

 **RMIT University**



**Australian Government**  
**National Water Commission**  
Raising National Water Standards Program



# **Urban Greywater Design and Installation Handbook**

**November 2008**





## PREFACE

This Handbook has been developed to provide practical information for gaining approval, diversion and for treatment and irrigation of greywater within single households for the uses specified.

The Handbook forms 1 component of a three part package that includes the following:

- (a) *Urban Greywater Installation and Use and Greywater Design and Installation for a Single Household* (this document) which provides practical and technical information for plumbers to gain approval, install and maintain rainwater systems for single households, multi-unit dwelling, community and commercial buildings.
- (b) *The Greywater Handbook* which provides practical and technical information for plumbers to gain approval, install and maintain greywater systems for single households.
- (c) *The National Water Commission Waterlines Publication* which provides an initial overview of necessary information for communities to understand before pursuing the installation of greywater or rainwater re-use devices in the domestic settings.

Together this package aims to progress urban water reform under the commitments outlined in the National Water Initiative (NWI), to encourage innovation in water supply, re-use and recycling, and increasing the efficient use of water within domestic settings.

To optimise the full potential of greywater as an alternative water resource it is recommended that greywater be treated to a suitable level and be connected to internal plumbing connections (e.g., toilet, washing machine).

The primary purpose of this Handbook is to provide practical guidance to plumbers and Councils. The Handbook will assist them in understanding the benefits and risks associated with greywater use, to enable management of any associated risks, and ensure that greywater is approved (where required), installed, used and maintained at a residential household site without compromising public health and the environment. The secondary purpose is to provide a valuable insight for householders and regulators as to the approval and installation process and responsibilities of the householder when using and maintaining their greywater system. This will ensure the community is informed sufficiently to manage their greywater effectively.

This Handbook has been developed jointly by the Master Plumbers and Mechanical Services Association of Australia (MPMSAA) and RMIT University.

Additional editorial and technical services were provided by Arris Pty Ltd (Dr Daryl Stevens). The Handbook provides comprehensive information for the design, approval, installation, use and maintenance of greywater systems for a single household.



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## INTRODUCTION

Recent widespread drought in Australia, combined with the continued population growth of cities, has resulted in increasing pressure on drinking water supplies in most areas of Australia. Public perception is that household greywater is a valuable resource that should be used, with many State and local governments encouraging the use of greywater as part of a wider water demand management strategy.

Greywater from a single household, if treated appropriately, can be considered a resource and can be used on-site for garden and lawn irrigation, toilet flushing, washing machines, and other outdoor uses as defined in States and Territories of Australia. Greywater refers to the wastewater generated from kitchens, laundries and bathrooms, not blackwater, which is waste containing human excrement.

This Handbook covers greywater use for a single household on a single land title in a sewered area, and has identifies the potential risks associated with single household greywater use. It discusses the design and installation of greywater treatment systems (GTSs) and greywater diversion devices (GDDs), and the use of this greywater. The Handbook initially covers treated greywater, which has the least risk to public health and the environment (Chapter 3), followed with untreated greywater (Chapter 5).

This Handbook does not cover greywater use for a site comprising more than one household or dwelling. The definitions and terminology used throughout this Handbook are consistent with AS/NZS 3500, *National plumbing and drainage* and other plumbing regulations. (Refer to the Glossary of terms at the rear of this Handbook for terms relating to greywater).



## **Greywater Design and Installation for a Single Household**

### **C H A P T E R 1      G E N E R A L**

#### **1.1 WHAT IS GREYWATER?**

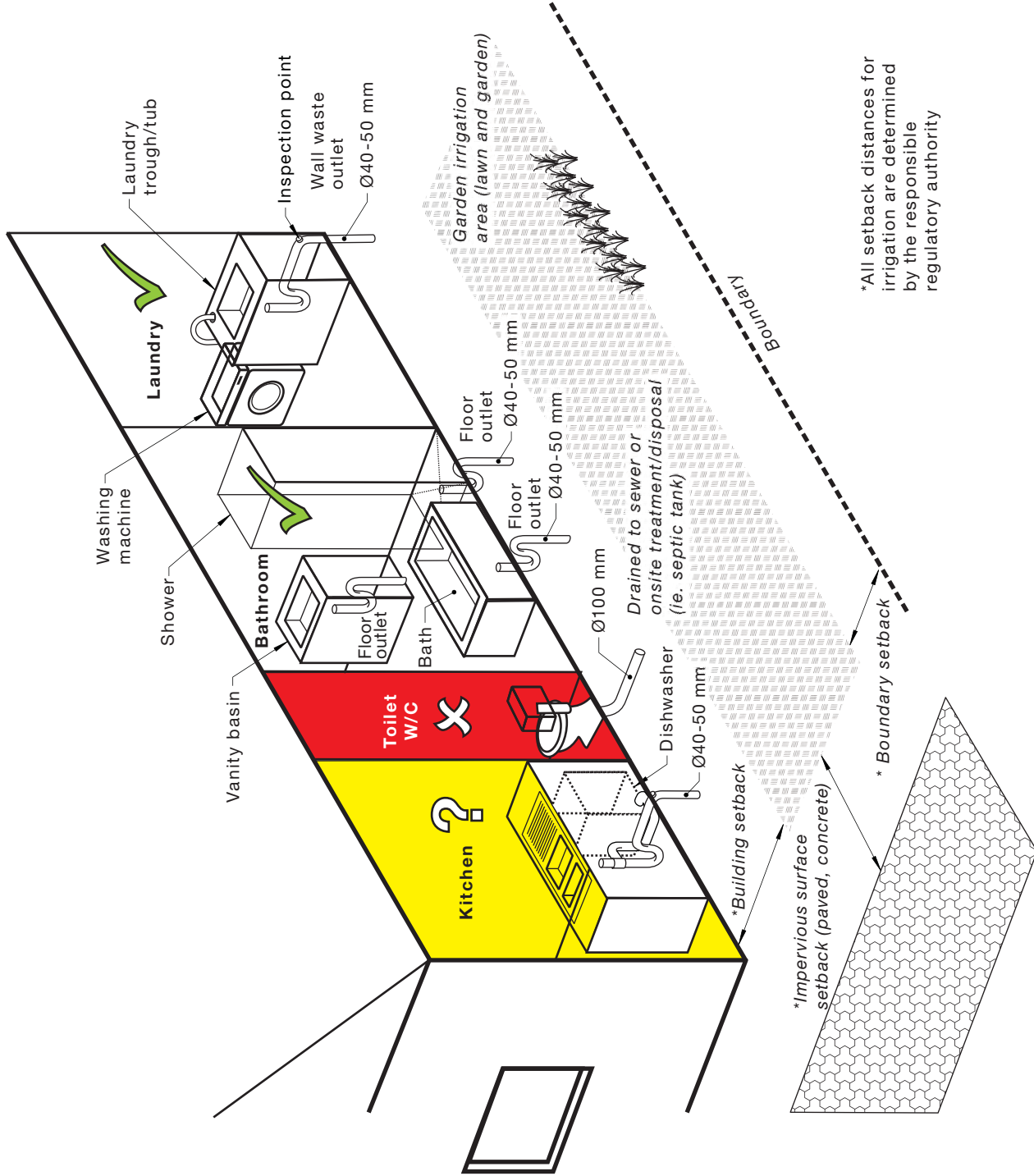
Greywater is the wastewater from:

- (a) Washing machines.
- (b) Laundry tubs.
- (c) Showers.
- (d) Basins.
- (e) Baths.
- (f) Kitchen (kitchen wastewater is not recommended for use as greywater if untreated. (See Figure 1.1 and Chapter 5).

Greywater does not include wastewater from toilets, urinals, or bidets. This is referred to as blackwater (water containing human excrement).

Greywater can be used via a greywater diversion device (GDD) and treatment (Chapter 3) with a greywater treatment system (GTS), or via diversion with a GDD without treatment (Chapter 5).





**FIGURE 1.1 POTENTIAL GREYWATER DRAINAGE ACCESS POINTS FOR A SINGLE HOUSEHOLD**



## 1.2 WHAT ARE THE RISKS OF USING GREYWATER?

The risks associated with greywater potentially impact on the following:

- (a) *Human health*—Greywater can contain large numbers of disease-causing organisms (human pathogens such as bacteria, viruses and protozoa).
- (b) *Environment*—Greywater can also include a number of contaminants including fats and oils, food scraps, nutrients, salts, sodium, phosphorus, detergents, cleaning products, sunscreens and personal care products. Long-term watering with greywater containing these contaminants can affect sensitive plants and soil.

Managing the potential risks posed by greywater use will depend on—

- (i) the source of greywater;
- (ii) what the house occupants contribute to these sources;
- (iii) the volume of greywater used;
- (iv) how it is used; and
- (v) the level of treatment (if any).

## 1.3 PUBLIC HEALTH CONSIDERATIONS

It is important to remember that greywater can be contaminated by activities such as bathing and clothes washing. Disease-causing organisms in greywater are principally transmitted through ingestion of greywater via contaminated hands, aerosols from spray irrigation (usually only allowed for use with suitably treated greywater), or indirectly through contact with contaminated items such as grass, soil, toys and garden implements.

Untreated greywater is not considered suitable for spray irrigation and human contact should be avoided if bucketing or maintaining greywater diversion or irrigation systems—hands must always be washed with mains water.

Wherever possible a preventative approach should be used to reduce the concentration of hazards in the greywater (especially if it is untreated). This approach includes—

- (a) not collecting water from the laundry after washing nappies or other laundry items soiled by potentially infectious matter, such as faeces or vomit;
- (b) not disposing of household or garden chemicals into greywater systems; and
- (c) excluding kitchen waste.

## 1.4 ENVIRONMENTAL CONSIDERATIONS

The inappropriate use of domestic untreated greywater has the potential to harm the environment by the following:

- (a) Overloading the garden with nutrients or salt, causing degradation to the soil structure, decreased permeability and changes to soil pH levels.
- (b) Exceeding the site's hydraulic loading, causing runoff of contaminated water into stormwater drains, rivers, streams and other properties.
- (c) Causing the soil to become permanently saturated, preventing plants from growing and causing offensive odours.
- (d) Degrading the soil with contaminants, which affect the soil's ability to assimilate organic material, nutrients and water.



Soil, microbes and plants can degrade and adsorb many of the contaminants found in greywater if they are not overloaded. Many nutrients can even be beneficial if they do not exceed plant requirements.

Some of the environmental risks associated with the use of greywater can be managed through the careful selection and use of detergents and other household chemicals that do not contain contaminants that pose a risk to the environment (a preventative approach). Many washing powders contain salts and are highly alkaline. If applied continually to the garden they can lead to saline and high pH soils. Bleaches and disinfectant can kill beneficial soil organisms and damage plants. Ensure the label on the packaging of cleaning products indicates that they are suitable for the environment.

## 1.5 USING GREYWATER

There are two major types of greywater systems—treated and untreated (Table 1.1). The levels of treatment affect the general uses of greywater, how it is stored, the quality and the approvals required to recycle this water (Table 1.2). The treatment levels required and allowed uses vary across Australia with national and State guidelines (Chapter 11).

**TABLE 1.1**  
**TWO MAJOR TYPES OF GREYWATER**

<b>Parameter</b>	<b>Treated greywater (Chapter 3)</b>	<b>Untreated greywater (Chapter 5)</b>
Source	Bath, shower, laundry and kitchen.	Bath, shower and laundry.
General Use*	Garden irrigation, laundry washing (cold water), toilet flushing and vehicle washing.	Direct sub-surface garden irrigation or surface application (usually though manual bucketing).
Storage	Storage of treated greywater is allowed—stored water quality may need to be monitored on an ongoing basis	No storage of untreated greywater is permitted—system must be emptied every 24 hours or less depending on the State or Territory.
Quality*	Level of treatment required will depend on the end use and local/State health authority (see Table 3.2).	Untreated greywater quality will vary greatly depending on the source of the greywater within the household and the cleaning and personal care products used at these sources.
Approvals	Installation must be approved by local council and the greywater treatment systems (GTS) usually require State health department approval	Greywater diversion device (GDD) must be installed by licensed plumber. Some councils required notification.



**TABLE 1.2**  
**USES OF GREYWATER ALLOWED IN THE STATES AND TERRITORIES OF**  
**AUSTRALIA FOR SINGLE HOUSEHOLDS**

State	Bucket irrigation of garden	Sub- surface irrigation of garden	Spray irrigation of garden	Laundry use (Cold water only)	Sanitary flushing	Vehicle washing	Path/wall wash down
	Low level of human contact (treatment not required—GDS)		Moderate level of human contact* (Treatment generally required) - GTS	High level of human contact* (Must be treated—GTS)			
ACT	√	√	√	√	√	√	x
NSW	√	√	√	√	√	x	x
NT	√	√					
Qld	√	√	√	√	√	√	√
SA	√	√	√	x	√	x	x
Tas	√	√	x	x	x	x	x
Vic	√	√	√	√	√	x	x
WA	√	√	√	x	x	x	x

\* Uses that are moderate and high levels of human contact require specific uses and/or treatments see Table 3.2 and Table 5.2

x = not allowed, √ = allowed, check with you the appropriate government department.



## CHAPTER 2 GREYWATER CHARACTERISTICS

### 2.1 OVERVIEW

Greywater is generated by any residential premise that is occupied, and as such the water can be recycled to provide a reliable source of water for activities that do not require drinking water quality (e.g., irrigation, toilet flushing and washing). The characteristics of greywater produced by a residential premise will vary according to the number, age, lifestyle, health status and water usage patterns of the household's occupants.

### 2.2 GREYWATER QUALITY

#### 2.2.1 Microbiological quality

The concentrations of human pathogen hazards in greywater vary over a wide range. In the worst cases, concentrations of faecal microorganisms are almost as high as those found in sewage. The reason for this variation is that pathogens depend on the behaviour of people living in or visiting the house, and the control of materials discharged into the greywater.

Microbiological quality depends on the amount of faecal material that enters greywater from activities such as washing nappies or other types of soiled clothing, and the health of the individual living in or visiting the house.

#### 2.2.2 Chemical and physical quality

There is a high amount of variability in the chemical and physical quality of greywater produced by any household, which is due to factors such as the source of household water, the water use efficiency of appliances and fixtures, individual habits and products used in the household (e.g., detergents, shampoos, soaps).

The amount of salt (e.g., sodium, calcium, magnesium, potassium and other salt compounds), nutrients, oils, grease, fats, and chemicals in greywater are a direct result of the type of products and foods used within the household. Greywater from laundries and bathrooms will contain some body fats, urine, faeces or blood.

Phosphorus and nitrogen are two nutrients of concern to the environment, as they can cause algae blooms in surface water. These nutrients are also limited in Australian soils and necessary for plant growth. The nitrogen and phosphorus in greywater can substitute fertilizer requirements and provide phosphorus and nitrogen to the garden and lawn; however, if too much greywater is used, nitrogen and phosphorus can move off-site into water bodies where they can cause environmental problems.

By managing the type and amount of washing detergents, personal hygiene products and cleaning agents that are used, the amount of nutrients in greywater can be managed.

A large portion of the salts in greywater originate from washing detergents, which vary considerably in their salt content. Reducing the quantity of salts, particularly sodium, is the most effective method of reducing the risk to soil and vegetation posed by salts. Generally, powdered detergent contains the most salt, as it is used in washing powders as filler. Concentrated powders contain less salt than normal powdered detergents, and liquid detergents generally contain the least salt of all washing detergents.

### 2.3 GREYWATER VOLUMES AND SOURCES

Greywater generation will vary according to the water saving practices of each individual in the household. On average the volume of water use in the house per day in Australia is 135 L/person/day (Table 2.1). Approximately 84% (113 L/person/day) of this water can be captured and recycled from the greywater. AS/NZS 1547 gives an informative value of 90 to 120 L/person/day.



Bathroom greywater (bath, basin and shower) contributes approximately 50% of the total greywater volume (Table 2.1). Bathroom greywater can be contaminated with hair, soaps, shampoos, hair dyes, toothpaste, lint, nutrients, body fats, oils and cleaning products. It may also contain some faecal contamination (and the associated pathogens) through body washing.

Laundry greywater contributes approximately 30% of total greywater volume (Table 2.1). Wastewater from the laundry varies in quality from wash water to rinse water to second rinse water. Laundry greywater can be contaminated with lint, oils, grease, laundry detergents, chemicals, soaps, nutrients and other compounds. It may also contain some faecal contamination (and the associated pathogens) through washing contaminated clothes. Greywater generated from the laundry is often the easiest source of greywater to access although it is usually more contaminated than bathroom greywater.

Kitchen wastewater is sometimes considered as a greywater source. If a suitable treatment is not available, kitchen wastewater should not be used due to the amount of contaminants (food particles, oil, grease, etc.) it contains. Fortunately kitchen greywater contributes a relatively small portion of the total available greywater (15%); however, if additional water is needed, an appropriate greywater treatment system (GTS) can be installed to recycle greywater from the kitchen also.

NOTE: In some states the collection of kitchen wastewater as part of greywater for recycling in a single household in sewerred areas is illegal (e.g., Qld—Qld DIP 2007b).

A family of four uses approximately 200,000 L per year in the house. This has the potential to generate 165,000 L (Table 2.1) per year of greywater from—

- (a) Bath.
- (b) Shower.
- (c) Basin.
- (d) Washing machine.
- (e) Laundry tub.
- (f) Kitchen.

Total volumes of greywater generated will depend on the water efficiency of fixtures in the household (Table 2.2, Table 2.3 and Table 2.4)

**TABLE 2.1**  
**SUMMARY OF GREYWATER VOLUMES ESTIMATED TO BE GENERATED**  
**FROM A SINGLE PERSON IN AUSTRALIA**

Wastewater source	Volume used	
	L/person/day	L/person/year
Blackwater		
Toilet	22	8030
Greywater		
Shower	56	20440
Handbasin	6	2190
Kitchen tap	12	4380
Dishwasher	5	1825
Laundry tap	7	2555
Washing machine	27	9855
Total—Greywater	113	41245
Total—Overall (Black and greywater)	135	49275

Source: [www.greenhouse.gov.au/yourhome/technical/fs23.htm](http://www.greenhouse.gov.au/yourhome/technical/fs23.htm) (Accessed May 2008)



**TABLE 2.2**  
**WATER EFFICIENT LABELING AND STANDARDS (WELS)**  
**RATINGS FOR SHOWERS AND TOILETS**

Appliance	Unit	WELS 2006 Rating						
		0 Star	1 Star	2 Star	3 Star	4 Star	5 Star	6 Star
Shower	L/min	>16	>12–16	>9–12	>7.5–9	N/A	N/A	N/A
Toilet	L*	N/A	>4.5–5	>4.0–4.5	3.5–4.0	>3–3.5	>2.5–3.0	0–2.5

\* Average flush volume (1 full and 4 low flush—must also meet additional conditions specified in AS/NZS 6400)

Source AS/NZS 6400 and [www.waterrating.gov.au](http://www.waterrating.gov.au)

>= greater than

**TABLE 2.3**  
**ESTIMATES OF GREYWATER GENERATED FROM A SHOWER**

Number of residents	Volume used per week (L/week) for WELS rating		
	1 Star	2 Star	3 Star
1	784–588	588–441	441–368
2	1568–1176	1176–882	882–735
3	2352–1764	1764–1323	1323–1103
4	3136–2352	2352–1764	1764–1470
5	3920–2940	2940–2205	2205–1838
6	4704–3528	3528–2646	2646–2205
7	5488–4116	4116–3087	3087–2573

Assumptions: Average shower: 7 minutes. Every resident showers (or bathes) once per day (7 times/week)

Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.

**TABLE 2.4**  
**ESTIMATE OF GREYWATER GENERATION FROM FRONT**  
**AND TOP LOADING WASHING MACHINES**

Number of residents	Number of washes per week	Greywater generation—Washing machine (L/week)					
		Front loading washing machine			Top loading washing machine		
		Small (up to 5.5 kg)	Medium (6–7 kg)	Large (over 7.5 kg)	Small (up to 5.5 kg)	Medium (6–7 kg)	Large (over 7.5 kg)
1	2	103	133	164	210	273	336
2	3	154	200	246	315	410	504
3	4	205	267	328	420	546	672
4	6	308	400	492	630	819	1008
5	7	359	466	574	735	956	1176
6	8	410	533	656	840	1092	1344
7	9	461	600	738	945	1229	1512



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**NOTES TO TABLE 2.4:**

- 1 Assumptions: Top Loading: average machine is larger (over 7.5 kg) with a 2 Star WELS rating. Front loading: average machine is medium (6-7 kg) with a 4 Star WELS rating. For one unit increase in Star rating there is approximately a 30% decrease in water requirements per load.
- 2 Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.
- 3 Many washing detergents can be detrimental to the environment, if unsure it is recommended that the first wash be directed to sewer not greywater re-use. If this is the case, the volume of greywater produced from a washing machine will be less than that stated in this Table.

The volumes of greywater produced from the use of a bath and basin are considerable less than showers and washing machines and will vary based on the size and use patterns of these fixtures. These volumes can be estimated using the information given in Table 2.1.

## **2.4 DIVERTING GREYWATER**

In Australia, all modifications or installation of greywater diversion devices (GDDs) and/or greywater treatments systems (GTSs) must be carried out by licensed plumbers. This is regulated by the specific State plumbing code or Australian Standard e.g., AS/NZS 3500 series which requires that any work conducted on the water supply, sanitary plumbing or drainage systems is to be carried out by a licensed plumber.

If wastewater goes down the fixture waste outlet in a household it requires a licensed plumber to install the GDD and/or GTS. Any plumbing material used as part of the GDD or GTS must also comply with Australian Standards e.g., WaterMark certification). Product approval for GDD and GTS requires local responsible regulatory authority approval (Table 10).

In most States and Territories greywater can be diverted before it enters the sewer system, and this does not require a licensed plumber. Examples of this are washing machine wastewater pumped directly from the washing machine (rinse cycle preferred), collection of shower water in buckets prior (while warming up) or during showering, and siphoning water from laundry troughs.

The use of greywater is usually regulated by State or Territory Government environmental, health and/or water authorities. Local councils may also have special requirements for the installation of greywater systems on sites within their area, such as council overlays.

Greywater diversion devices (GDDs) do not treat greywater.



## CHAPTER 3    TREATED GREYWATER — GREYWATER TREATMENT SYSTEMS (GTS)

### 3.1 TREATED GREYWATER OVERVIEW

A greywater treatment systems (GTS) collects, stores, treats and may disinfect greywater to the standards specified by the various State government/local government authorities. They can be installed in residential households in most sewered areas to provide treated greywater for use for irrigation (including surface irrigation), toilet flushing, washing machines and washing of vehicles, paving and fences (Table 3.2)—please check with local/State authorities. Treated greywater can also be stored for later use. Note that some councils or States do not allow GTS to be installed in sewered areas (e.g., Tasmania)—check with your local council.

The degree of treatment is usually measured by a number of parameters that include:

- (a) Biochemical Oxygen Demand recorded over five days (BOD5)—less than 20 mg/L
- (b) Suspended solids (SS)—less than 30 mg/L
- (c) Thermo-tolerant Coliforms or E. Coli (an indicator of faecal contamination)—less than 30 colony forming units (CFU) per 100 mL.
- (d) Residual chlorine (usually between 0.5 and 2 mg/L after 30 minutes contact time)
- (e) Turbidity, less than 2 nephelometric turbidity units (NTUs) (Only used in South Australia and Queensland)

The level of treatment indicates what the greywater can be used for (Table 3.2).

Some GTSSs can also lower concentrations of nitrogen and phosphorus. This is relevant from an environmental perspective if these nutrients are not required for plant growth, or greywater is used for washing vehicles or fences, as this water may run off-site and cause environmental problems.

A GTS is small wastewater treatment plant and the installation and maintenance must comply with strict guidelines to ensure human health and the environment is protected. To ensure this the plumber and householder must taken on the responsibilities associated with the correct installation and ongoing management of the GTS (Table 3.1).



**TABLE 3.1**  
**RESPONSIBILITIES FOR GREYwater TREATMENT SYSTEM (GTS)**

Responsibility	Householder/owner	Plumbers
Undertake a water balance to determine water demand requirements	√	√
Ensure GTS meets the requirements of the local State and Territory authority		√
Ensure the GDD bears WaterMark		√
Apply for and obtain approval to install and operate the GTS and greywater irrigation system from the local council		√
Engage a licensed plumber to install the GTS	√	
Install sub-soil, sub-surface or surface irrigation system to distribute greywater (the level of treatment will reflect possible irrigation systems—see Table 3.2)	√	
Notify the local water utility that a GTS has been installed at the property		√
Undertake regular maintenance of the GTS in accordance with the manufacturer's recommendations and relevant guidelines	√	
Ensure that annual testing of backflow protection device is undertaken	√	

GDD = greywater diversion device

### 3.2 SOURCE AND APPLICATION OF TREATED GREYwater

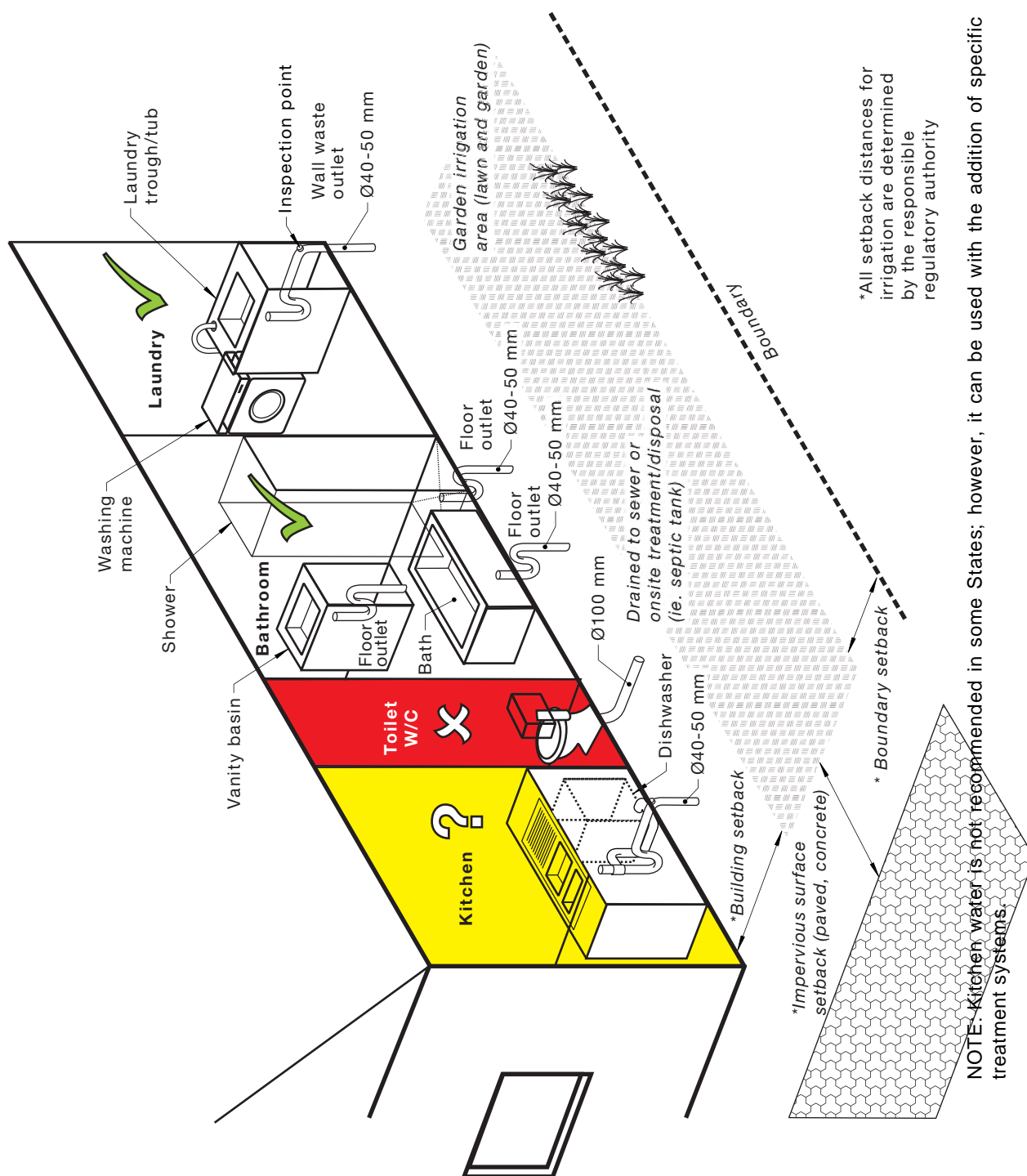
The sources of greywater for a GTS include the following:

- Washing machines
- Laundry tubs
- Showers
- Basins
- Baths
- Associated floor drains
- Kitchen water

Kitchen water is generally not recommended as the solid material, fats and oils can impact the treatment process. If used, additional filtration may be required. Check with manufacturers of the GTS.

NOTE: Kitchen greywater use for GTS is not permitted in Queensland.





### FIGURE 3.1 GREYWATER SOURCES FOR GREYWATER TREATMENT SYSTEMS



TABLE 3.2

**GSTs FOR SINGLE HOUSEHOLDS—GREYWATER QUALITY AND USES ACCEPTABLE IN STATES AND TERRITORIES OF AUSTRALIA  
(CURRENT AS OF MAY 2008)**

State	Bio-chemical oxygen demand (BOPD5) (mg/L)	Suspended solids (SS) (mg/L)	Thermo-tolerant Coliform* (CFU/100 ml)	Turbidity (NTU)	Acceptable irrigation methods for treated greywater					Non-irrigation used of treated greywater			Ref
					Above ground drip/broadcasting	Above ground spray	Manual bucket surface	Sub-surface irrigation	Sub-surface trench	Toilet	Laundry washing machine (cold)	Wash (vehicle)	
ACT	20	30	10	N/A	√	√	×	√	√	√	√	√	
		30	N/A	N/A	×	×	×	√	√	×	×	×	
NSW	10	10	10	N/A	√	√	×	√	√	√	√	×	
	<20	<30	<30	N/A	√	√	×	√	√	×	×	×	
	<20	<30	N/A	N/A	×	×	×	√	√	×	×	×	
NT	20	30	10	N/A	√	√ <sup>A</sup>	×	√	√	×	×	×	
		N/A	N/A	N/A	√ <sup>B</sup>	×	×	√	√	×	×	×	
QLD	10	10	10	2 <sup>D</sup>	√	√	×	√	√	√	√	√	
		30	30	5 <sup>D</sup>	√	√	×	√	√	×	×	×	
		180	N/A	N/A	√	√	√	√	√	×	×	×	
SA	20	N/A	1	<2	√	√	√	√	√	×	×	×	
	<20	<30	<10	N/A	√	√ <sup>C</sup>	√	√	√	√	×	×	
TAS <sup>E</sup>	N/A	N/A	N/A	N/A	×	×	×	√	√	×	×	×	6
VIC	10	10	10	N/A	√	×	×	√	×	√	√	×	
		30	10	N/A	√	×	×	√	×	×	×	×	
		30	N/A	N/A	×	×	×	√	×	×	×	×	
WA	20	30	10	N/A	√	√	×	√	√	×	×	×	8

\*E coli, for NSW and Vic, 'or E coli' for SA, N/A = not applicable. CFU = colony forming units.

√ = allowed, × = not allowed,

NOTE: Updated guidance should be checked for water quality parameters and uses. See relevant State and Territory guidelines.

(continued)



**TABLE 3.2** (*continued*)

References:

- 1 ACT Health 2007
- 2 NSW Health April 2000; Feb 2005
- 3 DHCS 2004; 2007; DHCS NT 1996; DNREA NT 2007 (accessed)
- 4 DLGPSR ; LGP 2003; Qld DIP 2007a, [www.lgp.qld.gov.au/planning/?id=7036](http://www.lgp.qld.gov.au/planning/?id=7036)
- 5 DoH SA 2006a; b; 2007
- 6 DIER 2005
- 7 EPA Victoria 2008 (In press release expected July)
- 8 DoH WA 2005
- <sup>A</sup> Chlorine residual 0.5 to 2.0 after 30 min detention. Vegetables or food plants, including fruit and nut trees, must not be grown in the surface irrigation disposal area. If drip irrigation is used, fruit and nut uses may be allowed with a covering of at least 50 mm of hay, mulch or other absorbent organic material,.
- <sup>B</sup> Access to area restricted
- <sup>C</sup> Dedicated irrigation area required
- <sup>D</sup> 95 percentile
- <sup>E</sup> Not allowed in sewerred areas, diversion must be to an approved on-site wastewater management systems
- <sup>F</sup> Allows washing of paving and fences also
- <sup>G</sup> Assumes for most States and Territories GTS must be connected directly to irrigation systems.



**TABLE 3.2 (continued)**

References:

- 1 ACT Health 2007
- 2 NSW Health April 2000; Feb 2005
- 3 DHCS 2004; 2007; DHCS NT 1996; DNREA NT 2007 (accessed)
- 4 DLGPR ; LGP 2003; Qld DIP 2007a, [www.lgp.qld.gov.au/planning/?id=7036](http://www.lgp.qld.gov.au/planning/?id=7036)
- 5 DoH SA 2006a; b; 2007
- 6 DIER 2005
- 7 EPA Victoria 2008 (In press release expected July)
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- A Chlorine residual 0.5 to 2.0 after 30 min detention. Vegetables or food plants, including fruit and nut trees, must not be grown in the surface irrigation disposal area. If drip irrigation is used, fruit and nut uses may be allowed with a covering of at least 50 mm of hay, mulch or other absorbent organic material,.
- B Access to area restricted
- C Dedicated irrigation area required
- D 95 percentile
- E Not allowed in sewerer areas, diversion must be to an approved on-site wastewater management systems
- F Allows washing of paving and fences also
- G Assumes for most States and Territories GTS must be connected directly to irrigation systems.



It is the responsibility of the installing licensed plumber to install the greywater treatment system and distribution system to meet the requirements of the local/State plumbing and drainage authority

Further information on wastewater treatment systems and general plumbing requirements are given in AS 1547 and AS/NZS 3500 series, respectively.

The plumber must also ensure that controls to prevent the incidence of cross-connection with the drinking water supply are implemented. This includes appropriate signage, identification of all plumbing pipework and backflow prevention devices where required. All backflow control measures will have to comply with AS/NZS 3500.5 and local plumbing authority guidelines.

Table 9 summarises a list of items to check before beginning the approval and installation process for treated greywater systems.

**TABLE 3.3**  
**TREATED GREYWATER SYSTEMS—PRE INSTALLATION CHECKLIST**

Checklist item	Requirements	Comments
Local council authority		
State authority		
Source of greywater <ul style="list-style-type: none"> <li>• Bath</li> <li>• Shower</li> <li>• Vanity basin</li> <li>• Laundry tub</li> <li>• Washing machine</li> <li>• Kitchen sink</li> </ul>		
Estimated greywater volume available for intended use (Table 3, Table 4, Table 5 and Table 6)		
Site conditions <ul style="list-style-type: none"> <li>• Slope</li> <li>• Climate (incl. local rainfall)</li> <li>• Landfill</li> <li>• Groundwater</li> <li>• Erosion potential</li> <li>• Site shading</li> </ul>		
Soil conditions <ul style="list-style-type: none"> <li>• Soil type</li> <li>• Soil pH test</li> <li>• Soil moisture level</li> </ul>		
Set back distances from <ul style="list-style-type: none"> <li>• Dwelling</li> <li>• Paths/hard surfaces</li> <li>• Swimming pools</li> <li>• Natural waterways</li> </ul>		
Best practice irrigation design and use		
Area available for irrigation		
Product approvals/local authority conditions		



### 3.3.2 Product approval

GDDs connected to the greywater sanitary plumbing should have WaterMark certification. This doesn't apply where greywater is collected before entering the drainage system; for example, bucketing greywater, connection to a washing machine waste or siphoning of greywater from laundry basin.

Only diversion devices require WaterMark approval (Table 3.4) under 5200:4600 all other systems are approved by the local responsible regulatory authority ([www.standards.org.au/](http://www.standards.org.au/)).

Local State Health/Plumbing/Environmental departments (responsible regulatory authority) are responsible for the approval of GDDs and GTSS (Table 3.4). WaterMark certification (Figure 3.3) for GDDs will have to be in accordance with the Standards listed in AS 5200.000, or authorisation under the Plumbing Code of Australia. Systems and products installed must be approved as per Table 10.



**FIGURE 3.3 WATERMARK CERTIFICATION MARK**

**TABLE 3.4**

**WEBSITES FOR APPROVED GREYWATER TREATMENT SYSTEMS AND GREYWATER DIVERSION DEVICES IN AUSTRALIA**

State or Territory	System/device	Websites for approved greywater treatment systems
Australian Capital Territory	GTS	The ACT Government does not provide a list of approved greywater products, it provides links from its Think Water website for information about greywater systems approved or accredited in other States and Territories. <a href="http://www.thinkwater.act.gov.au/water%20savingtips/Greywater_faqs.shtml#approvals">www.thinkwater.act.gov.au/water%20 savingtips/Greywater_faqs.shtml# approvals</a>
	GDD	
Northern Territory	GTS	<a href="http://www.nt.gov.au/health/healthdev/enviro_n_health/wastewater.shtml">www.nt.gov.au/health/healthdev/enviro_n_health/wastewater.shtml</a> <a href="http://www.nt.gov.au/health/docs/cdc_envhealth_register_Greywater_Treatment%20Systems.pdf">www.nt.gov.au/health/docs/cdc_envhealth_register_Greywater_Treatment%20Systems.pdf</a>
	GDD	<a href="http://www.nt.gov.au/health/docs/cdc_envhealth_register_greywaterdiverters.pdf">www.nt.gov.au/health/docs/cdc_envhealth_register_greywaterdiverters.pdf</a>
New South Wales	GTS	<a href="http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/gts/index.html">www.health.nsw.gov.au/public-health/ehb/general/wastewater/gts/index.html</a>
	GDD	<a href="http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/diversion_devices.html">www.health.nsw.gov.au/public-health/ehb/general/wastewater/diversion_devices.html</a>
Queensland	GTS	<a href="http://www.localgovernment.qld.gov.au/?id=4016">www.localgovernment.qld.gov.au/?id=4016</a>
	GDD	<a href="http://www.localgovernment.qld.gov.au/?id=4077">www.localgovernment.qld.gov.au/?id=4077</a>
South Australia	GTS	<a href="http://www.dh.sa.gov.au/pehs/branches/wastewater/alternative-onsite-systems.htm">www.dh.sa.gov.au/pehs/branches/wastewater/alternative-onsite-systems.htm</a>
	GDD	Included in above



Tasmania	GTS	<a href="http://www.tasmanianenvironmentcentre.org.au/documents/greywater_treatment_systems.pdf">www.tasmanianenvironmentcentre.org.au/documents/greywater_treatment_systems.pdf</a>
	GDD	Not available contact local councils.
Victoria	GTS	<a href="http://www.epa.vic.gov.au/water/wastewater/onsite.asp">www.epa.vic.gov.au/water/wastewater/onsite.asp</a> <a href="http://epanote2.epa.vic.gov.au/epa/septic.nsf/920b236424bf4a7bca256dcc001fb5bd?OpenView">http://epanote2.epa.vic.gov.au/epa/septic.nsf/920b236424bf4a7bca256dcc001fb5bd?OpenView</a>
	GDD	<a href="http://www.ourwater.vic.gov.au/_data/assets/pdf_file/0011/740/List20of20Greywater20Systems201020Oct2007.pdf">www.ourwater.vic.gov.au/_data/assets/pdf_file/0011/740/List20of20Greywater20Systems201020Oct2007.pdf</a>
Western Australia	GTS	<a href="http://www.health.wa.gov.au/envirohealth/water/greywater.cfm">www.health.wa.gov.au/envirohealth/water/greywater.cfm</a>
		<a href="http://www.health.wa.gov.au/envirohealth/water/docs/Approved_Greywater_Systems.pdf">www.health.wa.gov.au/envirohealth/water/docs/Approved_Greywater_Systems.pdf</a>
	GDD	<a href="http://www.health.wa.gov.au/envirohealth/water/greywater.cfm">www.health.wa.gov.au/envirohealth/water/greywater.cfm</a> (included in greywater systems)

GTS = greywater treatment system

GDD = greywater diversion systems

### 3.4 BEST PRACTICE MANAGEMENT CONTROL MEASURES—TREATED GREYWATER

It is important that a GTS be installed and maintained to ensure that public health and the environment are protected. The control measures listed below have been compiled to provide plumbers, owners and residents with a guide on how to best manage the installation and use of a greywater treatment system. Following these DOs and DON'Ts will ensure the use of greywater achieves the performance standards required by local authority and manufacturer's recommendations.

#### DOs

##### Plumber

- ☐ Install a greywater treatment system that has been accredited by local/State authorities.
- ☐ Undertake a water audit, with the householder, before installing a greywater treatment system to calculate the amount of greywater that can be generated and used on-site.
- ☐ Mark and label all pipes and use signs to indicate treated greywater on outlets.
- ☐ Ensure greywater will not contaminate any source of drinking water. Avoid cross-connections by using color-coded pipe and install backflow prevention devices where required.
- ☐ Ensure that the greywater diversion system has a valve to allow untreated greywater to be diverted back to the sewer when it is too wet to go onto the garden.
- ☐ Install a diversion device that has a WaterMark licence\*.
- ☐ Indicate where untreated greywater is being used by signage.
- ☐ Ensure the greywater irrigation systems complies with state guidelines and plumbing codes AS/NZS 3500 series.
- ☐ Use suitably treated greywater for irrigation (including surface irrigation if appropriate), toilet flushing and washing machines only.

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\* [www.saiglobal.com/assuranceservices/certification/Productcertification/](http://www.saiglobal.com/assuranceservices/certification/Productcertification/)



### Householder

- ☐ Select garden-friendly detergents that are biodegradable and low in phosphorus, sodium, boron and chloride. Select liquid washing detergents, as they are comparatively low in salts.
- ☐ Avoid bleaches or softeners, and products that are used to clean drains.
- ☐ Monitor plant and soil response to treated greywater irrigation.
- ☐ Ensure that regular maintenance of the treated greywater system is undertaken and wash hands immediately after contact with greywater.

### DON'Ts

#### Plumber

- ☐ Don't install any component of an irrigation system within 1 m of site boundary, buildings, other hard surfaces and swimming pools—refer to local council irrigation setback requirements.
- ☐ Don't make contact with the mouth or face either directly (e.g., fingers, hands) or indirectly (e.g., smoking) until after washing hands.

#### Householder

- ☐ Don't make contact with mouth or face during any maintenance of greywater treatment system.
- ☐ Don't put paints, automotive oils and grease, or matter designated as trade waste or industrial liquid waste into the greywater system.
- ☐ Don't irrigate with greywater during rain.
- ☐ Don't use greywater to top up rainwater tanks or swimming pools.
- ☐ Don't irrigate if the premise is located near an aquifer that is used for drinking water (see local council for requirements).
- ☐ Don't use greywater on plants that will be eaten raw or where fruit has fallen to the ground.
- ☐ Don't use greywater so that it flows into the streets or down stormwater drains.
- ☐ Don't let greywater go beyond the premise and cause a nuisance to neighbours.
- ☐ Don't drink or allow pets or animals to drink greywater.

These DO'S and DON'TS have been compiled from guidelines across Australia (Chapter 11)

### 3.5 INSTALLATION SOLUTIONS FOR GREYWATER TREATMENT SYSTEMS

Greywater must be diverted at appropriate locations (40-50 mm diameter drainage pipe before entering the blackwater system (100 mm diameter drainage pipe) within the drainage system of the household (Figure 3.4). The GTS must maintain a permanent connection to the sewerage system to allow greywater to be discharged during periods of wet weather or when the household is producing excessive amounts of greywater (Figure 3.4).

Any internal connection of appropriately treated greywater must comply with AS/NZS 3500 series and relevant signage, tap and pipe labelling requirements (Clause 3.8). An appropriate backflow prevention device must be installed (Figure 3.5, Clause 3.7).

Care should be taken to ensure that groundwater used for drinking water is not contaminated by the use of greywater. Special attention needs to be given to the protection of in-ground rainwater tanks from contamination.



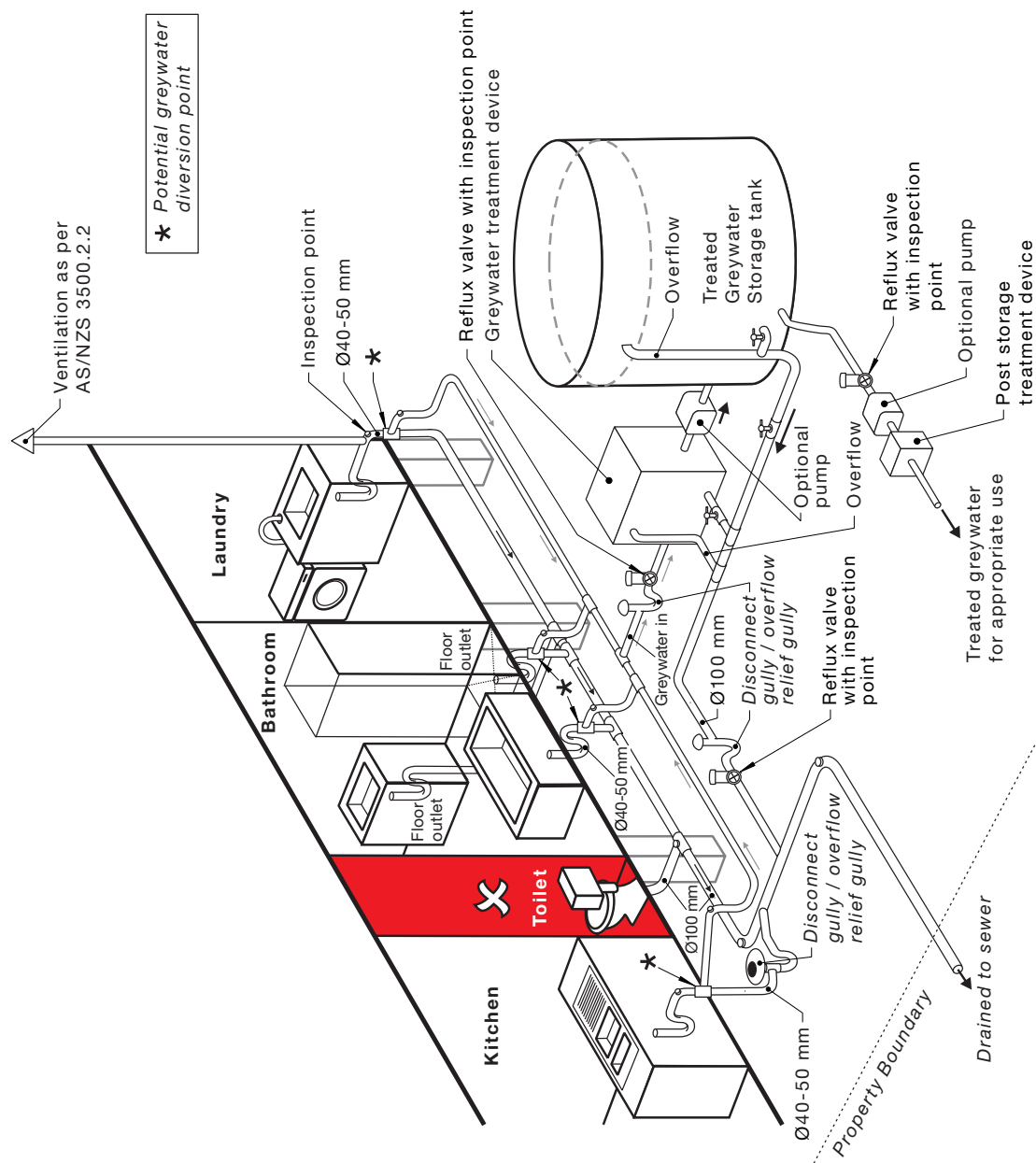
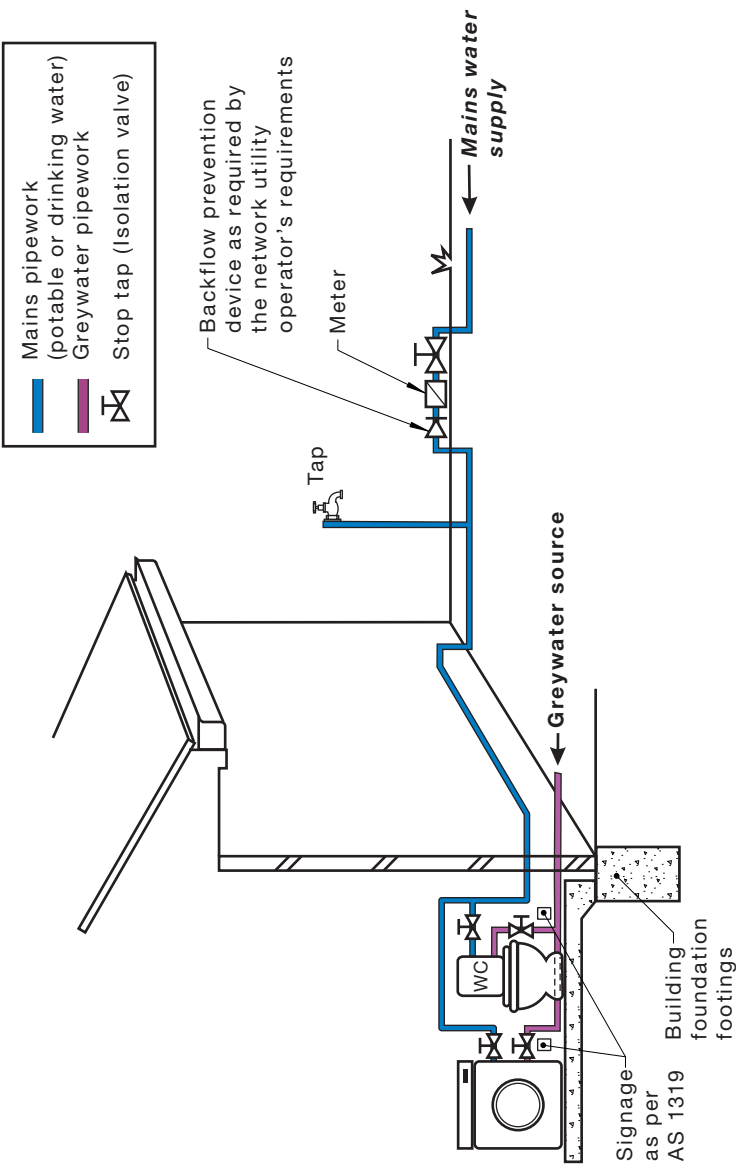


FIGURE 3.4 GREYWATER TREATMENT SYSTEM (GTS) INDICATING POTENTIAL GREYWATER DIVERSION POINTS





**FIGURE 3.5 CONNECTION OF APPROPRIATELY TREATED GREYWATER FOR TOILET FLUSHING AND LAUNDRY USE (SIGNAGE AS PER AS/NZS 3500 SERIES WHICH REFERS TO AS 1319)**



### 3.6 GREYWATER IRRIGATION SYSTEM—TREATED GREYWATER

The type of greywater irrigation system that can be installed will depend on greywater quality (Table 3.2) and the site to be irrigated. The irrigation system associated with the GTS does not require accreditation by State authorities; however, it does require prior local council approval of design and maintenance agreement.

Distribution of treated greywater can be through 5 major types of irrigation systems dependent on the level of treatment (Table 3.2):

- *Sub-soil irrigation* Greywater is distributed into trenches dug into the ground through gravity. This method is usually associated with septic systems and there are a number of variations that rely upon absorption and/or transpiration of the greywater with limited control of water release to match plant requirements. Sub-soil irrigation is not considered an efficient irrigation method for beneficial use of greywater and therefore not recommend unless deep rooted plants are irrigated to match demand.
- *Sub-surface irrigation* This system is usually pressurised and installed 100 mm below the ground. The greywater is distributed through small-diameter perforated pipes or dripper lines and applied directly to the root zone at rates required by the plants so that the plants can utilise the water without excessive runoff or leaching.
- *Covered surface drip irrigation* This enables greywater to be applied directly to the surface of the soil under a layer of mulch. The greywater is distributed under pressure from small diameter perforated pipes or dripper lines at rates required by the plants.
- *Surface irrigation* Exposed dripper is one form of surface irrigation
- *Spray irrigation systems* These systems are not recommended as they increase the risk of exposure to people. If spray irrigation is used, the greywater needs to be treated to a higher level (Table 3.2) to ensure the risk of exposure is minimised. The greywater is distributed under pressure through surface spray devices that should maximise droplet sizes, throw and plume height to minimise water loss through evaporation and maximise plant use of the greywater.

When designing a greywater irrigation system it should be capable of supplying sufficient greywater to meet the highest daily demands of the garden, or for additional water to be applied from non-greywater sources in a supplementary irrigation system. Considerations are as follows:

- (a) Greywater volume potentially available (L per person per day × number of people in the household).
- (b) Site conditions:
  - (i) Slope.
  - (ii) Climate (incl. local rainfall).
  - (iii) Land fill.
  - (iv) Groundwater.
  - (v) Erosion potential.
  - (vi) Site shading.
- (c) Soil conditions:
  - (i) Soil type/texture.
  - (ii) Soil pH test.
  - (iii) Slope.



- (d) Design irrigation rate (DIR).
- (e) Setback distances from:
  - (i) Dwelling.
  - (ii) Paths/hard surfaces.
  - (iii) Swimming pools.
  - (iv) Natural waterways.
- (f) Land area available for greywater irrigation.

See Chapter 6 for details on greywater irrigation system design and site considerations

### **3.7 TREATED GREYWATER USE FOR TOILET FLUSHING AND WASHING**

Greywater can also be used for flushing the toilet (sanitary use) or for washing laundry (cold only), and outdoor use such as cleaning vehicles, fences or footpaths in some States (Table 3.2). When connecting greywater to internal plumbing fixtures such as toilets and/or washing machines, appropriate backflow prevention devices should be fitted (in most cases the hazard rating for the backflow device will be classified as a high hazard—confirmation of this is required from the local plumbing authority). Backflow prevention has to comply with AS/NZS 3500.1 (Table 3.5).

All external plumbing should have appropriate labels for piping, signage for taps and purple coloured taps as described in AS/NZS 3500 series.



**TABLE 3.5**  
**SUITABILITY OF BACKFLOW PREVENTION DEVICE**

Registered or testable backflow prevention device	Cross-connection hazard rating	Protection against back-pressure	Protection against back-siphonage pressure
<b>(a) Registered testable devices</b>			
Registered break tank (RBT)	High/medium/low	Yes	Yes
Registered air gap (RAG)	High/medium/low	Yes	Yes
Reduced pressure zone device (RPDA)*	High/medium/low	Yes	Yes
Double-check valve assembly (DCV)*	Medium/low	Yes	Yes
Double-check detector assembly (DCDA)*	Medium/low	Yes	Yes
Anti-spill pressure tyre vacuum breakers (APVB)*	High/medium/low†	No	Yes
Pressure type vacuum breaker (PVB)*	Medium/low	No	Yes
<b>(b) Non-testable devices</b>			
Dual-check valve with atmospheric port (DVAP) ‡	Low	Yes	Yes
Dual-check valve (DUAL CV) ‡	Low	Yes	Yes
Dual-check valve with intermediate vent (DuCV) ‡	Low	Yes	Yes
Air gap (AG)	Low	Yes	Yes
Break tank (BT)	Low	No	Yes
Atmospheric vacuum breaker (AVB) ‡	Low	No	Yes
Hose connection vacuum breaker (HCVB) ‡ (See Note 3)	Low	No	Yes
Beverage dispenser dual-check valve (BDDC)	Low	Yes	Yes
Vacuum break-check valve (VBCV)	Low	No	Yes
Single-check valve (in Australia only)	Fire services only		

Source: AS/NZS 3500.1.

\* Backflow prevention devices that are provided with test taps for the purposes of testing the operation of the devices, which do not necessarily include isolating valves.

† Anti-spill vacuum breakers are suitable for high-hazard installation for mains pressure flushing valves only.

‡ Backflow prevention devices that are not provided with test taps for the purposes of testing the operation of the devices.

### 3.8 SIGNAGE AND LABELLING


The marking, labelling and signage of the treated greywater plumbing and/or irrigation systems must be in accordance with AS/NZ 3500 and other Australian Standards (Table 3.6).



Prominent signage indicating that the water is not suitable for drinking (e.g., ‘Recycled water—not suitable for drinking’) should also be positioned at the boundary of the property visible from entry points. External signage provides warnings and alerts plumbers, visitors and the general public that recycled water (greywater) is being used on the property. Signage promotes that additional water is being sourced from recycling of wastewater on the property and the household is complying with water restrictions.

The incorporation of symbols should be considered also, and warning signs should be designed with reference to AS 1319 and AS 2416.

**TABLE 3.6**  
**PIPE LABELS, SIGNAGE AND TAP COLOR REQUIREMENTS FOR TREATED GREYWATER SYSTEMS**

 	All internal pipework or pipe sleeves (i.e. copper pipes within dwellings) and identification tapes (including those on pressurised irrigation systems) shall be coloured purple as per AS 2700 and marked with the following in accordance with AS 1345 'WARNING RECYCLED/RECLAIMED WATER—NOT FIT FOR DRINKING' or similar at intervals not exceeding 0.5 m.
	Greywater outlets (connections, taps, appliances) shall have signs that are marked 'WARNING DO NOT DRINK' or similar in accordance with AS 1319.

(continued)



**TABLE 3.6** (*continued*)

	<p>Colouring of taps to indicated water is recycled and not suitable for drinking</p>
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NOTE:: Check for any local requirements with the local responsible authority.

### 3.9 MAINTENANCE

Once installed a GTS must be maintained so as to not compromise public health or the environment. This is the responsibility of the owner. The maintenance procedures provided by the manufacturer and any conditions of approval from the local council/authority must be carried out as specified for the life of the system. A typical maintenance program for a GTS is outlined in Table 3.7.



**TABLE 3.7**  
**TREATED GREYWATER SYSTEMS—MAINTENANCE CHECKLIST**

<b>Maintenance required</b>	<b>Recommended timeframe<sup>*</sup></b>
Check plumbing fixtures connected to dispersion system are working and draining	Daily
Clean filter (if installed)	Weekly
Replace filter (if installed)	As recommended by manufacturer
Check sub-surface irrigation distribution system	Weekly
Monitor soil conditions for—	
- becoming wet and boggy	Weekly
- surface ponding and run-off	Weekly
- poor vegetation growth	Monthly
- unusual odours	Monthly
Soil moisture level reading	Every 3 months
Check soil pH	Every 6 months
Inspect tanks, insect screens on vents and inspection points, checking for presence of mosquito breeding	Monthly
Test water quality output	To local authority requirements
Clean surge tank	Every 6 months
De-sludge sediment tanks	5 years

<sup>\*</sup> or to manufacturer's requirements



## CHAPTER 4    APPLIANCE AND WASHING USES OF TREATED GREYWATER

### 4.1 TOILET FLUSHING

Toilets are either full flush (one button) or dual flush (two buttons). The average flush volumes vary depending on the WELS rating (Table 2.2) and the number and type of flush. Estimates for common non-WELS rated toilets are indicated in Table 4.1. These volumes will be lower if water-efficient toilets have been installed. To estimate more accurately the amount of treated greywater (fit for the purpose of toilet flushing and washing, Table 3.2) that can potentially be recycled for toilet flushing in a specific premise, the number of residents and the type of toilet/s installed at the premises needs to be determined.

When fitting suitably treated greywater to the toilet cistern, fittings should be marked, pipes labelled and backflow prevention devices installed as required in AS/NZS 3500 series (Figure 4.1).

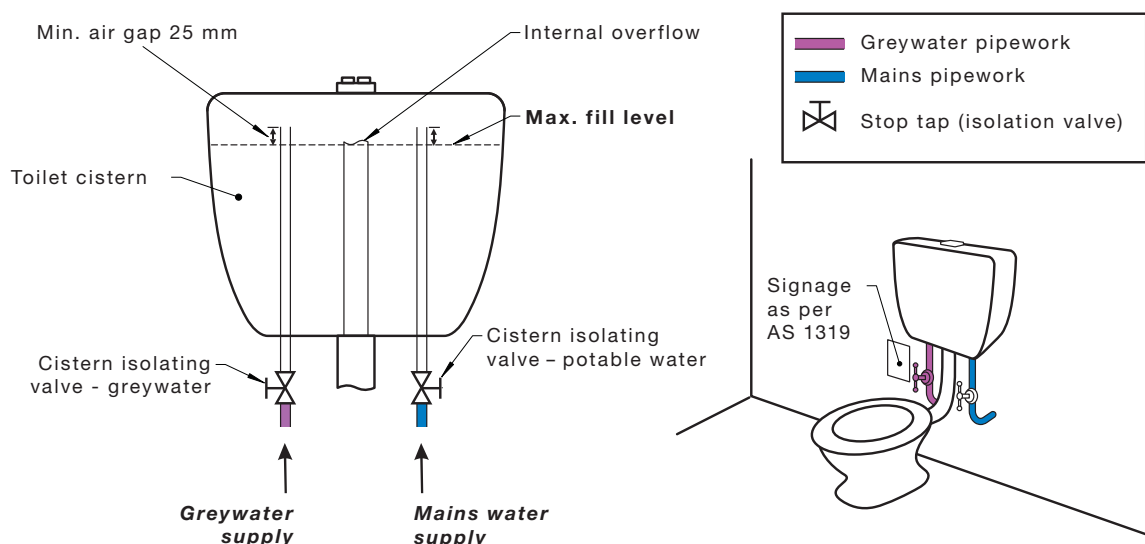
**TABLE 4.1**  
**POTENTIAL FOR USING TREATED GREYWATER FOR TOILET FLUSHING**

Number of residents	Potential for re-use—Toilet flushing (L/Week)	
	Full Flush	Dual Flush
1	308	101
2	616	202
3	924	302
4	1232	403
5	1540	504
6	1848	605
7	2156	706

Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.

NOTE: The above assumes: Full flush, 11 L per flush; half flush, 3.0 to 5.5 L per flush. Ratio of four half flushes to every one full flush. Assumed 4 total flushes per resident per day. Sources: AS 1172.2 and AS/NZS 6400. Different WELS rated toilets will use less water (Table 2.21)





NOTES:

1. Greywater must be treated to an acceptable standard (Table 3.2).
2. Some manufacturers of WCs will not permit the introduction of greywater as it may affect the flushing function, performance and warrantee (refer to manufacturers instructions).

**FIGURE 4.1 TREATED GREYWATER CONNECTION TO CISTERN**

## 4.2 WASHING MACHINE

Some States allow the use of treated greywater in the washing machine provided it has been treated to the appropriate level (fit for this purpose—Table 3.2). To estimate the amount of greywater that can potentially be used by the washing machine, the number of residents (or the number of washes per week) and the type of washing machine needs to be determined. Table 4.2 may be used to estimate the amount of greywater required for washing machine use at a specific household.

**TABLE 4.2**

**ESTIMATES OF GREYWATER VOLUMES REQUIRED FOR WASHING MACHINES**

Number of residents	Number of washes	Greywater generation—Washing machine (L/Week)					
		Front loading washing machine			Top loading washing machine		
		Small (up to 5.5 kg)	Medium (6-7 kg)	Large (over 7.5 kg)	Small (up to 5.5 kg)	Medium (6-7kg)	Large (over 7.5 kg)
1	2	103	133	164	210	273	336
2	3	154	200	246	315	410	504
3	4	205	267	328	420	546	672
4	6	308	400	492	630	819	1008
5	7	359	466	574	735	956	1176
6	8	410	533	656	840	1092	1344
7	9	461	600	738	945	1229	1512

Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.

NOTE: The above assumes: Top Loading: average machine is large (over 7.5 kg) with a 2 Star WELS rating. Front loading: average machine is medium (6-7 kg) with a 4 Star WELS rating.



### **4.3 WASHING VEHICLES AND INFRASTRUCTURE**

Some States allows the use of treated greywater for washing vehicles, fences and paving provided it has been treated to the appropriate level (fit for this purpose—Table 3.2). Refer AS/NZS 3500 series for signage and backflow requirements.



## CHAPTER 5    UNTREATED GREYWATER — GREYWATER DIVERSION DEVICES (GDD) AND SYSTEMS

### 5.1 UNTREATED GREYWATER OVERVIEW

#### 5.1.1 General

Untreated greywater is used extensively throughout urban Australia; however, use is often practised without a clear understanding of the health and environmental risks. Untreated greywater contains contaminants derived from household cleaning and personal hygiene activities. Untreated greywater must be used in an appropriate way to ensure public health and environmental risks are managed to prevent illness and environmental degradation.

It is the responsibility of the individual and the plumber who undertakes these activities to obtain appropriate approvals where necessary and to ensure that the system is maintained and operated in a safe and sustainable way (Table 5.1).

**TABLE 5.1**  
**RESPONSIBILITIES FOR UNTREATED GREYWATER SYSTEM**

Responsibility	Householder/owner	Plumbers
Undertake a water balance to determine water demand requirements	√	√
Ensure GDD meets the requirements of the local and State/territory authorities		√
Ensure the GDD bears the WaterMark		√
Apply for and obtain approval to install and operate the GDD and greywater irrigation system from the local council	√	√
Engage a licensed plumber to install the GDD	√	
Install the greywater diversion device. Plumbing of internal and external fixtures (laundry washing, toilet flushing) or outdoor (washing or irrigation)		√
Install irrigation system (sub-soil, sub-surface or surface (not spray)	√	
Notify the local water utility that a GDD has been installed at the property	√	
Undertake regular maintenance of the GDD in accordance with the manufacturer's recommendations and relevant guidelines	√	

GDD = greywater diversion device.

#### 5.1.2 Untreated greywater systems

Greywater may be used without a GTS (Chapter 3) by—

- (a) manual bucketing, siphoning of water from sinks or connection to washing machine wastewater outlets before the greywater enters the household drainage system; or
- (b) the use of a greywater diversion device (GDD) installed into the appropriate greywater drainage of a household. A GDD is a hand-activated switch that diverts untreated greywater from the drainage system by gravity or pump directly to a sub-surface irrigation system.



A greywater diversion system incorporates—

- (i) a hand-activated valve;
- (ii) a switch or tap that is fitted to the outlet of the waste pipe of the plumbing fixture (e.g., a washing machine);
- (iii) a coarse filter for screening out solids and oils/grease;
- (iv) non-storage surge attenuation;
- (v) an overflow device; and
- (vi) a sub-surface (usually) garden irrigation or distribution system.

Greywater diversion should be for beneficial use only; it is not an option for easy disposal of wastewater.

Owners and residents have to recognise that a GDD must be treated like a garden tap (i.e. turned on only when the garden needs water). If the GDD is turned on all the time, there is a high risk of detrimental impact to the environment (plants, soil and water bodies) and to residents' health.

Any greywater that cannot be immediately re-used for sub-surface irrigation at the residential premise must be diverted to sewer.

### **5.1.3 Untreated greywater use**

Owners and residents need to ensure untreated greywater systems (UGSs) are designed, installed and maintained to protect public health and the environment. Greywater from a GDD has restrictions on its use; these restrictions vary across the States and Territories of Australia (Table 5.2).

The quality of untreated greywater is variable and restricts what it can be used for.

Bucketing of greywater doesn't require approval from any local or State/Territory authority. This is because small volumes of water are usually involved and application to the garden when it is not required (to wet) is unlikely.

Greywater diversion devices will require some approvals and the uses for the greywater will be restricted. General requirements are as follows:

- (a) Use a licensed plumber to install the diversion system.
- (b) Water diversion systems are restricted to low risk sources such as bath, shower and laundry rinse water (Figure 5.1).
- (c) Kitchen water cannot be used as it is heavily contaminated with fats, grease and solids.
- (d) Avoid laundry wash water, which is high in detergent concentrations, use rinse water and be aware of biodegradable labelled products—soaps and detergents—liquid products are generally better—read the ingredients on the packaging.
- (e) Only divert in hot dry conditions, in quantities that can be taken up by plants and soil.
- (f) Ensure there is no cross-connection of greywater with the drinking water supply (e.g., underground rainwater tanks, cross-connections with the drinking water pipes).
- (g) It is illegal to store untreated greywater for later use in a tank (surge or <24 hour storage is allowed—Table 5.2).
- (h) Do not discharge untreated greywater near agricultural drainage pipes as the greywater could flow into the stormwater drainage system.
- (i) Sub-surface garden irrigation can be used in most parts of Australia (Table 5.2).
- (j) Adhere to council setback requirements.



- (k) The diversion system must have a valve to allow untreated greywater to be diverted back to the sewer when it is too wet to go onto the garden.
- (l) Don't apply untreated greywater to edible foods grown in the garden.
- (m) Indicate where untreated greywater is being used by signage on the property.

The quality of untreated greywater will vary greatly depending on the source of the water and the general health and cleanliness of users of the source water.

Like other forms of wastewater, when greywater is stored it will turn septic giving rise to offensive odours and provide conditions for microorganisms to multiply. All untreated greywater should be used within less than 24 hours of diversion. This varies across States and Territories of Australia and most States indicate a surge tank must be used, which empties continually after addition of greywater, (Table 5.2).



**TABLE 5.2**  
**UNTREATED GREYWATER—ACCEPTABLE USES IN STATES**  
**AND TERRITORIES OF AUSTRALIA.**

State	Acceptable Irrigation method					Comment	Ref
	Above-ground drip or broadcasting	Above-ground spray	Manual bucket surface broadcasting	Sub-surface dripper	Sub-surface trench		
ACT	√*	×	√	√	√	<24 hours storage	1
NSW	×	×	√	√	√	Does not allow storage and must have a non-storage surge attenuation device. Allows the temporary containment of greywater to be released to an irrigation system at a constant rate via gravity or pump.	2
NT	×	×	×	√	√	Storage not allowed	3
Qld	√	×	√	√	√	Must have surge tank designed on household fixture ratings of AS/NZS 3500.2—max discharge 500 L. Surge tank must not operate as a storage tank	4
SA	×	×	√	√	√	<24 hours storage	5
Tas	×	×	×	√	√	Not allowed in sewered areas, diversion must be to an approved on-site wastewater management systems.	6
Vic	×	×	√	√	√	<24 hours storage	7
WA	×	×	√	√	√	Includes primary treated (sedimentation or diversion device)	8

√ = allowed,

×

\* Recommends restricted access

NOTE: For all untreated greywater systems kitchen greywater must not be used and edible food plants should not be watered. Updated guidance should be checked for appropriate uses. See relevant State and Territory guidelines.

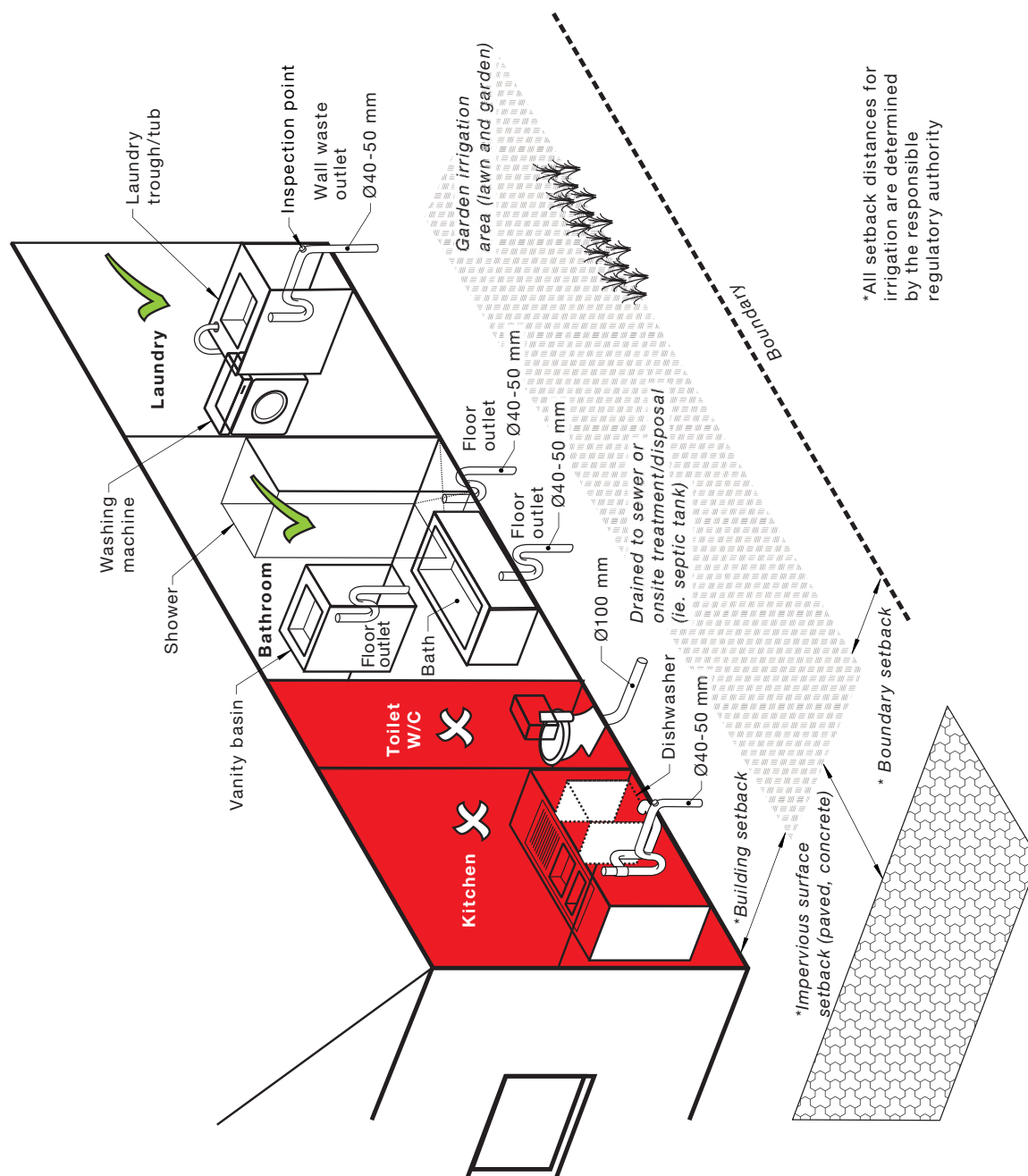
#### References

- 1 ACT Health 2007
- 2 NSW Health April 2000; Feb 2005
- 3 DHCS 2004; 2007; DHCS NT 1996; DNREA NT 2007 (accessed)
- 4 DLGPSR ; LGP 2003; Qld DIP 2007a, [www.lgp.qld.gov.au/planning/?id=7036](http://www.lgp.qld.gov.au/planning/?id=7036)
- 5 DoH SA 2006a; b; 2007
- 6 DIER 2005
- 7 DoH Vic 2007; EPA Victoria 2003 refers to EPA Victoria 2006
- 8 DoH WA 2005











### 5.3 APPROVALS FOR UNTREATED GREYWATER SYSTEMS (UGSS)

#### 5.3.1 Design and installation approval—UGS

Approval and installation requirements for UGSs is shown in Figure 5.2. Approval and installation requirements for manual diversion of untreated water systems is shown in Figure 5.3.

If greywater is diverted from the sewer, the GDD needs WaterMark certification. This doesn't apply for bucketing as the greywater is collected before it enters the drainage/sewer system.

Within most States of Australia the Local Government Act requires prior council approval of untreated greywater diversion installations. Check local council requirements.

Untreated greywater diversion devices should be installed under the following conditions;

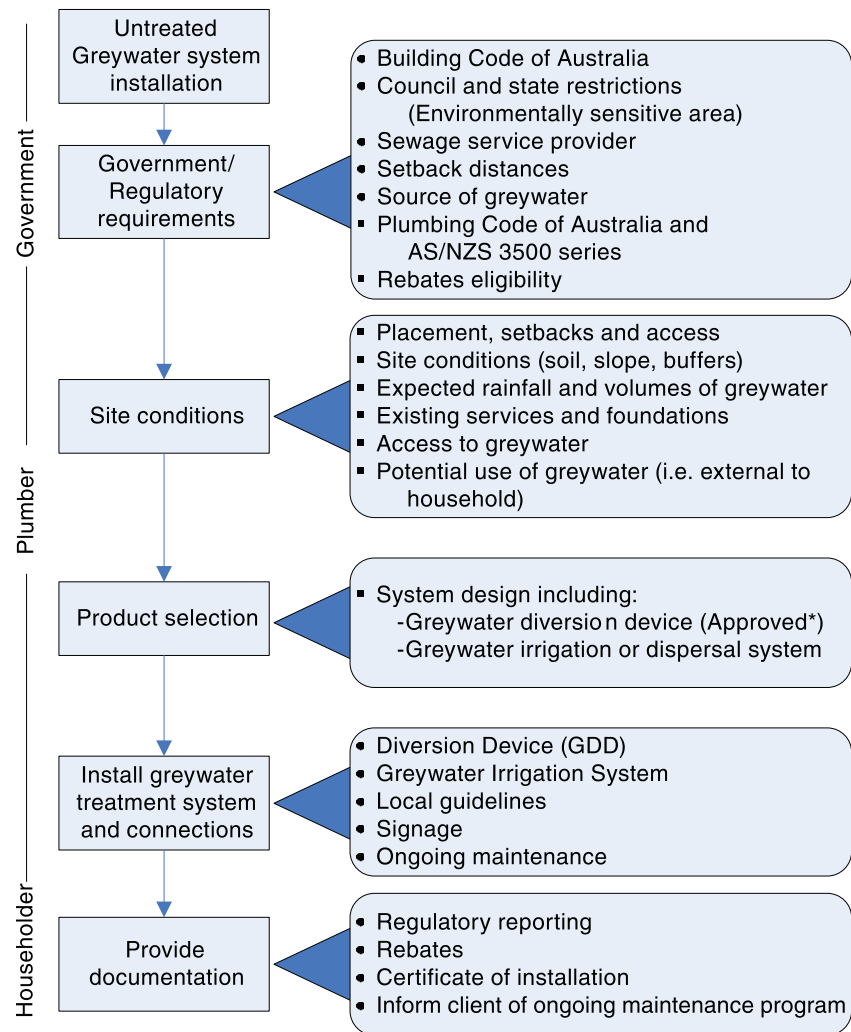
- (a) Wastewater is not diverted from kitchen or toilet plumbing.
- (b) An on-site sewage management facility is not in place.
- (c) Untreated greywater is not stored in any way, or treated other than primary screening or filtration.
- (d) A washing machine standpipe, or licensed diversion device delivers the greywater to a sub-surface irrigation system.
- (e) The standpipe or diversion device has a manual switching or selection facility so that greywater can be easily diverted back to sewer.
- (f) Any diversion device connected to, or modifying the existing plumbing system is a WaterMark licensed device, and must be installed by a licensed plumber.
- (g) Any diversion other than by gravity is only via an approved non-storage surge tank and pump system installed by a licensed plumber.
- (h) Some form of non-storage surge attenuation is installed as part of the diversion device.
- (i) The local authority must be notified by the installing plumber that a greywater diversion device is in place.
- (j) Appropriate backflow prevention devices are fitted to drinking water supply connected to the property.

It is the responsibility of the household owners to engage a licensed plumber to install the untreated GDD and associated non-storage surge attenuation. The irrigation system connected to the untreated GDD also needs to be installed to site setback requirements, which can differ between authorities depending on soil conditions.

It is the responsibility of the installing licensed plumber to install the untreated GDD and non-storage surge attenuation to meet the requirements of the local plumbing and drainage requirements.

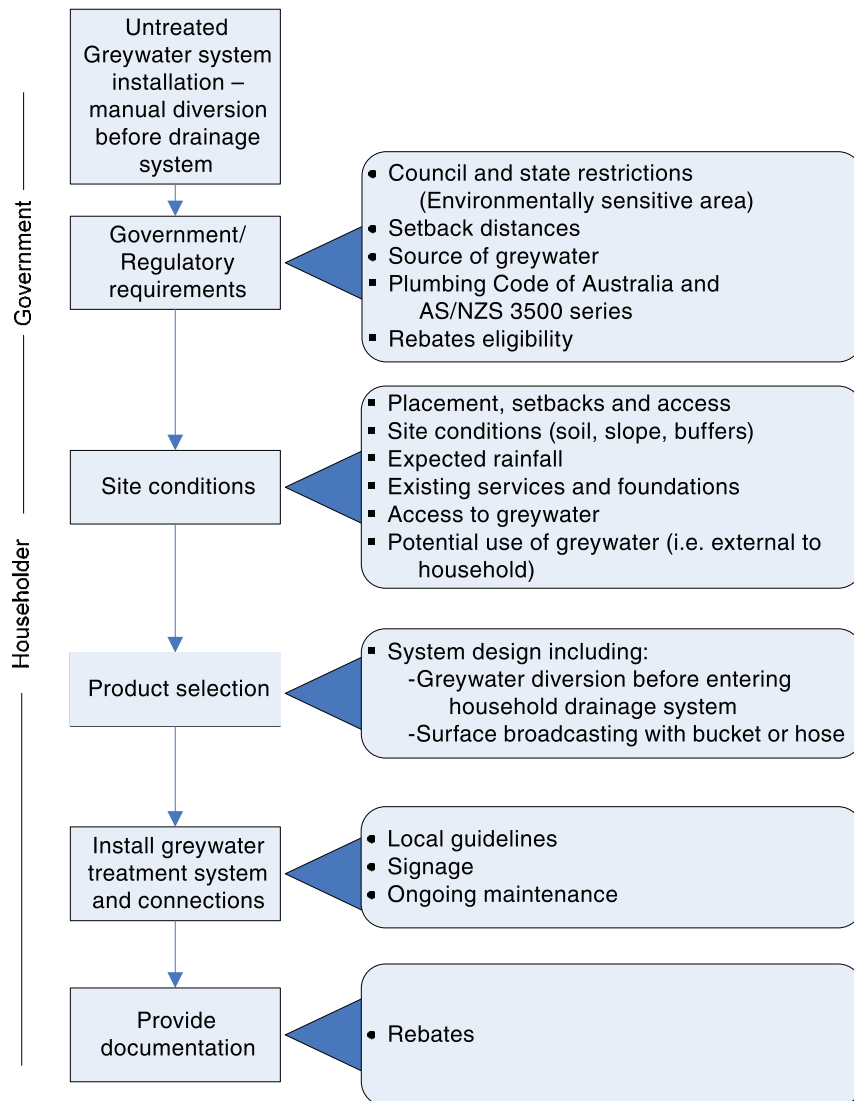
The plumber must ensure that controls to prevent the incidence of cross-connection are implemented for both the drinking water supply and stormwater drainage system.





**FIGURE 5.2 THE APPROVALS AND INSTALLATION REQUIREMENTS FOR UNTREATED GREYWATER SYSTEM (UGS) IN AUSTRALIA—INCLUDES A GREYWATER DIVERSION DEVICE AND IRRIGATION SYSTEM (COLLECTION OF GREYWATER AFTER IT HAS ENTERED THE HOUSEHOLD GREYWATER DRAINAGE SYSTEM)**





**FIGURE 5.3 APPROVALS, DESIGN AND INSTALLATION FOR MANUAL DIVERSION OF UNTREATED GREYWATER USING BUCKETING, SIPHON HOSE OR WASHING MACHINE WASTE CONNECTION (COLLECTION OF GREYWATER BEFORE ENTERING THE HOUSEHOLD GREYWATER DRAINAGE SYSTEM).**



**TABLE 5.3**  
**UNTREATED GREYwater DIVERSION SYSTEMS—PRE INSTALLATION CHECKLIST**

Checklist	Requirements	Comments
Local council authority		
State authority		
Source of greywater <ul style="list-style-type: none"> <li>• Bath</li> <li>• Shower</li> <li>• Vanity basin</li> <li>• Laundry tub</li> <li>• Washing machine</li> </ul>		
Estimated greywater volume available for intended use (Table 3, Table 4, Table 5 and Table 6)		
Site conditions <ul style="list-style-type: none"> <li>• Slope</li> <li>• Climate (incl. local rainfall)</li> <li>• Land fill</li> <li>• Groundwater</li> <li>• Erosion potential</li> <li>• Site shading</li> </ul>		
Soil conditions <ul style="list-style-type: none"> <li>• Soil type</li> <li>• Soil pH test</li> <li>• Soil moisture level</li> </ul>		
Setback distances from		
Dwelling <ul style="list-style-type: none"> <li>• Paths/hard surfaces</li> <li>• Swimming pools</li> <li>• Natural waterways</li> </ul>		
Best practice irrigation design and use		
Area available for irrigation		
Product approvals/local authority conditions		

### 5.3.2 Product approval—UGS

All GDDs connected to the greywater sanitary plumbing should have WaterMark certification. This doesn't apply where greywater is collected before entering the drainage system; for example, bucketing and siphoning of greywater from laundry basin.

Only the diversion devices require WaterMark approval (Table 5.4) under 5200:4600 all other systems are approved by the local responsible regulatory authority ([www.standards.org.au/](http://www.standards.org.au/)).

Local State Health/Plumbing/Environmental Departments (Responsible regulatory authority) are responsible for the approval of GDD (Table 3.4). Greywater Diversion Devices shall have WaterMark certification (Figure 5.4) in accordance with the Standards listed in AS 5200.4600, or authorisation under the Plumbing Code of Australia.





Water Mark

FIGURE 5.4 WATERMARK CERTIFICATION MARK

TABLE 5.4

WEBSITES FOR APPROVED GREYwater DIVERSION DEVICES IN AUSTRALIA

State or Territory	Websites for approved greywater diversion devices
Australian Capital Territory	<a href="http://www.thinkwater.act.gov.au/water%20savingtips/Greywater_fags.shtml#approvals">www.thinkwater.act.gov.au/water%20 savingtips/Greywater_fags.shtml#approvals</a>  NOTE: The ACT Government does not provide a list of approved greywater system products, it provides links from its Think Water website to information about greywater systems approved or accredited in other States and Territories.
Northern Territory	<a href="http://www.nt.gov.au/health/docs/cdc_envhealth_register_greywaterdiverters.pdf">www.nt.gov.au/health/docs/cdc_envhealth_register_greywaterdiverters.pdf</a>
New South Wales	<a href="http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/diversion_devices.html">www.health.nsw.gov.au/public-health/ehb/general/wastewater/diversion_devices.html</a>
Queensland	<a href="http://www.localgovernment.qld.gov.au/?id=4077">www.localgovernment.qld.gov.au/?id=4077</a>
South Australia	<a href="http://www.dh.sa.gov.au/pehs/branches/wastewater/alternative-onsite-systems.htm">www.dh.sa.gov.au/pehs/branches/wastewater/alternative-onsite-systems.htm</a>
Tasmania	<a href="http://www.wst.tas.gov.au/_data/assets/pdf_file/0006/75507/greywater_report.pdf">www.wst.tas.gov.au/_ data/assets/pdf_file/0006/75507/greywater_report.pdf</a>
Victoria	<a href="http://www.ourwater.vic.gov.au/_data/assets/pdf_file/0011/740/List20of20Greywater20Systems201020Oct2007.pdf">www.ourwater.vic.gov.au/_ data/assets/pdf_file/0011/740/List20of20Greywater20Systems201020Oct2007.pdf</a>
Western Australia	<a href="http://www.health.wa.gov.au/envirohealth/water/greywater.cfm">www.health.wa.gov.au/envirohealth/water/greywater.cfm</a> (included in greywater systems)

#### 5.4 BEST PRACTICE MANAGEMENT CONTROL MEASURES—UNTREATED GREYwater

When undertaking the diversion of untreated greywater using a GDD:

##### DOs

##### Plumber

- ☐ Undertake a water audit, with the householder, before installing a greywater diversion system to calculate the amount of greywater that can be generated and used on-site.
- ☐ Ensure that the greywater diversion system has a valve to allow untreated greywater to be diverted back to the sewer when it is too wet to go onto the garden.
- ☐ Ensure greywater will not contaminate any source of drinking water. Avoid cross-connections by using color coded pipe and install backflow prevention devices.
- ☐ Install a diversion device that has a WaterMark license.
- ☐ Indicate where untreated greywater is being used by signage.

##### Householder

- ☐ Use a licensed plumber to install the diversion system.
- ☐ Use low risk sources for water diversion systems such as bath, shower and laundry rinse water (Laundry wash water is much higher in detergent concentrations than rinse water).



- ☐ Be aware of biodegradable labelled products (e.g., soaps and detergents). Liquid based products are generally better (check the ingredients on the packaging).
- ☐ Avoid bleaches or softeners, and products used to clean drains.
- ☐ Only divert greywater in dry conditions, in quantities that can be taken up by plants and soil (i.e. avoid over irrigation and runoff).
- ☐ Keep children away from areas watered with greywater until it has soaked into the ground.
- ☐ Wash hands after gardening.

## **DON'Ts**

### **Plumber**

- ☐ Don't connect kitchen waste to the greywater system.
- ☐ Don't use greywater diversion devices if the property is connected to a municipal effluent re-use system and the sewerage service provider doesn't allow diversion of wastewater from the effluent re-use scheme.
- ☐ Don't discharge untreated greywater near agricultural drainage pipes as the greywater could flow into the stormwater drainage system.
- ☐ Don't discharge untreated greywater in an environmentally sensitive area.

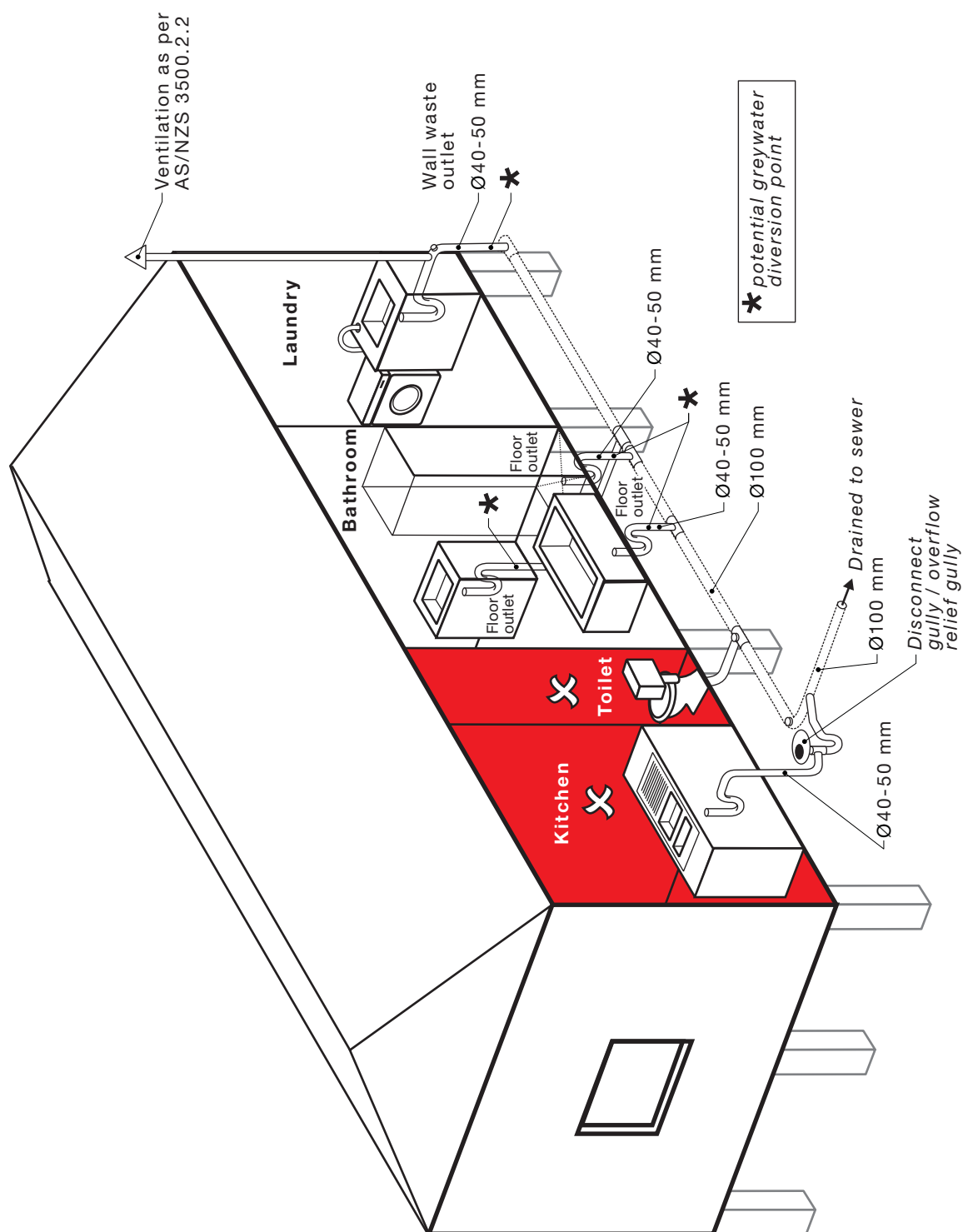
### **Householder**

- ☐ Don't use greywater from the washing of nappies or soiled clothing.
- ☐ Don't use greywater when a resident has diarrhoea or is sick.
- ☐ Don't use greywater generated by cleaning in the laundry or bathroom, or when using hair dye or other chemicals.
- ☐ Don't use greywater generated by washing rags used for painting or for maintaining machinery.
- ☐ Don't store untreated greywater (use surge tanks or pump or pump out <24 hrs—Table 5.2).
- ☐ Don't use kitchen water as it is heavily contaminated with fats, grease and solids.
- ☐ Don't allow pooling and runoff of greywater onto other properties, into watercourses and the stormwater system.
- ☐ Don't over water with greywater, as it can raise the local water table.
- ☐ Don't use greywater for irrigation of fruit or vegetables, or where fruit can fall to the ground and be eaten.
- ☐ Don't drink or allow pets or animals to drink greywater.
- ☐ Don't put paints, automotive oils and grease, or matter designated as trade waste or industrial liquid waste into the greywater system.
- ☐ Don't use untreated greywater to wash paths, driveways, fences or cars.
- ☐ These do's and don'ts have been compiled from guidelines across Australia (Chapter 11)

## **5.5 INSTALLATION SOLUTIONS FOR UNTREATED GREYWATER SYSTEMS AND GREYWATER DIVERSION DEVICES**

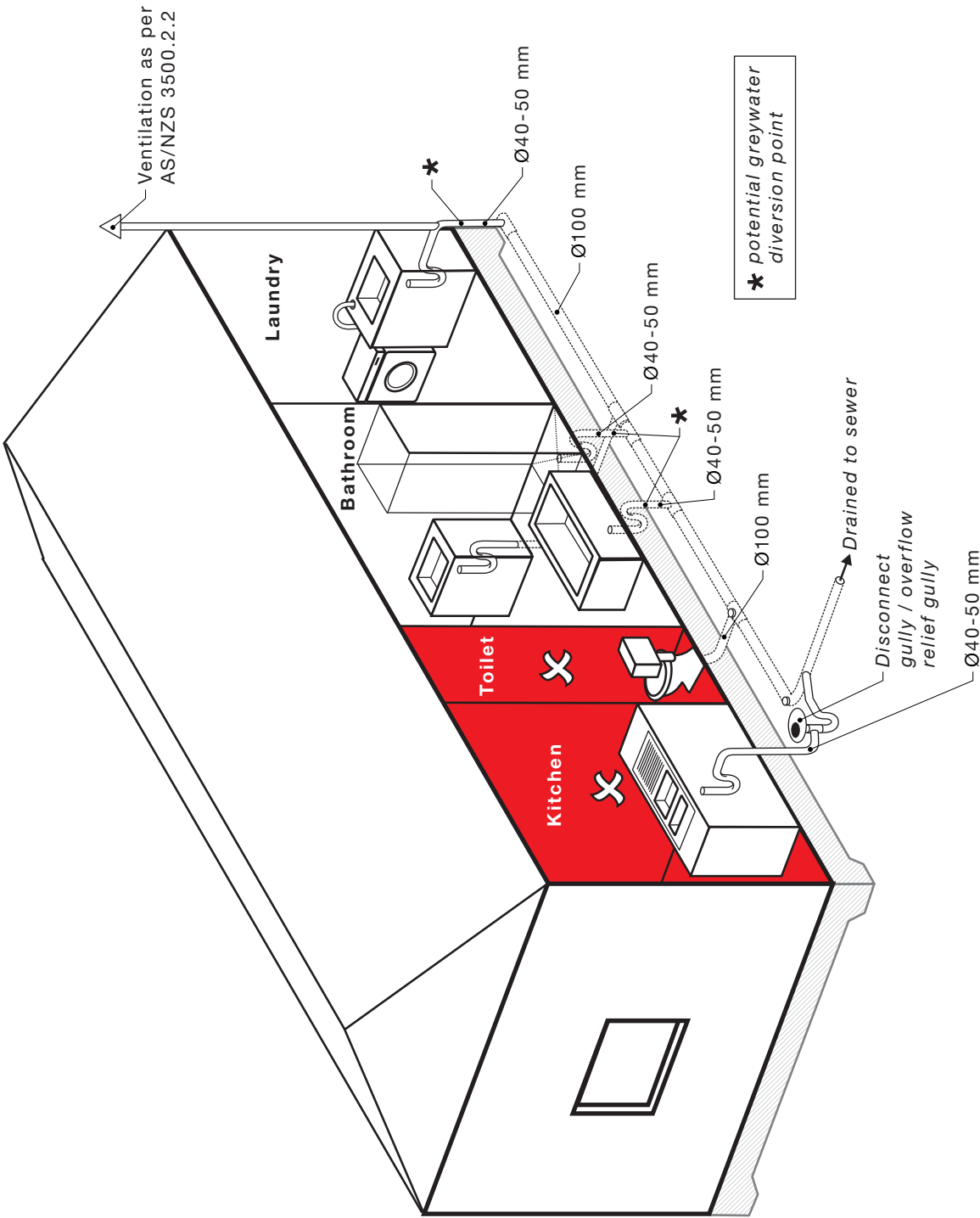
### **5.5.1 Untreated greywater systems and diversion points**





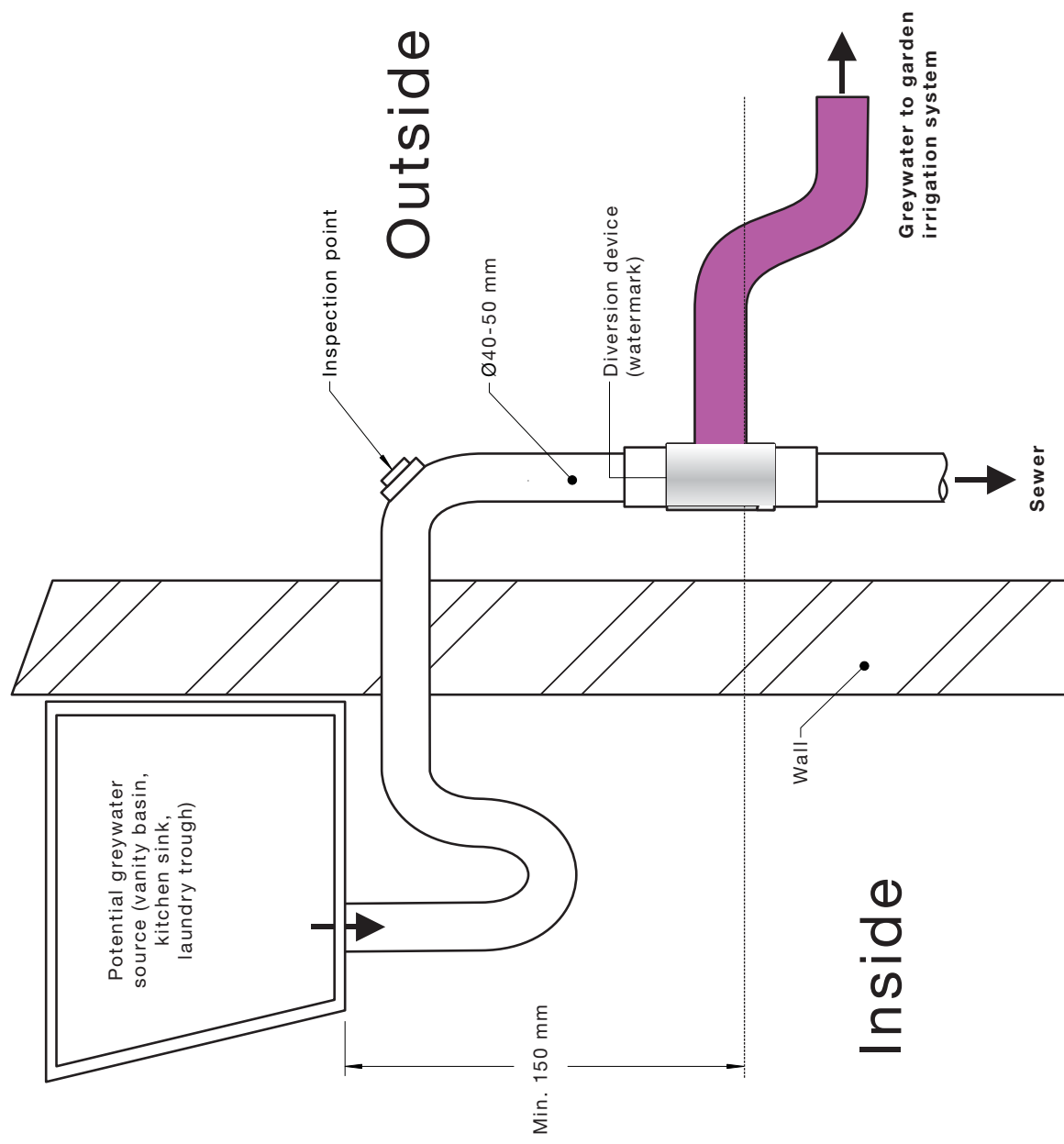
**FIGURE 5.5 GREYWATER DIVERSION POINTS WITH UNDER FLOOR ACCESS (SEWERED AREAS) INDICATING POTENTIAL GREYWATER DIVERSION POINTS ON 40-50 MM DIAMETER PIPEWORK ONLY**





**FIGURE 5.6 GREYWATER DIVERSION POINTS WITHOUT UNDER-FLOOR ACCESS (CONCRETE SLAB) INDICATING POTENTIAL GREYWATER DIVERSION POINTS ON 40-50 MM DIAMETER PIPEWORK ONLY**





NOTE: Some greywater diversion devices include a primary filter to remove hair and lint.

FIGURE 5.7 ABOVE GROUND GREYWATER DIVERSION DEVICE (GDD) TEE (GRAVITY SYSTEM)



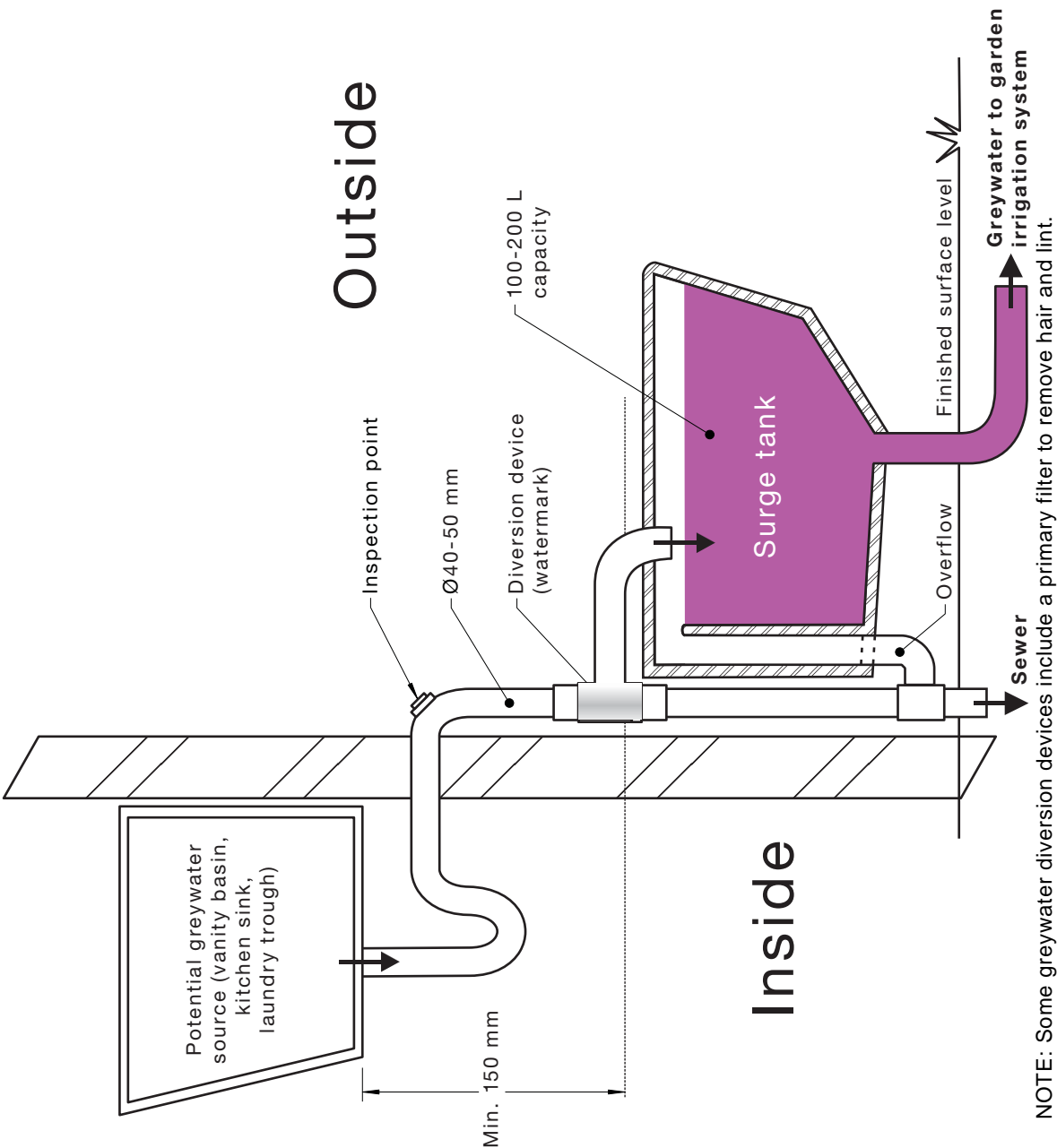
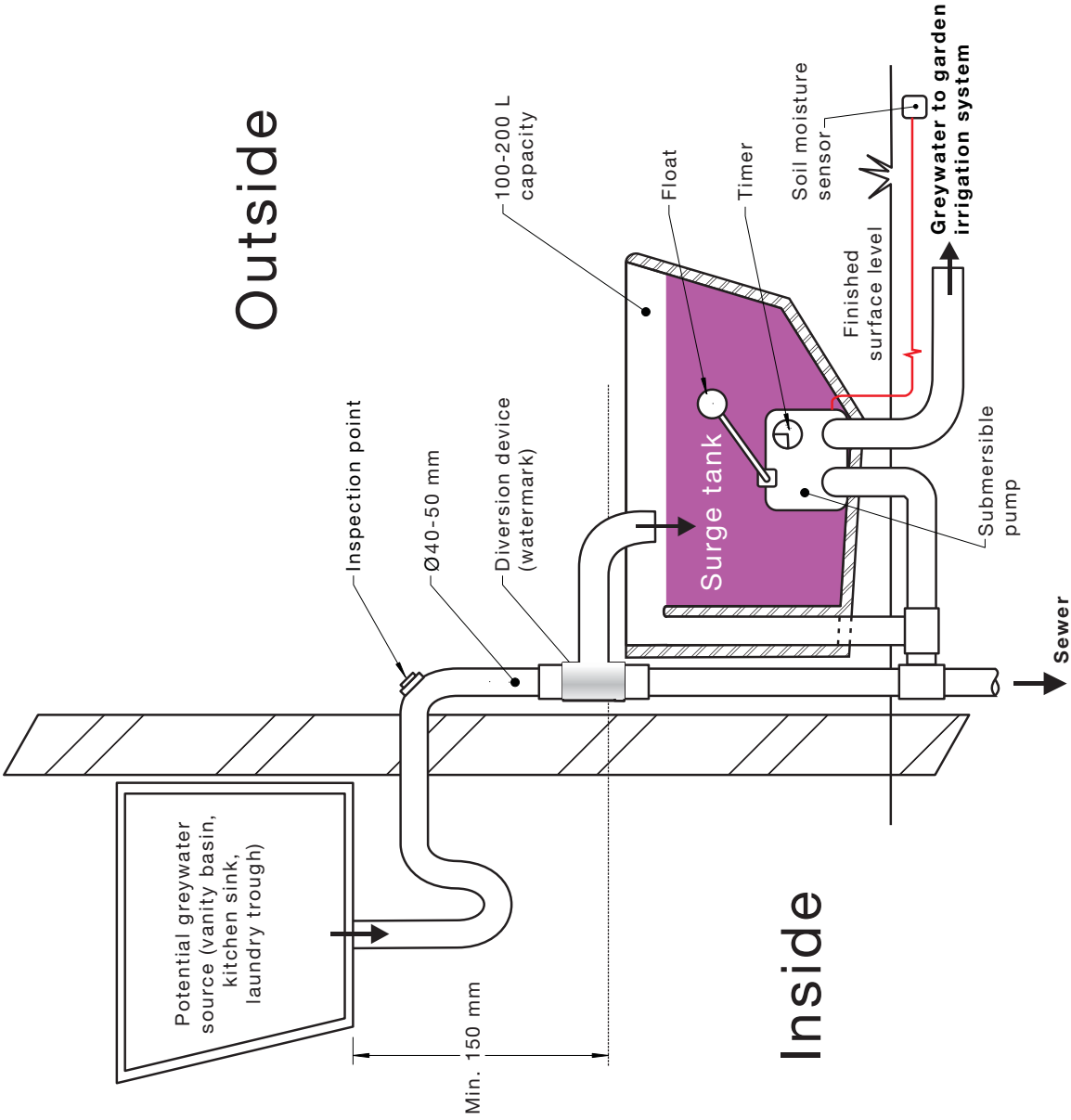


FIGURE 5.8 ABOVE GROUND GREYWATER DIVERSION DEVICE (GDD) WITH SURGE TANK

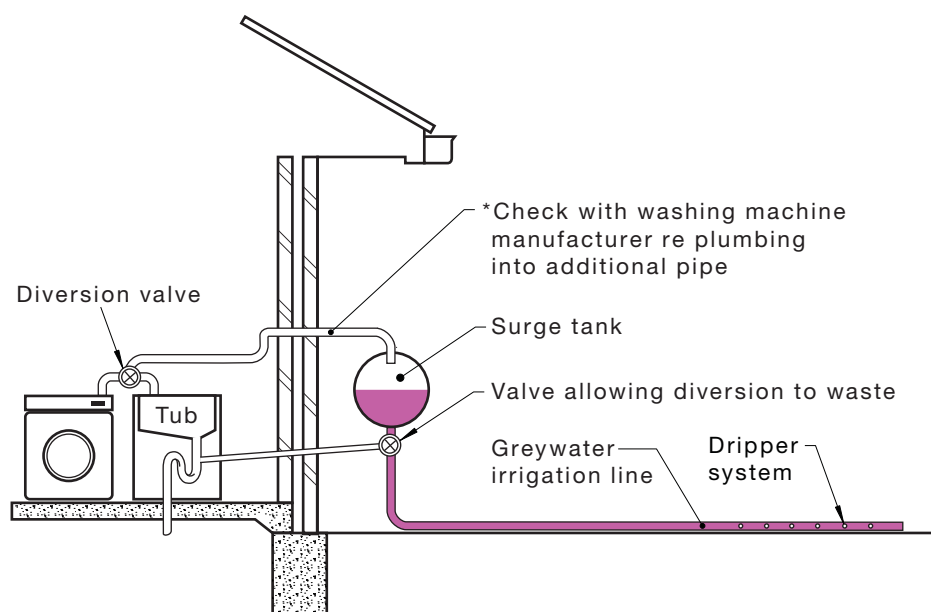




NOTE: Some greywater diversion devices include a primary filter to remove hair and lint

**FIGURE 5.9 ABOVE GROUND GREYWATER DIVERSION DEVICE**





**FIGURE 5.10 UNDERGROUND UNTREATED GREYWATER SYSTEM—WITH TIME LIMITED STORAGE GREYWATER IRRIGATION SYSTEM—UNTREATED GREYWATER**

Distribution of untreated greywater can be through 4 types of irrigation systems.

- (a) *Sub-soil irrigation*—greywater is distributed into trenches dug into the ground through gravity. This method is usually associated with septic systems and water disposal rather than beneficial use. There are a number of variations that rely upon absorption and/or transpiration of the greywater trenches are usually greater than 100 mm deep. This type of irrigation is not recommended as it is generally not good irrigation practice and not the most efficient use of the water unless deep rooted plants are watered.
- (b) *Sub-surface irrigation*—this system is usually pressured and installed between 100 mm and 150 mm below the ground, usually in grassed areas. The untreated greywater is distributed through small-diameter perforated pipes or dripper lines and applied directly to the root zone at a control rate so that the plants can utilise the water. Adequate filtration is required to ensure pipe perforation or drip holes are not clogged with suspended solids in the untreated greywater.
- (c) *Covered surface drip irrigation*—this enables untreated greywater to be applied directly to the surface of the soil under a layer of mulch. The greywater is distributed under pressure from small diameter perforated pipes or dripper lines. This system is usually applied to plants such as, fruit trees and grape vines.
- (d) *Manual bucketing*—Manually irrigating with greywater using a bucket (e.g., collecting shower and laundry water for re-use) enables re-use of small quantities of untreated greywater. This should not be done during wet weather conditions.
- (e) *Surface broadcasting*—Not recommended but allowed in some states (e.g., Queensland, *Queensland Plumbing and Wastewater Code*. Amendment 23/11/2007)

Spray irrigation shall not be practiced with untreated greywater because the water is of a lower quality and aerosol produced could expose humans to pathogens in greywater impacting human health. All irrigation systems should only apply water when it is required by the plants in volumes that stored by the soil and subsequently used by the plant.



### 5.5.2 Manual bucketing—Untreated greywater

Manually irrigating with untreated greywater using a bucket (e.g., collecting shower and laundry water for use) has the potential to use small quantities of untreated greywater from the bathroom and laundry (Figure 18). Bucketed untreated greywater can be used for irrigation of gardens, lawns and outdoor pot plants. Setback distances for use of untreated greywater should followed. Some additional (see Chapter 5.4) best practices to consider are:

#### **DO**

- ☐ Be careful lifting and carrying buckets of greywater.
- ☐ Apply with buckets onto garden or use sub-surface garden irrigation (some state and territories allow surface broadcasting, but no spray irrigation—see Table 5.2).
- ☐ Rotate greywater irrigation using mains (drinking) or rain water, especially in areas of low rainfall. This will help to flush salts from the soil.
- ☐ Label the bucket for use with greywater only and wash with drinking water after use.



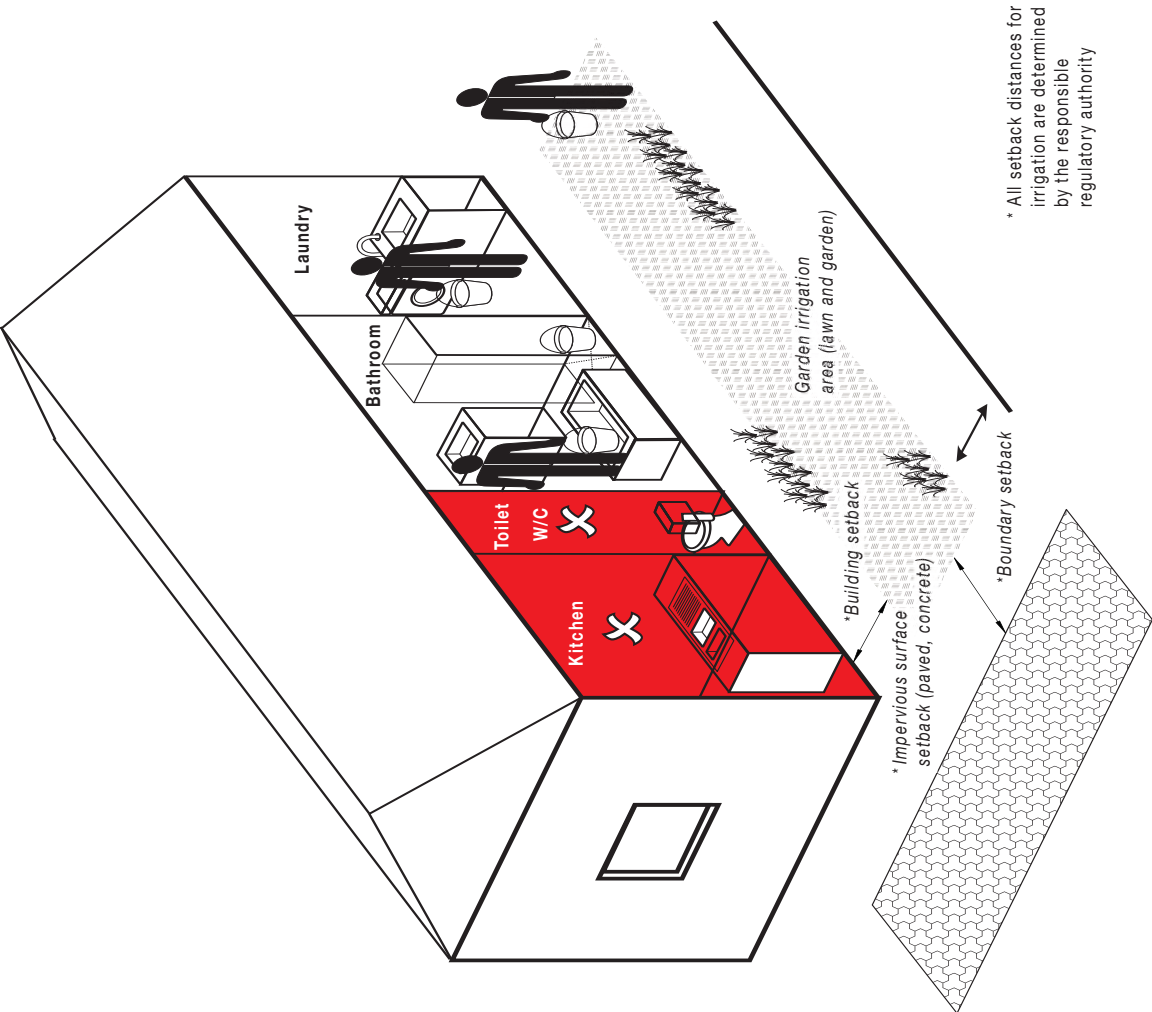


FIGURE 5.11 UNTREATED GREYWATER IRRIGATION WITH MANUAL BUCKETTING



5.6 SIGNAGE AND LABELLING

The marking, labelling and signage of the untreated greywater irrigation system must be in accordance with AS/NZS 3500.

**TABLE 5.5**  
**PIPE LABELS, SIGNAGE AND TAP COLOR REQUIREMENTS FOR UNTREATED GREYWATER SYSTEMS**

	<p>All pipes or pipe sleeves and identification tapes on garden irrigation systems) shall be coloured purple as per AS 2700 and marked with the following in accordance with AS 1345, 'WARNING RECYCLED/RECLAIMED WATER—NOT FIT FOR DRINKING' or similar at intervals not exceeding 0.5 m.</p>
	<p>All below ground pipes (including those used for sub-surface irrigation) shall have an identification tape marked in accordance with the Australian/New Zealand Standard AS/NZS 3500.1 installed on top of the greywater pipeline, running longitudinally, and fastened to the pipe at not more than 3 m intervals (Picture above)</p>

5.7 MAINTENANCE

Once an untreated greywater system is installed it is the owner’s responsibility to ensure it is maintained for the life of the installation. Untreated greywater diversion devices require regular maintenance, such as regular cleaning and replacing of filters and periodic cleaning of the surge tank (Table 5.6). Refer to manufacturers recommendations.



**TABLE 5.6**  
**UNTREATED GREYWATER SYSTEMS—MAINTENANCE CHECKLIST**

<b>Maintenance required</b>	<b>Recommended timeframe<sup>*</sup></b>
Check plumbing fixtures connected to dispersion system are working and draining	Daily
Clean filter (if installed)	Weekly
Replace filter (if installed)	As recommended by manufacturer
Check irrigation distribution system	Weekly
Monitor soil conditions for	
- becoming wet and boggy	Weekly
- surface ponding and run off	Weekly
- poor vegetation growth	Monthly
- unusual odours	Monthly
Soil moisture level reading	Every 3 months
Check soil pH.	Every 6 months
Inspect tanks, insect screens on vents and inspection points, checking for presence of mosquito breeding.	Monthly
Clean surge tank	Every 6 months

<sup>\*</sup> or to manufacturers requirements



## CHAPTER 6 IRRIGATION OF GREYWATER — DESIGN AND SITE CONSIDERATIONS

### 6.1 SITE AND SOIL CONSIDERATIONS FOR GREYWATER IRRIGATION SYSTEMS

#### 6.1.1 General

Both untreated and treated greywater may be used for irrigation (Table 3.2 and Table 5.2). A number of site and soil features will impact on the suitability of land for irrigation with treated or untreated greywater as follows:

##### *Soil*

- Depth to bedrock
- Depth to water table
- Permeability
- Texture
- pH
- Salinity

##### *Site*

- Underground rainwater or drinking water tanks
- Climate and exposure
- Slope
- Run-on and upslope seepage
- Erosion potential
- Drainage
- Landfill
- Rock and rock outcrops
- Geology
- Setback distance requirements

The above soil characteristics are most critical because they provide an indication of the potential of the soil to absorb greywater; holding it for plant use without run-off or excessive seepage (deep drainage).

It is also important to be aware of soil features that affect plant growth as less healthy plants will use less water.

#### 6.1.2 Soil depth

Soil depth of less than 0.5 m to bedrock or hardpan might not have enough capacity to store sufficient water. Shallow soils also incur a risk of greywater resurfacing near the land application area.

The recommended minimum soil depth will vary depending on the volume of greywater, the type of land application system used and the site and soil characteristics.



### **6.1.3 Depth to water table**

Attention should be given to groundwater protection, particularly if the groundwater is used or may be used for drinking or irrigation water supplies. Once a particular contaminant has reached the groundwater, the rate of transport may be much greater than that in the soil's unsaturated zone and movement will be in the direction of the regional groundwater movement.

Minimum depths from the treated greywater dispersal area to the minimum water table and/or gravel layer in a plain adjoining a river or stream are recommended to maintain aerobic conditions in the soil, prevent surface ponding and prevent contamination of groundwater. These minimum depths will vary, depending on the type of application system proposed and the site and soil characteristics of the site.

### **6.1.4 Soil permeability**

Permeability is a measure of the ability of a soil to transmit water. It is affected by soil properties such as structure, texture and porosity.

In general, highly permeable soils such as gravels and sands will allow greywater to percolate rapidly through the soil profile, possibly allowing the transport of pathogens and nutrients to groundwater and off-site. Low permeability soils, such as medium and heavy clays, will encourage water logging and surface pooling of the applied wastewater.

Where the properties of a soil are correlated with a certain indicative permeability, permeability may be estimated by a local authority or by assessment of soil texture and structure,.

Further information on how to conduct a soil percolation test is given in AS/NZS 1547.

### **6.1.5 Soil texture**

Soil texture is determined by the percentage of sand, silt and clay in the soil. The percentages change the characteristics of a soil when it is made into a moist ball and manipulated by hand. This hand texturing is a convenient method to assess the soils texture on-site. Further information on hand texturing of soil is given in AS/NZS 1547.

The major soil particles that make up the soil texture are:

- (a) Clay (<0.002 mm diameter)
- (b) Silt (0.002–0.05 mm diameter)
- (c) Sand (0.05–2.0 mm diameter)

Any particles greater than 2 mm in size are not considered soil.

Soil texture can have a significant impact on the ability of the soil to transmit or retain irrigated greywater.

### **6.1.6 Soil pH**

The pH value of a soil influences soil conditions and vegetation growth. Soil pH affects the solubility of some nutrients in soils. Untreated greywater can impact on the pH of soil.

Soils with a pH of between 5.5 and 8.5 will pose limited constraints for land application areas.



### **6.1.7 Soil salinity**

Salinity is the presence of soluble salts in soils or waters. Salinity is measured as electrical conductivity (EC) and total dissolved salts (TDS).

Plant sensitivity to salinity varies considerable. As soils dry out, the salinity of the remaining soil water tends to increase, and so the effects become more severe. Plants affected by salinity have a reduced growth rate and show signs of water stress (e.g., wilting). Leaves may suffer burning along the margins.

### **6.1.8 Soil cation exchange capacity**

The cation exchange capacity (CEC) of the soil is defined as the sum of exchangeable cations that a soil can absorb at a specific pH. It is usually expressed in centimoles of charge per kilogram of soil (cmolc/kg). This gives an indication of the nutrient holding capacity of the soil.

### **6.1.9 Climate and exposure**

Climate and local exposure (microclimate of the site) influences the amount of untreated greywater required for all types of land application systems. Householders using irrigation and experiencing periods when rainfall exceeds evaporation must divert greywater to the sewer during periods of wet weather. Applying untreated greywater during wet weather could make pollutants leach to groundwater, or the untreated greywater could surface, with consequential environmental and health risks.

Factors affecting exposure at a specific site include the geographical aspect of the area, vegetation and buildings near the proposed application area. Evaporation may be reduced by up to two-thirds in some locations by a poor aspect or overshadowing and sheltering by topography, buildings or vegetation.

### **6.1.10 Site slope**

Excessive site land slope could pose problems for the installation of systems and create difficulties in the even distribution of the greywater to land, possibly resulting in run-off from surface land application areas. The recommended maximum slope will vary depending on the type of land application system used and the site and soil characteristics. Check State and Territory guidelines and AS/NZS 1547.

### **6.1.11 Run-on and upslope seepage**

Stormwater/surface water run-on should be diverted around any land application area by using earthworks or a drainage system approved by council. Upslope seepage can be at least partly controlled by installing groundwater cut-off trenches, provided the lowest level of the trench is above the level at which greywater can enter the land application area.

### **6.1.12 Erosion potential**

Greywater use facilities should not be put on land that shows evidence of erosion, or that has potential for mass movement or slope failure.

### **6.1.13 Site drainage**

Greywater irrigation systems should not be installed on damp sites where irrigation is not required. Poor drainage and surface dampness are often indicated by the type of vegetation growing on the site. Moss and ferns are likely to grow in damp soil conditions.



#### **6.1.14 Site land fill**

Fill can be described as soil resulting from human activities that have led to modification, truncation or burial of the original soil or the creation of new soil material by a variety of mechanisms. Fill often has highly variable properties, such as permeability. Fill can be prone to subsidence, and could contain material that might not be suitable for plant growth or for untreated greywater dispersal systems.

Fill can be removed, but if this is not possible, a detailed assessment of the site might be needed.

Fill less than 0.3 m deep could be suitable, depending on the nature of the material and the suitability of the underlying soil.

#### **6.1.15 Rocks and rock outcrops**

The presence of rock outcrops usually indicates highly variable bedrock depths and can be associated with preferential pathways for greywater to flow along rock and surface elsewhere. The presence of rocks can limit evaporation and interfere with drainage. Rocks can also interfere with trench and pipe installations.

#### **6.1.16 Geology**

Untreated greywater dispersal areas should not be installed near major geological discontinuities, fractured or highly porous soil, as these soil structures can provide preferential pathways for greywater to enter the groundwater.

#### **6.1.17 Setback distances**

Setback distances should be kept between greywater use areas and sensitive environments, to ensure protection of community health, the environment and community amenity. Setback distance should also be left between greywater irrigation areas and features like boundaries of sites, driveways, buildings, surface and groundwater, in-ground rainwater, and swimming pools (Figure 6.1).

Recommended setback distances vary across Australia (refer to local responsible regulatory authority requirements). On-site domestic-wastewater management standards e.g. AS/NZS 1547 indicate a range a minimum setback distances base on the associated risk (Table 6.1 and Table 6.2).

Check with the responsible regulatory authority (e.g., local council, plumbing authority) for appropriate setback distance for each location. A land capability assessment may be required before approval will be granted by the responsible regulatory authority for an untreated greywater irrigation system.

Regulatory authorities may consider reducing setback distances for highly treated effluent with well managed irrigation systems if the key performance objectives for any on-site domestic wastewater management risks identified in relevant guidelines and as specified in AS/NZS 1547, are managed appropriately. Key performance indicators are to—

- (a) protect public health;
- (b) maintain and enhance the quality of the environment;
- (c) maintain and enhance community amenity; and
- (d) protect resources.

Installers of irrigation systems should be aware of any structural requirements regarding the foundations of building and application of water in the area. If installing irrigation systems, ensure you obtain written approval from the householder regarding the location of the irrigation system.



**TABLE 6.1**  
**HORIZONTAL AND VERTICAL SETBACK DISTANCES IN METRES FOR LAND**  
**APPLICATION SYSTEMS (USE IN CONJUNCTION WITH TABLE 23)**

Site feature	Identified level of constraint LOW - HIGH	Site constraint items of specific concern (from Table 23, see Note 2)
Horizontal setback distance (m)		
Property boundary	1.5–50	A, D, J
Buildings/houses	2.0–>6	
(see Note 3)	A, D, J	
Surface water (see Note 4)	15–100	A, B, D, E, F, G, J
Bore, well (see Notes 5 and 6)	15–50	A, C, H, J
Recreational areas (Children's play areas, swimming pools etc) (see Note 7)	3–15	
(see Note 8)	A, E, J	
In-groundwater tank	4–15	
(see Note 9)	A, E, J	
Retaining wall and Embankments, escarpments, cuttings (see Note 10)	3.0 m or 45° angle from toe of wall (whichever is greatest)	D, G, H
Vertical setback distance (m)		
Groundwater (see Notes 5, 6 and 11)	0.6–>1.5	A, C, F, H, J
Hardpan or bedrock	0.5–1.5	A, C, J

(Source: AS/NZS 1547, p 158, v3308)

**NOTES:**

- 1 Check with State and Territory guidelines for specific setback distances that may be required.
- 2 The overall setback distance should be based on an evaluation of the constraint items and corresponding sensitive features in Table Y2 and how these interact to provide a pathway or barrier for movement of wastewater to the site feature.
- 3 Setback distance of <3 m from houses is only appropriate where a drip irrigation land-application system is being used with low design irrigation rates, where shallow sub-surface systems are being used with equivalent low areal loading rates, where the risk of reducing the bearing capacity of the foundation or damaging the structure is low, or where an effective barrier (designed by a specialist) can be installed. This may require consent from the regulatory authority.
- 4 Setback distance from surface water is defined as the areal edge of the land-application system to the edge of the water. Where land-application areas are planned in a water supply catchment, advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist. In this case, surface water refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. It also includes water in the coastal marine area and water in man made drains, channels and dams unless these are to specifically divert surface water away from the land-application area. It excludes any water in a pipe or tank.
- 5 Highly permeable stony soils and gravel aquifers potentially allow microbes to be readily transported up to hundreds of meters down gradient of an on-site system (see Table 1 in Pang et al. 2005). Maximum setback distances are recommended where site constraints identified at the high scale for all items A, C and H in TABLE T2. For further reading and guidance as to setback distances in soils of highly permeable soils and coarse-grained aquifers refer to the suggested list below. Note that microbial removal is not linear with distance, therefore extrapolation of experiments that have not been verified in the field should not be relied upon. Advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist.



- 6 Setback distances from water supply bores should be reviewed on a case by case basis. Distances can be dependent on many factors including; soil type, rainfall, depth and casing of bore, direction of groundwater flow, microbe species, existing quality of receiving waters and resource value of waters.
- 7 Where effluent is applied to the surface, the maximum value is recommended.
- 8 In the case of sub-surface application of primary treated effluent, the upper value is recommended.
- 9 It is recommended that land application of primary treated effluent be down gradient of in-groundwater tanks.
- 10 When determining minimum distances from embankments or cut slopes, the type of land-application system will also need to be taken into account. Such clearances may need to be increased in areas where slope stability is of concern.
- 11 Groundwater setback distance (depth) assumes unsaturated flow and is defined as the vertical distance from the base of the land-application systems to the highest seasonal water table level. To minimise potential for adverse impacts on groundwater quality, minimum setback distances should ensure unsaturated, aerobic conditions in the soil. These minimum depths will vary depending on the scale of site constraints identified in Table 6.2. Where insufficient groundwater setback is available, the ground level can be raised by importing suitable topsoil and improving effluent treatment. In this instance, the regulatory authority should make the final decision.
- 12 In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 1 m or a plume height not exceeding 0.3 m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account.

**TABLE 6.2**  
**SITE CONSTRAINTS SCALE FOR ESTABLISHING SETBACK DISTANCES**

	Site/system feature	Constant scale (see Note 1)		Sensitive features
		Lower	Higher	
		Examples of constraint factors (see Note 2)		
A	Microbial quality of effluent (see Note 3)	Effluent quality consistently producing 150 cfu/100 mL E. coli (e.g., secondary treated effluent with disinfection)	Effluent quality consistently producing 106 cfu/100 mL E. coli (e.g., primary treated effluent)	Groundwater and/or surface pollution hazard, public health hazard
B	Surface water (see Note 4)	C1–C3 soils (see Note 5). No surface water down gradient within >100 m, low rainfall area	C4–C6 soils, permanent surface water <50 m down gradient, high rainfall area, high resource/ environmental value (see Note 6)	Surface water pollution hazard for low permeable soils, low lying and/or poorly draining areas
C	Groundwater	C5, C6 soils, low resource/environmental value	C1–C2 soils, gravel aquifers, high resource/environmental value	Groundwater pollution hazard
D	Slope	0–6 % (surface effluent application) 0 - 10 % (sub-surface effluent application)	>10% (surface effluent application), >20% sub-surface effluent application	Off-site export of effluent, erosion
E	Position of land-application area in landscape (see Note 7)	Down gradient of surface water, property boundary, recreational area	Up gradient of surface water, property boundary, recreational area	Surface water pollution hazard, off site export of effluent

(continued)



**TABLE 6.2** (continued)

	Site/system feature	Constant scale (see Note 1)		Sensitive features
		Lower	Higher	
		Examples of constraint factors (see Note 2)		
F	Drainage	C1–C2 soils, gently sloping area	C6 soils, sites with visible seepage, moisture tolerant vegetation +/- low lying area	Groundwater pollution hazard
G	Flood potential	above 1 in 20 year flood contour	below 1 in 20 year flood contour	Off-site export of effluent, system failure, mechanical faults
H	Geology and soils	C3–C4 soils, low porous regolith, deep, uniform soils	C1, C6 soils, fractured rock, gravel aquifers, highly porous regolith	Groundwater pollution hazard for porous regolith and permeable soils
I	Landform	Hill crests, convex side slopes and plains	drainage plains and incise channels	Groundwater pollution hazard, resurfacing hazard
J	Application method	Drip irrigation or sub-surface application of effluent	Surface /above ground application of effluent	Off-site export of effluent, surface water pollution

Source: AS/NZS 1547:2008

**NOTES:**

- 1 Scale gives an indication of the level of constraint to siting an on-site system due to the constraints identified by SSE evaluator +/- regulatory authority.
- 2 Examples of typical siting constraint factors that may be identified by SSE evaluator and/or regulatory authority. Site constraints are not limited to those listed in this table when determining setback distances. Other site constraints may be identified and taken into consideration.
- 3 The level of microbial removal for any onsite treatment system needs to be determined and it should be assumed that unless disinfection is reliably used then the microbial concentrations will be similar to primary treatment. Low risk microbial quality value is based on the values given in ARC TP58, ANZECC and VIC EPA.
- 4 Surface Water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. It also includes water in the coastal marine area and water in man made drains, channels and dams unless these are to specifically divert surface water away from the land-application area. It excludes any water in a pipe or tank.
- 5 The soil categories C1–C6 are described in TABLE 5.1 Surface water or groundwater that has high resource value may include potable (human or animal) water supplies, bores, wells, and water used for recreational purposes. Surface water or groundwater of high environmental value include undisturbed or slightly disturbed aquatic ecosystems as described in the ANZECC Guidelines.
- 6 The regulatory authority may reduce or increase setback distances at their discretion, based on the distances of the land application up or down-gradient of sensitive receptors.



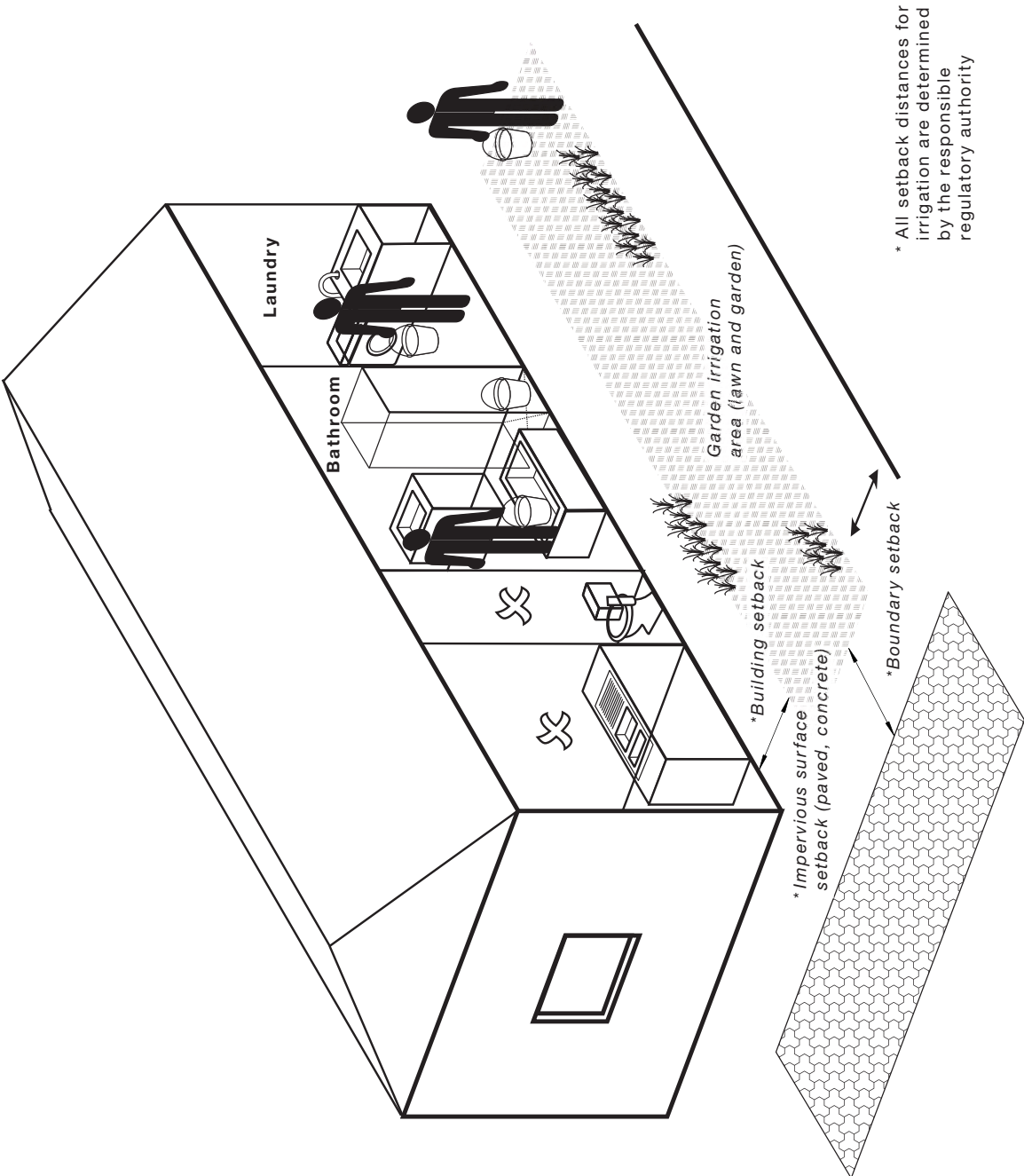


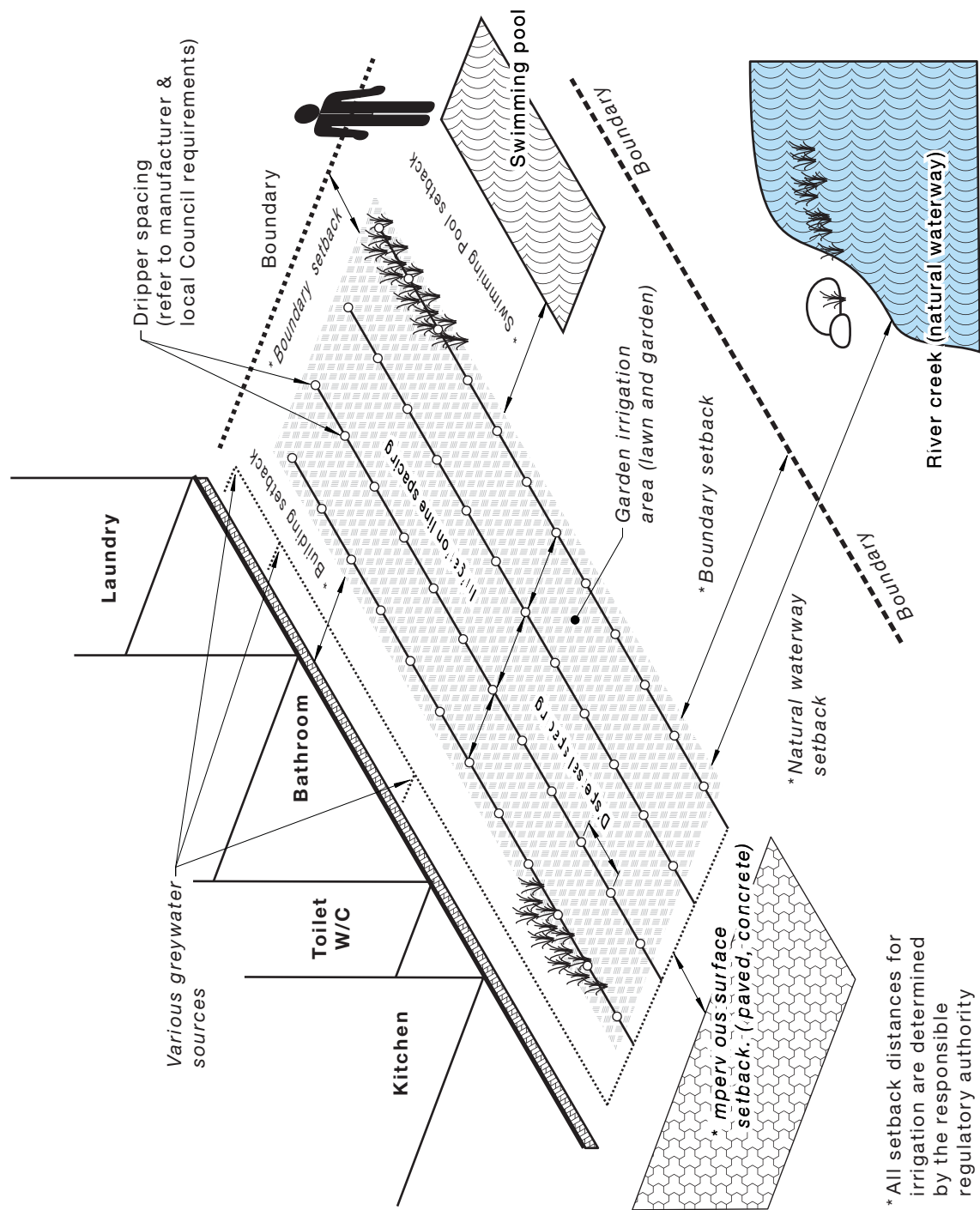
FIGURE 6.1 SETBACKS THAT MAY BE REQUIRED FOR IRRIGATION OF GARDENS WITH GREYWATER



6.2 IRRIGATION METHODS

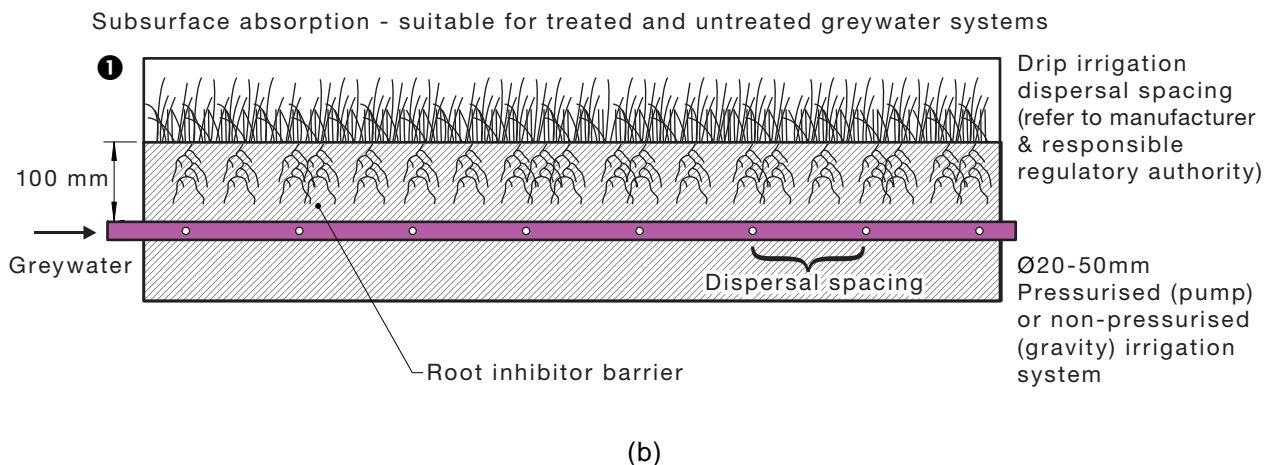
6.2.1 Sub-surface—Gravity feed irrigation systems

Gravity irrigation systems rely on gravity to evenly distribute the greywater to all parts of the irrigation area (Figure 6.2). Gravity irrigation systems should only be installed in flat/gentle slope sites, to avoid ponding of greywater at the lowest points in the irrigation area. Check with the manufacturer for recommended pipe diameters and maximum irrigation pipework lengths. The key to good irrigation practice is to maintain distribution uniformity across the irrigation area.



(a)





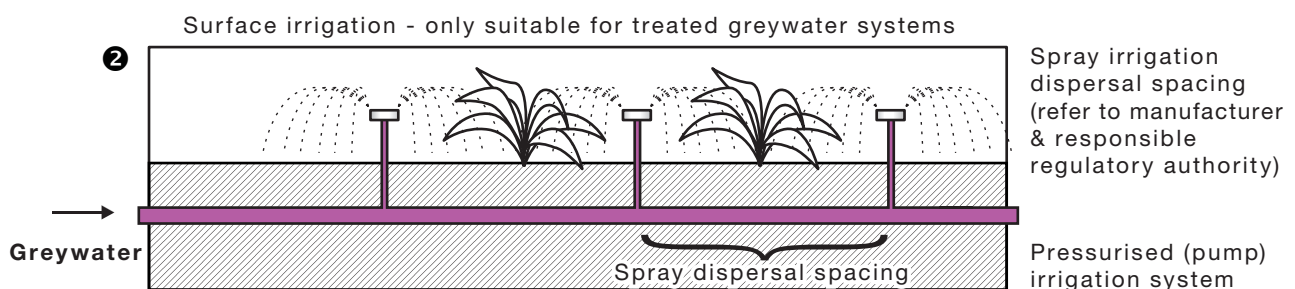
**FIGURE 6.2 GRAVITY FEED, LOW-PRESSURE IRRIGATION SYSTEM. (NOTE EVEN DISTRIBUTION AND NO POOLING OF WATER AT LOW POINT.)**

### 6.2.2 Sub surface—pressurised irrigation systems

Sub surface pressurised irrigation systems are ideal for sloping sites, as these systems can evenly distribute the greywater across the irrigation area. Check with the manufacturer for recommended pipe diameters and pump pressure requirements as items will vary depending on the irrigation pipework design, length and overall irrigation area as to the size required.

### 6.2.3 Surface—pressurised irrigation systems

Surface irrigation (Figure 6.3) may be used for relative level areas and the greywater usually needs to be treated to a high quality before it can be used for spray irrigation (Table 3.2 and Table 5.2). Check with the manufacturer for recommended pipe diameters and pump pressure requirements as items will vary depending on the irrigation pipework design, length and overall irrigation area as to the size required.



**FIGURE 6.3 PRESSURISED SURFACE IRRIGATION OF GREYWATER. CHECK WITH THE RESPONSIBLE REGULATORY AUTHORITY AS TO THE LEVEL OF TREATMENT AND SETBACK REQUIRED BY THE GREYWATER TREATMENT AND IRRIGATION SYSTEM PRIOR TO INSTALLATION (TABLE 3.2)**

## 6.3 RECOMMENDED IRRIGATION RATES FOR AND SIZING OF GREYWATER IRRIGATION SYSTEMS

All greywater irrigation systems shall be designed to ensure that greywater is not applied at rates that exceed the absorption capacity of the soil and the plants grown on it (AS/NZS 1547). Care will need to be taken to ensure that the application rate does not lead to:

- (a) Excess salt accumulation in the root zone during extended dry periods.



- (b) Harmful long-term environmental effects to the soil of the land-application system or the adjacent surface water and groundwater.
- (c) Increased risk to public health from surface ponding within the land-application area or channeling or seepage beyond the land-application area.

The design irrigation rates for greywater disposal irrigation systems (Table 6.3) estimates the irrigation rate for a range of soil textures.

These values are based on the on-site domestic—wastewater management standards (AS/NZS 1547) and focus on the permeability of soil. However, when irrigating for beneficial use of greywater the water requirement will vary considerably based on the plants grown and local climatic conditions. (Table 6.3) Irrigation design should be able to supply sufficient water to plants in times of peak water demand to ensure survival of the garden (Table 6.3).

Irrigation rates will depend on the soil category (Table 6.3) and the rate of evapotranspiration by the vegetation being irrigated (Table 6.4 and Table 6.5). The design irrigation rate (DIR; Table 6.3) values represent a conservative approach for the sizing of irrigation areas. Where systems are to be used to the maximum capacity of the site, the regulatory authority may require more refined design procedures and water-balance estimations integrating plant water requirements considering climatic conditions.

A simple method for making such an estimate (plant water requirement) is summarised in Table 6.4 and Table 6.5. This method integrates climatic data and major plant types found grown within the properties of single households. It does not consider leaching requirements, effluent salinity and local salinity hazards. Monthly average rainfall across a number of Australian cities is also given if more detailed water balances are required (Table 6.6).

Irrigation frequency and maximum volume applied per irrigation can be calculated by considering the maximum plant available water held by the soil in the plant rootzone (Table 6.3, Irrigation depths and rates). For example, a loam soil holds approximately 45 mm of water in the rootzone, if the evapotranspiration is 4.5 mm/day (Table 6.4, Adelaide cool season grass, high evaporation period) then this should last about 10 days before another irrigation is required (rainfall will extend this period). Irrigation application rate (mm/h) cannot exceed infiltration rates for a specific soil (Table 6.3). Ideally, infiltrations rates should be checked on each specific site.

Best practice for irrigation scheduling should integrate soil moisture sensors into the automatic irrigation system allowing greywater to be returned to sewer if soils already contain sufficient moisture and do not require irrigation.

The best method for managing salinity is to ensure the use of household products that minimise contribution of salinity and sodium into the greywater systems (e.g., use detergents low in sodium and salinity). Plant and soil health should be monitored to ensure there are no detrimental impacts on the soils or plants grown.

If a GDD only is to be used no storage should be considered as the greywater should be diverted back to sewer if plants in the irrigation area do not require water. In most areas (especially sensitive one), an irrigation specialist should undertake irrigation design work (AS/NZS 1547).



**TABLE 6.3**  
**RECOMMENDED DESIGN IRRIGATION RATE (DIR) FOR DRIP AND SPRAY**  
**IRRIGATION SYSTEMS**

Soil category	Soil texture	Indicative permeability (Ksat)*		Design irrigation rate (DIR) (mm/day)	Drainage class	Irrigation depth and rates†	
		(m/day)	(mm/h)			Plant available water held per 300 mm depth of soil	Estimate for maximum infiltration rate (mm/h)
1	Gravels and sands	>3	>125	5	Rapidly drained	12	>30
2	Sandy loams	1.4–3	58–125	5	Well drained	30	20–30
3	Loams	0.5–3	21–125	4	Moderately to well drained	45	10–20
4	Clay loams	0.06–1.5	3–63	3.5	Imperfectly drained	43	5–10
5	Light clays	0.06–1.2	3–50	3	Poorly drained	24–33 (poor to good structure)	1–5
6	Medium to heavy clays	<0.06	<3	2	Very poorly drained		

\* The values of indicative permeability as Ksat are based on the movement of water, and not effluent through the soil. They are estimates only and should be used with caution in determining soil category and design loading rates.

† Estimates for irrigation design should be checked on site. The best method for scheduling irrigation is using soil moisture sensors.

NOTE: Soil categories and DIR modified from AS/NZS 1547:2008 p 126. Note ideal soil categories are 2 and 3, category 4 and 5 may be improved, category 1 and 6 should not be used for beneficial irrigation with greywater unless modified. No single application should exceed the water holding potential of the soil accessed by the rootzone, unless a leaching fraction is required.



TABLE 6.4

**HIGH EVAPOTRANSPIRATION ESTIMATES FOR 4 MAJOR TYPES OF PLANT SPECIES  
GROWN AROUND HOUSEHOLDS IN CITIES ACROSS AUSTRALIA**

City	High* evaporation period						
	Most likely rainfall (mm/mth)	Months of higher evaporation	Evaporation (mm/day)	Cool season grass	Warm season grass	Water hungry gardens	Water wise gardens
				Plant water requirements (mm/day)			
Adelaide	22	Oct–Mar	6.3	4.6	3.2	4.1	1.9
Albany	25	Oct–Mar	5.8	4.2	2.9	3.8	1.7
Albury	31	Oct–Mar	6.4	4.6	3.2	4.1	1.9
Alice Springs	18	Oct–Mar	11.8	8.5	5.9	7.6	3.5
Bendigo	23	Oct–Mar	6.5	4.7	3.2	4.2	1.9
Brisbane	94	Oct–Mar	5.5	4.0	2.8	3.6	1.7
Broome	63	Sep–Apr	8.6	6.2	4.3	5.6	2.6
Cairns	302	Sep–Mar	7.2	5.2	3.6	4.7	2.2
Canberra	55	Oct–Mar	7.3	5.3	3.7	4.7	2.2
Darwin	279	Jun–Nov	7.4	5.4	3.7	4.8	2.2
Gold Coast	109	Oct–Mar	5.7	4.1	2.8	3.7	1.7
Hobart	38	Oct–Mar	3.7	2.7	1.9	2.4	1.1
Katherine	169	Aug–Jan	8.3	6.0	4.2	5.4	2.5
Launceston	39	Oct–Mar	5.9	4.3	2.9	3.8	1.8
Melbourne	39	Oct–Mar	5.0	3.7	2.5	3.3	1.5
Mount Gambier	28	Oct–Mar	5.5	4.0	2.7	3.6	1.6
Newcastle	63	Sep–Mar	6.3	4.6	3.1	4.1	1.9
Perth	6	Oct–Mar	7.3	5.3	3.7	4.8	2.2
Port Lincoln	14	Oct–Mar	6.4	4.6	3.2	4.2	1.9
Sydney	92	Oct–Mar	6.5	4.7	3.3	4.2	2.0
Townsville	126	Sep–Feb	8.6	6.2	4.3	5.6	2.6
Crop factors <sup>†</sup>				0.73	0.5	0.65	0.3

\* High and low evaporation and rainfall are based on 80th and 20th percentile, respectively, of monthly averages from [www.bom.gov.au](http://www.bom.gov.au)

† Crop factors used to estimate plant water requirements by multiplying evaporation.

**NOTES:**

- 1 Plant water requirement = evapotranspiration estimates for major cities and towns across Australia.
- 2 Plant requirements vary across Australia relative to the type of plant grown, the density grown and the local climatic conditions. During rainfall periods, water requirements can be met by rainfall. If so, soils should not be irrigated with greywater. If storage is not possible, greywater should be diverted to sewer.



TABLE 6.5

**LOW EVAPOTRANSPIRATION ESTIMATES FOR 4 MAJOR TYPES OF PLANT SPECIES  
GROWN AROUND HOUSEHOLDS IN CITIES ACROSS AUSTRALIA**

City	Low* evaporation period						
	Most likely rainfall (mm/mth)	Months of lower evaporation	Evaporation (mm/day)	Cool season grass	Warm season grass	Water hungry gardens	Water wise gardens
				Plant water requirements (mm/day)			
Adelaide	67	Apr–Sep	1.9	1.3	0.9	1.2	0.6
Albany	117	Apr–Sep	2.2	1.6	1.1	1.4	0.7
Albury	74	Apr–Sep	1.4	1.0	0.7	0.9	0.4
Alice Springs	2	Apr–Sep	5.0	3.6	2.5	3.2	1.5
Bendigo	41	Apr–Sep	1.6	1.2	0.8	1.1	0.5
Brisbane	30	Apr–Sep	3.1	2.2	1.5	2.0	0.9
Broome	1	May–Aug	6.8	4.9	3.4	4.4	2.0
Cairns	25	Sep–Mar	5.1	3.7	2.5	3.3	1.5
Canberra	33	Apr–Sep	2.3	1.7	1.1	1.5	0.7
Darwin	1	Dec–May	6.1	4.4	3.0	4.0	1.8
Gold Coast	51	Apr–Sep	3.0	2.1	1.5	1.9	0.9
Hobart	47	Apr–Sep	1.2	0.9	0.6	0.8	0.4
Katherine	0	Feb–Jul	5.9	4.3	3.0	3.8	1.8
Launceston	66	Apr–Sep	1.4	1.0	0.7	0.9	0.4
Melbourne	53	Apr–Sep	1.6	1.2	0.8	1.1	0.5
Mount Gambier	79	Apr–Sep	1.7	1.3	0.9	1.1	0.5
Newcastle	91	Apr–Aug	2.9	2.1	1.4	1.9	0.9
Perth	117	Apr–Sep	2.3	1.7	1.2	1.5	0.7
Port Lincoln	65	Apr–Sep	2.1	1.6	1.1	1.4	0.6
Sydney	58	Apr–Sep	3.1	2.2	1.5	2.0	0.9
Townsville	6	Mar–Aug	5.5	4.0	2.8	3.6	1.7
Crop factors <sup>†</sup>				0.73	0.5	0.65	0.3

\* High and low evaporation and rainfall are based on 80th and 20th percentile, respectively, of monthly averages from [www.bom.gov.au](http://www.bom.gov.au)

<sup>†</sup> Crop factors used to estimate plant water requirements by multiplying evaporation.

NOTES:

- 1 Plant water requirement = evapotranspiration estimates for major cities and towns across Australia.
- 2 Plant requirements vary across Australia relative to the type of plant grown, the density grown and the local climatic conditions. During rainfall periods, water requirements can be met by rainfall. If so, soils should not be irrigated with greywater. If storage is not possible, greywater should be diverted to sewer.



**TABLE 6.6**  
**MEDIAN AND RANGE OF RAINFALL FOR CITIES/TOWNS IN AUSTRALIA (MM/MONTH)**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Statistic
<b>Albany</b>													
15	16	31	62	115	125	145	117	93	72	40	23	924	Median
5–42	4–54	10–77	26–119	59–183	80–196	84–204	79–187	53–158	38–131	15–73	9–65	743–1112	Range
<b>Albury</b>													
27	33	26	30	50	67	83	88	63	75	52	41	760	Median
10–124	3–84	2–85	12–110	15–108	30–105	39–147	27–134	34–115	11–115	16–103	13–117	475–898	Range
<b>Alice Springs</b>													
13	14	11	2	7	4	3	2	1	18	20	24	237	Median
2–101	0–149	0–65	0–45	0–61	0–37	0–36	0–27	0–26	1–54	2–65	3–73	125–456	Range
<b>Bendigo</b>													
23	22	11	24	40	40	49	41	40	46	34	30	460	Median
10–59	4–59	4–48	4–51	12–86	21–94	18–87	12–80	21–91	8–82	16–83	1–94	302–682	Range
<b>Brisbane</b>													
94	93	67	48	67	51	25	26	26	55	106	116	886	Median
49–253	36–208	28–153	15–82	15–170	6–161	1–39	4–106	6–62	31–128	48–166	58–212	624–1232	Range
<b>Broome</b>													
114	165	71	4	4	1	1	1	1	0	1	33	533	Median
16–386	28–384	6–267	0–81	0–89	0–74	0–13	0–3	0–2	0–4	0–30	3–134	316–991	Range
<b>Cairns</b>													
335	403	378	167	86	35	24	19	19	28	65	127	1938	Median
117–634	170–750	136–739	71–403	27–175	11–93	6–59	4–62	2–85	5–83	16–213	43–340	1323–2782	Range

(continued)



TABLE 6.6 (continued)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Statistic <sup>*</sup>
<b>Canberra</b>													
49	55	32	33	38	32	36	46	53	55	60	42	618	Median
10–115	4–107	4–118	8–102	7–96	9–94	10–86	12–76	15–86	20–127	21–112	10–112	390–805	Range
<b>Darwin</b>													
409	353	293	75	5	0	0	0	6	52	142	221	1698	Median
208–663	157–633	137–531	16–212	0–56	0–3	0–5	0–13	0–39	4–152	58–220	102–409	1220–2150	Range
<b>Devonport</b>													
35	30	38	51	67	81	92	83	76	62	53	47	763	Median
16–88	6–66	6–89	15–116	28–138	34–122	44–159	36–152	26–118	27–118	21–93	12–102	575–1007	Range
<b>Gold Coast</b>													
111	144	98	88	83	57	33	49	25	85	101	128	1190	Median
45–167	45–316	20–160	29–120	38–228	24–291	1–120	12–164	12–105	31–132	43–235	72–175	919–1415	Range
<b>Hobart</b>													
39	32	37	46	38	44	47	45	42	54	49	47	596	Median
12–95	8–83	15–85	15–83	17–86	18–90	22–93	19–103	22–96	26–107	21–87	15–115	460–781	Range
<b>Kalgoorlie</b>													
4	9	14	9	22	21	21	16	8	12	7	9	230	Median
0–45	0–55	0–89	0–60	3–62	7–53	7–39	6–50	1–23	0–37	0–34	0–50	143–345	Range
<b>Katherine</b>													
233	264	170	19	0	0	0	0	0	21	86	164	1106	Median
117–435	98–386	28–456	0–115	0–4	0–1	0–0	0–2	0–33	1–99	28–133	86–393	756–1442	Range
<b>Launceston</b>													
39	24	31	42	54	59	74	67	69	53	48	43	696	Median
18–87	7–60	7–69	20–87	22–117	31–107	44–113	33–153	30–102	20–83	20–74	13–72	543–776	Range

(continued)



TABLE 6.6 (continued)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Statistic <sup>*</sup>
<b>Melbourne</b>													
37	32	38	50	55	43	47	49	53	68	52	51	646	Median
11–99	7–107	12–106	18–115	21–91	26–85	23–72	24–78	28–93	28–111	21–113	18–110	472–824	Range
<b>Mount Gambier</b>													
19	21	26	44	68	80	96	85	73	57	48	34	699	Median
6–54	4–55	7–63	17–97	30–128	41–144	51–144	52–145	43–101	24–106	16–75	13–63	544–855	Range
<b>Newcastle</b>													
72	88	96	91	102	85	81	59	57	63	64	63	1058	Median
25–175	20–216	30–255	27–237	23–229	22–246	15–199	13–140	18–148	18–142	15–135	20–157	798–1545	Range
<b>Perth</b>													
2	4	9	27	93	123	138	131	91	42	18	5	741	Median
0–40	0–24	3–53	9–65	39–135	62–214	94–223	98–166	61–113	17–80	6–33	0–16	653–885	Range
<b>Port Lincoln</b>													
9	12	14	28	54	70	74	68	48	31	17	14	487	Median
1–29	1–34	2–40	8–69	26–92	30–125	41–129	33–106	21–85	13–67	4–49	3–39	374–620	Range
<b>Sydney</b>													
80	92	101	92	91	96	75	57	53	56	67	59	1164	Median
28–192	20–256	30–282	24–272	19–268	24–293	10–221	10–187	14–156	17–175	17–155	22–172	821–1658	Range
<b>Townsville</b>													
205	226	138	30	20	9	3	5	2	14	32	78	1069	Median
41–518	57–571	22–412	3–173	2–86	0–73	0–30	0–41	0–31	1–54	4–132	19–350	590–1728	Range
<b>Wollongong</b>													
110	111	144	72	73	80	51	29	51	62	98	75	1309	Median
41–249	50–358	26–348	18–314	23–238	22–254	9–160	6–253	9–152	13–248	35–225	26–203	865–1863	Range

NOTE: Single values are median (most expected) and range of values is the 10th to 90th percentile of all available data from [www.bom.gov.au/climate/averages/](http://www.bom.gov.au/climate/averages/)



## 6.4 SOIL TYPES SUITABLE FOR GREYWATER IRRIGATION

For beneficial use of greywater soils should be suitable for growing plants and holding sufficient water to supply plants requirements, with a low risk of the greywater, or hazards found in greywater, moving off-site. Ideal soils for irrigation with greywater are topsoil of types 2 to 5 (Table 6.3) with depths of 200–300 mm (i.e. not gravels, sands or medium to heavy clays). Note for soil types 4 and 5 some soils may have permeability <20 mm/h, if so, soil permeability should be improved prior to irrigation. If an ideal soil type is not available, 200–300 mm of appropriate topsoil should be added to the site to ensure appropriate plant growth and management of greywater.

If soils types 1 or 6 are used there is a much higher risk of greywater moving off-site, either through overland flow or deep drainage. A more detailed risk assessment may be required for these soils if topsoil cannot be imported to the site. Consult an expert in water balances for urban soils and plants.

The calculation of land area and water requirements is discussed in Clause 6.5.

## 6.5 CALCULATING GREYWATER DEMANDS AND AVAILABILITY

### 6.5.1 Volumes of greywater potentially available

Greywater can be sourced from several areas within the household (Table 6.7). The volumes available will depend on the number of people in the household and the water efficiency of the appliances and fixtures (Table 6.8, Table 6.9 and Table 6.10).

**TABLE 6.7**  
**AVERAGE VOLUMES OF GREYWATER AVAILABLE FROM HOUSEHOLDS**

Number of people	Shower	Handbasin	Kitchen tap	Dishwasher	Laundry tap	Washing machine	Total greywater	Blackwater toilet
<b>Greywater generated (L/week)</b>								
1	392	42	84	35	49	189	791	154
2	784	84	168	70	98	378	1582	308
3	1176	126	252	105	147	567	2373	462
4	1568	168	336	140	196	756	3164	616
5	1960	210	420	175	245	945	3955	770
6	2352	252	504	210	294	1134	4746	924
7	2744	294	588	245	343	1323	5537	1078
<b>Percentage of total greywater</b>								
1 to 7	50%	5%	11%	4%	6%	24%	100%	

Estimated from Table 2.1.



**TABLE 6.8**  
**WATER EFFICIENT LABELING AND STANDARDS (WELS) RATINGS FOR SHOWERS AND TOILETS**

Appliance	Unit	WELS 2006 rating						
		0 Star	1 Star	2 Star	3 Star	4 Star	5 Star	6 Star
Shower	L/min	>16	>12–16	>9–12	>7.5–9	N/A	N/A	N/A
Toilet	L*	N/A	>4.5–5	>4.0–4.5	>3.5–4.0	>3–3.5	>2.5–3.0	0–2.5

Source AS/NZS 6400 and [www.waterrating.gov.au](http://www.waterrating.gov.au)

>= greater than

\* Average flush volume

**TABLE 6.9**  
**ESTIMATES OF GREYWATER GENERATED FROM A SHOWER**

Number of people	Volume used per week (L/week) for WELS rating					
	1 Star		2 Star		3 Star	
	Average	Range	Average	Range	Average	Range
1	686	784–588	515	588–441	405	441–368
2	1372	1568–1176	1029	1176–882	809	882–735
3	2058	2352–1764	1544	1764–1323	1213	1323–1103
4	2744	3136–2940	2058	2352–1764	1617	1764–1470
5	3430	3920–2940	2573	2940–2205	2022	2205–1838
6	4116	4704–3528	3087	3528–2646	2426	2646–2205
7	4802	5488–4116	3602	4116–3087	2830	3087–2573

Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.

NOTE: Assumptions: Average shower: 7 minutes. Every resident showers (or bathes) once per day (7 times/week)



**TABLE 6.10**  
**ESTIMATE OF GREYWATER GENERATION FROM FRONT AND TOP LOADING**  
**WASHING MACHINES**

Number of residents	Number of washes per week	Greywater generation/or requirement from a washing machine (L/week)					
		Front loading washing machine			Top loading washing machine		
		Small	Medium	Large	Small	Medium	Large
		(up to 5.5 kg)	(6–7 kg)	(over 7.5 kg)	(up to 5.5 kg)	(6–7 kg)	(over 7.5 kg)
1	2	103	133	164	210	273	336
2	3	154	200	246	315	410	504
3	4	205	267	328	420	546	672
4	6	308	400	492	630	819	1008
5	7	359	466	574	735	956	1176
6	8	410	533	656	840	1092	1344
7	9	461	600	738	945	1229	1512

Source: NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises.

**NOTES:**

- 1 Assumptions: Top loading: average machine is larger (over 7.5kg) with a 2 Star WELS rating. Front loading: average machine is medium (6–7 kg) with a 4 Star WELS rating.
- 2 Many washing detergents can be detrimental to the environment. If unsure, it is recommended that the first wash be directed to sewer not greywater re-use. If this is the case, the volume of greywater produced from a washing machine will be less than stated in this table.

### 6.5.2 Garden water requirements

The water requirements of a garden vary considerably throughout the year based on the plants grown, their density and the location within Australia (Table 6.4 and Table 6.5).

The general rule is:

**Every one millimetre (1 mm) of irrigation or rainfall over 1 m<sup>2</sup> = 1 litre (L)**

For example, for January in Alice Springs (a period of high evaporation) a low water requirement garden would require 3.5 mm/day (Table 6.5) and a high water use garden would require on average 7.6 mm/day (Table 6.4).

If the garden area that can be irrigated (considering setback requirements—Section 6.1.17) is 10 m × 10 m (100 m<sup>2</sup>), for a low water use garden in Alice Springs the water required for a week would be:

$$3.5 \text{ mm (average daily requirement)} \times 100 \text{ m}^2 \text{ (area requiring irrigation)} \times 7 \text{ days} = 2450 \text{ L/week}$$

Rainfall could on average contribute 18 mm/month (Table 6.5) which is approximately 4.18 mm per week (18/4.3 weeks in a month) over 100 m<sup>2</sup>:

$$4.18 \text{ mm (average weekly rainfall)} \times 100 \text{ m}^2 \text{ (area requiring irrigation)} = 418 \text{ L/week of rainfall}$$

Based on the water requirements and the available water from rainfall the most likely greywater requirement per week for a high evaporation period is:

$$2470 - 418 = 2052 \text{ L/ week.}$$



Using the same logic as above the greywater requirement for the low evaporation period can be determined as:

$$1.5 \text{ mm (average daily requirement)} \times 00 \text{ m}^2 \text{ (area requiring irrigation)} \times 7 \text{ days} = 1050 \text{ L/week}$$

Less rainfall contribution

$$0.47 \text{ mm (average weekly rainfall)} \times 100 \text{ m}^2 \text{ (area requiring irrigation)} = 47 \text{ L/week of rainfall}$$

Based on the water requirements and the available water from rainfall the most likely greywater requirement per week for a low evaporation period is:

$$1050 - 47 = 1003 \text{ L/week.}$$

That is greywater demand for the garden will most likely range between 1003 to 2470 L/week if there is average rainfall for these periods.

NOTE: All garden water requirements will vary depending on specific climatic conditions experienced.

Ideally, the irrigation systems should be designed to deliver this amount of water to ensure the garden survives through the peak demand period (i.e. January). This should consider the available greywater and other water sources that might be available (e.g., mains water, rainwater, bore water) and the associated restrictions on the use of these water sources. Note that, in nearly all cases across Australia, if greywater is used to meet all garden demands in the high evaporation period then some greywater will need to be diverted back to sewer or not captured during low evaporation period, especially if the higher rainfall is experienced through these periods.

### 6.5.3 Greywater availability and irrigation requirements

#### 6.5.3.1 Method

The method used to check greywater demand (internal and external to the household) and availability should at a minimum consider:

- (a) Minimum and maximum water requirements for appliance (Table 6.7 and Table 6.10) and garden/lawn (Table 6.4). If not represented in Table 6.4, check pan evaporation data from Bureau of Meteorology website ([www.bom.gov.au](http://www.bom.gov.au)) for your location. Multiply the pan evaporation by the crop factors in (Table 6.4) for the major plant types grown to determine the most likely water requirements. Ensure the greywater will be treated to the appropriate levels for the use required or type of irrigation systems used (Table 3.2 and Table 5.2).
- (b) Greywater volumes that can be diverted and recycled (Table 6.7 to Table 6.10).
- (c) Area to be irrigated (consider setback requirements—Section 6.1.17) – 1 mm of irrigation or rainfall over 1 metre squared ( $\text{m}^2$ ) = 1 L, or depth of irrigation (mm)  $\times$  area irrigated ( $\text{m}^2$ ) = litres of water required to irrigate that area.
- (d) Check the soil type is appropriate for irrigation with greywater (Clause 6.4) and that appropriate irrigation rates can be applied when required by the plants.
- (e) Ensure plans are in place to enable water balances to be achieved in high and low evaporation periods of the year, which also consider rainfall and other potential water sources (e.g., irrigate less, change garden plant species, capture more or less greywater, do not irrigate during period of high rainfall, top up with mains water if restrictions allow, capture rainfall for use in the garden, etc.).

NOTE: For additional considerations check with your responsible regulatory authority.



**6.5.3.2 Example 1: Use of greywater in the garden and washing machine (Perth)**

Example 1 illustrates that the water demand of a waterwise garden (95 m<sup>2</sup> with soil types 2–5 Table 6.3) will be met with 4 residents in a household that uses a large front loading washing machine if greywater is captured from the shower and washing machine only (Table 6.11).

In this Perth example (Table 6.11), there is 2109 L/week of greywater available, the garden requirement ranges from 466 L/week (low evaporation period) to 1463 L/week (high evaporation period). There is an excess of 220 L/week to 1617 L/week depending on climatic conditions. There is little impact on changes in rainfall during the high evaporation period in Perth (as the rainfall during this period is low—6 mm/month).



TABLE 6.11

**EXAMPLE 1: CALCULATION OF GREYWATER DEMAND (EXTERNAL AND INTERNAL TO HOUSEHOLD)  
AND GREYWATER VOLUMES AVAILABLE (PERTH)**

Greywater budget							
City	Perth						
Number of residents	4						
Demands for greywater		Oct–Mar		Apr–Sep		Help	
External demand	Area (m <sup>2</sup> )	High evaporation mm/day L/week		Low evaporation mm/day L/week		Line ID	Table calc.
Turf (cool season)		5.3	0	1.7	0		
Turf (warm season)		3.7	0	1.2	0		
Garden (water hungry)		4.8	0	1.5	0		
Garden (water wise)	95	2.2	1463	0.7	466		
External area and demand	95		1463		466	A	*
Most likely rainfall contribution		Mm/mth	6	Mm/mth	117	26–27	
		L/week	133	L/week	2565	B	**
External demand considering rainfall			1330		0	C	= A –B***
Internal (appliance) demand for greywater		All year round (L/week)					
Washing machine	Large front loader	492					33
Toilet	No	0				26–27	30
Internal water demands		492				D	
Total greywater demand (L/week)		1822	492			E	= C + D
VOLUMES OF GREYWATER AVAILABLE		All year round (L/week)					
Shower	3 Star	1617					31–32
Washing machine	Large front loader	492					33
All other greywater	No	0					30
Greywater volumes available (L/week)		2109				F	
GREYWATER BALANCE (L/week)		Oct–Mar		Apr–Sep			
Greywater balance based on average rainfall		Excess	287	Excess	1617	G	= F –E
Receiving 50% of average rainfall		Excess	220	Excess	1617	H	= F –E****

\* mm × area × 7 (days)

\*\* (mm/mth)/4.3 × area

\*\*\* If <0 = 0 (ie more rainfall than water required by plants)

\*\*\*\* Replace B with B × 50%, then calculate as per G.



During the low evaporation period (Apr–Sep), rainfall will exceed plant requirements and limited greywater will be required for the garden (C, Table 6.11). A soil moisture sensor should be used to divert greywater back to the sewer during periods of low demand for greywater, or the irrigation system should be turned off during those periods.

There is a constant demand for greywater throughout the year for washing clothes as internal water demand is not subject to climatic conditions the same as external greywater demand. Where the water balance produces excess greywater, a simple way to manage this system, would be to only capture greywater from one of the three showers used in the house during the low demand period. Then only sufficient greywater for the washing machine is treated. Recycling the washing machine greywater for use in the washing machine only is not recommend as it may lead to excessive build-up of hazards (e.g., salts) in the greywater. Generally most salts are not removed during the treatment process.

Check with the greywater treatment system supplier as to the flow that is required to maintain functionality of the greywater treatment system (especially if the house is not occupied for extended periods).

#### **6.5.3.3** *Example 2: Use of greywater for toilet flushing and garden watering (Melbourne)*

Example 2 illustrates that the water demand of a water hungry garden (200 m<sup>2</sup> with soil types 2–5, Table 6.3) and a water hungry turf (i.e. cool season) will be met with 5 residents in a household that uses a large top loading washing machine and 1 Star showers (Table 6.12). Greywater would need to be captured from all potential sources.



TABLE 6.12

**EXAMPLE 2: CALCULATION OF GREYWATER DEMAND (EXTERNAL AND INTERNAL TO HOUSEHOLD)  
AND GREYWATER VOLUMES AVAILABLE (MELBOURNE)**

Greywater budget									
City		Melbourne							
Number of residents		5							
Demands for greywater		Oct–Mar		Apr–Sep		Help			
External demand		Area (m <sup>2</sup> )		High evaporation mm/day L/week		Low evaporation mm/day L/week		Line ID	Table calc.
Turf (cool season)		100		3.72590		1.2840			
Turf (warm season)				0		0.8		0	
Garden (water hungry)		200		3.34620		1.11540			
Garden (water wise)				0		0.5		0	
External area and demand		300		7210		2380		A	*
Most likely rainfall contribution				Mm/mth39		Mm/mth53		26–27	
				L/week2721		L/week3669		B	**
External demand considering rainfall				4489		0		C	= A –B***
Internal (appliance) demand for greywater				All year round (L/week)					
Washing machine		No2.5		0				26–27	33
Toilet		Yes		770					30
Internal water demands				770				D	
Total greywater demand (L/week)				5259		770		E	= C + D
VOLUMES OF GREYWATER AVAILABLE				All year round (L/week)					
Shower		1 Star		3430					31–32
Washing machine		Large top loader		1176					33
All other greywater		Yes		1050					30
Greywater volumes available (L/week)				5656				F	
GREYWATER BALANCE (L/week)				Oct–Mar		Apr–Sep			
Greywater balance based on average rainfall				Excess397		Excess4886		G	= F–E
Receiving 50% of average rainfall				Deficit–964		Excess4341		H	= F –E****

\* mm × area × 7 (days)

\*\* (mm/mth)/4.3 × area

\*\*\* If &lt;0 = 0 (i.e. more rainfall than water required by plants)

\*\*\*\* Replace B with B × 50%, then calculate as per G.



In the Melbourne example (Table 6.12), there is 5656 L/week of greywater available, the garden requirement for water ranges from 2380 L/week (low evaporation period) to 7210 L/week (high evaporation period), not considering rainfall. Depending on climatic conditions, the water balance ranges from a deficit of 964 L/week to an excess of 4886 L/week. There is a large impact on the water balance due to changes in rainfall during the high evaporation period in Melbourne, as rainfall contributes significantly to plant water requirements during this period.

The Melbourne example illustrates that the water demand of a garden (200 m<sup>2</sup>), turf (100 m<sup>2</sup>) and toilet during the high evaporation period (Table 6.12) can be met if all possible sources of greywater are captured (5 people in the household). It also highlights that if rainfall is 50% less than average for the high evaporation period (Oct–Mar) there may not be sufficient greywater to meet demands (a deficit of 964 L/week). If this was the case there would need to be an alternative water source used (stored rainwater or mains water if water restrictions permit) to ensure the garden survived throughout the summer.

During the low evaporation period (Apr–Sep), rainfall will exceed plant requirements and little greywater will be required for the garden. A soil moisture sensor should be used to divert greywater back to the sewer during these periods of low demand for greywater, or the irrigation system could be turned off during this period.

There is constant demand for greywater throughout the year for flushing the toilet as this water demand is not subject to climatic condition. A simple way to manage this would be to only capture greywater from the washing machine (toilet demand is 770 L, washing machine produces 1176 L) used in the house during the low demand period so as to treat only sufficient greywater for the toilet's requirements. Check with the GTS supplier as to the flow that is required to maintain functionality of the GTS (especially if the house is not occupied for extended periods).

#### **6.5.3.4 Example 3: Use of greywater for toilet flushing and garden water (Brisbane)**

Example 3 illustrates the water demand for greywater for a garden (100 m<sup>2</sup>), turf (200 m<sup>2</sup>) (with soil types 2–5 Table 6.3) and a toilet for a house in Brisbane (Table 6.13). This demand will be met (excess of 751 L/week) with 3 residents in a household who capture greywater from a 3 Star showers only, provided average rainfall is received.

In this Brisbane example (Table 6.13), there is 1213 L/week of greywater available, the garden requirement ranges from 2730 L/week to 5110 L/week (A, Table 6.13). Much of this demand is met by rainfall in both low and high evaporation periods (C, Table 6.13). However depending on the climatic conditions the greywater balance can range from a deficit of 1080 L/week to an excess of 751 L/week (G and H, Table 6.13).

A soil moisture sensor should be used to divert greywater back to the sewer during periods of high rainfall where the demand for greywater will be low. Alternatively the irrigation system could be turned off manually during period of high rainfall.

This example also highlights that if rainfall is 50% less than average for the high evaporation period (Oct–Mar) there may not be sufficient greywater to meet demands (a deficit of 1080 L/week). This garden's water requirements would need to be topped up with stored rainwater or mains water; if water restrictions permit. Another option is to run the toilet off mains water to free up 462 L/week for garden use.

During the low evaporation period (Apr–Sep), rainfall is also lower and plant requirements would be met (deficit of 98 L/week) if average rainfall is received. Example 3 also highlights that if rainfall is 50% less than average for the low evaporation period (Apr–Sep) there may not be sufficient greywater to meet demands (a deficit of 941 L/week). This garden's water requirements would need to be topped up with stored rainwater or mains water; if water restrictions permit. Another possibility is to restrict the garden area irrigated.



TABLE 6.13

**EXAMPLE 3: CALCULATION OF GREYwater DEMAND (EXTERNAL AND INTERNAL TO HOUSEHOLD)  
AND GREYwater VOLUMES AVAILABLE (BRISBANE)**

Greywater budget							
City	Brisbane						
Number of residents	3						
Demands for greywater		Oct–Mar		Apr–Sep		Help	
External demand	Area (m <sup>2</sup> )	High evaporation mm/day /week		Low evaporation mm/day L/week		Line ID	Table calc.
Turf (cool season)		4.0	0	2.2	0		
Turf (warm season)	200	2.8	3920	1.5	2100		
Garden (water hungry)		3.6	0	2.0	0		26–27
Garden (water wise)	100	1.7	1190	0.9	630		
<b>External area and demand</b>	<b>300</b>		5110		2730	<b>A</b>	<b>*</b>
<b>Most likely rainfall contribution</b>		Mm/mth	<b>94</b>	Mm/mth	<b>30</b>		26–27
		L/week	<b>6558</b>	L/week	<b>2077</b>	<b>B</b>	<b>**</b>
<b>External demand considering rainfall</b>			<b>0</b>		<b>653</b>	<b>C</b>	<b>= A –B***</b>
<b>Internal (appliance) demand for greywater</b>		<b>All year round (L/week)</b>					
Washing machine	No	0					33
Toilet	Yes	462					30
<b>Internal water demands</b>		<b>462</b>				<b>D</b>	
<b>Total greywater demand (L/week)</b>		<b>462</b>		<b>1115</b>		<b>E</b>	<b>= C + D</b>
<b>VOLUMES OF GREYwater AVAILABLE</b>		<b>All year round (L/week)</b>					
Shower	3 Star	1213					31–32
Washing machine	No	0					33
All other greywater	No	0					30
<b>Greywater volumes available (L/week)</b>							
<b>GREYwater BALANCE (L/week)</b>		<b>Oct - Mar</b>		<b>Apr - Sep</b>			
<b>Greywater balance based on average rainfall</b>		<b>Excess</b>	<b>751</b>	<b>Excess</b>	<b>98</b>	<b>G</b>	<b>= F –E</b>
Receiving 50% of average rainfall		Deficit	–1080	Deficit	–941	<b>H</b>	<b>= F –E****</b>

\* mm × area × 7 (days)

\*\* (mm/mth)/4.3 × area

\*\*\* If &lt;0 = 0 (ie more rainfall than water required by plants)

\*\*\*\* Replace B with B × 50%, then calculate as per G.



## CHAPTER 7 NEW HOUSING CONSTRUCTION ALLOWING GREY WATER

**TABLE 7.1**

### REQUIREMENTS FOR SUSTAINABLE HOUSING RATING SYSTEMS IN STATES/TERRITORIES ACROSS AUSTRALIA

Area	System/website	Comments and website to check requirements
Aust	Building Code of Australia (BCA)	On 1 May 2008, the requirement for alterations to achieve 5 Star will come into effect in the BCA 2008 <a href="http://www.buildingcommission.com.au">www.buildingcommission.com.au</a> . The new standard for renovations or relocations applies to the thermal performance of a home and does not require a solar hot water system or a rainwater tank for toilet flushing. New homes should comply with 5 Star plus water savings.
	Website	<a href="http://www.abcb.gov.au/go/thebca/aboutbca">www.abcb.gov.au/go/thebca/aboutbca</a> ,
		NABERS (the National Australian Built Environment Rating System) is a performance-based rating system for existing buildings. NABERS rates a building on the basis of its measured operational impacts on the environment (energy and water efficiency). NABERS is a national initiative managed by the NSW Department of Environment and Climate Change. <a href="http://www.nabers.com.au">www.nabers.com.au</a>
	Website	<a href="http://www.nathers.gov.au">www.nathers.gov.au</a> , <a href="http://www.nabers.com.au">www.nabers.com.au</a>
NSW	BASIX	BASIX, the Building Sustainability Index, ensures homes are designed to use less potable water and be responsible for fewer greenhouse gas emissions by setting energy and water reduction targets for houses and units. Since 1 October 2006 BASIX applies to all new residential dwellings and any alterations/additions to dwellings throughout NSW. Some of the features of BASIX are rainwater tanks, plumbed to toilet, garden and/or laundry; and greywater systems where appropriate.
	Website	<a href="http://www.basix.nsw.gov.au">www.basix.nsw.gov.au</a>
Qld	Building Codes Queensland (BCQ)	BCQ introduced an amendment to the building code for water saving measures (including greywater use) <a href="http://www.lgp.qld.gov.au/planning/?id=7036">www.lgp.qld.gov.au/planning/?id=7036</a> . As part of new energy and water-saving laws introduced from 1 March 2006, councils have the option to amend their planning instruments to mandate rainwater tanks for new houses in their region. Councils will have the discretion to allow for local factors, such as rainfall and the demand for water in their area.
	Website	<a href="http://www.dip.qld.gov.au/sustainable-living/watertanks.html">www.dip.qld.gov.au/sustainable-living/watertanks.html</a>
SA	Building sustainability and efficiency—Planning SA	Since 1 July 2006 SA building rules have required new dwellings and extensions or alterations greater than 50 m <sup>2</sup> to have an additional water supply to supplement the mains water. (e.g., rainwater tanks >1,000 L, 3 <sup>rd</sup> pipe recycled water, bore). Some remote towns are exempt. The additional water supply has to be plumbed to a toilet, water heater or to cold water outlets in the laundry of a new or altered home.
	Website	<a href="http://www.planning.sa.gov.au/go/rainwater-tanks">www.planning.sa.gov.au/go/rainwater-tanks</a>

(continued)



TABLE 7.1 (continued)

Area	System/website	Comments and website to check requirements
Vic	5 Star	The 5 Star Standard for all new houses in Victoria came into full effect from 1 July 2005. This means it is compulsory for new houses to have a rainwater tank (min. 2,000 L and min. roof catchment of 50m <sup>2</sup> ) for toilet flushing or a solar hot water system. <b>This does not include greywater as compulsory, but comments that builders and consumers who wish to go further than 5 Star have plenty of choices. This can include using greywater for gardens, car washing and toilet flushing, and consideration is being given to the use of rainwater for hot water.</b> <a href="http://www.buildingcommission.com.au">www.buildingcommission.com.au</a> (VBC 2005).
	Website	<a href="http://www.5Starhouse.vic.gov.au/">www.5Starhouse.vic.gov.au/</a>
WA	Five Star Plus	For Stage 2 (due in 2008), owners of new houses will be required to install plumbing to toilets to allow for alternative water supply and easy recycling of greywater at a later date and, where single dwellings are located on larger lots, an alternative water supply (such as rainwater tanks) for flushing toilets and for washing machines.  5 Star Plus is based around two new building codes, the Water Use in Houses Code and the Energy Use in Houses Code
	Website	<a href="http://www.5Starplus.wa.gov.au">www.5Starplus.wa.gov.au</a>
ACT	Requirements for sustainable water management	From 31 March 2008, property owners who are building, redeveloping or significantly extending their properties will need to demonstrate how they meet a new 40% water efficiency target. This applies to all residential, commercial and industrial developments and includes an option of rainwater tanks being connected to at least toilet, laundry cold water, all external uses.
	Website	<a href="http://www.actpla.act.gov.au/topics/design_build/siting/water_efficiency">www.actpla.act.gov.au/topics/design_build/siting/water_efficiency</a>
Tas		Check with local councils
NT		Check with local councils
	Website	<a href="http://www.nt.gov.au/infrastructure/bss/strategies/buildingcode.shtml">www.nt.gov.au/infrastructure/bss/strategies/buildingcode.shtml</a>



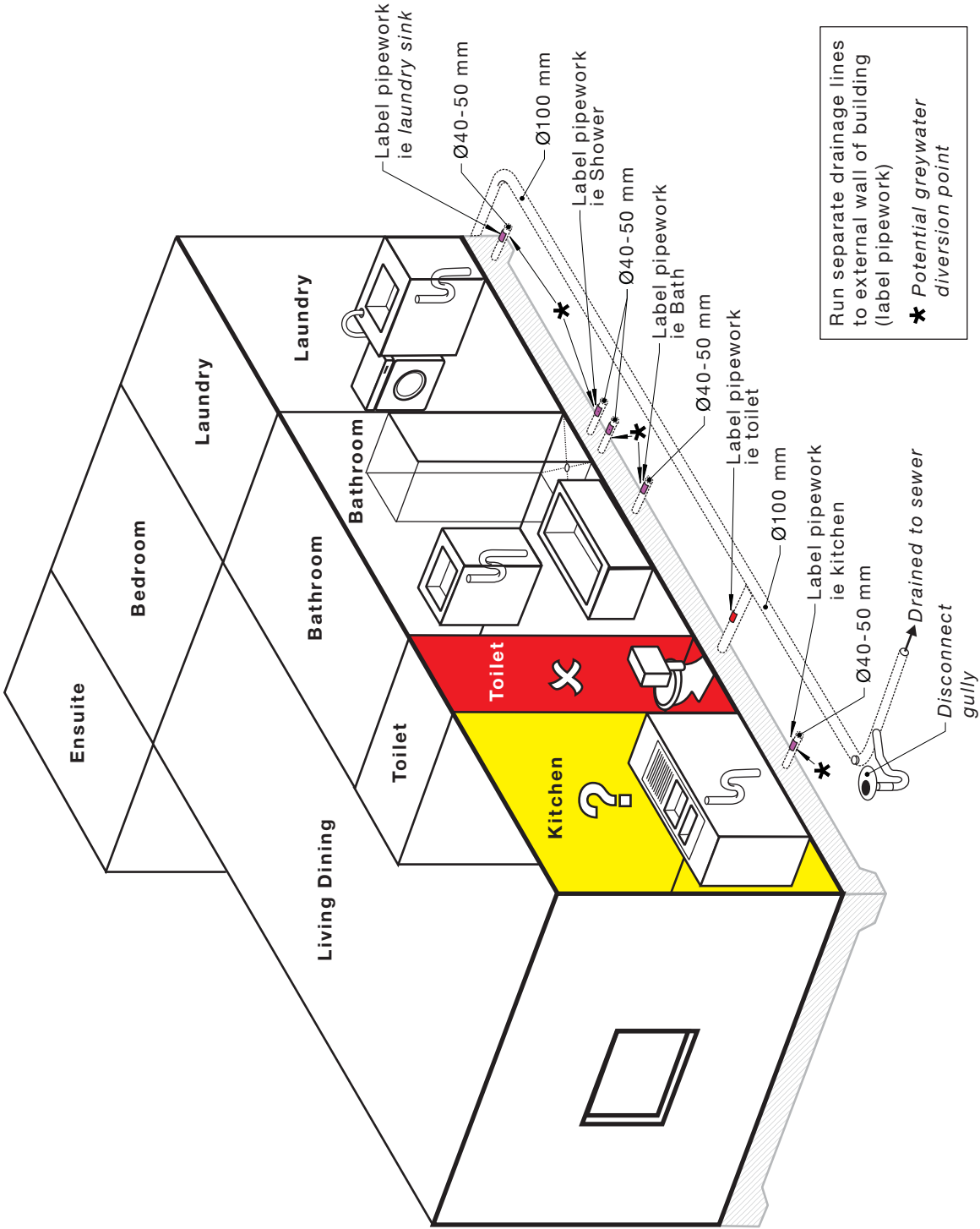


FIGURE 7.1 NEW HOUSE DESIGN FOR GREYWATER READY DRAINAGE SYSTEMS—THREE DIMENSIONAL VIEW



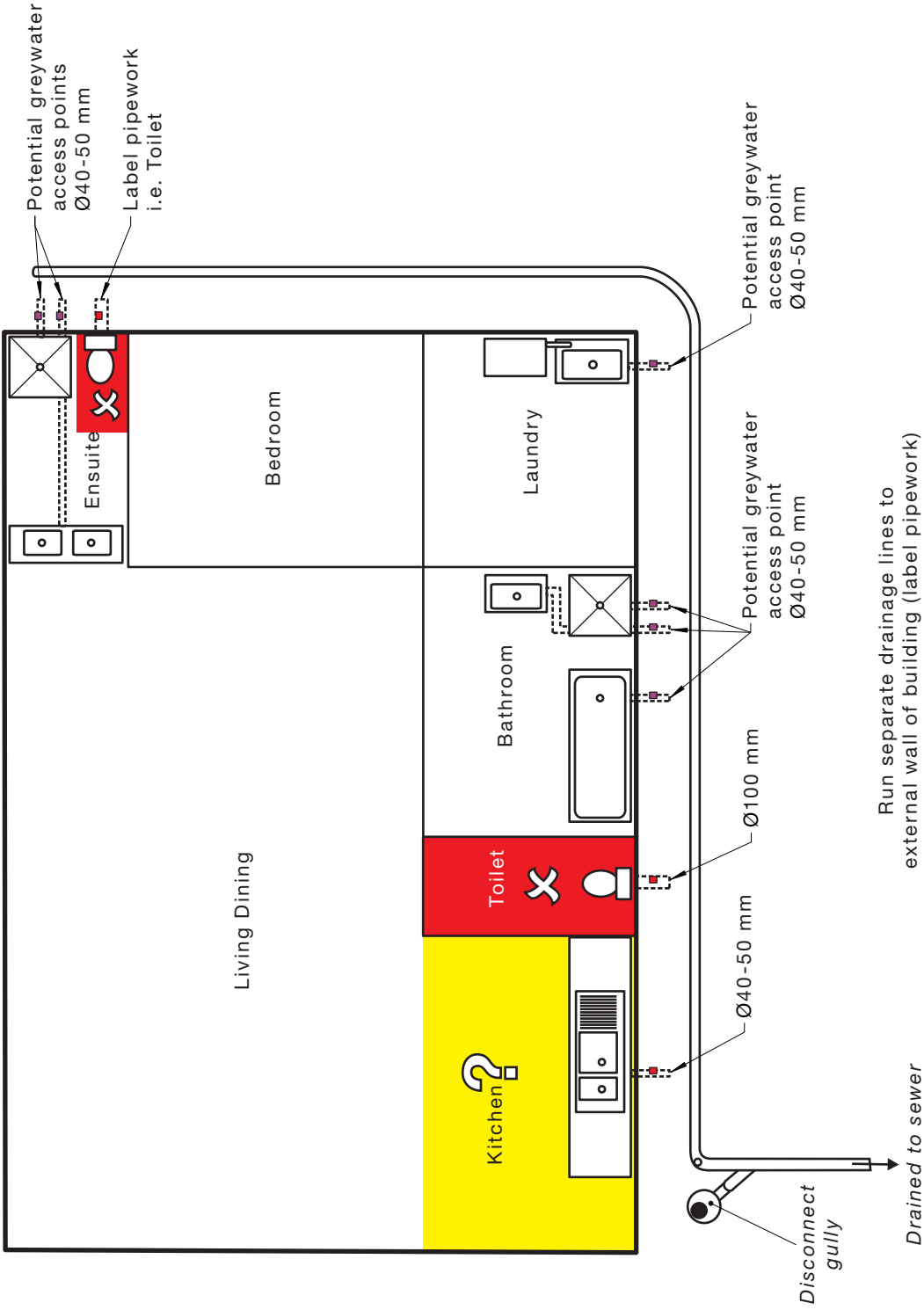


FIGURE 7.2 NEW HOUSE DESIGN FOR GREYWATER READY DRAINAGE SYSTEMS—PLAN VIEW OF FIGURE 7.1



## CHAPTER 8      ABBREVIATIONS

Abbreviations which may be experienced by plumbers during installation of rainwater systems, not necessarily found in this Handbook.

AAA	triple—A water efficiency (replaced by WELS Star rating 2005)
FSL	finished surface level
GL	gigalitres
ha	hectare
kg	kilogram
kL	kilolitres
km	kilometer
L	litre
m	metres
M	million
m <sup>2</sup>	square metres
Max.	maximum
Min.	minimum
ML	megalitres
ML/y	megalitres per year
mm	millimetres
mm/y	millimetres per year
MPMSAA	Master Plumbers and Mechanical Services Association of Australia
N	nitrogen
Na	sodium
NWC	National Water Commission
OSD	on-site detention
OH&S	occupational health and safety
P	phosphorus
WC	water closet
WELS	Water Efficient Labeling Scheme (Federal Government)

### **Water facts**

1 litre (L)	= 1 kilogram (kg)
1000 L	= 1 kilolitre (kL) $\approx$ 1000 kg = 1 tonne (t)
	1 mm of rainfall or irrigation over 1 m <sup>2</sup> = 1 L of water



## CHAPTER 9 GLOSSARY

backflow prevention device	A device to prevent the reverse flow of water from a potentially polluted source into a potable water supply system.
backflow	Flow in a direction contrary to the normal or intended direction of flow; or the unintended flow of water from a potentially polluted source into a (potable) drinking water supply.
bacteria	Single celled organism, bacteria which may be free living organisms or parasites. Bacteria cells range from about 1 to 10 microns in length and from 0.2 to 1 micron in width. Some bacteria are helpful to man, others harmful.
blackwater	Water containing human excrement.
Biochemical oxygen demand (BOD)	A chemical procedure for determining how fast biological organisms use up oxygen in a body of water through degradation of organic material.
council	Statutory corporation constituted under the Local Government Act within each State and Territory of Australia.
drinking water	Water suitable for human consumption.
effluent	The outflow of water or wastewater from any water processing system or device.
evaporation	Loss of water from the water surface or from the soil surface by vaporisation.
evapotranspiration	The combined loss of water from the soil through plant transpiration and evaporation from the soil surface.
greywater	Wastewater from washing machines, laundry tubs, showers, handbasins, baths and kitchens. Does not include wastewater from toilet, urinal or bidet.  NOTE: Greywater from kitchens cannot be used unless it has been treated by a greywater treatment system.
greywater diversion device (GDD)	A device that diverts untreated greywater from the drainage system before it enters the sewer (100 mm pipe) generated on a residential premise for use on that property (usually for sub-surface irrigation).
greywater treatment system (GTS)	A system that collects, treats, and disinfects greywater generated from a residential household, for use for one or more of the following end uses: toilet and urinal flushing, washing machine, and surface or sub-surface irrigation.
greywater	Wastewater from the handbasin, shower, bath, spa bath, washing machine, laundry tub, kitchen sink and dishwasher. Water from the kitchen is generally too high in grease and oil to be re-used successfully without significant treatment.
groundwater	Water beneath the surface held in, or moving through, saturated layers of soil, sediment or rock.
kilolitre (kL)	A term commonly used to measure water, equal to 1000 L. A cubic metre is the volume occupied by a cube measuring 1 m along each edge. One cubic metre contains 1 KL of water.



litre (L)	Unit of volume equal to one cubic decimetre.
local water authority	The organisation, agency or company that has responsibility and authority for treating and/or supplying water and wastewater services to a local government area.
mains water	Potable or drinking water from a reticulated water supply, e.g., town water supply.
non-potable water	Water suitable for purposes other than drinking water use.
non-return valve	Refer to backflow prevention devices
nutrients	Chemical elements essential for sustained plant or animal growth. The major nutrients essential for plant growth are nitrogen, phosphorus and potassium.
pathogen	Organism that is capable of causing disease in humans and animals.
percolation	The descent of water through the soil profile.
pH	A symbol denoting the concentration of hydrogen (H) ions in solution. A measure of acidity or alkalinity in water in which pH 7 is neutral, values above 7 are alkaline and values below 7 are acid.
reclaimed water	Water taken from a waste (effluent) stream and purified to a level suitable for further use (often used interchangeable with recycled water).
recycled water	Treated wastewater provided by the network utility's recycled water supply, which is clearly labelled recycled water (lilac coloured pipes), usually not fit for drinking water but can be treated to be fit for drinking.
reflux valve	One-way flap valve to prevent stormwater ingress back into the tank in the event of a blocked stormwater drain.
responsible regulatory authority	The authority that is empowered by statute to exercise jurisdiction over the installation and use of water, plumbing, wastewater, or sewerage works.
reticulation	A network of water pipes, which delivers water supply to customers.
salinity (irrigation salinity)	The increasing build-up of salts in irrigated soils. It can be a result of irrigation water salinity or from over-irrigation leading to raised water table levels that bring soil salts into the upper levels of the soil profile.
salinity of water	The concentration of chemical salts dissolved in the water. It is usually expressed in milligrams per litre (mg/L) or parts per million (ppm) or electrical conductivity (dS/m).
sewage management facility	A facility designed to collect and treat human excrement.
sodicity	To the content of sodium relative to other cations (magnesium and calcium predominately) in the soil. Soil with a high sodicity has a relatively high concentration of sodium compared to magnesium and calcium, which can lead to soil structural decline.
sub-surface irrigation	Irrigation at a depth of at least 100 mm below surface level.



sullage	Domestic wastes from bathrooms, showers, laundries and kitchens, including floor wastes from these sources.
surface irrigation	Water applied to the ground surface from above surface level.
surface water	All water naturally open to the atmosphere (e.g., rivers, streams, lakes and reservoirs).
thermo-tolerant coliforms	An indicator of microbiological quality. A type of micro-organism which typically grows in the intestine of warm-blooded animals (including humans) and are shed in their millions in each gram of faeces.
truncation	To cut off or disjoint a layer of soil, clay or rock.
wastewater	Water that has been contaminated by some activity (includes greywater and blackwater).
water quality	The physical, chemical and biological measures of water.
WaterMark	WaterMark is a graphic symbol that is issued for products that have been approved under the WaterMark Certification Scheme as defined in the Plumbing Code of Australia (PCA).



## APPENDIX A

### FURTHER INFORMATION

(Informative)

A review undertaken by the Australia Academy of Technological Sciences and Engineering Water recycling in Australia 2004.

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## APPENDIX B

### STANDARDS AND GUIDELINES

(Informative)

Several codes/standards/guidelines are available in Australia which relate to the installation of greywater diversion devices (GDDs), greywater irrigation systems (GISs) and greywater treatment systems (GTSs). These devices can be temporary (e.g., bucket) or permanent (GTS with greywater irrigation system). National guidance is given in the following publications:

- ABCB Building Code of Australia
- Australian Standards
  - AS/NZS 3500, Plumbing and drainage (series)
  - SAI Global 2003—Product Certification. Product Compliance Program WATERMARK Level 1.
  - AS/NZS 1546.1, On-site domestic wastewater treatment units—Septic tanks
  - AS/NZS 1546.2, On-site domestic wastewater treatment units—Waterless composting toilets
  - AS/NZS 1546.3, On-site domestic wastewater treatment units—Aerated wastewater treatment systems
  - AS/NZS 1547, On-site domestic-waste water management
  - AS 1319, Safety signs for the occupational environment
  - AS 2700, Colour Standards for general purposes
  - AS 1345, Identification of the contents of pipes, conduits and ducts
- State plumbing codes:
  - NSW - Payne 2004; 2006
  - Tas - TG 2007 (accessed)
  - WA - Water Services Coordination (Plumbers Licensing) Regulations 2000
  - Qld - DIP Qld 2007; Qld LGPSR 2006
  - NT - DHCS NT 1996
  - Vic - EPA Victoria 2008 (In press release expected July)



APPENDIX C

GREYWATER GUIDELINES FOR PROTECTION OF HUMAN HEALTH AND  
THE ENVIRONMENT USED ACROSS AUSTRALIA

(Informative)

State/Territory	Guideline and website to access guideline
Australia	NRMMC, EPHC (2006) Australian Guidelines for Water Recycling. Managing Health and Environmental Risks. Phase 1. National Water Quality Management Strategy 21. Natural Resource Management Ministerial Council. Environment Protection and Heritage Council Australian Health Ministers' Conference, Canberra, Australia. <a href="http://www.ephc.gov.au/ephc/water_recycling.html">www.ephc.gov.au/ephc/water_recycling.html</a>
Australian Capital Territory	ACT Health (2007) Greywater Use. Guidelines for residential properties in Canberra. Second Edition, published October 2007. ACT Health, Health Protection Service, Canberra, ACT. <a href="http://www.health.act.gov.au/c/health?a=da&amp;did=10087127&amp;pid=1103502499">www.health.act.gov.au/c/health?a=da&amp;did=10087127&amp;pid=1103502499</a>
New South Wales	DEUS (2007) NSW Guidelines for Greywater Re-use in Sewered, Single Household Residential Premises. Department of Energy, Utilities and Sustainability. NSW Government, Sydney, NSW, Australia. <a href="http://www.deus.nsw.gov.au/water/greywater/greywater.asp">www.deus.nsw.gov.au/water/greywater/greywater.asp</a> NSW Health (Feb 2005) Domestic greywater treatment system accreditation guidelines. Part 4, Clause 43(1), Local Government (Approvals) Regulation, 1999. New South Wales Health, Gladesville, NSW, Australia. <a href="http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/Wastewater.html">www.health.nsw.gov.au/public-health/ehb/general/wastewater/Wastewater.html</a>
Northern Territory	DHCS NT (1996) Code of practice for small on-site sewage and sullage treatment systems and the disposal or re-use of sewage effluent. Department of Health and Community Services Darwin, Northern Territory, Australia. <a href="http://www.nt.gov.au/health/healthdev/enviro_n_health/wastewater.shtml">www.nt.gov.au/health/healthdev/enviro_n_health/wastewater.shtml</a>



State/Territory	Guideline and website to access guideline
Queensland	<p>Qld EPA (2005) Queensland Water Recycling Guidelines. Queensland Government Environmental Protection Agency, Brisbane.  <a href="http://www.nrw.qld.gov.au/compliance/wic/guidelines_recycle.html">www.nrw.qld.gov.au/compliance/wic/guidelines_recycle.html</a></p> <p>Qld DIP (2006) Greywater. Guidelines for plumbers. Use of greywater for residential properties in Queensland sewered areas. Department of Infrastructure and Planning, Brisbane, Qld, Australia. (See also Qld DIP (2007) Queensland Plumbing and Wastewater Code. Amendment 23/11/2007. Department of Infrastructure and Planning., Brisbane, Queensland, Australia.)  <a href="http://www.dip.qld.gov.au/guidelines/queensland-development-code.html">www.dip.qld.gov.au/guidelines/queensland-development-code.html</a></p> <p>Qld DIP (2007) Greywater. Guidelines for councils. Use of greywater for residential properties in Queensland sewered areas. Department of Infrastructure and Planning, Brisbane, Qld, Australia.  <a href="http://www.dip.qld.gov.au/guidelines/queensland-development-code.html">www.dip.qld.gov.au/guidelines/queensland-development-code.html</a></p>
South Australia	<p>DoH SA (2006) Draft Guidelines for Permanent Onsite Domestic Greywater Systems: Greywater Products and Installation. Department of Health, Wastewater Management Section, Government of South Australia, Adelaide.  <a href="http://www.health.sa.gov.au/pehs/branches/wastewater/greywater-pr-install-draft-nov06.pdf">www.health.sa.gov.au/pehs/branches/wastewater/greywater-pr-install-draft-nov06.pdf</a></p> <p>DoH SA (2006) Installation of Permanent Onsite Domestic Greywater Systems. Department of Health, Wastewater Management Section, Government of South Australia, Adelaide.  <a href="http://www.health.sa.gov.au/PEHS/branches/wastewater/greywater-general-nov06.pdf">www.health.sa.gov.au/PEHS/branches/wastewater/greywater-general-nov06.pdf</a></p> <p>DoH SA (2007) Manual Bucketing and Temporary Diversion of Greywater. Department of Health, Wastewater Management Section, Government of South Australia, Adelaide.  <a href="http://www.health.sa.gov.au/pehs/branches/wastewater/greywater-manual-bucketing-jan07.pdf">www.health.sa.gov.au/pehs/branches/wastewater/greywater-manual-bucketing-jan07.pdf</a></p>
Tasmania	Not available
Victoria	<p>DoH Vic (2007) Greywater recycling: appropriate uses. Department of Human Services, Victoria, Australia, Melbourne.  <a href="http://www.health.vic.gov.au/environment/downloads/greywater_usage.pdf">www.health.vic.gov.au/environment/downloads/greywater_usage.pdf</a></p> <p>EPA Victoria (2008 (In press release expected July)) Code of practice onsite wastewater management. EPA Victoria Publication 891.1 (In press), Southbank, Victoria 3006, Australia.  <a href="http://www.epa.vic.gov.au/water/wastewater/onsite.asp">www.epa.vic.gov.au/water/wastewater/onsite.asp</a></p>
Western Australia	<p>DoH WA (2005) Code of Practice for the Re-use of Greywater in Western Australia. Department of Health, Perth, WA.  <a href="http://www.health.wa.gov.au/envirohealth/water/docs/Code_of_Practice_for_the_Re-use_of_Greywater_in_WA.pdf">www.health.wa.gov.au/envirohealth/water/docs/Code_of_Practice_for_the_Re-use_of_Greywater_in_WA.pdf</a></p>



## APPENDIX D

### REFERENCES

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