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DRAFT GUIDELINES FOR  
ENVIRONMENTAL MANAGEMENT

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DUAL PIPE WATER  
RECYCLING SCHEMES –  
HEALTH AND ENVIRONMENTAL  
RISK MANAGEMENT

Consultation draft, May 2005

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**DRAFT GUIDELINES FOR ENVIRONMENTAL MANAGEMENT**

**DUAL PIPE WATER RECYCLING SCHEMES:  
HEALTH AND ENVIRONMENTAL RISK MANAGEMENT**

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## FOREWORD

Improving the way we use our water resources is vitally important to ensuring a sustainable future for Victoria. Recycled water is recognised as a valuable source of water and, used appropriately, reduces the strain on our limited water resources.

These draft *Guidelines for Environmental Management: Dual pipe water recycling schemes: health and environmental risk management* provide a preventative risk management framework for managing health and environmental risks associated with dual pipe water recycling.

The release of these guidelines coincides with increased interest in the use of dual pipe networks to provide recycled water for garden watering and toilet flushing. The Victorian Government's water strategy *Securing Our Water Future Together* identifies a number of dual pipe water recycling schemes currently being developed or under investigation across the State of Victoria.

These guidelines complement the *Guideline for Environmental Management: Use of reclaimed water*. Compliance with these guidelines is a requirement for all schemes directly regulated by EPA Victoria and therefore the controls need to be applicable to all recycling schemes. They focus on key principles and performance objectives and outcomes through appropriate management practices, allowing scope for innovation.

The guidelines will provide the minimum regulatory requirements, with individual recycling schemes able to undertake increased risk management controls. An important feature of these guidelines will be its endorsement by the Department of Human Services.

These guidelines have been overseen by a steering committee comprising representatives from EPA, the Department of Human Services, the Plumbing Industry Commission, the Victorian water industry (representatives from Melbourne Water, Barwon Water, City West Water, North East Water, South East Water, Western Water and Yarra Valley Water), Australian Institute of Environmental Health, the Municipal Association of Victoria, the development industry (represented by the Urban Development Institute of Australia, the Association of Land Development Engineers and Coomes Consulting Group), and the Department of Sustainability and Environment. The document provides integrated guidance from the key government agencies with responsibility for recycled water management.

The steering committee is supported by four technical working groups providing guidance on: managing health risk; managing environmental risk; plumbing and systems management; and community management controls and consultation. Each of the working groups has developed technical background papers to support these guidelines.

The underlying philosophy of EPA's Guidelines for Environmental Management (GEM) is to provide a forward-looking approach rather than simply reflecting current trends. By focusing on those elements that represent

best practice and providing a systematic approach to achieving these, the GEM encourage suppliers and users of recycled water to strive for continuing improvement in environmental performance.

**Invitation to comment:**

EPA is pleased to receive comments on these draft guidelines for consideration. Comments on these guidelines should be sent to:

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The closing date for comments is 1 July 2005.

**MICK BOURKE**

**CHAIRMAN**

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These draft guidelines have been prepared with input from a wide range of departmental and industry stakeholders. Central to the development of the guidelines is the valuable contribution from members of the technical working groups, including:

### Managing health risk:

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- Ian Reimers, North East Water
- Chris Coulthurst, South East Water

A list of the Background Technical Papers developed by each of the working groups is provided in Appendix F.

## GLOSSARY OF TERMS AND ABBREVIATIONS

<b>Term</b>	<b>Definition</b>
<b>Beneficial use</b>	A use of the environment or any element or segment of the environment which (a) is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits or of the emission of noise or (b) is declared in State environment protection policy to be a beneficial use.
<b>Cross-connection</b>	A physical connection between the recycled water and drinking water supply systems.
<b>DHS</b>	Department of Human Services Victoria.
<b>Drinking water</b>	Water intended primarily for human consumption. Also known as potable water.
<b>Dual pipe scheme</b>	An urban water recycling scheme where recycled water is provided to householders for certain uses via a reticulation system that is separate from the drinking water supply. Sometimes referred to as a 'third pipe scheme'.
<b><i>E. coli</i></b>	<i>Escherichia coli</i> . A bacterium found in the gut of warm-blooded animals that indicates faecal contamination.
<b>EC</b>	Electrical conductivity. The capacity of the medium (water or soil) to conduct an electric current (measured in units of $\mu\text{S}/\text{cm}$ or $\text{dS}/\text{m}$ ).
<b>EC<sub>e</sub></b>	Electrical conductivity of a saturated soil extract.
<b>EPA</b>	Environment Protection Authority Victoria
<b>ESP</b>	Exchangeable sodium percentage – a measure of sodium in the soil that shows potential for sodicity.
<b>GEM</b>	Guidelines for Environmental Management. Publications released by EPA to provide a best-practice framework for managing environmental obligations.
<b>HACCP</b>	Hazard Analysis and Critical Control Point. An industry-recognised preventative risk management system that identifies, evaluates and controls hazards associated with the production of safe food or water.
<b>Hazard</b>	A biological, chemical, physical or radiological agent that has the potential to cause harm.
<b>Hazardous event</b>	An incident or situation that can lead to the presence of a hazard.

<b>HEMP</b>	Health and Environmental Management Plan. A plan covering the use of recycled water that details the management of health and environmental risks and thereby ensures a dual pipe water recycling scheme is sustainable and safe. The HEMP for a dual pipe scheme is equivalent to the Environment Improvement Plan that is discussed in the <i>GEM: Use of Reclaimed Water</i> (EPA publication 464.2).
<b>LCA</b>	Land capability assessment.
<b>Log reduction</b>	Removal/inactivation efficiency for a target organism. Calculated as $\log_{10}$ (feed water concentration) – $\log_{10}$ (product water concentration).
<b>Pathogen</b>	Organism capable of causing disease. In untreated wastewater, the key pathogen groups are bacteria, viruses, protozoa and helminths.
<b>PIC</b>	Plumbing Industry Commission.
<b>Preventative risk management</b>	A philosophy that focuses on the systematic evaluation of processes to identify hazards, assess risks and implement preventative strategies to manage risks.
<b>QRMA</b>	Quantitative microbial risk assessment – a tool that uses quantitative data to mathematically assess the health risk from exposure to pathogens.
<b>Recycled water</b>	Water that has been derived from sewerage systems or industry processes and treated to a standard that is appropriate for its intended use.
<b>Risk</b>	The likelihood of identified hazards causing harm in exposed populations in a specified time frame, including the severity of consequences.
<b>Risk assessment</b>	The overall process of using available information to predict how often hazards or specified events may occur (likelihood) and the magnitude of their consequences.
<b>RWQMP</b>	Recycled Water Quality Management Plan. A section of the HEMP that covers the production of Class A recycled water at the treatment plant.
<b>Salinity</b>	The content of salt in soil or water. Generally expressed in EC.
<b>SAR</b>	Sodium adsorption ratio. A measure of the amount of sodium present in a solution relative to the amount of calcium and magnesium (an indicator of the potential for sodicity to occur in the soil).
<b>Scheme manager</b>	The body identified as responsible for the management of recycled water reticulation within the dual pipe water recycling scheme and for engagement with residential users. The responsibilities are defined within the scheme HEMP.

<b>Scheme proponent</b>	An organisation or person that facilitates the development of a dual pipe water recycling scheme, but does not have responsibility for managing the scheme once recycled water is supplied. This may be the developer.
<b>SEPP</b>	State environment protection policy. SEPPs are adopted by Government, and gazetted pursuant to the <i>Environment Protection Act 1970</i> . The SEPPs describe environmental objectives for defined environmental segments (for example, water and land).
<b>Sodicity</b>	A chemical imbalance that occurs in soil when an excess of sodium (a monovalent ion) is present in the soil relative to divalent ions such as calcium and magnesium. Results in clay particles being held together more loosely and if this occurs when there is a low ionic concentration in the soil water, dispersion of the clay particles occurs.
<b>Supplier</b>	A person or organisation that supplies Class A recycled water for use in a dual pipe water recycling scheme. The responsibilities are defined within the scheme HEMP.
<b>TDS</b>	Total dissolved solids. A measure of water salinity, which has units of mg/L.
<b>User</b>	A person, community, group or organisation that uses recycled water.
<b>WSUD</b>	Water sensitive urban design. The integration of water cycle management into urban planning and design. Key principles are: protect natural systems; integrate stormwater treatment into the landscape; protect water quality; reduce run-off and peak flows; and add value while minimising development costs. For stormwater aspects of WSUD refer to <a href="http://www.wsud.melbournewater.com.au">www.wsud.melbournewater.com.au</a> .

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# DUAL PIPE WATER RECYCLING

## 1. INTRODUCTION

Recycled water derived from treated sewage and other water is widely recognised as a valuable and sustainable water resource.

Recycled water can be substituted for water that is currently harvested from stressed and over-allocated rivers, groundwater sources or drinking water supplies. It can provide increased water security for many users, including those in rural and urban areas. The use of recycled water also reduces the impact of discharges from sewage treatment plants to surface waters.

The *Guidelines for Environmental Management (GEM): Use of Reclaimed Water* (EPA Publication 464.2) present a generic framework for managing water recycling schemes. Whilst these guidelines allow the supply of Class A recycled water for urban (non-drinking) use with uncontrolled access, they do not provide detailed guidance on managing the specific risks associated with dual pipe water recycling for uses including garden watering and toilet flushing.

Dual pipe water recycling schemes require a high level of risk management, primarily due to the increased potential for the public to directly contact the recycled water and the limited control over their activities in using the water.

Therefore these guidelines (*GEM: Dual pipe water recycling*) have been developed to provide a detailed framework for managing human health and environmental risks associated with the use of Class A recycled water in urban areas, and should be used as the primary reference document in the development of dual pipe water recycling schemes.

### 1.1. Objective

These guidelines aim to facilitate sustainable and safe recycled water use in urban areas. To qualify as 'sustainable and safe', recycled water use must be undertaken in a manner that is protective in both the short and long term of soil ecosystems, soil productivity, surface and groundwater resources, and human health. To meet these objectives, these guidelines have been developed using a preventative risk management approach.

These guidelines are targeted to water suppliers, recycled water scheme managers, local councils and developers, and provide the basis for exemption of recycling schemes from EPA works approval and licensing requirements (refer to section 2.2).

### 1.2. Scope of guidelines

These guidelines focus on the management of health and environmental risks associated with urban dual pipe schemes where water is recycled from sewage treatment systems that have a design capacity or actual flow rate of greater than 5,000 litres per day (as defined in the *Environment Protection (Scheduled Premises and Exemptions) Regulations 1996*).

These guidelines are not intended for small on-site wastewater systems (that is, treatment plants having a design or flow rate of less than 5,000 litres per day).

Although the focus of these guidelines is on recycling from treated raw sewage, the principles could be applied to other water sources such as greywater (all non-toilet household wastewater) and stormwater.

## 1.3. Preventative risk management systems

Preventative risk management systems are being increasingly used by the water industry to assure water quality through focusing on the prevention of substandard water being delivered for use. These systems underpin the Australian Drinking Water Guidelines 2004 (NHMRC), the Victorian *Safe Drinking Water Act 2003* and the proposed redraft of the national water recycling guidelines that is being led by the Natural Resource Management Ministerial Council and the Environment Protection and Heritage Council. The National Health and Medical Research Council and Australian Health Ministers Council are also involved in this review.

Consistent with the Australian Drinking Water Guidelines 2004, these guidelines promote the use of a framework that encompasses the following areas:

1. **Commitment to responsible use and management of recycled water.** This involves commitment to the development and application of preventative risk management to support the sustainable and safe use of recycled water.
2. **System analysis and management.** This involves understanding the entire recycled water system, the hazards and events that can compromise recycled water quality, and the preventative measures and operational controls necessary for assuring safe and reliable use of recycled water.
3. **Supporting requirements.** These requirements include basic elements of good practice such as employee training, community involvement, research and development, validation of

process efficacy, and systems for documentation and reporting.

4. **Review.** This includes evaluation and audit processes to ensure that the management system is effective, and provides the basis for review and continual improvement. Effective risk management systems are not static and must be capable of accommodating change, such as emerging issues, advances in technology and new institutional arrangements. Development should be an ongoing process whereby performance is continually evaluated and reviewed.

The working groups involved in producing this guideline have assessed the generic risks associated with dual pipe schemes and documented the measures relevant to areas 2, 3 and 4 above, as far as possible. In most cases the Hazard Analysis and Critical Control Point (HACCP) framework has been used to undertake this assessment.

Some aspects of dual pipe schemes (including treatment processes and some receiving environment characteristics) will need to be assessed on a scheme-by-scheme basis to identify and manage risks, as there is no single set of management controls that is appropriate for all schemes.

## 1.4. Structure of guidelines

The framework for applying risk management to dual pipe water recycling schemes is organised into the following chapters:

*Commitment to responsible use and management of recycled water*

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- Regulatory framework (Chapter 2).
- Roles and responsibilities (Chapter 3).

## *System analysis and management*

- Recycled water system assessment (Chapter 4).
- Managing human health risks (Chapter 5).
- Managing environmental risks (Chapter 6).
- Managing the supply system (Chapter 7).
- Communicating management controls (Chapter 8).
- Incidents and emergencies (Chapter 9).

## *Supporting requirements*

- Employee awareness and training (Chapter 10).
- Research and development (Chapter 11).
- Documentation and reporting (Chapter 12).

## *Review*

- Auditing, review and improvement programs (Chapter 13).

## 2. REGULATORY FRAMEWORK

### 2.1. Legislation

The Acts, policies and regulations administered by EPA Victoria and other government agencies that are relevant to the use of recycled water in urban areas are listed in Appendix A.

#### **Acts**

Acts of particular significance to recycled water use in urban areas are:

- *Environment Protection Act 1970*
- *Health Act 1958*
- *Building Act 1993*.

Under the *Environment Protection Act 1970* discharges to the environment must be managed so that they do not adversely affect the receiving environment (for example, land, surface water or groundwater). This Act includes works approval and licensing requirements administered by EPA Victoria, to ensure the appropriate control of such discharges.

The *Health Act 1958* makes provision for the prevention and abatement of conditions and activities which are or may be offensive or dangerous to public health.

The regulatory requirements for on-site plumbing work in the State of Victoria are stated under Part 12A of the *Building Act 1993*. This Act establishes the Plumbing Industry Commission and its function to determine relevant plumbing regulations. The *Plumbing Regulations 1998* set the requirements and competencies for licensing and registering industry operatives and specify the minimum technical standards for all on-site plumbing work.

Refer to Appendix A for other important legislation, including the *Occupational Health and Safety Act 1985*, *Trade Practices Act 1974*, and the *Safe Drinking Water Act 2003*.

#### **Regulations**

The *Environment Protection (Scheduled Premises and Exemptions) Regulations 1996* outline the premises and activities that are scheduled and subject to works approval and licensing provisions of the *Environment Protection Act 1970*.

The regulations also provide for exemptions from these works approval and licensing provisions for certain, otherwise scheduled, activities and premises (see section 2.2).

#### **Policies**

Government declares State environment protection policies (SEPPs) and waste management policies (WMPs) under the *Environment Protection Act 1970*. The SEPPs provide ambient environmental quality objectives and attainment programs for achieving them. Compliance with the relevant policies must be attained for all activities that involve recycled water treatment and use.

The SEPPs of particular relevance to the use of recycled water include:

- SEPP (Waters of Victoria) 2003 (and its schedules)
- SEPP (Groundwaters of Victoria) 1997.

Other relevant state government policies include:

- SEPP (Management and Prevention of Contamination of Land) 2002.

## ***Guidance documents***

In addition to the aforementioned legislation, there is a variety of guidance material of which recycled water scheme proponents should be aware (such as the *Guidelines for Wastewater Irrigation*, EPA 1991, publication 168). Some of this documentation is referenced in the relevant sections of this guideline, with a summary list provided in Appendix A.

## **2.2. Exemption from works approval and licensing provisions**

Although waste discharges into the environment are typically subject to works approvals and licensing by EPA, an exemption from these statutory processes is provided for:

*'An effluent reuse scheme or activity which meets discharge, deposit and operating specifications acceptable to the Authority' - Environment Protection (Scheduled Premises and Exemptions) Regulations 1996).*

The exemption reflects that, in contrast to a waste discharge, recycled water can be sustained as a resource. These guidelines define the acceptable discharge, deposit and operating specifications referred to in the regulations above by providing 'performance objectives' for dual pipe schemes. Therefore, compliance with these guidelines forms a critical component of exemptions from EPA works approval and licensing requirements.

It should be noted that the exemption only extends to the use of recycled water in the scheme. Construction of a wastewater treatment plant may still be subject to works approval and licensing requirements.

In addition to providing performance objectives for dual pipe schemes, these guidelines include specific measures to meet the performance objectives. However, it is important to note that these measures are flexible. A recycling scheme proponent may propose alternative measures to those suggested, provided they can demonstrate to the satisfaction of EPA that the performance objectives will be reliably achieved.

Where a proposed scheme does not provide measures that will meet the performance objectives identified in these guidelines, works approval and licensing will apply.

## **2.3. The approval process**

All Class A water recycling schemes in Victoria require approval from EPA and endorsement from DHS. This approval/endorsement is based on demonstration that the performance objectives identified within these guidelines will be met.

The measures that will be taken to meet the performance objectives must be documented in a Health and Environment Management Plan (HEMP) that is submitted to EPA for assessment against these guidelines.

DHS must also review the HEMP in order to endorse the scheme. This review and endorsement is particularly focused on a Recycled Water Quality Management Plan (RWQMP) (a part of the HEMP covering production and delivery of Class A recycled water). However, other aspects of the HEMP relating to the protection of public health will also be considered. This is discussed in more detail in Chapter 5.

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The HEMP is discussed in more detail in Chapter 12 and an indicative schematic for the EPA and DHS approval process for a Class A water recycling scheme is provided in Figure 2.1.

The supplier and manager of a dual pipe water-recycling scheme that does not have a valid HEMP and the necessary approvals from both DHS and EPA, or does not comply with the requirements specified in the HEMP, could be subject to enforcement action.

Enforcement action could include such measures as the issuing of a Pollution Abatement Notice (which directs a scheme manager to undertake specified actions), prosecution or imposing fines via Penalty Infringement Notices.

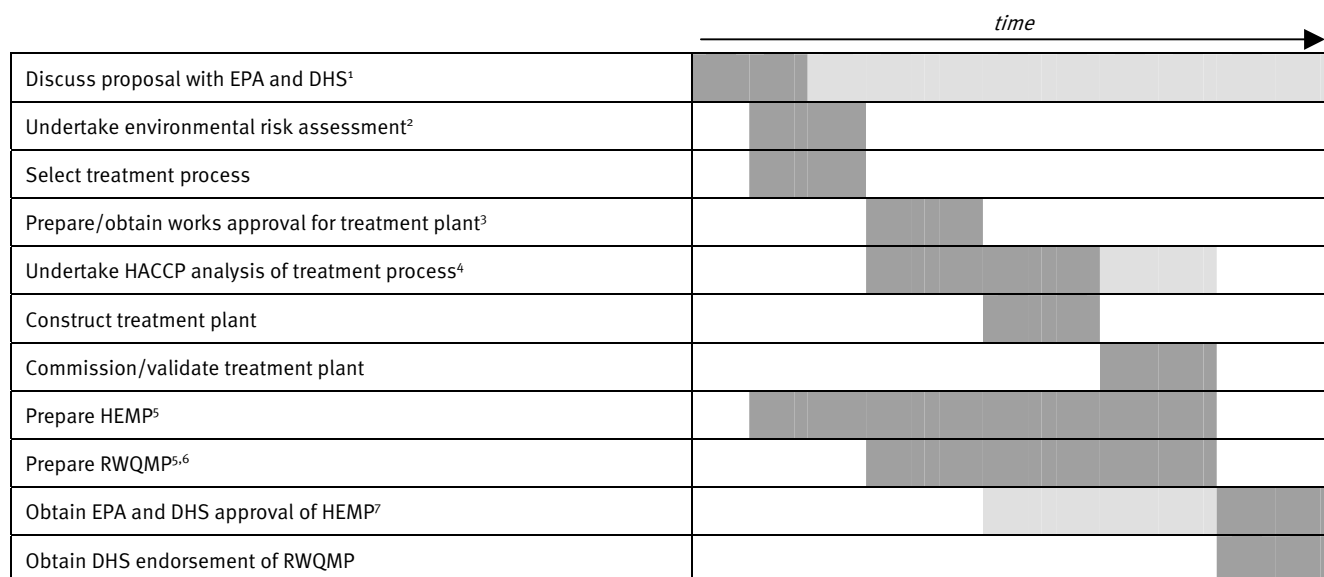
All proposed schemes should be discussed at the planning stage with the relevant EPA regional office (contact details are provided in Appendix B) and DHS. These initial discussions are important for identifying potential issues that may hold up the approvals process.

As noted earlier, treatment of wastewater is a scheduled activity pursuant to the *Environment Protection (Scheduled Premises and Exemption) Regulation 1996* and may require works approval and an EPA. EPA should be contacted for further advice on this matter.

Both the works approval for a treatment plant and a HEMP are required to cover aspects of the treatment process. The information in Table 2.1 provides an indication of the content and scope of these two documents.

# DUAL PIPE WATER RECYCLING

**Figure 2.1: Indicative EPA/DHS approval process for urban dual pipe schemes**



**Notes to Figure 2.1:**

1. Discussion with EPA and DHS is critical during the initial planning phase, but should also be ongoing.
2. The environmental risk assessment should include a land capability assessment (LCA) to assess the environmental sustainability of using recycled water. The environmental risk assessment forms a critical component in the selection of an appropriate treatment process (i.e., for the reduction of salinity), the design of the development (layout of reticulation system, stormwater management) and information to residents on appropriate management of recycled water. Refer to Chapter 6 for details on managing environmental risks.
3. Refer to Table 2.1 for indicative content of works approval.
4. Refer to Appendix C for details of HACCP process. Aspects of the HACCP plan may be amended during the commissioning and validation phase as more information on the practical operation of the treatment process is obtained.
5. Drafts of the Health and Environment Management Plan (HEMP) and Recycled Water Quality Management Plan (RWQMP) can be reviewed/discussed with EPA and DHS, as required.
6. The RWQMP is the section of the HEMP that covers the operation, management and monitoring of the treatment plant, and is specifically endorsed by DHS.
7. Approval of the HEMP may be obtained prior to finalisation and DHS endorsement of the RWQMP. If this occurs approval will be conditional on the scheme proponent obtaining DHS endorsement of the RWQMP, and the exemption of the scheme from works approval and licensing will not take effect until this endorsement has been obtained.

# DUAL PIPE WATER RECYCLING

**Table 2.2: Indicative content of works approval versus HEMP**

Works approval	HEMP
<p>Location and site plans for the treatment plant.</p> <p>Design basis of the proposed treatment plant, indicating:</p> <ul style="list-style-type: none"> <li>▪ treatment process, including details of waste generation, minimisation, collection and storage</li> <li>▪ evidence that target water quality objectives can be achieved by the proposed technology</li> <li>▪ operational and maintenance procedures and plant failure contingency plans (can be covered in detail in HEMP).</li> </ul> <p>Hazard and Operability (HAZOP) evaluation for the proposed treatment plant.</p> <p>Risk assessment of the impact of the treatment plant on the environment (includes storage lagoons and any environmental discharges outside the proposed recycling scheme).</p> <p>Compliance with relevant SEPP.</p> <p>Summary details of proposed recycling scheme.</p> <p><i>More information can be obtained from the EPA website.</i></p>	<p>Roles and responsibilities of individuals, groups and organisations within the scheme.</p> <p>Recycled water system description and hazard identification.</p> <p>Management controls for:</p> <ul style="list-style-type: none"> <li>▪ human health risks</li> <li>▪ environmental risks</li> <li>▪ plumbing and distribution system.</li> </ul> <p>Community involvement and awareness (communication of management controls).</p> <p>Incident and emergency management.</p> <p>Employee awareness and training.</p> <p>Research and development, reporting, auditing and review.</p> <p><i>The information required in the HEMP is covered in the following chapters of these guidelines.</i></p>

## 3. ROLES AND RESPONSIBILITIES

### 3.1. Suppliers, scheme managers and users

The supplier of recycled water should ensure that a RWQMP that has been endorsed by DHS is followed for the production of Class A recycled water.

The supplier should also ensure that any scheme using water from its premises complies with this guideline and has a site-specific exemption granted by EPA, or has an EPA works approval and licence for the recycling scheme.

Suppliers also have a responsibility to keep a register of all schemes to which they supply recycled water. This register should include the location of dual pipe schemes, the quality and quantity of supply, and end uses of the recycled water. It does not need to include the addresses of individual residential properties. Each year, the supplier should provide EPA with summary details of recycled water supply and end use (discussed further in Chapter 12).

The supplier should also ensure that all schemes have a HEMP that is approved by EPA and DHS, and should verify through an audit process that scheme managers are complying with HEMP requirements.

The scheme manager is the body identified as being responsible for the management of recycled water reticulation within the dual pipe scheme and for engagement with residential users.

The scheme manager is also responsible for ensuring that the scheme is managed in accordance with these guidelines, including the finalisation, endorsement and implementation of the HEMP (excluding the RWQMP, which is the responsibility of the supplier). This responsibility includes ensuring

residential users of recycled water are using the water appropriately and are informed of the potential risks associated with misuse.

In many instances a scheme proponent may initially draft the HEMP. However, the scheme manager is ultimately responsible for its finalisation and implementation.

Users of recycled water in a dual pipe scheme fall into two groups: large-scale users (such as industrial or municipal users) and residential users (that is, the community). Users of recycled water are responsible for using recycled water in the manner directed by the scheme manager.

In some cases large-scale users may also be scheme managers and will therefore be responsible for developing a HEMP for their specific recycling activities.

#### *Community liaison*

The community consists of both residential users of, and the general public who may be exposed to, recycled water in a dual pipe scheme.

Scheme managers should establish pathways and procedures for continual and open liaison with the community. Community awareness and involvement is discussed in Chapter 8 and is critical for ensuring that any management controls that are expected of residential users (such as using recycled water for intended purposes only, and maintaining recycled water fixtures and fittings) are in place and being adhered to.

#### *Legal risks*

Recycled water suppliers and scheme managers should be familiar with the Acts, regulations, policies, codes of practice, Australian Standards,

# DUAL PIPE WATER RECYCLING

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guidelines and other documents relevant to the use of recycled water (see Appendix A and the reference list at the end of these guidelines).

Suppliers and scheme managers should demonstrate 'due diligence' and ensure that the legal risks associated with recycled water schemes are appropriately addressed.

## ***Agreements***

An agreement should be developed between the supplier, the scheme manager and the users of recycled water. The HEMP should identify any specific responsibilities established in these agreements.

### **3.2. EPA Victoria**

EPA is responsible for developing environmental guidelines that encourage best practice and result in the development of safe and sustainable water recycling schemes. It is the role of EPA to ensure that these guidelines are effectively implemented. This is achieved by undertaking audits of selected recycling schemes (on a random or priority site basis).

EPA is also responsible for auditing and reviewing the effectiveness of these guidelines. Reviews will occur from time to time, reflecting up-to-date developments in the use and management of recycled water in Australia and overseas.

EPA will supplement these guidelines with technical support documents where additional guidance on interpretation of requirements is needed.

### **3.3. DHS**

DHS is responsible for ensuring that Class A recycling schemes do not pose a risk to public health. Given the high potential for the public to come into direct contact with recycled water in urban recycling schemes, DHS involvement is primarily in ensuring treatment plants reliably produce Class A recycled water. This is achieved by endorsing the HEMP and RWQMP developed for a dual pipe scheme.

### **3.4. Plumbing Industry Commission**

The Plumbing Industry Commission (PIC) will take on an ongoing, active role in the enforcement of standards and regulatory requirements for all on-site regulated plumbing work. The PIC will monitor the industry performance and make corrective action if required. The measure of the industry performance will be validated through the inspection and monitoring powers of the Building Act 1993.

# DUAL PIPE WATER RECYCLING

## Roles and responsibilities summary

### **Performance objective**

*To ensure that suppliers, scheme managers and users of recycled water understand and meet their obligations as outlined in these guidelines.*

### **Suggested measures to meet the performance objective**

#### ***Supplier***

- Develop an agreement covering the respective interests and obligations of suppliers, scheme managers and users.
- Identify and assess the risks posed by the production and supply of recycled water, including the development of a RWQMP.
- Ensure that any recycling scheme has an EPA site-specific exemption (that is, a HEMP that has been approved by EPA and endorsed by DHS), or has works approval and licence.
- Monitor, report and audit recycling schemes it supplies in accordance with these guidelines.
- Maintain a register of recycled water users it supplies and submit this information annually to EPA.

#### ***Scheme manager***

- Enter into a suitable agreement with the supplier.
- Identify and assess the risks posed by the use of recycled water.
- Ensure the recycling scheme has an EPA site-specific exemption (that is, a HEMP that has been approved by EPA and endorsed by DHS) or has works approval and licence.
- Ensure that recycled water is used in accordance with the HEMP. Engage in community liaison to ensure residential users of recycled water are aware of the safe uses of recycled water and any management controls they are expected to maintain.

## 4. RECYCLED WATER SYSTEM ASSESSMENT

The HEMP for a dual pipe water recycling scheme should include an assessment of the system to identify appropriate management controls for the risks associated with hazards and hazardous events. This assessment is best guided using a preventative risk management framework such as Hazard Analysis and Critical Control Point (HACCP). A discussion of the HACCP framework is provided in Appendix C.

This Chapter discusses some key aspects of HACCP – the hazard identification and risk assessment process – and provides the starting point for the analysis of the dual pipe system.

### 4.1. System analysis

An essential prerequisite for hazard identification and risk assessment is to document a detailed description of the recycled water system. The recycled water system is defined as everything from the collection or catchment of untreated water through to the end user or receiving environment.

This system analysis should include:

- the catchment for the sewage treatment plant, including an overview of the domestic and industrial/ commercial trade waste inputs
- the sewage treatment plant, including the operation and design of the treatment process; the efficiency of the processes for removal of pathogens, nutrients and parameters such as organic contaminants (if applicable); monitoring equipment; and process inputs such as coagulants
- the quality of the source water and the recycled water for physiochemical and microbiological parameters
- storages, including the size, configuration and location of the storages, potential seasonal impacts on the storage and intake or offtake locations
- the supply system (distribution, reticulation and plumbing), including the pipeline specifications, plumbing installation controls (pipe coding, installation audits), control valves and maintenance regimes
- intended uses of the recycled water within the scheme.

A process flow diagram should also be developed to schematically illustrate the system analysis.

### 4.2. Hazard identification

The dual pipe system analysis provides the basis for hazard identification, followed by risk assessment and control. In this context:

- a **hazard** is a biological, chemical, physical or radiological agent that has the potential to cause harm
- a **hazardous event** is an incident or situation that can lead to the presence of a hazard (what can happen and how)
- **risk** is the likelihood of identified hazards causing harm in exposed populations in a specified timeframe, including the severity of the consequences.

The distinction between hazard and risk is important to ensure that actions and resources are directed

based on the level of risk rather than just the existence of a hazard.

Key **hazards** in recycled water that require management to ensure dual pipe schemes are safe and sustainable can be grouped together as follows:

- biological hazards – for example pathogens, which pose human health risks through ingestion
- chemical and environmental hazards – for example inorganic and organic compounds or disinfection by-products, which can pose a risk through ecotoxicity; salinity and sodicity, which can pose environmental risks through plant or soil structure damage; and nutrients, which can pose risks through movement into groundwater or surface waters.

Some examples of **hazardous events** that can lead to an actual risk include:

- unanticipated system inputs such as trade waste discharges or spills that enter the sewer, or disease outbreaks in the community.
- treatment plant process or alarm/monitoring failures, or initial overestimation of process performance.
- inputs to storages due to birds or other sources of contamination, algal blooms.
- cross-connection of the recycled water system to the drinking water system
- bursts and leaks within the distribution system
- inappropriate uses of the recycled water, such as drinking, over-irrigation and discharges to waterways.

### 4.3. Risk assessment and control

Once hazards and hazardous events have been identified, the level of risk associated with each can be estimated. The framework provided by the *Australian Drinking Water Guidelines* (NHMRC 2004) or an alternative risk assessment framework can be used for this assessment.

The risk assessment allows for the prioritisation of risks to focus management controls on those risks that are considered significant.

Chapters 5, 6, 7 and 8 describe health and environmental hazards, risks and controls for specific aspects of the dual pipe system. However, it should be noted that in most cases these are not exhaustive and individual system analysis will be necessary.

## Recycled water system assessment summary

### **Performance objective**

*Assess the recycled water system, identifying potential sources of risk that will require control.*

### **Suggested measures to meet the performance objective**

- Develop a detailed description of the recycled water system, including inputs and water sources, treatment processes, the recycled water quality produced, storage, distribution and reticulation systems, and the intended uses of recycled water.
- Identify hazards, hazardous events at each point in the system.
- Undertake a risk assessment and identify control measures for significant risks.

## 5. MANAGING HUMAN HEALTH RISKS

This chapter identifies and assesses the potential health hazards associated with recycled water and describes the health-based targets or water quality objectives for recycled water that is to be used in dual pipe water recycling schemes. It also describes the risk management controls, covering the treatment and storage of recycled water, which should be in place to ensure the targets are being met and the recycling scheme is safe for human health. Health risk management controls relating to the supply (distribution, reticulation and plumbing) system and end use of the recycled water are discussed separately in Chapters 7 and 8.

Where possible, specific health risk management controls are provided in this chapter. However, it should be noted that, in contrast to previous Victorian recycled water guidelines, prescriptive operational criteria for treatment plants are not included (for example, median and maximum values for recycled water turbidity). These prescriptive criteria are not included, as it is not possible to set generic limits that are relevant to all wastewater treatment processes. Instead, a framework is provided to guide the assessment of individual treatment plants and establish appropriate operating conditions that will indicate the production of safe recycled water on a scheme-by-scheme basis.

### 5.1. Hazard identification

The hazards to human health that are potentially posed by recycled water are expected to be biological (pathogens) or chemical in nature.

### *Pathogens*

Pathogenic microorganisms that are excreted by humans in domestic waste and enter the sewerage system in domestic waste pose biological hazards. These pathogens fall into four major microbial groups:

- bacteria (such as *Salmonella*, *Campylobacter* and *Shigella*)
- viruses (such as rotavirus, hepatitis A virus and enterovirus)
- protozoa (including *Cryptosporidium* and *Giardia*)
- helminths (such as the tapeworm *Taenia* and roundworm *Ascaris*).

### *Chemicals*

Industrial and domestic chemicals that enter the sewerage system may pose chemical hazards. Chemicals of potential concern to human health include heavy metals and organic chemicals such as endocrine-disrupting chemicals (chemicals that mimic the effects of hormones such as oestrogen), pharmaceuticals and plasticisers.

## 5.2. Risk assessment

### *Pathogens*

The risks posed by pathogens via exposure through the anticipated uses of recycled water in dual pipe schemes have been analysed, and a Quantitative Microbial Risk Assessment (QMRA) was undertaken to determine the microbial criteria that will ensure adequate safety. These criteria are provided in Table 5.1.

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**Table 5.1: Microbial criteria for Class A recycled water in dual pipe schemes**

Group	Criterion
Bacteria <sup>1</sup>	<10 <i>E.coli</i> /100 mL.
Viruses <sup>2</sup>	7 log reduction <sup>3</sup> from raw sewage to recycled water.
Protozoa <sup>2</sup>	6 log reduction <sup>4</sup> from raw sewage to recycled water.

Notes to Table 5.1:

1. Median – to be demonstrated during treatment plant validation.
2. As a default, the most-resistant (or worst-case) pathogen for each step in the treatment process should be used as the reference for log reductions. However, treatment processes can also be assessed based on the removals provided across the system for key pathogenic organisms (rotavirus, adenovirus, *Cryptosporidium* oocysts, *Giardia* cysts).
3. Median removal, with a lower (critical) limit of 6 log reduction.
4. Median, with a lower (critical) limit of 5 log reduction.

### Commentary box

A guideline objective for helminths has not been included due to the lack of a QMRA model for this group of organisms. Human pathogenic helminth eggs are typically present in low levels in Australian raw sewage (around 10–20 per litre), so it would be expected that treatment processes capable of physically removing protozoa from sewage with high efficiency would effectively remove helminths due to their considerably larger size. This suggests that helminth eggs would be present in Class A recycled water in numbers significantly less than for other pathogens.

Comments on this are specifically sought.

The microbial criteria in Table 5.1 apply at the end of the treatment process (that is, prior to recycled water entering the distribution system or being introduced to storages), unless it can be demonstrated that further pathogen removal will be reliably achieved and controlled downstream of the treatment process.

The uses of recycled water included in the risk assessment and therefore considered acceptable are:

- irrigation of public open spaces, such as parks, sports fields and municipal areas, where public access is unrestricted and any irrigation method can be used
- domestic garden watering, including vegetable gardens
- toilet flushing
- washing machine use.

Class A recycled water can also be used for firefighting in fire protection systems. A risk assessment for this is documented in the Water Services Association of Australia’s *Occasional Paper No. 11: Health Risk Assessment of Fire Fighting from Recycled Water Mains* (WSAA 2004).

The following uses for Class A recycled water are also acceptable, as the exposure rates are anticipated to be much lower than those uses considered in risk assessments:

- general outdoor uses such as car washing, construction and wash-down
- filling water features and ornamental ponds that are not used for swimming

## DUAL PIPE WATER RECYCLING

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- industrial and commercial uses including construction, wash-down, dust suppression, use in cooling towers and toilet or urinal flushing.

While the uses listed in this chapter are considered acceptable from a human health perspective, other issues and controls are relevant (for example, environmental and plumbing controls). These are summarised in Table 5.2.

**Class A recycled water is not acceptable for the following uses:**

- **drinking**
- **cooking or other kitchen purposes**
- **bathing and showering**
- **filling swimming pools and spas.**

These uses are not considered appropriate as they may result in the regular consumption of significant volumes of recycled water. Management controls should therefore be in place to ensure that the recycled water is only used for its intended purposes. These controls are discussed in Chapters 7 and 8.

While not specifically relating to human health, it is considered acceptable for pets to drink recycled water but it should be noted that, under the *Livestock Disease Control Act 1994*, pigs should not drink recycled water sourced from human waste. This restriction reflects the fact that *Taenia solium* (a helminth with a pig–human life cycle) can cause a potentially severe disease in humans and needs to be stopped from establishing a life cycle in Australia.

## DUAL PIPE WATER RECYCLING

**Table 5.2: Considerations for acceptable<sup>1</sup> uses of Class A recycled water**

Potential use	Environmental <sup>2</sup>	Plumbing/ communication <sup>3</sup>	Other
<b>Residential</b>			
Garden watering, including vegetables	<i>Risk assessment</i>	<i>Controls required</i>	-
Car washing	<i>On grassed areas only</i>	<i>Controls required</i>	-
General outdoor (e.g., wash-down/construction)	<i>Avoid run-off to stormwater</i>	<i>Controls required</i>	-
Ornamental ponds/water features	<i>Management controls required</i>	<i>Controls required</i>	<i>Aesthetics</i>
Toilet flushing	-	<i>Controls required</i>	<i>Aesthetics</i>
Washing machines	-	<i>Controls required</i>	<i>Public acceptance, aesthetics</i>
<b>Commercial/industrial/municipal</b>			
Irrigation	<i>Risk assessment</i>	<i>Controls required</i>	-
Construction	<i>Containment measures required</i>	<i>Controls required</i>	-
Wash-down	<i>Containment measures required</i>	<i>Controls required</i>	-
Dust suppression	<i>Containment measures required</i>	<i>Controls required</i>	-
Cooling towers	-	<i>Controls required</i>	<i>Legionella control<sup>4</sup></i>
Toilet/urinal flushing	-	<i>Controls required</i>	<i>Aesthetics</i>
Fire protection systems/hydrants	-	<i>Controls required</i>	-

Notes to Table 5.2

1. Uses are considered acceptable from a human health perspective.
2. Environmental considerations including risk assessments and specific management controls are discussed in Chapter 6.
3. Plumbing and communication controls are discussed in Chapters 7 and 8.
4. Under the *Building Act 1993* a specific risk management plan is required to control the risk of *Legionella* from cooling tower systems. Contact the Department of Human Services for further information.

## ***Chemicals***

The presence of chemicals in recycled water at levels that could potentially pose a health risk is not anticipated for most schemes, particularly those recycling water sourced from predominantly domestic sewage.

Chemicals entering the sewerage system are managed through trade waste control, substantially diluted in other waste and generally removed or degraded by treatment processes. Therefore the concentrations of chemicals of health concern are generally orders of magnitude below the levels either permitted in our drinking water supply or routinely consumed through dietary exposure. For this reason, specific water quality objectives for heavy metals and organic contaminants have not been established.

However, for schemes where industrial or trade waste inputs are significant, specific management controls may be required.

### **5.3. Operational control and preventative measures**

The production of safe recycled water should be secured by the application of a Recycled Water Quality Management Plan (RWQMP).

The RWQMP forms a section of the HEMP for the dual pipe scheme and requires specific endorsement from DHS.

Unless chemical hazards are envisaged to pose a potential health risk within a water recycling scheme (section 5.2), the focus of the RWQMP is on ensuring that the treatment plant will produce water that meets the required microbial criteria, and that the water quality is not compromised downstream of the

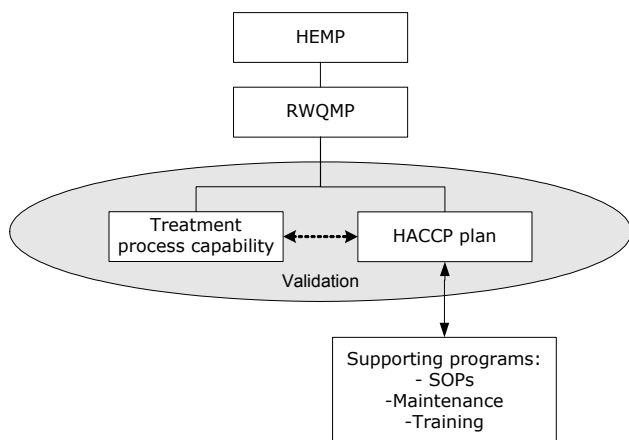
treatment process. Therefore the RWQMP should extend from the catchment of the system (including system inputs), through to treatment and storage. The system assessment described in Chapter 4 can be used as the basis for establishing the RWQMP.

The elements of the RWQMP are illustrated in Figure 5.1 and consist of:

- the treatment process's capability to meet the microbial criteria
- a management program for achieving and maintaining the microbial criteria, developed within a framework such as Hazard Analysis and Critical Control Point (HACCP), discussed in Appendix C. This program should identify significant risks to the water quality and management controls for these risks
- the supporting programs required for the treatment process and management program to be effective, such as standard operating procedures, equipment maintenance and calibration programs, and training requirements.

The RWQMP is underpinned by validation. Validation is discussed in more detail in Appendix C and involves the collection and analysis of data relating to the recycled water system to demonstrate that a) the treatment process is capable of achieving the required microbial criteria and b) any management controls identified in the HACCP process, such as operational monitoring, critical limits and corrective actions, will effectively prevent substandard water being delivered to the dual pipe scheme.

**Figure 5.1: Elements of the RWQMP**



As discussed previously, health risk management also applies to the distribution, reticulation and end-use aspects of a dual pipe scheme; however, these areas need not be included in the RWQMP. They are discussed in Chapters 7 and 8 and should be covered separately within the HEMP.

Management controls for specific aspects of the recycled water system are discussed in the remainder of this section.

### **System inputs**

The scope to manage inputs to the sewerage system that are of potential health risk is limited, as the predominant sources of health risk are from pathogens and the purpose of the sewerage system is to protect public health by collecting and treating pathogens from areas inhabited by humans.

The regular input of chemicals can be managed, for example through trade waste agreements. More information on the management of trade waste can be obtained from the EPA/VicWater publication *Best Practice Trade Waste Management by Water Businesses* (2004).

### **Treatment**

The management controls for a specific treatment process should be identified using a framework such as HACCP (Appendix C). It is generally expected that these controls will rely on the operational monitoring of parameters that will provide a ‘real-time’ indication of the effectiveness of individual components within the treatment process.

### **Storage**

Whilst the recycled water quality objectives must be met through treatment, the protection of water quality must extend throughout the system to the end user. Therefore controls should be in place to manage any downstream risks to the water quality.

Generic health risks for recycled water storages have been assessed (refer to document *Health Risk Management in Urban Recycling Schemes: Technical Background Paper*) and the management controls listed in Table 5.3 are recommended. However it should be noted that this list is not exhaustive and additional risks or alternative management controls might be identified using the HACCP framework.

- The management controls in Table 5.3 relate only to health. Aesthetic water quality issues such as odour due to stagnant water may also arise in storages, and may require management for community acceptance.

### **Drinking water back-up to the recycled water supply**

Most dual pipe schemes will incorporate a drinking water connection to the recycled water system in order to ensure a secure supply of water at all times. Backflow can potentially place the drinking water

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supply at risk from contamination with recycled water.

It is recommended that this risk be managed through the inclusion of a registered air-gap (checked once per year and certified as per AS 2845) between the drinking water supply and recycled water system.

Any connections between the recycled water and drinking water supplies should be considered in both the HEMP for the recycled water supply and the risk management plan that is required for the drinking water supply under the *Safe Drinking Water Act 2003*.

### Commentary box

The inclusion of an RPZ (reduced pressure zone) valve as equivalent backflow protection to a registered air-gap is also being considered. This is consistent with AS 3500, but not the *Water Supply Code of Australia* (WSA 03-2002, WSAA).

### End use

Management controls are required to ensure that recycled water is only being used for the purposes listed in Table 5.2. Measures should be in place to minimise the consumption of significant volumes of recycled water (for example via a cross-connection between the recycled and drinking water supplies) and water deliberately being used in a manner other than intended (for example, filling swimming pools).

Recommendations to manage these risks are provided in Chapters 7 and 8 respectively.

The following are **not** required to manage end-use health risks in dual pipe schemes:

- withholding periods for produce grown with recycled water
  - vaccinations.
- buffer distances for spray drift

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Table 5.3: Generic management controls to protect water quality in storages

Hazardous event	Control measure	Monitoring	Critical limit	Corrective action
Microbial contamination of or increased microbial activity in uncovered storages	Chlorination at storage outlet	Total chlorine At least monthly	For chlorination prior to storage: <0.5 mg/L at storage outlet For chlorination at storage outlet: <1 mg/L after 30 minutes	Increase chlorination
	Monitoring	<i>E. coli</i> Weekly	<10 org/100mL	Increase chlorination or bypass storage
Blue green algae growth in uncovered storages	Monitoring	Turbidity Weekly	<5 NTU	Bypass storage or filter water and undertake actions to address source of elevated turbidity
		Blue-green algae Every 2 weeks in summer Every 2 months in winter	As per DSE alert levels <sup>1</sup>	Bypass storage and act to reduce algal numbers if possible
Miscellaneous hazards	Monitoring/maintenance	Reservoir inspection/ maintenance Weekly (uncovered) Monthly (covered)	-	As required to address any identified hazard to water quality.

Notes to Table 5.3:

1. Refer to Department of Sustainability and Environment Circular No. 287 *Blue-green algae coordination arrangements for 2004/2005 and related matters*.

### Managing human health risks summary

#### **Performance objective**

*To produce and deliver recycled water of a quality that is safe for use in urban dual pipe recycling schemes.*

#### **Suggested measures to meet the performance objective**

- Utilise treatment technology that has been validated as being capable of routinely achieving the target water quality objectives specified in Table 5.1.
- Develop a Recycled Water Quality Management Plan within a preventative risk management framework. This should detail any risk assessments, and identify and validate control measures for the management of water quality.
- Implement measures to ensure recycled water is being used appropriately.

## 6. MANAGING ENVIRONMENTAL RISKS

These guidelines aim to facilitate sustainable recycled water use in dual pipe systems. In order to achieve this, dual pipe schemes must be operated in a manner that protects the environment.

This chapter identifies the potential environmental risks associated with the use of recycled water for irrigation in dual pipe water recycling schemes and provides a framework for assessing these risks to ensure the sustainable use of recycled water in dual pipe schemes.

The controls to manage environmental risks typically need to be derived on a site-by-site basis. If this approach was not adopted and generic water quality standards were established, then the water quality and management controls would not match the risk level for each site. This may result in some schemes being unnecessarily costly and other schemes not providing adequate environmental protection.

This chapter also identifies incidental exposures to the environment (such as bursts or leaks from reticulation system, system flushing for maintenance, firewater run-off) and inappropriate uses (such as garden over-watering, car washing on hard surfaces and hosing of hard surfaces).

This chapter does not address the:

- potential impacts of parameters on infrastructure, such as bio-clogging, corrosion in pipe infrastructure, and structural integrity impact due to saline and acidic soils
- management of storages and ornamental water features to prevent groundwater contamination, odour and algal blooms

- management of potential aesthetic impacts (such as recycled water colour and odour).

Detail supporting this chapter and generic risk assessments are contained in the document *Environmental Risk Management in Dual Pipe Water Recycling: Technical Background Paper*.

### 6.1. Hazard identification

Raw sewage can contain a range of contaminants that may need management to achieve sustainable water recycling. These contaminants may be sourced from industrial/commercial (trade waste) and domestic inputs, and infiltration into the sewerage system.

The scope of these guidelines is limited to the contaminants most commonly expected in recycled water and having wider environmental implications. These contaminants are nutrients and salts.

The presence of other key contaminant groups (such as metals, trace organics, pH) in recycled water at levels that could potentially pose an environmental risk is not anticipated for most schemes using recycled water for irrigation purposes. However, the risk assessment for a specific scheme should cover these other key contaminant groups. Additional management controls (such as targeted treatment) may be required for schemes where industrial or trade waste inputs are significant.

#### **Nutrients**

Elevated nutrient concentrations are considered to be key contributors to algal blooms and associated water quality problems. Considerable effort and resources have been invested to reduce nutrient loads from stormwater to enhance water quality of urban watercourses. Hence, it is important that

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water recycling schemes are managed such that they do not compromise these efforts by increasing loads to waterways.

Of the range of nutrients expected in recycled water, phosphorus and nitrogen are environmentally the most significant.

Nutrients are beneficial for plant growth, but an excess build-up of some nutrients in soil and migration to surface water and groundwater can cause:

- toxicity to some plants (including phytotoxicity to native plants sensitive to high nutrient levels)
- loss of soil productivity
- toxicity to aquatic life
- nuisance growths of aquatic plants, algal blooms and associated water quality problems.

## ***Salinity***

Salinity impacts from irrigation result from accumulation of applied salt and the mobilisation of existing salt (from subsoils and/or groundwater) as a result of irrigation. These include:

- impact to plant growth due to increases in osmotic pressure and reduced ability of the plant to extract water and nutrients. The problem is more severe in hot and dry climatic conditions because of increased water demands by plants and is even more severe when irrigation is inadequate
- toxicity due to specific ions (such as chloride, sodium and boron) being taken up with the soil water and accumulating in the leaves during water transpiration.

- foliar damage through the direct absorption of sodium and/or chloride ions. This is particularly a concern when using overhead sprinklers during periods of high temperature and low humidity
- degradation of soil physical conditions
- impact to groundwater and surface water quality.

Further complications of salinity problems can occur in geographic locations where the watertable is high. A high watertable can cause a possible upward flow of high-salinity water into the root zone.

## ***Sodicity***

Sodicity is the presence of a high proportion of sodium ions relative to calcium and magnesium ions in soil or water, and is indicated by the sodium adsorption ratio (SAR). Excessive sodium in irrigation water can impact on the integrity of the soil structure by making the soil more dispersible and erodible, leading to water entry infiltration and hydraulic conductivity of the soil being restricted, and hence limiting the drainage capability of the soil. If the soil drainage capacity is restricted this may lead to waterlogging or build-up of salinity.

## **6.2. Risk assessment**

A risk-based approach should be adopted to define an appropriate water quality for a given scheme. This needs to consider typical residential water use patterns and their potential impact on the environment.

A land capability assessment (LCA) is an important tool for assessing environmental risk and provides information for the development of the HEMP.

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The overall objective of an environmental risk assessment is to:

- understand the condition and sensitivity of the environment (plants, soils, groundwater and surface water) and beneficial uses
- assess the capability of the catchment to sustainably utilise and manage recycled water of a given quality
- determine treatment requirements to produce an appropriate water quality
- define the environmental monitoring program and appropriate management controls for the scheme.

The assessment should consider the following policies and guidelines:

- State Environment Protection Policy (*Waters of Victoria*), which establishes catchment-specific water quality objectives for surface waters and an attainment program for driving improvements in water quality
- State Environment Protection Policy (*Groundwaters of Victoria*), which defines segments of the groundwater environment and their associated beneficial uses, and establishes the levels of groundwater quality required to protect these beneficial uses
- the National Water Quality Management Strategy - *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000)
- *Guidelines for Wastewater Irrigation* (EPA Victoria 1991, Publication 168).

## Nutrients

The performance objective for nutrient management is to ensure:

- the applied nutrients (in recycled water or additional fertiliser application) are utilised for plant growth or remain safely in the soil for future uptake by plants
- the applied nutrients do not build up in the soil to a level where they cause an adverse impact on beneficial use on-site, or off-site (via surface run-off or leaching to groundwater).

Factors that should be considered in undertaking an LCA for nutrients are summarised in Figure 6.1. The technical background paper should be referred to for further details on the considerations and background for the LCA.

Tables 6.1 and 6.2 provide indicative risk levels for nitrogen and phosphorus loading on soils. In these tables, the amount of nutrients applied includes those sourced from both recycled water and fertiliser. Tables 6.1 and 6.2 may assist in identifying key risk areas for the LCA.

**Table 6.1: Indicative nitrogen risk**

Risk Level	Nitrogen applied (kg/ha/yr) <sup>1</sup>
Very low	<50
Low	50–100
Moderate	100–300
High	>300

Note to Table 6.1:

1. Only the applied nitrogen is considered due to complexity in analysing soil nitrogen; therefore risk figures quoted are conservative.

**Table 6.2: Indicative phosphorus risk<sup>1,2</sup>**

Phosphorus application (kg/ha/yr)	Soil phosphorus (mg/kg Olsen P <sup>3</sup> )				
	<20	20-30	30-40	40-60	>60
<20	VL	VL	L	M	H
20-40	VL	L	M	H	H
40-60	L	M	H	H	EX
>60	M	H	H	EX	EX

Notes to Table 6.2:

1. Very low (VL), low (L), moderate (M), high (H) and extreme (EX).
2. Risk is dependent on a combination of the application rate and the level of phosphorus in the soil.
3. Olsen P is an extractable phosphorus test method which measures the phosphorus potentially available for plant uptake. The P test is a method of measuring available phosphorus P in the soil.

### **Salinity and sodicity**

The performance objective for salinity and sodicity management:

- salt or sodicity levels in the water or soil do not impact on plant health, surface waters, groundwater or surrounding land
- stored salt in the subsoil and groundwater is not mobilised by irrigation.

Figure 6.1 illustrates factors that should be considered in the LCA for salinity and sodicity, some of which are discussed in more detail below.

### Soil salinity

Soil salinity risk depends on factors including the existing salt levels in the soil, the irrigation water quality and volume, and the adequacy of drainage through the soil profile. The accumulation of salt in the root zone of plants can impact on plant growth.

The impact is dependent on the plant sensitivity. For information of specific salt tolerances of plants, refer to ANZECC/ARMCANZ (2000) and *Water Quality for Agriculture – Irrigation and Drainage Paper No. 29 Rev.1* (FAO 1985).

Additional leaching to that provided by rainfall is difficult to manage in a residential context. If not undertaken appropriately it may lead to excessive salt and nitrate migrating to groundwater, export of salt and nitrate to surface waters and groundwater table rise with subsequent waterlogging and salinisation. Therefore, if the LCA identifies that excessive additional leaching would be required on residential properties to manage soil salinity, then consideration should be given to measures that reduce salt levels in the recycled water.

Table 6.3 provides an indicative relationship between irrigation water salinity, soil class, existing soil salinity (EC<sub>e</sub>) and subsequent risk of soil impact.

**Table 6.3: Soil salinity risk<sup>1</sup>**

Application salinity <sup>2</sup> (mg/L TDS)	Soil class <sup>4,5</sup>				
	I	II	III	IV	V
<175 (<500) <sup>3</sup>	VL	VL	VL	L	L
175-500 (500-1000)	VL	VL	L	L	M
500-1000 (1000-1500)	VL	L	M	M	H
1000-1500 (1500-2000)	L	M	M	H	E
>1500 (>2000)	M	M	H	E	E

Notes to Table 6.3

1. Very low (VL), low (L), moderate (M), high (H) and extreme (EX).
2. Application salinity is the annual average of all sources of irrigation water applied to the site.

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3. Figures in brackets are the application salinities for high rainfall area (>700 mm/annum).
4. Matrix is for the following soil salinity classes: Class A ( $EC_e < 3.8$  dS/m) and B ( $3.8 < EC_e < 6.5$  dS/m). Where Class C ( $6.5 < EC_e < 8.6$  dS/m) or D ( $EC_e > 8.6$  dS/m) salinity soils are irrigated, the risk above should be increased by one level.
5. Refer to Appendix D for descriptions of soil classes according to their inherent properties.

## Toxicity/foiar injury

ANZECC/ARMCANZ (2000) and FAO (1985) provide a list of crops and their relative tolerance to sodium and chloride ions. Impact due to direct application of water to foliage can be broadly defined as:

- low-risk situation: TDS <300 mg/L
- high-risk situation: TDS >1500 mg/L.

## Sodicity

An important consideration is the relationship between salinity and SAR. The higher the sodicity, the higher the salinity of the irrigation water must be to stabilise the soil structure and keep the clay flocculated, but the higher the salinity of the water, the more restricted the choice of plant species. ANZECC/ARMCANZ (2000) provides a relationship between SAR and  $EC_e$  of irrigation water for prediction of soil structural stability.

Soil sodicity can be determined by measuring soil SAR or the exchangeable sodium percentage (ESP). The ESP is the proportion of sodium absorbed onto the clay mineral surfaces as a proportion of the total cation exchange capacity (CEC, the ability of soil particles to adsorb cations). Low-risk situations can be broadly defined as: non-sodic soils ( $ESP < 6$ ) and low sodicity recycled water ( $SAR < 6$ ).

## Risk to groundwater

The use of recycled water in developments must be managed so that the beneficial uses of groundwater specified in the SEPP (Groundwaters of Victoria) are not impacted.

The risk to groundwater is influenced by the recycled water quality (salt loading), quality of groundwater, depth to the watertable and geology (soil type, depth and permeability).

## Waterlogging/salinisation

The use of recycled water must not result in secondary salinisation or waterlogging of soils.

These risks are influenced by:

- groundwater salinity
- depth to the watertable
- hydraulic loading
- soil permeability.

It should be noted that these issues are relevant for other irrigation water sources, including drinking water.

## ***Incidental events***

Environmental impacts as a result of these exposures depend on the contaminant levels in recycled water. The greatest risk in terms of nutrients is considered to be the entry of high-nutrient recycled water into waters during dry periods when natural flows are low.

An assessment should be undertaken to determine the impact of incidental events on the environment. Events that should be considered include:

- bursts and leaks: pollutant loads are likely to be very large compared to even less frequent storm

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events. Given that bursts are more common during summer months, the environmental risks are considerably increased if there are no management controls in place

- **flushing:** usually an infrequent event and is typically avoided during dry periods due to the limited availability of water.
- **firefighting:** the type and magnitude of damage that occurs during a fire is a complex product of the type of fire, the emergency planning measures in place, and the location of the fire with respect to susceptible ecological resources.

Irrespective of water source, the water quality resulting from firefighting activities is potentially acutely toxic to aquatic life due to the contaminants that may be released. The available literature indicates that house fires represent the lowest potential risk when compared with other fires such as those on industrial and commercial premises.

However, the expectation is that industrial and commercial premises have provisions for containing and managing firewater run-off. It is also the expectation that, during training drills, controls are implemented to prevent contaminated run-off into the stormwater drainage systems.

Therefore it is not anticipated that additional environmental management controls would be required for these event

### ***Inappropriate uses***

Inappropriate uses include those that generate considerable run-off. These can include washing

down hard surfaces, washing cars on hard surfaces and over-watering gardens.

The greatest risk area is considered to be the entry of high-nutrient recycled water into waterways during the dry periods when natural flows are low.

### **6.3. Operational control and preventative measures**

Operational control and preventative measures are required to ensure that the use of recycled water in dual pipe schemes is environmentally sustainable.

In addition to the management controls identified below, a monitoring program should be established to monitor priority risk areas as defined by the land capability assessment.

#### ***System Inputs***

Opportunities to manage the input of contaminants of concern, as defined by the risk assessment, into the sewerage system should be identified.

A program should also be developed to identify and evaluate the impacts of potential new inputs to the system or variations to an existing trade waste agreement.

#### ***Treatment management***

The treatment process should be selected and managed to ensure the required recycled water quality for environmental protection are met.

#### ***Storage and reticulation***

To mitigate the impact of bursts and leaks:

- accommodate resulting loads into water sensitive urban design (WSUD)
- provide an appropriate buffer between surface waters and large reticulation mains carrying

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recycled water with high nutrient loads. In determining a suitable buffer distance consider slopes of land, soils drainage characteristics, and vegetation

- install metering distribution systems such that losses due to leaks are minimised/managed
- devise an incident response plan.

Flushing is a planned activity. As with drinking water mains, flushing from recycled water mains can be managed such that there is no direct discharge to nearby waterways. One option is to locate flushing points to ensure discharges are accommodated through WSUD.

The discharge of recycled water from disinfection or slug dosing procedures should, where practicable, be to land or to sewer for treatment.

### ***End-use management***

#### Residential use

Recycled water can be used for a number of purposes at the residential level, including garden watering, car washing, and outdoor wash-down activities (excluding hard surfaces such as driveways) and construction.

The residential community should be appropriately informed to ensure that these activities do not adversely impact the environment. Information on appropriate uses and the risks to the environment if recycled water is used inappropriately should be provided to residents. Key messages should include:

- Minimise garden watering so that waterlogging and run-off do not occur.
- Limit watering to sensitive plants such as natives.

- Wash cars, boats and so forth on grassed areas to minimise run-off to the stormwater system.
- Avoid run-off of recycled water during construction and renovation activities.

More information on communicating key messages is provided in Chapter 8.

Influencing customer behaviour through messages about conservation and demand management will have an important role in risk management. While residents should not be responsible for complex management regimes such as leaching, they should be expected to use recycled water appropriately.

Metering and appropriate pricing of recycled water are important mechanisms to encourage responsible use of recycled water, as they impose a user-pays system. Individual meters should be installed at each household to monitor recycled water use.

#### Water sensitive urban design (WSUD)

Each development should demonstrate that waterways are not directly connected to recycled water through the drainage system and that any additional pollutant loads as a result of recycled water runoff from the development can be accommodated within the stormwater treatment and management system. As with all residential developments, the stormwater system should be capable of reducing pollutant loads to levels that contribute to the achievement of identified water quality objectives for waterways.

Guidance on stormwater management systems can be found in *Best Practice Environmental Management Guidelines Urban Stormwater* (1999), *Australian Runoff Quality* (Engineers Australia)

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2004) and *WSUD Engineering Procedures: Stormwater* (Melbourne Water 2004).

### Firefighting use

As discussed in the risk assessment, it is not suggested that additional environmental management controls be specifically imposed as a result of the use of recycled water.

### Ornamental water features

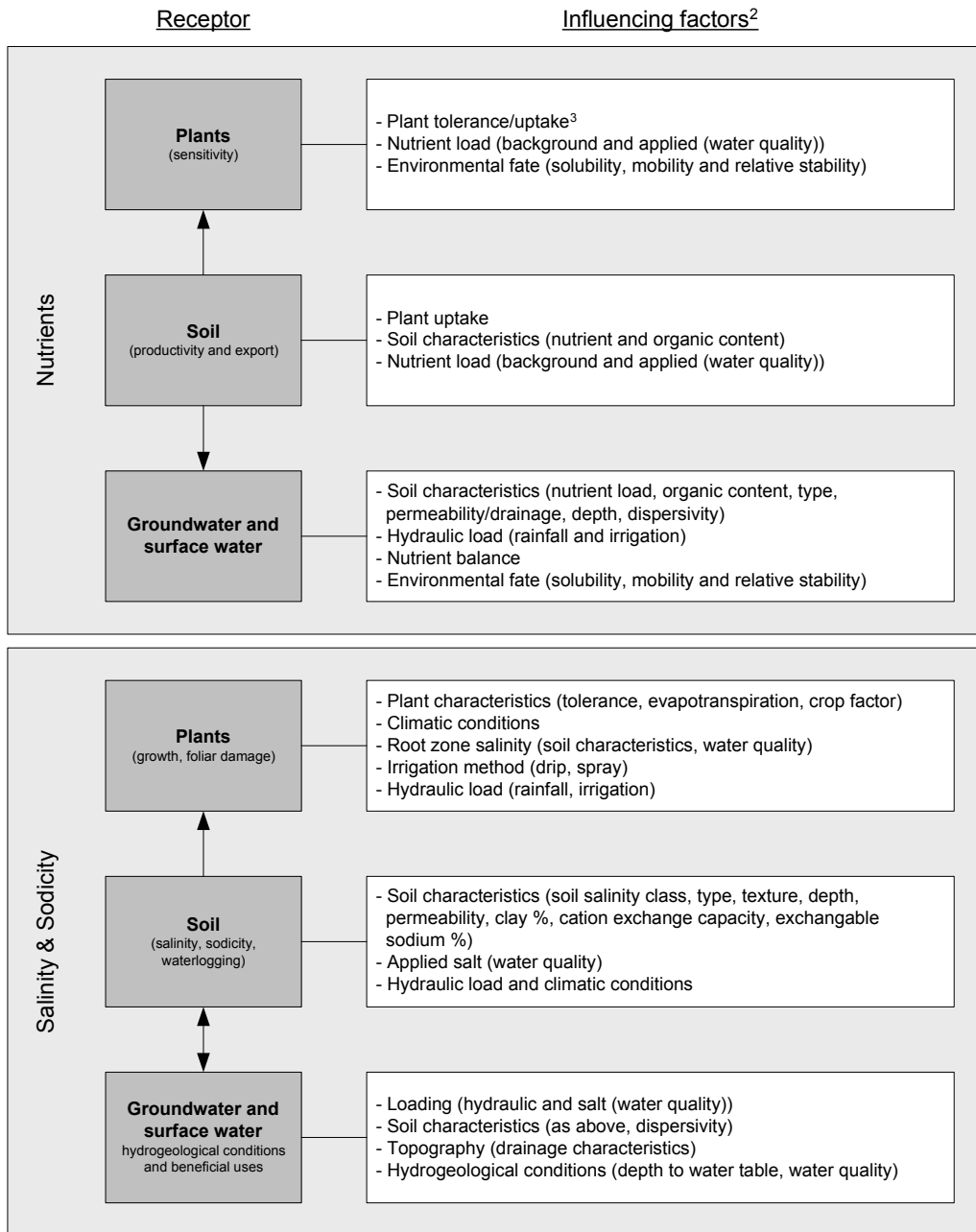
While not specifically assessed in this chapter, the use of recycled water in ornamental water features should be managed to ensure that:

- features are not connected to waterways and groundwater
- algal blooms, odour and other nuisances are controlled
- presence of nutrients and other contaminants (such as disinfection by-products, salt and heavy metals) are not toxic to aquatic life.

The management controls required should be determined on a scheme-by-scheme basis.

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Figure 6.1: LCA<sup>1</sup> considerations



Notes to Figure 6.1:

1. This process may be iterative in defining appropriate water quality objectives, which are protective of environmental receptors.
2. In many cases environmental receptors are linked. For example, the accumulation of salt in soil affects the average root zone salinity and subsequently affects plant growth.
3. Information on plant uptake rates can be sourced from NWQMS 2000 and Water Quality for Agriculture (FAO, Irrigation and Drainage Paper No. 29 Rev.1, 1985). Although natives have a low uptake rate, their limited watering requirements factored into the resident communication material.

## Managing environmental risk summary

### Performance objective

*To ensure that the recycled water system, treatment and the use of recycled water are managed in a manner that protects the environment.*

### Suggested measures to meet the performance objectives

- Undertake an environmental risk assessment including a land capability assessment (LCA).
- Utilise treatment technology that is capable of achieving water quality objectives as determined by land capability assessment.
- Establish a strategy to reduce contaminant inputs into the sewerage system.
- Develop a program to monitor priority risk areas as defined by the environmental risk assessment. Establish triggers and corrective actions.
- Provide information to customers on appropriate use and management of recycled water.
- Install meters at residential properties.
- Implement water sensitive urban design (such as stormwater management and treatment which is capable of accommodating additional pollutant loads).
- Install and maintain the distribution system to minimise losses to the environment.
- Avoid the direct discharge of recycled water to waterways during flushing events.
- Implement an incident response plan for bursts in the distribution and reticulation system.

## 7. MANAGING THE SUPPLY SYSTEM

This chapter identifies hazards, risks and management controls associated with the construction, operation and maintenance of the dual pipe supply system. The supply system is defined as the distribution, reticulation and plumbing components of the dual pipe scheme.

This chapter does not address the risk of inadequately treated water entering the system from storages or the treatment plant. These risks are specifically addressed in Chapter 5.

The first section of this chapter identifies the key potential hazards and recommended preventative measures for control within the distribution and reticulation system. In general, it is anticipated that the preventative measures identified in this chapter will be adequate for risk control in most schemes, but all scheme proponents should consider other potential risks and controls that may be applicable for their specific scheme.

The second section of this chapter outlines the key operational hazards and recommended preventative measures for control within a residential property.

The technical background paper *Plumbing and system operation report* provides further details and background information relevant to the distribution, reticulation and plumbing systems.

### 7.1. Distribution and reticulation

The identified key potential risks include the following:

- contamination of the drinking water supply system with recycled water due to cross-connections between the two supplies

- pathogen contamination from mains alteration and repair from the use of sewer repair equipment
- pathogen contamination during mains alteration and repair from the environment
- environmental impact due to burst mains and flushing events.

In order to control these risks the following preventative measures are recommended:

#### ***Design, construction and installation***

- Design and construct the system in accordance with the *Water Supply Code of Australia* (WSA 03-2002, WSAA), including supplement codes. It should be noted that this code recommends against permanent cross-connections between the recycled water and drinking water systems within the network downstream of storages.
- Protect any drinking water supply back-up to the recycled water system using an approved registered air-gap at the inlet to the recycled water storage (refer to section 5.3 and the *Water Supply Code of Australia* (WSA 03-2002, WSAA)).
- Develop a process to ensure that:
  1. the drinking water service pipe and drinking water meter into the property is only connected to the drinking water main in the street
  2. the recycled water service pipe and recycled water meter into the property is only connected to the recycled water main in the street.

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Refer to Appendix E for a suggested process for inspections of recycled water and drinking water supply systems in developments. All service pipe and meter assemblies should be inspected. The recommendation to inspect all (100%) service pipes and meter assemblies may be reviewed over time.

- Design the system to eliminate or reduce the need for flushing.
- Engage water main contractors with appropriate quality accreditation.
- Conduct regular auditing of contractors.

## ***System operation***

- Implement standard operating procedures for managing and maintaining the recycled water system.
- Devise and implement a scheduled maintenance program.
- Ensure that sewer repair tools are not used to repair the recycled water main.
- Flush the recycled water system after recharge.
- Manage burst mains and flushing events in accordance with Chapter 6.

The maintenance of chlorine residual for the control of microbial growth in the supply system is not considered essential for the protection of public health. However, maintaining a total chlorine residual of between 0.5 and 1 mg/L within the system may assist in the control of aesthetic issues (for example, biofilm growth and sloughing).

## **Commentary box**

These draft guidelines do not include a requirement to maintain chlorine residual in the supply system.

This is an area is subject to ongoing research. However, expert opinion currently indicates that there is no demonstrable health risk associated with biofilm growth or pathogen sequestration in the distribution system and therefore a guideline requirement to manage this is not warranted (refer to Health technical background paper).

Comment on this is sought.

## **7.2. Plumbing within the customer property**

This section details installation requirements. Further details can be found in the technical background paper *Plumbing and system operation report*.

The identified key potential risks include the following:

- pathogen, chemical or physical contamination via backflow
- pathogen, physical or chemical contamination from pipework failure below ground and backflow into the system
- pathogen, physical or chemical contamination of the drinking water with recycled water due to cross-connections
- pipework failure below ground and backflow into the system.

In order to control these risks the following preventative measures are recommended:

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- Undertake all plumbing works in accordance with AS/NZS 3500:2003 – *National Plumbing and Drainage Code*, which is consistent with the Plumbing Industry Commission (PIC) *Recycled Water Plumbing Guide*.
- Ensure a licensed plumber installs the recycled water system, including the backflow prevention device on the recycled water service.
- Conduct auditing of meter and backflow prevention device installations.
- Use approved materials with the appropriate watermarks and standard markings.
- Separate above-ground recycled water and drinking water infrastructure by at least 100 mm.
- Separate below-ground recycled water and drinking water infrastructure by at least 300 mm.
- Use purple identification tape for all below-ground recycled water pipes.
- Ensure that outdoor recycled water taps are coloured purple, have a removable handle and are located at least 300 mm from any drinking water tap.
- Ensure recycled water taps are not interchangeable with drinking water taps. To prevent drinking water taps from being installed on a recycled water outlet, tap inlets should have different size threads.
- Locate prohibition signs on all recycled water tap outlets no further than 150 mm from the tap handle. These signs should read 'Do Not Drink' (refer to Figure 7.1).

**Figure 7.1: Prohibition sign**



- Use purple coloured recycled water meters.
- Ensure the recycled water meter is not interchangeable with the drinking water meter. To prevent the swapping of waters or incorrect meters being used, recycled water meters should have different threads from a drinking water meter.
- Inspect all internal plumbing connections as per the standard PIC audit process detailed in the PIC *Recycled Water Plumbing Guide*. The three inspections points are:
  1. connection from the recycled water meter to the house prior to backfilling
  2. rough-in stage within the house
  3. test and commissioning.

The recommendation to inspect all (100% of) internal plumbing connections may be reviewed over time.

### **7.3. Ongoing system audit**

As a minimum, the water authority should provide advice that will enable the customer to self-check that the drinking water outlets are connected to the drinking water supply. This advice should also be provided to new owners and occupants.

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The water authority should also consider the development of an audit program to inspect a percentage of properties for incorrect connections.

### **Commentary box**

These draft guidelines do not include a requirement for the water authority to undertake regular cross-connection inspections at customer properties and only proposes that customers undertake cross-connection inspections as a 'minimum standard'. Comment on this approach is sought.

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## Managing the supply system summary

### Performance objective

*To ensure that the construction, operation and maintenance of the dual pipe supply system protects human health and the environment.*

### Suggested measures to meet the performance objective

- Design and construct the recycled water system in accordance with the *Water Supply Code of Australia* (WSA 03-2002, WSA).
- Undertake all plumbing works in accordance with AS/NZS 3500:2003 – *National Plumbing and Drainage Code* and the Plumbing Industry Commission (PIC) *Recycled Water Plumbing Guidelines*.
- Ensure that any drinking water supply back-up to the recycled water system is protected through an approved registered air-gap at the inlet to the recycled water storage.
- Develop an inspection/audit process for the recycled and drinking water supply system.
- Undertake installations as per section 7.2 Plumbing within the customer property.
- Identify the distribution systems in accordance with AS 1319 *Safety Signs for the Occupational Environment*.
- Identify all piping and conduits in accordance with AS 1345 *Identification of the contents of pipes, conduits and ducts*.
- Provide appropriate training to contractors, operators and plumbing personnel.
- Develop an audit and education program for identification of household cross-connections, including a cross-connection self-test kit for residents.
- Implement standard operating procedures for managing and maintaining the recycled water system.
- Develop contingency plans for potential incidents and emergencies.
- Implement an inspection and audit program for the recycled water system.
- Ensure that environmentally acceptable provisions are made for the maintenance of the distribution and reticulation network (refer to Chapter 6).

## 8. COMMUNICATING MANAGEMENT CONTROLS

Community engagement is a critical component of a dual pipe water recycling scheme and must be documented within the HEMP. Effective community engagement is necessary for ensuring that household plumbing is managed appropriately and recycled water is used responsibly for protection of human health and the environment.

This chapter identifies key components for effective engagement and communication of management controls.

Detail supporting this chapter is contained in the background paper *Community behaviour and engagement in dual pipe water recycling: A discussion paper of community perception and learning for future recycled water schemes*.

### 8.1. Developing and implementing an engagement and communication strategy

The sustainability of a dual pipe recycled water scheme is reliant on the willingness and ability of the community to adopt the behaviours required to ensure protection of human health and the environment.

An engagement and communication strategy should be tailored to address the specific needs of the community and should encompass the following principles:

- focused information
- inclusiveness, accessibility and diversity
- flexibility
- commitment to ongoing consultation

- provision of information in an open and accountable way
- appropriate and considered timing
- responsiveness to and seeking of feedback
- evaluation and review.

The key components of the strategy are:

- determining roles and responsibilities
- defining the community
- determining community needs
- identifying key messages
- identifying communication tools
- implementation, maintenance and review.

#### ***Determine roles and responsibilities***

The scheme manager, developer and water supplier, and any other key stakeholders (including local government) should assume responsibility for developing the strategy for the dual pipe scheme.

The organisation/body responsible for the implementation, maintenance and review of the strategy should be clearly identified.

#### ***Define the community***

Segments of the community that should be considered include:

- the 'live-in' community:
  - residents
  - businesses, organisations and groups that will be established within the development.
- the 'regional' community:
  - individuals, groups and organisations with an interest in the development, but who will

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not necessarily live there. This may include landlords, business owners, real estate agents, and builders and plumbers.

Information will need to be appropriately targeted to each segment of the community.

### ***Determine needs of the community***

Segments of the community may have specific communication needs depending on their role within the community, demographic and language needs. The following should be considered in identifying the specific needs of the community:

- demographic study
- audience that is targeted for marketing and sales
- relevant public authorities and organisations that may have a stake in the scheme. For example, the local council, EPA Victoria, Melbourne Water, the Catchment Management Authority, DSE and DHS
- local environment and 'friends of' groups. Usually local government can provide a list of active groups in the region
- builders and developers.

### ***Identify the key messages for the community***

For the purpose of the HEMP, the key messages to be communicated are those regarding the management controls required in order for the scheme to be sustainable and safe.

Key messages should cover:

- appropriate/acceptable uses of recycled water (refer to Chapters 5 and 6)

- inappropriate or potentially unsafe uses of recycled water (refer to Chapters 5 and 6)
- the risks of inappropriate uses of recycled water
- the identification of the recycled water infrastructure versus the drinking water infrastructure (Chapter 7)
- the responsibilities of recycled water users, for example:
  - using recycled water appropriately and responsibly
  - advising visitors of appropriate uses of recycled water
  - undertaking cross-connection tests
  - maintaining recycled water infrastructure on own property – what works a resident may undertake themselves, what work must be undertaken by a licensed plumber and where appropriate plumbing supplies can be obtained.
- instructional information – for example:
  - step-by-step guides for cross-connection tests
  - conservation measures, responsible irrigation and fertiliser applications.
- where to get further information and advice.

The strategy can also include the dissemination of other information regarding the scheme, such as:

- the source and quality of recycled water, how it is produced and how it is different from drinking water
- the expected look and smell of recycled water

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- the security of supply
- the recycled water billing system and whether or not water restrictions will apply to the recycled water supply
- When recycled water will be available (if residents occupy the development before the recycled water system is operational).

## ***Identify communication tools***

Expertise is required for the identification of communication tools that are most appropriate for the needs of the community. Tools may include:

- focus groups
- one-on-one interviews
- public information sessions
- community instructional workshops
- ‘frequently asked questions’
- home occupant kits, which may include:
  - fact sheets on recycled water quality and its appropriate use to ensure protection of human health and the environment
  - fact sheets on irrigation or garden watering with recycled water
  - instruction sheets on household plumbing and self cross-connection tests
  - list of roles and responsibilities
  - contacts list and notification instructions.
- water bill inserts
- multilingual signs on all recycled water taps, using internationally recognisable symbols and tactile aids for the visually impaired

- signage and information boards in public areas
- open days
- media involvement
- school education programs.

Tools should include pictorial representation of any instructions or messages that require communication

## ***Implement, maintain and review***

The strategy is not static. Ongoing community education is extremely important. A program should be developed to reinforce key messages and target new residents (including tenants of rental properties).

During the lifetime of the scheme the strategy should undergo regular review and revision. This review should involve broad community consultation to assess knowledge retention and obtain feedback on the effectiveness of communication tools.

## **8.2. Terms and definitions**

It is important that plain and consistent language is used in dual pipe water recycling schemes. The following terms and definitions are recommended for use in documentation that is to be distributed to the community, and are not intended to replace terms that are widely used and accepted within the water industry.

**Sewage:** Water that has been used by households, commercial premises or industry and discharged to the sewerage system for treatment at a sewage treatment plant.

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**Drinking water:** Defined in the *Australian Drinking Water Guidelines 2004* and suitable for human consumption. Also known as potable water.

**Recycled water:** Water that has been derived from sewerage systems or industry processes and treated to a standard that is appropriate for its intended use.

This term should replace the following terms currently used: reclaimed water; reused water; new water; and treated effluent.

**Sewage treatment plant:** A treatment plant that treats sewage.

**Recycled water treatment plant:** A treatment plant that produces recycled water of a quality that is appropriate for its intended use.

**Water treatment plant:** A treatment plant that produces drinking water.

**Recycled water system:** The infrastructure that conveys recycled water from a recycled water treatment plant to the customer.

## *Commentary box*

Comments are sought on the terminology for dual pipe recycling schemes. It is hoped that the use of common terms will ensure consistency and clarity in communicating with residents and the broader community.

## Communicating management controls summary

### Performance objective

*To develop an engagement and communication strategy that will ensure protection of human health and the environment by promoting the appropriate use of recycled water.*

### Suggested measures to meet the performance objective

- Identify who is responsible for the implementation, maintenance and review of the communication strategy.
- Identify the segments of the community to whom the strategy will be targeted.
- Determine the communication needs of each segment of the community.
- Identify the key messages for communication, covering the management controls required.
- Identify effective tools for communicating key messages.
- Implement, maintain and review the communication strategy.
- Use consistent terminology that is easily understood by the layperson and/or target audience.

## 9. INCIDENTS AND EMERGENCIES

A preventative risk management strategy should include the development of considered and controlled responses to incidents or emergencies that can compromise the safety of using recycled water.

Many incidents and emergencies situations will be identified during the application of HACCP principles to the recycled water system, and appropriate corrective actions will be established during this process. However, it is essential that all realistic emergency scenarios are identified, and incident and emergency protocols planned and documented in the overarching HEMP for the recycled water scheme. Including incidents identified in specific HACCP-based assessments, these events may include but are not limited to:

- non-conformance with guideline values or water quality objectives
- incidents that increase the levels of potentially harmful contaminants or cause failure of treatment systems (such as spills, illegal discharges or incorrect dosing of chemicals)
- equipment breakdown and failure
- prolonged power outages
- extreme weather events
- natural disasters
- human actions (such as human error, sabotages or strikes)
- outbreaks of illness leading to increased pathogen challenges on treatment systems

- cyanobacterial (blue-green algae) blooms in storages
- other specific incidents or emergencies relevant to the recycled water scheme.

It is acknowledged that some events cannot be anticipated or controlled, or have such low probability of occurring that providing preventative measures would be too costly. For such incidents there must be an adaptive capability to respond constructively and efficiently.

### 9.1. Protocol development

For all identified incidents and emergencies, response protocols should be developed to ensure that public and environmental health risks are managed efficiently and effectively. These protocols should be developed in consultation with the relevant regulatory authorities and other key agencies, and should be consistent with existing government emergency response arrangement.

Key areas to be addressed in any incident or emergency response protocol include:

- response actions
- responsibilities of individuals or groups both internal and external to the organisation
- plans for alternative water supplies
- mechanisms for increased health or environmental surveillance.

It is critical that employees are trained in emergency response to ensure that they can manage potential incidents and emergencies effectively.

In addition to the above, effective communication is vital in managing incidents and emergencies, for

both responding efficiently to the situation and maintaining consumer confidence in the recycled water system. Therefore incident and emergency protocols should incorporate aspects relating to communication, including:

- the key people, agencies and other businesses that must be notified of the incident or emergency
- detailed notification forms including procedures for internal and external notification
- the responsibilities of the relevant organisations and authorities.

A public and media communication strategy should also be developed for effectively delivering key messages regarding an incident or emergency. This should be developed before any emergency situation occurs, and should ensure that:

- an appropriately trained, authoritative contact is designated to handle all incident and emergency communications
- draft public and media notices are prepared in advance
- all employees are kept informed during any incident
- all consumers are notified of incidents that may have affected their supply or safety, and are provided with information on the detail of the incident, the actions taken and the measures put in place to minimise future occurrences.

### 9.2. Review and documentation

Emergency and incident response protocols should be regularly reviewed to ensure they are practicable and up to date, and to provide opportunities to improve the effectiveness of them before an emergency occurs.

Following any emergency or incident situation, an investigation should be undertaken, considering factors such as:

- What was the cause of the problem?
- How was the problem first identified or recognised?
- What were the most critical actions required?
- What communication problems arose and how were they addressed?
- What were the immediate and longer-term consequences?
- How well did the protocol function?

Appropriate documentation and reporting of the incident or emergency should also be established. The organisation should learn as much as possible from the incident to improve preparedness and planning for future incidents. Review of the incident may indicate necessary amendments to existing protocols.

## Incidents and emergencies summary

### **Performance objective**

*To ensure that incidents and emergencies are responded to efficiently and effectively.*

### **Suggested measures to meet the performance objective**

- Identify potential incidents and emergencies relating to the recycled water system.
- Develop sound protocols, documenting response actions, roles and responsibilities, and communication strategies.
- Train employees and regularly review emergency protocols.

### 10. EMPLOYEE AWARENESS AND TRAINING

For the successful operation of the dual pipe recycled water system, it is essential that employee training needs are identified, and all employees who are working within the recycled water system are adequately trained. Employees should have a sound knowledge base from which to make effective operational decisions. This requires training in the methods and skills required to perform their tasks efficiently and competently.

At a minimum, employee training should cover:

- the principles of risk management
- knowledge and awareness of the HEMP, including roles, responsibilities and liabilities
- the recycled water system, including its operation and the control measures that are in place to ensure public and environmental health protection
- the organisation's protocols and policies for the system, such as system management and maintenance, sampling and analysis of water, consumer complaints, or incident and emergency plans
- statutory requirements relating to the recycled water system
- the roles and responsibilities of individuals and agencies that relate to the recycled water system, both internal and external to the organisation
- the documentation, reporting and auditing of the system.

Training can take place in a number of forms. It may include formal induction or training sessions (in-house or external), seminars, courses, manuals, newsletters, briefings and meetings, and should encourage employees to communicate and think critically about the operational aspects of their work.

Specific training needs should be identified, and it should be noted that the degree of training required by a particular employee, or group of employees, will depend on their role in the recycled water scheme. For some employees, their actions will have potential to impact on the health and environmental safety of the scheme. Treatment process operators in particular are critical in the production of safe water, and must have a sound understanding of the RWQMP. They should have detailed knowledge of the purpose of the critical control points in a treatment process and the significance if critical limits for these are not met.

Training programs should be adequately resourced, as sound training is fundamental to the operation of the recycled water system.

All training activities should be documented, and the records of employees who have participated in training maintained. Mechanisms for evaluating the effectiveness of training should also be established and documented.

## Employee awareness and training summary

### **Performance objective**

*To ensure that employees are adequately trained in the operational aspects of their work, and understand the potential impact of their actions on the safety of the recycled water scheme.*

### **Suggested measures to meet the performance objectives**

- Ensure that employees, including contractors, maintain appropriate experience and qualifications.
- Ensure that training needs are identified, and that adequate resources are available for training.
- Document training and maintain records of all employee training.

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## 11. RESEARCH AND DEVELOPMENT

Ongoing review and improvement is essential to ensure that the HEMP remains relevant and new information is used to revise and improve the HEMP.

Local research increases the understanding of specific characteristics of individual water supply systems. It may range from investigating mechanisms to improve and optimise treatment plant performance to an analysis of variation in source water quality parameters and their relationship with soil and groundwater changes at receiving sites

Research activities should be carried out under controlled conditions by qualified staff, and all protocols and results should be documented and recorded.

Participation in research and development activities through partnerships and industry-wide cooperation can be a cost-effective way to address broader issues associated with recycled water quality and treatment.

Applied research and development may be directed towards:

- increasing the understanding of potential hazards within the specific catchment – for example, through:
  - examining the chemical quality of sewage to identify potential sources of industrial discharges
  - assessing trade waste agreements to identify chemical contaminants that may be discharged into source waters
  - examining seasonal or outbreak impacts on the microbial quality of sewage and recycled water
  - monitoring source water to understand the temporal and spatial variability of water quality parameters.
- investigating improvements, new processes, emerging water quality issues and new analytical methods
- validating the operational effectiveness of new products and processes
- improving assessments of potential impacts of recycled water on human health, soils and other receiving environments.

### Research and development summary

#### Performance objective

*To undertake research that allows for the continuous improvement of the recycled water scheme in terms of environment and health risk management.*

#### Suggested measures to meet the performance objectives

- Participate in research and development initiatives.

## 12. DOCUMENTATION AND REPORTING

### 12.1. Documentation

The HEMP should document how the requirements of the guideline will be met, specifically addressing the following:

- roles and responsibilities (Chapter 3)
- recycled water system assessment (Chapter 4)
- managing human health risks (Chapter 5)
- managing environmental risks (Chapters 6)
- managing the supply system (Chapter 7)
- communicating management controls (Chapter 8)
- incidents and emergencies (Chapter 9)
- employee awareness and training (Chapter 10)
- research and development (Chapter 11)
- documentation and reporting (Chapter 12)
- auditing, review and improvement programs (Chapter 13).

The HEMP should also document each step of the risk management process that is important:

- to demonstrate to stakeholders that the process has been conducted properly
- to provide evidence of a systematic approach to risk identification and analysis
- to provide a record of the risks
- to enable review and continuous improvement
- to provide an accountability mechanism and tool

- to ensure scheme sustainability.

In accordance with AS/NZS 4360:2004 *Risk Management*, documentation should include assumptions made, methods, data sources, analyses, results and reasons for decision.

Records of all monitoring results and analyses should be kept for at least 10 years in order to analyse trends and demonstrate ongoing compliance with the objectives of these guidelines.

Records should include:

- monitoring data
- breaches of critical limits and corrective actions taken
- details of incidents and emergencies and corrective actions taken
- inspection and maintenance reports
- annual reports, as discussed in this chapter
- assessment of community behaviours in the use of recycled water.

These records should be made available to EPA and users upon request.

### 12.2. Reporting

An annual report should be prepared for EPA including:

- an analysis of the monitoring data collected for the management of environmental risks
- an analysis of the monitoring data collected under the RWQMP. EPA will refer this to DHS for review and comment
- details of incidents and emergencies, including corrective actions

## DUAL PIPE WATER RECYCLING

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- a listing or register of supplied recycling schemes, including quality, quantity and type of use
- a summary of audit outcomes
- proposed measures for continual improvement.

### ***Notifications***

In the event of an emergency incident, the supplier or scheme manager must notify the appropriate regional office of EPA, any other relevant regulatory body and affected parties as soon as practicable.

The Environmental Health Unit of the DHS should be notified of the following:

- a system failure that may potentially impact on the end users of the recycled water

- an emergency or an incident that potentially places public health a risk
- any changes to the RWQMP or operation of the treatment process that may potentially impact on achieving the required microbial criteria.

Notification should be prompt and include details of corrective and future preventative action being taken.

The HEMP should document responsibilities and reporting arrangements for emergency situations.

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## *Documentation and reporting summary*

### **Performance objective**

*To ensure the HEMP documents the measures in place to ensure a safe, sustainable and compliant dual pipe scheme.*

*To ensure appropriate arrangements are in place for the submission of performance reports to agencies and the community.*

*To ensure appropriate arrangements are in place to report incidents of non-compliance to the relevant agencies and stakeholders.*

### **Suggested measures to meet the performance objectives**

- Document all aspects of the guideline in the HEMP, including the management controls, monitoring, reporting, and auditing requirements.
- Keep records of all monitoring results and analyses.
- Record and maintain details of all inspection and maintenance programs.
- Ensure the suppliers of recycled water notify the scheme manager and/or user of any non-compliance.
- Notify DHS and/or EPA of emergencies and incidences in a timely manner.
- Submit annual reports to EPA.

## 13. AUDITING, REVIEW AND IMPROVEMENT PROGRAMS

### 13.1. Auditing

Auditing of the dual pipe water recycling scheme is required to ensure that suppliers, scheme managers and recycled water users meet their obligations under these guidelines. Initially this auditing should occur annually, but reduction of this frequency may be considered over time.

The audit program should comply with the principles in ISO 14010's *Guidelines for Environmental Auditing*.

The objective of the audit program should be to assess compliance with the HEMP.

It is a requirement for dual pipe water recycling schemes to engage an auditor appointed pursuant to Part IXD of the *Environment Protection Act 1970* to undertake an annual statutory audit of the scheme and submit an audit report pursuant to Part IXD of the *Environment Protection Act 1970* to EPA Victoria. Information on the appointment process and a list of appointed auditors is available from the EPA website (<http://www.epa.vic.gov.au/Industry>).

The process for commissioning, undertaking and scoping the audit, and the individuals or organisations involved in the process should be described in the HEMP.

### *Commentary box*

Annual statutory audits are required for dual pipe water recycling schemes. If it is subsequently deemed unnecessary to conduct audits on an annual basis, the frequency may be extended.

Comments are sought on experts who might meet the qualification requirements for EPA-appointed auditors for dual pipe schemes.

### 13.2. Review and improvement

The HEMP should be reviewed and improved in response to the outcomes of audits and analysis of monitoring results to ensure it remains relevant.

The aim of the review is to:

- assess overall performance against guidelines and regulatory requirements and ensure scheme sustainability
- identify emerging problems and trends as indicated by monitoring results, supply system audits, and incidents and emergencies.
- assist in determining priorities for improving recycled water quality management, and research and development opportunities.

## Auditing, review and improvement programs summary

### Performance objective

*To ensure an auditing program is implemented to monitor compliance with these guidelines.*

*To undertake review and improvement activities to ensure the HEMP remains relevant.*

### Suggested measures to meet the performance objectives

- Audit recycling schemes annually to verify compliance with these guidelines.
- Ensure audit programs comply with the principles in ISO 14010 *Guidelines for Environmental Auditing*.
- Review and improve the HEMP in response to auditing outcomes and monitoring results.

## APPENDIX A – KEY ACTS AND REGULATIONS

### Acts

*Environment Protection Act 1970*

*Building Act 1993*

*Health Act 1958*

*Trade Practices Act 1974*

*Safe Drinking Water Act 2003*

*Food Act 1984*

*Livestock Disease Control Act 1994*

*Occupational Health and Safety Act 1985*

### Regulations

Environment Protection (Scheduled Premises And Exemptions) Regulations 1996, No. 66/1996

### State environment protection policies

State Environment Protection Policy (*Groundwaters Of Victoria*) Publication S160

State Environment Protection Policy (*Waters Of Victoria*) Publication S13

State Environment Protection Policy (*Prevention And Management Of Contaminated Land*) 2002

### Codes, standards and guidelines

EPA Victoria (2003) Publication 464.2: *Guidelines for Environmental Management: Use of Reclaimed Water*

EPA Victoria (1991) Publication 168: *Guidelines for Wastewater Irrigation*

EPA Victoria (2002) Publication 730: *Guidelines for Environmental Management: Disinfection of Treated Wastewater*

EPA Victoria (1999) Publication 441: *A Guide To The Sampling And Analysis Of Water, Wastewaters, Soils And Wastes*

EPA Victoria (2000 Draft) Publication 668: *Environmental Guidelines For Hydrogeological Assessments (Groundwater Quality)*

EPA Victoria (1993) Publication 384: *Enforcement Policy*

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Australian and New Zealand Environment Council and Agriculture and Resource Management Council of Australia and New Zealand (2000), *National Water Quality Management Strategy – Australian New Zealand Guidelines for Fresh and Marine Water Quality*

ISO 14010 *Guidelines For Environmental Auditing*

WSA 03–2002, *Dual Water Supply Systems*, First Edition, Version 1.1, A Supplement to the Water Supply Code of Australia, Water Services Association of Australia.

AS/NZS 4360:2004 *Risk Management*

AS/NZS 3500:2003 *National Plumbing And Drainage Code*

AS 1345 *Identification Of The Contents Of Piping, Conduits And Ducts*

AS 1319 *Safety Signs for the Occupational Environment*

AS 2845.1 *Water Supply – Backflow Prevention Devices*

AS 2845.3 *Water Supply – Backflow Prevention Devices – Field Testing And Maintenance*

AS 2031 *Sample Collection And Preservation Techniques*

Plumbing Industry Commission & Water Authorities (2005) *Recycled Water Plumbing Guide*

NHRMC *Australian Drinking Water Guidelines 2004*

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## APPENDIX B – KEY GOVERNMENT DEPARTMENTS AND AGENCIES

### **EPA Victoria head office**

Herald and Weekly Times Tower,  
40 City Road Southbank VIC 3006  
Tel: (03) 9695 2700  
<http://www.epa.vic.gov.au>

### **EPA Victoria metropolitan offices**

#### South Metropolitan

35 Langhorne St Dandenong Victoria 3175  
Tel: (03) 8710 5555

#### West Metropolitan

Refer head office details

#### Yarra Region

Refer head office details

### **EPA Victoria country offices**

#### Gippsland Region

7 Church Street Traralgon VIC 3844  
Tel: (03) 5176 1744

#### North East Region

24 Ely Street Wangaratta VIC 3677  
Tel: (03) 5721 7277

#### North West Region

43 Williamson Street Bendigo VIC 3550  
Tel: (03) 5442 4393

#### South West Region

Cnr Lt Malop and Fenwick St Geelong 3220  
Tel: (03) 5226 4852

### **Department of Human Services**

Environmental Health Unit

120 Spencer Street Melbourne VIC 3000  
Tel: (03) 9637 4156

### **Plumbing Industry Commission**

450 Burke Road Camberwell 3124  
Tel: (03) 9889 2211

### **Municipal Association of Victoria**

GPO Box 4326PP Melbourne 3001  
Tel: (03) 9667 5555

### **Building Industry Commission**

PO Box 536E Melbourne 3001  
Tel: (03) 9285 640

### **Water Services Association of Australia**

Level 8 469 Latrobe St Melbourne 3000  
Tel: (03) 9606 0678

## APPENDIX C – HACCP FRAMEWORK

The production of safe and sustainable recycled water can be secured by the application of a water quality management system. This focuses on the prevention of substandard water being delivered for use, by ensuring that treatment steps, controls, monitoring and verification that are essential for achieving the required water quality objectives are in place.

This approach has been used by the food industry for many years through the application of the Hazard Analysis and Critical Control Point (HACCP) system. The water industry is increasingly adopting similar principles, as demonstrated in the Victorian *Safe Drinking Water Act 2003*, the *Australian Drinking Water Guidelines (2004)* and the *WHO Guidelines for Drinking-Water Quality (2004)*.

This appendix describes the application of HACCP to analyse and control a wastewater treatment plant to ensure the removal of pathogens to achieve the required microbial criteria (Table 5.1). These principles can be equally applied to other aspects of the dual pipe scheme, including the supply system, end uses, and management of environmental risks.

HACCP comprises 12 steps – five preliminary steps and seven principles, as shown in Figure C.1. These are discussed in detail below.

### Preliminary steps

#### *i) Assemble team*

The HACCP team should be multidisciplinary, encompassing a broad range of expertise and skill in all aspects of the recycled water system.

Management within the organisation producing

recycled water should also be represented to ensure organisational support for the HACCP process.

#### *ii) Describe product*

The HACCP plan should specify that the product is Class A recycled water, including the specific microbial criteria and other any water quality objectives that are applicable.

#### *iii) Identify intended use*

The intended uses of Class A recycled water within the dual pipe scheme should be specifically described.

#### *iv) Construct flow diagram*

The recycled water system should be mapped, from the catchment of raw water to the delivery of water to the customer property. The flow diagram should include all transfer, treatment, input and monitoring steps, and is integral to a comprehensive system assessment (Chapter 4).

#### *v) Confirm flow diagram*

The flow diagram should be confirmed with any detailed design specifications or functional design reports that have been developed for the scheme. If the scheme is utilising any existing treatment processes or infrastructure, the flow diagram should be confirmed with an on-site inspection.

### Principles

#### *1) Identify hazards and assess risk*

A significant hazard is one that must be prevented, eliminated or reduced to an acceptable level to produce safe recycled water. Hazards may be biological, chemical or physical. Generally the hazards of greatest concern for the recycled water plant are those that are biological (pathogens).

However, it may also be appropriate to consider chemical and physical hazards, such as those that may result in chemical contamination of the recycled water or physical damage to the recycled water plant.

The hazard analysis consists of three steps, which should be documented:

- Identify hazardous events at each step in the process that may impact on water quality. These, for example, are events that may result in ineffective pathogen removal or recontamination of treated water with pathogens.
- Determine the risk and significance of each hazardous event. This is the product of how frequently the hazardous event is expected to occur and what the consequences of that event occurring are. The framework provided in the Australian Drinking Water Guidelines (NHMRC 2004) or alternative risk assessment framework can be used for this assessment.

The HACCP team needs to identify at what point a hazardous event is considered to be significant. A rule of thumb for a risk assessment model that results in risk scores ranging from 1 to 25 (with 1 representing low risk and 25 representing extreme risk) is to consider that all events with a risk score of 5 or greater as significant.

- Identify control measures for each hazardous event. These include system input management, physical barriers (such as treatment steps), monitoring, standard

operating procedures and personnel training. More than one control measure may be required to control a particular hazard, and more than one hazard may be controlled by a particular control measure.

### **2) Determine Critical Control Points (CCPs)**

Hazardous events assessed as significant must be further assessed to identify whether they fall at a CCP. A CCP is essentially a step in the process that is critical for achieving or maintaining the required water quality. The decision tree in Figure C.2 can be used to determine if a hazardous event falls at a CCP.

CCPs must meet a number of criteria:

- They must have control measures with operational parameters that can be measured and for which critical limits can be set to define the operational effectiveness of the activity (for example, chlorine residual for chlorination or integrity tests for membrane filtration processes).
- They must have control measures with operational parameters that can be monitored at a frequency that will reveal any failures in a timely manner.
- There must be corrective actions that can be implemented in response to deviation from critical limits.

Appropriate selection of CCPs is essential because the focus of operational control will be directed towards these processes and activities.

### **3) Establish critical limits**

All CCPs must have critical limits for their operational parameters that are defined and validated. A critical limit distinguishes between acceptable and unacceptable performance. When a critical limit is not met, corrective actions should be immediately instituted to resume control of the process.

For treatment processes, critical limits must indicate a decline in performance that equates to at least a 6-log removal of viruses and a 5-log removal of protozoan parasites. The derivation of these limits is discussed in the document *Health Risk Management in Urban Recycling Schemes: Technical Background Paper*.

For many processes operational parameters can be closely linked to performance and tightly controlled (for example, CTs for disinfection indicate the log removal of specific pathogens). However, for processes where operational parameters cannot be as definitively linked to performance (for example secondary treatment processes) a 5th percentile of performance, in terms of log removal, can be adopted. This value should be derived using a rigorous data set for pathogen removal and linked to a specific range of operating parameters. The upper and lower range of these operating parameters then form the critical limits for this step and upstream or downstream processes in the treatment train must be tightly managed to ensure that at this 5th percentile of performance the total train will still provide at least 6-log removal of viruses and 5-log removal of protozoa.

The information used to determine critical limits for monitoring of a particular CCP may include

experimental studies, scientific literature and supplier specifications.

Critical limits must be validated to confirm they are accurate. Validation of critical limits forms part of the verification of the water quality management system, and is discussed later in this appendix.

### **4) Determine monitoring requirements**

Monitoring provides assurance that the treatment process is under control. All CCPs must have an associated monitoring activity to ensure that critical limits are met. A monitoring regime that identifies the location and frequency of monitoring, and a description of the method or procedure of monitoring must be established.

### **5) Establish corrective actions**

Corrective actions are taken when a critical limit is not met. If a critical limit is indicative of the treatment process providing sufficient pathogen removal, then the corrective action for not meeting that limit might be to stop water delivery to end users or increase treatment downstream to adequately compensate for the loss in performance. The documentation of corrective actions must include what immediate action is required to resolve the problem, who is responsible for undertaking the corrective action, and who must be notified.

### **6) Establish verification procedures**

Verification procedures are used to determine whether the control measures are effective and whether the water quality management plan is being implemented appropriately.

Verification includes:

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- testing the monitoring and procedures identified in the HACCP plan during commissioning of the treatment process
- validation of critical limits (discussed later in this appendix)
- equipment calibration
- cleaning and maintenance programs
- HACCP plan reviews and internal/external audits
- ongoing evaluation of monitoring data to assess the overall performance of the treatment process and HACCP plan.

### 7) *Establish documentation and record-keeping*

Appropriate documentation provides the foundation for establishing and maintaining an effective HACCP plan. Documentation should include:

- information used to develop the HACCP plan
- CCPs, critical limits, monitoring and corrective actions
- standard operating procedures relied upon or specifically developed for the HACCP plan
- verification activities, including the validation of critical limits
- records generated as a result of monitoring
- reviews and modifications to the HACCP plan.

### **Validation**

The validation of critical limits is essential for substantiating that the system can be controlled to meet the water quality objectives, and the associated monitoring activities will be able to

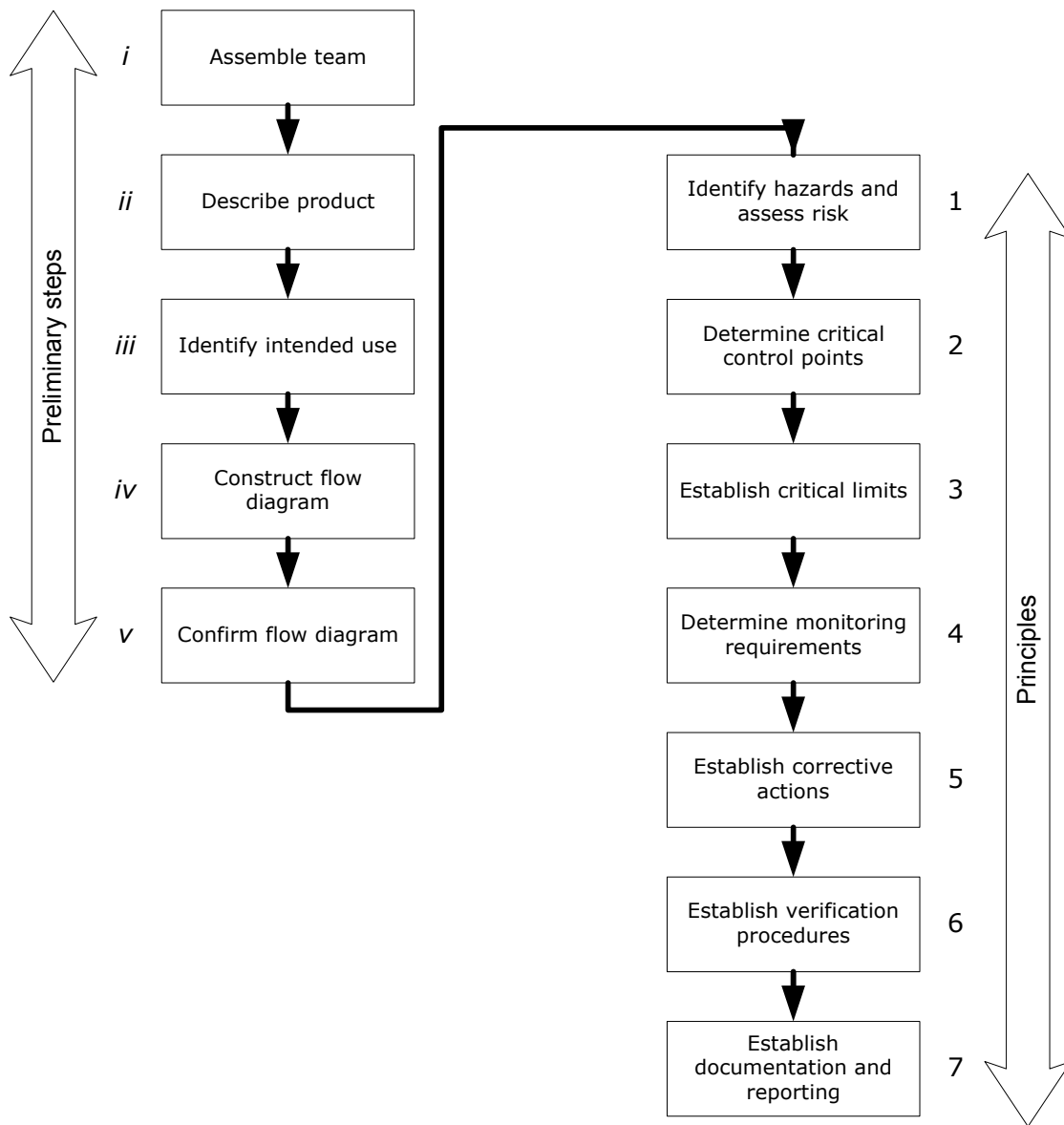
effectively indicate this. Validation must occur before supply of recycled water can commence.

The first stage of validation is to consider data that already exist. This can include data from the scientific literature, existing guidance, historical data (for example from other schemes) and supplier knowledge.

The second stage of validation is to determine whether additional testing is required – for example, whether specific on-site studies are necessary – and to collect and analyse the appropriate data. As validation is not used for the day-to-day management of the system, parameters that may be inappropriate for operational monitoring can be used. These may include microorganisms or tracer studies.

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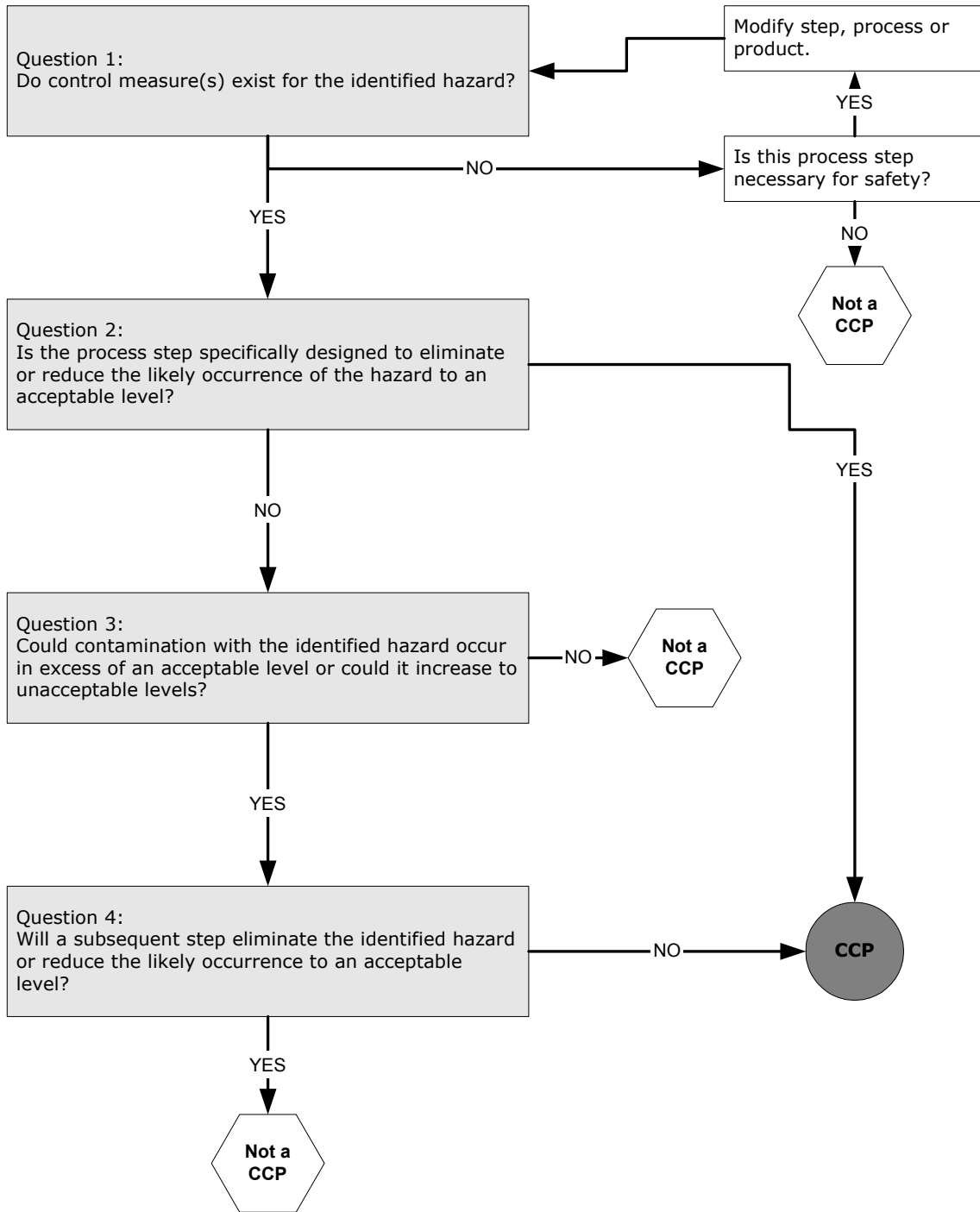
Figure C.1: The HACCP process



(adapted from Codex Alimentarius, WHO)

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Figure C.2: Decision tree to identify CCPs



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## APPENDIX D – SALINITY CLASS AND SOIL CLASS

**Table D1: Salinity classes of irrigation waters**

Class	TDS (mg/L)	Electrical conductivity (µS/cm)	Comments
1	0–175	0–270	Can be used for most crops on most soils with all methods of water application with little likelihood that a salinity problem will develop. Some leaching is required but this will occur under normal irrigation practices, except in soils of extremely low soil permeability.
2	175–500	270–780	Can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown, usually without special salinity management practices. Sprinkler irrigation with the more saline waters in this group may cause leaf scorch on salt-sensitive crops.
3	500–1500	780–2340	The more saline waters of this class should not be used on soils with restricted drainage. Even with adequate drainage, best-practice management controls for salinity may be required and the salt tolerance of the plants to be irrigated must be considered.
4	1500–3500	2340–5470	For use, soils must be permeable and drainage adequate. Water must be applied in excess to provide considerable leaching, and salt-tolerant crops should be selected.
5	>3500	>5470	Not suitable for irrigation except on well-drained soils under good management, especially in relation to leaching. Restrict to salt-tolerant crops or for occasional emergency use.

Source: *Guidelines for Wastewater Irrigation* (EPA Victoria, Publication No. 168, 1991)

**Table D2: Allocation of soils into classes based on inherent properties**

Class	Suitability for agriculture	Depth of A horizon (cm)	Texture of A horizon	Texture of B horizon	Texture of C horizon	Depth to lime (cm)
I	Excellent productivity	>25	Fine sandy loam & lighter	Light clay & lighter	Clay loam & lighter	>60
II	Very good for most agriculture	17–25	Sandy loam, Fine sandy loam, Loam	Light clay, Medium clay	Clay loam, Sandy clay, Sandy clay loam, Sandy loam	45–60
III	Good for a range of agriculture	11–16	Loam	Medium clay, Heavy clay	Light clay, Medium clay	30–45
IV	Fair for a limited range of agriculture	7–10	Loam, Clay loam, Sandy clay	Medium clay, Heavy clay	Light clay, Medium clay	15–30
V	Low yields: pastures and some crops only	5–6	Clay loam, Clay	Heavy clay	Medium clay, Heavy clay	6–15
VI	Unsuitable for agriculture	<5	Clay	Heavy clay	Heavy clay	<6

Source: *A Soil Survey Method for Productivity in Agriculture* (Bruce Cockroft, Soil Surveying in Agriculture: Current Practices and Future Directions Symposium Proceedings 3 October, 2003 DPI Tatura).

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## APPENDIX E – MANAGING THE SUPPLY SYSTEM

**Table E.1: Suggested inspections for the recycled and drinking water supply systems**

<b>Inspection 1: System integrity inspection on street main to ball valve at end of service pipe – dry tapping</b>	
1.	Turn off recycled water system and drain main empty.
2.	Charge drinking water system with water.
3.	Open successively all hydrants/fire plug and scours on drinking water system. Check that all outlets run with water.
4.	Open successively all hydrants/fire plug and scours on recycled water system. All outlets should run dry after a short time.
5.	Check that all hydrants/fire plug covers marked 'Recycled Water' and hydrants/fire plugs/valve surrounds and marker posts/retro-reflective pavement markers coloured purple.
6.	Open successively all service line ball valves on drinking water water system. Check that all outlets run with water.
7.	Check that all service pipes and ball valve handles on drinking water system meet WSAA/water company standard and are not coloured purple.
8.	Open successively all service line ball valves on recycled water system. All outlets should run dry after a short time.
9.	Check that all service pipes and ball valve handles on recycled water system are coloured purple.
10.	Recharge recycled water system.
<b>Inspection 2A: Meter assembly installation inspection – dry tapping</b>	
1.	Check that drinking water meter has a dual non-return aspect or single non-return aspect with dual check valve and is connected to the drinking water service pipe ball valve and is not coloured purple. Check that stop valve handle is not coloured purple.
2.	Check that purple recycled water meter has at least a single non-return aspect and is connected to purple ball valve with purple handle. Check that stop valve handle is coloured purple.

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### Inspection 2B: Service pipe and meter assembly installation inspection – wet tapping

1. Check that tapping ferrule for drinking water is on blue drinking water main and handle is not coloured purple.
2. Check that drinking water service pipe is not coloured purple and is connected to drinking water tapping ferrule.
3. Check that drinking water meter has dual non-return aspect or single non-return aspect with dual check valve aspect and is connected to the drinking water service pipe ball valve and is not coloured purple.
4. Check that tapping ferrule for recycled water is on purple recycled water main and handle is coloured purple.
5. Check that purple recycled water service pipe is connected to recycled water tapping ferrule.
6. Check that purple recycled water meter is connected to purple service line and stop valve handle is coloured purple.
7. Turn on drinking water water system ferrule.
8. Turn off recycled water system ferrule.
9. Open stop valve on drinking water system. Check that outlet runs with water.
10. Open stop valve on recycled water system. Check that outlet runs dry after a short time.
11. Turn off drinking water system ferrule.
12. Turn on recycled water system ferrule.
13. Open stop valve on drinking water system. Check that outlet runs dry after a short time.
14. Open stop valve on recycled water system. Check that outlet runs with water.
15. Turn on drinking water system ferrule.

## APPENDIX F – TECHNICAL BACKGROUND PAPERS

Technical background papers to this guideline (available from the EPA Victoria website <http://www.epa.vic.gov.au>) are:

- *Health Risk Management in Dual Pipe Water Recycling Schemes*
- *Environmental Risk Management in Dual Pipe Water Recycling Schemes*
- *Plumbing and System Operation Report*
- *Community behaviour and engagement in dual pipe water recycling: A discussion paper of community perception and learning for future recycled water schemes*

Relevant references are provided within the technical background papers.