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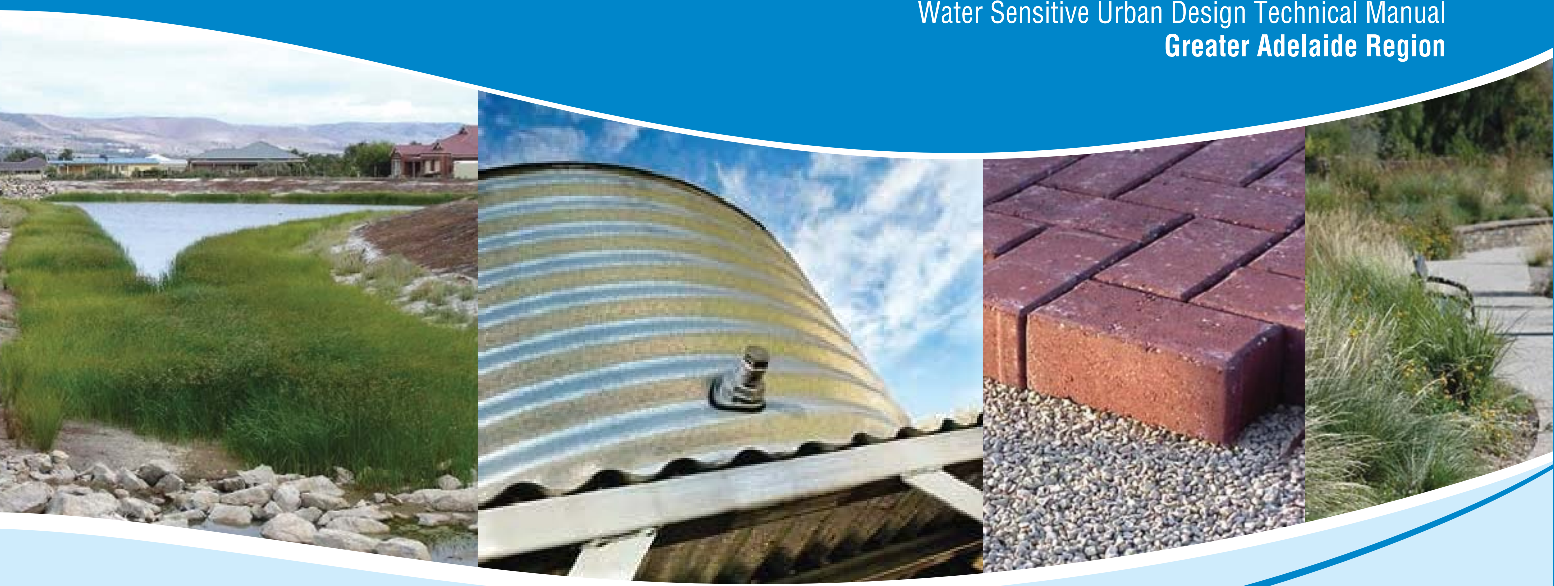
Chapter 14

Wastewater Management

Water Sensitive Urban Design Technical Manual
Greater Adelaide Region



Government of South Australia

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Department of the Environment, Water, Heritage and the Arts

Securing tomorrow's water today.

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Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is an approach to urban planning and design that integrates the management of the total water cycle into the urban development process. It includes:

- Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values;
- Storage, treatment and beneficial use of runoff;
- Treatment and reuse of wastewater;
- Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity; and
- Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non drinking water supplies.

Therefore, WSUD incorporates all water resources, including surface water, groundwater, urban and roof runoff and wastewater.

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The project partners gratefully acknowledge all persons and organisations that provided comments, suggestions and photographic material.

In particular, it is acknowledged that material was sourced and adapted from existing documents locally and interstate.

Overall Project Management

Christine Lloyd (Department of Planning and Local Government)

Steering Committee

A group of local government, industry and agency representatives provided input and feedback during preparation of the Technical Manual. This group included representatives from:

- Adelaide and Mt Lofty Ranges Natural Resources Management Board;
- Australian Water Association (AWA);
- Department for Transport, Energy and Infrastructure (DTEI);
- Department of Water, Land and Biodiversity Conservation (DWLBC);
- Environment Protection Authority (EPA);
- Housing Industry Association (HIA);
- Local Government Association (LGA);
- Department of Planning and Local Government (DPLG);
- South Australian Murray-Darling Basin Natural Resources Management Board;
- South Australian Water Corporation;
- Stormwater Industry Association (SIA); and
- Urban Development Institute of Australia (UDIA).

Technical Sub Committee

A technical sub committee, chaired by Dr David Kemp (DTEI), reviewed the technical and scientific aspects of the Technical Manual during development. This group included representatives from:

- Adelaide and Mt Lofty Ranges Natural Resources Management Board;
- City of Salisbury;
- Department for Transport, Energy and Infrastructure (DTEI);
- Department of Health;
- Department of Water, Land and Biodiversity Conservation;
- Department of Planning and Local Government; and
- Urban Development Institute of Australia.

From July 2010, DWLBC was disbanded and its responsibilities allocated to the newly created Department For Water (DFW) and the Department of Environment and Natural Resources (DENR).

Specialist consultant team

Dr Kylie Hyde (Australian Water Environments) was the project manager for a consultant team engaged for its specialist expertise and experience in water resources management, to prepare the Technical Manual.

This team comprised Australian Water Environments, the University of South Australia, Wayne Phillips and Associates and QED Pty Ltd.

Beecham and Associates prepared Chapter 16 of the Technical Manual.

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14.1 Overview

As detailed in **Chapter 1**, there are many different WSUD measures which together form a 'tool kit' from which individual measures can be selected as part of a specific design response suiting the characteristics of any development (or redevelopment). Wastewater management is one of those measures.

This chapter of the Technical Manual for the Greater Adelaide Region is aimed at providing a general overview of the benefits of wastewater management and how water quality and water quantity objectives can be met through treatment and reuse of wastewater on a site and community scale.

Other chapters of the Technical Manual for the Greater Adelaide Region to be read in conjunction with this chapter include:

- Introductory chapters (**Chapters 1-3**);
- Demand Reduction (**Chapter 4**);
- Urban Water Harvesting and Reuse (**Chapter 8**); and
- Modelling Process and Tools (**Chapter 15**).

On average, more than half of the mains water used in homes in the Greater Adelaide Region is returned to sewers as wastewater from toilets, showers, kitchens and washing machines. Added to this is wastewater from industrial, commercial and other sources. Over the last 5 years, on average about 95,000 megalitres of domestic wastewater was generated in the Greater Adelaide Region each year, of which around 75,000 megalitres of treated wastewater was discharged into Gulf St Vincent.

The Government plan, Water For Good (2009), will reduce the amount of wastewater generated by urban development in Greater Adelaide.

Already 30% of our treated wastewater is recycled each year for irrigation use, toilet flushing and garden watering. Wastewater reuse is expected to increase to nearly 45%, given a range of significant wastewater projects underway (Water For Good, 2009).

Description

There are two main types of domestic wastewater:

- Blackwater is wastewater containing, or likely to be contaminated by, human waste matter (e.g. toilet wastewater or waters contaminated by toilet wastewater); and
- Greywater is wastewater from the hand basin, shower, spa bath, washing machine, laundry tub, kitchen sink and dishwasher.

(It should be noted that water from the kitchen sink is generally too high in grease and oil to be reused successfully without significant treatment.)

A typical household discharges an average of approximately 35 litres of blackwater and 95 litres of greywater, per person per day. Typical greywater and wastewater quality is summarised in **Table 14.1**.

Table 14.1 Comparison of Greywater Quality and Wastewater

Parameter	Greywater	Wastewater
Thermotolerant coliforms (per 100 mL)	10^1 - 10^7	10^6 – 10^8
Suspended solids (mg/L)	2 – 1500	100 – 500
BOD (mg/L)	6 – 620	100 – 500
Nitrite	<0.1 – 4.9	1 – 10
Ammonia (mg/L)	0.06 – 25.4	10 – 30
Total kjeldahl nitrogen (mg/L)	0.06 – 50	20 – 80
Total phosphorus (mg/L)	0.04 – 42	5 – 30
pH	5.0 – 10.0	6.5 – 8.5

Source: Environment Protection and Heritage Council (2006)

Greywater may contain urine and faeces from nappy washing and showering, as well as kitchen scraps, soil, hair, detergents, cleaning products, personal care products, sunscreens, fats and oils. Cleaning products discharged in greywater can contain boron and phosphates, and the water is often alkaline and saline – all of which pose potential risks to the receiving environment. Greywater quality can be affected by inappropriate disposal of domestic wastes.

Treated wastewater (or recycled water) use describes the treatment of wastewater to a standard where it can be safely used (in a public health sense) within our community. The State Government agencies in South Australia with the primary responsibility for regulating reuse schemes are the Department of Health and the Environment Protection Authority. For further information see **Section 14.2**.

Wastewater Services

In the Greater Adelaide Region, there are two distinct areas of wastewater services – sewered and non-sewered areas.

SA Water is responsible for the provision of wastewater services in sewered areas, while some local councils provide wastewater services to most non-sewered areas (i.e. Community Wastewater Management Schemes (CWMS)).

Figure 14.1 Gumeracha Wastewater Treatment Plant

Source: Courtesy of Australian Water Environments

Sewered Areas

The conventional water management system in the Greater Adelaide Region consists of a large scale centralised water supply network and sewerage collection and treatment systems. Sewerage is treated at three major metropolitan coastal wastewater treatment plants (WWTPs) at Bolivar, Glenelg and Christies Beach, and several smaller WWTPs, including Hahndorf, Aldinga, and Gumeracha. Wastewater that is not reused is discharged from these plants to receiving waters (depending on the WWTP location, into river systems or directly into Gulf St Vincent).

The majority of the Greater Adelaide Region is serviced by a sewer system.

Non-sewered Areas

For the areas where a sewer system does not exist, the on-site treatment and reuse options include:

- Septic tanks and subsurface disposal systems with drainage trenches on individual properties;

- Septic tanks with a community wastewater management scheme (CWMS) collection system; and
- Aerobic treatment units with designated irrigation areas.

Composting toilets and greywater treatment systems are also options that are able to be utilised on site.

The Department of Health provides information regarding requirements and approval procedures for new applications, including a list of systems which are approved for use in the Greater Adelaide Region. Septic tank installations can be approved by the local council for that area.

In some cases, community scale WWTPs are provided by developers as part of the development. These are normally associated with larger land divisions in non-sewered areas, however they are also occurring in areas that are sewered. Treated wastewater is generally reused for community irrigation purposes with appropriate approvals. There is currently only one local example of treated wastewater being plumbed back in to dwellings for toilet flushing – Mawson Lakes in the City of Salisbury.

Purpose

On-site or community scale wastewater treatment and reuse has many economic and environmental benefits for the community.

In overall terms, sustainable water management is an important goal and a key element of sustainable urban development. Government authorities and the land development industry are increasingly seeking to use alternative sources, such as treated wastewater, to conserve drinking quality water supplies and minimise wastewater disposal (and associated contaminants) to the marine environment.

The Greater Adelaide Region has an extensive sewerage network, presently designed to transport water to large scale treatment plants. Rather than transport this water from the city, potential exists to reuse this water as a resource.

The reduction of wastewater discharged to reticulated sewerage systems by more efficient water use, greywater and wastewater reuse, and alternative toilet systems can produce significant economic and environmental advantages to the community. However, this needs to be balanced against potential health risk, as sewerage systems and safe drinking water supplies have had a larger positive impact on public health than any other intervention.

It is also possible that in some locations, properly managed and maintained decentralised reuse might be able to cost effectively augment or replace existing sewerage infrastructure that would otherwise need to be replaced or upgraded.

Scale and Application

The potential for treatment and reuse of wastewater will depend on:

- The scale and location of the development;
- The volume, quality and timing (i.e. seasonality) of wastewater generated; and
- The volume, quality and timing (i.e. seasonality) of treated wastewater demand.

For urban developments, treated wastewater is suitable (depending on the quality and utilising the precautionary approach) for:

- Toilet flushing;
- Public open space irrigation;
- Private garden irrigation/outdoor use;
- Environmental flows; and
- Ornamental water bodies integrated into the development.

In general, there is likely to be less overall risk where water is recycled to developments by a dedicated authority with ongoing capacity to properly manage, monitor and maintain the system. The Mawson Lakes development in the City of Salisbury is a good example of a centralised wastewater treatment with a third pipe system used to return treated wastewater to dwellings for reuse in toilets and for irrigation.

Scale and applications for blackwater and greywater treatment and reuse are discussed briefly below.

Blackwater

Options for treatment and reuse of blackwater are applicable to a range of scales including on-site, community and regional.

Methods of blackwater treatment and disposal include:

- A composting toilet or other type of blackwater treatment/disposal system (i.e. aerobic system) approved for installation in South Australia;
- A septic tank with effluent disposal by subsurface disposal or connection to a Community Wastewater Management Systems (CWMS) (formerly known as Septic Tank Effluent Disposal Systems (STEDS));
- Connection to a Community Wastewater Management Scheme (without a septic tank on the individual property); or

- Connection to an SA Water sewerage system or a private or council scheme.

The specific requirements are as stated in available reference material from the Department of Health (see **Section 14.8**).

The treatment system is generally required to (depending on the end use):

- Remove non-organic materials (e.g. toilet paper, hair etc);
- Remove suspended solids (SS) to defined levels (in South Australia less than 30 milligram/litre);
- Reduce BOD (Biological Oxygen Demand) to defined levels (in South Australia less than 20 milligram/litre); and
- Provide an acceptable level of disinfection – normally by chlorine tablets in domestic units, liquid chlorine dosing or UV systems in larger community units.

An alternative potential option is sewer mining. Sewer mining uses existing infrastructure for transport of household wastewater to a small treatment plant which abstracts and treats wastewater from the sewer at an appropriate location. Suitable locations have an appropriate end use nearby such as a park area, golf course or a building or development complex. Effective sewer mining matches required demand with available supply.

A range of treatment technologies can be employed for sewer mining including:

- Subsurface flow wetlands;
- Suspended growth systems (e.g. activated sludge systems);
- Fixed growth systems (e.g. trickle filters);
- Recirculating media filters (fixed film bioreactor);
- Sand and depth filtration;
- Membrane filtration (micro, ultra, nano filtration and reverse osmosis); and
- Membrane bioreactor.

This technology list is indicative only, with new technologies expected to become commercially viable as competition increases in the water market.

Appropriate applications for sewer mining are commercial high rise developments, where other potential water sources are limited (such as rainwater harvesting which is limited by the available roof catchment and storage space). Likewise, greywater production is limited by lack of showers in commercial buildings. Thus the sewer provides a consistent water resource and sewer mining can be a suitable treatment technology.

Greywater

Reuse of residential (and commercial) greywater (water from the laundry, bathroom taps and shower) along with industrial greywater (slightly polluted water which can be reused in manufacturing) can save significant quantities of drinking quality water and reduce the need for treatment of wastewater.

Greywater generation is essentially a regular continuous supply. The site needs to be capable of accommodating the annual greywater load as well as the seasonally distributed rainfall.

Greywater can be collected in an on-site system and distributed by gravity or a pump to underground (subsurface) lawn and garden watering. Alternatively, a greywater system can include a storage tank with treatment using various combinations of physical, chemical and biological processes that supplies greywater for toilet flushing and garden irrigation via a pump.

The systems listed below are referred to as alternative on-site wastewater systems. These are waste control/wastewater systems not covered under codes prescribed under the Public and Environmental Health Act (Waste Control) Regulations 1995. With individual assessment and approval these alternative on-site systems may be installed:

- Greywater/sullage systems (laundry, bath, wastewater, shower, kitchen etc);
- Reed bed systems; and
- Nutrient removal systems.

This document does not provide detailed information on the responsibilities of plumbers, installers or manufacturers of systems. Specific local, state (and federal) requirements exist for plumbers, installers and manufacturers of systems as defined in the relevant Department of Health Guidelines, the Australian Guidelines for Water Recycling and plumbing regulations.

14.2 Legislative Requirements and Approvals

Treatment and reuse of wastewater is subject to various requirements to meet defined wastewater quality, maintenance of systems and associated health issues.

Before developing a wastewater treatment and reuse system it is important to check whether there are any planning regulations, building regulations or local health requirements that apply to wastewater reuse in your area.

The legislation which is most application to wastewater reuse in the Greater Adelaide Region includes:

- *Development Act 1993*;
- *Public and Environmental Health Act 1987*;
- *Environment Protection Act 1993*; and
- *Sewerage Act 1929.*

Development Act 1993

Installing a wastewater reuse system will generally be part of a larger development, however whenever a wastewater reuse system is planned, it is advised that the local council be contacted to determine whether development approval is required under the *Development Act 1993*.

Public and Environmental Health Act 1987

The Department of Health (Environmental Health Branch) is responsible for the implementation of the *Public and Environmental Health Act 1987* in South Australia. This agency provides information and assistance in establishing the requirements for installation of an on-site or community scale wastewater treatment system, whether black or greywater.

Installation of an on-site treatment system must take into account the Department of Health requirements for setback distances outlined in SAHC Code Waste Control Systems – Standard for Construction, Installation and Operation of Septic Tank Systems in South Australia and Supplement B – Aerobic Wastewater Treatment Systems (see **Section 14.8**).

Where it is intended to install a greywater treatment/diversion system in a sewered (or other reticulated system) area, approval must be obtained from the owner/operator of the system (i.e. SA Water for the majority of cases in the Greater Adelaide Region).

Permanent greywater systems such as diversion devices or treatment systems require installation approval from council or the Department of Health and all systems must be installed by a licensed plumber.

It is to be noted that the new On-site Wastewater Systems Code, presently in draft form, will be implemented late in 2008. This code will stipulate that all on-site wastewater related approvals for black and grey water will be addressed by the relevant local council (subject to some conditions and only up to 50 equivalent persons (EP)).

The Department of Health will assess and approve new treatment systems/devices for both classes of wastewater. This process involves:

- Engineering assessment of submission;
- Assessing compliance with relevant Australian Standard(s); and
- Preparation of Approval Conditions.

The unit can then be installed in accordance with manufacturer's specifications and conditions of approval.

Environment Protection Act 1993

Any development, including the installation of a wastewater reuse scheme, has the potential for environmental impact. There is a general environmental duty, as required by Section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities on a site, including during construction, do not pollute the environment in a way which causes or may cause environmental harm.

Aspects of the *Environment Protection Act 1993* which must be considered when planning on installing a wastewater reuse scheme are discussed below.

Water Quality

Water quality in South Australia is protected using the *Environment Protection Act 1993* and the associated Environment Protection (Water Quality) Policy 2003. The principal aim of the Water Quality Policy is to achieve the sustainable management of waters by protecting or enhancing water quality while allowing economic and social development.

In particular, the policy seeks to:

- Ensure that pollution from both diffuse and point sources does not reduce water quality; and
- Promote best practice environmental management.

Through inappropriate management practices, construction sites can be major contributors of sediment, suspended solids, concrete wash, building materials and wastes to the stormwater system. Consequently, all precautions will need to be taken on a site to minimise potential for environmental impact during construction of a wastewater reuse scheme.

The Environment Protection (Water Quality Policy) 2003 establishes thresholds above which it is an offence to discharge wastewaters to a water resource. This policy provides the legislative controls (*Environment Protection Act 1993*) to bring about improvements in the management of wastewaters, of which one method is the application of wastewater to a beneficial use.

The South Australian Reclaimed Water Guidelines (Environment Protection Authority South Australia 1999) describe methods by which reclaimed water can be used in a sustainable manner without imposing undue risks to public health or the environment.

The Australian Guidelines for Water Recycling (Environment Protection and Heritage Council 2006) are intended to replace the Reclaimed Water Guidelines and are now the primary reference for assessment of all reclaimed water/recycling projects.

Noise

The issue of noise has the potential to cause nuisance during any construction works and ongoing operation of wastewater reuse schemes. The noise level at the nearest sensitive receiver (which may be the nearest allotment for residential development purposes) should be at least 5 dB(A) below the Environment Protection (Industrial Noise) Policy 1994 allowable noise level when measured and adjusted in accordance with that policy. Reference should be made to the EPA Information Sheets on Construction Noise and Environmental Noise respectively to assist in complying with this policy (see **Section 14.9**).

Odour

The operation and maintenance of wastewater treatment and reuse schemes must be able to demonstrate that they will not cause significant adverse environmental impact or nuisance (e.g. odours).

Reference should be made to the EPA Guidelines for Separation Distances (see **Section 14.9**).

Licences

The EPA licenses wastewater treatment schemes that serve more than 1000 EP (equivalent persons) or 100 EP where the scheme is intended to operate in a sensitive environment. Advice on such large schemes should be sought from the Environment Protection Authority early in project development.

Sewerage Act 1929

SA Water administers the South Australian *Sewerage Act 1929* which is applicable to areas where there is a government sewerage system available. These areas are known as proclaimed drainage areas.

Areas where an SA Water sewerage system is not available are the responsibility of the local government authority and/or the Department of Health.

Section 36 of the *Sewerage Act 1929* provides for an exemption from the requirement to discharge to the sewerage system from a property. The Act allows for the exemption to be granted by SA Water and is used when application is made for the installation of a permanent greywater diversion system.

Exemption may be granted by SA Water in cases when they are satisfied that the proposal does not compromise the sewerage or drinking water systems.

In all cases within sewered areas, SA Water is to be contacted if on-site reuse is planned, particularly if seasonal (winter) discharges to sewer will/may be required.

In existing urban areas of the Greater Adelaide Region, each allotment generally has access to the sewerage system. A new home (single lot) development simply requires an application to SA Water for approval to connect to the system.

In the case of a larger land division (multiple lots) the process is the same with SA Water assessing the impacts of the hydraulic and organic loadings on the existing system. In general, the system will be able to handle the increases but if upgrading is necessary, the developer will be required to contribute to the required headworks.

For further information see www.sawater.com.au

National Guidelines and Standards

Any wastewater reuse projects will need to be undertaken in accordance with the Australian Guidelines for Water Recycling (Environment Protection and Heritage Council 2006). The guidelines include a risk-based approach to the reuse and recycling of wastewater and greywater from large scale centralised treatment facilities. Specific guidance is provided in Phase one for use of recycled water from centralised sewerage and greywater systems, and decentralised grey water. Phase two deals with stormwater, managed aquifer recharge (MAR) and drinking water augmentation.

Standards which are applicable to on-site wastewater management include:

- Standards Australia (1994). AS1547: Disposal Systems for Effluent from Domestic Premises, Standards Australia, Homebush, NSW;
- Standards Australia (1998). AS/NZS 1546: On-site Domestic Wastewater Treatment Units. Standards Australia, Homebush, NSW;

- Standards Australia (1994). AS/NZS 1319: Safety Signs for the Occupational Environment;
- Standards Australia (1996). AS/NZS 2700: Colour Standards for General Purposes; and
- Standards Australia (2003). AS/NZS 3500.1: Plumbing and Drainage – Water Services.

14.3 Design Considerations

When considering opportunities to develop treated wastewater reuse schemes, the interaction with the built environment and past investments should be taken into account. A sustainable approach aims to optimise the community's past investments with future requirements to deliver ecologically sustainable solutions. The ideal approach is to transfer investment from water transportation to the treatment, creating a useful resource.

Wastewater reuse schemes should only be considered when environmental and health concerns can be adequately addressed through design and realistic operation and maintenance regimes.

A number of the design considerations for wastewater reuse schemes include:

- Demand pattern and demand management;
- Infrastructure;
- Social and human health;
- Evaluation of the impact on the natural environment;
- Greenhouse gas emissions; and
- Sludge disposal.

The following sections provide an overview of the key design issues that should be considered when conceptualising and designing a wastewater reuse scheme.

Demand Pattern and Demand Management

A key consideration is the intended use of the treated wastewater and the associated demand profile for that application. For example, if the intended use is irrigation, less water will be required during the winter months.

Demand management is an important measure to reduce water consumption. Typically this applies to mains water but it also applies to reused water. A frequent misconception is that reused water is an inferior product that is cheaper and in plentiful supply. In fact, reused water is a high quality resource and should be considered as such.

To upgrade water quality, treatment is usually required. This process requires energy to remove pollutants. The reused water may then need to be pumped to the end user. By minimising consumption of reused water, energy is also minimised, ensuring a more efficient and sustainable water supply system.

Typical demand management strategies include the installation of water efficient taps and fittings (e.g. 6/3 litre dual flush toilets). These are cost effective and sustainable ways of minimising resource consumption. Further information on demand management can be found in **Chapter 4** of the Technical Manual.

Infrastructure

New developments will increase the demands on the existing water supply and wastewater collection, treatment and disposal infrastructure:

- Infill developments will increase the population density in that immediate area; and
- New land development areas will increase the overall population required to be serviced.

Sufficient capacity is required for conveyance of wastewater from the development site to the centralised or local treatment facilities. Typically, the surrounding infrastructure may need to be upgraded to accommodate this population growth.

The capacity of the existing infrastructure should therefore be considered for any development or redevelopment.

Social and Human Health Considerations

Treated wastewater is a safe and reliable alternative water source for our community as long as the use meets the requirements of the relevant codes and standards, particularly the Australian Guidelines for Water Recycling which are framed around a risk management approach.

Reliable treatment is essential to ensure health risks are minimised. Human risks from the use of treated wastewater are primarily associated with exposure to pathogenic microorganisms causing illness, in extreme cases possibly death. Pathogenic organisms can be discharged into waterways by humans and are typically in high concentrations in wastewater.

Adequate treatment is required to reduce pathogens with a risk based approach defining the water quality requirements for end uses. Generally a higher water quality is required as potential human exposure increases.

Guidelines and targets have been specified by regulatory authorities on national and state levels for water quality, receiving water body quality and a range of water reuse applications.

The social acceptance of water reuse is also an important consideration for urban development.

Public concerns regarding the use of treated wastewater may include:

- Perceived health risks;
- 'Yuck factor' or disgust of reusing water that once contained waste;
- Specific applications of treated wastewater;
- Source of water to be reused;

- Trust and knowledge;
- Attitudes about the environment; and
- Cost of treated wastewater.

The concept of treated wastewater reuse is becoming more widely accepted by the community for most applications including toilet flushing and outdoor use (garden irrigation and car washing). The current prolonged drought has increased community awareness of alternative water sources.

Figure 14.2 Treated Wastewater from the Hahndorf WWTP Utilised at The Cedars

Source: Courtesy of Australian Water Environments

In general, people are comfortable with reusing treated wastewater when the end use is not directly ingested. Community acceptance reduces as and when treated wastewater use comes closer to human contact or ingestion, for example, for use in the laundry for clothes washing.

The following approach can assist in gaining approval and social acceptance of a treated wastewater reuse scheme:

- Adopt a risk based approach to defining methods of delivery and corresponding water quality requirements as defined in the Australian Guidelines for Water Recycling;
- Define requirements for pre-commissioning monitoring and demonstration of compliance to current health standards for reused water; and
- Identify community receptiveness to different applications of reused water.

Evaluation of the Impact on the Natural Environment

Selection of wastewater treatment technologies must consider the broader environmental impact. The interaction between the wastewater treatment technology to the aquatic environment, land capability, greenhouse gas emissions and solids management is a key part of the decision making process.

Treated wastewater can have several associated environmental risks. These are site-specific and dependent on the topography, geography and location associated with specific water treatment technology and water end use. Key risks to the environment include:

- Impact on the aquatic environment (or receiving water body) (i.e. eutrophication);
- Impact on the land primarily from irrigation (i.e. waterlogging and impact on the soil and plant toxicity);
- Nutrient imbalance which may result in plant deficiencies and toxicities;
- Loss of biodiversity from mortality of native biota;
- Production of greenhouse gases; and
- Production of biosolids and other wastes.

Treated wastewater in urban settings can provide water for irrigation. The suitability of treated wastewater to specific environmental conditions depends on soil conditions, site topography and geology. The risks associated with applying reused water for land irrigation (both rural and urban) include:

- Elevated nutrient levels leading to eutrophication of water surface waters and soils;
- Elevated salinity levels which may cause corrosion of assets;
- Elevated chlorine disinfection residuals which can be toxic to plants;
- Elevated boron levels; and
- Excessive sodicity (soil with excessive exchangeable sodium (> 6%), leading to poor soil structure).

Increased salinity from using treated wastewater for irrigation has the potential to impede plant growth and degrade soil conditions. Soil sodicity due to the high presence of sodium ions relative to magnesium and calcium ions can also degrade the soil structure.

Increased nutrient levels will also be present in treated wastewater. The urban environment with an adjusted botanical landscape (from pre-development conditions) may benefit from the increased nutrient loading. Proper management is required to ensure minimal nutrients excretion to the groundwater, thereby protecting the groundwater quality.

Greenhouse Gas Emissions

A combination of factors determines greenhouse gas emissions including:

- The type of water treatment and its energy consumption;
- Organic loading in wastewater; and
- Transportation – energy requirements for reticulation.

The potential generation of greenhouse gas emissions from treating wastewater can be calculated. It is recommended that greenhouse gas emissions be incorporated into the final evaluation process for wastewater treatment and reuse technology selection.

On-site abatement of greenhouse gas emissions may not always be possible. To mitigate greenhouse gas emissions an option is off-site abatement.

Sludge Disposal

Wastewater contains solids, known as biosolids or sludge, which requires disposal. The site boundary and surrounding infrastructure determine the options for sludge disposal. Disposal options include through the conventional sewer system or by dedicated sludge processing facilities. Processed biosolids are used in compost and as soil additives.

14.4 Design Process

Overview

There is a range of scales and types of wastewater treatment and reuse schemes. The type of scheme can vary from a greywater diversion hose in a household yard for garden irrigation to a community scale dual reticulation system using tertiary treated wastewater. The scope and degree of complexity is dependent on the individual system.

The greater the treatment requirements, the more complex the treatment component and the more involved the monitoring and management systems will need to be.

The context of the system will influence the nature of the planning and design process.

The key steps in the design process for a wastewater treatment and reuse scheme include:

- Assess the site, catchment and appropriate regulatory requirements;
- Identify the objectives and targets;
- Undertake a water balance;
- Identify the potential options;
- Consult with key stakeholders and relevant authorities;
- Evaluate options;
- Undertake detailed design of selected option;
- Check the design objectives; and
- Develop a maintenance and monitoring plan.

The design process is likely to be iterative, requiring several rounds of review in the earlier stages as new information becomes available and negotiations progress with stakeholders that may alter the objectives and/or available options.

Detailed wastewater reuse systems design information is contained in various publications (see **Section 14.8**). However, a number of elements of the design process are discussed briefly below.

General information on the design process can be obtained in **Chapter 3** of the Technical Manual.

Assess Site, Catchment and Appropriate Regulatory Requirements

WSUD responds to site conditions and land capability and cannot be applied in a standard way. Careful assessment and interpretation of site conditions is therefore a fundamental part of designing a development that effectively incorporates WSUD.

To understand the drivers and appropriate end uses for the treated wastewater, an understanding of the development and the environment is required. This step identifies and assesses the potential constraints and opportunities of the proposed project site.

Development characteristics and location influence viable options for wastewater reuse. The factors influencing water reuse viability include:

- Size (equivalent tenancy, occupancy);
- Development density (subdivision, medium density, high rise);
- Development type (greenfield, brownfield, retrofit, infill for residential or commercial);
- Public open space requiring irrigation; and
- Integration with the surrounding environment.

Constraints for the wastewater reuse scheme must be identified and considered. In the Greater Adelaide Region, these constraints may include (depending on the intended form of reuse):

- Land availability, including future land use plans;
- Geology and soil properties;
- Depth to groundwater table or confining layers (e.g. bedrock);
- Topography (e.g. very flat or steep site);
- Site specific constraints (e.g. environmental, conservation and heritage issues, neighbouring land uses);
- Location and type of existing vegetation;
- Location of service infrastructure (e.g. roads, sewerage, scheme water and gas pipelines, and telephone and power lines);
- End use of the treated water (e.g. delivery into downstream waterways or reuse as irrigation water); and
- Availability of potential users of wastewater.

In particular, the proximity of the proposed wastewater reuse scheme to residential areas needs to be considered in the selection and design of this WSUD measure (see EPA's Guidelines for Separation Distances).

Neighbouring communities will need to be consulted on the appearance, functionality and role of the wastewater reuse scheme where appropriate (i.e. when above ground storage is involved). There are also safety concerns where the treated wastewater is utilised in a publicly accessible area.

The level of site and catchment investigation required should match the size and scale of the development and its potential impacts (i.e. larger developments having a greater impact would require greater site investigations).

A staged approach to site investigations can be adopted to minimise costs. This involves an initial screening level assessment using readily available information to identify major constraints and opportunities, then focusing efforts on any identified constraints.

For example, if the treated wastewater is intended to be used for irrigation, the proponents may be required to undertake a soil test to determine the capability of the soil to ensure that treated wastewater will not pool, or runoff irrigated areas. In addition, a soil assessment will assist in selecting vegetation types that will be suitable for the soil type and enhance treated wastewater absorption.

Identify Objectives and Targets

Design objectives and targets will vary from one location to another and will depend on site characteristics, development form and the requirements of the receiving ecosystems. It is essential that these objectives are established as part of the conceptual design process and discussed with the relevant council prior to commencing the engineering design.

Objectives include environmental benefits (such as water quality improvement, water conservation, detention and erosion control), habitat value (enhancing biodiversity and conservation) and/or aesthetic and recreational values.

Undertake a Water Balance

To estimate water requirements, a water balance can be undertaken to:

- Align recycled water uses with available water sources (including rainwater, stormwater, drinking water) on a fit-for-purpose basis;
- Assess water demands with an end-use analysis; and
- Align the demand profile with the supply profile.

The water balance provides a starting point to assess the viability of reusing water to complement other available water sources i.e. drinking water, rainwater harvesting and conventional large scale water management approaches. The availability of reused water is dependent on a combination of:

- The site boundary;
- Operation scale;
- Potential water resource (e.g. sewer carrier);
- Treatment capacity (average and peak flows);
- Treatment reliability; and
- On-site storage.

An end-use water approach should be utilised for the water balance. An end-use model enables specific water uses to be matched to appropriate water sources on a fit-for-purpose basis and calculates the water demand for each use. Relating water demands to specific activities and end uses provides a greater understanding of the demands on water services. The focus shifts from supplying a finite amount of water to the provision of appropriate and sustainable urban water services (including wastewater and stormwater management services). Within this framework, wastewater reuse opportunities are identified and quantified.

Quantifying wastewater reuse indicates the average wastewater reuse flow rate required and thus the operational scale. Operational scale provides a first assessment in the selection of viable wastewater reuse technologies. Commercially available wastewater treatment technologies have a defined operational scale.

The demand profile influences the technology selection. The sizing and selection of water treatment technologies must cater for peak as well as average demands. For example, water supplied for toilet flushing has a fairly constant demand throughout the year, whereas irrigation requirements fluctuate with seasonal requirements, peaking in the summer months. Satisfying peak demands requires a technology that can respond rapidly or provide adequate storage to buffer against fluctuating water demands.

Physical treatment systems are particularly well suited to meeting fluctuating demands by being able to respond quickly.

Biological systems require a greater lag time to respond to changing water demands, and often require storage volumes to cater for daily and seasonal variations in demands. Storages such as tanks, dams, wetlands and aquifers provide a buffer. This enables reused water to be processed at a constant rate despite variable water demand. The storage requirements can be high, especially to meet seasonal variations in water demands. In some such cases, it may be more sustainable to provide reused water for a base load and have this supplemented by other water sources during periods of high water demands.

Storage requirements must be considered in the evaluation, and sufficient land allocated during the masterplanning phase. Tanks can be incorporated into buildings, underground or within public open spaces. Managed aquifer recharge (MAR) is another viable option depending on the level of treatment of the wastewater and the suitability of the aquifer.

Often, ornamental water bodies and wetlands are also considered for on-site storage. The key factors in the evaluation of water bodies are:

- Nutrient loads from reused water;
- Appropriate algal management strategies to prevent algal blooms; and
- Draw down of water bodies impacting on aesthetics (typically the highest demand for water occurs during summer periods when evaporation rates are the greatest, exacerbating the water body draw down).

Select Appropriate Wastewater Management System

This step identifies various possible layouts for a scheme to meet its objectives. Each treatment train and associated technology option should be evaluated on a case-by-case basis.

Technology selection is dependent on several criteria including:

- Scale of the development (including site characteristics);
- How the water will be used and demand profile;
- Water quality and quantity before treatment;
- The quality and quantity of water needed following treatment;
- Available space for treatment and storage;
- Surrounding infrastructure;
- Social and human health considerations;
- Economic considerations, including life cycle costs;
- Other environmental objectives (e.g. greenhouse gas emissions, land capability, receiving water bodies);
- Climatic conditions;
- Operating and maintenance; and
- Ongoing ownership of the treatment system.

As stated above, there are various treatment technologies that can be selected depending on the scale and application of the scheme. Reference to the Department of Health approved unit register is recommended for on-site domestic or small community installations.

For single households, simple greywater reuse systems are preferable (in general). Larger systems are more appropriate for larger scale applications with associated management and maintenance.

Identify and Consult with Key Stakeholders

The designer (or applicant) should liaise with civil designers and council officers prior to proceeding any further to ensure:

- The wastewater reuse scheme will not have an adverse impact on existing services or structures;
- Access for maintenance to existing services is maintained;
- No conflicts arise between the location of services and WSUD devices; and
- The objectives and targets are consistent with council directions stated in documents such as strategic plans and stormwater management plans.

The council will also be able to advise whether:

- Development approval is required, and what information should be provided with the development application;
- Any other approving authorities should be consulted (e.g. SA Water, EPA, DoH); and
- Any specific council requirements need to be taken into consideration.

Land and asset ownership issues are key considerations prior to construction of a WSUD measure (including wastewater treatment systems). A proposed design should clearly identify the asset owner and who is responsible for maintenance and this aspect should also be discussed during a meeting with the local council.

If on-site treatment and reuse is proposed, two aspects require consideration by the proponent:

- If all wastewater can be reused on site all year round then the local council only need be consulted in project development stages; and
- If seasonal (winter) discharge to sewer is proposed, then approval of both SA Water and local council will be required.

Key stakeholders should also be consulted throughout the planning process (depending on the scale of the scheme), particularly during the setting of project objectives. Their engagement in the development of large scale schemes from the planning stage will:

- Allow for any concerns or misconceptions to be identified and addressed early in the process; and
- Provide opportunities for educating and informing the community and build user confidence in the scheme.

The key stakeholders will depend on the nature and location of the scheme.

Evaluate Options

Conventional evaluation of treatment technologies compares technical viability and cost effectiveness. The type of methodology for assessment depends on the scale of the development, but a simple cost-benefit analysis may not adequately assess the breadth of issues for considering wastewater reuse alternatives. Site characteristics, an integrated water management perspective and 'externalities' such as downstream infrastructure interactions and the impact on the natural environment should also be taken into account.

The selection of appropriate, sustainable and suitable water treatment technologies is dependent on economic, environmental and social considerations.

Detailed Design of Selected Option

During the detailed design of the selected scheme, a risk management strategy should be developed. This should, in particular, identify public health and environmental hazards and an appropriate mix of controls to be implemented during the design and operational phases.

14.5 Design Tools

Several design tools are available for the concept and detailed design of wastewater reuse schemes as detailed in **Chapter 15**.

The modelling tools which are able to assist include:

- MUSIC;
- WaterCress; and
- E2.

The local council will be able to advise whether modelling is required as part of the development application process.

14.6 Maintenance Requirements

Adequate maintenance of wastewater treatment and reuse schemes is important to ensure that the scheme continues to meet its design objectives in the long-term and does not present public health or environmental risks.

Each wastewater treatment system will have its own maintenance requirements with manufacturers and suppliers able to provide relevant maintenance regimes. A risk management plan is also required.

Adequate provision for downtime, such as scheduled maintenance, should be accounted for. For example, the greywater plumbing should be connected to the mains sewer, enabling immediate diversion and greywater disposal and provision for drinking (or mains) water to be temporarily used for toilet flushing.

All maintenance should be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure. Maintenance personnel and asset managers (or the building owner) will use this plan to ensure the wastewater reuse scheme continues to function as designed. To ensure maintenance activities are appropriate for the scheme as it develops, maintenance plans should be updated a minimum of every three years.

The maintenance plans and forms should address the following:

- Inspection frequency;
- Maintenance frequency;
- Data collection/storage requirements (i.e. during inspections);
- Detailed clean-out procedures including:
  - Equipment needs
  - Maintenance techniques
  - Occupational health and safety
  - Public safety
  - Environmental management considerations
  - Disposal requirements (of material removed)
  - Access issues
  - Stakeholder notification requirements
  - Data collection requirements (if any)
  - Design details.

More complex designs with mechanical devices, such as valves or pumps, may require much more detailed maintenance plans, including manufacturers' maintenance recommendations.

For example, membrane filtration processes will require regular membrane cleaning either chemically or physically, with eventual membrane replacement. Operation can be affected by the variable wastewater quality which can potentially harm the system, for example a peak caustic load in the sewer from an industrial customer.

To determine whether the wastewater treatment process is performing as expected, a monitoring program detailing the water quality of inflow and outflow is recommended.

The recommended maintenance for a greywater treatment system is contained in **Appendix A**.

14.7 Approximate Costing

Due to the variability in the scale and type of wastewater treatment and reuse schemes, it is difficult to provide an indication of costs of construction and operation of such schemes. Local data should be obtained, wherever possible, when considering the design of a wastewater treatment and reuse scheme.

Life cycle provides an important economic indicator for the selection of wastewater treatment technologies. Life cycle costing enables the consideration of all costs including the capital expenditure, operating costs and ongoing replacement costs to be considered. The key components to a life cycle costing evaluation are:

- Capital expenditure;
- Ongoing maintenance and labour costs;
- Replacement costs and timing for significant expenditure;
- Life span; and
- Decommissioning costs.

As wastewater treatment and reuse technologies and their commercialisation are developing quickly, costs are expected to decrease.

14.8 Case Studies

Overview

There are many examples of wastewater treatment and reuse schemes in the Greater Adelaide Region including:

- The City of Holdfast Bay, where a small amount of treated wastewater from the Glenelg Wastewater Treatment Plant is used for reserve irrigation, Adelaide Airport, Adelaide Shores and a number of other sites;
- Onkaparinga Council (McLaren Vale and McLaren Flat), where treated wastewater is used to irrigate vineyards in McLaren Vale;
- City of West Torrens uses about 4 megalitres/year on the Adelaide Airport grounds plus 20-30 megalitres/year on the university sports playing fields; and
- City of Port Adelaide Enfield, where several industries are using treated wastewater for landscape irrigation.

The wastewater treatment and reuse schemes at Mawson Lakes and Laratinga Wetland are described briefly below.

Mawson Lakes, City of Salisbury

Mawson Lakes is a world-class third pipe greenfields development 12 km from Adelaide which has approximately 2000 residents and is expected to have over 10,000 residents by 2010. The scheme is innovative from both energy conservation and water perspectives. Mawson Lakes has been developed by a consortium of Delfin Lend Lease and the SA Government in cooperation with the City of Salisbury.

Residents have agreed to live there with the understanding that they have to use recycled water in their toilets and outside in the garden through a dual water supply system. Construction of this greenfields suburb began in 1997.

The recycled water is delivered through lilac taps (and a water meter) and these have been installed on all properties.

The supply of reclaimed water is achieved by treating wastewater from the Mawson Lakes community at the Bolivar WWTP and returning the reclaimed wastewater to mix with recycled stormwater from Parafield Wetlands in a mixing tank at Greenfields. The reclaimed water is then pumped back to the Mawson Lakes development. This whole system is called the Mawson Lakes Reclaimed Water Scheme.

This scheme reduces the environmental impact by reclaiming wastewater from the Bolivar WWTP and stormwater from the Dry Creek Catchment.

Laratinga Wetland, District Council of Mt Barker

Figure 14.3 Laratinga Wetland

The Laratinga Wetland, constructed in 1999, is a District Council of Mount Barker development, located in Mount Barker in the Adelaide Hills.

The main function of the wetland is to filter 'A class' water from the nearby wastewater treatment plant.

Wastewater from Littlehampton and Mount Barker is treated at this plant. With a growing population, the disposal of this treated water became a concern to council in 1993. For many years the treated water flowed into the Mount Barker Creek, and the impact on the ecology of the creek was becoming an issue. Upgrading of the treatment plant in the late 1990s included plans to build the large artificial wetland to filter the water further and reuse it for local irrigators, parks and gardens. Wastewater from nearby Nairne is now being pumped to the wastewater treatment plant and through the wetland, bypassing the Nairne oxidation lagoons, which is benefitting the health of the Nairne Creek. The improvements to the wastewater treatment plant, including the wetland, cost approximately $5 million.

The wetland has taken several years to resemble a natural ecosystem. Landscaping design with the use of indigenous plant species has encouraged birds to utilise the wetland.

Location: Corner of Springs Rd and Bald Hills Rd, Mount Barker

Elevation: 310 metres

Area: Total area of 16.7 hectares (10.7 hectares under water)

Wetland type: Storage basin/sedimentary pond to remove excess nutrients from the 'A class' water being released from the wastewater ponds.

14.9 Useful Resources and Further Information

Fact Sheets

http://cweb.salisbury.sa.gov.au/manifest/servlet/binaries?img=4044&stypen=html

Mawson Lakes Recycled Water Scheme fact sheet

www.health.sa.gov.au/pehs/branches/wastewater/ph-factsheet-greywater-bucketing.pdf

Department of Health Manual Bucketing fact sheet

www.waterforgood.sa.gov.au

Water For Good fact sheets

www.waterforgood.sa.gov.au/wp-content/uploads/2010/07/fs0005_asr_in_sa.pdf

ASR in South Australia (DWLBC)

www.deus.nsw.gov.au/Publications/dwe_greywater_factsheet_1.pdf

Greywater Fact Sheet 1 – Greywater Diversion Do's and Don'ts (NSW)

www.deus.nsw.gov.au/Publications/dwe_greywater_factsheet_2.pdf

Greywater Fact Sheet 2 – Choosing the Right Greywater System for Your Needs (NSW)

www.deus.nsw.gov.au/Publications/dwe_greywater_factsheet_3.pdf

Greywater Fact Sheet 3 – Irrigating with Greywater (NSW)

www.deus.nsw.gov.au/Publications/dwe_greywater_factsheet_4.pdf

Greywater Fact Sheet 4 – Keeping your Plants and Soils Healthy with Greywater (NSW)

www.deus.nsw.gov.au/Publications/dwe_greywater_factsheet_5.pdf

Greywater Fact Sheet 5 – Maintenance of Greywater Diversion Devices and Treatment Systems (NSW)

www.sawater.com.au/SAWater/YourHome/SaveWaterInYourGarden/Lawns.htm

WaterWise for Your Lawn… information sheet

Regulations and Legislation

www.health.sa.gov.au/pehs/branches/wastewater/ph-factsheet-greywater-permanent.pdf

Department of Health Installation of Permanent On-site Domestic Greywater Systems

www.health.sa.gov.au/pehs/branches/wastewater/0808-alt-onsite-ww-appform.pdf

Department of Health Application for Alternative On-Site Wastewater / Waste Control System Installation

www.health.sa.gov.au/PEHS/publications/Septic-tank-book.pdf

Department of Health Standard for the Construction, Installation and Operation of Septic Tank Systems in South Australia

www.sawater.com.au/NR/rdonlyres/7F6C9876-A17D-442F-9FA2-1DB007AA4729/0/greywater_factsheet.pdf

SA Water Greywater Guidelines Information Sheet

www.sawater.com.au/SAWater/YourHome/MawsonLakesResidents/

SA Water Recycled Water System in a Sewered Area, and Recycled Water Plumbing Guide

www.epa.sa.gov.au/pdfs/sepguidepcd.pdf

EPA Guidelines for Separation Distances

www.epa.sa.gov.au/pdfs/cop_aquifer.pdf

Code of Practice for Aquifer Storage and Recovery, EPA

www.epa.sa.gov.au/pdfs/guide_wws.pdf

Water and Wastewater Sampling Guideline, EPA

www.epa.sa.gov.au/pdfs/reclaimed.pdf

South Australian Reclaimed Water Guidelines

www.epa.sa.gov.au/pdfs/guide_lagoon.pdf

Wastewater and Evaporation Lagoon Construction Guideline

www.legislation.sa.gov.au/LZ/C/POL/ENVIRONMENT%20PROTECTION%20(NOISE)%20POLICY%202007/CURRENT/2007.-.UN.PDF

Environment Protection (Industrial Noise) Policy 1994

www.epa.sa.gov.au/pdfs/info_construction.pdf

EPA Information Sheet on Construction Noise www.epa.sa.gov.au/pdfs/info_noise.pdf

EPA Information Sheet on Environmental Noise

www.epa.sa.gov.au/pdfs/building_sites.pdf

EPA Handbook for Pollution Avoidance on Building Sites

http://dataserver.planning.sa.gov.au/publications/654p.pdf

Guide for Applicants, Planning SA

Products and Manufacturers

www.health.sa.gov.au/PEHS/branches/wastewater/090703-wwproducts-greywater.pdf

Department of Health Approved Greywater Diversion and Treatment Systems for Marketing, Sale & Installation in South Australia

www.watermark.standards.org.au

WaterMark

www.greywatersaver.com

Greywater diverter

www.hrproducts.com.au

HR Products

www.nylex.com.au/products/water_garden.html

Nylex Water

www.plasticplumbing.com.au

Plastic Plumbing

www.greenplumbers.com.au

Green Plumbers

General Information

www.sawater.com.au/NR/rdonlyres/04C0CB50-30AF-4A64-A902-020DBBD37F43/0/Recyledwaterplumbingguide.pdf

SA Water Recycled Water Plumbing Guide

www.lga.sa.gov.au/site/page.cfm?u=253

Community Wastewater Management Schemes Information www.greenhouse.gov.au

Australian Greenhouse Office

www.lanfaxlabs.com.au

Review of detergents

www.dbce.csiro.au/urbanwater

CSIRO Urban Water Program

www.sustainablehouse.com.au

Michael Mobbs Sustainable House

www.waterrating.gov.au

Water Efficiency Labelling Standards

www.ata.org.au

Alternative Technology Association

http://waterbydesign.com.au/TechGuide/

Aquifer Storage and Recovery – WSUD Technical Guidelines for South East Queensland

www.brisbane.qld.gov.au/documents/building_development/subdivision_development/wsud_chapt10_aquifer_storage_and_recovery.pdf

Aquifer Storage and Recovery – Brisbane City Council Draft WSUD Technical Guidelines

www.sydneywater.com.au/Publications/FactSheets/SewerMiningHowToEstablishASewerMiningOperation.pdf#Page=1

Sewer Mining - How to Establish a Sewer Mining Operation (note: relates to Sydney)

(Websites current at August 2010)

14.10 References

Department of Energy Utilities and Sustainability NSW (2007). *NSW Guideline for Greywater Use in Sewered, Single Household Residential Premises.* March. www.deus.nsw.gov.au/Publications/NSW%20Guidelines%20for%20Greywater%20Reuse%20in%20Sewered,%20Single%20Household%20Residential%20Premises.pdf

Environment Protection and Heritage Council (2006). *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1).* November. www.ephc.gov.au/sites/default/files/WQ_AGWR_GL__Managing_Health_Environmental_Risks_Phase1_Final_200611.pdf.

Environment Protection Authority South Australia (1999). *South Australian Reclaimed Water Guidelines.* Adelaide, South Australia. www.dh.sa.gov.au/pehs/branches/wastewater/reclaimed-water.pdf.

(Websites current at August 2010)

Appendix A

Greywater Treatment Systems Recommended Maintenance

Greywater Treatment System

Recommended Maintenance

Greywater Diversion Device Component	Maintenance Required	Frequency
Filter	Clean filter - filter should be removed and cleaned, removing physical contaminants	Weekly
	Replace filter	As recommended by manufacturer or as required (usually every 6 – 12 months)
Surge tank	Clean out sludge from surge tank	Every 6 months
Subsurface irrigation distribution system	Check that water is dispersing - regularly monitor soil to ensure all areas are wet after an irrigation period	Weekly
Soil condition	Check that soil is healthy. Signs of unhealthy soil include: - damp and boggy ground hours after irrigation - surface ponding and runoff of irrigated water - poor vegetation growth - unusual odours - clumping of soil - fine sheet of clay covering surface	Monthly

Source: Department of Energy Utilities and Sustainability NSW (2007)