, in an average rainfall year, some 10 to 15 per cent of water requires full treatment. Most of this water comes from the Yan Yean and Sugarloaf reservoirs. Predominantly, the Sugarloaf Reservoir holds water pumped from the Yarra River that comes from rural and urban areas.

Although a closed catchment, there are also water quality issues at Yan Yean. Being relatively shallow, the reservoir tends to encourage algal growth which can have a negative impact on water quality.

We also manage the Tarago Reservoir, near Neerim South, which harvests some of its water from rivers and creeks flowing through privately owned farmland. We do not currently use water from Tarago Reservoir to supply Melbourne. However this will be necessary in future, as the city grows. At present, Gippsland Water takes a small amount of water from Tarago and treats it before supplying customers.

The Tarago Reservoir catchment supports a diverse range of commercial activities including forestry, dairying, beef and sheep farming and growing potatoes. Water entering the reservoir is of inferior quality to that from protected water supply catchments. Research by the Cooperative Research Centre for Catchment Hydrology showed that simple changes to land management practices could achieve cost-effective improvements in water quality. The water would still need to be treated before being used domestically.

Our most important priorities in protecting water sources from contamination are preventing bushfires and keeping people and farm animals out of our closed catchments.

Major bushfires can reduce the amount of water harvested and contaminate it with soot and ash. Our fire crews patrol the catchments over the summer, responding quickly to any outbreaks. During the year there were no fires big enough to have a negative impact on water quality.

Our security officers patrol the catchments regularly. During 2000/01, they recorded 282 security breaches (down from 330 the previous year) including acts of vandalism, horse riding, fishing and damaged fences. They apprehended 82 people (111 in 1999/2000). Of these, 61 (compared with 92) were recommended for prosecution.



Service reservoirs

Unauthorised entry and vandalism at service reservoirs in the metropolitan area can result in contamination of water supplies. During 2000/01, there was one instance of unauthorised entry to each of our service reservoir sites at Boronia, Hallam North and St Albans. These incidents did not affect water quality. During the year, we, along with the retail water companies, Department of Human Services and Victoria Police, adopted a new protocol for responding to unauthorised entry. The protocol is designed to improve communication among the agencies and better manage incidents with public health implications.

Management systems

We have standard procedures covering all facets of operating and maintaining our water, sewerage and drainage systems. We train our employees who are familiar with procedures covering their field of responsibility. Our procedures are supported by site and function-specific contingency plans that detail action when an incident occurs. We have an incident management plan establishing the overall framework for our emergency operational responses. We have protocols for managing public health incidents, which involve the retail water companies and relevant government agencies.

Traditional management systems for protecting drinking water quality relied heavily on individual employee's knowledge of systems and on monitoring water supplied to consumers. This approach identified system failures after the event and provided little or no information on why or where contamination occurred. Melbourne Water and the Australian water industry as a whole have adopted an alternative approach using quality assurance principles.

We undertook a full review of risks to our water supply system from catchments through to our delivery points to the retail water companies. This led to us adopt, and being certified for, the Hazard Analysis and Critical Control Point system for providing safe drinking water. Certification is for three years, subject to six-monthly surveillance audits which are undertaken by Lloyds Register Quality Assurance.

The system assesses hazards and establishes control points that focus on potential consequences and prevention, rather than relying on end-point testing to ensure that safe drinking water is delivered to people's taps.

In December 2000, our management system for treating and supplying drinking water was audited and formally certified to the international standard ISO9001-2000 by Lloyds Register Quality Assurance. This system is also subject to six-monthly surveillance audits by Lloyds to verify its ongoing integrity.

We received a certificate of recognition for our participation in the Australian Water Association's Water Treatment Alliance. This is a pilot study for introducing a national voluntary program to ensure operational excellence at drinking water treatment plants. As part of the program, we completed a self-assessment report on our Winneke Treatment Plant. This assessment was reviewed and highly commended by water treatment experts. As a result of the study we have implemented improvements to our standard operating procedures at Winneke to improve water quality.

Disinfecting water supplies

We disinfect all water we supply to the retail water companies, almost exclusively by chlorination, to ensure the water is free from microorganisms which can cause disease. Excessive chlorination can have a negative impact on water taste and odour, while insufficient chlorination may not achieve the desired health outcomes. We operate 40 disinfection plants which serve our systems that are open to contamination, such as major storage reservoirs, and the closed distribution system where there is a need to control regrowth of bacteria in the pipe network. Our target is for 92 per cent of the disinfection plants to meet their reliability measures quarterly. During 2000/01 we met this target. From July 2001, we have raised this target to 94 per cent.

During the year there were 15 minor incidents involving our disinfection plants. The most common causes were equipment failures. In all cases we took action to minimise the impact on our customers. We have installed standby power generators to enable critical disinfection plants to continue operating when mains power fails. A summary of incidents during the year and comparison with the previous three years are on page 38.



Monitoring programs

We undertake comprehensive drinking water quality testing. During 2000/01, we carried out more than 50,000 tests on samples from some 160 sites. We took the samples from our reservoirs, aqueducts, transfer mains, service reservoirs and points of supply to the retail water companies.

We examine a range of parameters to determine the water's microbiological, physical, chemical and radiological quality.

The parameter that defines the extent of health risks due to faecal contamination is the indicator organism *E.coli*. The objective is for no *E.coli* to be present in the water supply system or detected in any sample. We investigate all detections and take appropriate action.

For reporting and compliance purposes our target is 99 per cent of water samples being free of faecal coliform or *E.coli* bacteria.

This target is more stringent than required by the NHMRC guidelines. During 2000/01 we met this target. Our quarter-by-quarter compliance was:

- > Quarter 1 – 100 per cent.
- > Quarter 2 – 99.9 per cent.
- > Quarter 3 – 99.9 per cent.
- > Quarter 4 – 100 per cent.

A less important parameter is total coliforms, where we also met compliance targets during the year.

The *Health (Fluoridation) Act 1973* (Vic.) sets monthly and long-term targets for the performance of our fluoridation plants. The act requires fluoride to be added to the water supply to reduce tooth decay. The 12-month average level of fluoride in the water is not to exceed one milligram per litre. The quarterly concentration levels are to be between 0.7 and 1.2 milligrams of fluoride per litre of water. We met these standards during the year.

The bluestone water race at Yan Yean Reservoir – site of Melbourne's original water catchment.

MICROBIOLOGICAL PERFORMANCE SUMMARY 2000/01

Performance category	Target	Achieved
Disinfection plant reliability.	92% of plants to meet combined reliability measures.	Yes
Testing of water supplied to the retail water companies.	<i>E.coli</i> : 99 per cent of samples less than one organism per 100 millilitres.	Yes
Testing of water supplied to the retail water companies ⁽¹⁾ .	Total Coliforms: 95 per cent of samples less than one organism per 100 millilitres.	Yes
Testing of water supplied to the retail water companies ⁽²⁾ .	Total Coliforms: 90 per cent of samples no more than 10 organisms per 100 millilitres.	Yes

Note: Water supplied to the retail water companies is tested at monitoring points⁽¹⁾ immediately downstream of Melbourne Water's primary disinfection plants and at points⁽²⁾ at storages or water mains within the wholesale transfer system. The monitoring points are identified in our supply agreements with the retail water companies.

Pathogens

Pathogens – disease causing microorganisms – are the most significant contamination risks for water. We undertake routine monitoring for notifiable and other pathogens, principally bacteria and viruses, within the water supply system. The testing laboratories we contract are required to notify the Department of Human Services if notifiable pathogens are detected in water samples. These notifiable pathogens are *Campylobacter*, *Cryptosporidium*, *Giardia*, *Listeria*, *Salmonella*, Verotoxin-producing *E.coli* and *Vibrio*, and, from May 2001, *Cyclospora*.

We respond to any detection of notifiable pathogens. The results from our pathogen-monitoring program are on page 13. There were no notifiable pathogens detected by our routine monitoring program during 2000/01.

To help us better understand how the water supply system behaves, we also monitor source waters each quarter for the protozoa *Cryptosporidium* and *Giardia*. On three occasions in 2000/01, we recorded low levels of protozoa. In August 2000, we detected *Giardia* flowing into Cardinia Reservoir. In November 2000, we detected *Cryptosporidium* in the Maroondah Aqueduct at Yarra Glen. In May 2001, we detected *Cryptosporidium* at the O'Shannassy Aqueduct. Our protocols require resampling which did not detect further protozoa at any of these sites. The initial readings did not represent a risk to public health.

Water quality improvement works

During 2000/01, we spent \$35 million on capital works to protect public health. Our major project was duplicating the 30-kilometre Cardinia to Pearcedale Pipeline, for which we completed the third and final phase in December 2000. This has enabled us to take the Devilbend Reservoir, which has an unprotected catchment, out of service. It also means we do not have to use water from Tarago Reservoir, even at times of high demand. The result is significantly improved drinking water quality for the Mornington Peninsula.

Major works we began during the year include:

- > Lining and covering Garfield Reservoir and replacing the open Johns Hill Reservoir with a 10-megalitre steel water storage tank. These works will improve water quality by eliminating potential contamination from birds and animals.
- > Upgrading outlet screening chambers at the Silvan Reservoir to screen out waterborne organic matter.
- > Constructing a pump station at Cardinia to allow water to be pumped from Cardinia Reservoir to Kallista. This will provide security of supply in emergency circumstances.
- > Installing underfloor cathodic protection to the North Essendon Service Water Tanks to prevent further rusting and deterioration of the tank floor.

Works scheduled for 2001/02 include lining and covering Dromana Reservoir and replacing the open Frankston and Mornington reservoirs with steel tanks. Our planned capital expenditure on water quality improvement works to protect public health next year is \$11 million.



Catchment research role

Restricting public access and farming in Melbourne's water catchments protects our water supplies from many health risks. It prevents contamination by pathogenic microorganisms associated with human faeces and farm animals.

Protected catchments, however, can contain large numbers of native animals and some feral animal species. Their faeces could be washed into rivers and creeks during extreme wet weather. We are playing a major role in research into how this affects the quality of water harvested after storm events.

The Cooperative Research Centre for Water Quality and Treatment is managing the project. It aims to measure differences in the quality of water harvested from protected, semi-protected and unprotected catchments.

The other water companies involved are South Australian Water, Australian Capital Territory Electricity and Water, and Water Corporation (Western Australia).

An automatic water-sampling device has been developed for the project. It is triggered during heavy rainfall and collects water samples for the duration of a storm event. These automatic samplers have been installed in our protected catchments at O'Shannassy River and McMahons Creek. They will be programmed to collect storm event samples over the spring and summer of 2001/02.

The samples collected will be analysed for pathogenic bacteria, viruses and protozoa as well as traditional microbiological and chemical indicators of water quality. The results of the research project will help water authorities understand the influence of catchment activity on the types and concentrations of pathogens that wash into waters.



Research

During the year we began, or continued, several research projects aimed at understanding, and improving, catchment management and water quality. Research is generally carried out by external organisations such as universities and the Cooperative Research Centre for Water Quality and Treatment.

A major focus has been on turbidity, which is the presence of fine suspended matter in the water. Turbidity has a direct impact on the efficiency of water chlorination systems as organisms attach to the suspended particles. We are assessing remedial options for managing streamflow after rainfall and reducing turbidity.

We are involved in a national study of pathogen levels in closed, managed and open catchments and the impact of storms on pathogen wash-off. Researchers are also investigating which animals and birds are the source of microorganisms that can be harmful to human health. This is a three-year study to be completed by June 2003.

We are also investigating the biological processes that cause algal blooms and associated taste and odour problems at Yan Yean Reservoir.

At Tarago Reservoir, we are undertaking a land-capability assessment. This assessment involves considering housing and farming the catchment can sustain without further compromising future use of water from the reservoir. The work will provide a sound technical basis for reviewing planning applications for property development in the catchment and is part of the Tarago Water Resources Review.

Progress on the Tarago project was slower than we expected, largely due to protracted community consultation on issues such as recreational use of the reservoir for boating and fishing.

Melbourne Water is a partner in a new catchment pathogen research project with the American Water Works Association Research Foundation, the University of New South Wales, the Sydney Catchment Authority, the Water Services Association of Australia and the Cooperative Research Centre for Water Quality and Treatment. The American research foundation is providing US\$300,000 for the project. The project examines the transport and fate of pathogens, such as *Cryptosporidium* and viruses, within catchments.

We concentrated our water treatment research in our distribution system on optimising chlorine residuals. These residuals are chlorine remaining in water when it reaches the consumer's tap. If residuals are not high enough, bacteria could regrow.

The research involves comprehensive systems modelling as well as investigating how biological films that form on pipe walls, and how bacterial regrowth in these films behave under various chlorine levels. Scheduled for completion in 2001/02, the work is being carried out in conjunction with the Cooperative Research Centre for Water Quality and Treatment and other partners.

During 2000/01, we spent \$356,000 on catchment and storage related water quality research. Our planned expenditure in 2001/02 is \$305,000. We spent a further \$123,000 on other water quality research. Our planned expenditure for this research during 2001/02 is \$60,000. These figures do not include our routine water quality monitoring costs.

Target for 2000/01	Progress			Performance Target for 2001/02
	Little or none	Some	Achieved	
Catchment management Undertake fire protection and security patrols.			✓	Annual target.
Management systems Maintain re-certification of the Hazard Analysis and Critical Control Point system for drinking water quality.			✓	Maintain certification through six-monthly surveillance audits.
Achieve water treatment and supply system certification to ISO 9001–2000.			✓	Maintain certification through six-monthly surveillance audits.
Conduct monitoring and quality assurance programs.			✓	Annual target.
Disinfecting water supplies Achieve plant reliability above 92 per cent.				Target increased to 94 per cent.
Water quality monitoring Achieve 99 per cent of water samples free of <i>E.coli</i> bacteria.			✓	Annual target.
Water quality improvement Complete duplication of the Cardinia-Pearcedale pipeline.			✓	Project completed.
Line and cover the Garfield Reservoir. Replace the Johns Hill Reservoir. Upgrade the Silvan-Preston Reservoir outlet screening chambers.		✓		Complete project by June 2004.
New projects Line, cover or replace the Dromana, Mornington and Frankston service reservoirs.				Complete by June 2004.
Research Undertake research on turbidity in the Silvan system.			✓	Project on target. Complete research by June 2004.
Investigate catchment sources of microorganisms.			✓	Project on target. Complete research by June 2003.
Undertake research on management options for pathogens in catchments.			✓	Project on target. Complete research by June 2004.
Undertake research on taste and odour at Yan Yean Reservoir.			✓	Complete research by June 2003.
Assess land capability of Tarago Reservoir catchment.		✓		Complete project by March 2002.
New project A national research project on the transport and fate of pathogens in catchments.				Complete by June 2004.
Optimise chlorine residuals (chlorine levels in water when it reaches the tap).		✓		Complete project by June 2002.

Drinking water quality data

Drinking water quality data

The results of water quality tests are reported against recommended levels in either the joint National Health and Medical Research Council (NHMRC)/Australian Water Resources Council 1987 Guidelines for Drinking Water Quality in Australia or the World Health Organization 1993 Guidelines for Drinking Water Quality. The Australian guidelines also recommend sampling frequencies for microbiological parameters related to the size of the population served by a particular zone.

WATER QUALITY – PARAMETERS AND REPORTING LEVELS

Parameter	Guideline basis	Units	Reporting level
Microbiological – routine			
<i>E.coli</i>	NHMRC 1987	organisms/100mL	1
Total coliforms	NHMRC 1987	organisms/100mL	20**
Plate counts	MW Corporate	Colony forming units/100mL	1000
Physical – routine			
Colour	NHMRC 1987	True colour units (TCU)	15
Turbidity	NHMRC 1987	Nephelometric turbidity units (NTU)	5
pH	NHMRC 1987	pH units	6.5 to 8.5
Chemical – routine			
Aluminium	NHMRC 1987	milligrams/litre – mg/L	0.2
Iron	NHMRC 1987	mg/L	0.3
Manganese	NHMRC 1987	mg/L	0.1
Fluoride	Health Act	mg/L	0.7 - 1.2
Chemical – routine less frequent			
Arsenic	NHMRC 1987	milligrams/litre – mg/L	0.05
Cadmium	NHMRC 1987	mg/L	0.005
Chromium	NHMRC 1987	mg/L	0.05
Copper	NHMRC 1987	mg/L	1
Cyanide	NHMRC 1987	mg/L	0.1
Lead	NHMRC 1987	mg/L	0.05
Mercury	NHMRC 1987	mg/L	0.001
Selenium	NHMRC 1987	mg/L	0.01
Zinc	NHMRC 1987	mg/L	5
Chloride	NHMRC 1987	mg/L	400
Hardness	NHMRC 1987	mg/L	500
Nitrate (as N)	NHMRC 1987	mg/L	10
Sodium	NHMRC 1987	mg/L	300
Sulphate	NHMRC 1987	mg/L	400
Total alkalinity	*	mg/L	*
Calcium	*	mg/L	*
Magnesium	*	mg/L	*
Silica	*	mg/L	*
Total organic carbon	*	mg/L	*
Total phosphorus	*	mg/L	*
Total solids	*	mg/L	*
Radiological			
Radioactivity – alpha	NHMRC 1987	Becquerel/litre	0.1
Radioactivity – beta	NHMRC 1987	Becquerel/litre	0.1

Notes:

* Items marked with an asterisk have not had a reporting level set but are monitored for operational purposes.

** At consumer taps. The Melbourne Water target at monitoring points is less than 10.

WATER QUALITY – PARAMETERS AND REPORTING LEVELS continued

Parameter	Guideline basis	Units	Reporting level
Pesticides			
Aldrin	NHMRC 1987	micrograms/litre – µg/L	1
Dieldrin	NHMRC 1987	µg/L	1
Chlordane	NHMRC 1987	µg/L	6
DDT	NHMRC 1987	µg/L	3
Heptachlor	NHMRC 1987	µg/L	3
Heptachlor epoxide	NHMRC 1987	µg/L	3
Lindane	NHMRC 1987	µg/L	100
2,4-D	NHMRC 1987	µg/L	100
Industrial chemicals			
Carbon tetrachloride	NHMRC 1987	micrograms/litre – µg/L	3
Tetra chloroethene	NHMRC 1987	µg/L	10
Trichloroethene	NHMRC 1987	µg/L	30
1,1 Dichloroethene	NHMRC 1987	µg/L	0.3
1,2-Dichloroethane	NHMRC 1987	µg/L	10
Benzene	NHMRC 1987	µg/L	10
Polynuclear aromatic hydrocarbons (PAH's)			
Benzo-a-pyrene	NHMRC 1987	micrograms/litre – µg/L	0.01
Byproducts of disinfection			
Pentachlorophenol	NHMRC 1987	micrograms/litre – µg/L	10
2,4,6-Trichlorophenol	NHMRC 1987	µg/L	10
Trihalomethanes (THM's) – total only			
Bromoform		micrograms/litre – µg/L	200
Dibromochloromethane		µg/L	
Bromodichloromethane		µg/L	
Chloroform		µg/L	
Chloroacetic acids – no limit set			
Chloroacetic acid		micrograms/litre – µg/L	
Dichloroacetic acid		µg/L	
Trichloroacetic acid		µg/L	

Notes:

> NHMRC 1987 – National Health and Medical Research Council/Australian Water Resources Council 1987:

Guidelines for Drinking Water Quality in Australia

> milligrams/litre = mg/L or parts per million

> micrograms/litre = µg/L or parts per billion

Drinking water quality results 2000/01

Microbiological parameters

The reporting levels for *E.coli* and total coliforms are based on the NHMRC 1987 guidelines. There is no corresponding guideline for plate counts so the reporting level for that parameter is a corporate target adopted to reflect the conditions of protected catchments and Melbourne's generally unfiltered water supplies. Sampling results are based on monitoring at locations in our agreements with the retail water companies. *E.coli* and coliforms have been assessed using the defined substrate technology (Colilert) method. The *E.coli*, coliform and plate count numbers should not exceed the reporting level.

Parameter/ retail companies	Reporting level	Total no. of zones	Total no. of tests	Total (%) exceedence	No. of tests exceeding reporting level in water supply zones serving different population size groupings					
					Pop. <10K		Pop. 10K to 100K		Pop. > 100K	
					No. of tests	Exceedence %	No. of tests	Exceedence %	No. of tests	Exceedence %
<i>E.coli</i> (org/100mL)										
All	1	65	6274	3 (0.05)	2119	0 (0.0)	3691	2 (0.05)	1854	2 (0.11)
Yarra Valley Water	1	35	3541	3 (0.08)	1390	0 (0.0)	1916	2 (0.10)	1008	2 (0.20)
City West Water	1	11	1653	1 (0.06)	–	–	1009	0 (0.0)	802	1 (0.12)
South East Water	1	30	2954	1 (0.03)	830	0 (0.0)	1439	0 (0.0)	1050	1 (0.10)
Total coliforms (org/100mL)										
All	10	65	6274	55 (0.88)	2119	16 (0.76)	3691	33 (0.89)	1854	12 (0.65)
Yarra Valley Water	10	35	3541	26 (0.73)	1390	9 (0.65)	1916	13 (0.68)	1008	10 (0.99)
City West Water	10	11	1653	18 (1.09)	–	–	1009	14 (1.39)	800	6 (0.75)
South East Water	10	30	2954	17 (0.58)	830	7 (0.84)	1439	9 (0.63)	1050	2 (0.19)
Plate count (cfu/mL)										
All	1000	65	6269	9 (0.14)	2117	5 (0.24)	3687	5 (0.14)	1854	0 (0.0)
Yarra Valley Water	1000	35	3541	5 (0.14)	1390	1 (0.07)	1916	4 (0.21)	1008	0 (0.0)
City West Water	1000	11	1653	0 (0.00)	–	–	1009	0 (0.0)	802	0 (0.0)
South East Water	1000	30	2949	5 (0.17)	828	4 (0.48)	1435	1 (0.07)	1050	0 (0.0)

Note:

> Some monitoring locations cover multiple zones, different population groups or more than one retail company.

Routine physical parameters

The reporting levels are based on the NHMRC/AWRC 1987 guidelines. Sampling results are based on monitoring at locations listed in our agreements with the retail water companies. Target levels are at equal to or less than the reporting level or, in the cases of pH, within the range shown. The physical reporting levels are based on aesthetic rather than health considerations. Values that would be a concern for health are well beyond the reporting levels.

The testing for colour is done as “apparent colour” rather than “true colour”; the latter test involves a filtered sample and would not be representative of Melbourne’s water supply. “Apparent colour” gives a higher number than would be obtained for “true colour” for the same sample.

Parameter/ retail companies	Reporting level	Total no. of zones	Total no. of tests	Total (%) exceedence	No. of tests exceeding reporting level in water supply zones serving different population size groupings					
					Pop. <10K		Pop. 10K to 100K		Pop. > 100K	
					No. of tests	Exceedence %	No. of tests	Exceedence %	No. of tests	Exceedence %
Colour (Pt/Co units)										
All	15	65	2235	81 (3.6)	675	19 (2.8)	1434	61 (4.3)	719	34 (4.7)
Yarra Valley Water	15	35	1321	79 (6.0)	386	24 (6.2)	881	54 (6.1)	415	30 (7.2)
City West Water	15	11	755	25 (3.3)	–	–	471	13 (2.8)	337	13 (3.9)
South East Water	15	30	1042	20 (1.9)	337	0 (0.0)	440	11 (2.5)	447	15 (3.4)
Turbidity (NTU)										
All	5	65	2236	2 (0.1)	676	1 (0.1)	1434	1 (0.1)	719	1 (0.1)
Yarra Valley Water	5	35	1322	2 (0.2)	387	1 (0.3)	881	1 (0.1)	415	0 (0.0)
City West Water	5	11	755	1 (0.1)	–	–	471	1 (0.2)	337	1 (0.3)
South East Water	5	30	1042	0 (0.0)	337	0 (0.0)	440	0 (0.0)	447	0 (0.0)
pH										
All	6.5-8.5	65	2235	10 (0.4)	676	7 (1.0)	1433	1 (0.1)	718	3 (0.4)
Yarra Valley Water	6.5-8.5	35	1321	4 (0.3)	387	1 (0.3)	880	1 (0.1)	415	3 (0.7)
City West Water	6.5-8.5	11	754	2 (0.3)	–	–	470	0 (0.0)	336	2 (0.6)
South East Water	6.5-8.5	30	1042	8 (0.8)	337	6 (1.8)	440	0 (0.0)	447	2 (0.4)

Note:

> Some monitoring locations cover multiple zones, different population groups or more than one retail company.

Routine inorganic chemical parameters

The reporting levels for iron, aluminium and manganese are based on the NHMRC/AWRC 1987 guidelines. The level for fluoride is based on the *Health (Fluoridation) Act 1973* (Vic.). Target levels are equal to or less than the reporting level or, in the cases of fluoride, within the range shown. The reporting levels for iron, aluminium and manganese have been established on aesthetic grounds rather than health considerations. The range for fluoride is that recommended for the control of dental caries.

The guideline/reporting level for aluminium is for acid soluble form. Sampling results are based on monitoring at the locations listed in our agreements with the retail water companies.

Fluoride concentrations at the points of introduction into the system comply with the calculated annual and short-term averages required under the Standards for Fluoridation of Public Water Supplies.

Values outside the reporting range tend to be low rather than high and zones where fluoride is not added or is incidentally reduced by further treatment, influence results.

Parameter/ retail companies	Reporting level	Total no. of zones	Total no. of tests	Total (%) exceedence	No. of tests exceeding reporting level in water supply zones serving different population size groupings					
					Pop. <10K		Pop. 10K to 100K		Pop. > 100K	
					No. of tests	Exceedence %	No. of tests	Exceedence %	No. of tests	Exceedence %
Iron mg/L										
All	0.3	65	2234	3 (0.1)	675	2 (0.3)	1433	0 (0.0)	718	1 (0.1)
Yarra Valley Water	0.3	35	1320	1 (0.1)	386	1 (0.3)	880	0 (0.0)	415	0 (0.0)
City West Water	0.3	11	754	0 (0.0)	–	–	470	0 (0.0)	336	0 (0.0)
South East Water	0.3	30	1042	2 (0.2)	337	1 (0.3)	470	0 (0.0)	447	1 (0.2)
Aluminium mg/L										
All	0.2	65	309	2 (0.6)	153	1 (0.7)	165	1 (0.6)	86	0 (0.0)
Yarra Valley Water	0.2	35	266	2 (0.8)	140	1 (0.7)	135	1 (0.7)	49	0 (0.0)
City West Water	0.2	11	103	0 (0.0)	–	–	43	0 (0.0)	73	0 (0.0)
South East Water	0.2	30	99	0 (0.0)	13	0 (0.0)	48	0 (0.0)	73	0 (0.0)
Manganese mg/L										
All	0.1	65	1042	0 (0.0)	299	0 (0.0)	655	0 (0.0)	344	0 (0.0)
Yarra Valley Water	0.1	35	633	0 (0.0)	204	0 (0.0)	401	0 (0.0)	192	0 (0.0)
City West Water	0.1	11	393	0 (0.0)	–	–	252	0 (0.0)	167	0 (0.0)
South East Water	0.1	30	409	0 (0.0)	117	0 (0.0)	167	0 (0.0)	190	0 (0.0)
Fluoride mg/L										
All	0.7-1.2	65	936	21 (2.2)	117	4 (3.4)	820	19 (2.3)	488	15 (3.1)
Yarra Valley Water	0.7-1.2	35	638	19 (3.0)	113	5 (4.4)	574	17 (3.0)	216	10 (4.6)
City West Water	0.7-1.2	11	397	7 (1.8)	–	–	216	1 (0.5)	233	6 (2.6)
South East Water	0.7-1.2	30	437	10 (2.3)	52	0 (0.0)	234	7 (3.0)	307	10 (3.3)

Note:

> Some monitoring locations cover multiple zones, different population groups or more than one retail company.

Chemical and radiological parameters

The reporting levels are based on the NHMRC guidelines.

Results should not exceed the reporting levels. Items marked with an asterisk have not had a reporting level set but are monitored for operational purposes. Sampling is conducted at headworks reservoirs.

Parameter	Reporting level mg/L	Total number of analyses	Exceed reporting level no. (%)
Arsenic	0.05	38	0
Cadmium	0.005	38	0
Chromium	0.05	38	0
Copper	1	38	0
Cyanide	0.1	38	0
Lead	0.05	38	0
Mercury	0.001	38	0
Selenium	0.01	38	0
Zinc	5	38	0
Chloride	400	38	0
Hardness	500	38	0
Nitrate (as N)	10	38	0
Sodium	300	38	0
Sulphate	400	38	0
Total Alkalinity	*	38	
Calcium	*	38	
Magnesium	*	38	
Silica	*	38	
Total Organic Carbon	*	38	
Total Phosphorus	*	38	
Total Solids	*	38	

Parameter	Reporting level Bq/L	Total number of analyses	Exceed reporting level no. (%)
Radioactivity – alpha	0.1	9	0
Radioactivity – beta	0.1	9	0

Organic chemicals

The reporting levels are based on the NHMRC 1987 guidelines. Results should not exceed the reporting levels. Sampling is conducted at headworks reservoirs.

Parameter	Reporting level µg/L	Total number of analyses	Exceed reporting level no. (%)
Pesticides			
Aldrin	1	22	0
Dieldrin	1	22	0
Chlordane	6	22	0
DDT	3	22	0
Heptachlor	3	22	0
Heptachlor epoxide	3	22	0
Lindane	100	22	0
2,4-D	100	22	0
Industrial chemicals			
Carbon tetrachloride	3	22	0
Tetra chloroethene	10	22	0
Trichloroethene	30	22	0
1,1-Dichloroethene	0.3	22	0
1,2-Dichloroethane	10	22	0
Benzene	10	22	0
Polynuclear aromatic hydrocarbons (PAHs)			
Benzo-a-pyrene	0.01	21	0
Byproducts of disinfection			
Pentachlorophenol	10	22	0
2,4,6-Trichlorophenol	10	22	0
Trihalomethanes (THMs)			
	0.2*	43	0
Bromoform	**	43	
Dibromochloromethane	**	43	
Bromodichloromethane	**	43	
Chloroform	**	43	
Chloroacetic acids			
Chloroacetic acid	**	43	
Dichloroacetic acid	**	43	
Trichloroacetic acid	**	43	

Notes:

* Guideline refers to all THMs present

** No guideline value set

Routine pathogen monitoring

Routine monitoring is conducted at major service reservoirs. The NHMRC 1987 guidelines do not contain recommendations for microbiological quality other than for coliforms. The Australian Drinking Water Guidelines 1996 place microorganisms into two general categories—those that should not be detected and those for which guidelines have not been set due to lack of sufficient data.

Parameter	Reporting level	Number of analyses	Detection rate no. (%)
Should not be detected			
<i>Yersinia</i> spp	Detected (per 2 litres)	128	0
<i>Salmonella</i> spp	Detected (per 2 litres)	128	0
<i>Campylobacter</i> spp	Detected (per 2 litres)	128	0
<i>Vibrio</i> spp	Detected (per 2 litres)	128	0
Enteroviruses by PCR			
adenovirus	Detected (per 20 litres)	129	0
rotavirus	Detected (per 20 litres)	129	0
hepatitis A	Detected (per 20 litres)	129	0
norwalk virus G1 Genotype	Detected (per 20 litres)	129	0
Norwalk virus G2 Genotype	Detected (per 20 litres)	129	0
Norwalk like virus	Detected (per 20 litres)	129	0
No guideline set			
<i>Faecal Streptococci</i>	Detected (per 100mL)	128	0
<i>Legionella</i> species	Detected (per 2 litres)	129	0
<i>Legionella</i> PN SG 1	Detected (per 2 litres)	128	0
<i>Legionella</i> PN SG2-14	Detected (per 2 litres)	129	0
<i>Clostridium</i>	Detected (per 100mL)	128	0
<i>Pseudomonas aeruginosa</i>	Detected (per 100mL)	128	0
<i>Aeromonas</i>	Detected (per 100mL)	128	3 (2.3)

Note:

> *Aeromonas* are present to some degree in all water systems and are a measure of the health of the systems. They can grow on the inside of the distribution pipes and are only considered a problem if numbers are very high or many samples are positive which has not been the case here.

The marine environment

Melbourne Water is responsible for treating most of Melbourne's sewage. The treated sewage is discharged into Port Phillip Bay and Bass Strait under licences issued by EPA Victoria.



We are responsible for ensuring these discharges are not a threat to public health. We have to meet EPA Victoria licence requirements and the Australian Guidelines for Recreational Use of Water published by the National Health and Medical Research Council in 1990.

We accept sewage from the three retail water companies serving the greater Melbourne metropolitan area. Effectively we operate two sewerage systems, the eastern and the western, which processed a total of 335,000 million litres of sewage during 2000/01.

Our eastern system includes some 213 kilometres of sewers, the Kew and North Road pumping stations, four minor pumping stations and the Eastern Treatment Plant. This system transfers and treats about 38 per cent of Melbourne's sewage. Treated effluent is discharged to Bass Strait at Boags Rocks between St Andrews and Gunnamatta.

Our western system includes some 167 kilometres of sewers, the Brooklyn and Hoppers Crossing pumping stations and the Western Treatment Plant. This system transfers and treats about 55 per cent of Melbourne's sewage. Treated effluent is discharged at four shoreline outlets on the western shores of Port Phillip Bay between the Werribee River and Point Wilson.

The remaining sewage is treated at local treatment plants operated by the retail water companies.





Managing public health impacts of the sewerage system

Melbourne's sewerage system was established in response to outbreaks of disease, such as typhoid, and to combat odour from untreated sewage. As in other developed countries, the public health benefits of treating and disposing of household and industrial wastes are largely taken for granted. Most public concern about sewage treatment focuses on environmental impacts. (See *Melbourne Water Environment Review 2000/01* for more information)

Recycling water standards

Melbourne Water is committed to increasing recycling of the effluent produced at its sewage treatment plants to 20 per cent of the total output by 2010. Some treated effluent from the Eastern Treatment Plant is already used for market gardens, wineries and sports ovals.

Use of the recycled effluent is subject to national and state health guidelines. In November 2000, new national guidelines were published under the National Water Quality Management Strategy. These guidelines provide advice on recycled water quality, treatment levels, safeguards and controls, and monitoring. Particular use of recycled water depends on its degree of treatment and pathogen reduction as measured by the level of faecal coliforms or *E.coli* it contains.

EPA Victoria guidelines are modelled on the national guidelines.

Eastern Treatment Plant

Our Eastern Treatment Plant covers 1,000 hectares. It uses both mechanical and bio-chemical processes in a sewage treatment method called the activated sludge process. The plant produces secondary-quality disinfected effluent which is piped 56.3 kilometres from Carrum to Boags Rocks where it is discharged into Bass Strait. We are required to monitor the treated effluent's effect on the bacteriological quality of the receiving water near the discharge point at Boags Rocks. During 2000/01, we met all licence requirements.

Western Treatment Plant

Our Western Treatment Plant is a lagoon and land treatment facility that discharges secondary-quality effluent to Port Phillip Bay. There is no public access by land to the points where we discharge treated effluent from the plant.

The EPA Victoria operating licence for this plant requires us to monitor the effect of effluent discharges on the bacteriological quality of the receiving waters. During 2000/01, we met the licence conditions.

We have irrigated land at our Western Treatment Plant with raw or primary treated sewage for more than 100 years. We graze cattle and sheep on the land before selling them for human consumption.

Constituents in the sewage could contaminate the land the animals graze on. Of concern are organochlorine residues, principally dieldrin and polychlorinated biphenyls. We work within a property management plan approved by the Department of Natural Resources and Environment that is designed to manage the organochlorine risks.

We are undertaking a major four-year redevelopment of treatment processes at the Western Treatment Plant. As a result, we will treat all wastewater through lagoons before it is used to irrigate land around the treatment plant. This will remove the contaminants of concern before the water is used on the land. Contaminant levels in the soil will reduce over time.

There is also some potential public health risk associated with beef measles, *Cysticercus bovis*, which may be caused by cattle eating soil or grass containing eggs of the tapeworm, *Taenia saginata*. We currently manage this risk by ensuring animals spend at least 18 months on the land before being sold for human consumption. Within that period, the animals build up a natural resistance to beef measles.

Treating water through lagoons will largely overcome the beef measles issue because of its effect on the viability of *Taenia saginata* eggs.



Health monitoring at Boags Rocks

Gunnamatta is the nearest recreational beach to the treated effluent discharge point at Boags Rocks. The beach is popular though dangerous for swimming. Signs advise where the discharge is located and there is a “No swimming” warning sign.

However the area immediately offshore from Boags Rocks is a favourite spot for experienced surfers. Some organisations and individuals have expressed concerns about the impact of the discharge on their health, on the marine environment and on the amenity of the water near the discharge point. Generally, they oppose the present outfall and are against extending it offshore as a means of overcoming any health and environmental problems.

During 1999, the Department of Epidemiology and Preventive Medicine at Monash University carried out a microbiological health risk assessment for the waters around the Boags Rocks outfall. Their objective was to see if people swimming or surfing in nearby waters were likely to become sick as a result. The researchers found it very unlikely that swimmers and surfers faced an increased risk of illness due to faecal microorganisms in the water, compared to swimmers or surfers at other ocean beaches.

We undertook an expanded microbiological monitoring program during 2000/01 involving:

- > Water quality sampling in the swimming and surfing zones.

- > Statistical assessment of the data.
- > Determining the impact of operational changes.
- > An assessment of compliance with the World Health Organization draft Guidelines for Safe Recreational-water Environments: Coastal and Fresh-waters.

Again, the study found that on the basis of available evidence, it would be unlikely that swimmers or surfers at Gunnamatta would be at increased risk of illness due to faecal microorganisms in the water, compared to swimmers at other ocean beaches around Melbourne.

However, the researchers identified two main areas of uncertainty. These related to relative exposure levels of surfers and swimmers, and differences in the nature of the effluent at Boags Rocks. The effluent from the Eastern Treatment Plant is treated to secondary stage and disinfected. At other overseas study sites, there is little treatment and the effluent is not disinfected.

The study recommends an ongoing microbiological monitoring program and further assessment of the uncertainties identified above. We will address these issues in 2001/02, although we have not yet decided how this will be done.

This study will be covered in a report to EPA Victoria outlining our preferred approach to the ongoing management of effluent from the Eastern Treatment Plant. The report is due in November 2001.

Gus Fabris collects mussels from Boags Rocks for analysis. We contracted CSIRO to undertake a long-term monitoring program at Boags Rocks to increase our knowledge of the impact of effluent on the marine environment.



World Health Organization guidelines for recreational waters

The World Health Organization has sought international comment on draft guidelines that introduce a new approach to assessing public health risks in waters used for swimming, surfing and other recreation. Melbourne Water is playing a key role in developing the Australian water industry's response.

The draft guidelines move away from the traditional approach of relying solely on testing levels of faecal indicator bacteria, such as *E.coli*, to decide if water is safe for recreational use.

The proposed guidelines include assessing the sources of pollution that are contributing to contamination of recreational water. Microbiological risk assessment, using information from studies of individuals exposed to pathogens, is used to decide what level of contamination is acceptable. Risk assessment is also used to support guideline development for drinking water and reusing treated effluent.

We project-managed a review of the draft guidelines on behalf of the Water Services Association of Australia. Researchers from Monash University and the Cooperative Research Centre for Water Quality and Treatment conducted the review. It formed the basis of the Association's submission to the World Health Organization on applying the guidelines to Australian conditions. We expect the organization will finalise the guidelines in early 2002.

Eastern Treatment Plant licence compliance

Bacteriological monitoring – beach samples

We sample the receiving waters throughout the year at six locations along the Gunnamatta and St Andrews beaches and have them analysed for *E.coli*. Our Eastern Treatment Plant is required to report to EPA Victoria any time the 42-day geometric mean exceeds 200 organisms per 100 millilitres of water or if the 80th percentile exceeds 400 organisms per 100 millilitres of water.

Sample points 5 and 6 are north west from the outlet along St Andrews Beach and sample points 1, 2, 3 and 4 are south east from the outlet along Gunnamatta Beach. Sample points 1 and 5 are adjacent to the outlet.

E. COLI – GEOMETRIC MEANS FOR 42-DAY PERIODS FOR 12 MONTHS FROM 30 JUNE 2000

42-day period ends	Geometric (Log) Mean (org/100mL)					
	SEPP (Waters of Victoria) Objective: 200 org/100mL					
	ETP beach 1	ETP beach 2	ETP beach 3	ETP beach 4	ETP beach 5	ETP beach 6
11 August 2000	7.8	1.3	1.3	1.3	21.2	1.3
22 September 2000	3.6	1.6	1.1	1.3	13.6	1.0
3 November 2000	4.3	1.0	1.3	1.5	13.5	1.4
15 December 2000	27.4	1.0	1.3	1.0	47.9	3.5
26 January 2001	3.4	1.0	1.0	1.0	24.7	1.1
9 March 2001	5.3	1.1	1.1	1.0	13.9	1.3
20 April 2001	5.0	1.6	1.1	1.0	14.3	4.0
1 June 2001	8.9	2.2	2.4	1.9	37.5	1.8
30 June 2001	6.9	3.0	2.4	3.5	10.4	1.2

E. COLI – 80TH PERCENTILES FOR 42-DAY PERIODS FOR 12 MONTHS FROM 30 JUNE 2000

42-day period ends	80th Percentile (org/100mL)					
	SEPP (Waters of Victoria) Objective: 400 org/100mL					
	ETP beach 1	ETP beach 2	ETP beach 3	ETP beach 4	ETP beach 5	ETP beach 6
11 August 2000	14	2	2	2	18	1
22 September 2000	4	2	1	1	14	1
3 November 2000	10	1	1	1	16	2
15 December 2000	340	1	2	1	68	4
26 January 2001	6	1	1	1	40	1
9 March 2001	14	1	1	1	28	2
20 April 2001	8	2	1	1	30	4
1 June 2001	32	2	4	1	130	4
30 June 2001*	12	9	4	5	15	1

* Four samples only in period to 30 June 2001

Western Treatment Plant licence compliance

Bacteriological monitoring – beach samples

Every seven days a sample of seawater is collected in 60-centimetre deep water off-shore from Beach Road and 160 South Road. The samples are analysed for *E.coli*. The two sampling sites are public access points to Port Phillip Bay, within Western Treatment Plant and outside the designated mixing zones for *E.coli*.

Melbourne Water must advise EPA Victoria if:

- > the 42-day geometric mean exceeds 1,000 *E.coli* organisms per 100 millilitres; or
- > more than 20 per cent of samples (80th Percentile) in any 42-day period exceed 2,000 *E.coli* organisms per 100 millilitres.

***E. COLI* – 42-DAY GEOMETRIC MEAN AND 80TH PERCENTILE SAMPLES RESULTS (ORG/100ML)**

42-day period ends	Geometric Mean		80th Percentile	
	Beach Road	160 South Road	Beach Road	160 South Road
11 August 2000	3.8	3.0	10	10
22 September 2000	3.4	1.5	28	6
3 November 2000	3.3	23.4	2	32
15 December 2000	2.5	2.8	10	10
26 January 2001	3.3	10.4	10	16
9 March 2001	0.9	9.5	3	30
20 April 2001	0.8	5.0	2	12
1 June 2001	6.6	3.4	18	4
30 June 2001*	3.2	4.7	50	18

* Four samples only in period to 30 June 2001



Target for 2000/01	Progress			Performance Target for 2001/02
	Little or none	Some	Achieved	
Eastern Treatment Plant				
Undertake Boags Rocks beach monitoring program and health assessment.			✓	<i>Complete further monitoring and analysis of areas of uncertainty on health issues.</i>
Report to EPA Victoria on improvement works and outfall options.			✓	Project on schedule. <i>Complete report by November 2001.</i>
Project-manage a review of World Health Organization guidelines for recreational waters.			✓	Review completed.
Western Treatment Plant				
Undertake major redevelopment of reuse scheme and treatment processes*.			✓	Project on target. Complete redevelopment by June 2005.

* See Melbourne Water Environment Review 2000/01 for more information

Waterways

Melbourne Water is responsible for managing Melbourne's main drains and waterways. Water quality in creeks, rivers and lakes is generally seen as an environmental rather than public health issue.



However, there are potential health risks associated with drinking or swimming in contaminated waters. There are also risks from litter and stormwater that can be washed onto suburban beaches and into Port Phillip Bay through the drainage system. The quality of stormwater run-off can have a significant impact, sometimes forcing EPA Victoria to advise against swimming at some beaches.

Syringes discarded on city streets are a serious problem. Rain can wash them into street drains and waterways, from where they are carried to beaches on the bay, creating the risk of needle-stick injuries. We work with EPA Victoria, local councils and other organisations to reduce litter and contamination problems on the beaches.



All freshwater bodies naturally contain low concentrations of various algae species. In some environmental and weather conditions, the algae can “bloom”, resulting in high concentrations in the water. Some blue-green species produce toxins that are harmful to humans and animals.

We coordinate the management of blue-green algae outbreaks in most areas of metropolitan Melbourne, including the Bunyip, Yarra and part of the Maribyrnong catchments. We are required to advise EPA Victoria, Department of Natural Resources and Environment and Department of Human Services if our monitoring detects algae concentrations above “alert” levels.

We have algae management response plans for any incidents. When blue-green algae outbreaks occur, our standard procedures include erecting warning signs and notifying relevant government agencies and councils. Where the affected water is accessible to the public, we also advise local communities.



Managing public health risks on the beaches and the bay

We work with councils, EPA Victoria and other bodies to improve the quality of stormwater run-off and reduce litter washed through the drainage system to Port Phillip Bay. With councils, we develop local stormwater management plans. (See *Melbourne Water Community Review 2000/01 and Environment Review 2000/01* for more detail.)

Spills from Melbourne’s sewers can end up in drains and waterways, polluting the water they carry to the bay. We have made significant progress in recent years in reducing sewage spills. We have a “no sewage spills” policy. Our strong progress in reducing sewage spills places us among the global leaders in this area of spill prevention.

EPA Victoria runs Beach Report, a program which provides the community with information on water quality and beach conditions over the summer months each year. EPA Victoria monitors faecal bacteria in water near the shore at 36 bay beaches and at Gunnamatta near the outfall that discharges treated effluent piped from our Eastern Treatment Plant.

Between 1 December 2000 and 31 March 2001, usually following rain, EPA Victoria recorded unacceptable levels of the indicator organism *E.coli* at some stage at 26 beaches. In most cases, resampling showed the water quality had returned to acceptable levels by the next day.

There were four occasions when the EPA recommended against swimming – one each at Mentone, Fairy Dell (between Geelong and Portarlington), Frankston and Mornington. Water quality at Gunnamatta was acceptable throughout the summer.

Syringes

We are a key player on the Syringes on Victorian Beaches Taskforce set up in January 2000. Government departments, EcoRecycle Victoria and local councils are all represented on the taskforce.

Reducing the number of syringes washed through the drainage system on to beaches is a high priority because they carry a risk of Hepatitis C and HIV through needlestick injuries. Research in 1993 found that 15 per cent of all litter dropped in the Yarra catchment ends up on bayside beaches. Syringes are buoyant and move through drains and waterways quickly.

We commissioned research into the syringe issue, including a trial of two types of syringe litter traps. A total of 40 traps were installed in “hotspots” in Port Phillip and Frankston municipalities with monitoring equipment to count the number of syringes they capture.

The traps were trialed from February to June 2001. The study found that the traps did reduce the number of syringes reaching beaches. It also provided information on ways to improve trap performance.

Target for 2000/01	Progress			Performance Target for 2001/02
	Little or none	Some	Achieved	
Syringes on beaches Conduct research into the effectiveness of litter traps designed to stop discarded syringes ending up on suburban beaches.			✓	Field trials of litter traps completed in June 2001. Results are being reviewed.
Waterways and drainage Actions to reduce blooms in the Quiet Lakes.			✓	Continue improvement actions. <i>Develop a consolidated management plan by June 2002.</i>
CSIRO phosphorus research in the Quiet Lakes.			✓	On hold. Management by natural ecological processes favoured (see over).
Manage algae in our Monbulk Retarding Basin.			✓	<i>Complete a further investigation and review of system hydraulics and structural design by June 2002.</i>

The Quiet Lakes

Patterson Lakes is a suburban waterfront development on the Patterson River, some 30 kilometres south east of Melbourne. The development has three lakes not connected to the river system – Legana, Illawong and Carramar – known as the Quiet Lakes.

Blue-green algal blooms were present in all three lakes for most of the 1999-2000 summer. Over the summer of 2000/01, Lake Carramar did not bloom and Lake Illawong bloomed for only a short period. However a strong bloom of the blue-green algae, *Planktolyngbya*, persisted in Lake Legana for almost nine months from October 2000.

Several factors favour blue-green algal blooms occurring in the Quiet Lakes including:

- > being primarily fed by urban stormwater, which has high nutrient levels
- > a lack of shade
- > poor water circulation
- > little throughput of fresh water
- > biological factors such as a lack of water plants, high numbers of carp and low levels of zooplankton to graze on algae.

Over the past two years, we have been actively involved in managing blooms within these lakes. Recent water quality improvements, particularly in Lake Carramar, are considered to be the result of these management actions. There has been a slower response in the other two lakes, possibly because they are larger.

On 1 May 2001, we held a public meeting to discuss management of algal blooms within the Quiet Lakes. Some 80 people attended to hear a presentation by Melbourne Water and a consultant to a local residents' group, the Patterson Lakes Advisory Committee. The committee commissioned the consultant to conduct an independent review of our management of the lakes. The consultant and residents generally support our actions. We are developing a long-term management plan to reduce the likelihood of algal blooms in the lakes.

Algal blooms

For the last two summers, blue-green algal blooms have occurred in the three Quiet Lakes in the Patterson Lakes development. Our continuing actions to improve water quality and reduce the probability of blooms include:

- > planting aquatic flora
- > removing European carp
- > introducing estuary perch, a native fish that feeds on small fish, to help control the carp
- > introducing zooplankton to graze on the blue-green algae.

Each year, for the past six years, blue-green algae has bloomed in our Monbulk Retarding Basin. Prior to last summer, we made changes to the inlet structure to prevent stratification. These were not entirely successful. When the bloom appeared we erected warning signs and letterboxed the local community. We are planning a hydrodynamic study and review of the basin's structural design to determine what further works are needed.

No toxic impacts were observed in the algal blooms that occurred during the year.

However an outbreak of avian botulism in Cherry Lake, Altona, led to the death of some local waterbirds. We worked with the City of Hobsons Bay, which is responsible for the adjacent public open space, to manage the outbreak. Actions included disposing of dead birds to prevent further spread of botulism and installing warning signs.

Outbreaks of botulism tend to be seasonal. They usually occur in mid-to-late summer in hot, dry weather. Poisoning is a result of ingesting a toxin that is produced by *Clostridium botulinum*, a species of anaerobic bacteria that is widely distributed in soil and sediment.

Avian botulism is commonly spread when birds eat maggots that ingest and concentrate the *C. botulinum* toxin within animal carcasses. While not considered a significant risk to humans, water birds and other animals can ingest the toxin and suffer paralysis and death.

Outbreaks occurred in other water bodies during the summer months, including at Edwardes Lake in Darebin and the Hedgeley Dene Gardens pond in Malvern.

Incident reporting

Melbourne Water reports and records all incidents with the potential to create public health problems. All incidents are classified according to an incident hierarchy with five different levels.

In determining the level of an incident, we consider factors including:

- > the degree to which Melbourne Water contributed to the incident
- > whether Melbourne Water had to suspend operations
- > whether the incident was within Melbourne Water's control or influence
- > the severity and duration of the incident.

Examples of incident levels are:

- > Level one—minor equipment failure at a chlorination plant
- > Level two—vandalism at a local reservoir that would lead to it being taken out of service
- > Level five—a major outbreak of water-borne disease with a serious impact on public health.

The following table shows the number of public health incidents that occurred for each level in 2000/01 with comparable figures for the previous three years.

Level	Public health incidents			
	1997/98	1998/99	1999/2000	2000/01
5	0	0	0	0
4	0	0	0	0
3	1	0	0	0
2	7	3	5	2
1	21	33	35	20
Total	29	36	40	22

During the year, there were 15 minor equipment failures at disinfection plants, three occasions of unlawful entry to service reservoir grounds, three blue-green algae blooms in water-bodies or sewage treatment lagoons and an outbreak of avian botulism at Cherry Lake, Altona. The reduced number of incidents in 2000/01 is largely due to fewer disinfection plant failures and outbreaks of blue-green algae.

We use more general definitions for incidents under our incident management system ("prompt emergency response plan for Melbourne" or PERFORM). This plan covers a broader range of incidents and the definitions are based on remedial resource requirements, impacts on the community, customers and the environment and also have regard to legal, political and media aspects. There are four categories of incident: minor, significant, major and crisis. Under these PERFORM categories all the public health incidents in 2000/01 would be classed as minor.

Verification statement



Melbourne Water commissioned jointly the Sustainable Investment Research Institute (SIRIS) and the Snowy Mountains Engineering Corporation Victoria (SMEC Victoria) to verify the data and content of this Annual Public Health Review 2000/01 (the 'report'). Melbourne Water has the responsibility for the preparation of the report and this statement represents the auditor's independent opinion. Neither SIRIS nor SMEC Victoria was responsible for preparation of any part of this report.

Our Opinion

A high level of data accuracy is presented within the report. However, there were a small number of anomalies that were attributable to human transcription errors or misinterpretation of information in report writing.

Each of the data trails selected was identifiable and traceable and the personnel responsible were able to reliably demonstrate the origin(s) and interpretation of data.

Overall the auditor is satisfied, based on the past four years experience in verifying the Melbourne Water stakeholder reports and associated systems, that:

- > the report is a fair and honest representation of the organisation's policies, management systems and performance. The report is fairly presented and materially not mis-stated;
- > the report is a good reflection of management commitment towards public health performance and a fair description of outcomes achieved during 2000/01;
- > the systems and processes in place to generate the numerical data presented in the report are sound; and
- > the written statements made in the report accurately reflect the results and progress achieved during the reporting period.

General Findings and Recommendations

The following observations and recommendations are made as a result of the verification process to assist in further improving the standard of reporting:

By separating community and public health reporting, Melbourne Water has achieved the outcome of emphasising the importance of addressing public health issues in its day to day operations.

Melbourne Water has recently re-structured its operations. As a result, traceability of project data and access to relevant project files was more resource intensive. However, it is expected that this will not continue to be a source of concern in future reporting periods as the new structure is bedded down.

Where reporting templates are used from previous years, due care needs to be taken to ensure that template formats are applicable to the current reporting requirements.

Melbourne Water's stakeholder reporting process has evolved over the past five years and this year is moving towards a triple bottom line reporting framework.

Further analysis of key business issues from a triple bottom line perspective is recommended. This is necessary to continue developing a relevant and responsive performance measurement and reporting mechanism that comprehensively addresses Melbourne Water's triple bottom line aspects and impacts.

The above findings represent a summary of a more detailed assessment report presented to Melbourne Water.

On behalf of the audit team, 4th September 2001, Melbourne, Australia

Terence Jeyaretnam
Accredited Environmental Auditor (EPA Victoria)
Senior Environmental Auditor (QSA)
Principal, SIRIS

Glossary

Algae Large group of non-flowering plants, many microscopic, generally containing chlorophyll. Most algae are aquatic.

Algal bloom Microalgae occurring in dense numbers in a water body, as a result of favourable conditions such as nutrient enrichment.

Bacteria Single-celled microscopic organisms.

Beef measles Beef measles occurs when the eggs of the human tapeworm (*Taenia saginata*) are ingested by cattle and lodge as cysts (*Cysticercus bovis*) in the animal's large muscle groups.

Blue-green algae Refer to cyanobacteria.

Botulism Poisoning due to ingesting toxins contained in carrion or decaying vegetation that has been infected with the bacteria, *Clostridium botulinum*.

Chlorination Adding chlorine to water for purification.

Chlorophyll Green pigments of plants, which capture and use the energy from the sun to drive the photosynthesis process.

Coliforms Bacteria that predominantly inhabit soil and water systems but can also be present in the intestines of warm-blooded animals. *E.coli* is the only coliform of exclusively human origin.

Cryptosporidium A parasitic protozoan pathogen that can cause gastrointestinal illness and is resistant to common disinfection processes.

Cyanobacteria Bacteria with a typical bacterial intercellular structure except for extensive membranes containing the enzymes and pigments associated with photosynthesis. They occur as cells, filaments or colonies. They are often referred to as blue-green algae.

Detection limit Minimum level of quantification for a particular analytical method.

Dieldrin An organochlorine insecticide that is persistent in the environment. It is no longer manufactured.

E.coli A bacteria of the coliform group which is present in high numbers in human and animal faeces. Its presence in water indicates faecal contamination.

Faecal coliforms Thermotolerant coliform organisms mainly indicating faecal pollution of a water supply.

Fluoridation The addition of fluoride to the water supply to protect teeth against dental caries.

Giardia A parasitic protozoan pathogen that can cause gastrointestinal illness.

Pathogens Disease causing organisms including bacteria, viruses and protozoa.

pH The negative logarithm of the hydrogen ion concentration; an index of acidity or alkalinity.

Polychlorinated Biphenyls (PCBs) A group of highly stable chlorinated organic chemicals that are persistent in the environment and accumulate through the food chain.

Notifiable pathogens Designated pathogens whose detection in drinking water samples must be notified to the Department of Human Services.

Protozoa Small single-celled animals.

Sewage Strictly speaking household waste but loosely applied to any waste sent to a treatment plant.

Treated effluent Water discharged after processing of sewage at a treatment plant.

Turbidity A measure of the light scattering property of water due to the presence of fine suspended matter.

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