APPENDIX B: WATER SENSITIVE URBAN DESIGN

B.1 INTRODUCTION TO WSUD

One of the major ways to improve the water quality in urbanised areas is to ensure new developments as well as infill and redevelopments reduce pollutant loads (both nutrients and erosive flows) by implementing Water Sensitive Urban Design (WSUD). WSUD devices should be designed for normal flood conditions and will have little or no impact on large floods. They will however, if designed appropriately, have an impact on reducing smaller and more frequent storm events including those that are likely to contribute to erosion in natural streams. The term WSUD refers to many different possible actions (new devices, management interventions and practices and are under constant development). In this plan, six main types of WSUD devices are considered in more detail:

- bioretention systems/raingardens,
- gross pollutant traps,
- vegetated swales,
- rainwater tanks,
- buffers, and
- riparian revegetation.

Benefits of WSUD

While WSUD aims to minimise the impact of urbanisation on the water cycle, it delivers a range of other benefits:

- Introducing vegetated water treatment systems into the landscape can influence micro-climates and reduce the urban heat island effect,
- Vegetated treatment systems provide green infrastructure and green links to improve the look, function and recreational value of our cities,
- Road upgrades and/or traffic calming which include WSUD features can reduce stormwater loadings,
- Stormwater and wastewater reuse for council infrastructure such as sports ovals provide insurance against water scarcity and water restrictions,
- Reduced need for rehabilitation and maintenance of waterways.

A set of standard detail drawings for specific WSUD elements has been developed by other Councils and WSUD practitioners across Australia and these are added to concept designs to complete the work. It is recommended a set of standard drawings ether be adopted or developed (possibly through the current Ryde WSUD strategy) for the Lane Cove Estuary Councils.

Bioretention Systems/Raingardens

Bioretention is a site-based system for using the physical, chemical and biological properties of plants, soil and microbes to filter stormwater. Bioretention systems can typically be used close to the source of urban runoff. Rainfall-runoff is captured and filtered through a planted out soil medium before being conveyed to a waterway, stormwater system or storage device for reuse. Water begins to pond on the surface once the capacity of the soil medium is reached and they can be designed to detain runoff from smaller events. The water is only allowed to pond for short periods and small

depths. The bioretention system contains vegetation that takes up nutrients and traps sediments. These systems operate in a similar way to an ephemeral wetland.

Bioretention systems have been further developed to incorporate a submerged or wet zone in their base. Typically some stormwater is trapped in a zone that is up to 45cm deep and made up of gravel or sand in the presence of a small amount of carbon (5% by volume). Because this zone becomes anaerobic it promotes denitrification. This significantly improves the nitrogen removal of the bioretention system. The process also improves copper and zinc removal rates (can meet ANZECC targets), and improves plant survival during long dry periods. Several of these systems have already been constructed in Sydney and South East Queensland.

Site Selection

The following criteria can be used as a first pass to determine where raingardens can be implemented:

- Catchment area: Catchment areas greater than 500m^2 require detailed analysis of storm flow levels and detailed consideration of the inlet and overflow structures.
- Raingarden size: Spaces less than 50m^2 may not be able to collect sufficient water to supply the plants without flooding.
- Road slope: Not greater than 5^o. Too much slope could cause significant erosion issues within the garden beds both at the inlets and along the length of the vegetated area. However, in some cases, cascading structures can be used to reduce the slope of the filter area.
- Traffic and pedestrian interference. Footpaths need to be at least 1.2m and raingardens, greater than 1.5m wide. High traffic zones and dense parking on the adjacent streets also will impact on the raingarden and should be reconsidered.
- Stormwater infrastructure: The presence of downstream stormwater pits allows raingardens to be drained into them, rather than back onto the street or infiltrated into the soil. Systems connected to stormwater pits can be lined to reduce the spread of surface runoff water into the groundwater.
- Soil type: Around the Lane Cove catchment, most of the geology is Sydney sandstone, with some clay on the ridges. Care must be taken on rocky substrates that water filtering through the raingardens cannot find its way along rock ledges and discharge onto private property or otherwise disturb infrastructure.

  On clay soils, adequate subsurface draining and a connection to the stormwater system must be provided. Lining the raingardens with impermeable or near impermeable materials such as concrete render or geofabric will reduce the risk and contain the treatment area.

  However, in locations with highly permeable (i.e. sandy) soils, and no risk of impact on nearby structures, the water from the raingardens can be allowed to filter directly into the ground water.

If the site complies with most of these criteria, a detailed concept design should be all that is required for smaller systems. Detailed engineering plans of the WSUD civil works will most likely be prepared

by a civil engineer and detail the road ways, kerb and pit concreting specifications and pipe designs. The overall WSUD construction plan should be additional to these plans, and should include inlet and outlet levels, the filter area surface material and shaping, lining of the base, a cross section of the filter media and drainage layers and a list of recommended plants.

Distributed WSUD elements around the catchment, totally approximate 1% of the catchment area, can be a very effective mechanism for intercepting and filtering stormwater pollutants. A plan showing potential areas can then be progressively implemented as opportunities arise. These could be road works, traffic calming devices, footpath works or larger developments, where open space or street realignment is occurring.

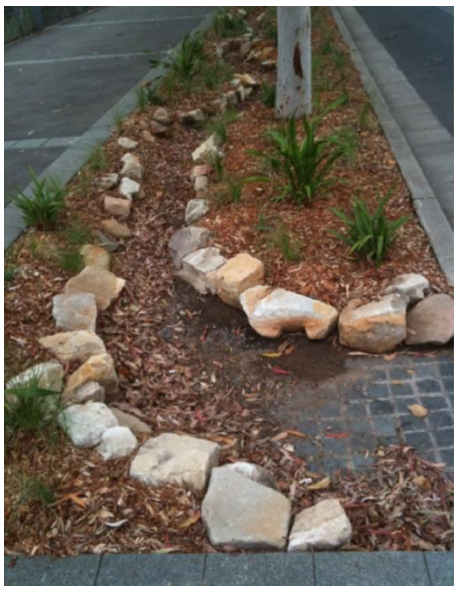

Figure B-1: Example Raingarden in Sydney

Vegetated/Grassed Swales

Vegetated/grassed swales are constructed open channel drainage ways, vegetated with native or exotic grasses, trees and shrubs and are used to treat and convey stormwater runoff. Filtered stormwater is generally collected in slotted pipes at the base of the swale where it can be conveyed to a drainage system or waterway or even a storage device for reuse. Water is not allowed to pond for any significant period of time. Vegetated swales generally have gentle side slopes and can be roughly trapezoidal or parabolic in shape.

Figure B-2: Examples of Grassed and Vegetated Swales

Gross Pollutant Traps (GPT)

A gross pollutant trap is a device designed to trap litter, coarse sediments and organic matter from runoff entering the stormwater system. They are generally thought to be inefficient at trapping nutrients and may impact on water quality by creating anaerobic zones if not regularly maintained.

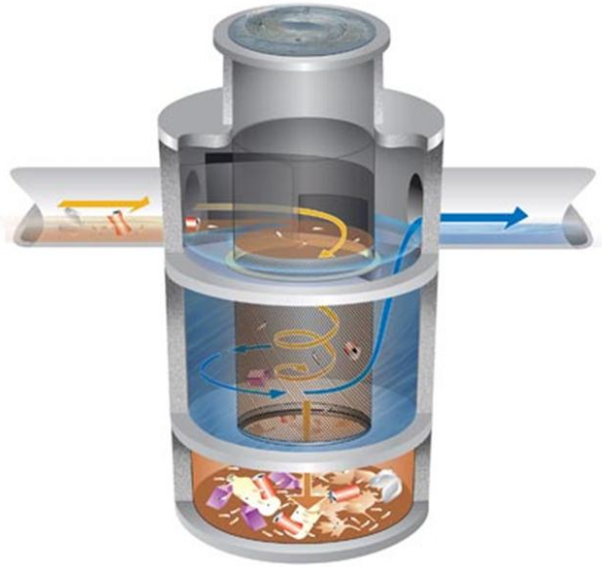

Figure B-3: Gross Pollutant Trap Schematic[9]

Rainwater tanks

A rainwater tank is a water storage system designed to be installed on individual houses or businesses to catch rainfall falling on a roof surface. These tanks can provide water for non-potable domestic use, such as for flushing toilets, watering gardens, washing clothes and in hot water systems, or for irrigation of parks, supplying Council water trucks and cleaning of Council property and vehicles. These systems reduce the amount of water running off impervious areas and entering the stormwater system.

[9] *Source: Leichhardt Council*
http://www.leichhardt.nsw.gov.au/Cleaner-Water-for-Iron-Cove.html

Figure B-4: Example Rainwater Tank[10]

Buffer Strips

A buffer strip is a relatively narrow area of land adjacent to a road or river, which is vegetated. This is intended to filter surface runoff before it reaches the stormwater system or stream.

Other WSUD Devices

There are other WSUD devices such as sediment basins, sand filters and permeable paving that can also be used in urban developments. If they are designed and maintained correctly they will each have a positive impact on water quality.

B.2 EXISTING WSUD MEASURES IN THE CATCHMENT AREA

Hunters Hill Council

Hunter's Hill Council is moving towards creating an urban landscape that mimics the natural environment more closely. This is happening slowly, with features such as infiltration trenches, grassed swales, wetlands, riparian strips and detention ponds becoming part of the landscape.

Hunters Hill has developed a 'Sustainable Water – Development Control Plan 25 (DCP 25)' which requires any new buildings or home additions greater than 40 metres square in area, to adopt 'Water Sensitive Urban Design' principles. These are included in a publication available from council for builders/developers/home-owners and advise of the technical design practices they must use to fulfil the requirements of the DCP. This DCP was drafted and is compatible with the BASIX assessment tool.

[10] *Source: Rainwater Tanks Direct Online website*
http://www.rainwatertanksdirect.com.au/water-tanks/small-tanks.php

Lane Cove Council

There are GPTs installed around the main shopping area on Longueville Road and in other GPTs in strategic locations. A raingarden at Tambourine Bay Road uses vegetation and biofiltration soils to treat the stormwater runoff from the roadway so that fewer pollutants enter the creek, bay and river. The raingardens are planted out with local indigenous plants. A stormwater harvesting system, shown in Figure B-5, has been installed at Blackman Park to supply the park and the Council depot.

Figure B-5: Existing Stormwater Tank at Blackman Park

Lane Cove Council bushland management involves armouring the drainage lines below storm water outlets in bushland areas. There have been several projects within the creek lines of the reserves to armour creek banks and repair eroded sections.

Ryde Council

Ryde Council is updating its WSUD policy and standards and is facilitating on-ground initiatives throughout the local government area. A bio-retention system at Santa Rosa Park on Shrimptons Creek is shown in Figure B-6 and the provision of a stormwater quality improvement device and constructed wetlands on Buffalo Creek (Figure B-7) are examples of projects undertaken by Ryde Council to better manage the local stormwater catchment. There are also stormwater harvesting initiatives completed near the commercial centres in Buffalo Creek catchment.

WSUD in Ryde DCP

The pollution control targets mentioned in the DCP are:

- 90% reduction in the post development mean annual load of total gross pollutant loads (greater than 5 mm).
- 85% reduction in the post development mean annual load of Total Suspended Solids (TSS).
- 60% reduction in the post development mean annual load of Total Phosphorus (TP).
- 45% reduction in the post development mean annual load of Total Nitrogen (TN).

As discussed previously, setting these targets gives anyone planning development in the catchment an indication of the requirements for stormwater treatment measures which can be tested using the MUSIC program. SMCMA are also developing Sydney Harbour wide targets but the Ryde numbers are appropriate.

Figure B-6: Existing Bio-Retention System at Santa Rosa Park (Shrimptons Creek)

Figure B-7: Existing Wetland on Buffalo Creek

Willoughby Council

Willoughby Council has had a long term program of armouring the outlets of stormwater pipes discharging into bushland with rock lined channels. This reduces erosion and the creation of

sediment from these high flow locations. The bush regeneration team also maintains the creek banks by progressively replacing weeds with native vegetation and armouring eroding sections as necessary. There have also been GPTs installed across the Council but none to date in the Lane Cove catchment.

B.3 FURTHER WSUD OPPORTUNITIES

Some key aspects of each Council which enable the implementation of WSUD were identified during site visits in June-July 2012. It is again recommended to consider WSUD in all on ground works conducted by Council using the site criteria listed above and to observe the progress of the Ryde Council's WSUD Strategy.

Hunters Hill Council

In some of the steeper streets draining towards the River, wide road reserves with unlined kerbs allow for the easy retrofitting of swales. There are also pollutant hot spots around shopping areas which would be ideal for GPTs or small raingardens.

Figure B-8: Mount St, Hunters Hill has the potential to include a swale

There is considerable development occurring on the western side of Burns Bay Rd and the DCP needs to be stringently applied to these development and to other future works to ensure erosion and sediment, as well as peak flows of stormwater flowing into the rivers are reduced.

Lane Cove Council

The residential areas in Lane Cove Council have wide nature strips next to the footpaths which are suitable for incorporating raingardens. Some sites are shown in Figure B-9.

Figure B-9: Wide Nature Strips in Lane Cove Council

Ryde Council

Ryde should continue developing the WSUD DCP and strategy. There are opportunities with the catchments for further raingarden and biofiltration systems as Ryde also has wide nature strips and reserves along the main drainage lines.

Willoughby Council

Future development in Blue Gum Creek and along the Pacific Highway should be strictly controlled for sediment and erosion management.