



# Optimising water sensitive urban design (WSUD) for coastal benefits

Coastal Communities Forum: West Beach, SA.  
December 2023.

**Dr Kerri Muller**  
Principal Ecologist  
Water Sensitive SA





Guidelines for design, construction and maintenance of WSUD assets

[Learn More](#)

## Water Sensitive SA

supports government, industry and community to mainstream water sensitive urban design and integrated water management practices that enhance wellbeing and ecological health.

### Latest news

[Subscribe](#) 

**Kensington Wama /Kensington Gardens Reserve wetlands**

9 November 2023

**Stormwater infiltration could keep streams flowing**

8 November 2023

**Greater Adelaide Regional Plan**

6 November 2023

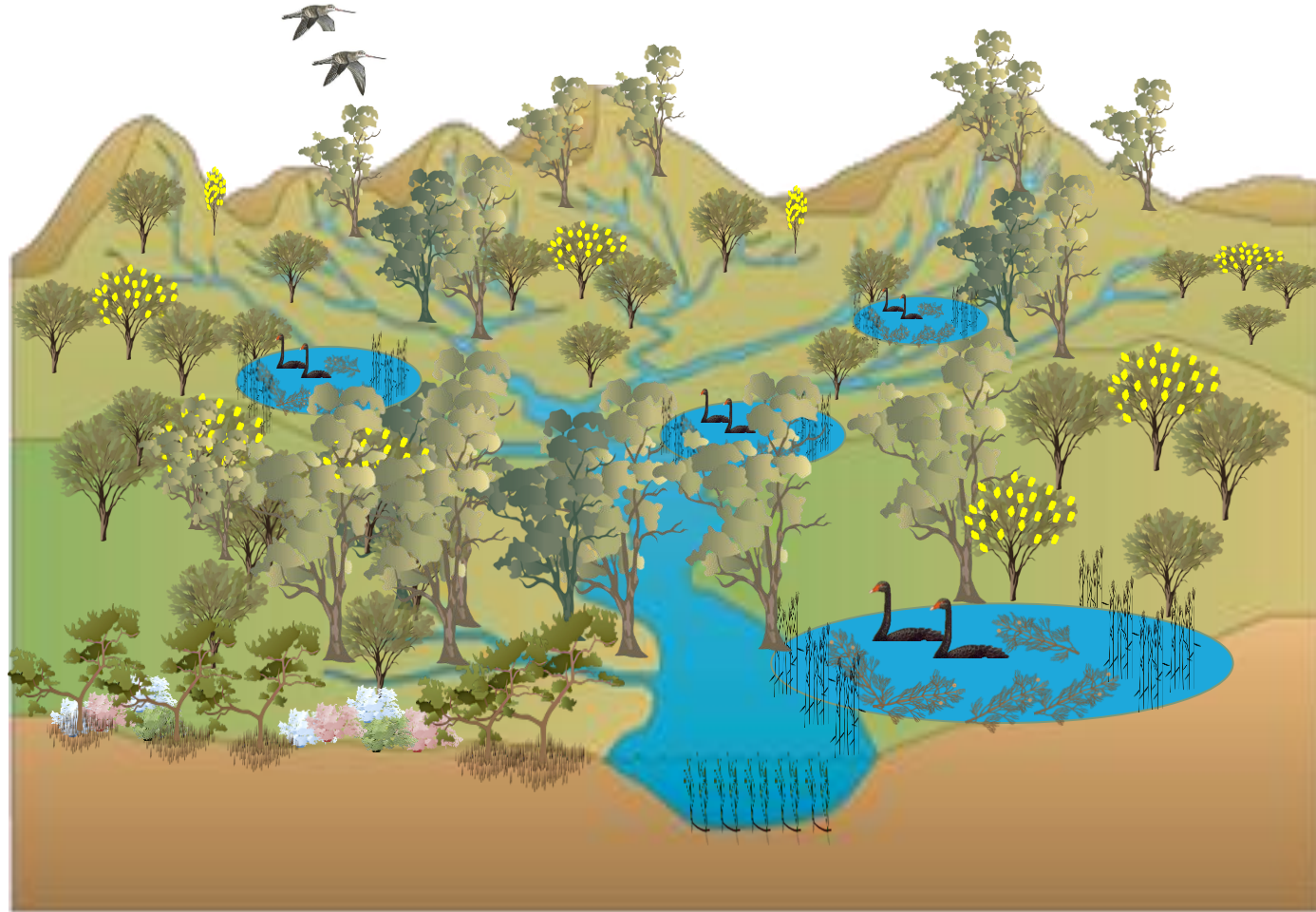
**New practice guide for lot-scale cooling**

27 October 2023

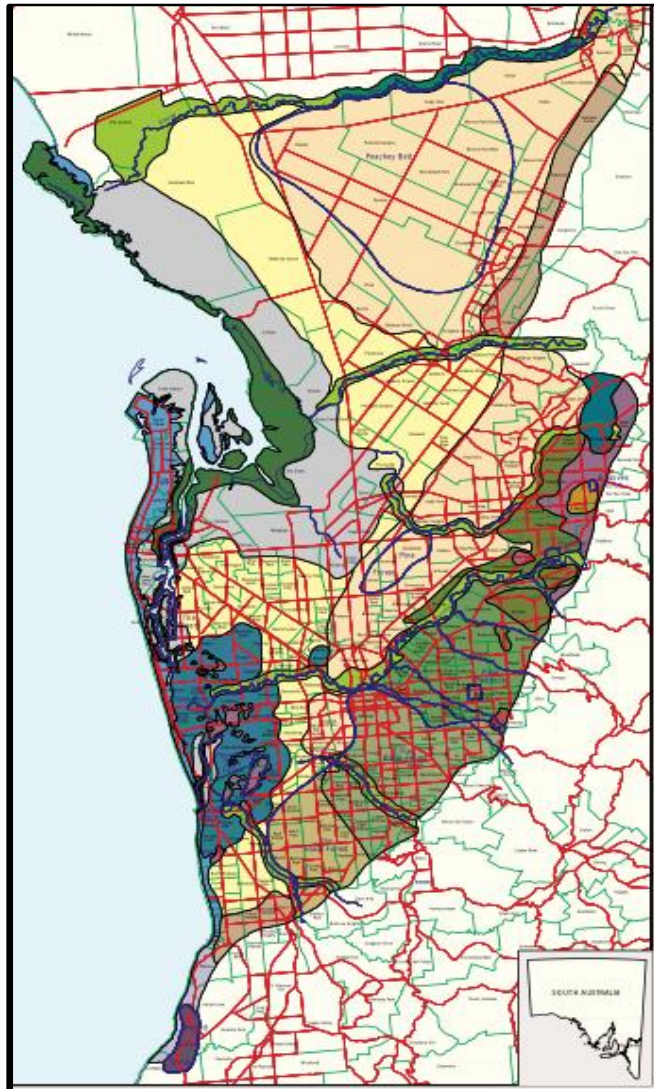


# Natural water quality improvers

- Soils
- Forests
- Streams
- Rivers
- Lakes
- Wetlands
- Floodplains
- Estuaries
- Samphires
- Mangroves



# Loss of water quality improvers



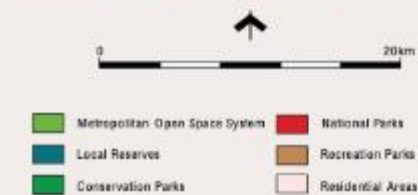
## Wetlands and Watercourses in 1836 vs 2000

Source: Planning SA (2000)

### FORESTS AND WOODLANDS OF THE ADELAIDE PLAINS IN 1836 A NATIVE VEGETATION PLANTING GUIDE

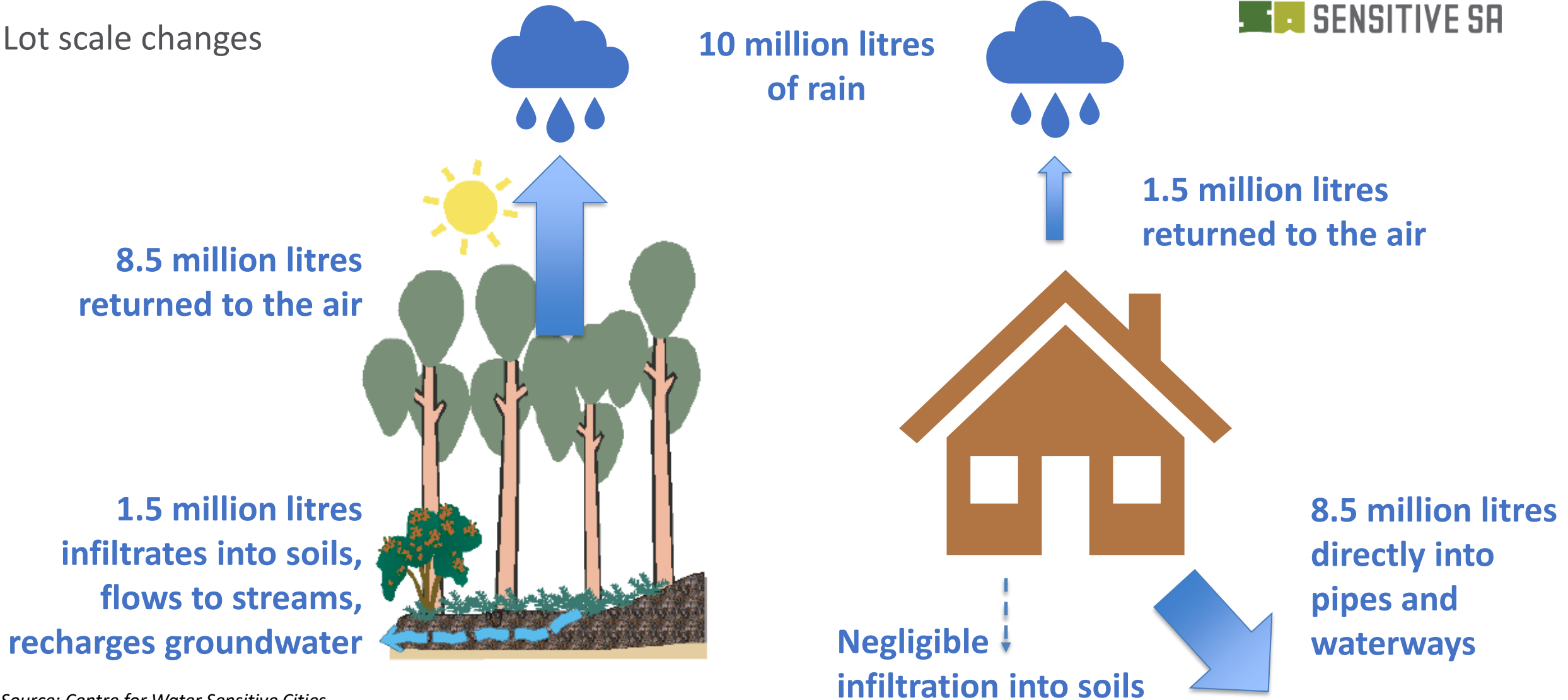
- 2** *Eucalyptus camaldulensis* (River Red Gum)  
*Eucalyptus largiflorens* (River Box) Open forest  
 Soil Description: Alluvial soils  
 Landscape Description: Watercourse
- 4** *Eucalyptus camaldulensis* (River Red Gum)  
*Eucalyptus leucoxylon* (SA Blue Gum) Woodland  
 Soil Description: Alluvial soils  
 Landscape Description: Watercourse
- 15** *Melaleuca halmaturorum ssp. halmaturorum*  
 (Swamp Paper Bark) Low woodland  
 (Port River and Patawalonga Outlet)  
 Soil Description: Estuarine mud and sands  
 Landscape Description: Watercourse
- 16** *Avicennia marina* (Mangrove) Low woodland  
 Soil Description: Estuarine mud and sands  
 Landscape Description: Tidal flats
- 19** *Mixed Halosarcia spp.* (Samphire)  
*Sclerostegia spp.* (Samphire)  
*Atriplex paludosa ssp.* (Marsh Saltbush)  
*Sarcocornia spp.* (Samphire) Low shrubland  
 Soil Description: Estuarine mud and sands  
 Landscape Description: Tidal flats
- 20** *Mixed Muehlenbeckia florulenta* (Lignum) Low shrubland  
*Phragmites australis* (Common Reed)  
*Potamogeton spp.* (Pond Weed)  
*Triglochin procerum var. procerum* (Water-ribbons) Reedbeds  
*Bolboschoenus spp.* Sedgeland  
 Soil Description: Alluvial soil  
 Landscape Description: Watercourse, swamps and lagoons

## OPEN SPACE AND RESERVE SYSTEM



# Replaced forest with a building

Lot scale changes



Source: Centre for Water Sensitive Cities



# Urbanisation of catchments



Fundamentally altered the eco-hydrological character of the catchment:

- Loss of our water quality improvers
- Development or other disturbance mobilises pollutants anywhere in the catchment
- Focus on conveyance over treatment
- Higher flows of polluted water entering waterways and the ocean (sediments, nutrients)

# Seagrass changes over time at Grange driven by water quality changes

Seagrass line

1972

Over the last half century around one third of seagrass along the Adelaide metropolitan coast has been lost. The dark blue colour shows seagrass meadows that once existed along the Adelaide coast.

1979

Once destroyed, seagrass ecosystems do not easily recover. The dark patches in the water show some of the remaining seagrass after the loss of the meadows.

2018

Since water quality has improved in our coastal waters, some seagrass has regrown, but it has taken many years.

2050?



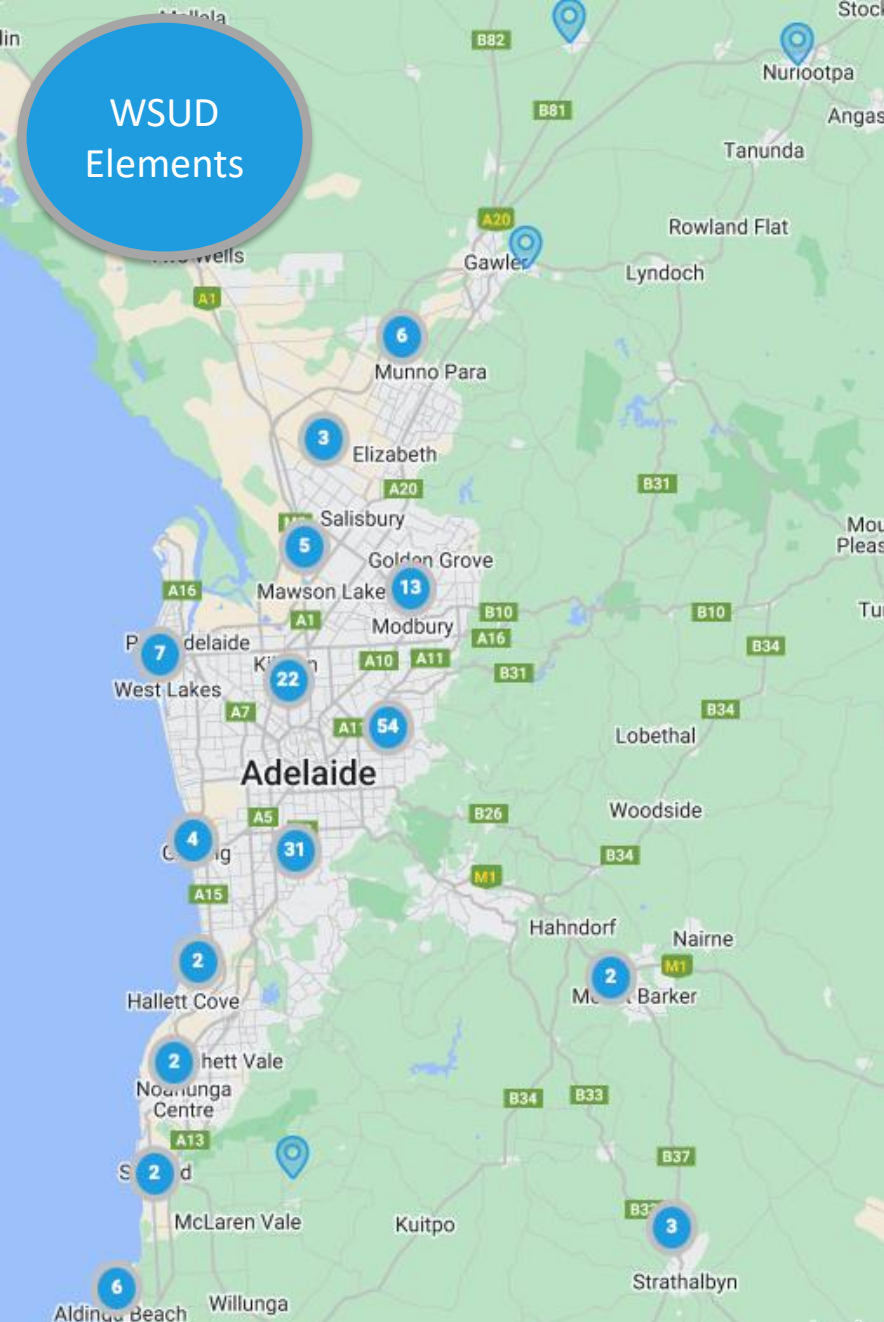
# WSUD coastal benefits



Water sensitive urban design (WSUD) protects coastal systems by:

- Improving incoming water quality
- Mitigating high flows and floods
- Harvesting fresh water for re-use before discharge
- Creating microclimates – turning grey to green
- Delivering a range of essential ecosystem services in small spaces
- Providing flexible solutions to integrated water management and master planning issues in coastal communities



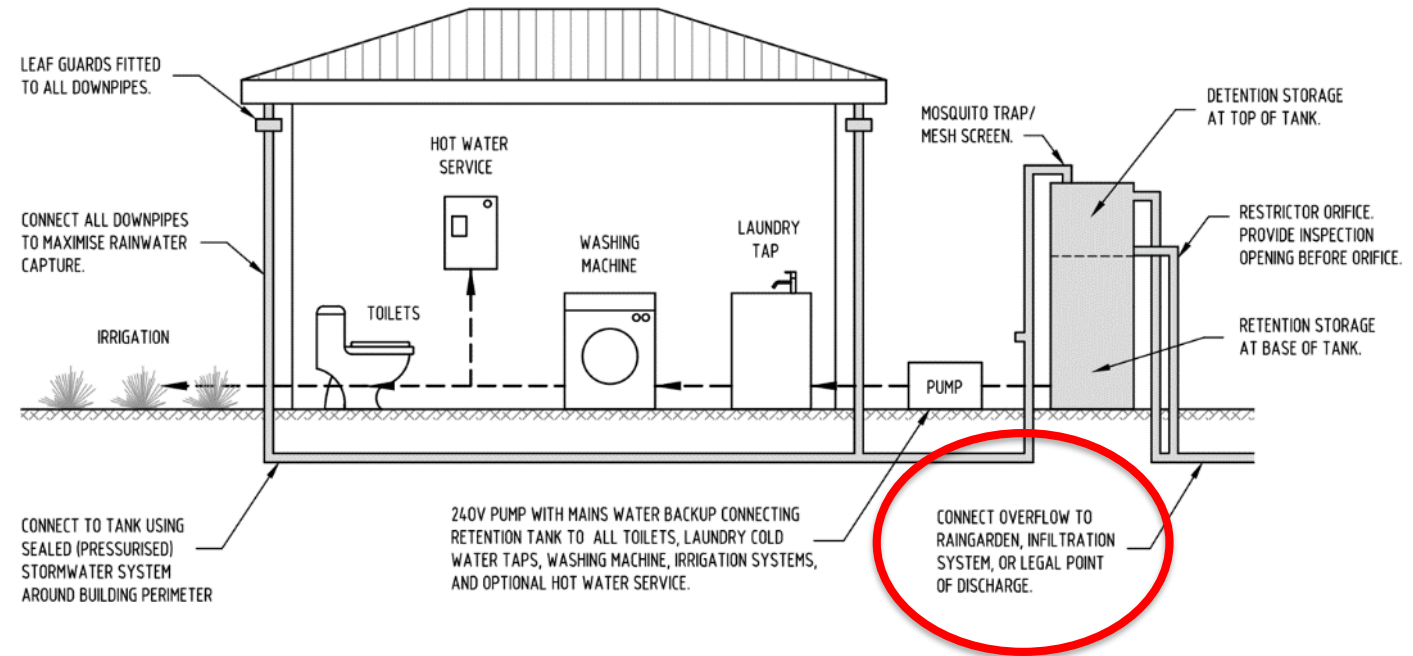
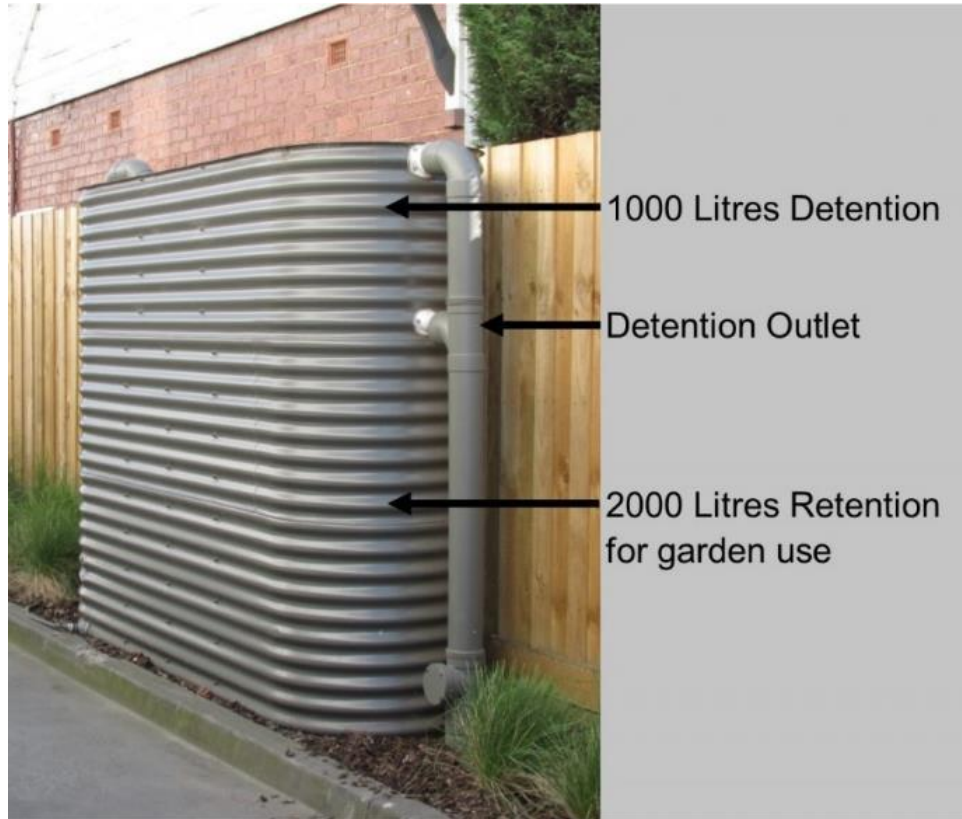


# New water improvers



- WSUD elements are built to overcome some of the problems of urbanisation
- Purpose-built chains of water quality improvers through catchment
- Each WSUD element in the chain provides ecosystem services and builds our natural capital

# Rainwater tanks



## RETENTION TANK RETICULATION DETAIL

N.T.S.

NOTE: THE DESIGN AND INSTALLATION OF ALL STORMWATER SYSTEMS SHALL COMPLY WITH AS/NZS 3500.3:2018 "STORMWATER DRAINAGE".



# Permeable paving



Hillview Road, Netherby – construction of permeable paving.  
*Source: Water Sensitive SA*



Old Treasury Lane, Adelaide – permeable paving with sediment trapped



# Tree pits



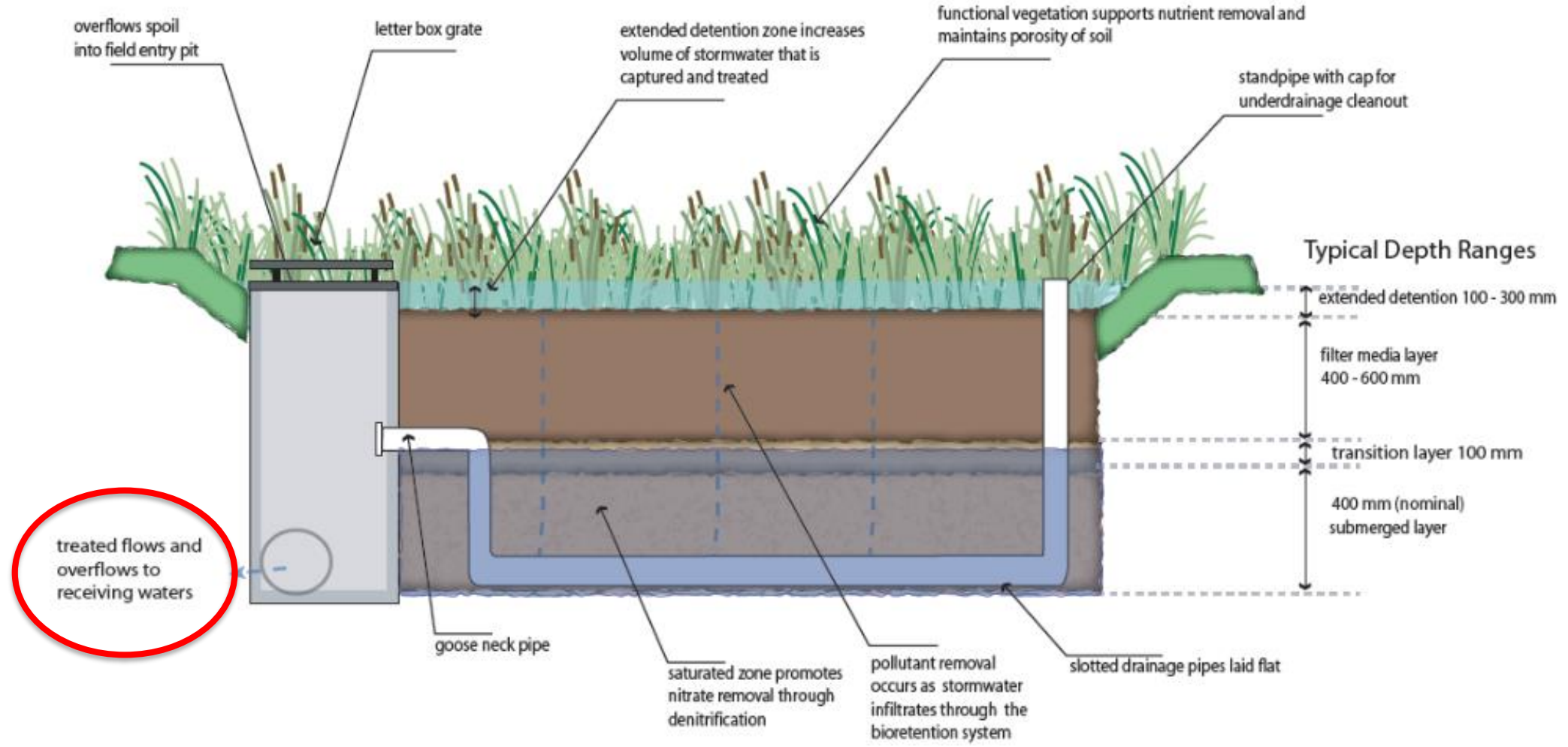
North Terrace *Source: City of Adelaide*



Beachway Avenue, Brooklyn Park



# Raingardens



Source: DesignFlow, Adapted from Heathy Waterways

# Constructed wetlands – ultimate WSUD



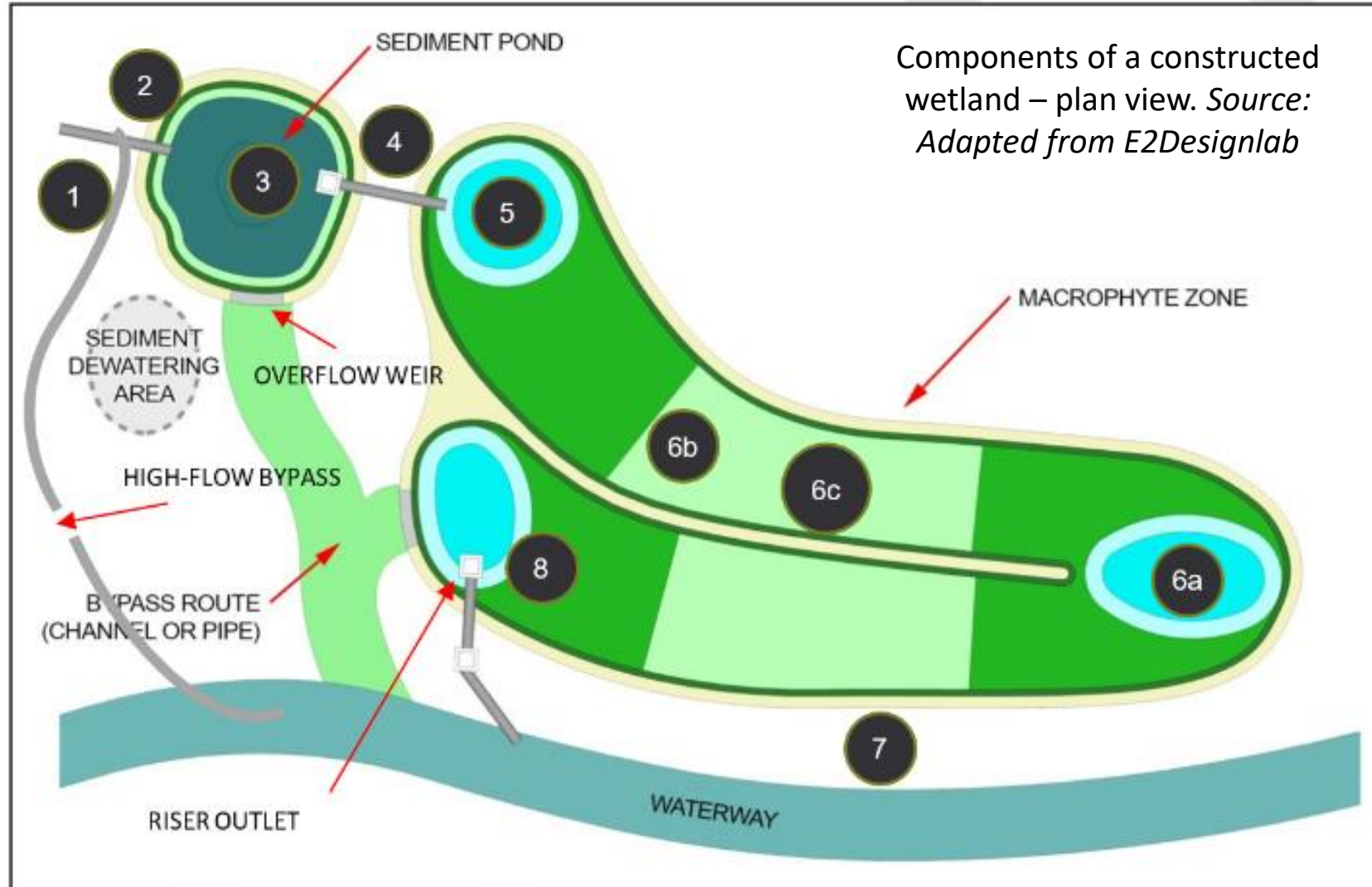
Wetland and detention basin near Hampstead Road, Lightsview. *Source: DesignFlow*



Felixstow Wetland Reserve, Felixstow



# Constructed wetlands – ultimate WSUD



Components of a constructed wetland – plan view. *Source: Adapted from E2Designlab*



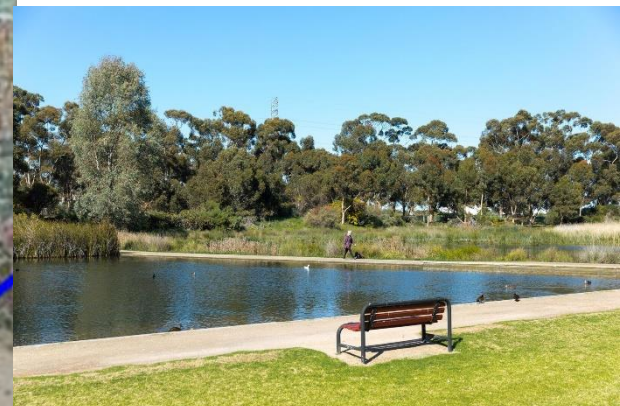
Beyond Development  
Hayborough, SA



# Unity Park- large-scale & integrated WSUD City of Salisbury



Source: Adapted from DesignFlow

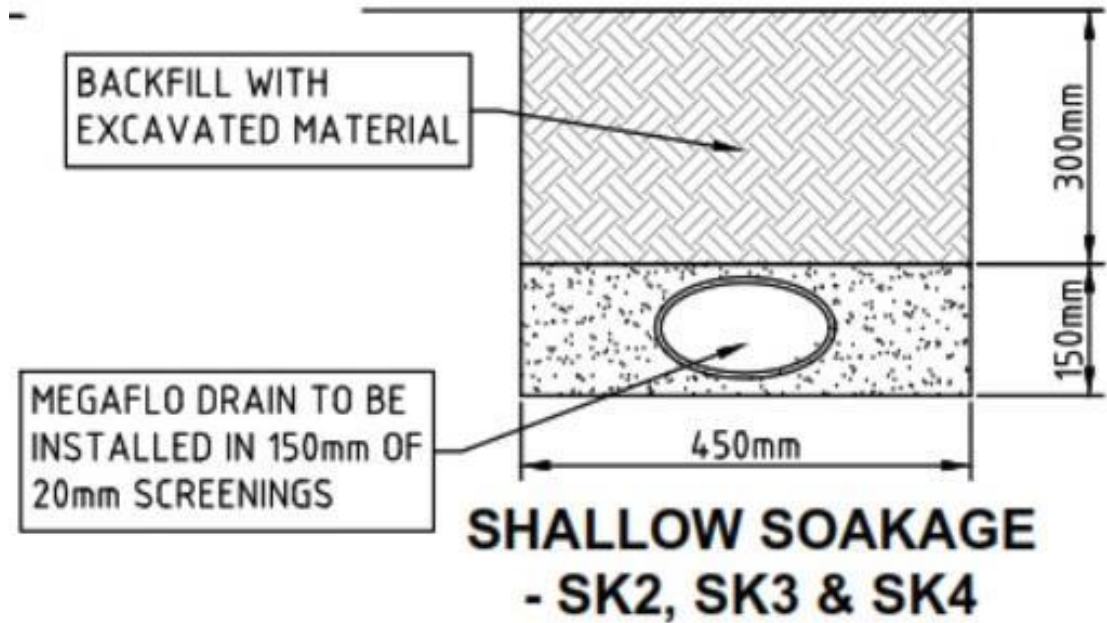




# Norman Street Reserve - infiltration trenches

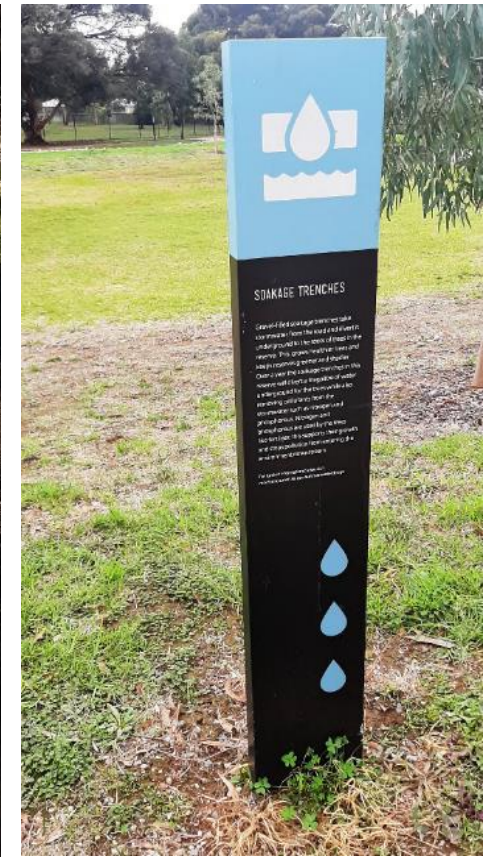
## City of Mitcham

Combined with permeable paving, swales, detention basin



**TYPICAL SOAKAGE TRENCH ARRANGEMENT**

NTS





# Norman Street Reserve – creek daylighting

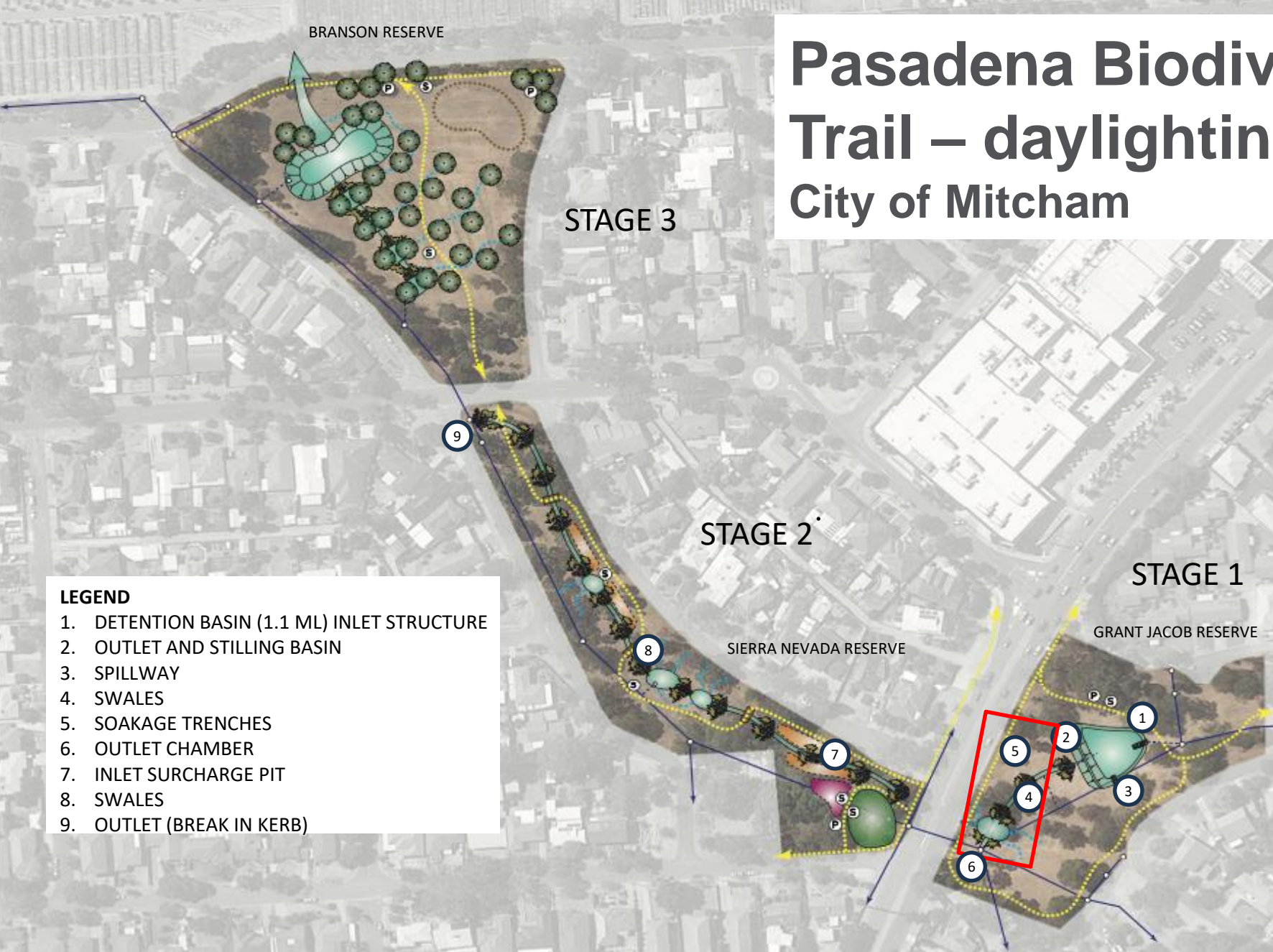
Half the cost of upgrading underground pipes.





# Pasadena Biodiversity Recreation Trail – daylighting of a creek

## City of Mitcham

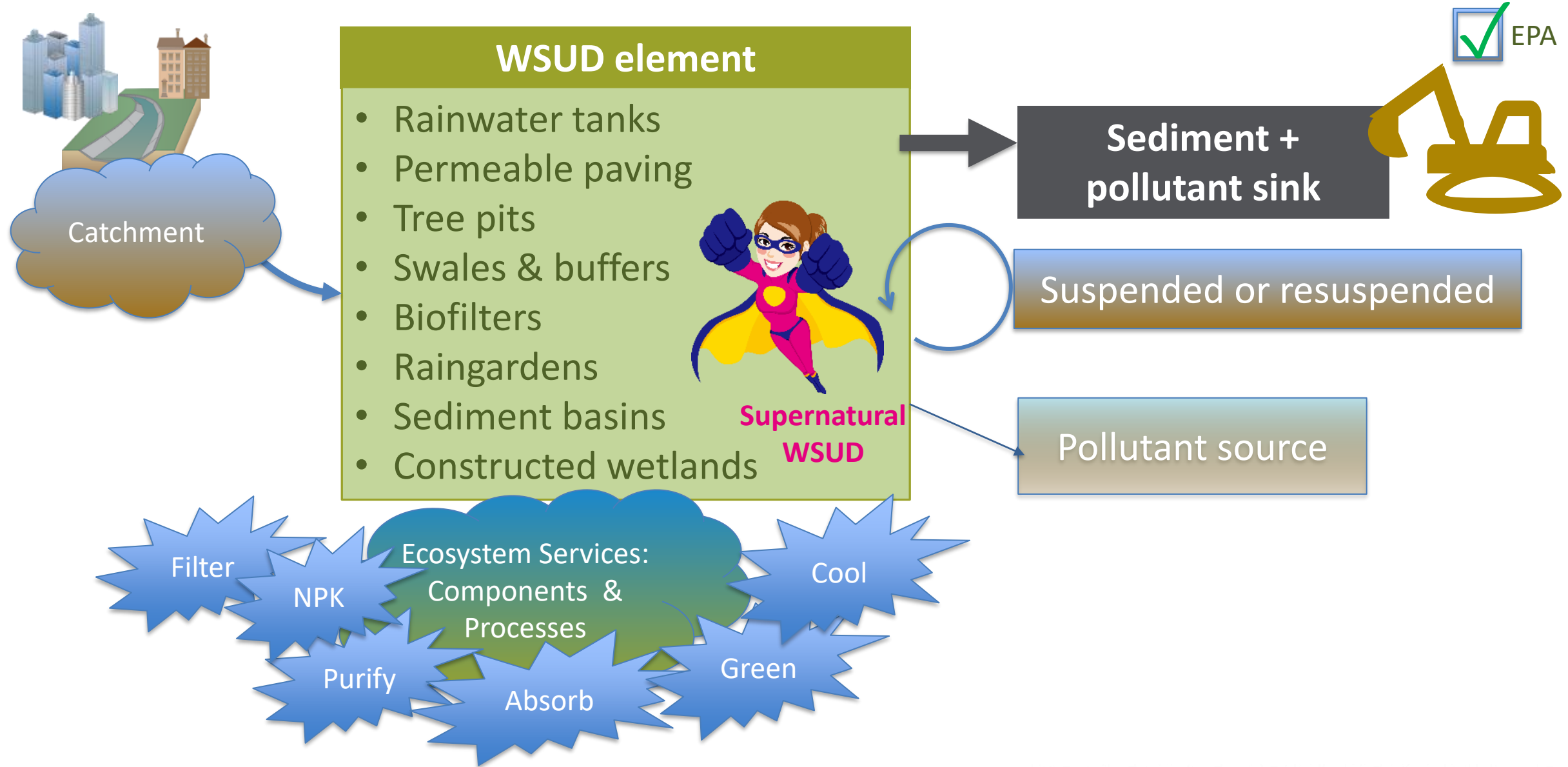


One of three 900mm pipes brought to surface now runs into:

- Detention basin
- Swales
- Rock riffles
- Infiltration trenches



# WSUD ecosystem services





# WSUD ecosystem service capacity



	Bioretention swales	Bioretention basins /raingardens	Vegetated swales/ buffer strips	Sand filters	Sedimentation basins	Constructed wetlands
✓ High applicability						
✓ Medium applicability						
✓ Low applicability						
<b>FUNCTION:</b>						
Water quality treatment	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Flow attenuation	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓✓
Stormwater conveyance	✓✓✓	✓	✓✓✓	✓	✓	✓
<b>Particle size removal</b>						
Coarse-Medium particles 5000 µm-125 µm	High	High	Medium	High	High	Medium
Fine particulates 125 µm-10 µm	High	Medium	Medium	High	Medium	High
Very fine/Colloidal particulates 10 µm-0.45 µm	High	Low	Medium	High	Low	High
Dissolved particles <0.45 µm	Low	Low	Low	Low	Low	Low

Summary of treatment function, applicability and cost

Source: Water sensitive urban design guidelines, South Eastern Councils. Melbourne Water

# Optimising WSUD for coastal benefits

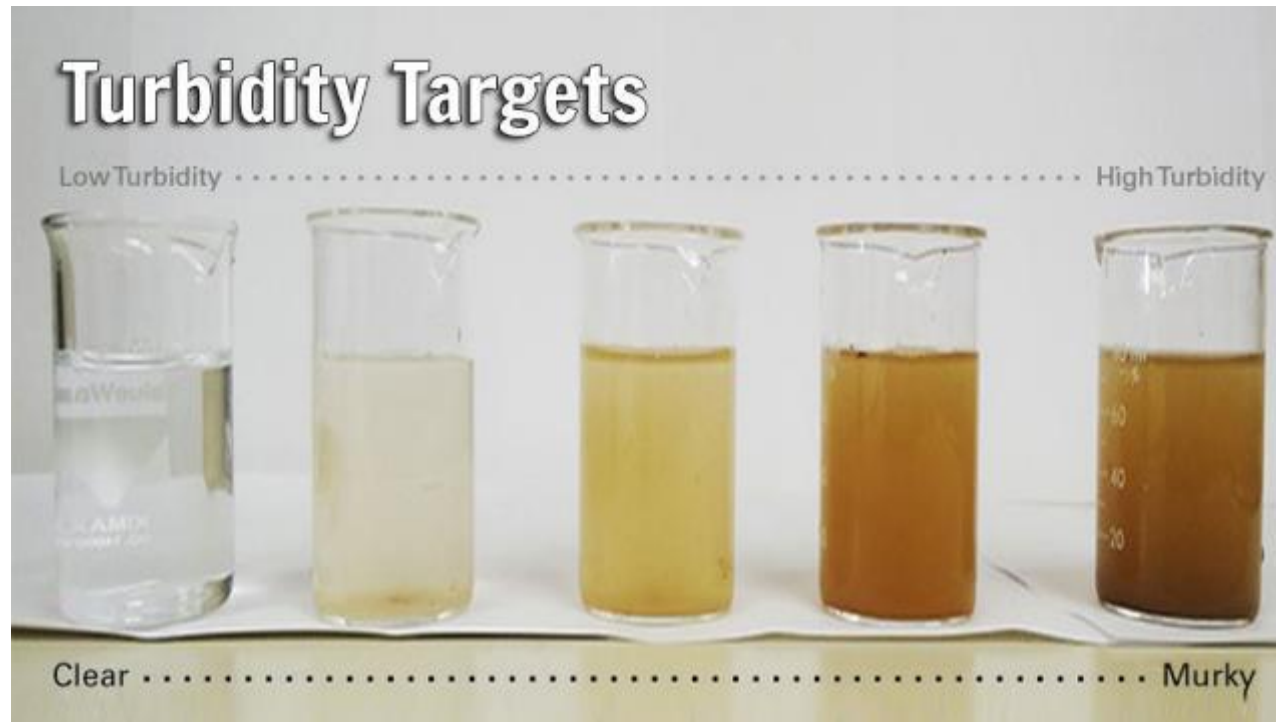


**Design, construct, operate and maintain based on:**

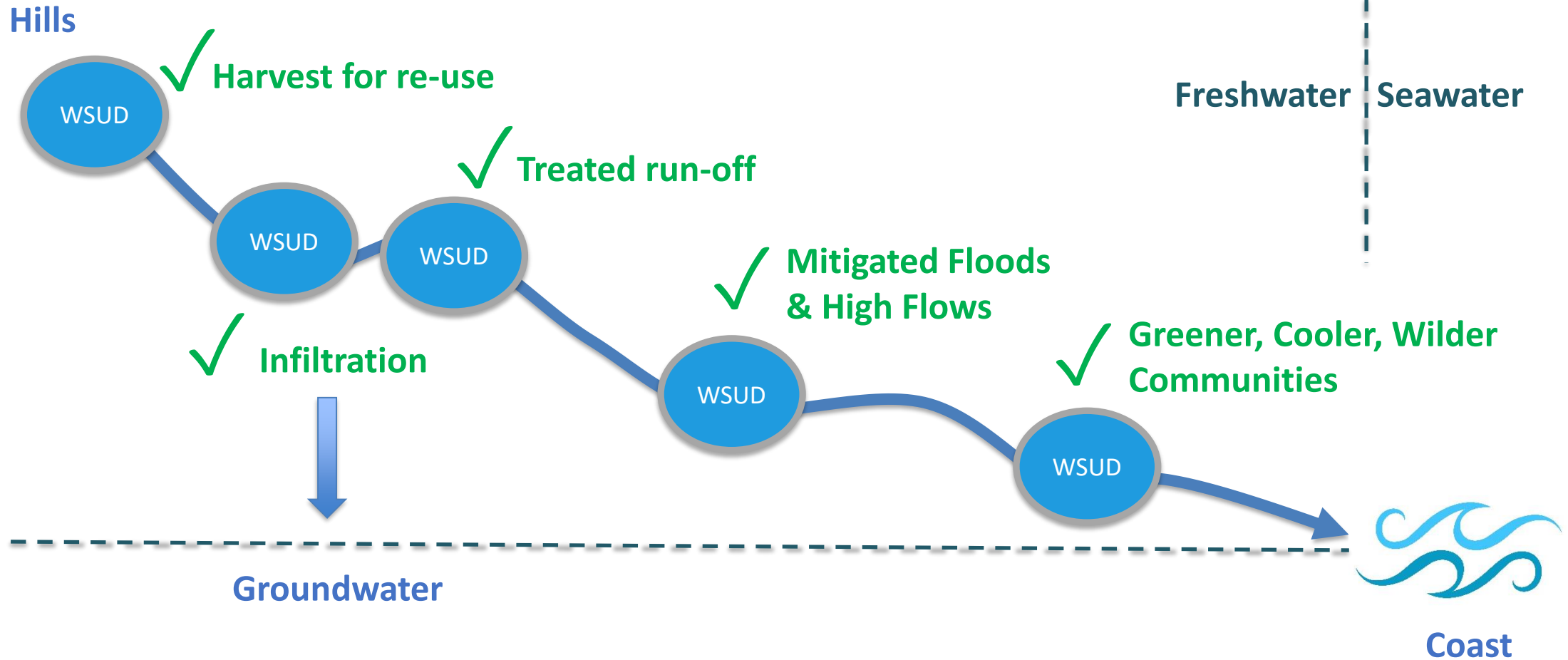
- **Ecosystem Services:** what's needed in that location?
- **Catchment Inflows:** Loads, particle size, 'slugs'
- **Design:** Fit-for purpose sediment traps, high flow bypass
- **Ease of cleaning:** Sediments removed often
- **Actual hydraulics:** As-constructed and maintained
- **Actual water regime:** Duration, frequency, timing, depth
- **Planting success:** Density, survival, species
- **Operations:** Gates, stop logs, pumps
- **Maintenance:** Dredging, GPT cleaning, infrastructure
- **Collaborations:** Total catchment management



# Work on end-of-system WQ targets

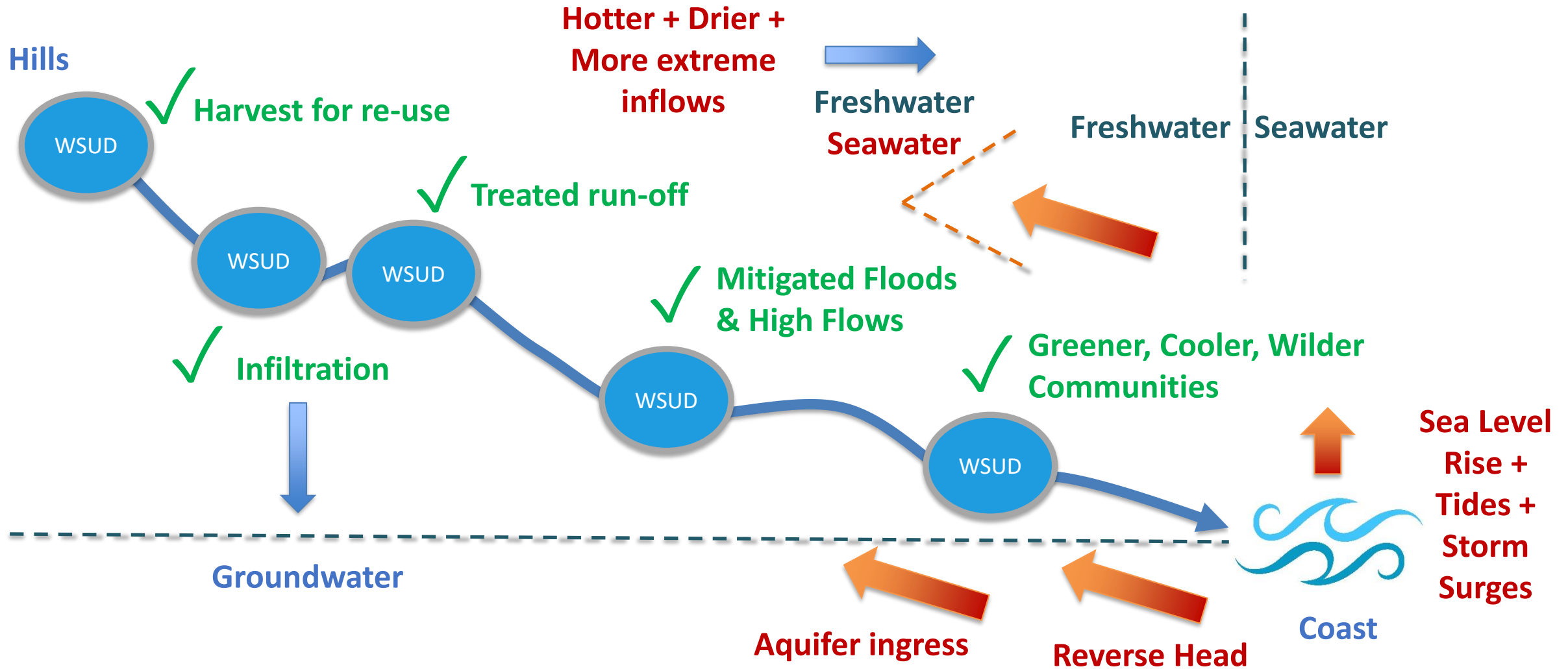


# The great coastal WSUD challenge





# The great coastal WSUD challenge



# Unstable salinity = unstable ecosystems

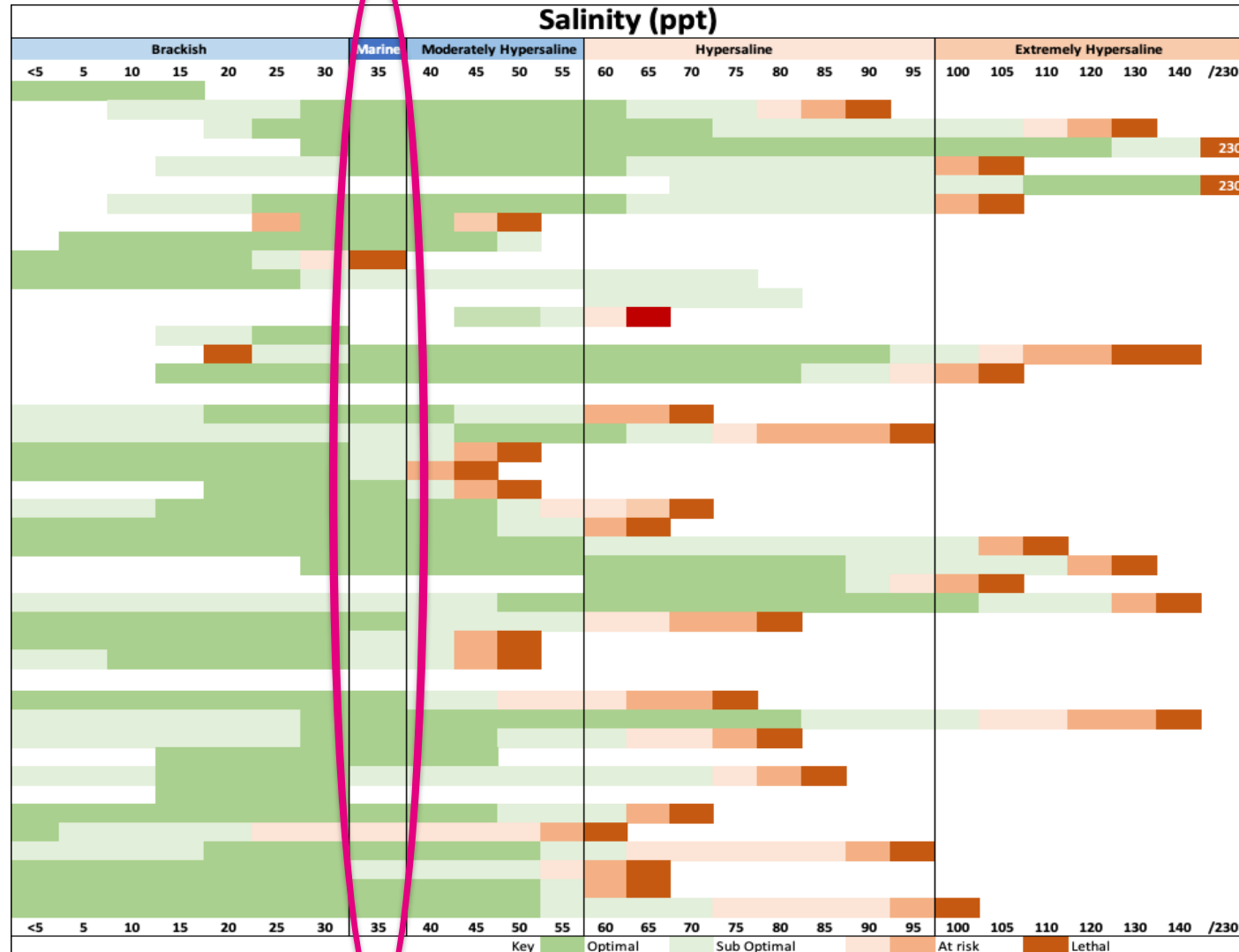
Seawater Concentrations

Aquatic Plants (15 species)

Algae

Macroinvertebrates (16 species)

Fish (12 species)



Based on literature and observations in Coorong Lagoons, SA. Unpublished data compiled by Coorong, Lakes Alexandrina and Albert and Murray Mouth Scientific Advisory Group.



# Optimising WSUD for coastal benefits



- **Understand whole water cycle** - including sea level rise, salinity challenges and predicted changes.
- **Set targets** – local & catchment scale
- **Prevent mobilisation of pollutants** – cheapest & best
- **Chains of WSUD** – supernatural ecosystems
- **Monitor** - water quality & loads
- **Inspect** WSUD elements regularly
- **Maintain & Rectify** as needed to perform well
- **Build-in true costs** - forward budgets
- **Think big and long-term** – future water challenges need lots of integrated and flexible solutions

# Our Partners



## Program Partners



## Project Partners







[www.watersensitivesa.com](http://www.watersensitivesa.com)

Dr Kerri Muller  
Principal Ecologist  
[kerri@watersensitivesa.com](mailto:kerri@watersensitivesa.com)

[www.watersensitivesa.com](http://www.watersensitivesa.com)

**LIVEABLE WATER SENSITIVE COMMUNITIES.**