**fact sheet three**

# Water Sensitive Urban Design (WSUD)

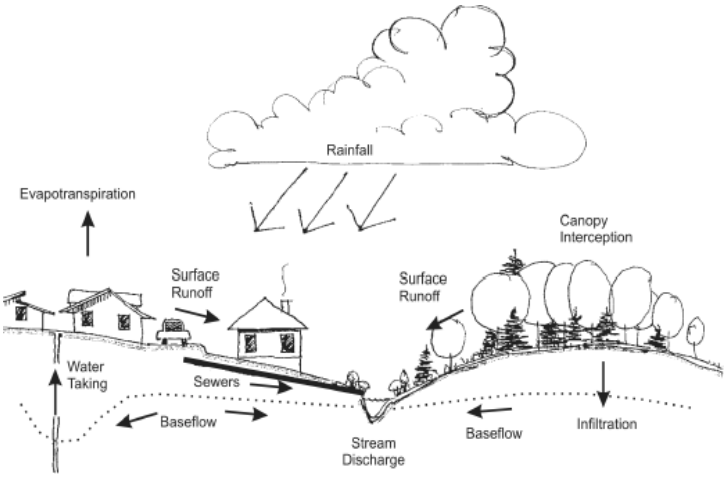
This is the third in a series of fact sheets produced by the District Council of Mount Barker on Sustainable Residential Subdivision Design. Council's Development Plan identifies a number of areas within and adjacent to existing townships that are intended for residential development. A number of policies within the Development Plan require that residential development, including residential subdivisions, satisfy a range of sustainability objectives and principles.

This is one of five fact sheets, which cover the following topics:

- Site Analysis
- Energy Efficiency
- ❑ **Water Sensitive Urban Design (WSUD)**
- Biodiversity, Open Space and Buffers
- Sustainable Transport

## What do we mean by Water Sensitive Urban Design (WSUD)?

Water Sensitive Urban Design (WSUD) is an holistic approach to the planning and design of urban development that aims to minimise negative impacts on the natural water cycle and protect the health of aquatic systems. It promotes the integration of stormwater, water supply and sewage management at the development stage.




The general objectives for WSUD are to:

- maintain the natural (i.e. pre-development) hydrologic regime
- maintain and, where possible, enhance the water quality of surface and ground water
- encourage water conservation, and
- maintain and enhance water-related environmental, recreational and cultural values and opportunities.

## Why do we need WSUD?

Urban development usually results in a more intensive use of land, an increased population and an increase in impervious area. These changes can:

- increase surface runoff
- increase pollutant loads and erosive forces on receiving watercourses
- place capacity pressure on downstream infrastructure
- adversely effect flood levels
- reduce soil moisture, water recharge and stream base flows
- increase sewage flows, and
- increase water demand.

WSUD represents a shift in the way urban development is conceived, planned, designed and built. Rather than using traditional approaches to impose a single form of urban development across all locations, WSUD considers ways in which urban infrastructure can be integrated within the natural features of a site. It also seeks to optimise the use of water as a resource.

WSUD can help counteract many of the potential adverse impacts of urban development on the natural water cycle. By incorporating water sensitive measures in the design and planning of land divisions it is possible to:

- reduce flood risk in urban areas
- prevent erosion of waterways, slopes and banks
- improve water quality in streams and groundwater
- make more efficient use of water resources
- reduce the cost of providing and maintaining water, stormwater and wastewater infrastructure
- protect and restore aquatic and riparian ecosystems and habitats, and

- protect the scenic, landscape and recreational values of streams and therefore improve amenity and the value of the development.

The key principles of WSUD are outlined in Table 1 at the end of this Fact Sheet, along with examples of how they can be applied in an urban development. Many opportunities exist for WSUD elements to address more than one principle. Maximising the multiple benefits created by innovative design is an essential aspect of good WSUD practice. The approach is able to add value while minimising development costs.

## How does WSUD differ from traditional approaches?

Traditional water supply, stormwater and wastewater practices have been largely based on centralised collection, conveyance and treatment of water flows. Whilst highly effective in some areas, these methods can also have major drawbacks, such as inefficient use of water resources, environmental degradation, flooding and rising infrastructure costs. Conveyance does not solve the problem but merely transfers it to the other end of the pipe and ultimately disturbs the local water balance.

## Steps in the land division process

A number of steps have been identified which should be followed when submitting a development application to Council for a land division development. Following these steps will assist in reducing the potential for delays in the approval process.

### *Consider relevant provisions of the Development Plan and Legislation*

The relevant provisions of the Development Plan need to be considered from the outset to ensure that Council requirements are met. Special consideration should be given to the Concept Plans for land division contained in the Development Plan. Relevant State and Federal Legislation must also be considered (see Table 1).

### *Review the physical properties of the site and identify specific constraints*

WSUD is applicable on all sites but the degree of application will vary according to the site opportunities and constraints. A site analysis will need to be conducted as detailed in **Fact Sheet One - Site Analysis**.

Included in this site analysis will be an identification of the potential impacts of the development on the existing environment.

### *Identify WSUD measures which are considered suitable for inclusion in the development (land division scale and allotment scale)*

This stage will involve matching the likely impacts with the most appropriate WSUD design elements to achieve a sustainable balance between development and the environment. Depending on local conditions, suitable measures may include swales, sand / gravel filters, landscaped filter strips and detention basins. These can be combined to form an integrated system, and an improved landscape.

For example, streets can be designed to incorporate a variety of stormwater detention and treatment measures. Street layout should respond to site topography (where possible), with streets aligned close to contours to eliminate the need for large-scale earth moving, whilst reducing stormwater velocities.

Recreational areas may also incorporate water features that have a multi-purpose of stormwater detention and treatment. However, it should be noted that areas that are intended to be used for the permanent retention of water within recreational areas cannot be considered as part of the required open space contribution (see Principle 20, 46e, and 166b of District Council of Mount Barker Development Plan).

It is important to be aware that WSUD cannot be considered on its own - the elements in the other four fact sheets of this series need to be taken into account and conflicts between the elements may arise. Therefore, a compromise between the elements may need to be made.

Some of the more common components of WSUD are summarised in Table 1 and described below.

### *Consult with Council*

Before going to the expense of designing a site layout, it is recommended that the findings of the previous steps of the process be discussed with the relevant officer of Council to ensure that the concept is progressing along the right path and that the requirements of the Development Plan can be met. Council will also be able to suggest whether consultation with any government agencies is appropriate or required (e.g. the Environment Protection Authority or the Natural Resources Management Board).

On-going maintenance issues with any potential WSUD elements will also need to be considered and discussed with Council at this stage of the process.

### *Develop an appropriate layout*

Based on the findings of the previous steps, an appropriate site layout will need to be prepared which takes into account WSUD elements as well as solar orientation, sustainable transport and biodiversity issues.

### *Analysis of pre-development and post-development flows (volume, quality and frequency) from the site*

Council require on-site detention to ensure runoff from the development does not exceed pre-development rates. This is not only to ensure flooding is not exacerbated downstream, but also to maintain natural water regimes for valuable wetlands and creeks. This may require additional on-site storage of stormwater as well as flood conveyance and the application of other water sensitive planning and management practices. However, if the applicant can demonstrate that the existing catchment has an adequate drainage system, detention may not be required or could be minimised. In order to establish this requirement, the applicant will need to provide a study prepared by a suitably qualified civil engineer which analyses the whole catchment and demonstrates that:

- the capacity of the existing drainage system is adequate for post-development runoff and allows for increased development of other sites within the catchment
- there is no increase in the incidence of flooding downstream, and
- there is no impact on downstream water quality or an increase in erosion.

*(Please note that the Council is currently establishing standards for stormwater management which will define the storm event requiring on-site detention.)*

Stormwater runoff from rare and intense storm events can pose serious risks to life and property. It is essential that the design of overland flow paths, on-site detention storage and other stormwater management measures meet relevant safety criteria for pedestrians, vehicles and property damage.

Detention and retention of water on the site may also be required to meet water quality targets that may be set by Council, the Environment Protection Authority or the Natural Resources Management Board.

### *Approvals process*

An application for land division must be lodged with the Development Assessment Commission. An application may be lodged in two stages by initially applying for Provisional Development Plan Consent only. A further application can then be made (within 12 months) for complete Development Approval. The application is forwarded to the local council and to any government agencies which may need to be consulted. The extent of the consultation depends on the location, nature and magnitude of the proposal.

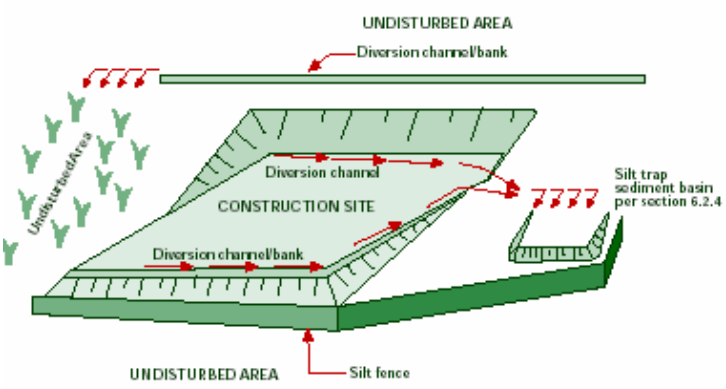
*See Guide for Applicants – Land Division Guide (http://www.planning.sa.gov.au/go/development-applications/assessment-processes-explained/guides-for-applicants)*

### *Detailed design*

Once the various elements have been identified and the development layout refined, detailed sizing of each element can proceed (either before or after Provisional Development Plan Consent has been obtained). It is possible that some further refinements and modifications to the elements or layout may be required.

### *Construction, operation and maintenance*

The construction, operation and maintenance phases must also be planned and undertaken in a manner sympathetic to the natural environment. The preparation (as part of the development application) and effective implementation of a Soil Erosion and Drainage Management Plan (SEDMP) is critical (and required by legislation) because it is during the construction phase that the environment is normally placed at greatest risk.




EXAMPLES OF SITE DEVELOPMENT MEASURES

It will also be important to ensure with Council that appropriate measures will be put in place for the ongoing operation and maintenance of WSUD elements incorporated on the development site.

### *Compliance*

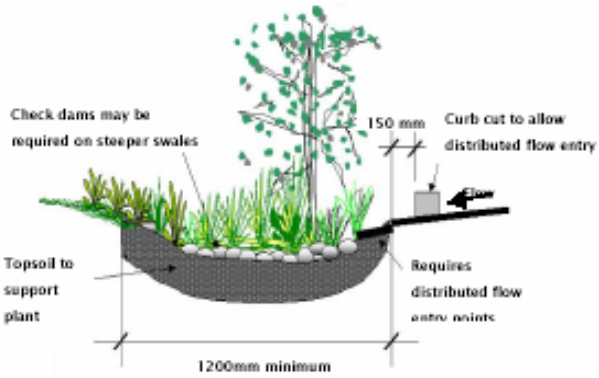
If Development Approval is granted, the development will be subject to conditions, which must be adhered to and are enforceable under the Development Act.

## WSUD Options

Alternative WSUD options, when used in conjunction with conventional practices, have many cost, aesthetic and environmental benefits. Some of these measures are detailed below.

### *Swales*

Swales are formed, vegetated depressions that are often used for the conveyance of stormwater runoff from impervious areas as an alternative to the use of a kerb and gutter along roadways. They can also be used to convey stormwater flows in recreational areas.




Typical section through a swale

Swales serve a number of functions including:

- removing sediments by filtration through the vegetated surface
- reducing runoff volumes (by promoting some infiltration to the sub-soils)
- reducing erosion, as the vegetation stabilises the soil, and
- delaying runoff peaks by reducing flow velocities.

The street crossfall can be designed to fall towards an adjacent swale on one side of the street or towards the median strip. A swale may convey minor stormwater flows, whilst the carriageway itself is designed to convey major stormwater flows, as it would with a conventional kerb, gutter and pipe system.

### *Channel Works*

Efforts should be made to retain the natural alignment of any existing watercourses through open space areas. Where it is necessary to increase channel capacity, similar alignment and natural shape should be maintained. Channels should be stabilised to avoid erosion, however, concreting of channels should be avoided. Stabilisation methods include

use of vegetation, geofabric materials and rocks.


*Urban streams should be protected within generous open space corridors*

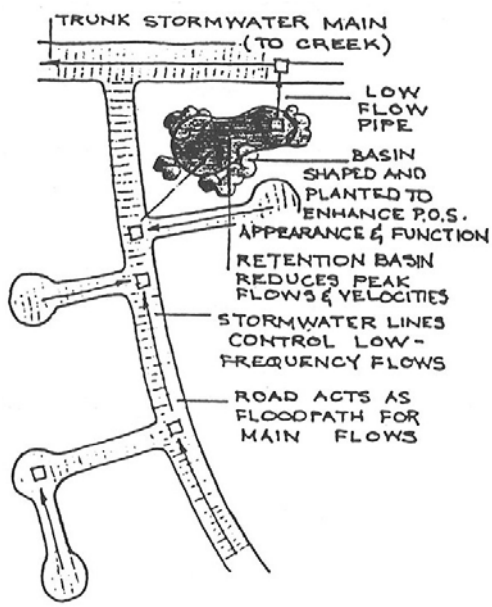
### *Sand / Gravel Filters*

Sand / gravel filters are a bed of sand or gravel overlying a subsoil drainage system. They can be used to remove oil and grit from stormwater runoff from roads or car parks. These devices protect groundwater and/or downstream surface water quality.

### *Detention Basins*

Detention basins can be used to reduce the effect of increased peak flow rates associated with catchment urbanisation. They can either have a permanent water storage component (i.e. a wet detention basin) or are completely dry during non-flood periods (i.e. a dry detention basin). Both types can serve multiple objectives in addition to their primary function of flood mitigation. Wet detention basins are commonly utilised to provide water pollution control, ecological and conservation functions as well as being public passive recreational amenities. Dry detention basins often serve as playing fields and recreation parks in addition to their flood mitigation function.

Particular consideration is required to surface and subsurface conditions within dry detention basins to ensure usability as soon as possible after rainfall and inundation. The standard of treatment will depend upon intended use.




Aspects to consider in the design of permanent water bodies include:

- quality of in-flowing waters and the standard of recreation and amenity which can be supported
- the need to incorporate gross pollutant traps or wetland filters
- the range of habitats to be provided
- the size and types of areas necessary to fulfil various water quality and flood mitigation functions (i.e. sediment basin, shallow pools, large enough to provide adequate detention time)
- bank treatments to satisfy safety requirements, provide access and minimise erosion
- requirements for boardwalks, jetties and crossings to maximise use, and

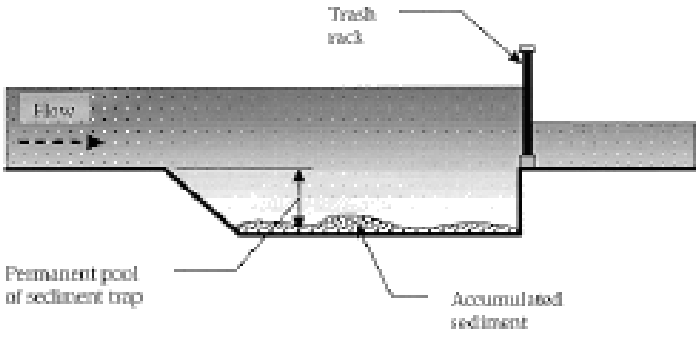
- possibility of incorporating Aquifer Storage and Recovery (ASR).

Detention basins must be designed by a qualified civil engineer.

### *Gross Pollutant Traps (GPTs) and Sediment Traps*

GPTs and sediment traps are utilised to reduce litter, debris and coarse sediments discharging to receiving waters or downstream treatment measures. The location of GPTs should be chosen to maximise the quantity of debris intercepted and should focus on protecting receiving waters but must be easily accessible for maintenance purposes. They can be installed in drain entrances, underground pipe systems, at pipe outfalls or on open channels.

GPTs come in many forms and there are numerous proprietary GPTs on the market which fulfil different requirements. Therefore, if it is determined that a GPT is required, it is important to select the appropriate product to meet the specific need of the particular development.




### *Landscape Measures*

A wide variety of landscape measures can be used to manage stormwater flows, utilise stormwater within the site and minimise supplementary watering of landscaping. The careful design and placement of landscape measures can have many benefits in the water cycle, including reduced peak stormwater discharges, increased groundwater recharge, reduced erosion and sedimentation, increased retention of soil moisture and lower watering costs. This is in addition to the likely water quality, aesthetic and ecological benefits. Examples of landscape measures include vegetated filter strips, contour banks, mulching and dense tree and shrub planting.

Street tree plantings should consider how leaf fall will affect stormwater drainage and aquatic ecosystems.

Indigenous vegetation within allotments, streets and open space should be retained.

### *Porous (or Permeable) Paving*

Porous paving is an alternative to conventional impermeable pavements with many stormwater management benefits. These surfaces allow water to percolate to a sub-base course, from where it infiltrates to the soil.

A number of porous paving products are commercially available including:

- pavements made from special asphalts that allow stormwater to percolate to a sub-base course from where it infiltrates to the soil
- concrete grid pavements that allow stormwater to filter through voids in the concrete, and
- plastic modular block pavements that allow stormwater to filter through voids in the plastic matrix.

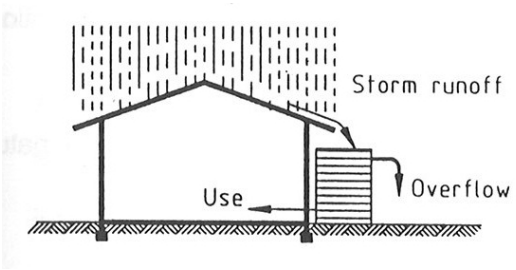
Benefits include reduced peak stormwater discharges, increased groundwater recharge, improved stormwater quality and multiple-use of paved areas.

Design and placement of porous paving needs to consider site conditions such as slope, soil conditions and traffic volumes.

Construction costs of porous paving is similar to that of traditional paving when savings in stormwater infrastructure are considered.

### *Rainwater Tank Collection / Use*

Rainwater collected from roofs and stored in tanks is an excellent source of high quality water. Tanks can be designed not only as a water source, but also to provide temporary stormwater detention. Benefits of rainwater tanks include reduced mains water demand, reduced water supply infrastructure costs, improved environmental flows downstream of water supply dams and reduced concentration of stormflows in urban streams.




New homes and household extensions of greater than 50m$^2$ are required to install a rainwater plumbed for internal use which must have a capacity of at least 1,000 kL. Studies have demonstrated that a 3,500 kL tank is able to supply water for indoor use 90% of the time in Mt Barker.

Households within townships in the District must also have 5,500 kL dedicated for firefighting (or 2,200 kL if households are located outside of the District).

*See Fact Sheet LG01 Rainwater Tank Use (www.samdbnrm.sa.gov.au/nrm/boards/samdb/projects/tankuse.html).*

### *Greywater Treatment / Reuse System*

The majority of water used for indoor domestic purposes is discharged after use as 'wastewater'. Wastewater is usually collected by a reticulated sewage system and treated at a conventional wastewater treatment plant. Alternatively it can be collected, treated and re-used on site. If on-site reuse of domestic wastewater is proposed there are various restrictions that need to be satisfied to ensure public health requirements and environmental concerns are met. Approval must be obtained from the Department of Health.

*See Draft Guidelines for Permanent Onsite Domestic Greywater Systems: Greywater Products and Installation (www.dh.sa.gov.au/pehs/branches/wastewater/greywater-pr-install-draft-nov06.pdf) for further information*

### *Maintenance*

Once established, multiple use of drainage systems requires regular monitoring and preventative maintenance to ensure the drainage and water quality system components maintain their effectiveness and aesthetic appeal. Regular maintenance is required to remove any blockages and debris, repair erosion and items damaged by floods and vandals, and to maintain vegetation and recreation surfaces and facilities.

The vast majority of potential problems associated with maintenance of WSUD elements can be eliminated by considering maintenance ramifications in the planning and design phase. It involves ensuring that good design and construction practices are adopted.

## What tools are available to help me implement WSUD?

A wide range of tools and resources are available to assist the implementation of WSUD. Useful Websites include:
www.wsud.org
www.dbce.csiro.au/urbanwater
www.catchment.crc.org.au
www.healthywaterways.org
www.arq.org.au
http://wsud.melbournewater.com.au
www.toolkit.net.au

A substantial project is currently being undertaken by Planning SA to provide guidance documents and similar web-based resources in South Australia. In the mean time, the use of the above web sites is recommended.

**Table 1: WSUD Principles and Legislative Requirements**

| WSUD Principle | Example of WSUD Approach | Example of Conventional Approach | Legislative Requirements |
|---|---|---|---|
| **Protect existing natural features and ecological processes** | Disturbance to soils and landscape minimised by maintaining natural landforms<br>Waterways protected by providing a buffer of natural vegetation to urban development<br>Natural channel design and landscaping used so that the drainage network mimics the natural ecosystem | Vegetation completely cleared and landscape and waterways reshaped with major earthworks<br>Natural waterways and drainage channels highly modified and lined with concrete<br>Natural waterways piped directly to downstream waterways | Native Vegetation Act 1991<br>Principle 21 DC Mt Barker DP<br>Objective 41 DC Mt Barker DP<br>Objective 49 DC Mt Barker DP<br>Objective 77 DC Mt Barker DP |
| **Maintain the natural hydrologic behaviour of catchments** | Limit the increase in stormwater runoff volume using natural drainage paths and infiltration basins | Piping and concrete lining of all waterways and drainage lines to connect stormwater runoff from hard surfaces direct to waterways | Principle 27 DC Mt Barker DP<br>Principle 46 DC Mt Barker DP<br>Objective 78 DC Mt Barker DP<br>Objective 79 DC Mt Barker DP<br>Principle 115 DC Mt Barker DP<br>Principle 204 DC Mt Barker DP<br>Principle 283 DC Mt Barker DP |
| **Protect water quality of surface and groundwaters** | Control sediment-laden runoff from disturbed areas during the construction phase of the development<br>All stormwater runoff from hard surfaces is treated through infiltration, sedimentation, storage or biological treatment before leaving the site | Minimal sediment and erosion control measures during construction<br>Stormwater directly discharged to waterways without treatment | Environment Protection Act 1993 and the Environment Protection (Water Quality) Policy 2003<br>Objective 78 DC Mt Barker DP<br>Principle 169 DC Mt Barker DP<br>Principle 202 DC Mt Barker DP<br>Principle 304 DC Mt Barker DP |
| **Minimise demand on the reticulated water supply system** | Rainwater tanks collect roof runoff to supply toilet, laundry and outdoor uses<br>Houses connected to (or utilise) a greywater or sewage recycling system to provide an alternative source of water for toilet flushing and outdoor use<br>Houses incorporate water efficient appliances<br>Low water use plants (preferably local provenance) used extensively in gardens | Total reliance on reticulated supply for all internal and external uses<br>Inefficient water appliances<br>Large lawn areas and exotic plants in gardens | Objective 83 DC Mt Barker DP<br>Objective 85 DC Mt Barker DP<br>Objective 87 DC Mt Barker DP<br>Principle 204 DC Mt Barker DP<br>Building Code of Australia (SA Provisions) |

| WSUD Principle | Example of WSUD Approach | Example of Conventional Approach | Legislative Requirements |
|---|---|---|---|
| **Minimise sewage discharges to the natural environment** | Fit for purpose reuse is incorporated on-site through recycling bathroom and laundry water<br>Contribution to council wastewater treatment and re-use scheme | No consideration given to water reuse and recycling of sewage | Objective 84 DC Mt Barker DP |
| **Integrate water into the landscape to enhance visual, social, cultural and ecological values** | Minimise the use of hard engineered structures<br>Native vegetation is used in stormwater management and all landscaping to maximise habitat values | All sewage treated at the sewage treatment plant and discharged to waterways<br>Water is 'hidden' in underground drainage and pipe systems | Objective 49 DC Mt Barker DP<br>Principle 79 DC Mt Barker DP<br>Principle 116 DC Mt Barker DP<br>Principle 151 DC Mt Barker DP<br>Principle 283 DC Mt Barker DP |
| **Add value while minimising development costs** | Reduces capital cost (pipework and drains)<br>Community demand for environmentally sustainable development | Developer pays contribution for downstream drainage capacities | Objective 15 DC Mt Barker DP |

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