City of Unley

DEVELOPMENT AND STORMWATER MANAGEMENT DESIGN GUIDE

Development and Stormwater Management

Design Guide- September 2016

This Guide outlines the key statutory and policy requirements for the management of stormwater on development sites. These requirements are necessary to :

- Detain stormwater to mitigate peak flows, rate of discharge and flooding;
- Retain roof water for reuse - in the toilet, laundry, hot water service, garden etc;
- Improve stormwater runoff quality through in-ground infiltration and filtering before discharge.

South Australia's ongoing water security is critical. The State Government's Water for Good plan and Planning Strategy set a broad framework for sustainable development. The City of Unley is committed to implementing effective urban development management through its Sustainability Plan and the Development Plan.

The purpose of this guide is to assist the planning and building development application processes for applicants. It outlines a framework to ensure development achieves the sustainable water management aims and requirements of the Unley (City) Development Plan and the Australian Building Code.

Contents

1 AIM OF THE GUIDELINES

1.1 Introduction

The Development and Stormwater Management Guide provides a framework for urban infill that helps to address the flooding impacts associated with increased development density on the stormwater network, water quality and sustainability of local water resources.

The City of Unley is committed to develop a more liveable and sustainable urban area along with opportunities to introduce the second generation of greening for Unley. By adopting a sustainable stormwater management approach across all forms of development, including Council projects, multiple objectives and benefits will be delivered. Council is encouraging a more integrated approach that can use on-site detention and retention techniques, or an alternative approach that utilises Water Sensitive Urban Design (WSUD).

The guideline seeks to show how developments can accomplish:

- reduced peak stormwater flows and improved flood management
- stormwater detention, retention, re-use and ground infiltration
- stormwater quality improvement for surface and ground waters
- improved micro climate benefits and reduced heat island affects, through enhanced streetscapes, landscaping and increased urban greening.

The aim of the guideline is to:

- identify the development stormwater management, objectives, principles and requirements
- outline the design standards, statutory requirements and guidance for onsite detention, retention and alternative Water Sensitive Urban Design (WSUD) solutions to manage stormwater discharge quality and quantity
- outline information required to be submitted with applications to demonstrate conformity with the design objectives and requirements
- provide typical development case studies that demonstrate how to develop a conforming solution for a development
- make the application process and implementation easy and convenient
- provide applicants with an understanding of Water Sensitive Urban Design (WSUD) solutions as an alternative to manage stormwater discharge quality and quantity.

1.2 Development Plan Stormwater Management Requirements

The City of Unley Development Plan calls for the following stormwater management strategies, objectives, principles and requirements to be addressed:

- **Detention of stormwater to manage peak flows and discharge rates.** To mitigate flooding and over-loading of down-stream systems, detention tanks, rain gardens, pervious pavements and other suitable techniques can be used to allow for dissipation of peak discharge and infiltration into in-ground resources. This slows the rate of run-off discharged from the site to the street drainage systems that results from increased impervious areas above recommended thresholds, namely:
    - The post-development peak stormwater discharge rate to be less than the pre-development site conditions as a result of increased impervious areas from the current site conditions (Objectives 74 and 75 and Principles 289(b), 290 and 292)
    - The maximum discharge rate is to be less than an equivalent of 40% impervious site coverage for residential properties and 80% for commercial properties to avoid overloading the capacities of downstream systems in accordance with the Brown Hill Keswick Creek Stormwater Management Plan flood capacity parameters (Objectives 74 and 75 and Principles 290 and 292).

      NB: 'Impervious area' includes all building roofed areas and hard paved areas

  Detention storage requires initial on-site storage of stormwater during a rain event which is then slowly released to control the rate of discharge and spread the peak flow avoiding flooding street drainage systems. The storage needs to ultimately be empty ready to receive water for the next rain event.

- **Retention of stormwater for re-use,** reducing the reliance on mains water and contribution to management of discharge rates by collection in tanks (above or below ground) to allow re-use on site (Objectives 74 and 75 and Principles 286, 288 and 295).

  Retention involves on-site storage of stormwater during a rain event that can be held for re-use a required, such as for the garden, toilet, laundry and or a hot water service. The Building Code requires a minimum of 1,000L tank for residential development, however the City of Unley requires larger volumes for applicable development to enable more effective and efficient utilisation of the investment and available water (refer Table 3.1).

- **Quality of stormwater** to protect receiving waters, by limiting the key pollutants discharged in stormwater through the use of vegetative filter treatment systems on-site, for example swales and rain-gardens, to improve infiltration to soils and cleansing before release from the site (Objective 74 and 75 and Principle 286, 289(a), 291, 293 and 295).

The Unley (City) Development Plan encompasses a Vision, Objectives and Principles that relate to flooding, stormwater management and environmental requirements for development, as outlined below:

- ***Strategic Vision;*** Objective
  - *1 Unley will be a sustainable city that incorporates contemporary living, water and energy efficient design and better management of stormwater and flooding in new development.*
- ***Form of Development;*** Objective
  - *9 Development designed and located to prevent / minimise the risk of downstream flooding.*
- ***Natural Resources;*** Objectives
  - *74 Development consistent with the principles of water sensitive design.*
  - *75 Development sited and designed to:*
    - *(a) Protect natural ecological systems*
    - *(b) Achieve the sustainable use of water*
    - *(c) Protect water quality, including receiving waters*
    - *(d) Reduce runoff and peak flows and prevent the risk of downstream flooding*
    - *(e) Minimise demand on reticulated water supplies*
    - *(f) Maximise the harvest and use of stormwater*
    - *(g) Protect stormwater from pollution sources.*
- ***Water Sensitive Design***; Principles of Development Control
  - *286 Development should be designed to maximise conservation, minimise consumption and encourage re-use of water resources.*
  - *287 Development should not take place if it results in unsustainable use of surface or under ground water resources.*
  - *289 Water discharged from a development site should:*
    - *(a) be of a physical, chemical and biological condition equivalent to or better than its pre-developed state*
    - *(b) not exceed the rate of discharge from the site as it existed in pre-development conditions.*

290 *Development should include stormwater management systems to protect it from damage during a minimum of a 1-in-100 year average return interval flood.*

291 *Development should have adequate provision to control any stormwater over-flow runoff from the site and should be sited and designed to improve the quality of storm water and minimise pollutant transfer to receiving waters.*

292 *Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.*

293 *Development should include stormwater management systems to minimise the dis charge of sediment, suspended solids, organic matter, nutrients, bacteria, litter and other contaminants to the stormwater system.*

294 *Stormwater management systems should preserve natural drainage systems, including the associated environmental flows.*

295 *Stormwater management systems should:*

- *(a) Maximise the potential for stormwater harvesting and re-use, either on-site or as close as practicable to the source*
- *(b) Utilise, but not be limited to, one or more of the following harvesting methods:*
  - *(i) the collection of roof water in tanks*
  - *(ii) the discharge to open space, landscaping or garden areas, including suitably sized landscape strips adjacent to car parks*
  - *(iii) the incorporation of detention and retention facilities*
  - *(iv) aquifer recharge*

1.3 Applicable Development

The stormwater management requirements apply to all forms of 'development' but for practical and equitable implementation, more commonly applicable development types are listed below:

- additions to residential dwellings greater than 50m² in area in accordance with the Building Code criteria (subject to the provision below)

  NB: the stormwater management requirements do not apply to developments less than 50m²

- increased site coverage by roofed and impervious areas above an average of 40% for residential sites and 80% for commercial sites when compared to current/pre-existing site conditions to avoid over-loading downstream stormwater systems and compounding potential flooding (See 1.2)

  NB: Impervious area includes all building roofed areas and hard paved areas.

- new dwelling(s) or multiple dwelling, unit or apartment complexes
- mixed use, commercial, non-residential and car parking development
- land division will be case specific and require examination of network capacity, site conditions and location to ensure impacts will be managed appropriately through direct negotiation with Council. The new allotments created within new land divisions, such as new dwellings however, will be subject to the requirements of this guide. Incorporation of collective WSUD treatments at the overall design stage would be beneficial and is encouraged.

2 DEVELOPMENT APPLICATION REQUIREMENTS

2.1 Demonstrating Compliance

Sections 2.2, 2.3, 2.4 and 3 outline the information and design requirements with respect to addressing stormwater management requirements and providing satisfactory documentation for the Development Application process.

Alternatively, specific calculations may be undertaken to demonstrate compliance with requirements and achieve a tailored acceptable solution. This will require the services of a suitably experienced Civil Engineer to demonstrate, through appropriate supporting documentation, calculations and modelling that the requirements have been met in the proposed design.

For the effective and practical implementation of the standard provisions of the Development Plan, Building Code and best practice standards as outlined in this Guide, it is required that:

- stormwater runoff generated from impervious areas discharged from the site is to be less than current pre-development conditions using a volumetric 5 year ARI 45 min event
- Impervious surfaces are to be less than the equivalent of 40% for residential areas and 80% for commercial areas
- a minimum 1,000L retention tank for residential development, however larger volumes are typically required for applicable development to enable more effective and efficient utilisation of the investment and availability of water for re-use (Refer Table 3.1).
- stormwater run-off to be treated to remove 90% of gross pollutants, 80% suspended solids, 60% total phosphorous, and 45% total nitrogen of the typical urban stormwater annual load. These requirements apply to larger developments (Commercial developments), to car parks of equal to or greater than 6 parking spaces, as well as large areas of hard paving (> 20m²).

For applicants who wish to undertake WSUD, the approach is similar to the standard provisions outlined above, with the following additions:

- stormwater treatment measures are integrated into the landscape and promote greening and visual amenity
- retention of the 5 year ARI 45 minute volumetric runoff generated from the additional site imperviousness (above current conditions, notionally set at 40% for residential and 80% for commercial) created on a site from the development using WSUD techniques.

2.2 Planning Consent Design and Information Requirements

The Planning Consent for applicable development needs to address the policy provisions of the Unley (City) Development Plan. This guide can help in the simple determination of design solutions that demonstrate compliance with the stormwater management policy requirements.

Sections 2.3 and 2.4 provide a checklist and stormwater management design requirements. Section 3 provides conforming total stormwater detention and retention volumes, i.e. tanks. Section 4 provides guidance, storage requirements and technical reference sheets for alternative WSUD techniques.

Alternatively, a specific tailored engineered solution can be determined and documented by a suitably qualified Civil Engineer.

The Planning Consent for applicable development should encompass the necessary information, documentation and designation on the plans including:

- existing and proposed total building roofed areas
- existing and proposed impervious (versus pervious) paved surface areas
- allocation of necessary space for tanks (detention and retention) without compromise to open space, building design or other requirements
- where the applicant is undertaking water sensitive urban design treatments (detention and retention) around the site, areas should be designated for:
  - pervious paving and underground storage
  - rain gardens and underground storage
  - vegetated swales as part of landscaping.

The Planning Consent will be subject to a condition confirming the stormwater management requirements. This will outline the:

- ongoing obligation for the owner to ensure the installation and maintenance of the stormwater management techniques
- flexibility for the proposed stormwater management techniques to be refined as part of the Building Consent if suitable engineering calculations are provided that still meet the minimum requirements.

2.3 Building Consent Specifications and Information Requirements

The Building Consent for the Development Application needs to address the Building Code and provide the necessary technical /engineering specifications to enable development approval to be issued.

This includes the provision of a mandatory minimum 1,000L tank for roof water that is plumbed into the toilet or laundry or hot water service. Compliance with the City of Unley minimum rainwater harvesting tank (RHS) and detention storage (DS) tank is required in accordance with Table 3.1.

The necessary stormwater detention storage tanks and controlled equivalent pre-developed discharge rate will need to be specified. This needs to be compared to the post-development discharge rate to ensure it does not exceed the pre-development rate.

A Stormwater Management Plan should accompany the application and identify all the storm-water management design elements proposed as per the following checklist.

Stormwater Management Plan Checklist

Development Application Number

Plans **must** be to scale, and should clearly show the following information where applicable:

Site Plan

- ☐ Minimum scale 1:200
- ☐ North point
- ☐ Property and/or boundaries (including dimensions)
- ☐ Location, size and nature of existing and proposed structures, showing setbacks from boundaries
- ☐ Detail how the water reaches the tank (if not immediately next to structure)

Elevation Plan

- ☐ The elevation of the proposed rainwater tank (please include dimensions)

Floor Plan

- ☐ Size of the rainwater tank

Support Details

- ☐ Schedule of building materials, finishes and colours
- ☐ Overflow details
- ☐ Details of any stands supporting the water tank

Building Information

- ☐ Retention/Detention tank design details including specifications
- ☐ Site Drainage plan (setbacks of tanks, pipe sizes, overflow provisions/ discharge to street)
- ☐ Ground and finished floor levels
- ☐ Engineering – structural design details for in ground tank
- ☐ Retention tank plumbed to WC, Laundry outlets, HWS as per BCA requirements
- ☐ Discharge rate/orifice size

*Note: **Tanks** do not require specific approval if they are:*

- *wholly above ground level*
- *part of a roof drainage system*
- *less than 10m² in area*
- *less than 4 metres in height*

Larger above ground or underground tanks will need further consideration and at least Building Consent. Tanks associated with State or Local Heritage Places need approval.

2.4 Stormwater Management Guidelines

The stormwater management plan shall be developed using the principles of Australian practice, Australian Rainfall and Runoff and the Building Code requirements. In addition, the Development submission shall consider where relevant the requirements listed in the table below. The requirements are in accordance with the City of Unley Development Plan. The adoption and sizing of WSUD elements refers to the acceptable solutions in Sections 3 and 4. A process to prepare your stormwater management plan is provided at the end of this Section. The next page provides a flow chart for the process to prepare your stormwater management plan.

GENERAL REQUIREMENTS	GUIDELINES	REFERENCE
1. New development will be required to control runoff for a 5yr ARI event.	• New developments must control stormwater runoff for a 5 year ARI event	Refer to Section 3 for storage size / volume requirements based on development area for the relevant case.
2. No run-off shall be directed from the development site to adjacent properties.	• Runoff shall be controlled on site up to a 1 in 20 year ARI event. • Paved area runoff should be directed into landscape areas and controlled to prevent it entering adjacent properties	
3. Site discharge rate shall be discharged at controlled pre-development rate* or retained on site.	Methods of Detention / Retention • Rainwater harvesting tanks • Detention tank • Soakage swale • Soakage Trench or well(s) • Permeable Paving • Rain garden	Refer to Sections 3 for storage size / volume requirements based on development area for the relevant case. Refer to Section 4 for WSUD elements
4. The floor levels shall be designed to provide 100 -year ARI protection against inundation	• This applies to a 100 year ARI storm over the development site and from street or watercourse • If the site does not slope away from the road by a grade of more than 0.5%, all finished floor levels shall be a minimum of 300mm above the street water table level (taken at the midpoint of the property frontage).	Check if site is located within a flood prone area. Refer to Council for advice.
5. Measures shall be incorporated within the proposed development boundary to prevent gutter flow entry to property.	• Driveway and property levels along the property/road reserve boundary shall be specified at least 100mm above the adjacent street top of kerb.	
6. Measures shall be incorporated in all development to ensure no stormwater borne pollutants (including litter, silt and any harmful substances) are discharged into Council's drainage system.	• Use stormwater treatment devices that are installed within the development to remove solid and liquid pollutants, prior to discharge to Council's drainage system. For car parks exceeding 150m^2 a suitably sized stormwater quality device is required. Using green initiatives is encouraged.	Refer Section 4 for the relevant case.
7. Soakage systems shall be appropriately located, and provide effective detention / retention. These systems shall be environmentally appropriate for the site and soil conditions.	Soakage systems: • Shall not be located within 6m of any structural footing or property boundary. • Shall not be located on ground sloping more than 1 in 10. • Shall collect only roof runoff (and include leaf and sediment interceptor) • Shall collect surface runoff from paved areas that have first been intercepted by a silt and debris trap and or a lawn area. • Shall be demonstrated to be empty within 1.5 days after a 1 in 5 year ARI 45 minute storm. • Shall incorporate an overflow for exceedance of the storage capacity • Bore logs required	Refer to Development Act 1993 Ministers specification SA78AA (Planning SA 2003) Bore logs required as part of approval process. Refer to WSUD Basic procedures for source control of stormwater Argue, .J)
8. When pump system failure may result in inundation of any building or adjacent property, measures shall be incorporated to minimise the risk of failure during a storm.	If failure of the pump system is likely to result in flooding of a building, under-croft or adjacent properties then the following shall apply: • Two pumps shall be provided, each capable of the design flow rate. • The pumps shall be configured to automatically alternate as the duty pump. • The system shall be configured to automatically revert to the alternate pump should the duty pump fail. • Either a back–up power supply or incorporate storage (in pump chamber and/or above ground) with a volume equal to a 100 year ARI 30 minute event or as negotiated with Council. Run-off without pump operation and without flooding of buildings, under-crofts or any properties shall be demonstrated and accommodated to discharge safely to street.	
9. All works necessary beyond the property boundaries shall be to Council's requirements and standard details.	All works (e.g. connections across Council's footpath and connection to Council's drains) should be underground, and should meet Councils requirements and standard details.	Refer to Council standard details.
10. All drainage infrastructures within the development site shall be maintained, serviced, cleaned and sustained operational for the life of the development to by the owner.		

** Pre-development rate – Pre-development rate has been determined based on traditional residential allotment with 40% impervious surface*

Prepare your stormwater management plan

Step 1

Refer to the Stormwater Storage Design Table 3.1 and select your case. Use the allotment area or roof area to identify the total storage requirement for the detetnion / retention. For alternative WSUD techniques to be applied on the development see Table 4.1.

Step 2

Plan the site layout to enable the stormwater storage requirements to be accommodated within the appropriate available space. Consider the guidelines when planning the site layout to ensure that you comply with the requirements. Refer to Section 3.2 for tank arrangement and 4.2 for alternative WSUD examples.

Step 3

Prepare your stormwater management plan for the application and follow the guidelines and checklist provided in this document in Sections 2.3 and 2.4.

Notes for Step 1

1. The retention rainwater harvesting tank (RWH) represents the primary storage that will be provided in a rainwater tank that must be reticulated to continuous daily uses. This shall include all or at least one of the following uses: toilets or laundry cold water outlets or hot water service. In addition to these, a connection could also be made to the irrigation system and external garden tap (s). The installation shall comply with Building and Plumbing Code requirements.
2. The sum of the RWH and DS must be sized to meet the total Stormwater storage requirement (SSR) in the design table for the relevant case.
3. The storage requirements for the RWH and DS can be alltered to some degree if in some cases the DS cannot be accomodated due to land use or other physical constraints. In such cases there is more reliance placed on the RWH size, then it is expected that the Applicant will increase the reuse demand significantly by adding more demands (such as HWS, toilet and laundry cold water taps) to ensure the storage is drawn down. For all developments the sum of RWH and DS must be not less than the Total Stormwater Storage Volume Requirement (SSV).

Note:

The alternative WSUD optional measures can be integrated into the site's landscaping represent the secondary retention storage (SRS). SRS includes the use of landscaping elements including, rain garden, vegetated swale, and or the RWH can be increased to meet the Total Stormwater Storage Requriement (SSV) if the requirements of Note 3 are met with regards to increasing water demand.

3 RETENTION AND DETENTION SIZING TABLES

In order to simplify the Development Assessment process certain development types as listed in these guidelines have the option to submit an 'Acceptable' solution. Acceptable solutions use techniques that conform with requirements and therefore help to simplify the design and development assessment process for managing stormwater on the development.

Table 3.1 for each development type provides you with the volume of total stormwater storage requirement to be met on the development using a combined retention and detention tank. The total stormwater storage requirement for each development type must be met in order to obtain a development approval.

Seeking out experienced Engineers to assist you in the design of your proposal may assist you should you wish to employ an alternative solution or use environmentally sustainable WSUD techniques on your development.

3.1 Site Detention and Retention Storage Requirements

The volume of retention and detention tank storage volumes are shown in Table 3.1. Council requires you to comply with the requirements of Table 3.1, or alternatively Council encourages you to use Table 4.1 (See Section 4) if you wish to use a WSUD approach to managing stormwater on the development.

Notes;
It is a requirement that a minimum of 60% of the impervious area of the site is connected to the detention and retention storage.

The detention tanks will require an orifice plate to control the rate of discharge of stormwater. The following orifice sizes apply for the developments:

Orifice size = 30mm
- Single allotments divided into two with dwellings
- Single residential dwellings
- Extensions to residential dwellings
- Multi unit developments comprising 3 to 5 units

Orifice size = 50mm
- Apartment buildings / town housing
- Commercial Sites

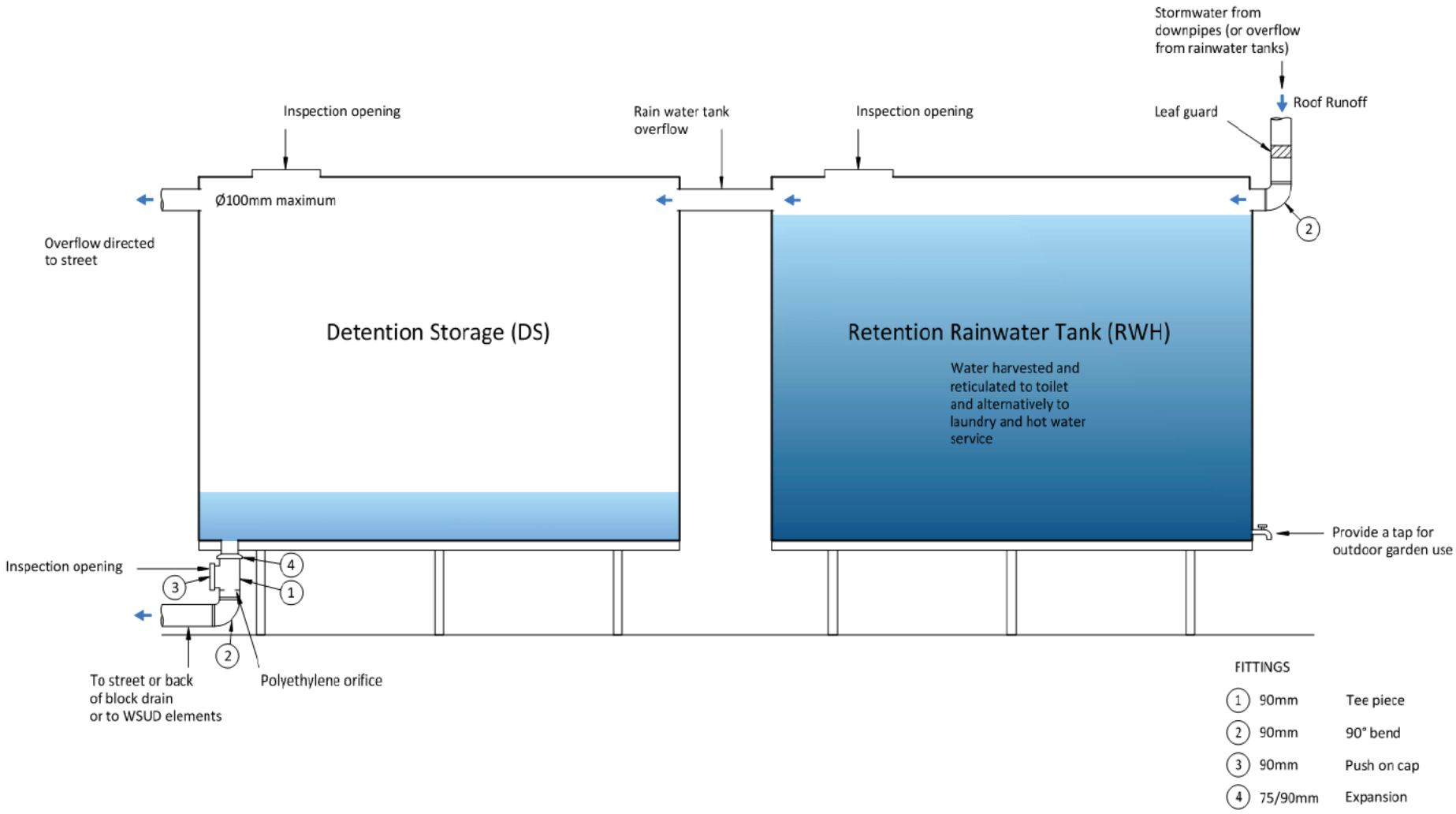
The design focus should consider to minimise the visual impact of the stormwater WSUD techniques by creating aesthetically pleasing and green landscape design elements while maximising space for other activities. This can be achieved by incorporating WSUD elements into the landscaping of the site, such as designing rain gardens to serve as planter boxes for green landscaped areas, or by integrating rainwater tanks in the building design by allocating the appropriate space to accommodate them.

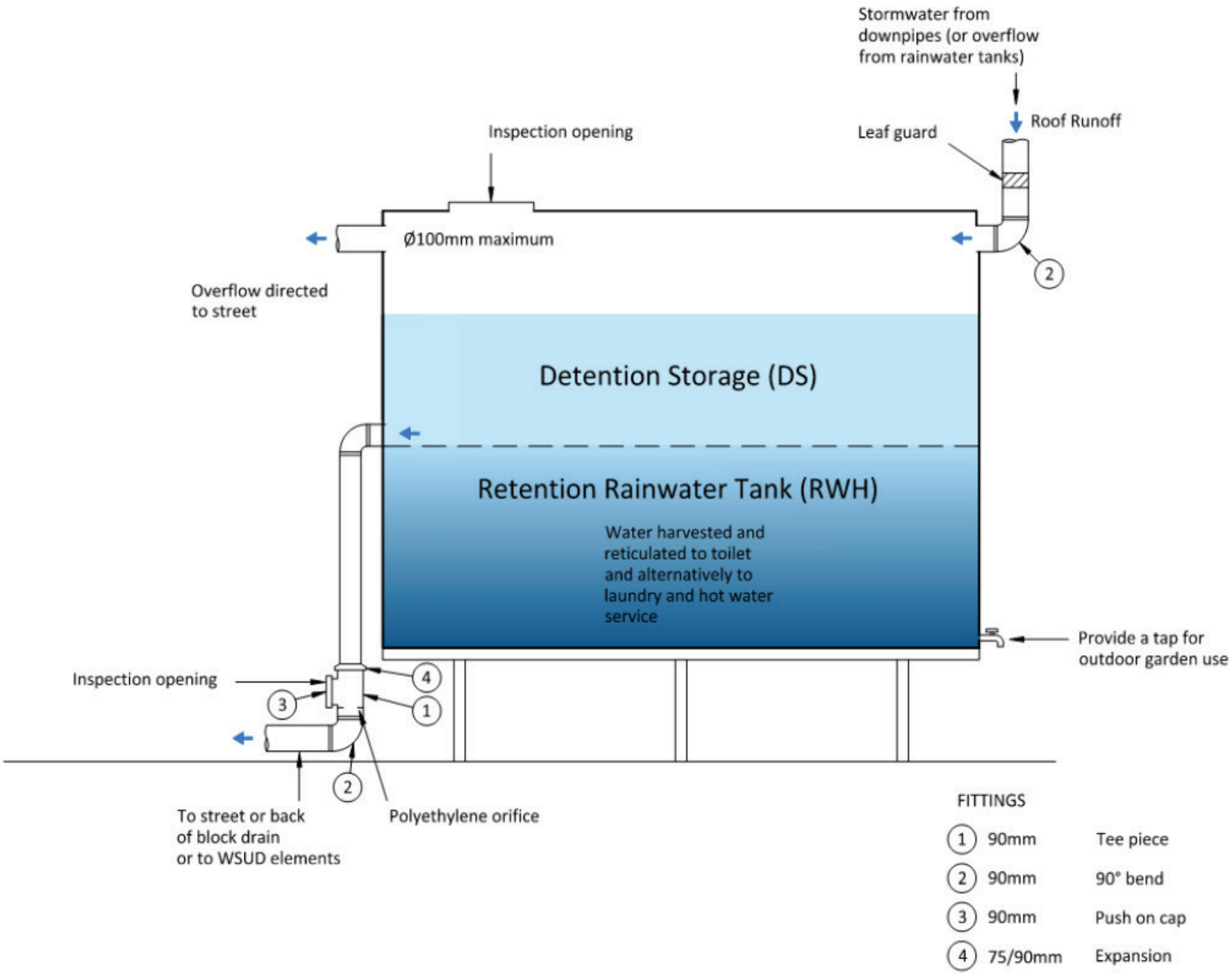
Table 3.1: Stormwater Detention and Retention Requirements for developments

Area of Allotment (m^2)		Storage Method: Retention Rain Water Harvest Tank, RWH (L)	Storage Method: Detention Storage, DS (L)	Total Stormwater Storage Volume for Site, SSV (L)	Maximum Discharge Rate to Kerb* (L/s)
Single Residential Dwellings/Town houses (Total storage requirements per allotment area)					
Up to 400		2000	1000	3000	4
401-500		2000	1500	3500	4
501 – 600		2500	1500	4000	4
601 – 700		2500	2000	4500	4
701 – 800		3000	2000	5000	4
800 +		3500	2500	5500	4
Extensions to residential dwellings (>50m^2 roof area) (Total storage requirement per new roof area created)					
51 - 100		2000	1000	3000	N/A
101 - 150		2500	1500	4000	N/A
151 - 200		3000	2000	5000	N/A
201 - 250+		3000	2500	5500	N/A
Multi-Unit Developments Comprising of 3-5 Units (Allotment area, number of dwellings, and storages per dwelling)					
Up to 1000	3	2000	1000	3000	4 per outlet
1001 – 1500	3	2500	1500	4000	4 per outlet
	4	2000	1000	3000	4 per outlet
1501 - 2000	3	3000	1500	4500	4 per outlet
	4	2500	1000	4000	4 per outlet
	5	2000	1000	3000	4 per outlet
Apartment Buildings (Total storage requirements for the full site)					
Up to 1000		5000	3500	8500	TBC
1001 - 1500		8000	4500	12500	TBC
1501 - 2000		10000	6500	16500	TBC
2001 - 2500		12000	8000	20000	TBC
Commercial sites (Total storage requirements for the full site)					
Up to 1000		5000	1500	6500	TBC
1001 - 1500		8000	2000	10000	TBC
1501 - 2000		10000	2500	12500	TBC
2001 - 2500		12000	3000	15000	TBC

*Connection to underground Council infrastructure requires Council approval.

3.2 Total Stormwater Storage Volume Arrangement




Stormwater from downpipes (or overflow from rainwater tanks)
Roof Runoff
Leaf guard
Inspection opening
Ø100mm maximum
2
Overflow directed to street
Detention Storage (DS)
Retention Rainwater Tank (RWH)
Water harvested and reticulated to toilet and alternatively to laundry and hot water service
Provide a tap for outdoor garden use
Inspection opening
4
3
1
2
To street or back of block drain or to WSUD elements
Polyethylene orifice
FITTINGS
1 90mm Tee piece
2 90mm 90° bend
3 90mm Push on cap
4 75/90mm Expansion

4 WATER SENSITIVE URBAN DESIGN

WSUD provides an alternative environmentally sustainable approach to maintaining stormwater on a development. Council encourages the use of WSUD on your development to create green spaces that can be integrated as part of the landscaping and to encourage greater utilisation of stormwater for reuse on site.

This Section provides general information to guide the stormwater storage requirements and the selection of techniques based on using WSUD to suit the different developments and applications at various scales. Information in the form of guide notes and concept details are also provided, however the applicant must provide the appropriate level of design rigor, engineering and landscaping detail as part of the documentation to be submitted for building approval.

4.1 Total Stormwater Storage Arrangement – WSUD Option

Examples using case studies based on using WSUD techniques applied on each development type are provided in this Section. This aims to provide guidance to demonstrate how various detention, retention and WSUD options can be used on their own, or in combination with other elements. The preferred option for a site will depend on many factors that will need to be considered when determining a suitable strategy for the development. These factors include:

- Soil conditions
- Land slope
- Spatial requirements to accommodate WSUD elements
- Site functionality and landscaping
- Extent of impervious areas
- Extent of roof (which can ideally be managed using rainwater tank to recycle water for non potable uses)

Council encourages the adoption of WSUD onto all forms of development.
The volume of retention storage is shown in Table 4.1 if you wish to use a WSUD approach to managing stormwater on the development.

Refer to Sections 4.3 to 4.8 for reference and practice notes relating to each WSUD technique.

Table 4.1: Stormwater Detention and Retention Requirements for developments using WSUD

Area of Allotment (m^2)		Storage Method		Total Stormwater Storage Volume for Site, SSV (L)	Maximum Discharge Rate to Kerb* (L/s)
		Retention Rain Water Harvest Tank, RWH (L)	Secondary Retention Storage, SRS (L)		
Single Residential Dwellings / Town houses (Total storage requirements per allotment area)					
Up to 400		2000	500	2500	4
401- 500		2000	1000	3000	4
501 - 600		2500	1000	3500	4
601 - 700		2500	1500	4000	4
701 - 800		3000	1500	4500	4
Extensions to residential dwellings (>50m^2 roof area) (Total storage requirement per new roof area created)					
51 - 100		2000	500	2500	N/A
101 - 150		2500	500	3000	N/A
151 - 200		3000	1000	4000	N/A
201 - 250+		3000	1500	4500	N/A
Multi-Unit Developments Comprising of 3-5 Units (Allotment area and number of dwellings)					
Up to 1000	3	2000	500	2500	4 per outlet
1001 – 1500	3	2500	500	3000	4 per outlet
	4	2000	500	2500	4 per outlet
1501 - 2000	3	3000	1000	4000	4 per outlet
	4	2500	500	3000	4 per outlet
	5	2000	500	2500	4 per outlet
Multi-Unit Developments Comprising of 3-5 Units (Allotment area, number of dwellings, and storages per dwelling)					
Up to 1000		5000	3500	8500	TBC
1001 - 1500		8000	4500	12500	TBC
1501 - 2000		10000	6500	16500	TBC
2001 - 2500		12000	8500	20500	TBC
Commercial sites (Total storage requirements for the full site)					
Up to 1000		5000	3500	8500	TBC
1001 - 1500		5000	7500	12500	TBC
1501 - 2000		6500	10000	16500	TBC
2001 - 2500		8000	12500	20500	TBC

*Connection to underground Council infrastructure requires Council approval.

4.2 Development Case Studies

The following diagrams provide examples of options of how stormwater retention and detention strategies could be applied to different development types. Water Sensitive Urban Design techniques are included.

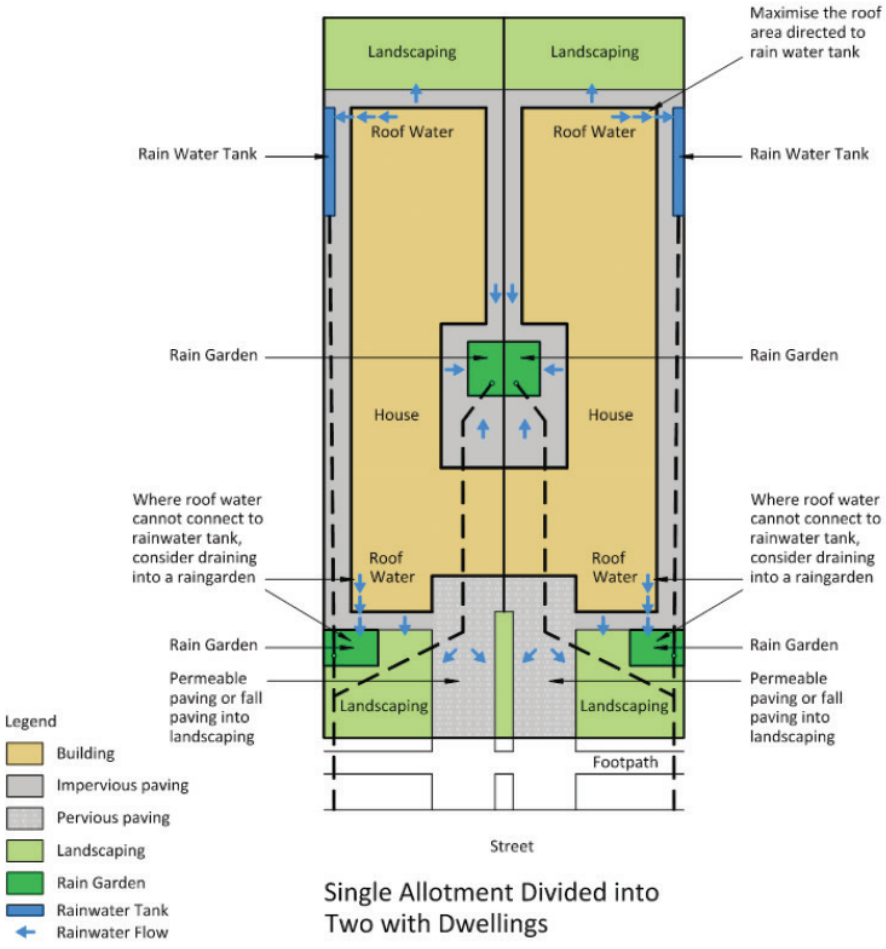
Example development types include:

- Single allotment divided into two allotments with dwellings
- Single residential dwelling
- Extension to residential dwelling (>50m²)
- Multi-unit development comprising 3-5 dwellings, units and courtyard homes
- Apartment building or town housing
- Commercial development

Single Allotment Divided into Two Allotments with Dwellings

This diagram presents one possible strategy for stormwater Management for a courtyard style dwelling using WSUD techniques. The strategy demonstrates how all paths and driveways can fall into landscaped areas and a rain garden feature. All or a majority of roof runoff can be directed and collected in a rainwater tank and can be reused for toilet, laundry and or hot water service. An infiltration system is ideal for larger allotments in a landscaped area to provide futher on site retention.

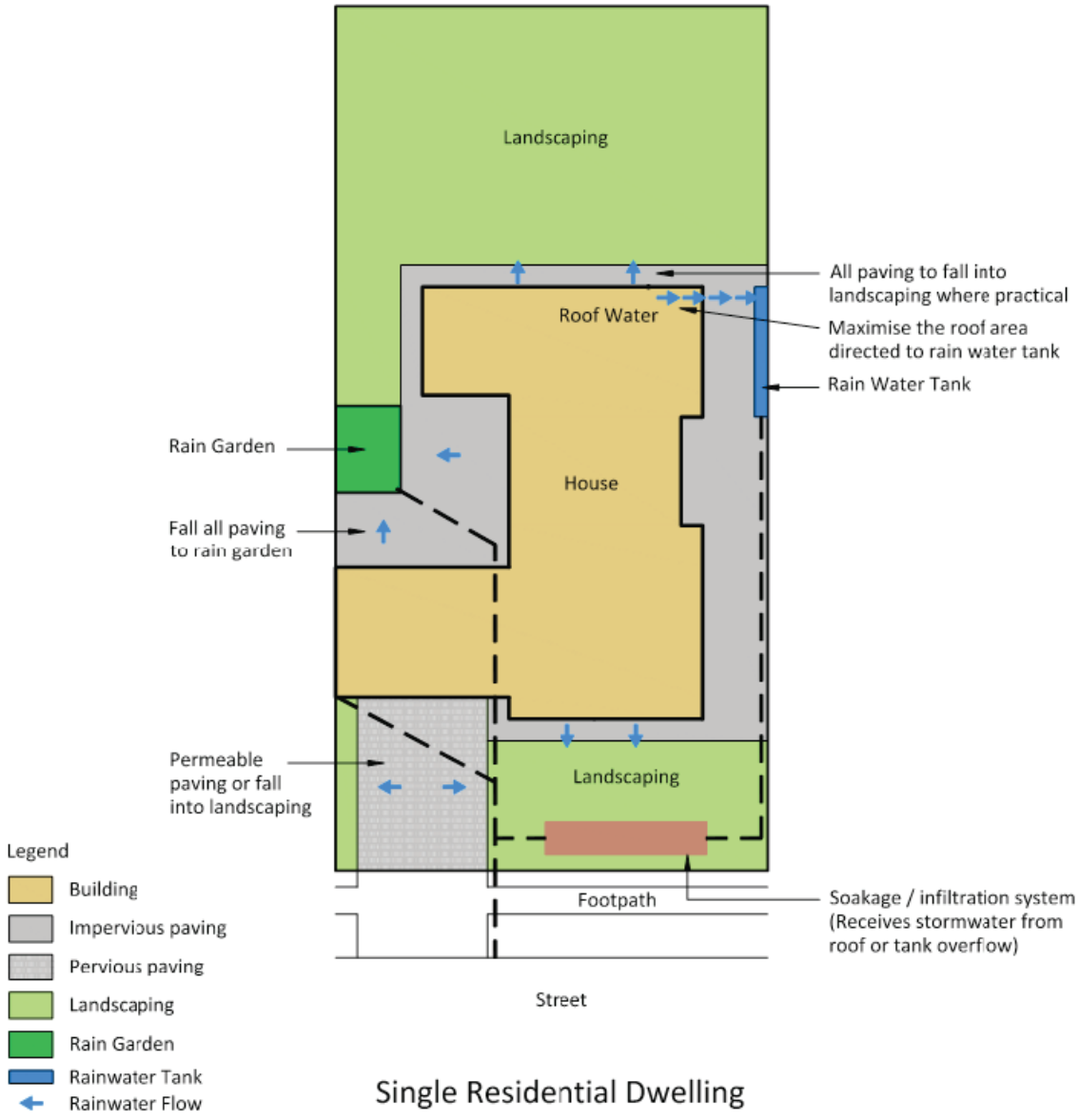
These requirements will also apply to a newly constructed single dwelling on an allotment. It equally applies to situations where an existing single dwelling is demolished and replaced with a new dwelling.



Single Allotment Divided into Two with Dwellings

Single Residential Dwelling

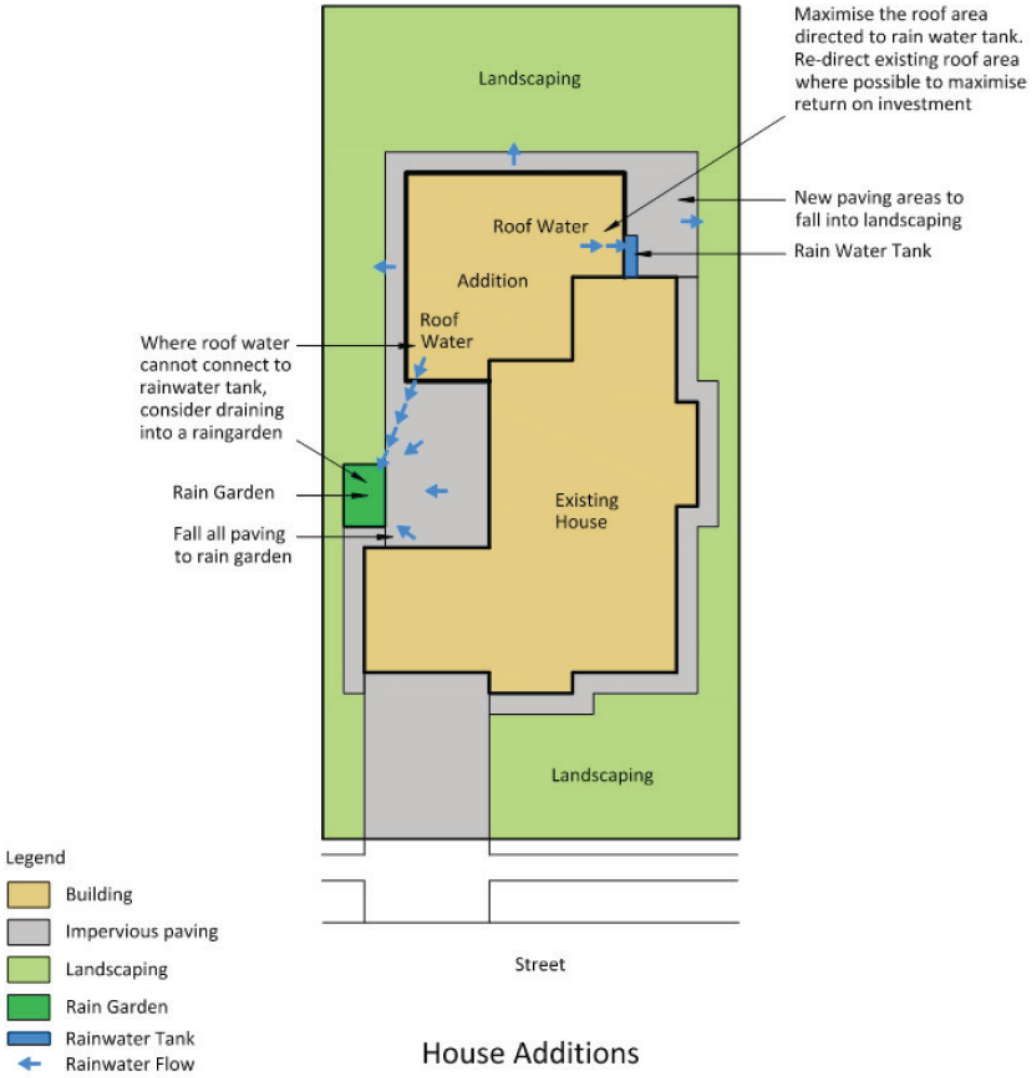
This diagram presents one possible strategy for stormwater Management for a typical family home using WSUD techniques. The strategy demonstrates how all paths and driveways can fall into landscaped areas and a rain garden feature. All or a majority of roof runoff can be directed and collected in a rainwater tank and can be reused for toilet flushing, laundry and or hot water service. An infiltration system is ideal for largerallotments in a landscaped area to provide futher on site retention.



Single Residential Dwelling

Extension to Residential Dwelling (>50m²)

This is one possible strategy for stormwater management for a typical house addition using Water Sensitive Urban Design (WSUD) techniques. The strategy demonstrates how all new pathways fall into landscaping and rain gardens. While the majority of the roof runoff is directed and collected in rainwater tank and can be reused for toilet flushing, laundry and or hot water service. If required, a smaller portion of roof runoff can be directed into a rain garden or another WSUD device. Owners are encouraged to connect additional roof area to the rain water tank to maximise return on investment.



House Additions

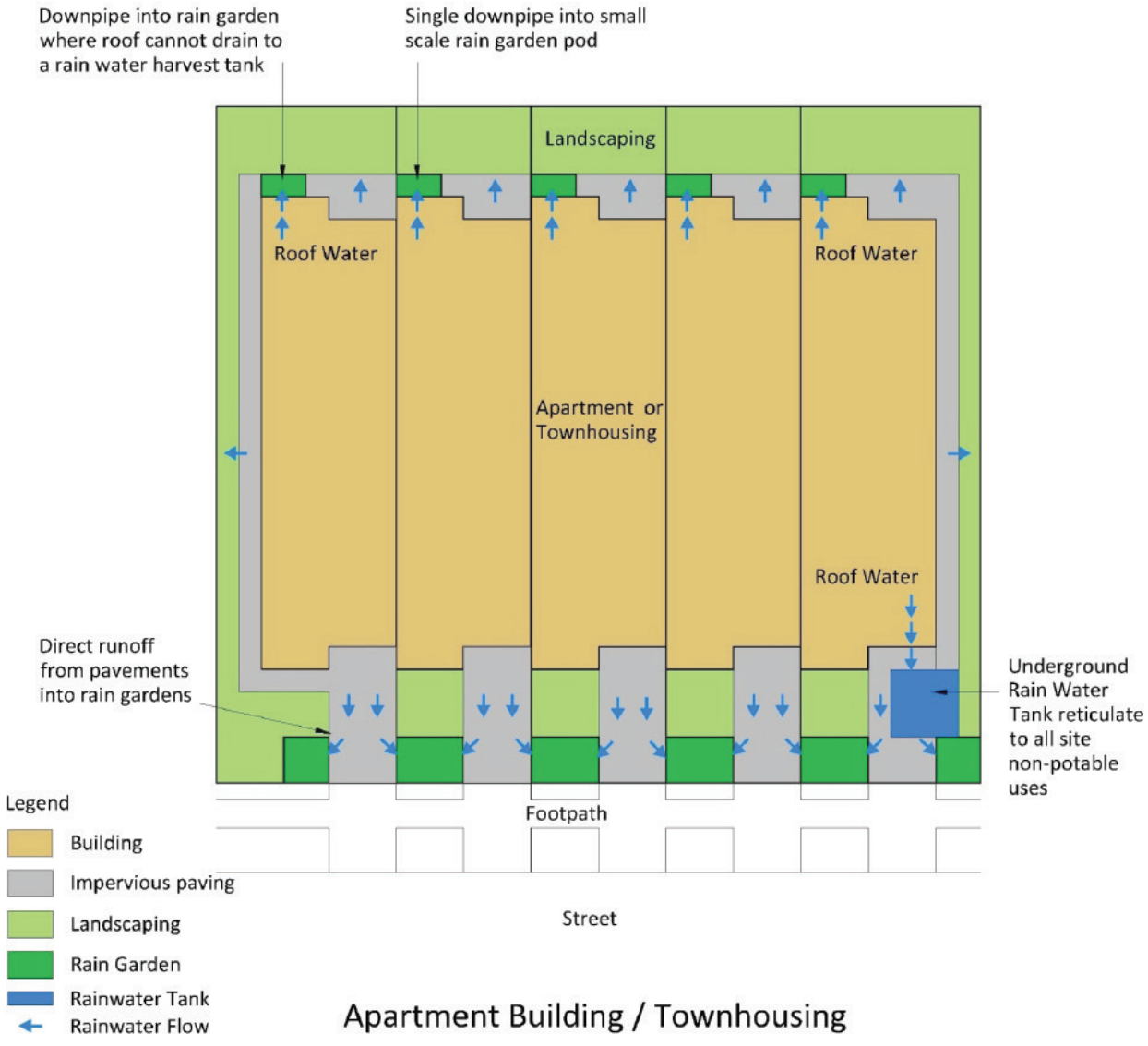
Multi-Unit Development Comprising 3-5 Dwellings, Units and Courtyard Homes

This is one possible strategy for the management of stormwater at a typical Multi Unit Development using Water Sensitive Urban Design (WSUD) techniques. The strategy demonstrates how all paths fall into landscaped areas. All driveways, car parking and hardstands should drain into a landscaped based WSUD elements such as swales and rain gardens to receive treatment. The surface area of Rain gardens should be sized at a minimum of 2.5% of the car park, driveway and hardstand catchment area. A majority of roof runoff can be directed and collected in a rainwater tank which is connected to non-potable demands for reuse for toilet flushing, laundry and or hot water service.

Multi Unit Development comprising
3 to 5 Units / Courtyard Dwellings

Apartment Building or town Housing

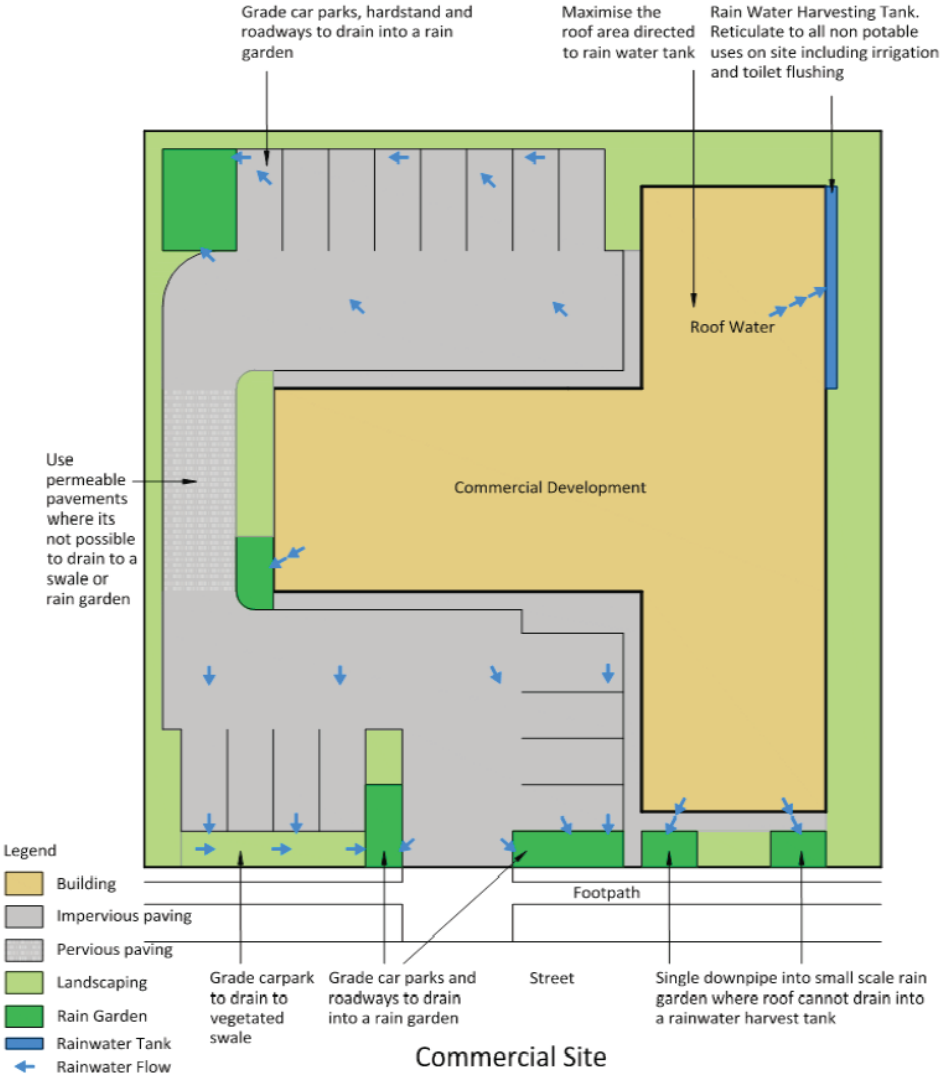
This is one possible strategy for the management of stormwater at a typical Apartment or Town House Development using Water Sensitive Urban Design (WSUD) techniques. The strategy demonstrates how all paths fall into landscaped areas. All driveways, car parking and hardstands should drain into landscaped based WSUD elements such as swales and rain gardens to receive treatment. The surface area of rain gardens should be sized at a minimum of 2.5% of the car park, driveway and hardstand catchment area. A majority of roof runoff can be directed and collected in a rainwater tank which is connected to non-potable demands for reuse for toilet flushing, laundry and or hot water service.



Apartment Building / Townhousing

Commercial Development

This is one possible strategy for the management of stormwater at a typical Commercial Development using Water Sensitive Urban Design (WSUD) techniques. The strategy demonstrates how all paths fall into landscaped areas. All driveways, car parking and hardstands should drain into a landscaped based WSUD elements such as swales and rain gardens to receive treatment. The surface area of rain gardens should be sized at a minimum of 2.5% of the car park, driveway and hardstand catchment area. A majority of roof runoff can be directed and collected in a rainwater tank which is connected to non-potable demands for reuse for toilet flushing, laundry and or hot water service.



4.3 Roof Runoff Capture and Reuse – Rainwater Tanks

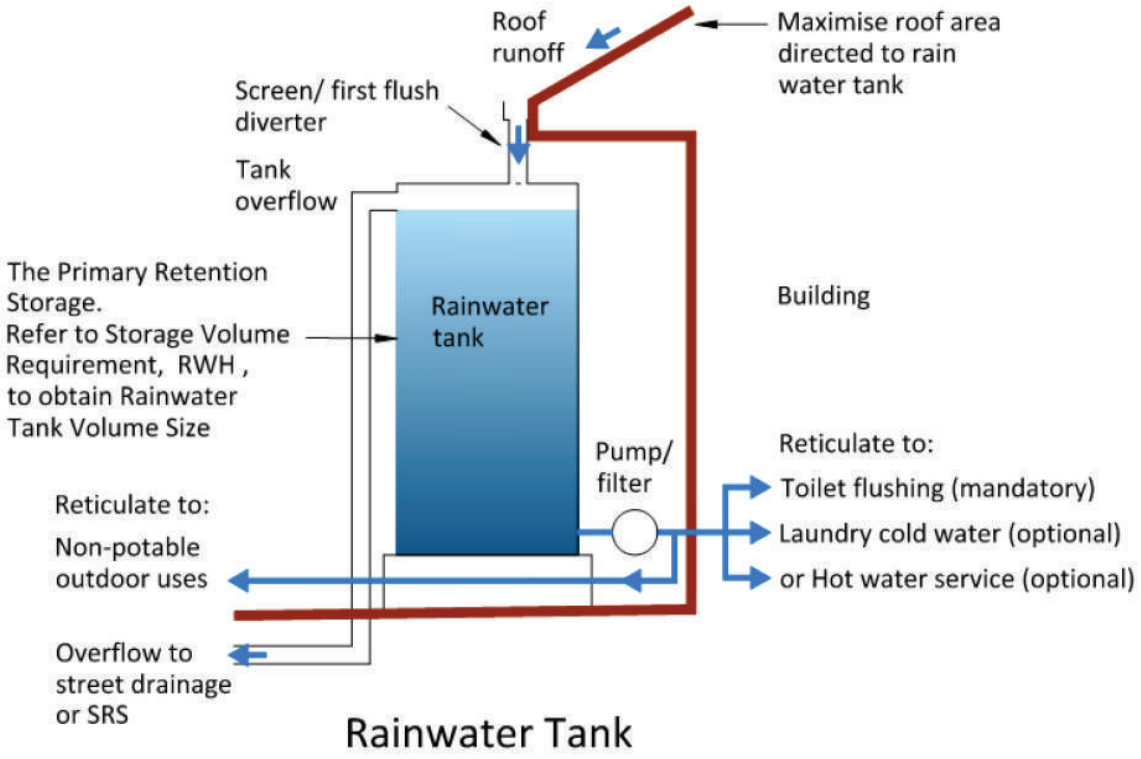
Water storage tanks can be above or below ground, strategically incorporated into new or existing buildings and open space areas without impacting on the aesthetics of the building or the use of the site. Tanks should be appropriately sized to maximise their usefulness and reticulated to various continuous demands / uses to ensure that the water captured in the tank is consistently emptied to allow it to be replenished following subsequent rainfall throughout the year.

Rain water capture from roofs is for non-potable uses, which include:

- Toilet flushing
- Garden irrigation, external taps and other external non potable uses such as car washing
- Washing machine / laundry cold water tap
- Hot water system

The capture and use of rainwater is an environmentally preferable option for sourcing alternative water supplies. Rainwater captured from a roof has a low level of pollution and this means that treatment requirements are minimal. Because the water is reused on the same site, this represents a good means of retaining stormwater on site.

The system shall include an automatic switch to supply from mains water when the tank is emptied.



Rainwater Tank

4.4 Infiltration

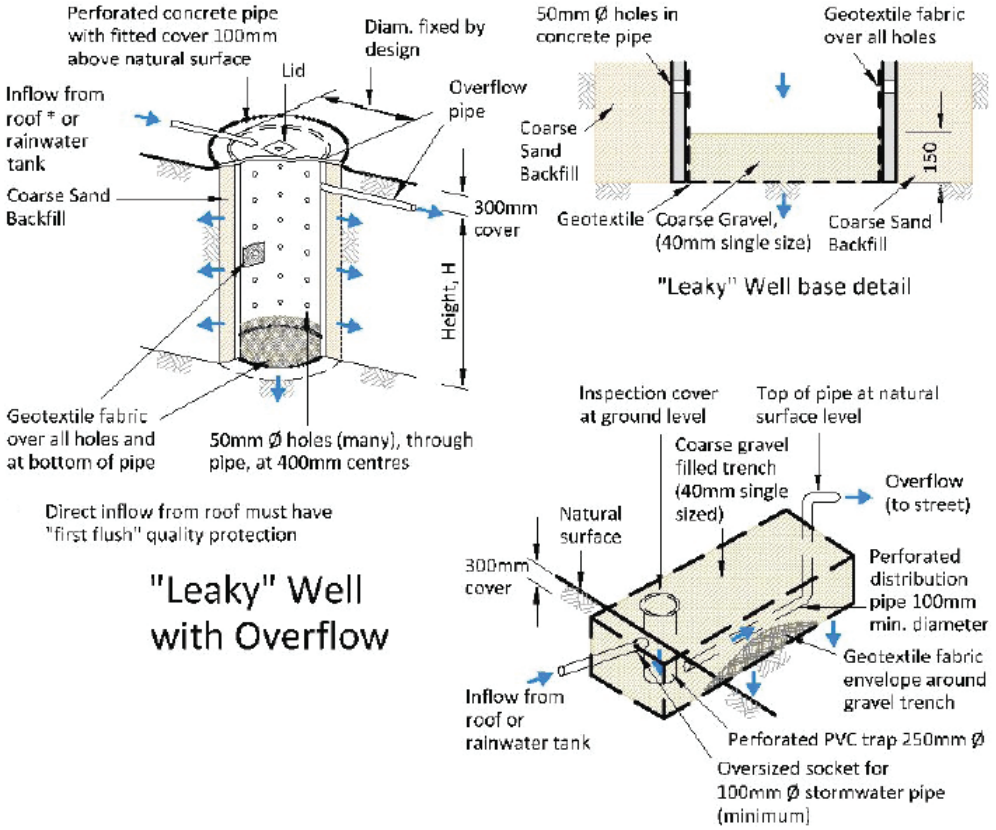
Infiltration systems can be an effective means of reducing the stormwater volume discharged to the street drainage system. They are highly effective at improving soil moisture conditions around trees and the landscape to enhance tree growth, health, and shade. However **specific design requirements must be met** in order to effectively use these techniques.

Infiltration devices (Soakage systems) can be based on using several different configurations, including:

- Trenches
- Wells
- Beds

Infiltration devices are generally gravel filled (excluding wells) designed to be incorporated into other WSUD elements or on their own. Runoff needs to be pre-treated to remove sediments, litter and organic matter prior to draining into a infiltration device. Runoff from roofs is best distributed into infiltration system with minimal treatment. In the clay soils of the City of Unley, **a minimum 6m separation distances to structures and buildings need to be carefully considered** as well as other infrastructure assets that may be impacted by soil moisture changes, and by the additional moisture itself.

Infiltration devices are designed as a retention system, however where the rate of infiltration into clay soils is quite slow, they can be designed to incorporate a slow flow outflow to the street drainage system by using a smaller diameter pipe (20 to 40mm diameter). Such systems are more within the realms of detention systems, however if the outflow is typically allowed to be released over a period of 1 to 3 days then they can be considered to be a retention system under these guidelines.



Stormwater Infiltration Devices (source University of SA, 2004)

Note:
The Volumetric Size of a Soakage System is based on the Volume of Stormwater that can be held within the Void Space of the Gravel. (Assuming 30% void space for 40mm single sized gravel, gives a Total Size Requirement of 3 Times the Stormwater Storage Requirement. This is referred to as the Secondary Retention Requirement, SRS.

4.5 Rain garden

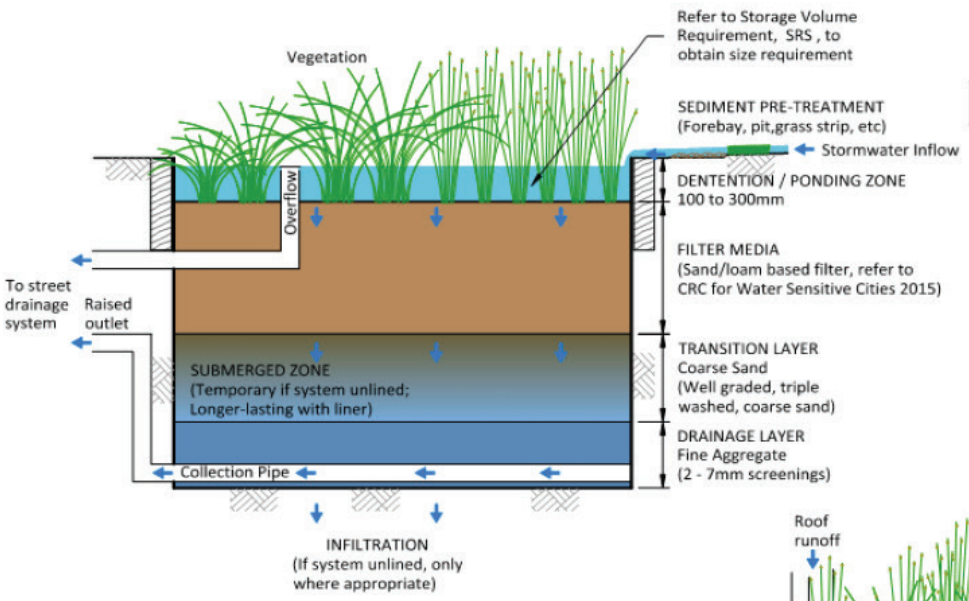
Raingardens can be used to provide an effective stormwater management technique integrated into the landscaping of any development to provide retention, detention and treatment of stormwater runoff. They are highly aesthetic systems when used as part of landscaping to provide dense green under planting. In raingardens, stormwater runoff is filtered through a densely vegetated bed comprising of layers of sandy loam, and gravel media. In lined systems seepage water is then collected through sub surface drains consisting of perforated pipes to drain to the street drainage system. In unlined systems, direct infiltration can occur to the underlying soils where a minimum offset of 6m can be provided to structures and boundaries, such that structural assets will not be at risk of soil movement from reactive clay soils. Detention ponding can be provided in the raingarden in the depression created as part of the garden bed. This will attenuate flows and reduce the rate of flow to the street drainage system.

The selection, planting and establishment of appropriate dense vegetation is very important factor to ensure its function is maintained over the long term. A combination of 5 to 6 species should be considered to provide a diversification of plants to improve habitat opportunities and the robustness of the system. Planting densities should be in the range of 5 to 9 plants / m^2 depending on the use of clumping and / or spreading sedge species. Suggested species for the Adelaide region can be found in: www.epa.sa.gov.au/files/10793_raingarden_guide.pdf

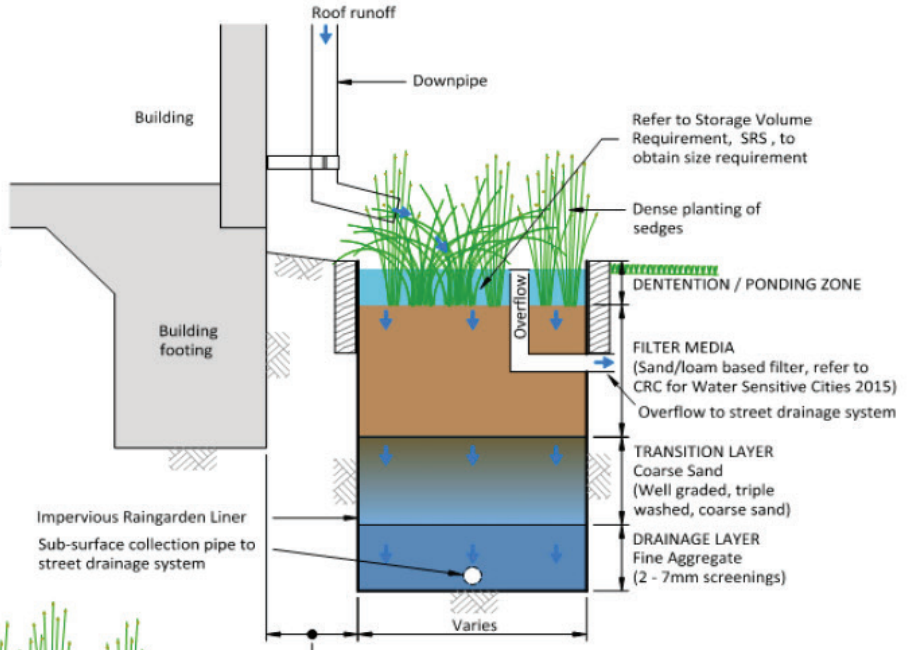
Raingardens can be implemented into all types of developments outlined in these guidelines and at all scales and types. They are best utilised to receive stormwater runoff from driveways, car parks and roof runoff. These can be installed at various scales including:

- In ground depressions (with or without impermeable liner)
- Planter boxes
- Swales
- Basins
- Traffic islands /calming measures in car parks, roadways and driveways

Refer to "Adoption Guidelines for Stormwater Biofiltration Systems" for the design and specification of these systems. Refer to publication reference in Section 5.



Main Components of Inground Raingarden Systems

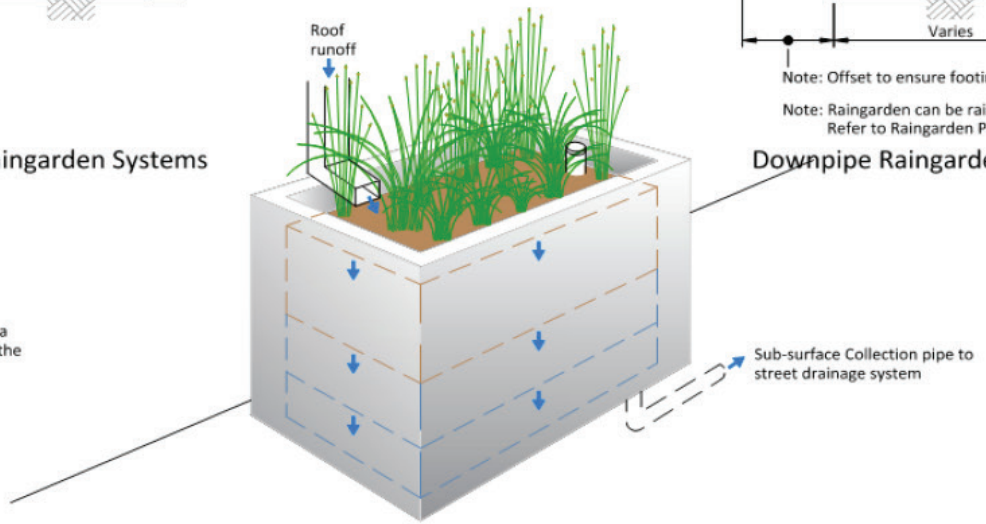


Note: Offset to ensure footings are not undermined

Note: Raingarden can be raised above ground level to create a planter box system. Refer to Raingarden Planter Box - Above Ground System

Downpipe Raingarden Components - Inground System

Note:
Add all the Storage Volumes held in a Raingarden for a development. The Total of this should correspond to the Total Storage Volume Requirement, SRS , for the development



Raingarden Planter Box - Above Ground System

4.6 Permeable Paving

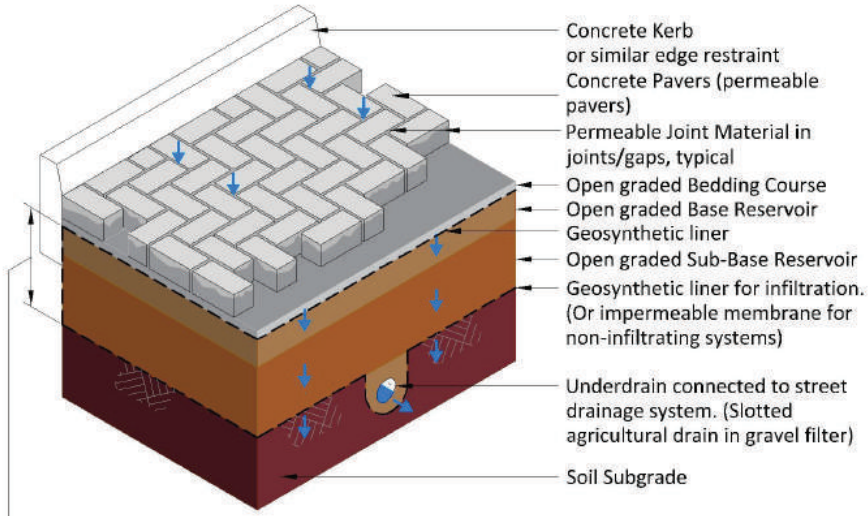
In urban developments, paved surfaces such as paths, driveways and courtyards cover a significant area. These 'impervious' surfaces do not allow rainfall to soak through them to the underlying soil and result in larger and rapid amounts of stormwater entering the street drainage system.

To counteract this additional flow, ideally it is best to reduce the amount of 'impervious' surfaces on our development. Otherwise, another way is to use permeable pavements instead of traditional concrete and brick pavements on driveways, car parks and large hardstands. Permeable pavements reduce the amount of runoff by allowing water to soak through the surface and into the underlying gravel or soil layers.

Permeable paving can be used to:

- Reduce the site impervious areas
- Reduce the stormwater that is discharged to the street drainage system
- Provide retention and detention storage on the site
- Delay and slow the rate of stormwater flow through the development to the discharge point
- Treat stormwater runoff (in particular ideal for car parks, driveways and large hardstand areas)

It is noted that the use of permeable pavements in the Adelaide region needs to be considered with caution with regards to allowing direct infiltration into clay soils. You are advised that in such cases where heavy clay soils exist, reactive soils and the potential for risk to structural footings etc may be present. In such cases, the use of an impermeable liner can be used to ensure seepage water is collected via sub surface drainage and directed to the street drainage system. For the purposes of these guidelines the use of permeable pavements with or without impermeable liners is considered to provide an approved stormwater treatment and retention measure.



Permeable Pavement - Typical Arrangement

Note:
The Stormwater Volume held in the Void Space of the open graded bedding layers in the pavement can be used to contribute towards the Secondary Retention Storage Requirement, SRS , for a development.
(This can be calculated by assuming a 20 % volume space within the pavement layers)

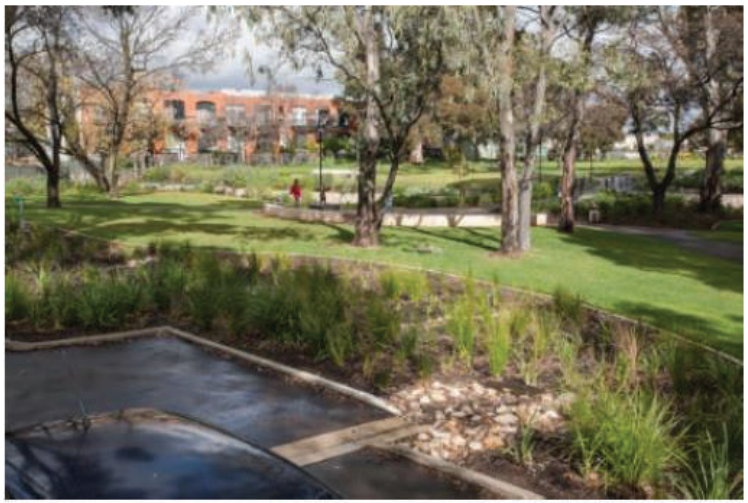
4.7 Vegetated Swale

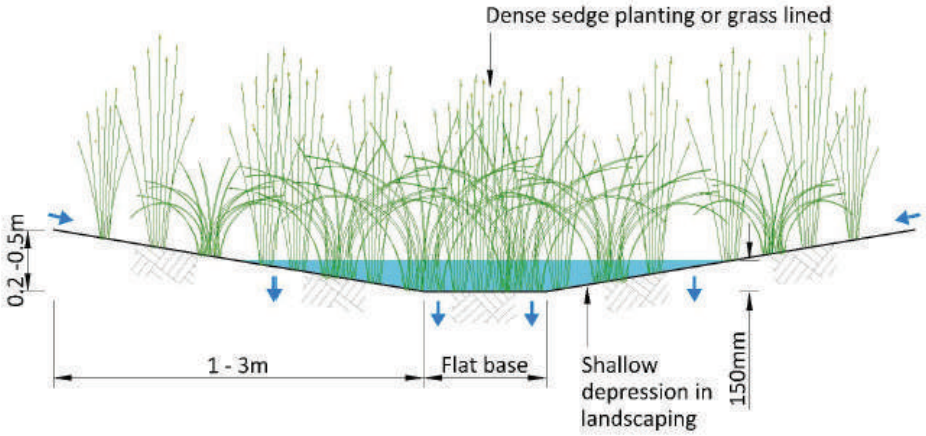
Vegetated swales can be used instead of pipes to convey stormwater. This approach can delay or slow the rate of outflow to the street drainage system.

Swales can be integrated with landscape features in car parks or landscaped areas to add to the aesthetics and greening of the development as well as reducing stormwater pollutants.

Pits draining to underground pipes can be used to convey the larger flows, in excess of the treatment design flow. It is recommended that the longitudinal slope of a swale should not exceed 0.8%.

Dense vegetation should be planted along swales to distribute flows evenly across the swales and slow velocities to prevent erosion, encourage infiltration and maximise the potential for greening.





Vegetated Swale - General Arrangement

Note:
The Stormwater Volume held in a Swale/Landscaped Depression can be used to contribute toward the Secondary Retention Storage Requirement, SRS , for a development.
(This can be calculated based on assuming 150mm pooling depth of water)

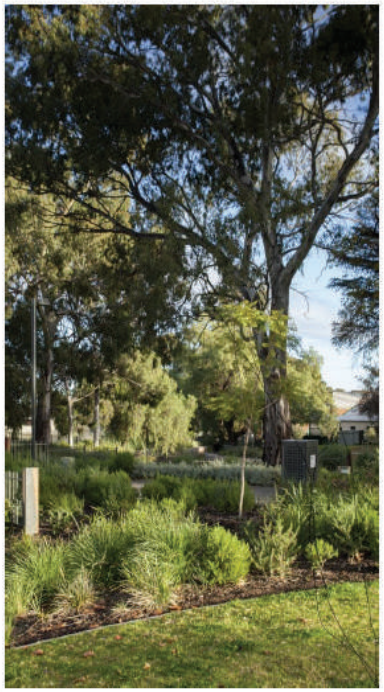
4.8 Buffer Strip / Landscaping

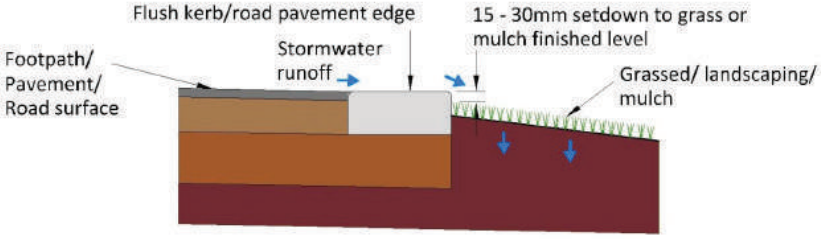
Buffer strips or landscaping aim to provide a disconnection between impervious surfaces and the drainage system. The key to their operation is to allow impervious surfaces such as paths, driveways and pavement surfaces to sheet flow over and evenly into a shallow, wide vegetated landscaped area. Buffer strips are a good and simple source control measure that promotes infiltration and reduces the flow rate off site from paved surfaces. A word of caution: Large paved areas that shed runoff into landscaped areas may need to be appropriately managed to prevent impact to structural footings and structures on the property and adjacent properties. Therefore, a drainage system of sub surface drains and or pits and pipes may be required to collect larger flows.

Buffer strips / landscaping should be set down from the pavement surface to allow for reasonable free flow into the buffer strip as well as to allow for:

- Sediment accumulation over time
- The height of the grass to be slightly set down from the pavement level.
- The finished mulch level to be slightly set down from the pavement level

Generally a 15 to 30mm set down from the paved surface to finished landscaping will be adequate for most cases.





Buffer strip/Landscape - General Arrrangement

Note:
This detail represents a practice note and therefore does not contribute towards RWH and SRS requirements for a development

5.1 Information Sources

For further information and guides for the design of WSUD, the following references can provide a good source of material.

CRC for Water Sensitive Cities 2015, Adoption Guidelines for Stormwater Biofiltration Systems – Summary Report, CRC for Water Sensitive Cities, Monash University, Clayton, Victoria

Department of Planning, Transport and Infrastructure, Development Plan – Unley City, Government of South Australia

Department of Water Environment and Natural Resources 2013, Water Sensitive Urban Design, FIS 92337, Government of South Australia

Engineers Australia 2006, Australian Runoff Quality – A Guide to Water Sensitive Urban Design, ISBN 0 85825 852 8

Environment Protection Authority, South Australia 2015, Rain Garden 500 Guide, www.epa.sa.gov.au/files/10793_raingarden_guide.pdf

University of South Australia 2004, Water Sensitive Urban Design: Basic Procedures for Source Control of Stormwater, ISBN 1 920927 18 2

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