GUIDELINES FOR ENVIRONMENTAL MANAGEMENT

USE OF RECLAIMED WATER

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Cover photograph

A photograph of one of the many current reclaimed water schemes operating in Victoria. Photograph courtesy of North East Water Authority.

FOREWORD

The release of this updated guideline comes at a time when reclaimed water is an established part of the journey towards sustainable management of our resources and environment. The use of reclaimed water can provide many benefits, including the stimulation of economic growth through providing a guaranteed supply of defined quality water. Reclaimed water can also make significant contributions to sustainability by reducing pressure on our existing water supplies and transferring nutrients to beneficial uses rather than discharges to our waterways.

The important contribution that reclaimed water can make to sustainability is reflected in a number of recent initiatives to further integrate this product into holistic water resource management. In planning for Melbourne's future water resource needs, the Water Resources Strategy for the Melbourne Area Committee recommended increase use of reclaimed water for non-potable uses. Likewise, a recently established 'whole-of-Government' Water Recycling Committee is leading the development of a Victoria wide strategic framework for increased water recycling.

This updated guideline has resulted from a review of the *Guidelines for Wastewater Reuse* (EPA Victoria, 1996, Publication 464) taking into account advances in technology and scientific knowledge, community expectations, stakeholder feedback on the 1996 guidelines, and the development of the national framework - the National Water Quality Management Strategy (NWQMS). The retitled *Guidelines for Environmental Management: Use of Reclaimed Water* widely adopts the approaches described in the recently released *NWQMS Guidelines for Sewerage Systems – Reclaimed Water* (ANZECC, 2000). However, in some instances, the Victorian guideline advocates "higher order" practices to better reflect our environmental and/or regulatory requirements. The Victorian guideline is focused on reclaimed water from the sewerage system as well as providing guidance for other potential sources. An important feature of the updated guideline is its endorsment by the Department of Human Services, the Department of Sustainability and Environment and the Department of Primary Industries. As such, this document provides integrated guidance from the key Government agencies with responsibilities associated with reclaimed water management.

This guideline provides a framework for best practice management of reclaimed water use and the exemption of reuse schemes from EPA Victoria's works approval and licensing provisions. The guideline focuses on desired performance objectives and outcomes through appropriate management practices, allowing scope for innovation. Suppliers and users of reclaimed water are able to consider and implement alternative measures to those suggested, provided an equivalent, or better, site-specific solution is achieved. At the same time, those seeking greater direction or certainty can simply apply the suggested measures.

The underlying philosophy of EPA Victoria'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 reclaimed water to strive for continuing improvement in environmental performance.

MICK BOURKE

CHAIRMAN

ACKNOWLEDGEMENTS

This guideline was prepared in consideration of feedback from a wide range of government (Victorian and interstate) departments, industry and other relevant stakeholders resulting from the release of the *Guidelines for Wastewater Reuse* (EPA Victoria, 1996 Publication 464).

This guideline refers to a number of key information sources, including:

- *NWQMS Guidelines for Sewerage Systems – Use of Reclaimed Water* (ANZECC, 2000);
- *NWQMS Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000);
- *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991, Publication 168); and
- *Guidelines for Environmental Management: Disinfection of Reclaimed Water* (EPA Victoria, 2003, Publication 730.1).

A large number of other information sources were referenced during the development of these guidelines. A more comprehensive list is appended to this document.

GLOSSARY OF TERMS

Term	Definition
'1 ML/d'	One megalitre per day (equivalent to 1,000,000 litres per day). This value has significance as it represents a threshold level for reclaimed water schemes needing an Environment Improvement Plan to be endorsed by EPA Victoria or an appointed Auditor. The value is based on expected use (for example, irrigation) of greater than 1 ML/d on any day. Reclaimed water flows into storage are not considered in this definition.
Activated sludge	A sludge made by continuous recirculation of solids from a secondary sedimentation tank to an aeration tank, thus acquiring many useful aerobic bacteria.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
ANZECC	Australian and New Zealand Environment and Conservation Council.
BOD	Biochemical oxygen demand - a measure of the amount of oxygen used in the biochemical oxidation of organic matter. The BOD test is typically conducted over a period of five days under specified conditions and may then also be referenced as BOD_5.
Chlorination	The application of chlorine or chlorine compounds to water, usually for the purpose of pathogen reduction. In some circumstances, chlorination may also provide chemical oxidation and odour control.
Coagulation	The addition of a chemical to a colloidal dispersion resulting in particle destabilisation by a reduction of the forces tending to keep the particles apart.
Controlled access	The limitation of public or livestock access to a site for defined periods of time so as to minimise the likelihood of direct physical contact with reclaimed water and, where required, to ensure adequate reductions in pathogen levels.
Crop factor	A factor relating crop water use to pan evaporation or potential evaporation over the same time.
Direct potable	In the context of these guidelines, the derivation of drinking water directly from reclaimed water without an intermediate stage of storage or mixing with surface or groundwater.
Disinfection	A process that destroys, inactivates or removes micro-organisms.

E.coli	*Escherichia coli*. A bacterium found in the gut of warm blooded animals that indicates faecal contamination.
EIP	Environment Improvement Plan. A plan covering the use of reclaimed water that manages identified risks and thereby ensures protection of the environment and human health.
Ensiling	Process for preservation of animal fodder crops by storage in silos, pits or trenches with exclusion of air.
Filter	A device or structure for removing solid or colloidal material from liquids by physically trapping the particles and removing them.
Flocculation	The formation of settleable particles from destabilised colloidal-sized particles.
Furrow irrigation	A method of irrigation whereby water is applied via small ditches or furrows that lead from the supply channel, thus wetting only part of the ground surface.
GEM	Guideline for Environmental Management. Publication released by EPA Victoria to provide a best practice framework for managing environmental obligations.
HACCP	Hazard Analysis and Critical Control Point. An industry recognised risk management system that identifies, evaluates and controls hazards including those aspects of food quality and production significant for food safety.
Indirect potable	In the context of these guidelines, the derivation of drinking water from surface or groundwater storages that have been supplemented by the addition of reclaimed water.
Membrane filtration	Reclaimed water is passed through porous membranes, with differentiation between classes of membranes typically on the basis of the maximum molecular weight or size of compound capable of passing through the membranes. Membrane techniques such as microfiltration typically have pores from 50 to 10,000 nm, ultrafiltration usually involves pores from 1 to 100 nm, while nanofiltration and reverse osmosis typically have filtration equivalent to pores of 0.1 to 1 nm.
90th percentile	When expressed as a limit, ninety percent of the samples taken over a specified period must not exceed the prescribed value, that is, the 90th percentile of the available data's statistical distribution.
NHMRC	National Health and Medical Research Council.
NWQMS	National Water Quality Management Strategy.

NTU	Nephelometric Turbidity Unit — unit of measure of the turbidity of water due to suspended, colloidal and particulate matter.
Pathogens	Organisms capable of causing disease. In untreated sewage, the key potential pathogens are bacteria, viruses, protozoans and helminths.
Primary treatment	Treatment involving sedimentation (sometimes preceded by screening and grit removal) to remove gross and settleable solids. The remaining settled solids, referred to as sludge, are removed and treated separately.
Reclaimed water	Water that has been derived from sewerage systems or industry processes and treated to a standard that is appropriate for its intended use.
Reuse	The utilisation of reclaimed water for some further beneficial purpose.
Secondary treatment	Generally, a level of treatment that removes 85 percent of BOD and suspended solids via biological or chemical treatment processes. Secondary treated reclaimed water usually has a BOD of ‹ 20 mg/L and suspended solids of ‹ 30 mg/L, but this may increase to › 100 mg/L due to algal solids in lagoon systems.
SEPP	State Environment Protection Policy. These policies are adopted by Government, and gazetted pursuant to the *Environment Protection Act* 1970. The SEPP describe environmental objectives for defined environmental segments (for example, water and land). These objectives must not be exceeded through reclaimed water use.
SS	Suspended Solids.
Sodium adsorption ratio (SAR)	An expression of the relative concentrations of sodium ions in reclaimed water to calcium and magnesium ions, indicating a potential sodium or alkali hazard to the soil.
Storage lagoon	A lagoon used to store treated reclaimed water prior to application, either to maintain adequate supplies, or to assist meeting the SEPP (*Waters of Victoria*) requirement for on-site retention of all wastes up to a 90th percentile wet year.
Supplier	A person or organisation that supplies reclaimed water for use.
Tertiary treatment	The treatment of reclaimed water beyond the secondary biological stage. This normally implies the removal of a high percentage of suspended solids and/or nutrients, followed by disinfection. It may include processes such as coagulation, flocculation and filtration.
Thermotolerant coliforms (also known as faecal	A subset of coliforms found in the intestinal tract of humans and other warm-blooded animals. They can produce acid and gas from lactose at 44.0-44.5°C;

coliforms)	hence the test for them is more specific than for total coliforms and selects a narrower range of organisms. *E.coli* are typically the major proportion of thermotolerant coliforms.
Treatment lagoon	Any large pond or holding used to contain reclaimed water while treatment processes including sedimentation and biological oxidation occur. Stabilisation and maturation lagoons are examples of treatment lagoons.
Uncontrolled access	Members of the public have unrestricted access to areas where reclaimed water is in use.
User	A person or organisation that uses reclaimed water.

TABLE OF CONTENTS

1. INTRODUCTION

Reclaimed water is increasingly viewed as a valuable resource for the agricultural, industrial and municipal sectors, rather than as a waste that requires disposal.

The safe and sustainable use of reclaimed water involves:

(a) taking what was regarded as a waste and treating it to a level appropriate for its intended use; and

(b) using the reclaimed water resource in a manner that provides some direct or indirect economic or social benefit, whilst still being protective of the environment, public and animal health, and food/produce safety.

Incentives to use reclaimed water include:

- potential treatment and disposal cost savings by turning a waste into a resource that can provide economic or social benefits;
- attractiveness of reclaimed water in terms of reliability of supply (quantity and quality) versus the variability associated with other traditional water sources;
- capacity to supplement potentially limited or costly traditional primary water sources. In many areas, access to reclaimed water should have significant economic benefits;
- minimisation of the diversion of water from watercourses, groundwater, etc; and
- reduction (ultimate aim is for avoidance) of discharges to surface waters, unless there are sufficient environmental benefits to justify the continuing discharge.

The concept of safe and sustainable reclaimed water reuse is different from that of disposal to land. The primary purpose of disposal to land is to discharge waste in a controlled manner so as not to cause surface or groundwater pollution. In contrast, the primary purpose of reuse is to accept reclaimed water as a resource and ensure safe and sustainable uses. In terms of irrigation reuse schemes, this means applying water at a rate that does not exceed the plant's water or nutrient needs, and maintaining soil conditions for optimum plant growth/yield (year after year).

1.1 Objectives

The overall objective of this guideline is to maximise the reuse of reclaimed water through minimising and managing any risks associated with its use.

To meet this objective, the guideline:

- encourages the sustainable and safe use of reclaimed water;
- sets clear performance objectives for the use of reclaimed water;
- establishes the obligations of the suppliers and users of reclaimed water; and
- suggests best practice environmental measures (based on available experience) for treatment, quality, site selection, application, site management, monitoring and reporting in order to meet the performance objectives.

This guideline provides the basis for exemption of reuse schemes from EPA Victoria works approval and licensing requirements (refer section 2.2).

1.2 Scope

Primarily, this GEM applies to the use of reclaimed water from sewage treatment plants. This includes both municipal sewerage facilities treating mainly human sewage and industrial process water accepted via trade waste agreements, as well as those serving individual commercial premises (for example, hotels, motels, schools and caravan parks).

Additional guidance for the treatment and disinfection of sewage is covered separately in the *Code of Practice for Small Wastewater Treatment Plants* (EPA Victoria, 1997, Publication 500), and *Guidelines for Environmental Management (GEM): Disinfection of Reclaimed Water* (EPA Victoria, 2003, Publication 730.1).

This guideline does not specifically address domestic reuse from individual household systems (for example sullage, greywater or effluent from residential septic tanks). Requirements for these systems are covered separately in the *Code of Practice - Septic Tanks* (EPA Victoria, 1996, Publication 451).

The principles (that is, performance objectives and suggested measures) of this guideline may be applied to the reuse of appropriately treated industrial process water. Reuse will occur in areas including intensive animal industries (feedlots, piggeries and dairies), abattoirs, stockyards, food and beverage manufacturing, winemaking and other industry. Appendix B provides guidance for these reclaimed water categories and highlights areas where additional issues may need to be addressed. As an example, the use of abattoir or saleyard effluent on grazing land poses specific risks that need to be assessed and managed.

From time to time EPA Victoria develops environmental guidelines for specific reuse activities (for example, *Guidelines for Wastewater Irrigation*) as well as waste generating industries (for example, *Environmental Guidelines for the Dairy Processing Industry*). Where available, these additional guidelines should be consulted.

The Department of Primary Industries (DPI) also has guidelines that should be consulted, such as the *Code of Practice Piggeries,* and the *Agriculture Notes* series (for intensive animal industries, dairy shed effluent management, etc). For information about other guidelines or publications refer to Appendix H, or EPA Victoria's website (www.epa.vic.gov.au), DPI's website (currently www.nre.vic.gov.au) or electronic information resource: "Land Channel" (www.land.vic.gov.au).

1.3 What Are Guidelines For Environmental Management?

The Guidelines for Environmental Management (GEM) series outlines key environmental objectives relevant to particular industries or activities, and provides suggested measures to achieve these objectives.

The *GEM: Use of Reclaimed Water* provides a framework of best practice management for the supply and reuse of reclaimed water.

This guideline includes the following chapter topics:

- statutory framework for reuse schemes (Chapter 2);

- risk identification and risk assessment (Chapter 3);
- roles and responsibilities for suppliers and users (Chapter 3);
- permissible end uses of reclaimed water based on reclaimed water treatment and quality (Chapter 4);
- treatment and distribution reliability (Chapter 5);
- site selection and site management practices (Chapters 6 and 7);
- monitoring, reporting and auditing programs (Chapter 8); and
- environment improvement plans (Chapter 9).

Reclaimed water use in accordance with this guideline will contribute to sustainability by: establishing an additional cost effective water supply, enabling more efficient use of scarce resources, providing opportunities for increased productivity (agriculture, for example), and reducing the impacts of disposal activities.

As previously stated and detailed in section 2.2, this guideline is significant as it provides the basis for exemption of reclaimed water reuse schemes from EPA Victoria's works approval and licensing requirements.

2. STATUTORY FRAMEWORK

2.1 Legislation

The current Acts, policies and regulations administered by EPA Victoria and other Government agencies that are relevant to the use of reclaimed water are listed in Appendix D.

Acts

Acts of particular significance to reclaimed water use are:

- *Environment Protection Act* 1970*;*
- *Health Act* 1958*;*
- *Livestock Disease Control Act* 1994*;*
- *Food Act* 1984*; and*
- *Australian New Zealand Food Authority Act* 1991.

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 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 *Livestock Disease Control Act* 1994 outlines requirements for livestock grazing land irrigated with "sewage" or "nightsoil", in order to protect health of stock (specifically cattle and pigs grazing pasture or fed fodder from that land), and humans (consuming meat and milk products). *Taeniasis* (also known as "Beef Measles" - refer to section 3.2) is specifically addressed by this Act.

The *Food Act* 1984 legislates on food quality standards. Food is considered "adulterated" under the Act if it does not meet prescribed standards. Victoria complies with these national quality standards by enforcing the Australian New Zealand Food Authority (ANZFA) *Food Standards Code*. Developed under the *Australia New Zealand Food Authority Act* this code specifies "maximum residue limits" (MRLs) and "maximum permitted concentrations" (MPCs) permitted to be present in food. MRLs are normally associated with pesticide resides, whilst MPCs are associated with metals, polychlorinated biphenyls (PCBs) and certain other organic chemical contaminants. It is an offence under the *Food Act* 1984 to sell food that is adulterated.

Refer to Appendix D for other important legislation, including the *Occupation Health and Safety Act* 1985 and the *Trade Practices Act* 1974

Policies

Government declares the SEPP and Industrial waste management policy (IWMP) under the *Environment Protection Act*. The SEPP provide ambient environmental quality objectives and attainment programs for achieving them. Compliance with the relevant policies must be attained for all activities that involve reclaimed water treatment and use.

The SEPP and the IWMP of relevance to the use of reclaimed water include:

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

Other relevant State government policies include:

- SEPP *(Management and Prevention of Contamination of Land)* 2002; and
- IWMP *(Prescribed Industrial Waste)* 2000.

This guideline provides a framework to achieve the objectives of the aforementioned policies.

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 exemptions from these works approval and licensing provisions for certain, otherwise scheduled, activities and premises.

Guidance documents

In addition to the previously mentioned legislation, there is a variety of guidance material of which reclaimed water managers should be aware. Some of this documentation is referenced in the relevant sections of this guideline, with a summary list provided in Appendix D.

2.2 Reuse Exemption From Works Approval and Licensing Provisions

Although waste discharges into the environment are typically subject to works approvals and licensing by EPA Victoria, 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 Regulations *1996 – Scheduled Premises and Exemptions)*.

The exemption reflects that, in contrast to a waste discharge, reclaimed water can be sustained as a resource. This guideline (*GEM: Use of Reclaimed Water*) defines the acceptable discharge, deposit and operating specifications referred to in the regulations above and therefore forms a critical component of exemptions from EPA Victoria works approval and licensing requirements. (Note: the exemption only extends to the specific reuse scheme, treatment is still subject to works approval requirements. Treatment plants that have 100 per cent recycling and do not have a discharge as part of treatment, that is treatment lagoons, do not have an obligation to hold a licence).

These guidelines highlight certain critical measures that need to be met to obtain an exemption. Schemes that do not comply with a guideline requirement will need to either obtain works approval and a discharge licence, or receive a specific exemption from EPA Victoria. Critical guideline measures that must be satisfied to obtain an exemption are indicated by an asterisk in the summary checklist at the end of each section.

These measures relate primarily to meeting requirements for:

- reclaimed water treatment and quality;
- site selection and management;
- permitted end-uses and restrictions;
- monitoring, reporting and auditing; and
- Environment Improvement Plans (EIPs).

Although specific measures are stated in this guideline to meet the performance objectives for reuse schemes, it is important to note that these measures are not inflexible. A reuse scheme proponent may propose alternative measures to those suggested, however, the onus of proof rests with them to demonstrate that alternative measures can achieve the required performance objectives.

Specific advice and endorsement from EPA Victoria and other Government departments (for example, the Department of Human Services (DHS) and DPI will be necessary if alternative measures to those required for exemption are being considered. Exemption of reuse schemes will be assessed on an individual case basis. Where a proposed scheme does not provide measures equivalent to this guideline, works approval and licensing requirements will apply.

The proponent should evaluate the need for further measures (in addition to those required for exemption) according to the size of the scheme, the sensitivity of the surrounding environment and the potential for human and livestock exposure to reclaimed water.

Although reuse schemes operated in accordance with this guideline are exempt from works approval and licensing, EPA Victoria and other departments do continue to have a significant role to play. EIPs for schemes requiring Class A reclaimed water must have EPA sign-off (regardless of volumes), while schemes involving greater than 1 ML/d must have sign-off from either EPA Victoria or an EPA Victoria appointed auditor. In specified circumstances, EIPs will also require endorsement from other departments (such as DHS) prior to the schemes commencing (refer section 3.1).

While not all schemes require formal endorsement from EPA Victoria or an EPA Victoria appointed auditor, all proposed schemes should be at least discussed at the planning stage with the relevant EPA Victoria regional office (contact details are provided in Appendix C). These initial discussions are important for identifying potential issues and thus avoid the need for EPA Victoria to take action on schemes found to be non-compliant with the guideline. Enforcement action could include such measures as the issuing of a Pollution Abatement Notice, which directs a scheme manager to undertake specified actions, or imposing fines via Pollution Infringement Notices.

A summary of the decision sequence for assessing whether a reuse scheme is exempt from works approval and licensing is provided in Figure 1.

As noted earlier, treatment is not an exempt activity under the *Scheduled Premises and Exemptions Regulations*. Treatment plants (greater than 5,000 litres per day), therefore, require works approval and may also require a licence.

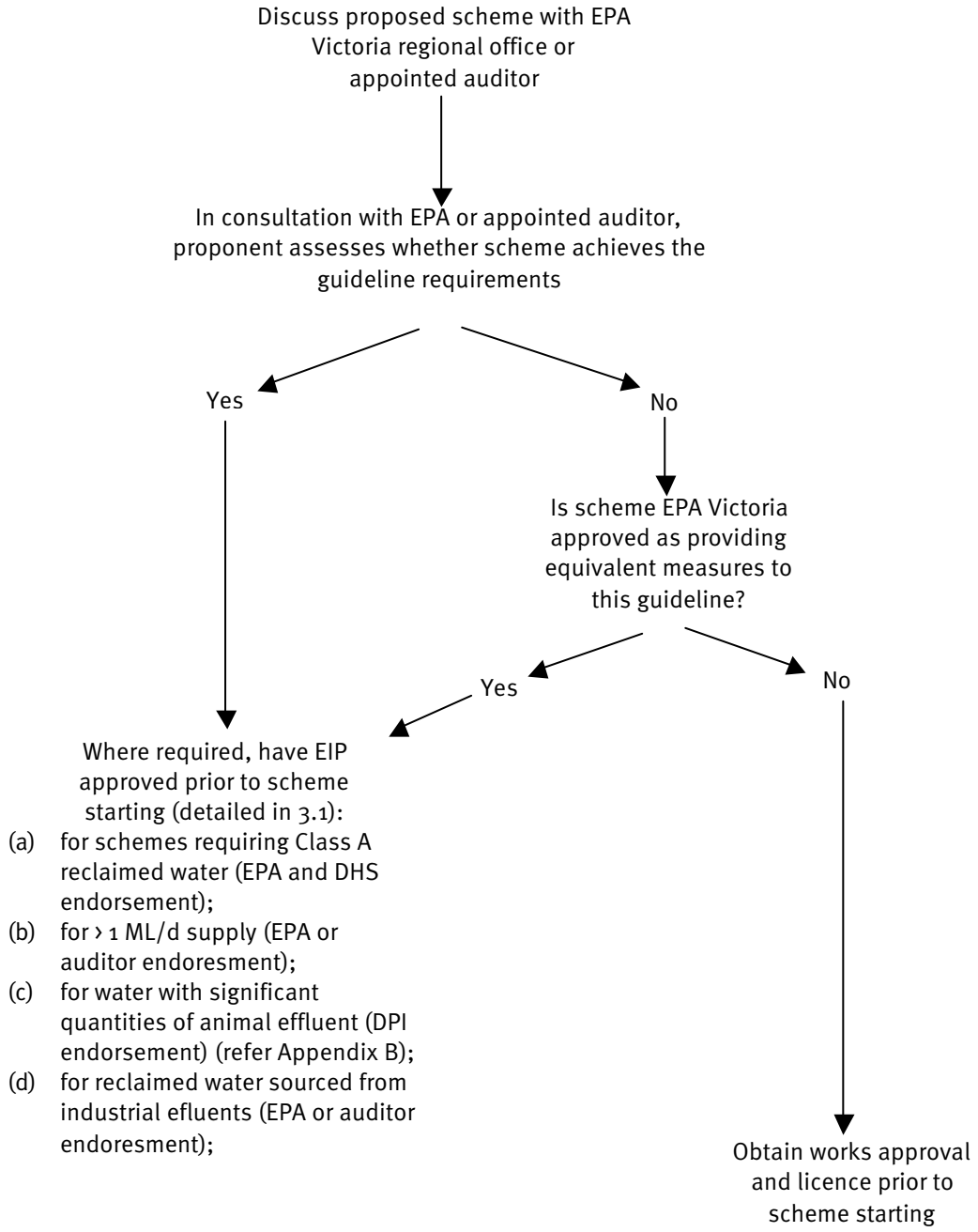

Figure 1. Reuse scheme assessment

3. ROLES, RESPONSIBILITIES & RISK

3.1 Roles and Responsibilities

Suppliers and users

It is important that suppliers and users of reclaimed water understand and meet their obligations under this guideline.

Suppliers of reclaimed water have a responsibility to ensure that the water is of a quality fit for its intended purpose.

The supplier should ensure that any reuse scheme claiming water from its premises, either complies with this guideline, has a site-specific exemption granted by EPA Victoria or has an EPA Victoria works approval and licence. Suppliers have a responsibility to assist customers in complying with this guideline (that is by assisting in the development of the EIPs and advising on appropriate management practices for the schemes).

Suppliers have a responsibility to keep a register of all schemes to which they supply reclaimed water. This register should include information about end-use site addresses, the quality and quantity of supply, and end-uses of the reclaimed water. Each year, the supplier must provide EPA Victoria with summary details of reclaimed water supply and end-use. A reporting proforma will be available from the EPA Victoria website (www.epa.vic.gov.au).

The supplier should also ensure that all schemes have an EIP (refer Chapter 9). In some circumstances, the EIP must have sign-off from the EPA Victoria regional office or an appointed auditor before the supply of reclaimed water commences. There are also circumstances under which the endorsement of other agencies (such as the DHS or the Chief Veterinary Officer (DPI)) will be required prior to the submission of an EIP to EPA Victoria or an appointed auditor.

Such circumstances are:

- uses requiring Class A reclaimed water. These must be endorsed by DHS* and have EPA Victoria sign-off;
- schemes using more than 1ML/d reclaimed water (on any day). These must have EPA Victoria (or an appointed auditor) sign-off;
- schemes with grazing on pasture irrigated with significant quantities** of abattoir, stockyard or intensive animal industry effluents generated off-site. These must be endorsed by the Chief Veterinary Officer; or
- schemes using reclaimed water sourced from industrial process water. These must have EPA Victoria (or an appointed auditor) sign-off.

*DHS involvement in Class A schemes is in ensuring the treatment plant is producing Class A reclaimed water quality. Unless Class A reclaimed water uses involve variations from this guideline, DHS is not required to endorse the aspects of an EIP dealing with end-use.

**A definition of "significant quantities" is not presently available. However, based on initial case studies, future guidance is expected to be provided through a technical guidance note published on the EPA Victoria website. In the interim, the measures described in Appendix B should be consulted.

Where an EPA Victoria appointed auditor is used for sign-off, they must send a letter to the local EPA Victoria regional office confirming the EIP has been assessed and found to be in compliance with this guideline. Auditors are appointed under section 57 of *the Environment Protection Act* 1970. Information on the appointment process and a list of appointed auditors is available from the EPA Victoria website (www.epa.vic.gov.au).

It is ultimately the responsibility of the user to ensure that the reuse scheme is managed in accordance with this guideline, including adherence to the EIP, assessment of site suitability for reclaimed water use and recording of monitoring results. However, suppliers need to verify through an audit process that users are following the EIPs requirements (refer Chapter 9). EPA Victoria will also randomly audit reuse schemes.

Community liaison

Reclaimed water suppliers and users should establish pathways and procedures for continual and open liaison with the community. The extent of liaison should reflect the site circumstances (for example, proximity to sensitive land uses or level of community interest).

Key effective community liaison measures are:

- education of likely affected parties (such as neighbours and reclaimed water users);
- free exchange of information; and
- a reliable system to respond to complaints.

It is important that the suppliers and/or users maintain records of all complaints and rectification actions. Complaint records should include the name and address of the complainant as well as the time and date of the incident.

The records should clearly state the nature of the problem or complaint, the outcome of the resulting investigation, solutions to the problem and who is involved. Complaint records should be made available to EPA Victoria upon request for auditing purposes.

Agreements

A formal agreement should be developed between the supplier and users of reclaimed water. Suggested issues that may be addressed in the reclaimed water use agreement include:

- definition of roles and responsibilities to meet the objectives of the guidelines;
- responsibility for conveyance works;
- ownership of the facilities;
- cost of reclaimed water;
- contract duration (term and conditions for termination);
- reclaimed water characteristics (source, quality, quantity, pressure, flow variations);
- reliability of supply;
- commencement of use;
- intended uses;
- responsibility for operation, maintenance, monitoring and auditing processes;
- liabilities (including risk allocation and insurance);

- food or stock feed safety controls associated with sale of produce or products generated with the use of reclaimed water;
- responsibility for preparing and implementing the EIP (see Chapter 9); and
- other issues determined relevant by the parties involved.

The detail in any agreement will vary according to the type of scheme implemented.

EPA Victoria

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

EPA Victoria 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 reclaimed water in Australia and overseas.

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

DHS

DHS is responsible for ensuring that Class A reuse schemes do not pose a risk to public health. Given the potential lack of exposure 'barriers' in Class A schemes DHS involvement is in ensuring treatment plants produce Class A reclaimed water. Unless Class A reclaimed water uses involve variations from this guideline, DHS is not required to endorse the aspects of an EIP dealing with end-use. As such, the treatment plant commissioning and water quality verification aspects of Class A schemes must be referred to DHS for endorsement, prior to submission to EPA Victoria for sign-off.

3.2 Risk Identification and Management

Avoiding contamination of reclaimed water

The focal point for risk management of reclaimed water schemes is the maximisation of water quality.

Water authorities should develop reclaimed water reuse management strategies (including trade waste management), the primary objective being the production of high quality reclaimed water with low levels of pathogens and chemical contaminants. High quality reclaimed water will facilitate a wider range of end-use opportunities whilst at the same time minimising the risks to the environment, health, agriculture and food safety.

Identifying exposure potential (risks)

Depending on reclaimed water quality, restrictions on end-uses are needed to control the exposure routes from residual pathogens and chemical contaminants to humans, food crops and/or livestock.

It is therefore important that suppliers and users of reclaimed water work together to identify and assess the potential exposure routes associated with their reuse scheme.

Potential exposure routes and/or risks fall into the following categories:

- environmental;
- human and stock health;
- produce (food) safety; and
- legal liability.

The risks posed will vary depending upon the location (for example, relative to houses or watercourses), land capability (such as climate, soil types, slopes, salinity, depth to watertable, etc), size of the scheme (volume of reclaimed water used), application techniques and the end-use (such as irrigation of golf courses or growing food crops).

For the use of reclaimed water, details of risk identification and assessment should be provided in any EIP, thus providing an effective mechanism for third party review.

Environmental risks

Reclaimed water use schemes should meet the following environment protection objectives:

- protect the beneficial uses of groundwater and surface waters as defined in the relevant SEPP (see Section 2.1, and Appendix D);
- avoid structural changes to the soil or contamination (for example, soil salinity or sodicity) that may reduce the (short or long term) productivity of the land; and
- avoid contamination of the air environment by the production of offensive odours, spray drift and aerosols.

To evaluate whether these objectives can be met, the following risks need to be assessed:

- **Soils:** impacts on soils from nutrients, salts, organic and inorganic contaminants that may be present in reclaimed water including:
  - risk of soil salinity, deterioration of soil structure and loss of soil permeability from reclaimed water containing elevated salt levels (typically total dissolved solids (TDS) greater than 500 milligrams per litre, and high proportion of sodium relative to other cations - SAR trigger level for further investigation is typically SAR greater than three);
  - loss (erosion) of saline or nutrient-rich (especially phosphorus) soils;
  - waterlogging effects of over-irrigation, poor drainage, high water tables; and
  - impact on soil biota and risks of disease transmission to native flora and fauna from inappropriate management of reclaimed water and/or inappropriate stock and crop management practices.
- **Groundwater:** impacts on the beneficial uses of groundwater particularly from salts, nitrogen (nitrate) and pathogens that may be present in reclaimed water;
- **Surface waters:** impacts on the beneficial uses of surface waters from contaminated run-off containing nutrients, salts, metals and pathogens from reclaimed water; and
- **Air:** risk of air pollution problems from aerosols generated by the spray application of reclaimed water or odours from inadequate treatment.

Chapters 4 to 8 outline suggested measures for reclaimed water quality, site control, monitoring and record keeping required to manage environmental risks. Where risk assessment indicates a relatively high risk to the environment, appropriate additional precautions should be implemented.

Human and livestock exposure routes

Reclaimed water use must not pose an unacceptable risk to humans (general public and on-site workers), livestock health and associated food products (such as milk and meat).

To manage human and livestock health risks, treatment processes should ensure appropriate levels of pathogen and contaminant removal before reuse. Appropriate restrictions should be placed on both human and livestock exposure to reclaimed water based upon the reductions in pathogen levels achieved by the treatment process. In general, as the extent of treatment increases and the level of human or stock exposure decreases, the potential health risks also decrease.

The receiving land (particularly agricultural la nd) should not be utilised as an extension of the treatment process for pathogen control, nor chemical contamination dispersal and dilution. These circumstances would be considered as disposal and therefore be subject to works approval and licensing.

Pathogens in reclaimed water that need to be considered for health risk assessment include:

- helminths – intestinal nematodes such as *Taenia* which causes tapeworm in humans and "Cysticercosis" in cattle and pigs, and *Ascaris* that causes roundworms in humans;
- bacteria (such as those causing cholera, typhoid, and shigellosis);
- protozoa (causing amoebiasis, giardiasis); and
- viruses (such as those causing viral gastroenteritis or infectious hepatitis).

The degree of risk from each of the above pathogen groups will depend upon the Class of reclaimed water and the reuse application. Potential impacts both to and from reclaimed water of pathogen regrowth and disease transmission need to be assessed and appropriately controlled. This is particularly relevant where contamination via "vectors", such as birds (that could be attracted to reclaimed water ponds) is concerned. If not controlled, pathogens have the potential to be transmitted to humans or stock by (i) direct routes (that is through skin contact, ingestion or inha lation) or (ii) indirect contact (that is consumption of contaminated food or feed).

Reclaimed water schemes that require particular attention for health risk assessment include:

- those that will result in consumption of reclaimed water (for example, indirect potable reuse);
- irrigation of readily accessible public areas with potential for direct exposure to reclaimed water (for example, via spray drift);
- consumption of produce that has come into direct contact with reclaimed water and is not cooked or processed prior to eating;
- discharging reclaimed water to surface waters that are used for fishing, or water contact sports; and

- industrial reuses where workers may either come into direct contact with reclaimed water or ingest aerosols.

Given that reclaimed water originates mostly from domestic sources, the health risk posed by chemical contaminants is typically less than that posed by pathogens. Metals and organic compounds tend to settle into the sludge stream and are then subject to sludge treatment and biosolids management controls.

Algae that flourish in secondary treatment lagoons and winter storages may pose a risk to the adequate treatment and distribution of reclaimed water during bloom events. Blue-green algae may also pose a risk to human and stock health through the production of toxins if the site is not appropriately managed. Generally, algae applied to pasture via reclaimed water will not affect stock health provided the appropriate withholding periods are implemented and stock are grazed on dry land (Chapter 6). There is, however, a greater risk to stock health associated with drinking reclaimed water containing blue-green algae. On-site workers who come into direct contact with reclaimed water containing high numbers of blue-green algae may also be at risk of developing skin and eye irritations or gastric upsets.

Chapters 4 to 8 of the Guidelines outline the treatment, water quality, site control and monitoring measures for managing risks to the public and livestock.

Produce (food safety) risks

Reuse schemes must not result in the unacceptable microbial or chemical contamination of produce or food, or otherwise adversely affect farm produce quality.

Exposure routes need to be carefully managed to prevent contamination of produce via:

(i) direct routes (for example, contact between food crops and pathogens/contaminants in reclaimed water and/or receiving soils); or

(ii) indirect routes (for example, chemical bioaccumulation in animal meat/fat or microbiological contamination of milk via exposure of cow teats and udders to pasture irrigated with reclaimed water).

Victoria has a comprehensive food safety regulatory system based on the *Food Act* 1994 and the *Food Standards Code* developed by ANZFA. This framework is supported by Codes of Practice and other Acts specific to particular industries such as livestock disease control and dairy industry legislation.

A number of industries (for example, dairy, meat and horticulture) have adopted accreditation programs, such as FlockCare, and quality assurance (QA) systems under the HACCP (Hazard Analysis and Critical Control Point) framework to manage produce safety risks. The management controls needed for food and produce safety associated with the use of reclaimed water must be addressed as part of these QA management systems.

Domestic and international markets for some agricultural produce may perceive the use of reclaimed water negatively, and therefore not wish to source produce that has been grown on land having received such water. Persons wishing to use reclaimed water in agricultural applications should

undertake strategies to ensure consumer and market acceptance of such practices.

The acceptance of reclaimed water use in food production may be influenced through education programs or similar means. However, situations may exist where the use of reclaimed water is potentially unacceptable to consumers.

Detailed advice regarding produce (food safety) risk management associated with the use of reclaimed water, and the relevant regulations, industry codes and approved QA systems can be obtained by contacting the appropriate Government agencies listed in Appendix C.

Legal risks

Treatment plant owners, operators and reclaimed water end-users may be liable under common law and under the *Trade Practices Act* 1974 for the use of a product (including reclaimed water) that causes harm.

Reclaimed water suppliers and end-users should be familiar with the Acts, regulations, policies, codes of practice, Australian Standards, guidelines and other documents relevant to the use of reclaimed water (see Appendix D and the reference list at the end of these guidelines).

Supplies should ensure that the legal risks associated with reclaimed water reuse schemes are minimised. Such risk minimisation could include:

- the implementation of "due diligence" procedures and systems such as an environmental management system, which are specifically designed to prevent environmental and public health problems; and
- demonstrating they are environmentally responsible and acting diligently regarding reclaimed water supply and use (that is, complying with these guidelines and other relevant codes and standards).

Roles, Responsibilities and Risk Checklist

Performance Objective

To ensure that suppliers and users of reclaimed water understand and meet their obligations as outlined in this Guideline.

Suggested measures to meet the performance objective

Supplier

Design

- Develop an agreement covering the respective interests and obligations of suppliers and users.
- Identify and assess the risks posed by the supply of reclaimed water.*
- Ensure that any reuse scheme it supplies either complies with these Guidelines, has an EPA Victoria site-specific exemption, or has works approval and licence.*
- Ensure that all reuse schemes supplied have an appropriate EIP in place, with EPA Victoria sign-off for schemes requiring Class A reclaimed water. For schemes involving >1 ML/d or industrial process waters, sign-off from EPA or an appointed auditor.*
- Ensure that reuse schemes requiring Class A reclaimed water have been endorsed by DHS.*
- Ensure that reuse schemes involving grazing associated with the off-site use of an effluent derived from abattoir, stockyard or intensive animal industry, have been endorsed by the Chief Veterinary Officer.*
- Ensure awareness of the relevant legislation, Codes and Guidelines relevant to the use of reclaimed water.

Operational

- Monitor, report and audit reuse schemes it supplies in accordance with these Guidelines*.
- Maintain a register of reclaimed water users it supplies and submit this information annually to EPA Victoria.*

User

Design

- Enter into a suitable agreement with the supplier.
- Identify and assess the risks posed by the use of reclaimed water.*
- Ensure the reuse scheme either complies with these Guidelines, has an EPA Victoria site-specific exemption, or has works approval and licence.*
- Develop an EIP and where required, submit to EPA Victoria (or an appointed auditor) for sign-off (where required with DHS or Chief Veterinary Officer endorsement).*

Operational

- Ensure that the use of reclaimed water is undertaken in accordance with these Guidelines and the EIP.*

4. RECLAIMED WATER TREATMENT AND QUALITY

The required level of treatment and the associated water quality objectives vary depending upon the nature of the end-use scheme. This guideline outlines four classes of reclaimed water that represent the minimum standards of biological treatment and pathogen reduction for defined categories of use.

As would be expected, the required level of treatment increases with the potential for higher levels of exposure thus reflecting the risks associated with particular uses. In addition to minimum levels of treatment, a specific reclaimed water use may also be subject to site management controls (see Chapters 6 to 8) to ensure protection of public health, agriculture and the environment.

Note: The reclaimed water criteria apply at the end of the treatment process (that is, prior to the water being supplied to irrigation storages).

4.1 Treatment And Classification Overview

The classification criterion for reclaimed water is provided in Table 1. As described in this Table, reclaimed water is classified into four "Classes" (A-D), principally on the basis of:

- generic categories of treatment processes known to result in particular levels of pathogen reduction;
- physical-chemical water quality (for example, turbidity and biochemical oxygen demand (BOD)) and *E.coli* limits which are designed to ensure optimal performance of the treatment processes (including disinfection where required) and provide a mechanism for monitoring process performance; and
- adoption of specific measures known to remove pathogens that may otherwise not be adequately controlled under the above process provisions (such as, helminth removal which requires lagoon storage or filtration prior to reuse).

4.2 Treatment Processes

Secondary treatment is the minimum standard of treatment needed for most agricultural and municipal reclaimed water use schemes.

Secondary treatment is typically regarded as either:

(i) low rate stabilisation process such as stabilisation lagoons, aerated lagoons and facultative lagoons designed to achieve median concentrations for BOD of 20 milligrams per litre and SS of 30 milligrams per litre. This level of actual performance may be difficult for lagoon-based systems to achieve over summer due to algal productivity. Therefore, in times of algal blooms, it is appropriate to also monitor filtered BOD to establish a correlation between the BOD levels for the treatment process under normal conditions with BOD levels due to algal growth (for low rate processes, SS is used as a design criteria and is not used for ongoing confirmation of process efficiency); or

(ii) primary sedimentation or an equivalent process for removal of solids, followed by organic matter and solids reduction via biological/mechanical treatment (for example, biofiltration, trickling filter, intermittently decanted extended aeration (IDEA), or activated sludge plants) processes to

achieve median BOD of 20 milligrams per litre and SS of 30 milligrams per litre.

Tertiary or other advanced treatments that produce very low pathogen levels are required for schemes having high exposure potential to humans, livestock, agricultural produce, etc. Reclaimed water discharges to waterways for environmental flow purposes or to groundwater for recharge purposes would also require advanced treatment levels. Tertiary treatment to reduce nutrient concentrations will also be required for schemes that pose a risk of off-site movement of reclaimed water.

For Class A-C reclaimed water, the treatment process also needs to include a pathogen reducing disinfection step such as chlorination or detention lagoons. However, systems using only detention lagoons do not typically provide a Class A reclaimed water and this process is unsuitable as the sole means of pathogen reduction for high contact uses. Detention lagoons are also not best practice for reliably obtaining a Class B reclaimed water. More detailed guidance on disinfection is provided in the *GEM: Disinfection of Reclaimed Water* (EPA Victoria, 2003, Publication 730.1).

Primary treatment of sewage is generally not a suitable level of treatment for reuse schemes under this guideline. The appropriate level of treatment for other sources of reclaimed water needs to be consistent with this guideline giving due consideration to its specific characteristics.

4.3 Physical-Chemical And Pathogen Limits

The water quality objectives given in Table 1 (that is, BOD, SS, turbidity (as NTU), pH, residual chlorine and *E.coli* bacteria) are indicators of treatment process performance and pathogen reductions. These criteria need to be achieved, and therefore regularly monitored to determine the Class of reclaimed water. Further discussion of the requirements for Class A reclaimed water is provided in section 4.4.

It should be noted that *E.coli* is the specified and strongly preferred microbiological indicator, however, *thermotolerant coliforms* may be used as an alternative. If thermotolerant coliforms are monitored, the values for *E.coli* are used as the thermotolerant coliform limits.

The treatment processes described in Table 1 are nominally effective in removing viruses and other pathogenic micro-organisms to safe levels, given the specified use of the reclaimed water. However, operators of treatment plants should periodically undertake process verification ("due diligence" monitoring) to confirm that adequate removal of pathogenic organisms is occurring.

It must be noted that there is a limit of less than one milligram per litre chlorine at the point of application of reclaimed water. This limit corresponds to the aesthetic threshold and will not usually cause adverse effects on plants. However, some sensitive crops may be damaged at chlorine levels below one milligram per litre and users should consider the sensitivity of any crops prone to irrigation with chlorine disinfected reclaimed water.

4.4 Class A Reclaimed Water

Uses that require Class A reclaimed water will potentially not include 'barriers' between the water and direct human contact. These uses include recreational watering without restrictions on public access, or direct irrigation of food crops that may be consumed raw. Therefore, it is critical that treatment processes for Class A uses are demonstrated to reliably provide the required levels of pathogen reductions.

Given the importance of demonstrating treatment performance, the objectives in Table 1 for Class A reclaimed water should be considered as indicative limits (for example, turbidity is less than two NTU). The principal focus for schemes requiring Class A reclaimed water is demonstrating that the treatment train process can achieve sufficient log removal of pathogens from raw sewage to final product water to achieve median quantitative standards of:

- less than ten *E.coli* per 100 millilitres;
- less than one helminth per litre;
- less than one protozoa per 50 litres; and
- less than one virus per 50 litres.

Reclaimed water schemes that need Class A reclaimed water require DHS endorsement of the proposed treatment plant commissioning and water quality verification prior to submission of the EIP to EPA Victoria for sign-off. The water quality verification necessary for each scheme will be assessed on an individual basis (refer section 8.1).

4.5 Treatment Measures For Specific Pathogens

Conventional primary and secondary treatment processes, including disinfection via chlorination or UV, may not ensure adequate removal of helminths such as intestinal nematodes. The specified treatment measures to reduce helminth numbers are:

(i) at least 25 days detention in treatment lagoons (this may include either primary, secondary or maturation lagoons provided the helminth settling process is not disturbed by processes such as mixing, aeration or any other process), or a storage facility where all reclaimed water must be detained for at least 25 days from the time of the last discharge into the storage facility (further information on storage lagoons is provided in section 7.1.4); or

(ii) an approved method of filtration, such as sand or membrane filtration.

The requirement for helminth control is a key component of the *Livestock Disease Control Act* 1994 which specifies that in order for reclaimed water not to be regarded as sewage and to be suitable for use on cattle grazing land, treatment processes must be specifically designed and managed to reduce pathogens (particularly helminths) to acceptable levels. This is to prevent livestock diseases including helminth infections in cattle ("beef measles" or *Cysticercus bovis*).

Reclaimed water that isn't subject to the required level of treatment is prohibited under the *Livestock Diseases Control Act* 1994 (with some exceptions) from being applied to land grazed by cattle or pigs (Note: Regardless of treatment level, these

guidelines prohibit pigs grazing on land applied with reclaimed water, refer Chapter 6).

Alternatives to the approved sewage purification standards require specific approval from NRE's Chief Veterinary Officer before the reclaimed water can be used in association with cattle grazing.

Note. At the time of publication of this guideline, the *Livestock Diseases Control Act* specified lagoon based helminth control via 30-day retention. However, the Chief Veterinary Officer has advised that 25-day retention is adequate and the legislation is being amended to reflect the 25 day period.

4.6 Contaminants and Algae

Organic chemicals and heavy metal contaminants present in reclaimed water may adversely affect soils and the safety levels of produce, particularly if reclaimed water contains industrial waste inputs.

The *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991, Publication 168) provide guidance on salinity assessment and other potential contaminants present in different sources of reclaimed water. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2001) provides criteria for the quality of reclaimed water in order to protect agricultural land, farm produce quality, groundwater, surface waters and the environment in general.

Suppliers should periodically undertake investigations for the presence of toxicants such as heavy metals and organic chemicals in reclaimed water. Such toxicant investigations should occur when a modification to a treatment plant process commences operation, or when significant changes occur within the sewerage catchment (such as new or modified trade and/or industrial waste connections). Investigations should also be undertaken periodically according to the size of the treatment facility and potential risks, of the associated reclaimed water schemes.

Algae

Algal blooms can affect the treatment reliability of reclaimed water supplies. For systems subject to algal blooms, a blue-green algal emergency response plan should be developed. The emergency response plan should detail:

- allowance for alternative supply systems;
- measures to allow the screening or filtering of reclaimed water before supply or application;
- suitable mechanisms to clean and flush the distribution system;
- a blue-green algal monitoring program; and
- threshold blue-green algal cell numbers that trigger actions, such as cessation of supply for stock drinking.

Table 1. Classes of reclaimed water and corresponding standards for biological treatment and pathogen reduction. (Acceptable uses are detailed in Table 3)

Class	*Water quality objectives - medians unless specified* [1, 2,]	*Treatment processes*[a]	*Range of uses– uses include all lower class uses*
A	Indicative objectives • ‹ 10 *E.coli* org/100 mL • Turbidity ‹ 2 NTU[4] • ‹ 10 / 5 mg/L BOD / SS • pH 6 – 9[5] • 1 mg/L Cl_2 residual (or equivalent disinfection)[6]	Tertiary and pathogen reduction[7] with sufficient log reductions to achieve: ‹10 *E.coli* per 100 mL; ‹1 helminth per litre; ‹ 1 protozoa per 50 litres; & ‹ 1 virus per 50 litres.	Urban (non-potable): with uncontrolled public access Agricultural: eg human food crops consumed raw Industrial: open systems with worker exposure potential
B	• ‹100 *E.coli* org/100 mL • pH 6 – 9[5] • ‹ 20 / 30 mg/L BOD / SS[8]	Secondary and pathogen (including helminth reduction for cattle grazing) reduction[7]	Agricultural: eg dairy cattle grazing Industrial: eg washdown water
C	• ‹1000 *E.coli* org/100 mL • pH 6 – 9[5] • ‹ 20 / 30 mg/L BOD / SS[8]	Secondary and pathogen reduction[7] (including helminth reduction for cattle grazing use schemes)	Urban (non-potable) with controlled public access Agricultural: eg human food crops cooked/processed, grazing/fodder for livestock Industrial: systems with no potential worker exposure
D	• ‹10000 *E.coli* org/100 mL • pH 6 – 9[5] • ‹ 20 / 30 mg/L BOD / SS[8]	Secondary	Agricultural: non-food crops including instant turf, woodlots, flowers

Notes to Table 1

1. Medians to be determined over a 12-month period. Refer table 6 for Notification / reclassification limits.
2. Refer also to Chapter 6 and7, and Waste Water Irrigation Guideline (EPA Victoria, 1991 Publication 168) for additional guidance on water quality criteria and controls for salts, nutrients and toxicants.

3. Refer section 4.4 for further description of water quality objectives for Class A reclaimed water.

4. Turbidity limit is a 24-hour median value measured pre-disinfection. The maximum value is five NTU.

5. pH range is 90th percentile. A higher upper pH limit for lagoon-based systems with algal growth may be appropriate, provided it will not be detrimental to receiving soils and disinfection efficacy is maintained.

6. Chlorine residual limit of greater than one milligram per litre after 30 minutes (or equivalent pathogen reduction level) is suggested where there is a significant risk of human contact or where reclaimed water will be within distribution systems for prolonged periods. A chlorine residual of less than one milligram per litre applies at the point of use.

7. Guidance on pathogen reduction measures and required pre-treatment levels for individual disinfection processes are described in *GEM: Disinfection of Reclaimed Water* (EPA Victoria, 2003 Publication 730.1). Helminth reduction is either detention in a pondage system for greater than or equal to 30 days, or by an NRE and EPA Victoria approved disinfection system (for example, sand or membrane filtration).

8. Where Class C or D is via treatment lagoons, although design limits of 20 milligrams per litre BOD and 30 milligrams per litre SS apply, only BOD is used for ongoing confirmation of plant performance. A correlation between process performance and BOD / filtered BOD should be established and in the event of an algal bloom, the filtered BOD should be less than 20 milligrams per litre.

a Where schemes pose a significant risk of direct off-site movement of reclaimed water, nutrient reductions to nominally five milligrams per litre total nitrogen and 0.5 milligrams per litre total phosphorous will be required.

4.7 Supply issues

Supplementing reclaimed water supply

Supplementing reclaimed water quantities with other primary water sources (such as potable, bore water, irrigation, stream or drainage channel water) is an acceptable practice to dilute elevated TDS concentrations or to supplement volumes. This practice is acceptable because other than reverse osmosis, current treatment processes do not significantly decrease TDS concentrations.

However, supplementing reclaimed water with other water sources in order to meet the minimum treatment standards (such as levels for BOD, SS, *E.coli*, pH) listed in Table 1 is not an acceptable practice as reclaimed water must meet the required criteria prior to dilution with other sources.

If supplementation of the reclaimed water supply is undertaken, the user should evaluate the quality of the other water sources (particularly microbiological quality) and the associated safety and sustainability risks. Appropriate microbiological water quality monitoring of any "shandied" supplies would be necessary.

Transport of reclaimed water

The transport of reclaimed water is not subject to EPA Victoria prescribed waste regulations or waste transport controls. However, where reclaimed water is to be tanked, procedures must ensure that this does not result in spillage, odours or the contamination of the water being transported.

Suggested best practice measures include:

- ensuring that the full quantity of water supplied to the transporter is delivered to the reuse site;
- transporting reclaimed water in a watertight and enclosed tanker;
- ensuring that the tanker or pipeline is not contaminated with other sources of waste that will in turn contaminate the reclaimed water and cause public health, food produce or environmental problems on the reuse site; and
- ensuring that reclaimed water is not transported in tankers used for transporting potable water for human drinking (refer *Guideline for Potable (Drinking) Water Transport in Victoria* (available from www.foodsafety.vic.gov.au);

RECLAIMED WATER TREATMENT AND QUALITY

Performance Objective

To ensure that reclaimed water is treated to an acceptable quality that will minimise the risk to the environment, public and stock health.

Suggested measures to meet the performance objectives

- The level of treatment of the reclaimed water satisfies the treatment and water quality objectives listed in Table 1 and specific provisions for Class A reclaimed water.*
- Reclaimed water used for the irrigation of pasture or fodder grazed by stock is either retained for at least 25 days in detention lagoons or filtered by an approved method (such as sand filtration).*
- Disinfection of reclaimed water is undertaken in accordance with the *GEM: Disinfection of Reclaimed Water* (EPA Victoria, 2003, Publication 730.1).*
- Transport of reclaimed water is undertaken in accordance with best practice.
- Reclaimed water is monitored for the presence of other potential contaminants to ensure compliance with the guideline numbers listed in *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2001)*.
- An emergency blue-green algal management plan is prepared for schemes at risk from algal bloom impacts.
- Reclaimed water is not supplemented with other water sources to improve the quality of inadequately treated reclaimed water*.

5. TREATMENT & DISTRIBUTION

Treatment plants and associated reclaimed water distribution systems should be designed and managed to consistently provide reclaimed water of desired quality and quantity. This Chapter outlines the measures that can be employed to improve the performance reliability of the treatment plants and distribution system.

5.1 Treatment Reliability

Generally, a higher quality of reclaimed water requires a greater importance placed on treatment reliability measures. The following measures should be considered to improve treatment reliability:

- minimise the concentrations of potential contaminants entering the sewer through a trade waste management program (for example, generators having waste management plans or cleaner production programs);
- adoption of QA systems;
- duplicate and/or provide standby facilities for power, treatment units, pumps and disinfection systems;
- flexible modes of operation;
- independence of multiple treatment processes or barriers;
- alarm systems and automatic controls;
- appropriately trained and experienced operators;
- effective inspection, maintenance and monitoring programs;
- contingency plans such as diversions for non-compliant events and emergencies (for example, unacceptable reclaimed water quality, treatment plant and disinfection system failures, transfer pipeline bursts, illegal waste discharges, overflows or spills); and
- provision for emergency storage.

5.2 Distribution Reliability

To improve distribution reliability, distribution systems (including all pipe work, fittings and drainage of the reclaimed water) should be designed:

- in accordance with AS/NZS 3500 series - *National Plumbing and Drainage Standards* and other relevant *Australian Standards* (refer to checklist);
- to ensure the separation and prevention of cross-connection between reclaimed water and potable water systems; and
- to allow the disinfection or slug dosing of distribution pipe work with disinfectant or algicide to control biological solids and bacterial re-growth. (The discharge of reclaimed water drained or scoured from these procedures should, where practicable, be to land or back to the treatment and/or storage facilities).

TREATMENT AND DISTRIBUTION SYSTEM RELIABILITY CONTROLS

Performance Objective

To ensure the reliably consistent treatment and distribution of reclaimed water.

Suggested measures to meet the performance objective

Treatment systems

Design

- Design, operate and maintain plants in accordance with the appropriate Australian Standards, Codes of Practice and/or relevant Guidelines.*
- Provide appropriate training of operator personnel.*
- Develop contingency plans for potential non-compliant and emergency events.*
- Develop waste management plans for industrial trade waste discharges in accordance with EPA Information Bulletin No # 363 and 383.
- Provide back-up power supply systems for essential plant elements, such as the disinfection system and individual treatment units.
- Implement alarm systems, automatic controls and on-line monitoring to detect process malfunctions.
- Provide emergency storage facilities for overflows or inadequately treated water.

Operational

- Document (in EIP) and implement effective inspection and maintenance programs to detect process malfunctions and optimise treatment efficiency.*

Distribution systems

Design

- Connection of the reclaimed water system into the potable supply system is not permitted.*
- Install reclaimed water distribution systems in accordance with AS/NZS 3500 *National Plumbing and Drainage Code - Parts 1.2 and 2.2.**
- Identify all piping and conduits in accordance with AS 1345 *Identification of the Contents of Piping, Conduits and Ducts.**
- Ensure above-ground distribution systems are not laid closer than 100 millimetres from potable water pipes and below ground distribution systems are not laid closer than 300 millimetres from potable water pipes.*

- Ensure above-ground and buried facilities and water hose tap outlets in areas of public access are distinctively colour-coded (deep purple) and/or marked with the words: WARNING: RECLAIMED WATER — NOT FOR DRINKING.*
- Install an approved registered air gap or backflow prevention device meeting the requirements of AS 3500 - AS/NZS 3500-1.2 where potable water is supplied into the reclaimed water system as make-up water.*
- For dual potable and reclaimed water distribution systems, where practical use different materials and pipe sizing to distinguish the supplies.
- For dual potable and reclaimed water distribution systems, develop an audit or educational program for identification of household cross connections.
- Where there are cross connections with potable (or other critical) water supply systems, operate the reclaimed water system at a lower pressure than the potable system or install back flow prevention devices complying with AS 2845.1 *1995 Water Supply -Back Flow Prevention Devices*.*
- Identify distribution systems in accordance with AS 1319 *Safety Signs for the Occupational Environment.*
- Design reclaimed water irrigation piping systems in accordance with AS 2698.2 *Plastic Pipes and Fittings for Irrigation and Rural Applications*.

Operational

- Implement a field test and maintenance program of back flow prevention devices in accordance with AS 2845.3 *1993 Water Supply – Backflow Prevention devices. Field Testing and Maintenance.*
- Implement an inspection program for non-potable supply systems to residential areas in accordance with *National Plumbing and Drainage Code - Part 1.2*.
- Ensure that environmentally acceptable provisions are made for the cleaning and disinfection of the distribution pipe work to control biological solids and bacterial re-growth.

6. ACCEPTABLE USES & SITE SPECIFIC CONTROLS

These guidelines aim to facilitate sustainable and safe reclaimed water use. To qualify as "sustainable and safe", 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, farm produce quality and stock or human health. This use must also have public confidence and the acceptance of agricultural produce markets.

This section describes the level of treatment required for specified uses of reclaimed water, and the controls needed to manage the key risks associated with those uses (for example, use on cattle grazing land versus forestry). This section should be read in conjunction with Chapter 7, 'Site Selection and Environmental Management', which describes the additional controls that apply independent of the actual use scenario (for example, managing nutrient run-off).

6.1 Determining acceptable uses

Once the Class of the reclaimed water is known (see Table 1), its range of potentially acceptable end-uses can be identified. Table 2 provides a generic overview of acceptable end-use categories thus enabling rapid identification of the scheme type that the reclaimed water is suited to.

Ultimately, however, the acceptability of a reuse scheme also depends on its ability to comply with the management controls necessary for the proposed use. All uses of reclaimed water require some site management to ensure appropriate management of the risks. The stringency of the specific controls depends on the reclaimed water quality and also on the human or stock exposure potential associated with each use (see also Tables 3 and 5).

When investigating potential reuse schemes for a treatment plant, it may be more appropriate to determine the local opportunities for reclaimed water reuse. Associated practicality and treatment levels can then be assessed as opposed to starting with a particular Class of reclaimed water and attempting to find suitable uses.

6.2 Agricultural Reuse

Livestock

The presence of helminths in untreated sewage is a key risk to be managed with the use of reclaimed water for cattle grazing. Without adequate treatment and management, helminths in sewage applied to grazing land have potential to establish cycles of infection between humans and animals (such as *Taenia* or tapeworms in humans and pigs, and *Cysticercosis* or "beef measles" in cattle). Consumption of contaminated, and uncooked meat by humans can complete infection cycles from animals back to humans.

The helminth reduction processes (that is a minimum of 25 days pondage detention or an approved method of filtration) discussed in Section 4.1 are required for any reuse scheme involving cattle grazing. If the reclaimed water has not had the prescribed helminth treatment, the *Livestock Diseases Control Act* 1994 requires specific approval to be obtained from DPI's Chief Veterinary Officer prior to use on cattle grazing land.

If the reclaimed water does not undergo the prescribed helminth treatment, a waiting period of at least two years may be required before cattle would be allowed to return to infected land for grazing, or before fodder could be grown as stockfeed for these animals. In warmer/drier areas, these long withholding periods may be shorter (for example, three summer months and reseeding to pasture). However, specific advice and approval must be sought from DPI on the appropriate "decontamination" practices for the land.

Pigs must not be fed or exposed to pasture or fodder produced or irrigated with reclaimed water sourced from human sewage. Also pigs should not be allowed to drink reclaimed water sourced from human wastes. This restriction reflects that *Taenia solium* (a helminth with pig–human lifecycle) can potentially cause a severe disease in humans and needs to be stopped from establishing a life cycle in Australia.

Class C reclaimed water used for animals such as sheep, horses and goats does not require helminth control.

The Class B and C treatment standards specified for water associated with livestock reflect the pathogen reductions necessary to protect livestock health and food safety. This is achieved through restricting livestock pathogen loads prior to slaughter or milking.

The appropriate withholding periods depending on the type of grazing and water class are described in Tables 3 and 5. A withholding period of four hours (or dry pasture) should be provided if Class B reclaimed water is used for irrigating pasture and fodder grazed by dairy cattle. This same period should also be provided where Class C reclaimed water is used for irrigating pasture and fodder grazed or fed by beef cattle, sheep, horses and goats.

When Class C reclaimed water is used on dairy farms, a minimum five-day withholding period is necessary before allowing lactating animals to graze the pasture.

If fodder or crops are grown using reclaimed water, after harvest they should be ensiled or dried before packaging.

Additional controls

If fodder is to be sold, growers should ensure that it is to be fed to livestock appropriate to the class of reclaimed water used for irrigation. This assurance could be through selling the fodder only to defined users, or if the fodder is for a broader market, labelling with the relevant prohibitions (for example, 'fodder not for consumption by pigs'). As a risk management step, this provision applies to the restriction for pigs with the use of Class A reclaimed water.

Labelling of livestock restrictions is not required for crops that are intended for human consumption, as an example, apples grown via drip irrigation with Class C reclaimed water do not require label restrictions. However, as a risk management measure, where the harvested produce comes in direct contact with reclaimed water of a quality less than Class A and could potentially be diverted to pig feed, the processor of the produce needs to be made aware of the restriction on supplying for pig feed.

Class A reclaimed water is acceptable for produce washing for packaging of food, however, growers must have industry specific HACCP processes in place.

The extensive pasteurisation processes in milk processing plants assists to provide protection of the milk products and public from reclaimed water use on dairy farms. In Victoria, all milk sold to the public is required to be pasteurised, regardless of whether the farm has been irrigated with reclaimed water.

Table 2. Classes of reclaimed water and the associated acceptable uses (typically subject to site controls)

Reclaimed Water Class	Agricultural Uses					Urban (non potable) and Industrial Uses	
	Raw human food crops exposed to reclaimed water	Dairy cattle[1] grazing/fodder, livestock drinking (not pigs)	Cooked/processed human food crops, or selected crops not directly exposed to reclaimed water	Grazing/fodder for cattle, sheep, horses, goats, etc	Non- food crops, woodlots, turf, flowers	Residential, unrestricted public access, open industrial systems	Restricted public access, closed industrial systems
A	✓	✓	✓	✓	✓	✓	✓
B	X	✓	✓	✓	✓	X	✓
C	X	X	✓	✓[1]	✓	X	✓
D	X	X	X	X	✓	X	X

Notes to Table 2

1. Dairy cattle grazing with Class C reclaimed water is also allowed subject to a five-day withholding period after irrigation.

☑ reclaimed water of this quality is generally acceptable for the corresponding uses, however, management controls may apply (refer Tables 3 & 5).

☒ reclaimed water of this quality will generally not be acceptable under these guidelines for the corresponding uses.

Table 3. Acceptable agricultural uses - livestock access and food safety controls for specific irrigation methods

Reuse category	Minimum water Class	Irrigation method	Key management controls for use eg withholding period
Raw human food crops exposed to reclaimed water			
Crops grown close to the ground and consumed raw (eg. celery, cabbage)	Class A	Unrestricted	
Root crops consumed raw (eg. carrots, onions, radish)	Class A	Unrestricted	
Human food crops cooked (>70°C for 2 minutes) or processed before human consumption, or consumed raw but with edible parts not exposed to reclaimed water			
Crops grown over 1 metre above the ground and eaten raw (eg. apples, pears, apricots, table grapes, olives)	Class A Class C	Unrestricted Flood, furrow, drip, sub-surface	 Dropped produce not to be harvested
Crops which are skinned, peeled or shelled before consumption (eg. lemons, limes, nuts, watermelons, rockmelons)	Class A Class C	Unrestricted Flood, furrow, drip, sub-surface	 Produce should not be wet from reclaimed water irrigation when harvested Dropped produce not to be harvested
Crops to be cooked (>70°C for 2 minutes) or processed before sale to consumers* (eg. wheat, wine grapes)	Class C	Unrestricted	Produce should not be wet from reclaimed water irrigation when harvested
Non food crops			
Crops not for consumption (eg. woodlots, turf growing, flowers)	Class D	Unrestricted	Restrict public access to application area Harvested products not to be wet from reclaimed water when sold

* Crops that are cooked prior to consumption can be sold uncooked to consumers provided the safety of the practice (such as considering the irrigation steps, preparation prior to sale and domestic cooking) can be demonstrated to the satisfaction of relevant Government agencies, EPA Victoria and DHS for example.
Note: The health risks associated with hydroponics has not been adequately assessed, therefore hydroponic crops consumed raw must currently use Class A reclaimed water.

Reuse category	Minimum water Class	Irrigation method	Key management controls for use eg withholding period
Livestock			
Irrigation of pasture and fodder for dairy animals	Class B (including helminth reduction)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Washdown water not to be used for milking machinery Controls to ensure pigs are not exposed to pasture or fodder (see section 6.1)
	Class C (including helminth reduction)	Unrestricted	Withholding period of 5 days before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder (see section 6.1)
Irrigation of pasture and fodder for beef cattle	Class C (including helminth reduction)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder (see section 6.1)
Irrigation of pasture and fodder for sheep, goats, horses, etc	Class C (no helminth reduction necessary)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder (see section 6.1)
Livestock drinking water or washdown water for dairy sheds.	Class B	-	Washdown water not to be used for milking machinery. Reclaimed water with a blue green algae bloom not suitable for stock drinking Pigs not to come into contact with reclaimed water

Horticulture

The required reclaimed water grade for irrigation of human food crops (detailed in Table 3) depends upon:

a) the potential for the edible portion of the crop to come into direct contact with the reclaimed water. This reflects both the irrigation method (such as spray, drip, flood, subsurface, or hydroponic systems) and the crop involved (that is, whether the produce is grown in contact with the soil or the produce has a protective and inedible covering); and

b) the level of processing or cooking of the food prior to consumption.

As would be expected, crops that are potentially consumed raw and may come in direct contact with the reclaimed water require the highest treatment standards. Lower risk scenarios are able to use lower classes of reclaimed water.

Only Class A reclaimed water should be used on human food crops, both surface and root crops, that are consumed raw and are likely to be exposed to reclaimed water.

Class C reclaimed water may be used on crops or produce that will be either cooked at greater than 70° Celsius for two minutes, or processed (such as cereals, wheat and grapes for wine production, etc) prior to sale to the domestic market. Class C reclaimed water may also be used on crops not in direct contact with reclaimed watersuch as fruit trees. Use of Class C reclaimed water on crops that will be cooked after sale to the domestic market may be acceptable, however, the safety of the practice (such as considering the irrigation steps, preparation prior to sale and domestic cooking) needs to satisfy the relevant government agencies, EPA Victoria and DHS for example.

Class D reclaimed water is not suitable for use with human food crops. This class of water is only suitable for crops such as flowers, instant turf and woodlots.

Additional controls

As an additional food safety measure and for protection of workers, unless reclaimed water is Class A quality, harvesting should not start until the produce is dry.

Class A reclaimed water is acceptable for produce washing for packaging of food, however, growers must have industry specific HACCP processes in place.

Aquaculture

There is significant interest in the use of reclaimed water for aquaculture. While this guideline currently provides guidance on the use of reclaimed water for non-food chain scenarios (Table 5), this guideline does not provide water quality criteria for aquaculture involving human food chain applications. The guideline also does not provide criteria on the water quality requirements relevant to environmental discharges from aquaculture facilities. There is research being undertaken to answer technical, environmental, food safety and economic questions on these later topics, however, until this research is available, proposed schemes will need to be assessed on a case-by-case basis.

Produce safety – quality assurance systems

Agricultural uses of reclaimed water need to address the associated produce safety issues through the use of QA systems.

Several agricultural industries (such as dairy, meat, horticulture, etc) have adopted food QA systems to manage produce safety. This means controlling risks, including microbiological, chemical and physical. A number of QA programs use *HACCP* as their basis. Where required to assess EIPs, EPA Victoria appointed auditors and DHS would need to be satisfied that an appropriate QA system is being implemented. Implementing a HACCP plan approved by a HACCP consultant may be one way of demonstrating an appropriate QA system.

There may be industry-specific issues not fully addressed by this guideline. Advice in relation to produce safety regulations, codes, issues, risks and quality systems associated with the use of reclaimed water can be obtained from various sources including:

- food safety regulators;
- industry associations;
- accredited QA consultants; and
- produce buyers (for example, supermarket chains).

Further advice can be obtained from the relevant Authority or industry association. Some relevant government agency and industry contacts include:

- human food crops: Institute for Horticultural Development (DPI); the Vegetable Growers Association; and
- cattle and dairy animals: Chief Veterinary Officer (DPI); Dairy Food Safety Victoria (DFSV).

Note that DFSV has produced complementary information for the use of reclaimed water on dairy farms, titled *Reclaimed Water on Dairy Farms – General Information and Requirements for Users,* (VDIA, 1999). This document contains practical QA advice for farmers and is expected to be revised to align with the *GEM: Use of Reclaimed Water*.

6.3 Urban (Non-Potable)

Reclaimed water is suitable for application under a wide range of urban non-potable uses. The potential level of exposure to reclaimed water determines the Class that is suitable for both urban or municipal reuse schemes. The potential level of exposure is influenced by a number of factors including:

- the distance from residential or public assess areas;
- the use of signage and/or fencing to restrict site access;
- the irrigation method used; and/or
- the use of restricted watering times (for example, night time watering).

Residential and municipal with uncontrolled public access

Only Class A reclaimed water may be used for residential or municipal reuse schemes where there is high exposure potential to humans due to limited controls on public access. Table 5 provides further site controls and guidance for these schemes.

Uses such as toilet flushing or where there is a risk of off-site movement may require additional nutrient removal.

Examples of relevant uses include:

- *Residential*
  - garden watering;
  - toilet flushing;
  - third pipe residential systems;
- *Municipal*
  - irrigation of open spaces, parks, sportsgrounds, golf courses (including those incorporating residential developments), median strips, etc with uncontrolled public access.

Municipal with controlled public access

Class B and C reclaimed water may be used for municipal schemes provided public access can be controlled by measures such as: irrigation practices, restricted watering times (for example, night-time watering), fencing and/or withholding periods (that is at least four hours) to ensure the areas are dry before access by humans. Table 5 provides further site controls and guidance for these controlled public access schemes

Note that Class D reclaimed water is not suitable for any urban non-potable schemes.

Irrigation methods for urban (non-potable)

As previously stated, the type of irrigation method can influence the appropriate Class of reclaimed water that is used and the extent of public access control required. The method of irrigation can also influence the design of the runoff controls that may be needed (Chapter 7).

The reclaimed water quality limits required for municipal irrigation are based on spray irrigation. EPA Victoria may approve reclaimed water quality of a lesser Class if application methods such as sub-surface, trickle or micro-irrigation systems are used. The proponent will need to demonstrate that public health will be adequately protected and no contaminated run-off occurs.

6.4 Direct & Indirect Potable Uses

There is currently not enough information available to develop generic guidelines for the use of reclaimed water as a direct or indirect potable water source. Proposals under these categories will need to be assessed on an individual case basis by appropriate authorities, such as EPA Victoria, DHS, DSE and the relevant Water Authority.

For indirect potable schemes, discharges to watercourses or groundwater would most likely need to meet background water quality standards (depending on the assessment and ultimate requirements of the responsible authorities). Such schemes must not result in the exceeding of water quality objectives of the SEPP (*Waters of Victoria*) or the SEPP (*Groundwaters of Victoria*).

6.5 Environmental Flows, Groundwater Recharge

Reclaimed water can potentially be used to supplement or create environmental flows in streams and wetlands, and augment groundwater supplies. Water may then be extracted from these systems and reused.

The complexities and variations of natural or engineered (in the case of wetlands) systems require the setting of site-specific treatment, water quality limits and appropriate site controls for proposals under this category. Therefore, each proposal will need to be assessed by EPA Victoria, the Water Authority, the Catchment Management Authority and other relevant agencies.

As with indirect potable uses, reclaimed water quality used for environmental flows or groundwater recharge would need to meet background water quality standards (depending on the assessment and ultimate requirements of the responsible authorities). Such schemes must not result in the exceeding of water quality objectives of the SEPP (*Waters of Victoria*) or the SEPP (*Groundwaters of Victoria*).

6.6 Industrial Use

There are many potential options for the reuse of reclaimed water within industry sectors. Some examples of reuse options include:

- cooling system make-up water;
- boiler feed water;
- process water (for example, concrete batching plants);
- washdown water;
- fire protection (such as sprinkler systems); and
- dust control/suppression at construction sites, quarries and mines.

Table 4. Potential quality concerns for industrial reuse

Quality	Problem
Microbiological quality	Risk to health of workers and the public
Chemical quality (eg ammonia, calcium, magnesium, silica, iron)	Corrosion of pipes and machinery, scale formation, foaming etc
Physical quality (eg suspended solids)	Solids deposition, fouling, blockages
Nutrients (eg phosphorus and nitrogen)	Slime formation, microbial growth

Reclaimed water quality for industrial uses needs to be protective of the industrial process and/or machinery. Water quality specifications are therefore highly variable according to the industrial use. *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2001) provides guidance on appropriate water quality for a range of industrial uses.

Industrial utilisation of reclaimed water within enclosed systems (such as sealed conveyance systems, tanks or vessels) will minimise the risk to workers and allow the use of a lower Class of

reclaimed water. Secondary treated water may be suitable for such "closed system" industrial reuse (see Chapter 7, Table 5). However, in some cases, further treatment may be needed to prevent typical contaminant and fouling problems outlined in Table 4.

A second category of industrial use is "open system" industrial reuse, where there is potential for worker exposure due to ingestion or inhalation of aerosols. Class A reclaimed water (that is, high level of disinfection) is generally needed for open system reuse to protect worker health. Lower levels of disinfection (reclaimed water Class B or lower) may be possible but will depend on assessment of the measures employed to control worker exposure to such water. Measures could include ventilation or extraction of enclosed spaces (adequate air exchange to outside the work area), or personal protective clothing and equipment where necessary.

6.7 Sensitive Land Uses

The proposed use of reclaimed water in areas having highly sensitive or valued ecological, natural, conservation, cultural or heritage values needs to be carefully considered. Due to the site-specific nature of these areas, a listing of candidate sites is not provided here.

Early advice should be sought from the relevant controlling authority (eg Parks Victoria, Melbourne Water, etc) as to whether reclaimed water use would be allowed in or adjacent to such sensitive areas. This advice should include appropriate buffer distances, management practices, etc.

SPECIFIC REUSE APPLICATION CONTROL CHECKLIST

Performance Objective

To ensure appropriate control measures are implemented for defined reuse applications to minimise the specific risks to the environment, public health and stock health.

Suggested measures to meet the performance objective

Agricultural schemes

- Ensure reclaimed water meets the relevant treatment and quality measures specified for agricultural applications listed in Table 1.*
- Implement specific controls listed in Table 3 and generic site management controls listed in Table 5.*
- Schemes involving production of produce, must manage food safety risks through a QA system such as the HACCP framework.*
- Ensure land irrigated with reclaimed water that has not had helminth removal is 'decontaminated' with Chief Veterinary Officer endorsement prior to cattle or pig grazing.*
- Unless product end-use can be confirmed, ensure labelling is present on products irrigated with reclaimed water that have sales restrictions*.

Urban non-potable schemes

- Ensure reclaimed water meets the treatment and quality measures recommended for urban non-potable applications listed in Table 1.*
- Implement relevant site controls listed for urban non-potable applications in Table 5.*
- Implement public and stock access controls where Class B, or C reclaimed waters are used.*

Industrial Use

- Ensure reclaimed water meets the treatment and quality measures recommended for industrial applications listed in Table 1.*
- Ensure reclaimed water quality meets the relevant industrial use limits in *ANZECC Water Quality Guidelines for Fresh and Marine Waters* (ANZECC, 2001).
- Implement relevant site controls listed for industrial applications in Table 5.*
- Implement appropriate controls to minimise worker exposure to reclaimed water.

7. SITE SELECTION & ENVIRONMENTAL MANAGEMENT

This chapter describes the site selection and management issues that are generic to reclaimed water reuse schemes. These issues include Occupational Health and Safety as well as impact management of nutrients, toxicants, salinity and sodicity on surface waters, soils and groundwater. While this chapter predominantly focuses on the management of reuse with irrigation, the generic objectives are potentially relevant to all reclaimed water schemes (for example, avoiding contaminated stormwater running off-site).

The management controls specific to water uses are described earlier in Chapter 6 (for example, withholding periods for livestock grazing).

7.1 Irrigation Management

Performance objectives for site selection, design and operation of an irrigation scheme include:

- optimisation of water and nutrient uptake by plants (crops);
- prevention of adverse environmental impacts in terms of the beneficial uses of surface waters and groundwater (as specified in the relevant SEPP);
- prevention of adverse changes to soil structure, chemistry and therefore productivity for growing plants; and
- protection of human and stock health, and food or produce quality.

The following sections outline suggested ways to achieve these performance measures. The EIP (Chapter 9) should document how the performance measures will be achieved.

7.1.1 Site selection

The *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991 Publication 168) contains guidance on the selection of appropriate irrigation sites.

Soils

Soil profile and hydraulic conductivity should be determined for irrigation areas. Soil types least suitable for irrigation include highly permeable (high sand and/or gravel content), or those with a low infiltration rate (heavy clay soils). While these soil types make a site less suitable, reclaimed water can still be applied providing associated risks are managed.

Slope

Sites with a slope of less than 10 per cent are preferred for irrigation, as this reduces the risk of run-off and erosion. The greater the slope the more restraints on the design of the irrigation system and the more site management controls that are required.

Groundwater

A hydrogeological assessment of the proposed irrigation scheme should be undertaken. This will determine possible impacts on the groundwater, particularly for schemes that pose a significant risk. The assessment should be undertaken in accordance with the principles outlined in EPA Victoria publication: *Environmental Guidelines for*

Hydrogeological Assessments (Groundwater Quality) (only available in draft version at the time of this guideline's release).

This assessment should consider the effect of the plant/crop production system and the effects of climate and reclaimed water on groundwater quality.

Where an assessment indicates that irrigation is likely to result in surface waterlogging, root zone salinity and/or groundwater contamination, advice should be sought from a suitably experienced agronomist to determine if these risks can be managed adequately through site-specific controls.

Climate

The average annual evapotranspiration rates should substantially exceed rainfall at sustainable irrigation sites. Drier climates, such as those in the northwest of Victoria, are the most suitable. In areas with high rainfall, irrigation is possible provided there is a distinct prolonged dry season coupled with adequate available land for storage and irrigation.

7.1.2 Buffer distances

Buffer distances between application sites and surface waters or sensitive developments are influenced by:

- the class of reclaimed water used;
- the irrigation methodology;
- site-specific parameters (such as land slope); and
- the type of surface waters involved.

As such, the following recommendations for buffer distances are guides that can potentially be changed whilst still achieving the required objectives.

Suggested buffer distances from the edge of the wetted area to surface waters for the use of class C reclaimed water are:

Irrigation type	Surface waters
Flood/high pressure spray	100 metres
Low pressure spray	50 metres
Trickle or subsurface irrigation	30 metres

It may be appropriate to reduce these buffer distances if:

- a Class A or B reclaimed water is used;
- the surface waters are seasonal or a drainage channel;
- best practice measures are implemented to prevent contaminated run-off leaving the site; or
- the site is particularly favourable such as an elevated or well vegetated area between the reuse site and the surface water.

Increased buffer distances may be required if:

- a class D reclaimed water is use;
- the surface water is highly sensitive (for example, heritage rivers and RAMSAR sites;
- the surface water is used for potable water supplies; or
- the site is unfavourable such as steep slopes and/or impermeable soils.

Spray drift of reclaimed water should not occur beyond the boundaries of the premises as it may result in the contamination of non-target produce and ingestion or inhalation of aerosols by the public.

The following buffer distances (boundary of the irrigation area to the nearest sensitive development — areas such as residential areas, public parks, schools and shops) are suggested for spray irrigation applications:

- Class A reclaimed water quality – no buffer distances are prescribed due to the high microbiological water quality, however, irrigation should ensure no spraydrift or water movement off-site to avoid nuisance aspects of water.
- Class B reclaimed water quality – at least 50 metres from the edge of the wetted area to the nearest sensitive development.
- Class C and D reclaimed water quality – at least 100 metres from the edge of the wetted area to the nearest sensitive development.

These buffer distances may need to be increased if high pressure spraying is conducted. The buffer distances may be reduced if suggested best practice measures are implemented to reduce spray drift. These measures may include one or a number of the following, dependent upon the sensitivities of the area:

- tree screens;
- anemometer switching systems;
- restricted times of watering; and
- using irrigation systems that prevent the generation of fine mist, such as low rise sprinklers, small throw or microsprinklers, and part circle sprinklers.

Other measures may be approved if the proponent demonstrates that they significantly reduce the risk to public health and amenity associated with spray drift.

7.1.3 Irrigation scheduling

Irrigation scheduling encompasses timing and quantity determination. It is important for scheme sustainability that the loading rates of water, nutrients and salts are balanced with the site's ability to safely convert, absorb, use or store the nutrients and salts over the long term (nominally 100 years).

This can be achieved by modelling a water balance and irrigation schedule for the site. The water balance spreadsheet contained in *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991, Publication 168) may be used to determine the size of an irrigation area based on calculated irrigation rates over the proposed season. Alternate water balance modelling methodologies may be used to undertake water balance calculations, provided they have been peer reviewed by appropriate educational and/or research institutions (with recognised expertise in agricultural engineering and science) and are accepted as being technically sound. Such alternative methods should result in equivalent environmental outcomes and factors of safety as those outlined in EPA Victoria's *Guidelines for Wastewater Irrigation*. An EPA Victoria agreement should be sought for usage of any water balance models that vary significantly from EPA Victoria's *Guidelines for Wastewater Irrigation* or are not widely utilised by irrigation practitioners.

Climate, irrigation area, and crop water and nutrient requirements will determine how much reclaimed water is needed in a typical year. Seasonal conditions, weather, and both soil physical characteristics and moisture levels will determine how much of the annual amount can be applied per day.

An irrigation scheme should be designed to supply reclaimed water to the crop at a level determined by that crop's requirements. This may be achieved by designing the system to meet irrigation needs in an average year, yet allows for the supply rate to be cut back during wet years. Alternatively, the system may be designed to cater for set reclaimed water flows up to and including 90th percentile wet years.

The maximum hydraulic loading rate and the crop factor for a specified volume of reclaimed water determines the minimum possible irrigation area in terms of water use. However, a larger area than the one calculated will generally be required to cope with variable factors, such as lower water uptake due to young or ageing crops.

Directly monitoring soil moisture levels is the preferred method for determining actual water application rates throughout the irrigation season. Alternatively, pan evaporation readings and the appropriate crop factor, or meteorological data and standard evapotranspiration models can be used.

During the irrigation season, the crop's capacity to take water needs to be monitored regularly (weekly to fortnightly) to determine when watering should occur.

7.1.4 Winter storage

The SEPP (*Waters of Victoria*) requires that facilities for reclaimed water storage and disposal by land irrigation should be designed and constructed to contain all wastes in at least the 90th percentile wet year. In practice, this means that in order for a treatment plant to be recognised as not discharging to surface waters, that plant needs to have a management framework enabling the handling of all effluent in a 90th percentile wet year. For a 'normal' reuse site, this is likely to involve storage facilities, and/or reserve land, to cater for the excess of reclaimed water caused by reduced demand during particularly wet periods.

For individual land application schemes, the SEPP does not require them to be able to store and manage 'normal' volumes, plus additional on-site water resulting from a 90th percentile wet year. Each scheme could reduce the quantity, or stop being supplied reclaimed water in wet years to rely solely on rainfall for the maintenance of soil moisture. However, the supplier of the reclaimed water would need to have contingencies to deal with this reduced demand.

Where storage is required, the *Wastewater Irrigation Guidelines* (EPA Victoria, 1991, Publication 168) provides guidance for the design capacity of winter storages for irrigation schemes.

Appropriate pondage base and embankment liners designed to minimise seepage and protect groundwater, as well as prevent excessive watertable rise should be provided. The appropriate technology and design of storage pondage liners will vary based on an assessment of the size of the storage, depth of storage (head over the liner),

reclaimed water quality (that is, salinity and nutrient concentrations), underlying geology, and vulnerability of groundwater. The pondage liner design should be an integral part of the overall site selection process (Section 7.1.1), and should be undertaken in accordance with the principles outlined in EPA Victoria Publication: *Environmental Guidelines for Hydrogeological Assessments (Groundwater Quality)* (only available in draft version at the time of this guideline's release).

Clay liners would be suitable in most circumstances. However, a HDPE liner may be more appropriate if the pondage is proposed for an area with sandy soils, and/or shallow (unconfined) and good quality groundwater. Also, if the groundwater is shallow and saline, then a vital liner design consideration is the need to prevent saline groundwater intrusion into reclaimed water storages.

As a general guide, storages posing a moderate risk to groundwater should be provided with compacted clay liners of permeability less than 10^{-9} metres per second with suggested thicknesses relevant to pondage capacities and maximum depths as follows:

- Storage capacity less than three megalitres, depth less than 1.5 metres and intermittently filled:
  - surface compacted clayey soils.
- Storage capacity greater than or equal to three megalitres and permanently filled:
  - pond depth less than 1.5 metres: 300 millimetre thick liner.
  - pond depth approximately three metres: 600 millimetre thick liner.
  - pond depth greater than five metres: one metre thick liner.

The use of 300 millimetre liners requires special care during the construction phase to avoid cracking and to ensure an even thickness and compaction.

Use of storages as part of the treatment process

The reclaimed water being discharged to storage facilities should already be treated to a Class such that it is suitable for intended use. Storage facilities that are needed to make reclaimed water suitable for a particular use will be considered part of the treatment process and therefore subject to EPA Victoria works approval processes (Note: The decision regarding whether the storage lagoon is part of the treatment process will need to be discussed with the EPA Victoria regional office). The storage will need to achieve required quality criteria given a worst case scenario (for example, to achieve 25 day storage for helminth control, the detention time needs to be based on the lowest storage volumes towards the end of summer irrigation). Care needs to be taken to avoid short-circuiting within storage lagoons. The management of any risks such as the resuspension of settled helminths should be detailed in the EIP.

7.1.5 Nutrient loading rates

In addition to a water balance, a nutrient balance must be completed during the design stages of an irrigation scheme. The nutrient balance needs to ensure that nutrients are applied at an optimal rate and load for the specific crop.

The nitrogen content of secondary treated sewage is normally between 10 and 30 milligrams per litre, while tertiary plants configured for nutrient removal

typically have a maximum of five milligrams per litre nitrogen. This loading (the amount of nitrogen applied by the reclaimed water application and by any other means, such as fertiliser) should be balanced annually with the crop requirement, to prevent excessive nitrogen leaching to groundwater. Typical nitrogen uptake rates are approximately 200 kilograms per hectare per year, but would rarely exceed 500 kilograms per hectare per year. Appendix F lists indicative nitrogen uptake rates for a range of plants and crops. These figures can vary according to site conditions.

Comparison of applied nitrogen levels to those upon harvest will indicate the likely magnitude of nitrogen leaching into groundwater. If excessive nitrate leaching is likely, it is essential that steps be taken to combat this problem. Such measures include removing biomass regularly through thinning or harvesting the crop, reducing the nutrient loading rate by using a less concentrated source of reclaimed water, removing nutrients from the reclaimed water or applying less reclaimed water to a larger area.

The phosphorus content of secondary treated sewage is normally between six and ten milligrams per litre, while tertiary plants configured for nutrient removal typically have a maximum level of one milligram per litre phosphorous. Phosphorus uptake rates for a broad variety of crops are typically around 20 kilograms per hectare per year and rarely exceed 50 kilograms per hectare per year. Appendix F lists indicative phosphorus uptake rates for a range of crops. These figures can vary depending on site conditions.

Information on the soil's phosphorus retention capacity should be obtained and assessed for all irrigation sites. Phosphorus can leach into the groundwater or accumulate in the surface layers of some soils, dependent upon type and application. If the surface layer is prone to erosion, phosphorus rich topsoils will erode with potential to end up in surface waters thus increasing nutrient levels. High phosphorus levels in soil can also affect soil productivity. As such, it may be important for some schemes to have erosion and drainage controls for phosphorus management of irrigated land.

The *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991, Publication 168) provide guidance in calculating and determining appropriate nutrient loadings for irrigation schemes.

7.1.6 Salt loading rates

A salt balance should be undertaken for reuse schemes so as to limit it's potential to contaminate groundwater and affect soil productivity. Salinity and sodicity management is critical for reclaimed water irrigation schemes. Salts in reclaimed water in some areas of Victoria limit the volume of water that can be applied to land.

If salt builds up in the root zone, the growth rate of the crop and its capacity to take up water and nutrients will be reduced. Leaching of salt from the root zone is required to prevent salt build up. In most locations, rainfall will provide enough leaching to protect the root zone. Where this does not occur, extra irrigation is needed. This requires careful management so as not to cause excessive nitrate leaching to groundwater.

Appendix G outlines an indicative salinity hazard associated with irrigation according to the TDS content of the reclaimed water. Reclaimed water with a salinity of up to 500 milligrams per litre can generally be used without significant risk to the environment and/or the crop provided an appropriate amount of leaching occurs. When reclaimed water with TDS levels over 500 milligrams per litre is used, there is a potential risk to groundwater, soil and the crop. Salinity controls will usually be needed. Irrigation using reclaimed water with TDS levels over 3500 milligrams per litre should not be undertaken irrespective of the site controls implemented.

Wastewater Irrigation Guidelines (EPA Victoria, 1991, Publication 168) and *Sustainable Effluent-Irrigated Plantations: An Australian Guideline* (CSIRO, 1999) further describe the technical issues associated with salinity and sodicity. They also provide guidance on appropriate site controls to manage and monitor the risks posed to groundwater, soils and crops.

7.1.7 Drainage and stormwater

All schemes should provide effective run-off controls including:

- efficient application methods;
- proper irrigation scheduling such as water budgets; and
- tailwater collection and recycling facilities for any excess runoff.

On-site surface drainage controls are important to prevent waterlogging, particularly if the site has poor drainage due to fine textured soils or an insufficient slope. *Wastewater Irrigation Guidelines* (EPA Victoria, 1991 Publication 168) provides information on appropriate drainage controls for irrigation sites.

External surface water (stormwater run-on) should be prevented from flowing onto the irrigation site. This may result in the reduction of the irrigation requirement and soil waterlogging. Suggested measures to control run-on include the placement of diversion banks and/or cut off drains around the irrigation site, where practicable.

Drip, sub-surface, spray irrigation and low-head pressure sprinkler systems are suggested as best practice to prevent contaminated run-off leaving the boundaries of the irrigation area. If managed correctly, catch and return sumps may not be necessary with these types of irrigation systems.

Methods such as flood or furrow irrigation generally result in over application and hence require greater site management controls to minimise runoff, seepage, waterlogging and salinity problems.

If flood irrigation is used, catch and return sumps are generally recommended. These will collect and reuse all irrigation run-offs during the irrigation season as well as the first flush of contaminated stormwater (for example, the first 10 millimetres) during and after an irrigation event. Generally, stormwater will only be contaminated with reclaimed water when rain occurs during or immediately following irrigation. The storage system should always be operated so that it is almost empty following irrigation. This enables the collection of the first flush of contaminated rainfall run-off following irrigation.

Irrigation should not occur during rain. The need for stormwater run-off and collection controls and hence their design will be site-specific for irrigation

methods other than flood. *Wastewater Irrigation Guidelines* (EPA Victoria, 1991 Publication 168) provides further information on suggested stormwater controls for irrigation sites.

Regardless of site use, Class A or B reclaimed water and nutrient reduction should be considered where there is high potential for reclaimed water runoff off-site. This would apply to schemes without runoff collection or recycling systems, and/or where there are high quality surface waters adjacent to the scheme, unconfined high quality groundwater/aquifers at the site, or sensitive neighbouring land uses (for example, protected flora and fauna sites). Nutrient reduction may also be necessary for reuse schemes having potential for runoff and off-site adverse impacts.

7.1.8 Public and stock access

Public and stock access controls for specific reuse schemes are outlined in Tables 3 and 5.

No specific public or stock access restrictions (other than pig prohibition) are recommended when a Class A microbiological quality water is used. Sensible stock restriction controls should be employed to protect soils from stock traffic and compaction when wet.

For lower quality reclaimed water (Class B, C and D), restrictions on public and stock access, and limits on irrigation times are necessary. These limitations will depend on human and stock exposure potential and the quality of reclaimed water used (also refer to Chapter 6 for agricultural schemes).

7.1.9 Signage

Wherever reclaimed water is used, prominent warning signs should be erected in compliance with AS 1319 - *Safety Signs for the Occupational Environment*.

When Class B reclaimed water is used in dairies, additional words should be added to warn: NO CONTACT WITH MILK OR MILKING EQUIPMENT. Signs with different wording but conveying the same message are acceptable.

7.2 Emergency Discharges

Section 30A of the *Environment Protection Act* 1970 provides EPA Victoria with the ability to approve emergency discharges of waste. If an emergency discharge of reclaimed water is anticipated, approval for the discharge must be sought from EPA Victoria. Examples of situations that may require emergency discharges (for example, to surface waters) are plant malfunction, or impending spillage from storage facilities as a result of very high rainfall (greater than one-in-ten wet year).

In the event that EPA Victoria cannot be notified prior to emergency discharge, notification must be as soon as practicable (with 24 hours) of the emergency discharge occurring. If pondages contain toxic blue green algae, EPA Victoria permission from EPA Victoria as well as the relevant drainage authority must be obtained prior to discharge.

These discharges should be undertaken in such a manner so as not to cause an adverse environmental impact. The EIP should address the contingencies for when a discharge may be required and summarise how the discharge will occur and

what management practices will be implemented to minimise environmental impact.

7.3 Occupational Health and Safety

Best practice measures should be implemented to reduce potential occupational health and safety risks for on-site workers exposed to reclaimed water.

Employers should make themselves aware of their associated responsibilities and duties under the *Occupational Health and Safety Act* 1985.

WorkCover Authority has the following publications to assist employers and employees:

- Workplace Consultation;
- Hazard Management, Workplace Inspection and Selecting a Health and Safety Consultant;
- Workplace Health and Safety Roles and Responsibilities, Training, Information and Records; and
- Workplace Health and Safety Policies, Procedures and Evaluation.

These four booklets will help establish a health and safety management program. They are available from regional WorkCover Information Offices.

The following best practice measures should be implemented to minimise the exposure of on-site workers to risks associated with the use of reclaimed water:

- education of on-site workers as to the risks associated with exposure to reclaimed water (ingestion and inhalation of reclaimed water droplets and mist);
- appropriate immunisations (Immunisations are not considered necessary for any Class A schemes, due to the high microbiological water quality);
- installation of wash basin;
- no consumption of food or drink while working directly with reclaimed water and the washing of hands with soap before eating, drinking or smoking, and at the end of the working day;
- using protective equipment appropriate to the tasks being undertaken and the quality of reclaimed water being used; and
- avoiding high exposure to, and inhalation of, reclaimed water spray by limiting access to irrigation areas to a minimum during irrigation periods.

SITE CONTROLS CHECKLIST

Performance Objectives

To ensure appropriate site controls are implemented to minimise the risk to the environment, public and stock health.

Measures

Design

- Calculate hydraulic, nutrient and salt loadings in accordance with the principles outlined in *Wastewater Irrigation Guidelines* (EPA Victoria, 1991, Publication 168) or other approved method.*
- Design and construct the irrigation system to meet the irrigation requirements in an average year provided supply rates can be reduced in wet years, or design for set reclaimed water flows with storage capacity up to and including 90th percentile wet years*.
- Complete a groundwater impact assessment.
- Design and construct schemes to contain all waste in at least a 90th percentile wet year.*
- Design and construct winter storages with an appropriate liner to minimise seepage to groundwater and protect groundwater quality.
- Undertake emergency discharges from winter storages only in accordance with EIP and EPA Victoria approval.*
- Signage in accordance with AS 3119 *Safety Signs for the Occupational Environment*.*
- Implement site controls listed in Tables 5 and 3 relevant to the reuse application.*
- Assess and implement stormwater controls based on the risk of contaminated run-off crossing the boundaries of the site in accordance with *Wastewater Irrigation Guidelines* (EPA Victoria, 1991, Publication 168).*
- Ensure appropriate buffer distances are met considering the detail of the specific scheme*.

Operational

- Ensure irrigation rates and scheduling do not result in the exceeding of water holding capacity of the soil or the plant uptake capacity.*
- Ensure irrigation practices do not result in off-site contaminated run-off*.
- Make employers aware of their occupational health and safety responsibilities and duties under the *Occupational Health and Safety Act* 1985*.
- Educate on-site workers about the risks associated with reclaimed water exposure and immunisations if needed*.
- Minimise access of on-site workers to the irrigation site during irrigation periods.
- Ensure food or drink is not consumed while working directly with reclaimed water.

8. MONITORING AND REPORTING

The development of a monitoring program that meets the provisions listed in Table 5 is an essential element of a sustainable reclaimed water scheme. In addition, for irrigation schemes, a program should be developed to monitor the potential impacts on the receiving environment. It must be documented in the EIP and describe the organisation that has responsibility for undertaking the monitoring. Usually it is the reclaimed water supplier that will undertake the monitoring for water quality.

Factors such as the quantity and quality of reclaimed water and the risks associated with use should be considered when developing the receiving environment monitoring program. For example, the monitoring requirements for a 10 kilolitres per day reuse scheme will generally be significantly less than those for a 10 megalitres per day scheme.

8.1 Reclaimed Water Monitoring

A reclaimed water monitoring program should:

- *Specify flow-monitoring provisions*. The volume of reclaimed water flowing to the reuse scheme should be monitored and recorded;
- *Specify the parameters to be monitored*. Monitoring of the water quality parameters listed in Table 5 should be undertaken. In addition, *Guidelines for Wastewater Irrigation* (EPA Victoria, 1991, Publication 168) specifies monitoring practices for potential contaminants and toxicants (heavy metals, organics and inorganics) in irrigation water containing trade and other industrial wastes. Monitoring for these additional parameters will depend on the source/s of reclaimed water (for example, domestic, industrial or animal waste sources), the concentrations of contaminant/s present, and the reuse schemes. Major irrigation schemes should also monitor key agronomy indicators, including salinity, nutrients and major cations and anions - the afore mentioned publication also provides guidance on this aspect;
- *Define appropriate sampling locations*. The point at which the quality of the reclaimed water is to be demonstrated should be described; and
- *Specify sampling frequencies*. Default sampling frequencies are specified in Table 5. The sampling frequencies for parameters not specified in Table 5 are recommended in *Wastewater Irrigation Guidelines* (EPA Victoria, 1991 Publication 168).

Monitoring of Class A reclaimed water

Although demonstration of reclaimed water quality prior to supply is important for all classes, a formal precommissioning phase is critical for Class A reclaimed water. The precommissioning phase must be described in the EIP and endorsed by DHS prior to submission to EPA Victoria. For treatment trains without a performance record, it is expected that the commissioning phase would at least involve monitoring of raw sewage and reclaimed water to detect *E.coli*, adenoviruses, rotaviruses, enteroviruses, reoviruses, hepatitis A, Cryptosporidium and Giardia. For treatment trains that have a demonstrated track record of achieving a Class A quality water, a reduced pre-commissioning phase may be appropriate.

For schemes requiring Class A reclaimed water, continuous monitoring to demonstrate treatment reliability must be undertaken (refer to Table 5). This includes online monitoring of turbidity and disinfection efficiency (such as chlorine residual). Weekly monitoring of other indicators and daily inspections of the disinfection unit are also suggested best practice. The need for an ongoing monitoring program to confirm removal of pathogenic organisms will also need to be assessed and described in the EIP.

Table 5. Reclaimed water uses, required Class, monitoring requirements and summary of site management controls

Reuse Options	*Class*	*Reclaimed water quality monitoring**	*Summary of site management controls (refer Chapters 6 and 7 for full details*
URBAN (NON POTABLE)			
Residential Garden watering; Closed system toilet flushing	**A**	Indicative monitoring**: • pH, BOD, SS, *E.coli*, weekly • Turbidity and disinfection efficacy (eg chlorine residual) - continuous • Disinfection daily [1] • Nitrogen, phosphorous[2]	• Environment improvement plan (EIP focus is on ensuring appropriate reclaimed water class) (refer Chapter 9) • Appropriate signage in accordance with AS 1319 – Safety Signs (refer section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Municipal with uncontrolled public access Irrigation of parks and sports grounds; Water for contained wetlands or ornamental ponds.	**A**	Indicative monitoring**: • pH, BOD, SS, *E.coli*, weekly • Turbidity and disinfection efficacy (eg chlorine residual) - continuous • Disinfection daily [1] • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9) • Application rates controlled to protect groundwater, soils and surface water quality (see section 7.1)[3] • Appropriate signage in accordance with AS 1319 – Safety Signs (refer section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Fire protection systems Standby reticulated sprinkler systems; Non emergency access situations.	**A**	Indicative monitoring**: • pH, BOD, SS, *E.coli*, weekly • Turbidity and disinfection efficacy (eg chlorine residual) - continuous • Disinfection daily [1] • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9) • Appropriate signage in accordance with AS 1319 – Safety Signs (see section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Office/factory toilet flushing Closed systems with no direct human contact with reclaimed water.	**A**	• Same as residential toilet flushing	• Same as residential toilet flushing, however, Legionella controls and biocide dosing may be required

Reuse Options	*Class*	*Reclaimed water quality monitoring**	*Summary of site management controls (refer Chapters 6 and 7 for full details*
Municipal with controlled public access Irrigation of parks, sports grounds; Water for contained wetlands or ornamental ponds.	**C**	• pH, BOD, SS[4], *E.coli*, monthly • Disinfection system daily [1] • Nitrogen and phosphorus [2]	• Environment improvement plan (refer Chapter 9) • Restrict public access during irrigation period and for a period of 4 hours after irrigation or until dry[5] • If off-site discharge is likely reclaimed water of Class A or B quality and nutrient reduction may be required • Application rates controlled to protect groundwater, soils and surface water quality (refer section 7.1) [3] • Appropriate signage in accordance with AS 1319 – Safety Signs (refer section 7.1) • Monitoring and auditing programs (refer Chapter 8)
AGRICULTURAL			
Food Production 'Class A uses' (Table 3) Human food crops grown less than 1 metre above ground (or in direct contact with reclaimed water) and consumed raw or sold to consumers uncooked or unprocessed	**A**	Indicative monitoring**: • pH, BOD, SS, *E.coli*, weekly • Turbidity and disinfection efficacy (eg chlorine residual) - continuous • Disinfection daily [1] • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9) • Application rates controlled to protect groundwater, soils and surface water quality (refer section 7.1) [3] • Appropriate signage in accordance with AS 1319 – Safety Signs (refer section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Food Production 'Class C uses' Table 3 ie. Human food crops not in direct contact with reclaimed water and grown over 1 metre above ground, or sold to consumers cooked or processed.	**C**	• pH, BOD, SS[4] monthly • *E.coli* weekly • Nitrogen, phosphorous[2]	• Environment improvement plan (see section 7.1) • Restrict public access during irrigation period and for a period of 4 hours after irrigation or until dry[3] • Specific agriculture controls as per section 6.1 and Table 3 eg withholding periods • Dropped produce that is potentially consumed raw is not to be harvested • Crops required to be cooked or processed must be cooked (›70°C for at least 2 minutes) or commercially processed before sale for domestic use (refer Chapter 6) • Application rates controlled to protect groundwater, soils and surface waters quality (refer section 7.1) [4] • Appropriate signage in accordance with AS 1319 – Safety Signs (refer section 7.1) • Monitoring and auditing programs (refer Chapter 8)

Reuse Options	*Class*	*Reclaimed water quality monitoring**	*Summary of site management controls (refer Chapters 6 and 7 for full details*
Food Production Pasture and fodder for grazing animals (except pigs).	**C**	• pH, BOD, SS[5] monthly • *E.coli* weekly • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9) • Restrict public and stock during irrigation period and for a period of 4 hours after irrigation or until dry[5], drying or ensiling of fodder • Specific agriculture controls as per section 6.1 and Table 3 eg withholding periods • Helminth control for cattle or dairy grazing (refer section 4.1) with dairy animals also requiring a 5 day withholding period. • Application rates controlled to protect groundwater, soils and surface water quality (see section 7.1)[3] • Appropriate signage in accordance with AS 1319 – Safety Signs (see section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Food Production Pasture and fodder for dairy animals Livestock drinking water (except pigs) Washdown water for dairy sheds and stockyards (but not milking equipment)	**B**	• pH, BOD, SS weekly • *E.coli* weekly • Disinfection systems daily[1] • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9) • Restrict public and stock access during irrigation period and for a period of 4 hours after irrigation or until dry[5], Drying or ensiling of fodder must be undertaken • Specific agriculture controls as per section 6.1 and Table 3 eg withholding periods • Application rates controlled to protect groundwater, soils and surface water quality (see section 7.1)[3] • Appropriate signage in accordance with AS 1319 – Safety Signs (see section 7.1) • Monitoring and auditing programs (refer Chapter 8)
Non-Food Crops and Aquaculture Turf, woodlots, forestry, flowers etc Aquaculture (not for human consumption eg. ornamental fish)	**D**	• pH, BOD, SS[4] monthly • *E.coli* weekly • Nitrogen, phosphorous[2]	• Environment improvement plan (refer Chapter 9). • Restrict public access or harvesting during irrigation period and for a period of 4 hours after irrigation or until dry[5] • Application rates controlled to protect groundwater, soils and surface water quality (refer section 7.1)[3] • Appropriate signage in accordance with AS 1319 – Safety Signs (see section 7.1) • Monitoring and auditing programs (refer Chapter 8)

ENVIRONMENTAL AUGMENTATION / INDIRECT POTABLE			
Environmental flow augmentation or discharges to surface water storages	Site specific	Site specific	• Environment improvement plan (refer Chapter 9). • Discharge of reclaimed water quality must not result in the exceeding of water quality objectives of the SEPP (*Waters of Victoria*) and the relevant schedules. • Site specific approval and controls by EPA Victoria in consultation with Catchment Management Authority and other relevant Authorities eg DHS, NRE.
Groundwater Recharge to reduce saline intrusion, augment flows Recharge by spreading or injection into potable aquifer	Site specific	Site specific	• Environment improvement plan (refer Chapter 9). • Reclaimed water quality will need to be assessed on a site-specific basis. • Discharge of reclaimed water quality must not result in the exceeding of water quality objectives of the SEPP (*Groundwaters of Victoria*) and the SEPP (*Waters of Victoria*) and the relevant schedules. • Site specific approval and controls by EPA Victoria in consultation with groundwater management authority, and other relevant Authorities eg DHS, NRE.
INDUSTRIAL			
Open systems Dust suppression on construction or mine/quarry sites Washdown water	Site specific, but typically **Class A**	Site and process specific	• Environment improvement plan (refer Chapter 9) • Additional treatment may be required to prevent scaling, corrosion, biological growth, fouling and foaming. • Class A reclaimed water generally recommended but could be site specific eg. Class B is acceptable for saleyard or stockyard washdown. • Controls to be implemented (eg. protective clothing and equipment) to prevent exposure of workers to spray drift, aerosols, etc.
Closed systems Boiler feed Cooling or quench water	Site specific, but	Site and process specific	• Environment improvement plan (refer Chapter 9) • Additional treatment may be required to prevent scaling, corrosion, biological growth, fouling and foaming. • Class C reclaimed water generally recommended but could be site specific.

Notes to Table 5

1. Disinfection systems refer to chlorination, UV or other chemical/physical disinfection systems. Monitoring requirements include checking chlorine residual or operational checking of equipment. Inspection frequency does not apply to lagoon-based systems.

2. The need for nutrient monitoring will depend on whether specific nutrient management such as tertiary, is needed due to the risks of run-off or the nature of the scheme (for example, toilet flushing).

3. Refer to section 7.1 and Appendix G for total dissolved salts and toxicant limits (if applicable) to protect the receiving crop and/or environment values. Additional monitoring will be required for the management of salinity, nutrient loading and toxicants in irrigation schemes (see Section 8.1).

4. Suspended solids are not used for monitoring the performance (water quality) of lagoon systems.

5. Public access restrictions do not cover on-site workers. On-site worker access should be restricted as far as it does not impede on their duties and to ensure compliance with any occupational health and safety guidelines.

* A monitoring frequency reduced below that described in this table may be acceptable for small treatment plants that have demonstrated reliability of performance coupled with uses that do not require high quality reclaimed water (for example, Class C).

** Monitoring described is indicative since monitoring programs for schemes requiring class A reclaimed water will need to be customised to reflect the treatment train process used and the available information on the treatment train efficiency and reliability. A commissioning phase with more detailed microbiological testing and an ongoing program for verification of pathogen (such as virus and protozoan) removal will also be undertaken (8.1).

For schemes that require a Class B microbiological quality, weekly monitoring of most parameters with daily inspections of the disinfection system are suggested best practice.

Monthly monitoring of most indicators (weekly for *E.coli*) should be undertaken for Class C and D microbiological quality schemes. A higher frequency may be required for large scale schemes or those involving variable treatment performance. Conversely, a lesser frequency may be acceptable for small treatment plants that have demonstrated reliability of performance coupled with uses that do not require high quality reclaimed water (for example, Class C uses).

8.2 Groundwater and Soil Monitoring

Groundwater

A groundwater monitoring program is suggested best practice where the use of reclaimed water poses significant risks. Such a program may not be needed if an impact assessment demonstrates that there is no significant risk to the groundwater in the short and long term.

The objectives of this monitoring program should be to provide early warning of changes in groundwater quality and to measure the effectiveness of site controls put in place to minimise the impacts to groundwater.

The SEPP *(Groundwaters of Victoria)* specifies the beneficial uses of groundwater that require protection and the quality of groundwater that must be maintained to ensure their protection. Monitoring programs should report against the recommended objectives in the SEPP.

This monitoring program should:

- *Specify the parameters to be monitored.* Groundwater should be regularly monitored for at least static water level, salinity (electrical conductivity) and nitrogen parameters (NO_3 and NH_3).
- *Define appropriate sampling locations*. Bores should be located up-gradient and down-gradient of the irrigation area and the storage lagoon.
- *Specify sampling frequencies*. Groundwater should be monitored for the standard parameters at least every four months for the first 12 months of the scheme's operation, then every six months (wet/dry season) after. This may be modified later based on the results/trends obtained.

Personnel with hydrogeological expertise must be consulted to assist in developing a program appropriate to the identified risks.

Soil

Soil quality should be monitored for major irrigation schemes to ensure that there are no adverse impacts on soil structure and productivity.

Generally, a soil-monitoring program for major schemes should:

- *Specify the parameters to be monitored and their frequencies.* Soil should be analysed at least every two-three years (including initial baseline monitoring) for pH, electrical conductivity, exchangeable cations, total N, P, K, total cation concentration and sodium adsorption ratio (SAR) to determine trends. If the reclaimed water

contains significant heavy metals and organic or inorganic contaminants, the relevant parameters should be searched for in the soil. Standard soil fertility parameters should be monitored according to the crop or pasture's specific fertiliser management approach and sustainable yield. Major soil layers should be identified for each sampling pit detailing soil texture, structure, cracking, colour, moisture, rocks and stones, and other biological features. The parameters specified above may be varied based on advice from an appropriately qualified agricultural consultant or soil scientist.

Soil moisture should be monitored regularly to determine irrigation scheduling rates.

- *Specify the sampling locations*. The number and location of sampling locations will depend on the distribution of soil types on the subject land. If there is little variation, three to five sites (which can be composites) may be sufficient for five to ten hectares. More sites will be required for complex land systems.

Personnel with expertise in soil science should be consulted to assist in developing a soil-monitoring program appropriate to the risks the scheme poses and the sensitivities of the site.

Stock and produce monitoring

Stock grazed on pasture irrigated with reclaimed water should be inspected and monitored in accordance with the *Livestock Diseases Control Act* 1994.

Monitoring for produce should be described as part of the farm's food safety QA plan. The development of the monitoring program should consider guidance material such as the alert level of 20 *E.coli* per gram of produce described in the AFFA *Guidelines for On-Farm Safety for Fresh Produce*.

8.3 Sampling and Analysis

Sampling and analysis should be done under the direction of suitably qualified persons in accordance with EPA Victoria Publication 441, *A Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*.

8.4 Cessation of Supply

Schemes that require Class A reclaimed water must have automatic shut down mechanisms in place. This ensures that there is no supply at times of non-compliance with specific treatment and water quality. The triggers for cessation of supply will depend on the treatment train used and will need to be specified in the EIP, after endorsement by EPA Victoria and DHS. Indicative triggers are:

- greater than 40 *E.coli* per 100 millilitres;
- any plant failure;
- any failure of the disinfection unit;
- a turbidity reading that exceeds the maximum of five NTU;
- an average 24 hour turbidity reading that exceeds two NTU;
- a reduction in disinfection efficiency or reduction in chlorine residual below one milligram per litre.

8.5 Reporting

Cessation of supply and any other non-compliant results for Class A reclaimed water must be immediately reported to EPA Victoria and DHS. Supply will only be resumed after DHS and EPA Victoria approval has been given.

Table 6 lists the microbiological notification limit for all schemes other than Class A. These limits apply at the end of the treatment process (that is, prior to discharge to storage facilities). If the notification limits are exceeded, immediate re-sampling should be undertaken. If they are exceeded on two consecutive occasions, supply should cease, an investigation undertaken and corrective action taken. The user and the appropriate EPA Victoria regional office need to be notified immediately. Supply may resume when the problem has been rectified. The action/s taken to rectify the problem should be documented.

Table 6. Microbiological notification limits for reclaimed water classes other than Class A

Class	Microbiological limits (*E. coli* per 100 mL)	Notification limits
B	<100	≥400
C	<1,000	≥4,000
D	<10,000	≥40,000

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

- an analysis of trends in the parameters monitored;
- the exceeding of quality limits and corrective action taken;
- details of incidents and corrective action taken;
- inspection and maintenance reports;
- monitoring data; and
- record of flow data.

Suggested measures for reporting by suppliers should include:

- annual reports summarising monitoring data against the appropriate recommended environmental criteria; and
- a listing or register of supplied reuse schemes, including quality, quantity and type of reuse supplied to.

These records should be made available to EPA Victoria and users upon request. Suppliers of reclaimed water must submit a summary report on the above information to EPA Victoria annually.

Emergency reporting

In the event of an emergency incident, the user and/or supplier must notify the appropriate regional office of EPA Victoria, any other relevant regulatory body and affected parties as soon as practicable. The Social and Environmental Health Branch of the DHS should be notified in the case of an emergency or an incident that significantly increases the risk to public health.

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

8.6 Auditing

Auditing is important to ensure that suppliers and those who reuse meet their obligations under these Guidelines.

An audit program for schemes with more than 1 ML/d should comply with the principles in ISO 14010's *Guidelines for Environmental Auditing*.

The objectives of the audit program should be to determine:

- that the supplier and user/s are meeting their obligations under these Guidelines and any other relevant legislation, policies, standards and guidelines;
- whether the EIP is being implemented resulting in compliance with the Guidelines; and
- any inadequately managed risk exposures (environmental, human and stock health) and possible adverse publicity associated with the reuse scheme.

The process for undertaking audits and the people or organisations involved in the process should be described in the EIP. This guideline does not include formal requirements for an EPA Victoria appointed auditor to undertake scheme audits. Although large schemes should consider a third party audit process.

Audits undertaken in accordance with other QA systems such as the HACCP will satisfy the provisions under these Guidelines, provided the system fully addresses the use of reclaimed water.

Audit frequency will depend upon the size of the scheme and the level of risk posed but should occur annually for schemes that use more than 1 ML/d. It is suggested that smaller reuse schemes be audited at least every three years.

As discussed, EPA Victoria will conduct selected audits of reuse schemes to ensure compliance with these Guidelines. Audits will also identify the effectiveness of such guidelines in the minimisation of risks associated with reuse schemes.

Monitoring Program Checklist

Performance Objectives

To ensure that a reclaimed water -monitoring program is implemented to demonstrate reclaimed water meets the appropriate standard for its intended use.

To ensure a receiving environment-monitoring program is implemented to demonstrate that the use of reclaimed water does not pose an unacceptable risk to the beneficial uses of the environment.

Suggested measures to meet the performance objectives

Operational

- Undertake the monitoring of reclaimed water in accordance with parameters and frequencies listed in Table 5 and customised requirements for Class A schemes.*
- Cease supply if non-compliance triggers for Class A reclaimed water are exceeded (refer section 8.1)*.
- Undertake repeat sampling and testing immediately if the microbiological results exceed the notification limits in Table 6, and take appropriate action.*
- Regularly inspect the treatment and disinfection systems in accordance with Table 5.*
- Monitor soils in accordance with these Guidelines for major irrigation schemes (greater than 1 ML/d) and/or where significant risk of soil degradation is identified.
- Monitor groundwater in accordance with these Guidelines (only relevant where significant risk to groundwater is identified).
- Monitor produce and livestock in accordance with the QA system.
- Monitor for contaminants other than those specified in Table 5 where the system inputs mean that elevated concentrations may pose a risk to the environment or produce.
- Obtain, preserve and analyse samples of reclaimed water in accordance with the *Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes* (EPA Victoria, 1999, Publication 441).*

REPORTING AND AUDITING CHECKLIST

Performance objectives

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

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

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

Suggested measures to meet the performance objectives

Design

- Document all monitoring, reporting and auditing procedures in the EIP.*

Operational

- Keep records of all monitoring results and analyses to demonstrate compliance with the Guidelines.*
- Record and keep details of all inspection and maintenance programs on site.
- Ensure soil and groundwater monitoring reports include an evaluation of quality against the appropriate environmental criteria and trend analyses.
- Ensure the supplier of reclaimed water notifies the user of any non-compliance problems.*
- Ensure the user of reclaimed water notifies the supplier of any non-compliance problems.*
- Submit supplier and user emergency or incident reports (non-compliance with the objectives) in writing to the appropriate regulatory agency as soon as practicable (Immediately for Class A schemes).*
- Submit annual reports to EPA Victoria detailing which reuse schemes are being supplied with reclaimed water.*
- Audit reuse schemes annually that use more than 1 ML/day to verify compliance with these Guidelines.
- Audit reuse schemes that use less than 1 ML/d at least every three years to verify compliance with these Guidelines.
- Ensure audit programs for schemes that use more than 1 ML/d comply with the principles in ISO 14010's *Guidelines for Environmental Auditing*.

9. ENVIRONMENT IMPROVEMENT PLANS

The development of an EIP is a key component of sustainable reclaimed water use. An EIP should combine important business planning and everyday site management practices to ensure a safe, sustainable and compliant (and therefore successful) reclaimed water use scheme.

The development of an EIP is essential for sustainable reuse and necessary for exemption from EPA Victoria works approval and licensing provisions.

9.1 When Is An EIP Required?

All reclaimed water users need to develop an EIP or equivalent management planning documentation. For smaller schemes, the level of detail should reflect the scale of operation, potential human or livestock exposure and environmental risk involved.

9.2 Preparing an EIP

The EIP document should address reuse scheme specifics and environmental risks posed. It will also address the concepts incorporating suggested measures and practices described throughout Chapters 2 to 8 of these guidelines.

The prime objectives of an EIP should be to:

- demonstrate that the performance objectives of these Guidelines can be complied with by detailing the procedures and practices that will be implemented to manage risk;
- address all aspects of the scheme which could pose a risk to the environment, human and stock health, and food safety; and
- provide the framework to assess the long-term performance of the reuse scheme and thereby ensure sustainability.

To meet these objectives, the EIP should at least address the following issues:

- type of reuse, and details of the reclaimed water quantity and quality (that is, Class) used;
- site selection or land capability assessment methods (refer to site selection checklist in *Wastewater Irrigation Guidelines,* EPA Victoria, 2001 Publication 168);
- reclaimed water transport and distribution systems;
- appropriate site controls;
- storage arrangements;
- inspection and maintenance programs;
- training programs;
- contingency plans; and
- monitoring, reporting, QA and auditing, including HACCP programs.

For an irrigation scheme, the EIP should also address:

- irrigation system controls, including irrigation methods, operation and maintenance procedures;
- irrigation scheduling based on water balance calculations, soil moisture monitoring, or other methods;
- winter storage facilities and overflow controls;
- management of algal blooms;

- fertiliser (nutrient) planning including application rates based on nutrients in reclaimed water and crop requirements;
- crop planning and management practices to ensure sustainable nutrient utilisation;
- salinity management programs (such as the maintenance of soil structure, methods of leaching and associated effects offsite);
- groundwater protection (including offsite effects of leaching, nutrient loss, etc);
- drainage and stormwater run-off collection and recycling facilities and controls; and
- spray drift and buffer distance controls.

Appendix E contains an EIP checklist for reclaimed water use schemes.

9.3 EIP sign-off

For reuse schemes:

- that will use greater than one megalitre of reclaimed water on any day; and
- use reclaimed water sourced from industrial processes;

the EIP must have sign-off by EPA Victoria or an auditor appointed under the *Environment Protection Act* 1970. If an auditor is used to sign-off the EIP, they must confirm in writing to EPA Victoria that the EIP complies with the requirements of this guideline. A list of EPA Victoria appointed auditors is available on the EPA Victoria website (www.epa.vic.gov.au).

For a reuse scheme that requires Class A reclaimed water, the EIP must have EPA sign-off, with the proposed treatment plant commissioning and water quality verification program referred to DHS for endorsement. The DHS referral should occur prior to submission to EPA Victoria for sign-off.

For a reuse scheme that is associated with livestock grazing and involves significant quantities* of abattoir, stockyard or intensive animal industry effluents, the EIP must be endorsed by the Chief Veterinary Officer.

*A definition of "significant quantities" is not presently available. However, based on initial case studies, guidance will be provided through a technical note published on the EPA Victoria website. In the interim, the measures described in Appendix B should be consulted.

For all reuse schemes using reclaimed water generated from industrial sources (for example, food industry process water), EIPs must have sign off from the EPA Victoria regional office (or an appointed auditor) irrespective of the size of the scheme.

Major updates of EIPs should also be sent to the parties involved in the reuse scheme and if sign-off is required, to the relevant authorities such as EPA Victoria. Copies of the EIP for any reuse scheme must be made available for EPA Victoria inspection upon request.

Reclaimed water use schemes should include a regular audit and EIP review program. For larger schemes (those with greater than 1 ML/d) the auditor should be independent and have experience with irrigation or other reuse schemes.

The EIP should be integrated with any QA systems (such as food safety), or whole farm management plans for the reuse scheme.

If a QA system such as HACCP has been adopted by a premises or industry (for example, dairy, meat or horticultural) , then it should be integrated with the EIP, and implemented to ensure the relevant food/produce safety issues are covered and that guidelines are met.

The supplier and/or the user may develop an EIP. A regional EIP may be prepared by the supplier to cover all the reuse sites served by the supply scheme. Individual irrigation or whole farm management plans can be prepared for each reuse site but must be intimately linked to the regional EIP.

A supplier's responsibility is to ensure that required copies of EIPs are duly submitted. Users must also fulfil this requirement along with the correct implementation of the plan. EIPs for reclaimed water use schemes should be made available to EPA Victoria officers upon request for auditing purposes.

EPA Victoria will periodically produce updated information bulletins and guidelines relating to EIPs. Preparation of EIPs should also consider the additional guidance provided by such publications.

Environment Improvement Plans

Objectives

Preparation of an EIP that ensures a safe, sustainable and compliant reclaimed water use scheme.

Suggested measures to meet the performance objective

- EIPs must be signed-off by the EPA Victoria regional office (or an appointed Auditor) for schemes that:

i) require Class A reclaimed water (these schemes must have EPA sign-off and DHS endorsement);

ii) involve more than 1 ML/d; or

iii) involve reclaimed water sourced from industrial process water.*

- EIPs associated with livestock grazing that involve the off-site use of reclaimed water containing significant quantities* of abattoir, stockyard or intensive animal industry effluents, need Chief Veterinary Officer endorsement.
- The EIP document should be prepared in detail appropriate to the scale of the specific use scheme, the risks posed and in reference to the objectives and suggested measures described throughout Chapters 2 to 8 (refer to the list of items in section 9.2 and EIP Checklist in Appendix E).
- Reclaimed water use should be undertaken in accordance with the EIP to ensure compliance with these guidelines.*

APPENDIX A – REUSE SCHEME CHECKLIST

Issue	Measures	Section
Compliance with legislation	Collect copies of all relevant legislation, regulations, Australian Standards and other government policy.	2.1
	Ensure management is aware of requirements and implements due diligence systems to ensure compliance.	2.1
Roles and responsibilities		
Supplier	Develop an agreement covering the respective interests and obligations of suppliers and users.*	3.1
	Ensure that any reuse scheme to which it supplies reclaimed water complies with these Guidelines, or has obtained a works approval or site-specific exemption from EPA Victoria.*	3.1
	Identify, assess and manage the risks posed by the supply of reclaimed water.*	3.2
	Ensure that any reuse scheme supplied has an EIP, and where required the EIP is signed off by EPA Victoria (or an appointed auditor), or has the endorsement of DHS or Chief Veterinary Officer.*	Chpt 9
	Monitor, report and audit reuse schemes they supply in accordance with the Guidelines.	Chpt 8
	Maintain a register of reclaimed water users they supply and submit this information annually to EPA Victoria.*	3.1, Chpt 9
User	Enter into a suitable agreement with the supplier.*	3.1
	Ensure that the use of reclaimed water is undertaken in accordance with these Guidelines and the EIP.*	Chpt's 6, 7 & 9
Reclaimed water treatment	Reclaimed water used for the irrigation of pasture or fodder grazed by stock is either retained for at least 25 days in treatment lagoons or filtered by an approved method (eg sand filtration).*	4.4

Issue	Measures	Section
	Undertake disinfection of the reclaimed water in accordance with *GEM: Disinfection of Reclaimed Water* (EPA Victoria, 2003 Publication 730.1).*	Chpt 4
	Ensure the level of treatment of the reclaimed water satisfies an approved treatment process for the relevant application listed in Table 1 and specific provisions for Class A.*	Chpt 4
	Undertake on-road transport of reclaimed water in accordance with good practice.	4.6
Treatment reliability	Design, operate and maintain the plant in accordance with the appropriate Australian Standards, Codes of Practice and/or relevant Guidelines.*	5.1
	Provide appropriate training for operator personnel.	5.1
	Develop contingency plans for potential non-compliant events.*	5.1
	Develop a blue-green algal management plan for schemes at risk from algal bloom impacts.	4.5
	Develop waste management plans for industrial trade waste dischargers in accordance with EPA Victoria Information Bulletins 363 and 383.	5.1
	Provide back-up power supply systems for essential plant elements, such as the disinfection system and individual treatment units.	5.1
	Install alarm systems, automatic controls and on-line monitoring to detect process malfunctions.	5.1
	Provide emergency storage facilities for overflows, improperly treated or unacceptable reclaimed water quality.	5.1
	Implement effective inspection and maintenance programs to detect process malfunctions and optimise treatment efficiency.	5.1
Distribution system reliability	Do not permit connection of the reclaimed water system into the potable supply system.*	5.2

Issue	Measures	Section
	Install reclaimed water distribution systems in accordance with AS/NZS 3500 *National Plumbing and Drainage Code - Parts 1.2 and 2.2.**	5.2
	Identify all piping and conduits in accordance with AS 1345 - *Identification of the Contents of Piping, Conduits and Ducts.**	5.2
	Ensure that above-ground distribution systems are not laid closer than 100 mm from potable water pipes and below-ground distribution systems are not laid closer than 300 mm from potable water pipes.*	5.2
	Ensure that above-ground and buried facilities in areas of public access are distinctively colour-coded (deep purple) and/or marked with the words: WARNING: RECLAIMED WATER — DO NOT DRINK.*	5.2
	Install an approved registered air gap or backflow prevention device meeting the requirements of the AS 3500- AS/NZS 3500-1.2 is installed where potable water is supplied into the reclaimed water system as make-up water.*	5.2
	Operate the reclaimed water system at a lower pressure than the potable system or ensure that back flow prevention devices complying with AS 2845.1 – *1995 Water Supply -Back Flow Prevention Devices* are installed.*	5.2
	Identify the distribution systems in accordance with AS 1319 *Safety Signs for the Occupational Environment.*	5.2
	Design reclaimed water irrigation piping systems in accordance with AS 2698.2 *Plastic Pipes and Fittings for Irrigation and Rural Applications*.	5.2
	Implement a field testing and maintenance program of back flow prevention devices in accordance with AS 2845.3 1993 *Water Supply – Backflow Prevention devices. Field Testing and Maintenance.*	5.2

Issue	Measures	Section
	Implement an inspection program for non-potable supply systems to residential areas in accordance with *National Plumbing and Drainage Code - Part 1.2*.	5.2
	For dual potable and reclaimed water distribution systems, where practical use different materials and pipe sizing to distinguish the supplies.	5.2
	For dual potable and reclaimed water distribution systems, develop an audit or educational program for identification of household cross connections.	5.2
	Ensure environmentally acceptable provisions are made for cleaning and disinfection of the distribution pipe work to control biological solids.	5.2
Reclaimed water quality	Ensure reclaimed water quality supplied satisfies the water quality parameters specified in Table 1 and specific provisions for Class A.*	Chpt 4
Acceptable Uses and Site Specific Controls		
Agricultural applications	Ensure that reclaimed water meets the treatment and quality controls for agricultural applications listed in Table 1 and specific provisions for Class A.*	Chpt 4
	Implement the relevant site controls listed for agricultural applications in Tables 3 and 5.*	6.2
	Ensure that schemes with dairy, cattle and vegetable produce adopt a QA system, such as HACCP, to protect produce safety.	6.2
	Implement the appropriate withholding periods (dependent upon the quality of reclaimed water) listed in Tables 3 and 5 for agricultural schemes.*	6.2
	Do not allow cattle to graze on land irrigated with reclaimed water unless it has had helminth removal treatment, or land has been 'decontaminated'.*	6.2

Issue	Measures	Section
	Ensure that fodder and crops irrigated with reclaimed water are ensiled or dried before packaging.	6.2
	Ensure that reclaimed water or produce grown with it is not used in pork production.	6.2
	Ensure that where needed, products are identified with sales restrictions eg restrictions on pig access.	6.2
Urban non-potable schemes	Ensure that reclaimed water meets the treatment and quality controls for urban non-potable applications listed in Table 1.*	6.3
	Implement relevant site controls listed for urban non-potable applications in Table 5.*	6.3
	Implement public and stock access controls where Class B and C reclaimed waters are used.*	6.3
	Install stormwater run-off controls where needed.*	6.3
	Implement nutrient reduction controls where off-site discharges are likely or toilet flushing is proposed.*	6.3
Industrial use	Ensure reclaimed water meets the treatment and quality controls for industrial applications listed in Table 1.*	6.6
	Implement relevant site controls listed for industrial applications in Table 5.*	6.6
	Ensure that reclaimed water quality meets the relevant limits specified in the industrial use section of *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000 or as amended).	6.6
	Implement appropriate controls to minimise on-site worker exposure to reclaimed water.	6.6

Issue	Measures	Section
Site Selection and Environmental Management		
Site selection	Choose irrigation sites in accordance with *Wastewater Irrigation Guidelines* (EPA Victoria Publication 168, 1991).	7.1
Site controls	Ensure that hydraulic, nutrient and salt loadings are calculated in accordance with the principles outlined in *Wastewater Irrigation Guidelines* (EPA Victoria Publication 168, 1991) or other approved documentation.*	7.1
	Design and construct the irrigation system and winter storage facilities to ensure there is no contaminated discharge up to a 90th percentile wet year.*	7.1
	Erect signage in accordance with AS 3119 – *Safety Signs for the Occupational Environment*.*	7.1
	Implement public and stock access controls in accordance with Tables 3 and 5.*	7.1
	Implement controls to prevent contaminated stormwater run-off for flood irrigation systems.*	7.1
	Implement all site controls listed in Table 5 relevant to the reuse application.*	7.1
	Meet the specified buffer distances based on the quality of water and type of irrigation system.*	7.1
	Implement controls to improve drainage and prevent stormwater run-on for poor drainage sites in accordance with the principles in *Wastewater Irrigation Guidelines* (EPA Victoria, 1991 Publication 168).	7.1
	Conduct a groundwater impact assessment for schemes that pose a risk to groundwater in accordance with the principles outlined in *Environmental Guidelines for Hydrogeological Assessments (Groundwater Quality)* (EPA Victoria draft).	7.1

	Design and construct winter storage with at least the minimum requirements for compacted lining to reduce seepage to groundwater.*	7.1
	Develop a protocol for emergency discharges from winter storages and seek approval for discharge from EPA Victoria.*	7.2
	Make employers aware of their occupational health and safety responsibilities and duties under the *Occupational Health and Safety Act* 1985.*	7.3
	Educate on-site workers about the risks associated with exposure to reclaimed water.*	7.3
	Immunise on-site workers against water-borne illnesses.	7.3
	Provide on-site workers with appropriate protective equipment to minimise inhalation and skin contact with reclaimed water aerosols.	7.3
	Minimise access by on-site workers to the irrigation site during irrigation periods.	7.3
	Ensure that workers do not consume food and drink while working directly with reclaimed water.	7.3
Monitoring program	Undertake monitoring of reclaimed water in accordance with parameters and frequencies listed in Table 5 and specific provisions for Class A reclaimed water.*	8.1
	Ensure that repeat sampling and testing are immediately undertaken if the microbiological results exceed the notification limits in Table 6, and appropriate action is taken.	8.4
	Conduct regular inspections of treatment and disinfection systems in accordance with Table 5.	8.1
	Undertake a monitoring program for contaminants where the concentration of contaminants in reclaimed water may pose a risk to the environment or produce.	8.1
	Undertake a soil-monitoring program for irrigated land in accordance with these Guidelines.	8.2

	Undertake a groundwater-monitoring program in accordance with these Guidelines (only relevant where significant risk to groundwater is identified).	8.2
	Implement a stock inspection and monitoring program in accordance with the *Disease Control Livestock 1994*.	8.2
	Undertake a program monitoring produce.	8.2
	Ensure that samples of reclaimed water are obtained, preserved and analysed in accordance with *A Guide to the Sampling and Analysis of Water, Wastewaters, Soils and Wastes* (EPA Victoria, 1991 Publication 168).	8.3
Reporting	Document all monitoring, reporting and auditing procedures and programs in the EIP.*	8.4
	Ensure that EPA Victoria (and DHS for Class A reuse schemes) is immediately notified of issues with non-compliant water.	8.4
	Ensure that the supplier of reclaimed water notifies the user of any non-compliance problems.	8.4
	Ensure that the user of reclaimed water notifies the supplier of any non-compliance problems.	8.4
	Submit all suppliers and users emergency or incident reports (non-compliance with the objectives) in writing to the appropriate regulatory agency as soon as practicable.	8.4
	Keep records of all monitoring results and analyses to demonstrate compliance with the Guidelines.	8.4
	Record and keep details of all inspection and maintenance programs on site.	8.4
	Ensure that soil and groundwater monitoring reports include an evaluation of quality against the appropriate environmental criteria, and trend analyses.	8.4
Auditing	Ensure that reuse schemes that use more than 1 ML/d are annually audited to verify compliance with these Guidelines.	8.5

	Ensure that all schemes using reclaimed water other than that generated from a sewage treatment plant are annually audited to verify compliance with these Guidelines.	
	Ensure that reuse schemes that use less than 1 ML/day are audited at least every three years to verify compliance with these Guidelines.	8.5
	Ensure that audit programs for schemes that use greater than 1 ML/day on any day comply with the principles in ISO 14010's *Guidelines for Environmental Auditing*.	8.5
	Ensure that an appropriately qualified independent auditor or internal expert undertakes the audit.	8.5
Environment Improvement Plan	Prepare an environment improvement plan in accordance with these Guidelines.*	9.2
	Ensure that where required, the necessary sign-off and endorsements are received eg schemes greater than 1 ML/day on any day.	9.3

APPENDIX B –SPECIFIC MEASURES FOR REUSE SCHEMES THAT USE RECLAIMED WATER GENERATED FROM SOURCES OTHER THAN SEWAGE TREATMENT PLANTS

Abattoirs

Abattoir process water used for irrigation schemes is subject to the same water quality standards that apply to municipal sewage reuse schemes (refer to Table 1).

The helminth treatment controls for municipal sewage (for example, 30 days detention in settling lagoons or filtration via an approved method, such as sand or microfiltration) are not required in relation to abattoirs. This is provided the reclaimed water generated does not contain effluent from human sewerage or septic tank systems. If the water contains effluent from such systems, the helminth treatment measures shall apply.

No restraints apply to the grazing of pigs on land irrigated with reclaimed water sourced from abattoirs, and there is no restraint on the use of fodder grown from this type of reuse scheme.

All other relevant measures specified in the Guidelines apply to abattoir reuse schemes.

Reuse schemes involving off-site use of abattoir reclaimed water in association with livestock grazing require individual endorsement from the Chief Veterinary Officer, DPI. Appropriate measures will need to be undertaken to minimise the risk of 'Johne's disease'.

Food processing

Reclaimed water from food processing used for irrigation schemes is subject to the same water quality standards as municipal sewage reuse schemes (refer to Table 1). In addition, the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000 or as amended) outlines water quality limits for the reuse of reclaimed water from specific food and beverage industries.

The treatment provisions for reclaimed water generated from food processing premises will vary dependent upon the process and end use. Water generated from food processing is generally distinguished by high BOD concentrations, high levels of dissolved and/or suspended solids (including fats, oils, and grease), nutrients such as nitrogen, and, potentially, biocides such as herbicides and pesticides. Human pathogens are not typically an issue provided the process water is not contaminated with effluent from human sewerage or septic tank systems.

Appropriate treatment will need to reduce specific contaminants to acceptable levels according to the end use, as outlined in these Guidelines and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000 or as amended).

Treatment controls to reduce helminth numbers (for example, 25 days detention or an approved filtration method) will not generally be required to treat food processing water unless it contains human wastes. In addition, the reclaimed water can also be used to irrigate areas with which pigs may come into contact provided there is no human waste in the water.

All other relevant measures specified in the Guidelines apply to this category of reclaimed water.

Dairy processing

Treatment of dairy processing waters should be undertaken in accordance with EPA Victoria Publication 570, *Environmental Guidelines for the Dairy Processing Industry*. The process water should be subject to the same water quality guidelines that apply to municipal sewage reuse schemes (refer to Table 1). Exceptions to this rule are helminth treatment control measures, and restraints regarding restriction of pigs from grazing on land irrigated with dairy effluent. However, some constraints may be imposed on reuse of reclaimed water from dairy processing within the industry itself and therefore DFSV and the Chief Veterinary Officer should be consulted.

All other relevant measures specified in the Guidelines apply to this category of reclaimed water.

Industrial

The appropriate treatment and quality of industrial process water will vary according to process source and the reuse option. Appropriate treatment should reduce contaminant concentrations to acceptable levels dependent upon end use. The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000 or as amended) outlines water quality guideline limits for key contaminants.

Generally, treatment controls to reduce helminth numbers (for example, 25 days detention or an approved filtration method) will not be required to treat industrial process waters unless they contain animal or human wastes.

All other relevant measures specified in the Guidelines apply to this category of reclaimed water.

APPENDIX C – GOVERNMENT DEPARTMENTS & 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

45 Princes Highway

Dandenong VIC 3175

Tel: (03) 9794 0677

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 Streets

Geelong VIC 3220

Tel: (03) 5226 4852

ANZECC

ANZECC Secretariat Environment Australia

16 Moore Street

Canberra City ACT 2600

Tel: (02) 6274 1384

Department Of Human Services

Environmental Health Unit

120 Spencer Street

Melbourne VIC 3000

Tel: (03) 9637 4156

Department of Primary Industries

http://www.nre.vic.gov.au/

Chief Veterinary Officers Unit

475 Mickleham Rd

Attwood VIC 3049

Tel: (03) 9217 4200

Institute of Horticultural Development

621 Burwood Highway

Knoxfield VIC 3180

Tel: (03) 9210 9222

Department of Sustainability and Environment

Water Sector Services

240 Victoria Parade

East Melbourne 3002

136 186

Dairy Food Safety Victoria

651 Victoria Street

Abbotsford VIC 3067

Tel: (03) 9426 5999

Victorian Meat Authority

150 Albert Road

South Melbourne VIC 3205

Tel: (03) 9685 7333

Standards Australia

19 – 25 Raglan Street

South Melbourne VIC 3205

Tel: 1300 654 646

APPENDIX D – KEY ACTS AND REGULATIONS

ACTS

Environment Protection Act 1970

Health Act 1958

Livestock Disease Control Act 1994

Occupational Health and Safety Act 1985

Trade Practices Act 1974

Food Act 1984

REGULATIONS

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

Health (Infectious Diseases) Regulations 1990

STATE ENVIRONMENT PROTECTION POLICIES, INDUSTRIAL WASTE MANAGEMENT POLICIES AND OTHER STATUTORY INSTRUMENTS

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

State Environment Protection Policy *(Waters Of Victoria)* Publication S 107

State Environment Protection Policy *(Air Environment)* And Amendments

Publications S63, 45, 120

State Environment Protection Policy *(Noise From Industry, Commerce And Trade N1)*

Publication S31

Draft State Environment Protection Policy *(Prevention And Management Of Contaminated Land*) 1998

CODES, STANDARDS AND GUIDELINES

AFFA (2001) Guidelines For On-Farm Food Safety For Fresh Produce. Agriculture Fisheries and Forestry, Australia.

ANZECC (2001) Australian New Zealand Guidelines for Fresh and Marine Water Quality Australian and New Zealand Environment Council.

ANZECC (2001) Guidelines For Sewage Systems – Use Of Reclaimed Water (#14) Australian And New Zealand Environment Council.

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

As 1477 *Unplasticised Pvc (Upvc) Pipes And Fittings For Pressure Applications*

As 2031 *Sample Collection And Preservation Techniques*

As 2698.2 *Plastic Pipes And Fittings For Irrigation And Rural Applications*

As 2845.1 *Water Supply – Backflow Prevention Devices*

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

AS 3500-1992 National Plumbing And Drainage Code AS/NZS 3500-1.2 (1998) National

Plumbing And Drainage Part 1.2: Water Supply – Acceptable Solutions

AS/NZS 3500-2.2 (1996) *National Plumbing And Drainage Part 2.2: Sanitary Plumbing And Drainage – Acceptable Solutions*

AS/NZS 4360: *Risk Management* (1995)

CSIRO (1999) Sustainable Effluent-Irrigated Plantations: An Australian Guideline. CSIRO Forestry And Forest Products, Land And Water, Canberra Australia.

EPA Victoria (1991) Publication 168 *Guidelines For Irrigation Of Wastewater*.

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

EPA Victoria (1997) Publication 570, *Environmental Guidelines For The Dairy Processing Industry*.

EPA Victoria (1998) Publication 500 *Code Of Practice For Small Wastewater Treatment Plants*.

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 (2003) Publication 730.1 *Guidelines for Environmental Management: Disinfection of Reclaimed Water*.

ISO 14010 *Guidelines For Environmental Auditing*.

VDIA (1999) Reclaimed Water On Dairy Farms – General Information And Requirements For Users, Victorian Dairy Industry Authority (1999).

APPENDIX E – ENVIRONMENTAL IMPROVEMENT PLAN CHECKLIST

Refer also to Chapter 9.

Suggested EIP checklist for schemes greater than 1 ML/day

- Type of reuse (including quantity and quality of reclaimed water used).
- Treatment and water distribution reliability controls.
- Plan showing location of prominent warning signs in accordance with the principles of AS 1319 - *Safety Signs for the Occupational Environment)* and sensitive features within 200 metres of the reuse site.
- Occupational health and safety controls.
- Spray drift controls (if relevant).
- Access controls – public and/or stock, including withholding periods (if relevant).
- Inspection and maintenance programs.
- Training program.
- Contingency plans.
- Reclaimed water monitoring program (including identification and measurement of chemical contaminants if significant trade waste).
- Reporting program.
- Auditing program.

Irrigation schemes

- A scaled locality plan of the reuse site showing site characteristics (eg slope, soil, groundwater characteristics - refer to *Wastewater Irrigation Guidelines*) and sensitive features within 200 metres of the irrigation boundary areas.
- Water budget (including irrigation scheduling), nutrient and salt balance calculations.
- Irrigation method, operation and maintenance procedures.
- Winter storage requirements, crop management practices, including crop nutrient utilisation practices (refer to *Wastewater Irrigation Guidelines*).
- Soil salinity controls if relevant (refer to *Wastewater Irrigation Guidelines*).
- Leaching controls (*Wastewater Irrigation Guidelines*).
- Groundwater controls if relevant (*Wastewater Irrigation Guidelines*).
- Drainage (if relevant) and stormwater run off and collection controls (*Wastewater Irrigation Guidelines*).
- Produce safety controls (if relevant).
- Receiving environment monitoring and reporting programs (including livestock monitoring program, if relevant).

Suggested EIP checklist for less than 1 ML/day

- Type of reuse (including quantity and quality of reclaimed water used).
- Plan showing location of prominent warning signs in accordance with the principles of AS 1319 - *Safety Signs for the Occupational Environment*) and sensitive features within 200 metres of the reuse site.

- Access controls – public and/or stock, including withholding periods (if relevant).
- Inspection and maintenance programs.
- Contingency plans.
- Reclaimed water monitoring program.
- Reporting program.
- Auditing program.

Irrigation schemes

- A scaled locality plan of the reuse site showing site characteristics (such as slope, soil, groundwater characteristics - refer to *Wastewater Irrigation Guidelines*) and sensitive features within 200 metres of the irrigation boundary areas.
- Water budget and nutrient balance.
- Salinity management where TDS is above 500 milligrams per litre.
- Irrigation method, operation and maintenance procedures.
- Run-off controls.
- Receiving environment monitoring program (if applicable).

APPENDIX F – INDICATIVE NUTRIENT UPTAKE RATES FOR SELECTED CROPS

Plant species	Nitrogen uptake (kg/ha/year)	Phosphorus uptake (kg/ha/year)
Bent grass	170	-
Bermuda grass	280	30 - 50
Clover	180	20
Eucalypts	90	15
Grapes	20	-
Lemons	60	-
Lucerne	220 - 540	20 - 30
Oats	60	50
Oranges	40	-
Poplars	115	25
Radiata pine	95	10
River Sheoak	140	20
Ryegrass	200 - 280	60 - 80
Rye/clover (2:1)	220	50
Sorghum	90	15
Tall fescue	150 - 320	30

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

APPENDIX G – SALINITY CLASSES OF IRRIGATION WATERS AND SALT TOLERANT PLANTS

Table G.1. 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's.
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 in 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.

Table G.2. Salt tolerance of some plants

Tolerant	Moderately tolerant	Moderately sensitive
Kikuyu grass, Red river gum, Swamp Sheoak, Tall wheat grass	Lucerne, Cocksfoot, Birdsfoot Trefoil, Phalaris, Perennial Ryegrass, Barley, Tall Fescue, Sudangrass, Bermuda Grass, Couch Grass, Balansa Clover, Bent Grass, Blue Gum, Bokhara Clover, Demeter Fescue, Flooded Gum, Rhodes Grass, River Sheoak	Big Trefoil, Cow Pea, Alsike Clover, Red Clover, White Clover, Strawberry Clover, Sub Clover, Grapes, Vetches, Citrus, Millet, Oats, Sorghum

APPENDIX H - SELECTED REFERENCES

(This list is not exhaustive, representing only key literature for further reading or reference.)

AGWEST (1997) *SQF 2000^{CM} Quality Code: 1997. A HACCP Quality Code for the Food Industry.* 2nd edition, Aug 1997. AGWEST Trade and Development, Agriculture, Western Australia.

ANZECC (1992) *Australian Water Quality Guidelines For Fresh And Marine Waters.* National Water Quality Management Strategy. Australian and New Zealand Environment Conservation Council.

ANZECC (1994) *Guidelines For Sewage Systems Acceptance Of Trade Wastes (Industrial Wastes)* National Water Quality Management Strategy. Australian And New Zealand Environment Conservation Council.

ANZECC (1997) *Australian Guidelines for Sewerage Systems – Effluent Management.* National Water Quality Management Strategy. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

ANZECC (2000) *Guidelines For Sewerage Systems – Reclaimed Water.* National Water Quality Management Strategy. Australian And New Zealand Environment Conservation Council, Agriculture And Resource Management Council Of Australia And New Zealand, National Health And Medical Research Council.

ANZECC (2001) *Australian New Zealand Guidelines For Fresh And Marine Water Quality.* National Water Quality Management Strategy. Australian And New Zealand Environment Conservation Council. (via website: www.environment.gov.au/science/water/index.html)

Anzfa (1987-2000). *Food Standards Code Schedule A12 Metals And Contaminants In Food.* Incorporating amendments up to and including Amendment 47 Nov./Dec. 1999. Originally published by the National Health and Medical Research Council in the Commonwealth of Australia, Gazette, No. P27, 27 August 1987.

ARMCANZ (1996) *Australian Drinking Water Guidelines.* National Water Quality Management Strategy. Agriculture And Resource Management Council Of Australia And New Zealand, National Health And Medical Research Council.

ARMCANZ (2000) *Revision Of The Australian Drinking Water Guidelines.* Public Consultation Document. National Water Quality Management Strategy. Agriculture And Resource Management Council Of Australia And New Zealand, National Health & Medical Research Council, June 2000.

Blumenthal UJ et al (2000) *Guidelines For The Microbiological Quality Of Treated Wastewater Used In Agriculture: Recommendations For Revising The WHO Guidelines.* Blumenthal U.J., Mara D.D., Peasey A., Ruiz-Palacios G. and Stott R. Bulletin of the World Health Organisation (WHO) 2000, 78(9), pp 1104-1116.

CSIRO (1995) *Effluent Irrigated Plantations: Design And Management.* CSIRO (Division of Forestry) Technical Paper No.2, Canberra 1995.

CSIRO (1999) *Sustainable Effluent-Irrigated Plantations. An Australian Guideline.* CSIRO Forestry and Forest Products, Land and Water, Canberra 1999. (see website www.ffp.csiro.au/pff//effluent_guideline/)

Department of Natural Resources and Environment (DNRE) *Agriculture Notes Series* (see DNRE's website (http://www.nre.vic.gov.au/) or electronic information resource: "Land Channel" (www.land.vic.gov.au):

- (1995) *Design Criteria Layout For Flood Irrigation Land Layout.* Agriculture Notes, Series No. Ago232.
- (1995) *Efficient Fertiliser Application In Orchards.* Agriculture Notes, Series No. Ago240.
- (1995) *Testing And Interpretation Of Salinity And Ph.* Agriculture Notes, Series No. Ago244.
- (1995) *Irrigation Scheduling For Regulated Deficit Irrigation (RDI).* Agriculture Notes, Series No. Ago299.
- (1995) *Fertilisers For Potatoes.* Agriculture Notes, Series No. Ago318.
- (1996) *Growing Cereals In Victoria.* Agriculture Notes, Series No. Ago547.
- (1997) *Salinity And The Growth Of Forage Species.* Agriculture Notes, Series No. Ago284.
- (1997) *Planning Farm Dams In The Northern Irrigation Region.* Agriculture Notes, Series No. Ago587.
- (1997) *Dairy Effluent: Infectious Diseases And Animal Health.* Agriculture Notes, Series No. Ago449.
- (1997) *Quality Assurance Systems In Horticulture.* Agriculture Notes, Series No. Ago532.
- (1998) *Sampling Soils Used For Growing Pastures, Field And Fodder Crops.* Agriculture Notes, Series No. AG0375.
- (1998) *How To Sample Soils Used For Flower, Fruit, Grape And Vegetable Production.* Agriculture Notes, Series No. AG0376.
- (1998) *Sampling Recreational Turf Or Soil Analysis.* Agriculture Notes, Series No. AG0395.
- (1999) *Dairy Effluent: Application To Pastures.* Agriculture Notes, Series No. Ago419.
- (1999) *Dairy Effluent: Sources Of Information On Dairy Shed Effluent Management.* Agriculture Notes, Series No. Ago430.
- (1999) *Dairy Effluent: Minimising Dairy Shed Effluent.* Agriculture Notes, Series No. Ago433.
- (1999) *Dairy Effluent: Management Of Dairy Shed Effluent In Victoria.* Agriculture Notes, Series No. Ago435.
- (1999) *Dairy Effluent: Choosing An Effluent Management System.* Agriculture Notes, Series No. Ago840.
- (1999) *Dairy Effluent: Protecting Groundwater.* Agriculture Notes, Series No. Ago841.
- (1999) *Johne's Disease In Cattle.* Agriculture Notes, Series No. Ago767.
- (1999) *Johne's Disease In Cattle - Prevention.* Agriculture Notes, Series No. Ago845.
- (2000) *Dairy Effluent: Applying Dairy Shed Effluent To Land.* Agriculture Notes, Series No. Ago432.

- (2000) *Guidelines For Sampling Soils, Fruits, Vegetables And Grains For Chemical Residue Testing*. Agriculture Notes, Series No. Ago889.
- (2000) *Productive Reuse Of Effluent On Tree Plantations.* Agriculture Notes, Series No. Ago789.
- (2000) *Organic Farming.* Agriculture Notes, Series No. Ago688.

DPH & DFA (1992) *Code of Practice Piggeries*. Department of Planning and Housing (DPH), Department of Food and Agriculture (DFA), Revised 1992.

EPA Victoria (1995) *Managing Sewage Discharges To Inland Waters.* EPA Victoria, Victoria. Publication No. 473.

EPA Victoria (1996) *Code of Practice – Septic Tanks (On-Site Domestic Wastewater Management).* EPA Victoria, Victoria. Publication No. 451.

EPA Victoria (1997) *Environmental Guidelines for the Dairy Processing Industry.* EPA Victoria, Publication No. 570.

EPA Victoria (1998) *Code of Practice for Small Wastewater Treatment Plants* EPA Victoria, Victoria. Publication No. 500.

EPA Victoria (2000) *A Guide to the Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*. EPA Victoria, Victoria. Publication No. 441.

EPA Victoria *Draft Environmental Guidelines for Hydrogeological Assessments (Groundwater Quality).* EPA Victoria, Publication No. 668.

EPA Victoria (2003) *Environmental Guidelines for the Disinfection of Reclaimed Water.* EPA Victoria, Publication No. 730.1.

Feacham R.G. et al (1983) *Sanitation and Disease: Health Aspects of Excreta and Wastewater Management.* Feacham R.G., Bradley D.J., Garelick H. and Mara D.D. World Bank Studies in Water Supply and Sanitation 3. Published for World Bank by John Riley and Sons.

Fegan N., Gardner T. and Blackall P. (1998) *Health Risks Associated With The Reuse Of Effluent For Irrigation. A literature review.* State of Qld Dept of Natural Resources, Dept of Primary Industries.

Gilbert R.O., *Statistical Methods for Environmental Pollution Monitoring*, Chapter 13, Van Nostrand Reinhold, 1987.

Harris M., Horvitz D.G. and Mood A.M. (1948) *On The Determination Of Sample Sizes In Designing Experiments. J. Amer. Statist. Assoc.* **43**: 391-402.

Mara D. and Caincross S. (1989) *Guidelines For The Safe Use Of Wastewater And Excreta In Agriculture And Aquaculture.* Published by the World Health Organisation in collaboration with the United Nations Environment Programme.

National Academy of Sciences (1996) *Use of Reclaimed Water and Sludge in Food Crop Production.* Committee on the Use of Treated Municipal Wastewater Effluents and Sludge in the Production of Crops for Human Consumption. Water Science and Technology Board. Commission on Geosciences, Environment and Resources. National Research Council. National Academy Press, Washington DC, USA, 1996.

NRA (2000). "*MRL Standard*". Maximum Residue Limits Of Agricultural And Veterinary Chemicals And Associated Substances In Food Commodities. National Registration Authority for Agricultural and Veterinary Chemicals (NRA) (or via AFFA website: www.affa.gov.au:80/nra/mr11.html).

NRE (2000) *Draft Code of Practice Piggeries*. November 2000 draft for public consultation. Department of Natural Resources and Environment.

Standards Australia (1997) *Australian Standard. Guide To The Sampling And Investigation Of Potentially Contaminated Soil. Part 1: Non-Volatile And Semi-Volatile Compounds. AS 4482.1 – 1997.* Standards Australia, Homebush, NSW, www.standards.com.au.

Shuval H. et al (1997) *Development Of A Risk Assessment Approach For Evaluating Wastewater Reuse Standards For Agriculture.* Shuval H., Lampert Y. and Fattal B. Water Science & Technology, Vol. 35, No. 11-12, pp15-20, 1997.

Thomas J.F. et al (1997) *Wastewater Re-use Stormwater Management and the National Water Reform Agenda.* Ed.s Thomas J.F, Gomboso J., Oliver J.E. and Ritchie V.A. CSIRO Land and Water Research Position Paper 1. See CSIRO website: www.clw.csiro.au/publications/position/RPP1.pdf

Toze S. (1997). *Microbial Pathogens in Wastewater*. *Literature Review for Urban Water Systems Multi-divisional Research Program.* CSIRO Land and Water Technical Report No 1/97. See CSIRO website: www.clw.csiro.au/publications/technical/tr1-97.pdf

US EPA (1992) *Manual - Guidelines for Water Reuse.* Technology Transfer, EPA/625/R-92/004, Sept 1992. United States Environmental Protection Agency.

VDIA (1999) *Reclaimed Water on Dairy Farms*. General Information and Requirements for Users. Victorian Dairy Industry Authority (VDIA), Abbotsford, Vic.

Additional guidance or technical addendums to this guideline will be available from the EPA Victorian website (www.epa.vic.gov.au).

EPA Victoria will be pleased to receive comments on these guidelines. Comments will, where appropriate, be incorporated in future editions. Comments on these guidelines should be sent to:

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