

A photograph of a savanna landscape. In the foreground, there is a dense patch of tall, dry, yellowish-brown grass. Several trees are scattered throughout the scene. A large, dark-trunked tree stands prominently in the center-right, with its branches reaching upwards. Other smaller trees with green foliage are visible in the background and to the left. The sky is a clear, bright blue with a few wispy white clouds. The overall scene depicts a natural, open environment.

WSUD Strategy for Darwin

Outline of the Day

- 9:30 Introduction to WSUD
- **11am Morning Tea**
- 11:15 am
 - Implementing WSUD in the wet-dry tropics
 - Overview of the Darwin Harbour WSUD Strategy
- **12:45 Lunch**
- 1:30 Integrating WSUD into the Development
- **2:40 Afternoon Tea**
- 3:00 Case Study: Bellamack
- 4:00 Finish

Water Sensitive Urban Design

- What are some of the key water issues in Darwin?

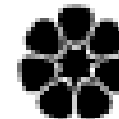
WSUD Strategy

- Joint project between
 - DPI
 - NRETAS
 - Australian Government CCI
- Provision of
 - Policy
 - Tools
 - Resources
 - Training



Australian Government

Department of the Environment, Water, Heritage and the Arts

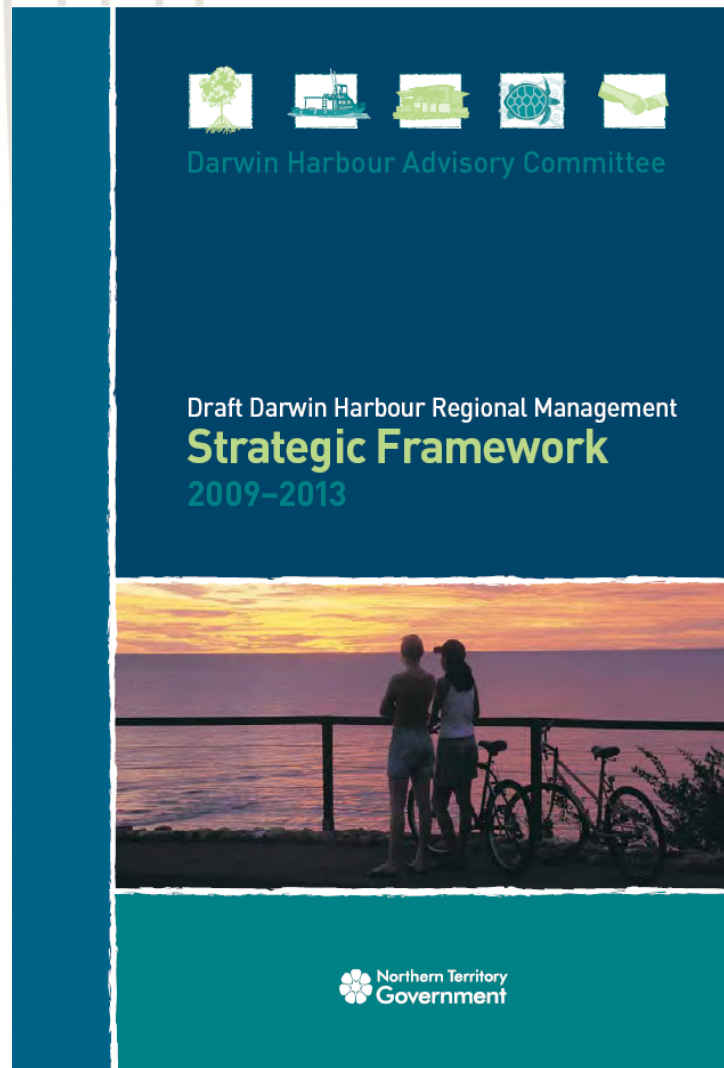


**Northern
Territory
Government**



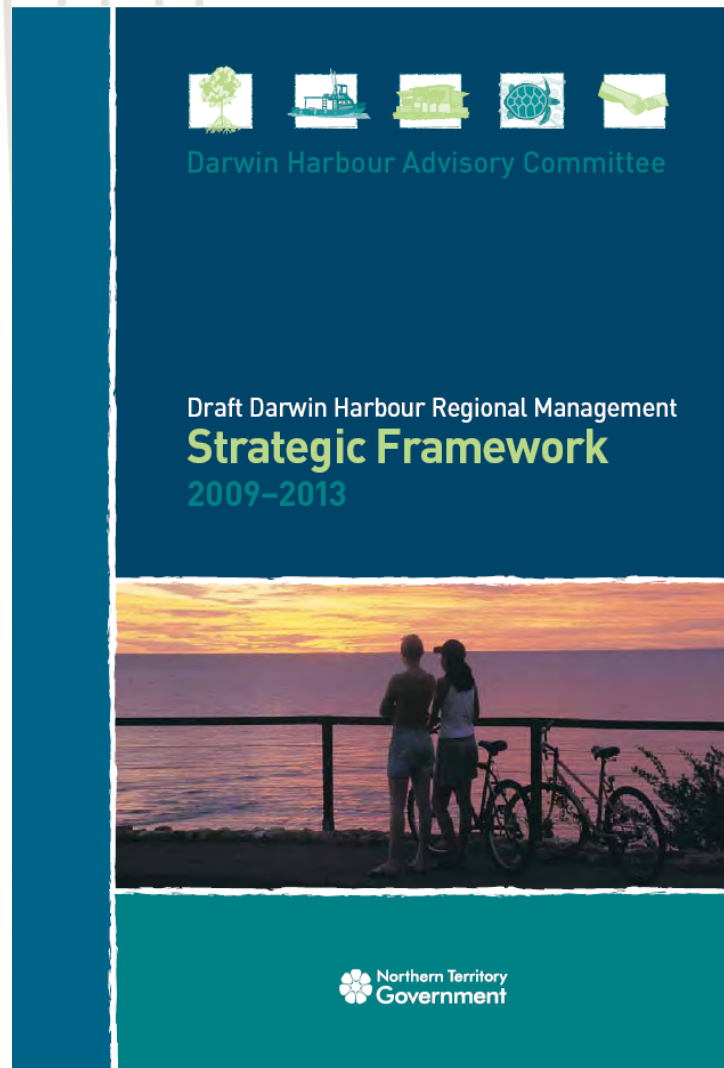
Darwin Harbour Advisory Committee

Darwin Harbour Strategy



- Determining **community values** for Darwin Harbour.
- Identifying **Beneficial Uses**.
- Water quality objectives.
- **Decision support tools** to protect Darwin Harbour.
- The Darwin Harbour **WSUD Strategy**.

Darwin Harbour Strategy



Goal 1: To maintain a healthy environment



Goal 2: To support recreational use and enjoyment of the environment



Goal 3: To ensure that development is implemented in an ecologically sustainable manner



Goal 4: To protect cultural values and heritage



Goal 5: To foster community awareness, industry partnerships and stewardship of the Darwin Harbour region

Goal 3: Development

4. For all development, it is the **responsibility of the developer to demonstrate the environmental sustainability of the development and its minimal impact.**
5. Development should **minimise use of water**, energy, and materials both embodied in infrastructure and during its operation.
10. Future **urban development** should be designed and constructed according to **sustainability principles.**
- 17. Residential, Commercial and Industrial developments should incorporate WSUD.**
19. Any development with the potential to pollute Darwin Harbour should **implement best practice management and pollution control technology to ensure waterways and the Harbour are protected from pollution.**

Darwin Harbour WSUD Strategy

Background Research

- Interviews and Desktop Research
- Implementation and Technical Issues

WSUD Policy and Targets

WSUD Technical Guidelines and Tools

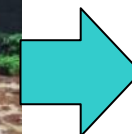
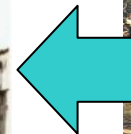
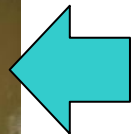
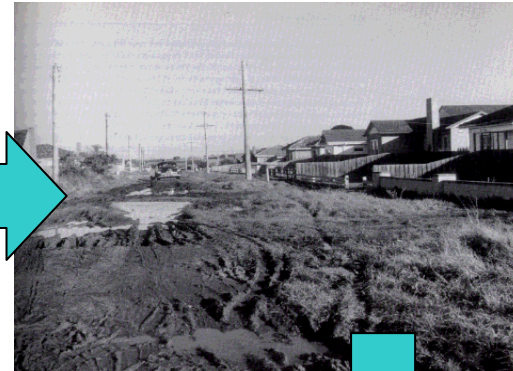
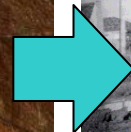
Practical Implementation - Bellamack

Water Sensitive Urban Design

- Evolving approach to development
- Holistic approach to planning and design
- WSUD aims to
 - minimise impacts on the natural water cycle
 - protect the health of aquatic ecosystems



Evolution in urban water management



Traditional urban water management

- 1950s to 1990s
- Designed to reduce flooding
- Get rid of water as fast as possible
- Whatever waste is produced is washed down the drain
- Significant downstream impacts on fragile environments



End-of-pipe treatment

- 1980s to 1990s
- Downstream, regional wetlands to reduce pollutant loads to lakes and bays
- Land uptake meant opportunities decreased rapidly over time
- Location in catchment meant upstream waterways were unprotected



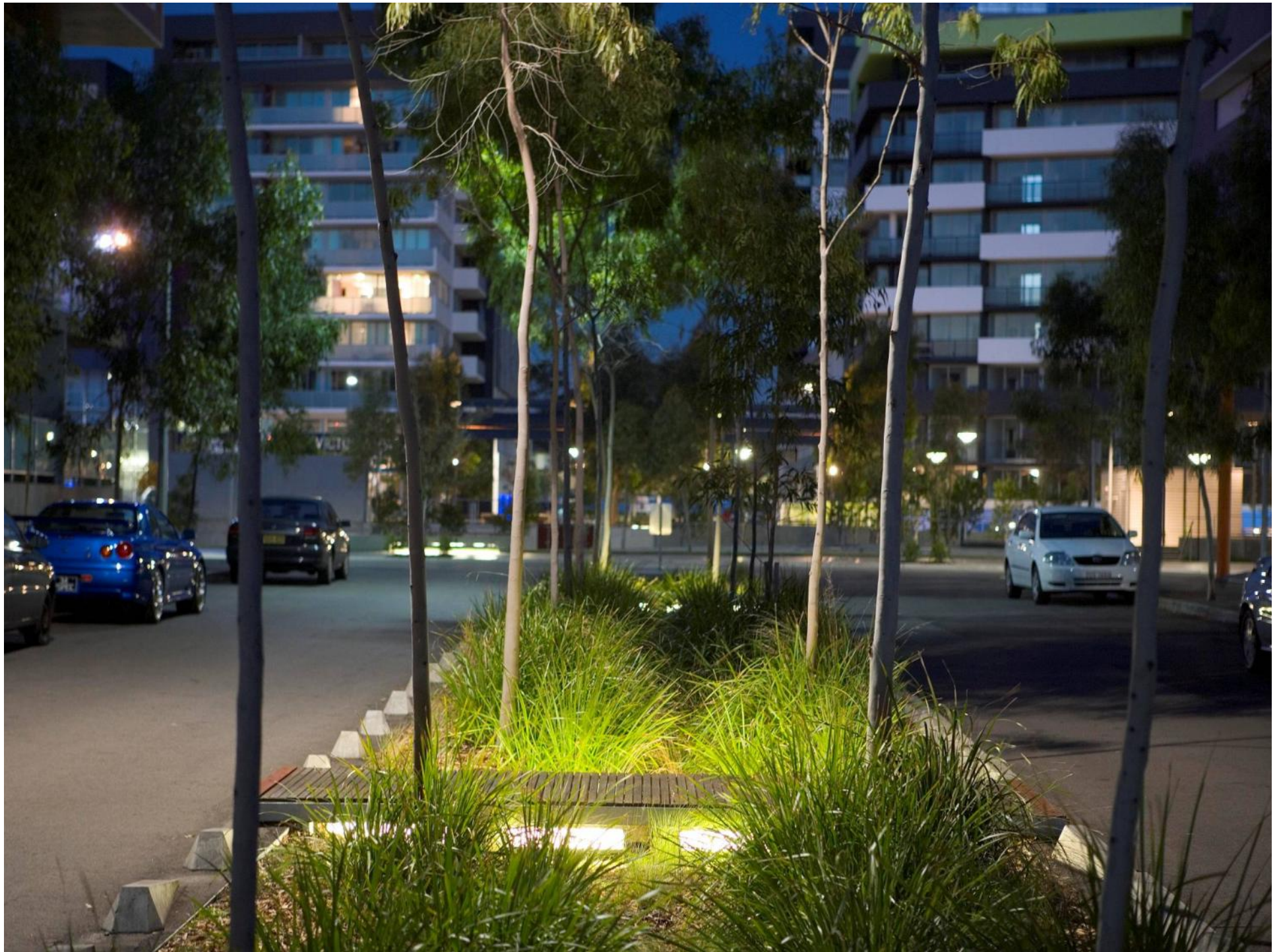
Water Sensitive Urban Design

- WSUD has evolved from its early association with stormwater management to provide a broader framework for sustainable urban water management.
- “WATER SENSITIVE”
 - Sustainable solutions for managing water resources
 - Protecting aquatic ecosystems
- “URBAN DESIGN”
 - Integrating into the urban design
 - Enhancing the landscape/recreation/habitat
 - Creating an “Urban Ecology”











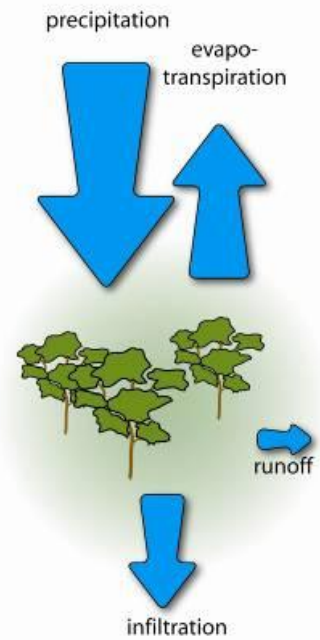


WSUD in Darwin

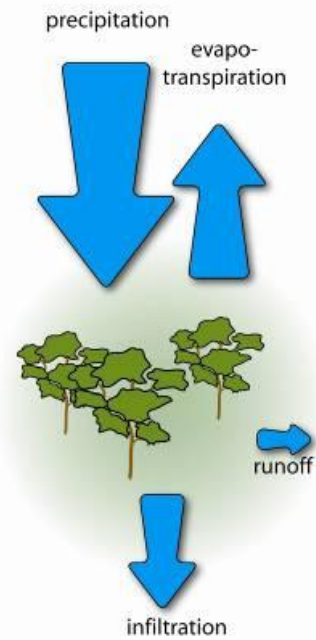
- Protection of aquatic ecosystems and Darwin Harbour
- Water resource conservation
- Significant pressures from urbanisation
 - 3700 new lots at Palmerston and Northern Suburbs
- Required in new release areas of Palmerston



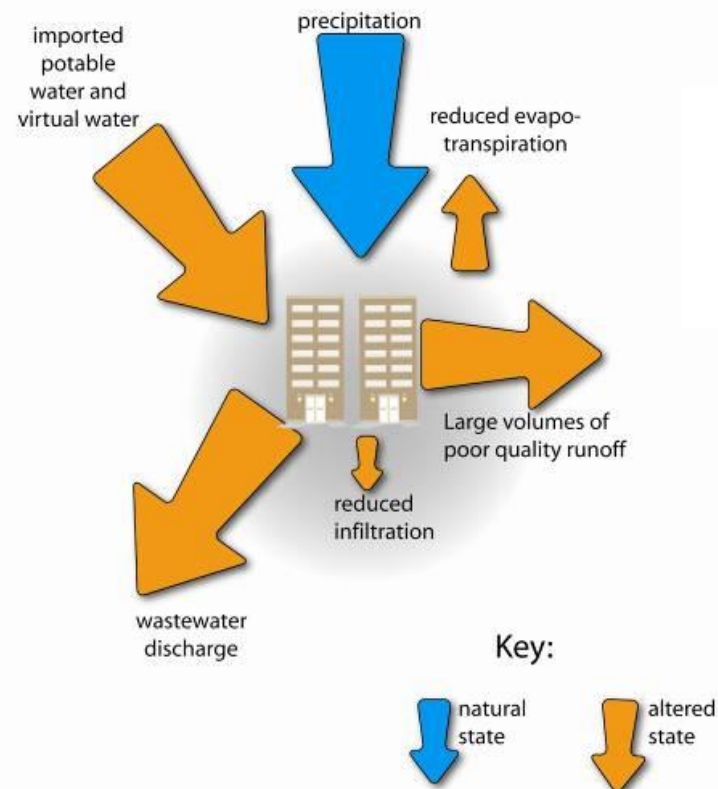
natural water balance



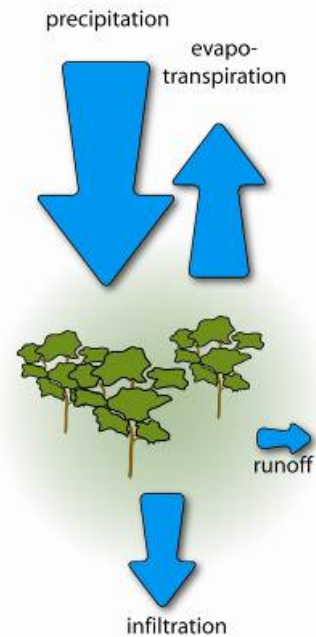
natural water balance



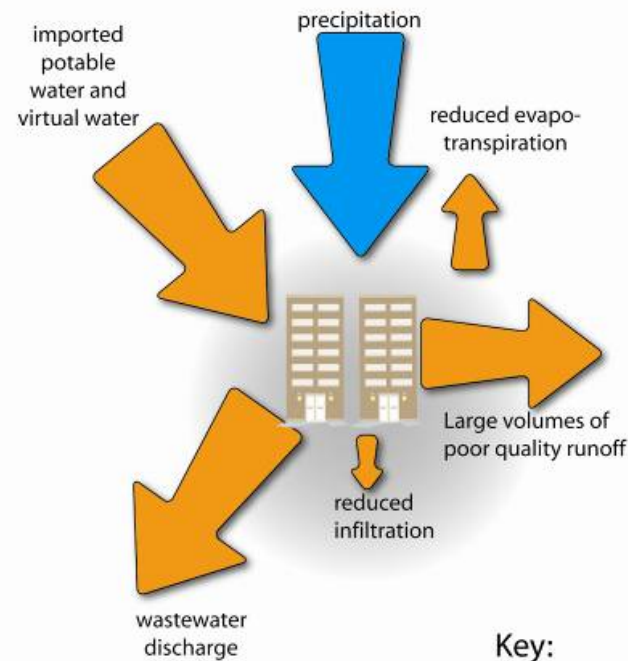
Urban water balance



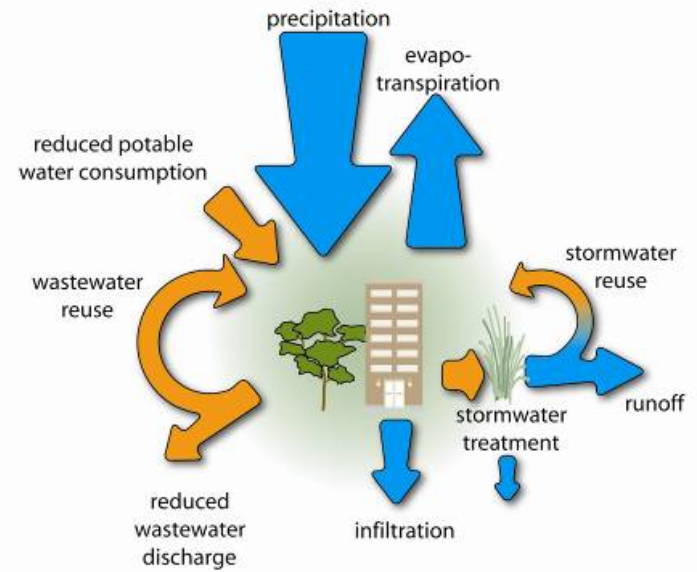
natural water balance



Urban water balance



WSUD water balance

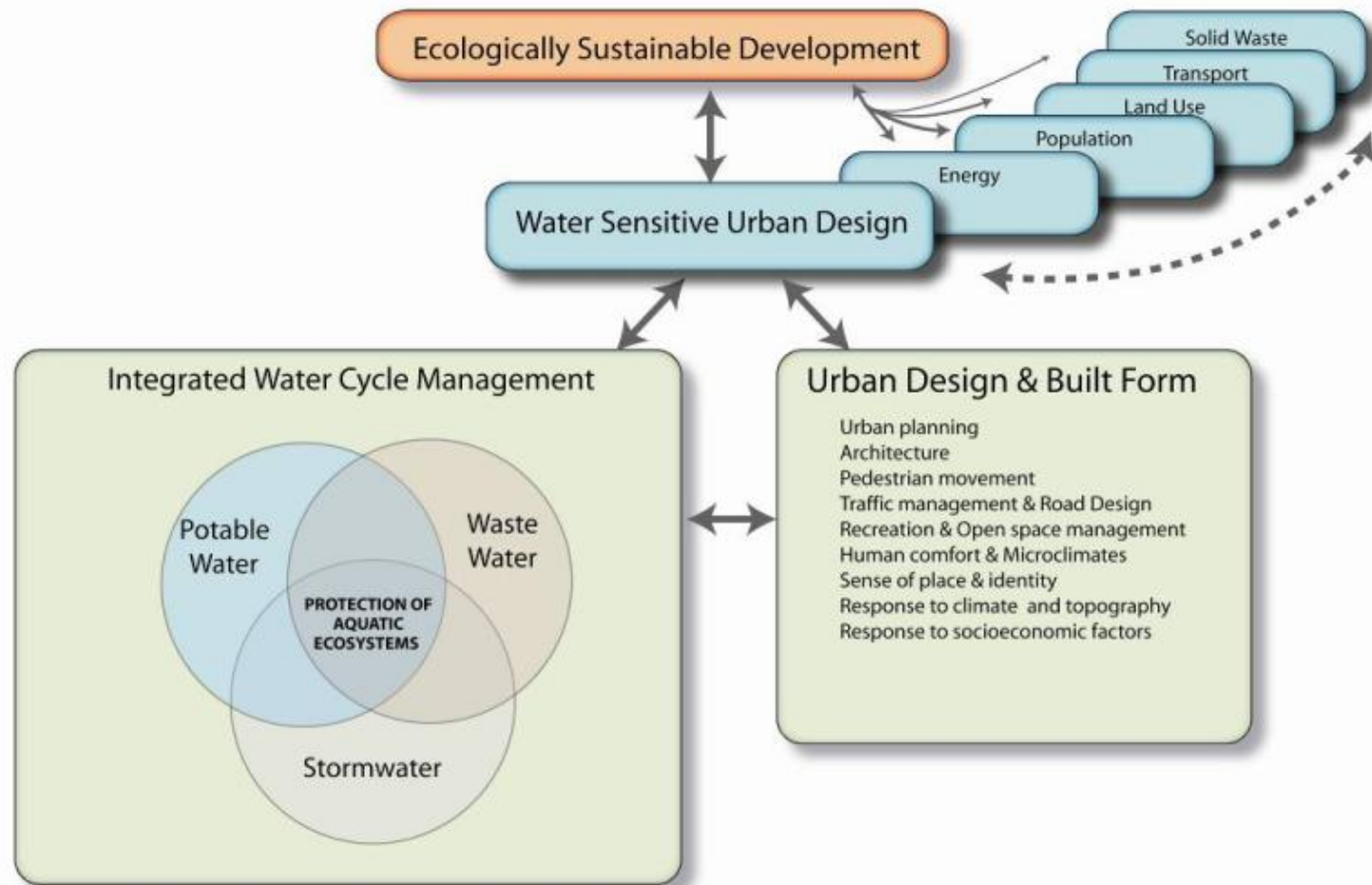


Key:

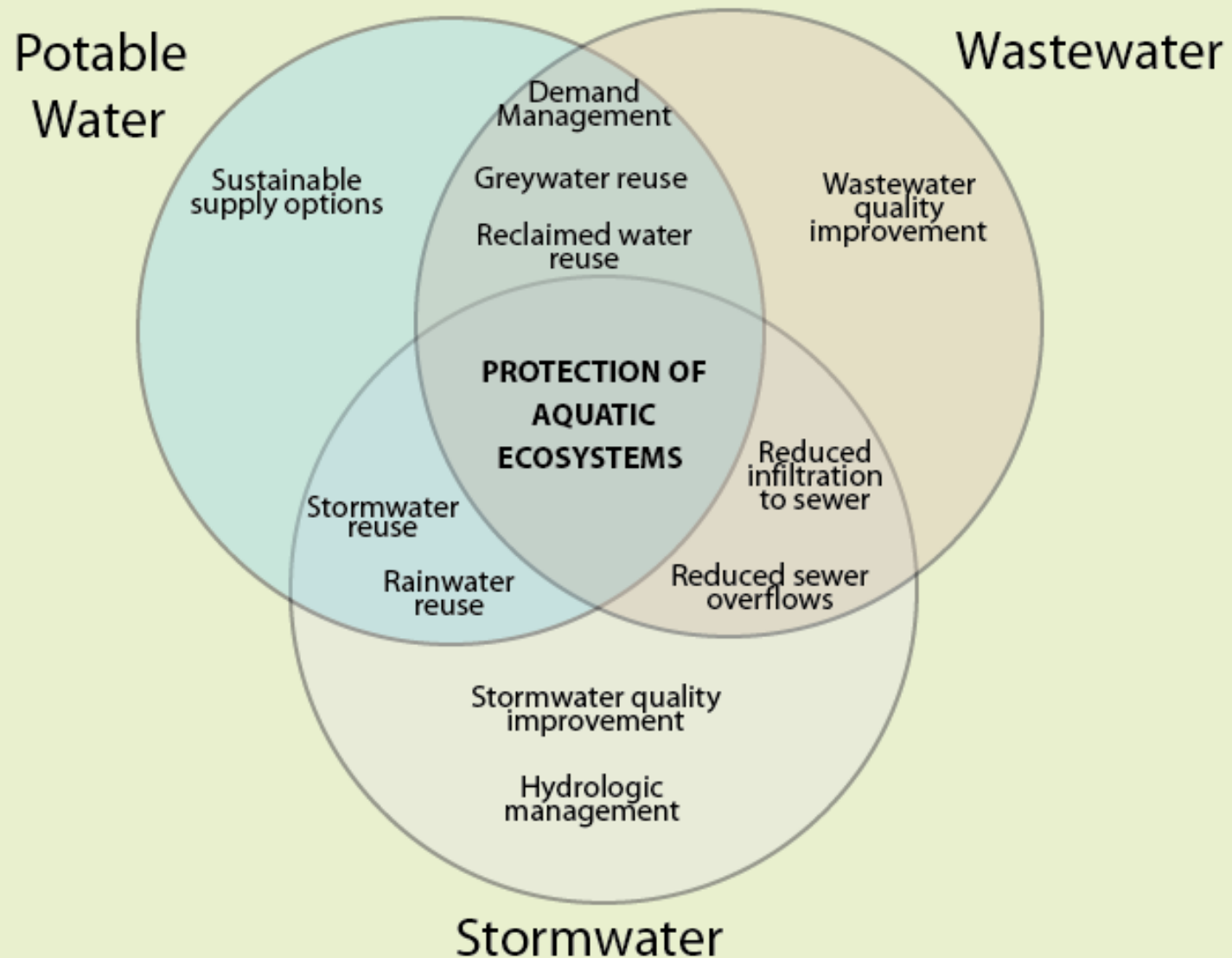


Hoban & Wong, 2006

Water Sensitive Urban Design



Integrated Water Cycle Management



Principles of WSUD

- Protection and enhancement of natural water systems
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to receiving waters.
- Matching the natural water runoff regime as closely as possible
- Reducing potable water demand
- Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent reuse opportunities
- Integrating stormwater management into the urban landscape



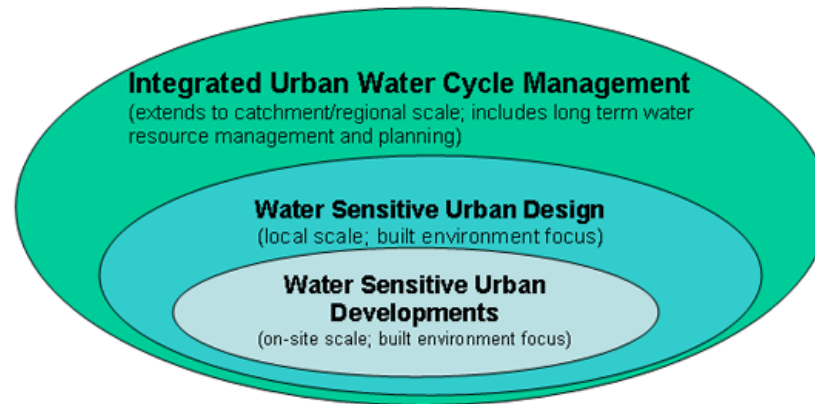
Darwin WSUD objectives

WSUD Objective	Performance Measure/Target
Potable Water Conservation	A 20% water conservation target is considered technically feasible and is suggested as an interim target
Stormwater Quality	<p>Stormwater discharged from development areas to be treated in accordance with best practice:</p> <ul style="list-style-type: none">• 80% reduction in the mean annual load of Total Suspended Solids (TSS)• 60% reduction in the mean annual load of Total Phosphorus (TP)• 45% reduction in the mean annual load of Total Nitrogen (TN)• 90% reduction in the mean annual load of Gross Pollutants

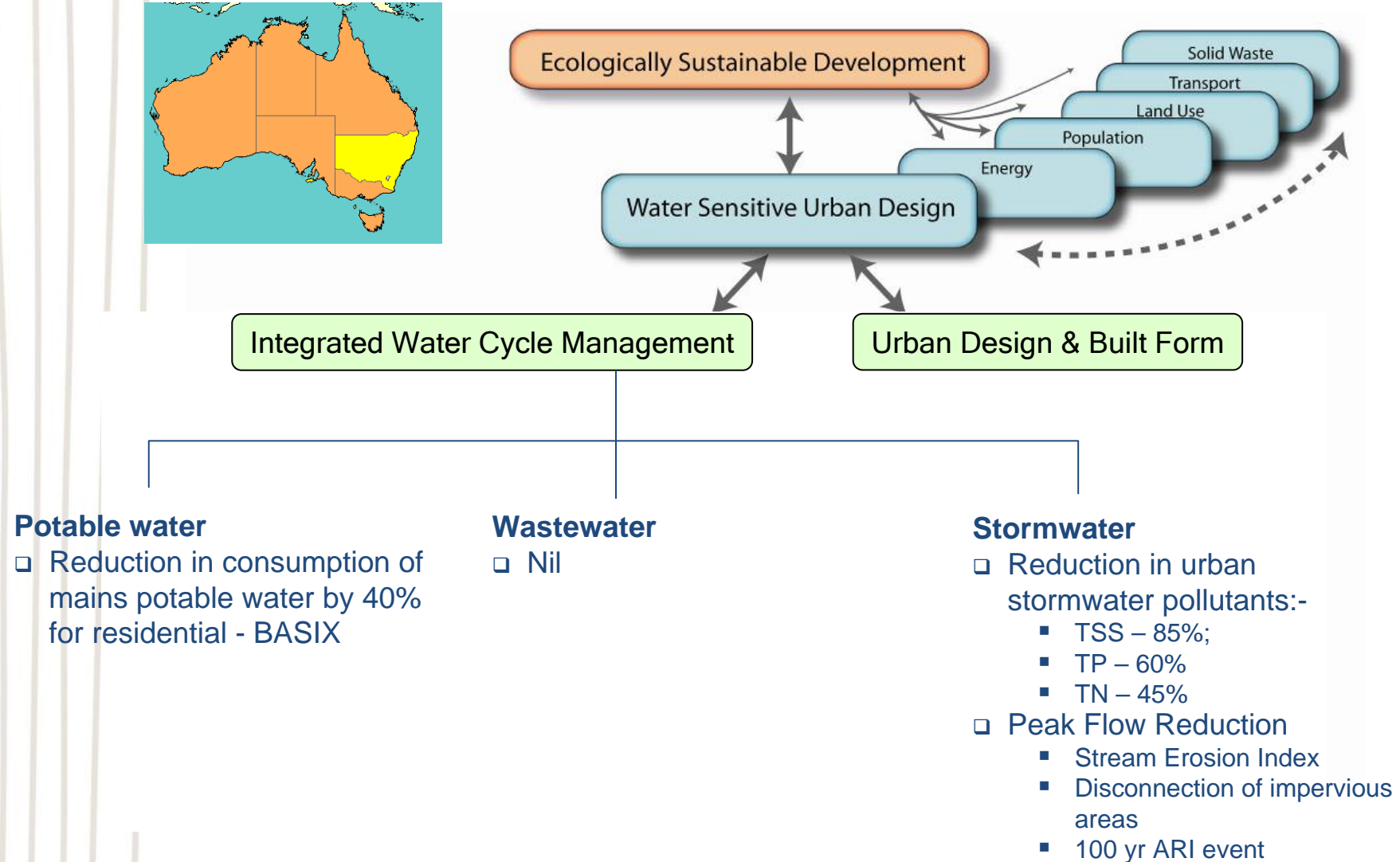
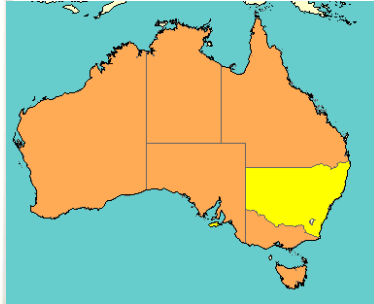
WSUD in the rest of Australia

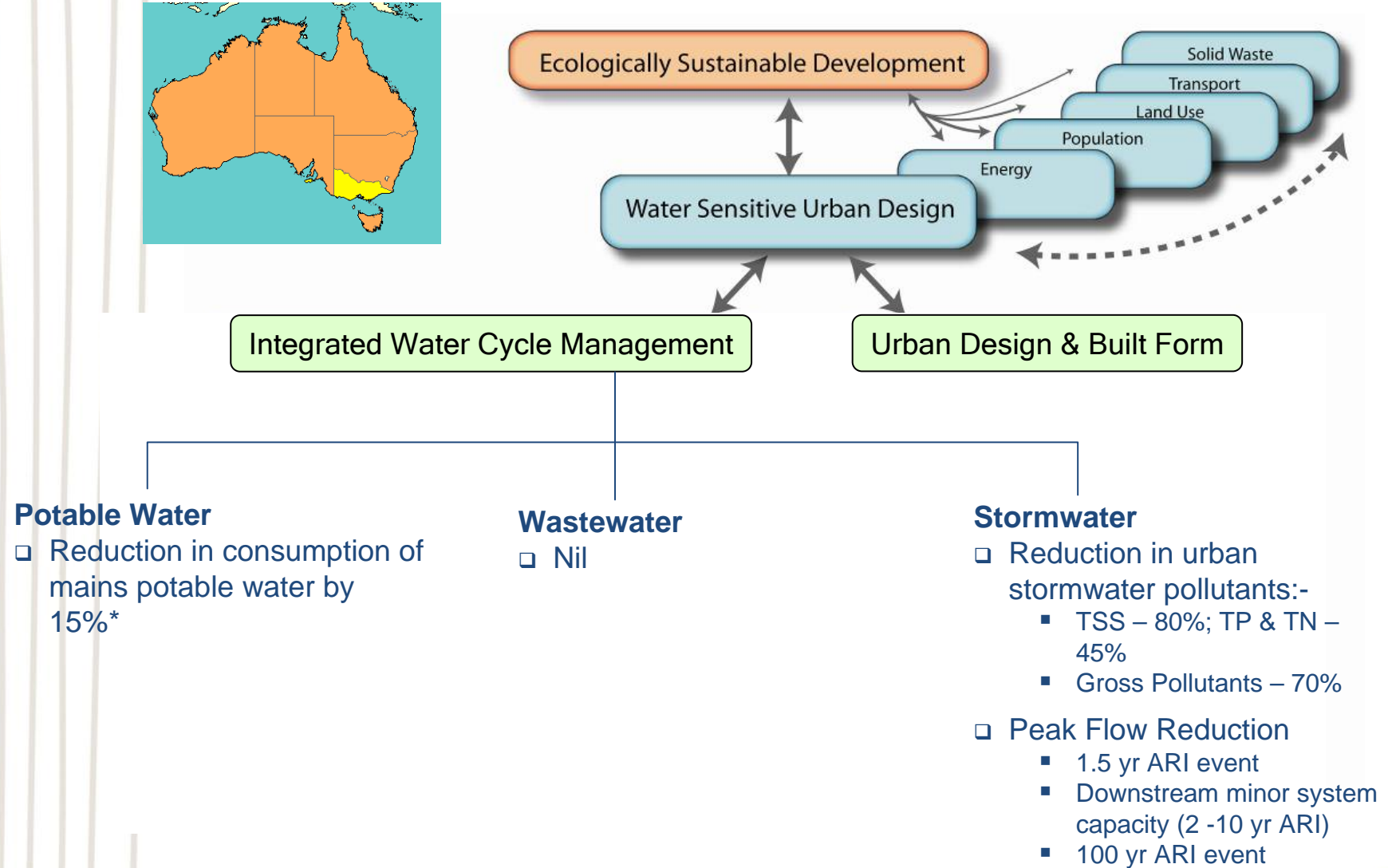
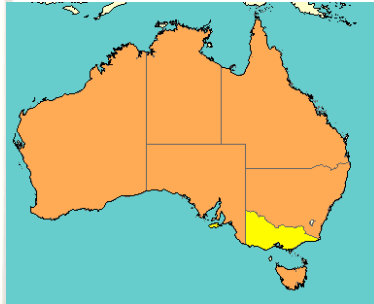
Federal response to WSUD

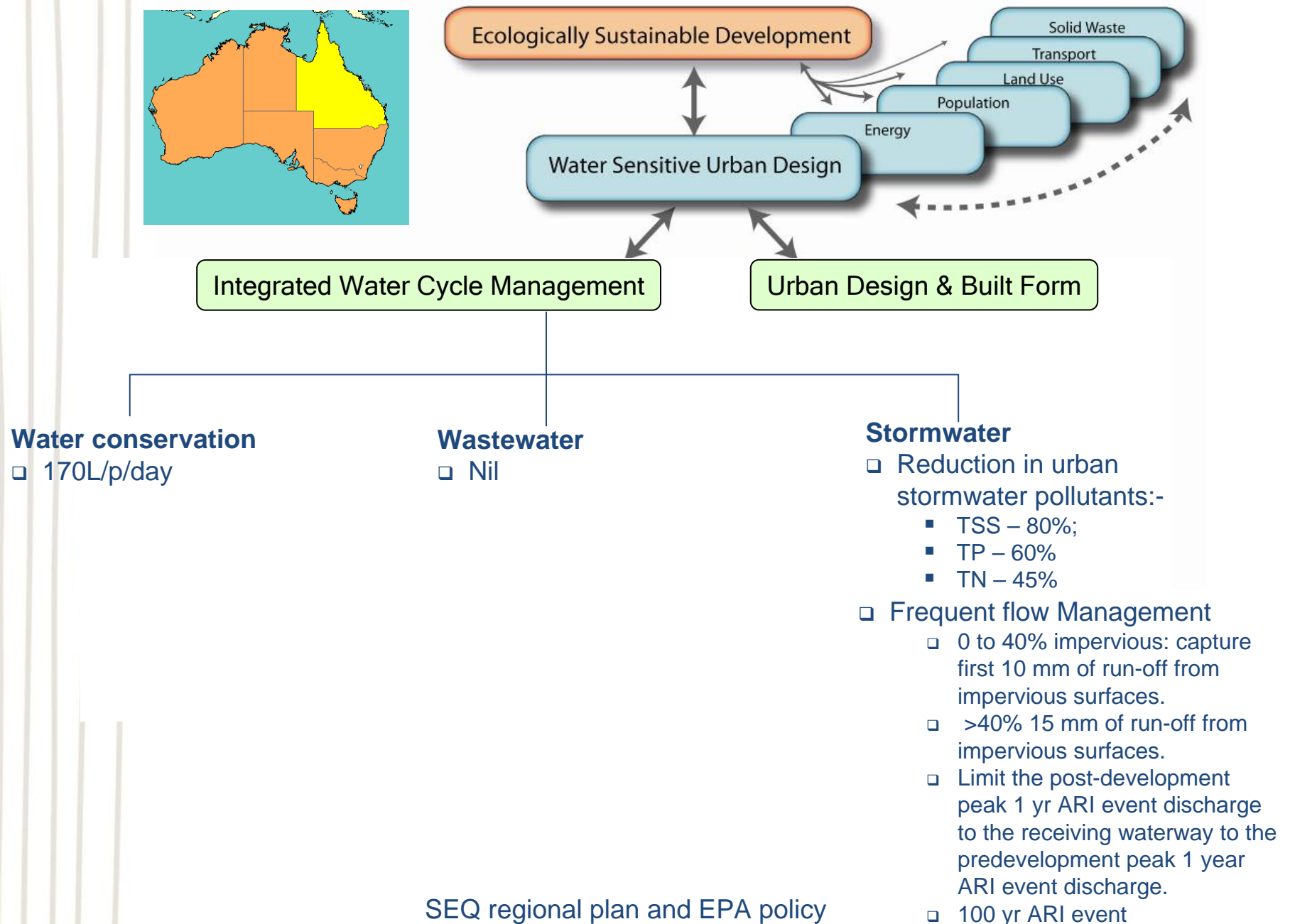
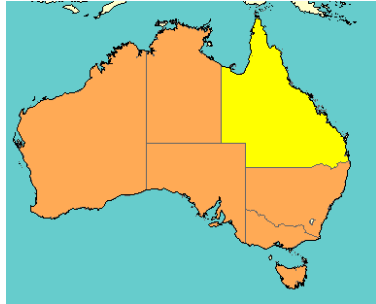
- NWI – promotes WSUD (National Design Guidelines)
 - *the integration of urban planning with the management, protection and conservation of the urban water cycle, that ensures urban water management is sensitive to natural hydrological and ecological cycles.*
- National Water Quality Management Strategy
 - *Improved developments to achieve of locally adopted water quality and river flow objectives*



- Australian Runoff Quality (Sister document to ARR)







WSUD Elements

WSUD Elements

Best Planning Practices

- WSUD in strategic and statutory planning
- Masterplanning
- Multiple Use public open space
- Street layout and streetscapes
- Industrial Sites
- Waterscapes as public art

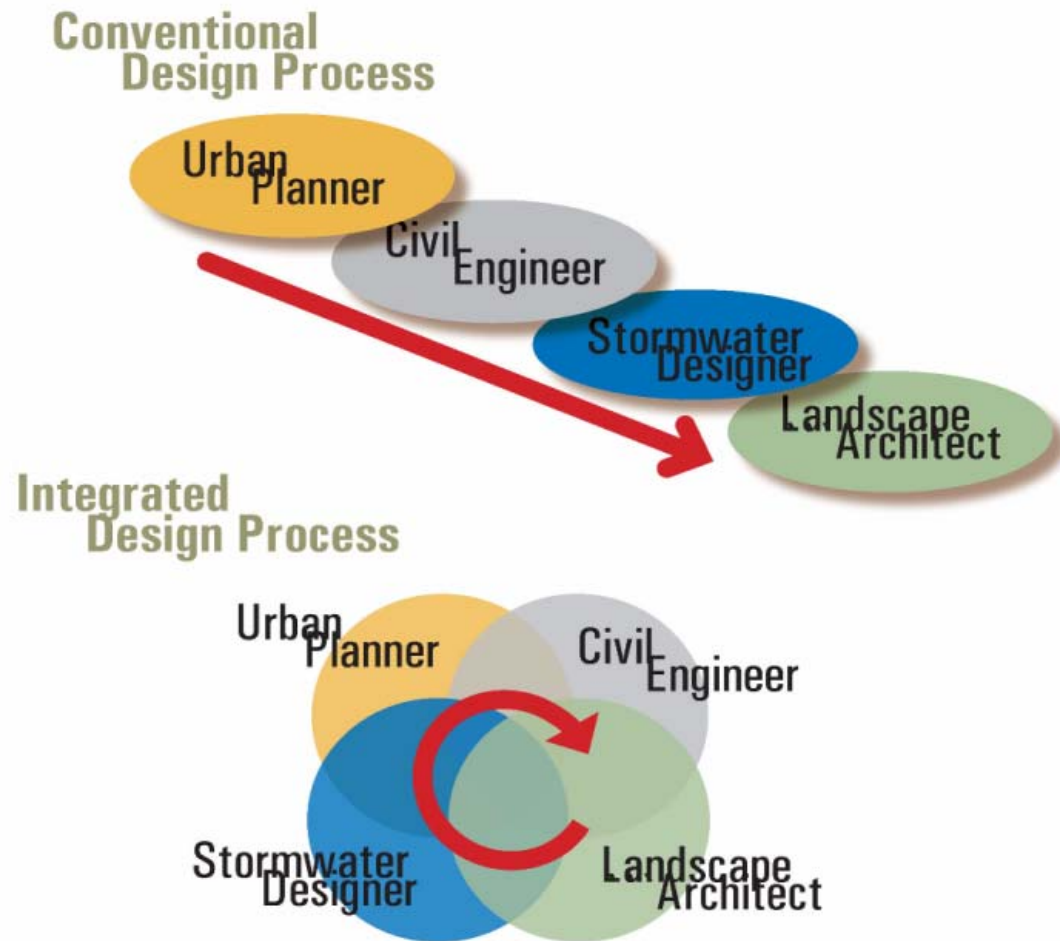
Best Management Practices

1. Demand Management
 - Demand Management
 - Water Efficient Landscaping
2. Supplementing potable mains water
 - Rainwater harvesting
 - Stormwater harvesting
 - Wastewater Recycling
3. Stormwater Treatment
 - Gross Pollutant Traps
 - Vegetated swales & buffers
 - Bioretention systems
 - Wetlands
 - Pavements / Infiltration

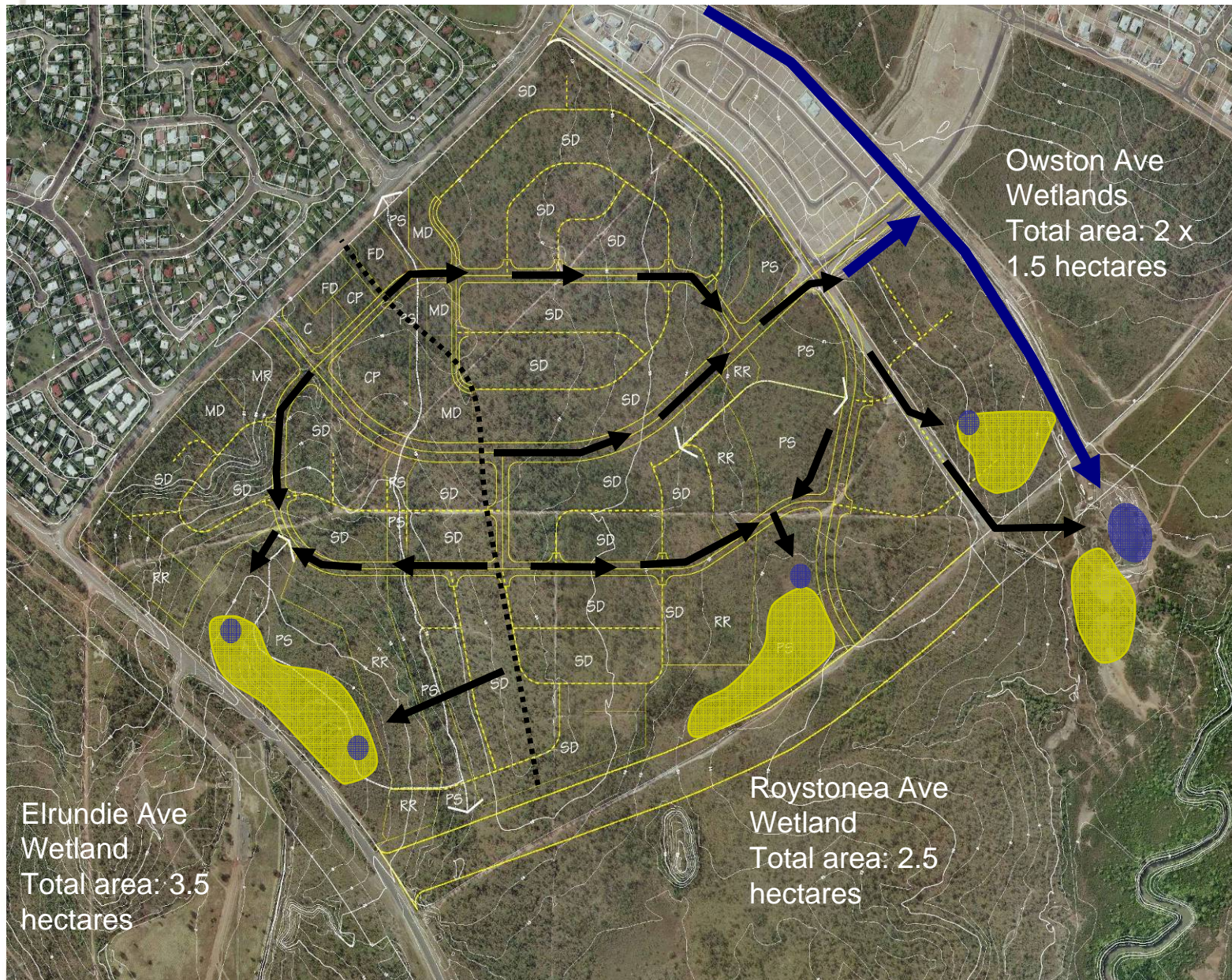
WSUD in strategic and statutory planning

- Darwin Harbour Strategy
- Requirements for WSUD in new release areas by DPI – Bellamack and Johnston
- Amendments to NT Planning Scheme
- Incorporation of WSUD into
 - Darwin City Council Development and Subdivision Guidelines (DCCDSG) 2005
 - City of Palmerston Subdivisional Guidelines (CPSG) 2007
- Darwin Harbour WSUD Strategy
- Darwin Harbour WSUD Technical Guidelines

Masterplanning



Masterplanning

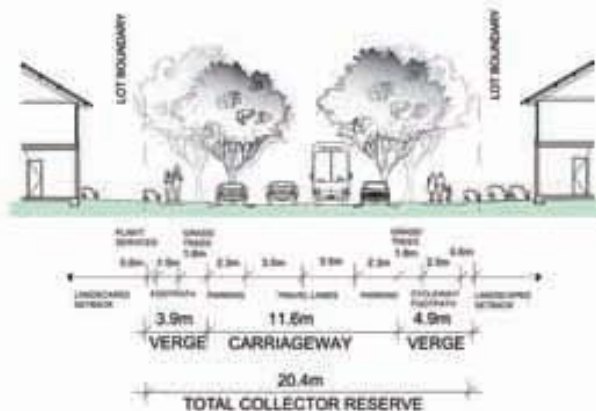


Multiple Use public open space

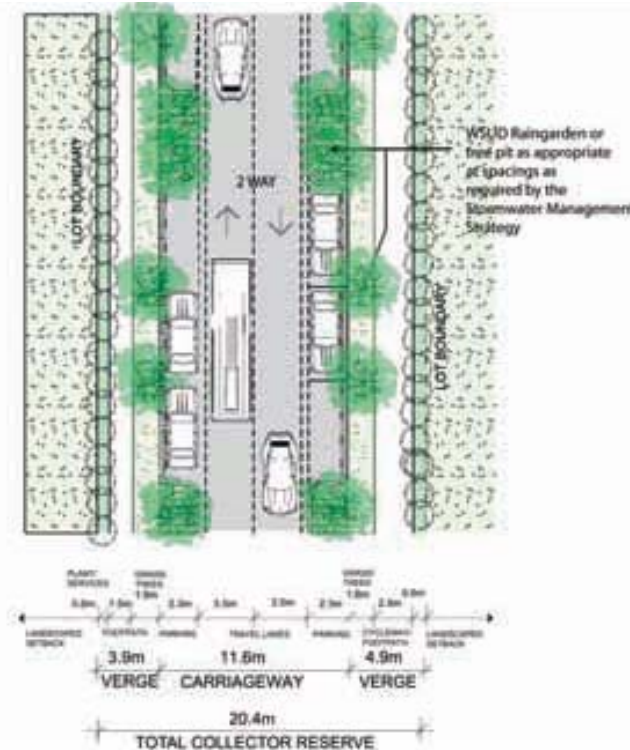


Street layout and streetscapes

Note: Dimensions are to the kerb upright, if the street is not to be used as a bus route then the width of the carriageway travel lanes can be reduced to 3.2m each i.e. 11m carriageway. Landscape verge dimension will vary with the tree species selected for the street.

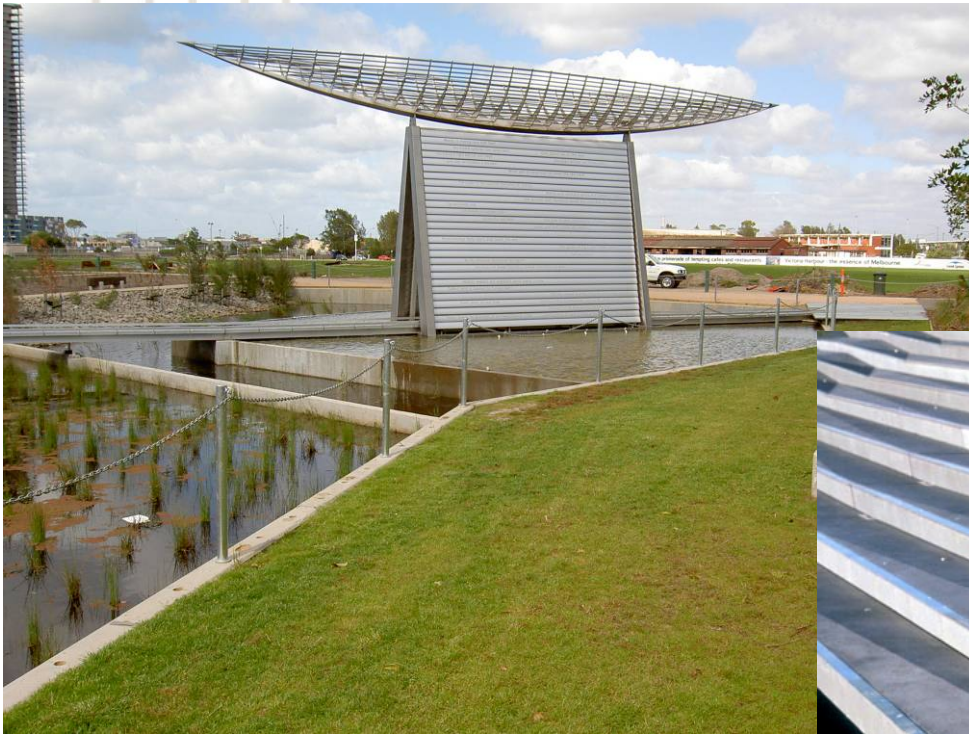


Section - Collector Street



Plan - Collector Street

Waterscapes as public art



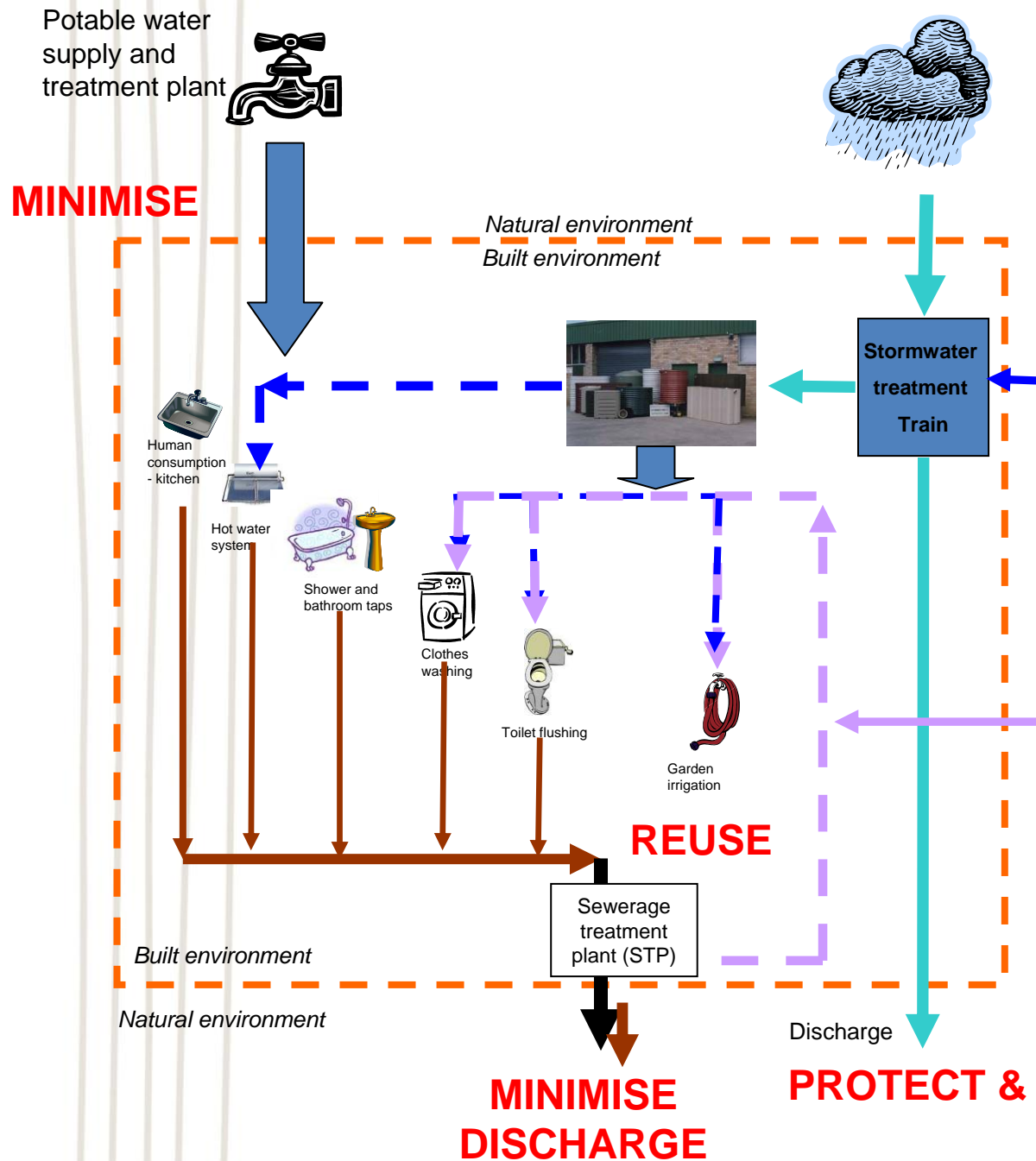
WSUD Elements – Demand Management / Water Reuse

Demand management



- Water efficient fixtures, fittings and appliances
- Water efficient landscaping and drought tolerant plants
- Efficient water irrigation systems (subsurface, drip systems or rainfall/moisture controlled systems)
- Supplement water supply using alternative sources of water





WSUD Elements – Stormwater Treatment

Particle Size	Pollution Issue					Treatment
	Visual	Sediment	Organics	Nutrients	Metals	
Gross Solids > 5mm	Litter	Gravel	Plant Debris			Screening
Coarse- to Medium- 5 mm – 125 μm						Sedimentation
Fine Particulates 125 μm – 10 μm		Silt		Particulate	Particulate	Enhanced Sedimentation
Very Fine/Colloidal 10 μm – 0.45 μm	Turbidity				Colloidal	Adhesion and Filtration
Dissolved Particles < 0.45 μm			Natural & Anthropogenic Materials	Soluble		Biological Uptake

Gross Pollutant Traps

- Benefits
 - reduce litter, debris, coarse sediment
 - pre-treatment for other systems (eg wetlands)
- Considerations
 - Can be ugly and/or expensive
 - Maintenance: capital vs. maintenance cost



Buffer Strips & Vegetated Swales

- Benefits
 - remove coarse and medium sediment
 - streetscape benefits
 - alternative conveyance system
- Considerations
 - Restricted to mild slopes (1-4%)
 - Interactions with driveways, footpaths





Bioretention v Wetland

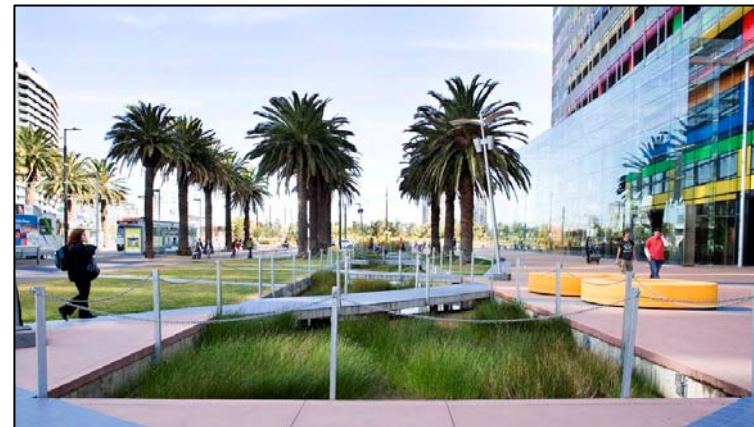
Bioretention

- Biological uptake N and P
- Filtration
- 2-3% catchment area
- Does not retain water
- Small to medium scale

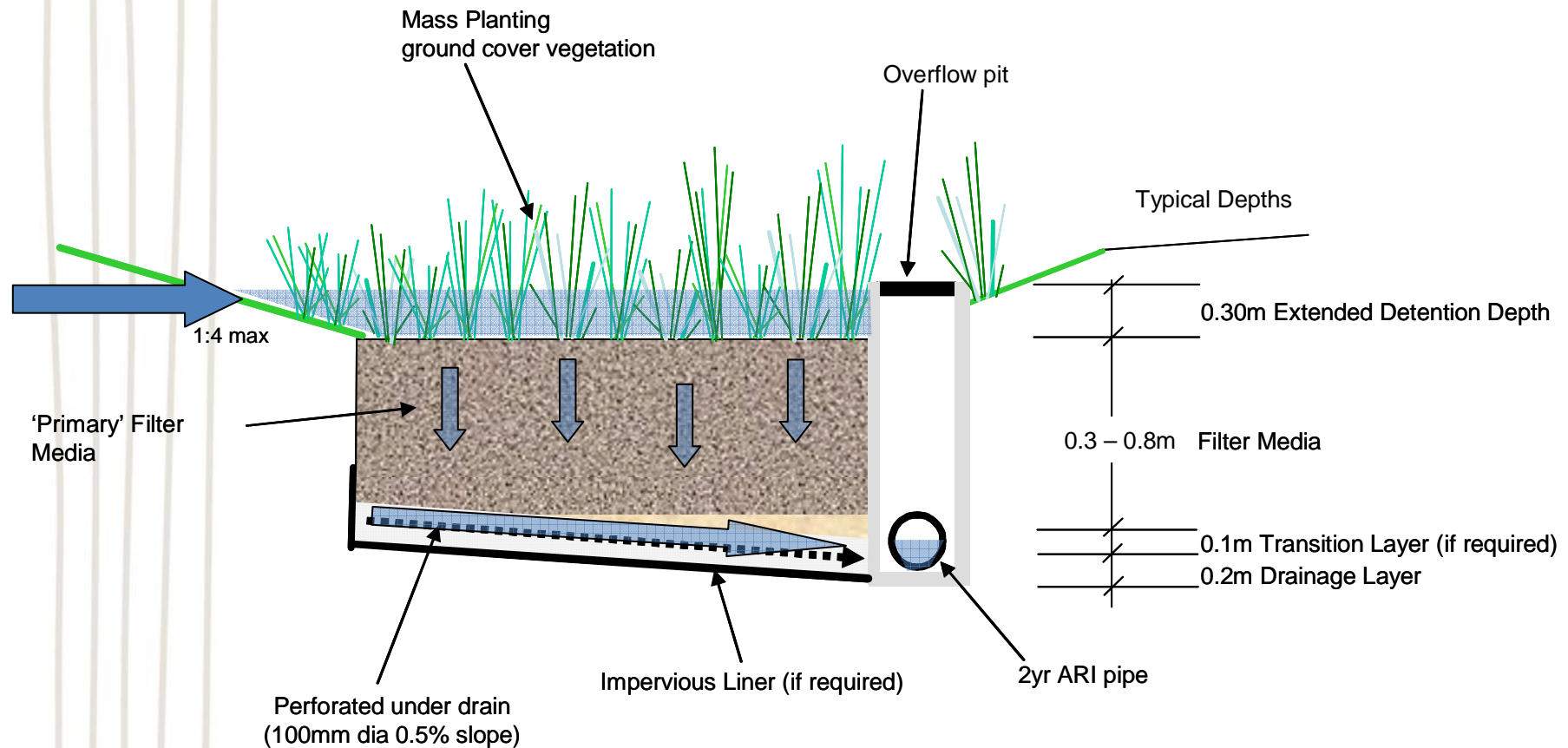


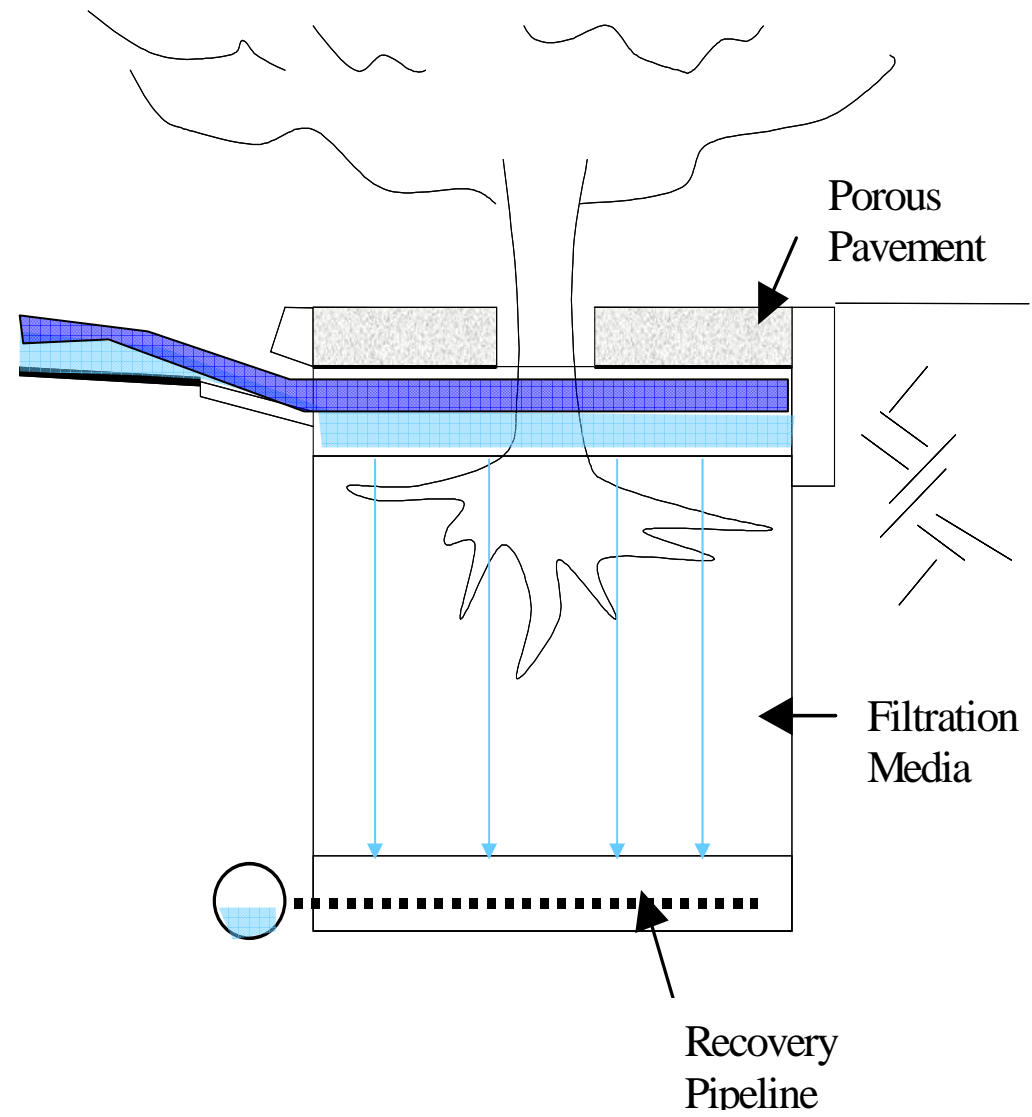
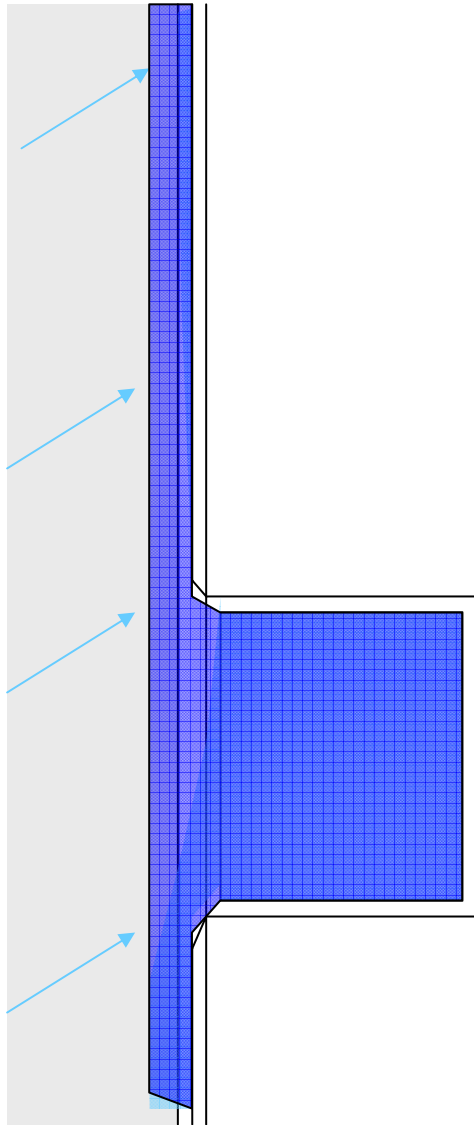
Wetland

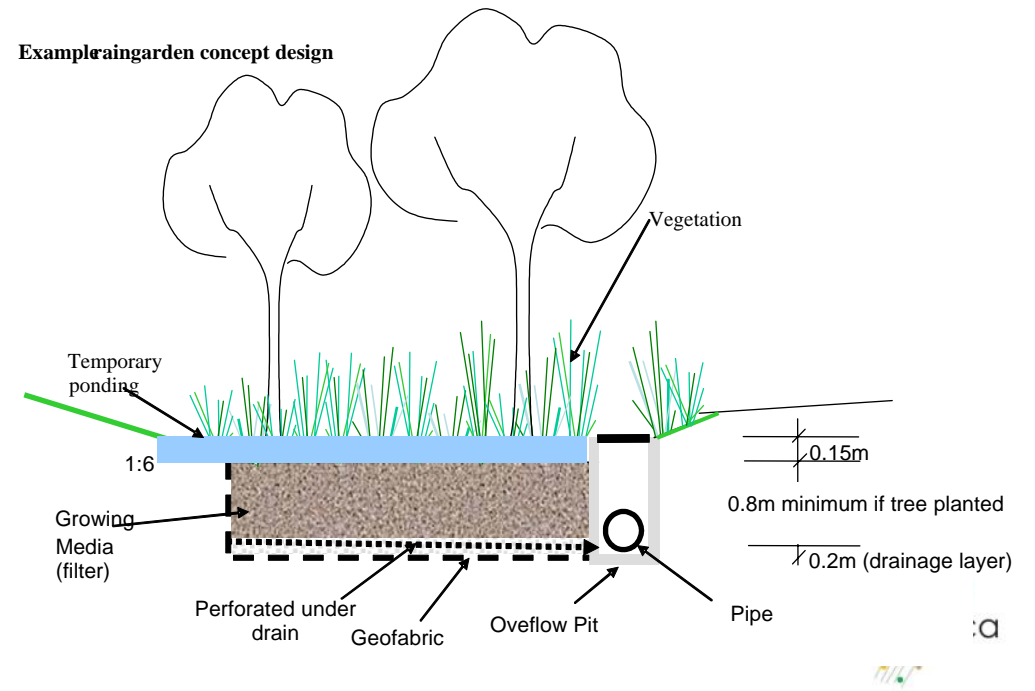
- Biological uptake N and P
- Sedimentation
- 6% catchment area
- Retain permanent water
- Medium to large scale

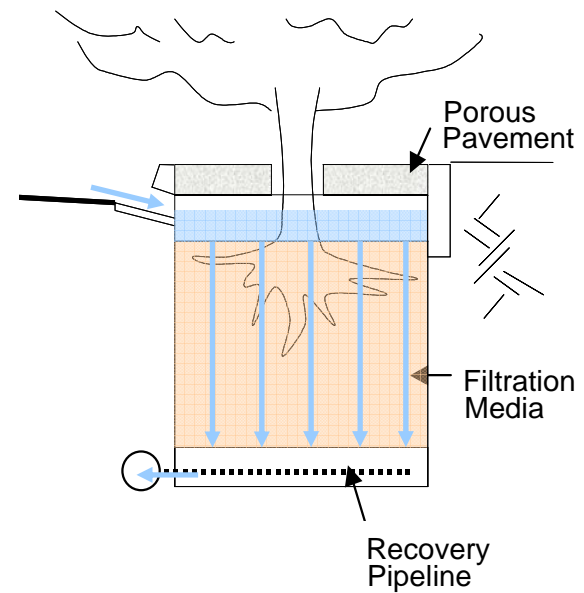


Bioretention Systems

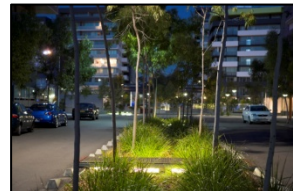




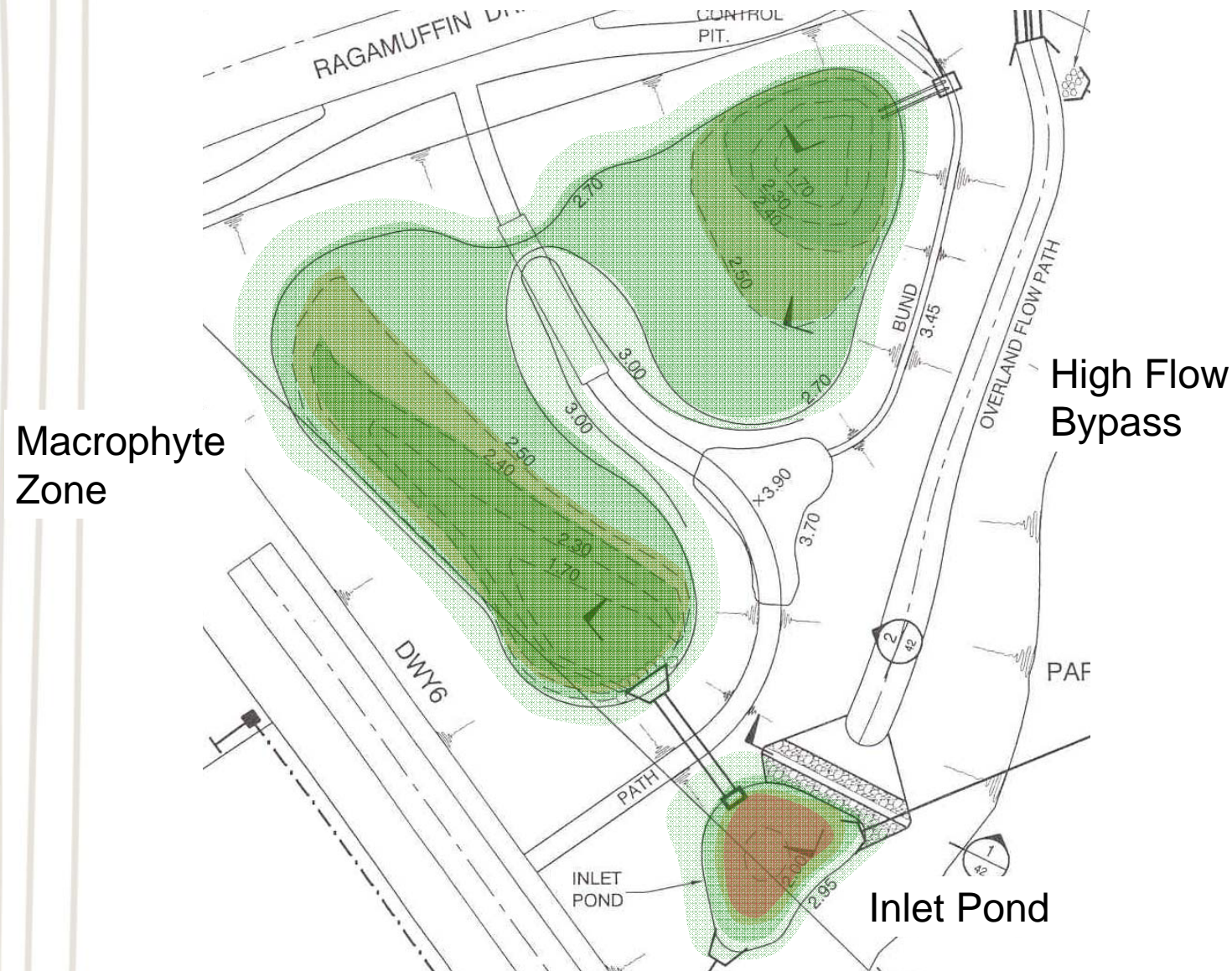




Integration of scale and landscape – rain gardens (bioretention systems)



CONSTRUCTED WETLANDS – How they work?



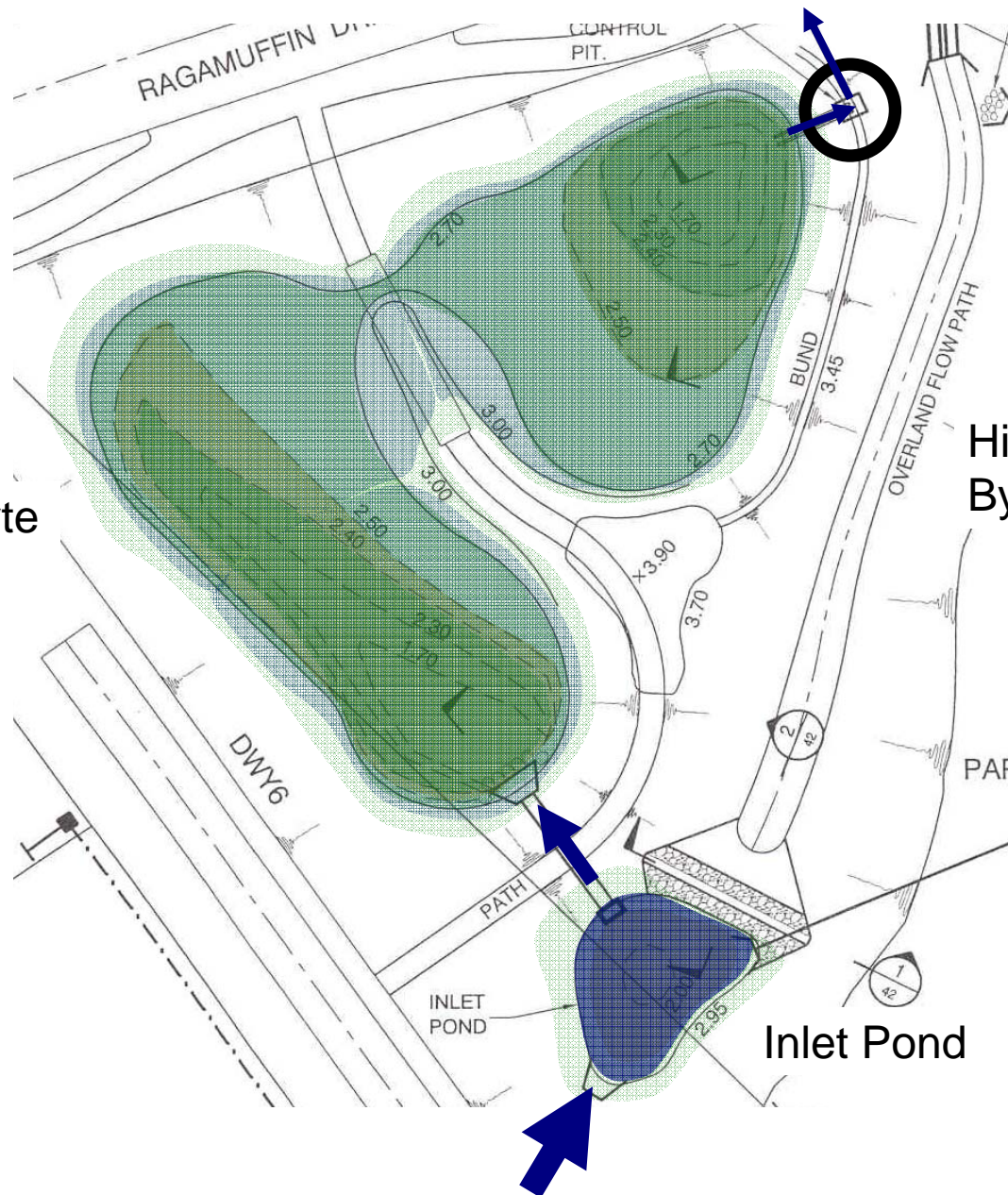
Macrophyte
Zone



High Flow
Bypass

Inlet Pond

Macrophyte
Zone



High Flow
Bypass

Inlet Pond

Integration of scale and landscape - wetlands



Wet Season



Dry Season



How do we know what we are doing?



What is MUSIC ?

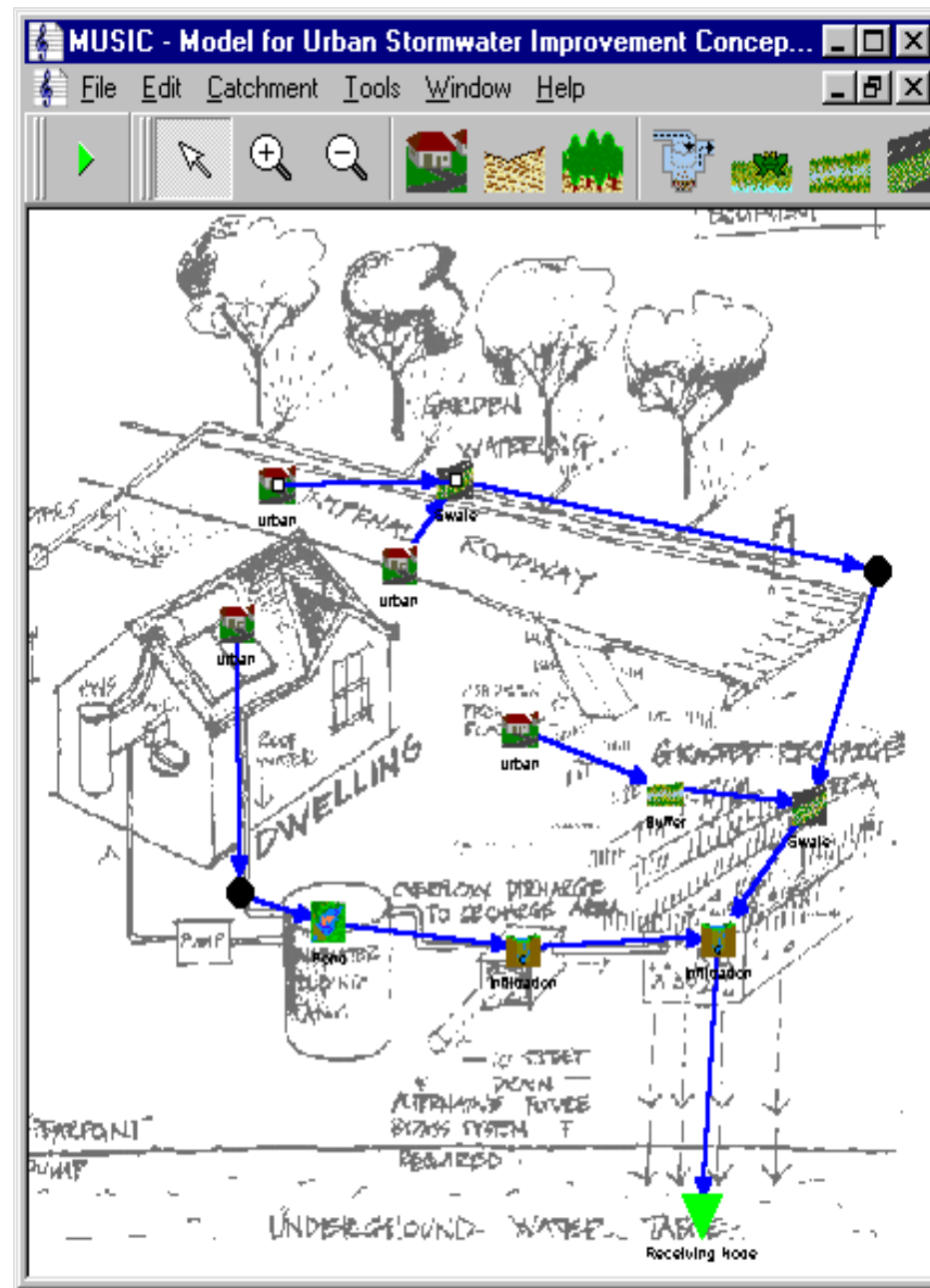
MUSIC is a user friendly computer based system that enables users to evaluate the performance and cost of stormwater management options

- *flow*
- *water quality*
- *lifecycle cost*

Can model treatment measures including;

- wetlands
- ponds & basins
- bioretention systems/rain gardens
- infiltration systems
- swales and buffers
- stormwater harvesting and reuse (including tanks & other storage options)





Break

WSUD = INTEGRATION.....

- Integration across the urban water streams
 - Potable water
 - Wastewater
 - Stormwater
 - Groundwater
- Integration of scale
 - Regional
 - Precincts
 - Streetscapes
 - Allotments
- Integration into built form
 - Building Architecture
 - Landscape architecture
 - Public Art



WSUD in Darwin

- What are some of the issues in implementing WSUD in Darwin?

WSUD in Darwin

- What are some of the issues in implementing WSUD in Darwin?
- Could WSUD be used to overcome the key water issues identified?

Overview WSUD Techniques

Option		Household	Medium Density	High Rise	Commercial and Industrial	Subdivision	Urban Retrofit
Stormwater management techniques	Sediment basins					✓	
	Bioretention swales	?	✓		✓	✓	
	Bioretention basins	✓	✓		✓	✓	✓
	Sand filters		?		✓	✓	✓
	Swales and buffer strips	✓	✓		✓	✓	?
	Constructed wetlands				?	✓	?
	Ponds and lakes				?	✓	?
	Infiltration systems	?	?		✓	✓	✓
	Aquifer storage and recovery	?	?		?	✓	?
	Porous pavements	✓	✓	?	✓	✓	?
	Retarding basins				?	✓	
	Green roofs/roof gardens	✓	✓	✓	✓		✓
	Stream and riparian vegetation rehabilitation				?	✓	✓
	Water quality education programs	✓	✓	✓	✓	✓	

WSUD = INTEGRATION.....

- Integration across the urban water streams
 - Potable water
 - Wastewater
 - Stormwater
 - Groundwater
- Integration of scale
 - Regional
 - Precincts
 - Streetscapes
 - Allotments
- Integration of disciplines
 - Engineers
 - Planners
 - Scientists
 - Officials

