

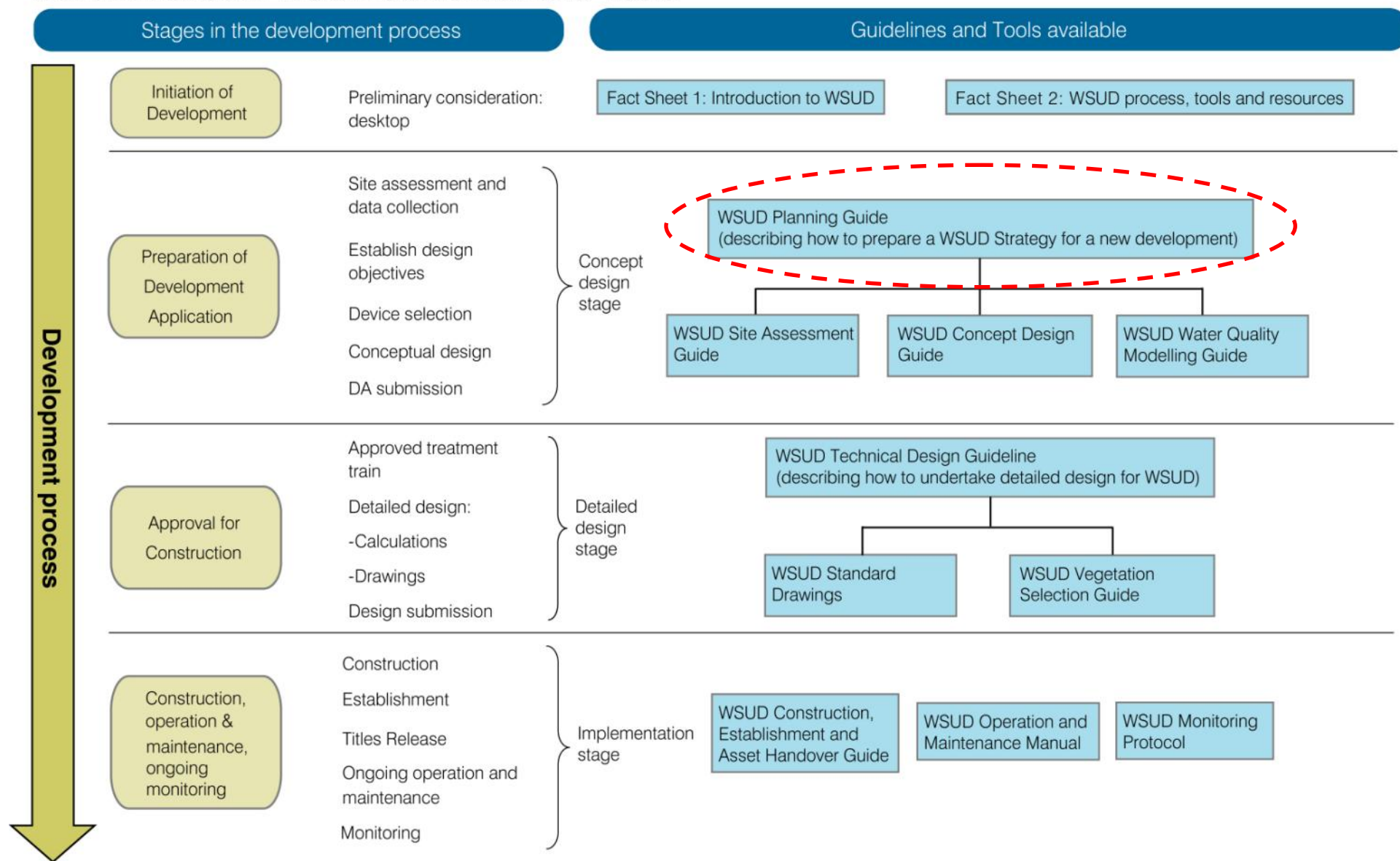


WSUD Planning and Concepts for Darwin

WSUD planning and concept design for Darwin

- WSUD Planning Guide
- WSUD Site Assessment
- Morning tea
- WSUD Concept Design (Practice) Guide
- Case studies
- Lunch

Darwin Harbour WSUD Guidelines and Tools



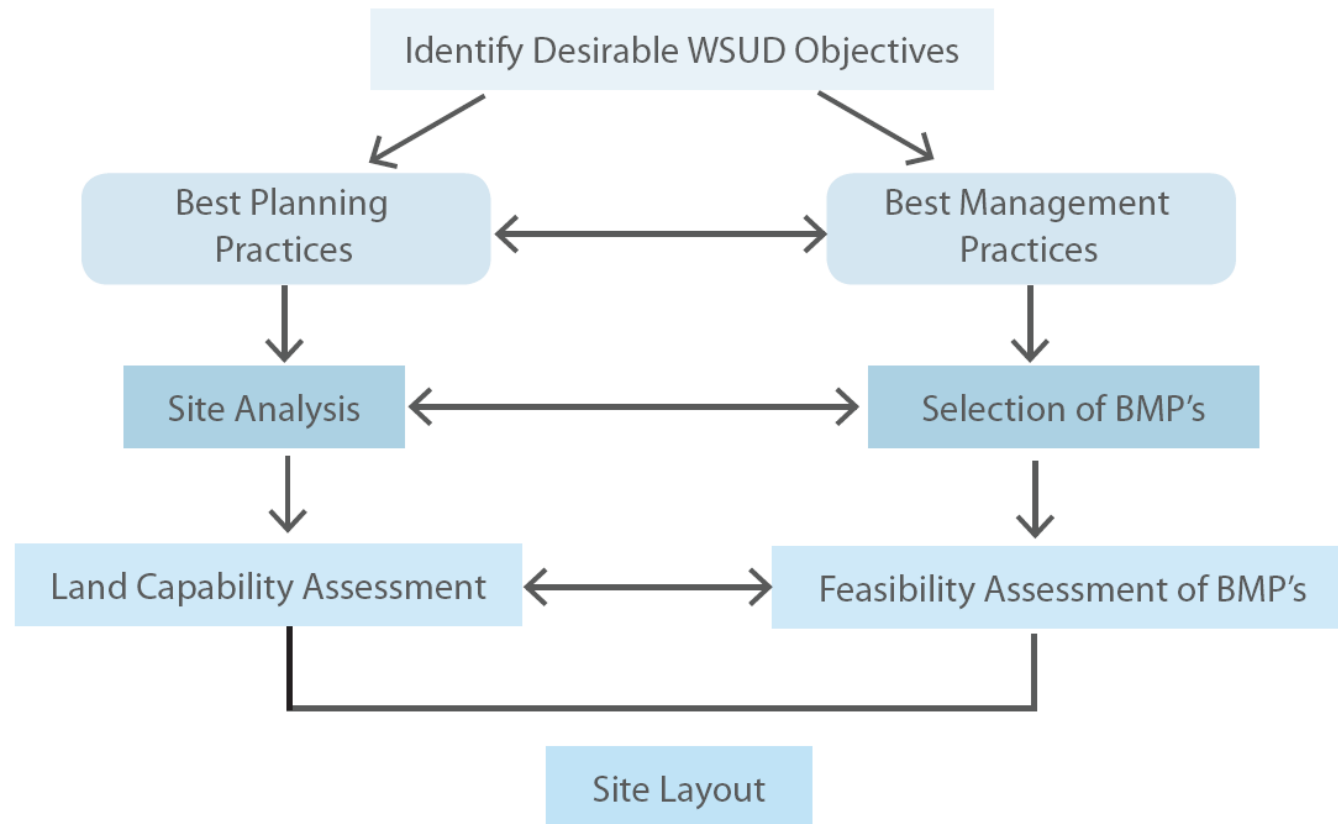
When is WSUD applied?

Development Type	WSUD Objectives	
	Stormwater Quality	Potable Water Conservation
Single Allotment	Long term	Recommended now
Medium and High Density Residential	Medium term	
Large Residential Subdivisions	Recommended now	
Commercial and Industrial	Recommended now	
Government Buildings	Short-medium term	
Infrastructure	Short-medium term	NA

What does WSUD involve?

WSUD measures		Single detached dwellings and low density attached dwellings	Medium and high density residential development	Commercial and industrial development	Public sector development		Transport infrastructure	Major subdivisions
					Buildings	Open space		
Potable water conservation	Water efficient fittings and appliances							
	Water efficient landscaping							
	Rainwater tanks							
	Water recycling							
	Stormwater harvesting and reuse							
Stormwater quality	Gross pollutant traps							
	Swales							
	Bioretention systems							
	Wetlands							
	Infiltration							

How is WSUD integrated into development?

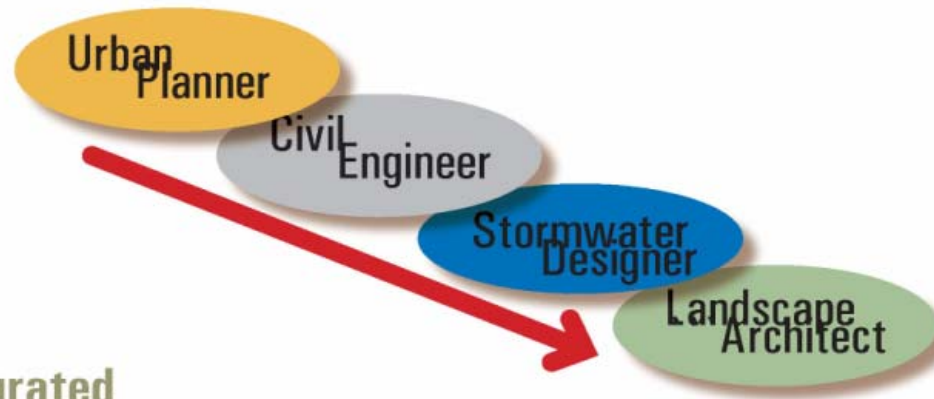


WSUD strategy process

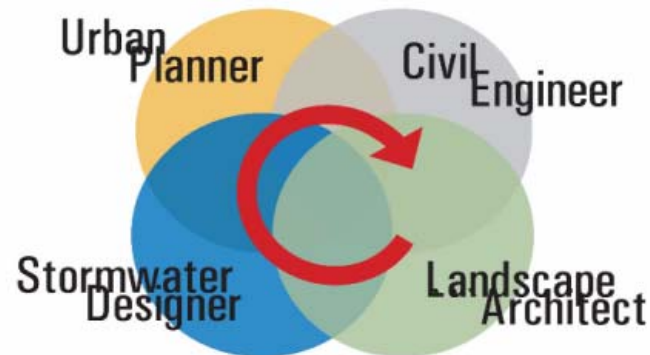
1. Establish the site context:
 - Climate
 - Natural capital
 - Local ecology
 - Landscape attributes (view lines, key site features)
 - Physical infrastructure (within the site and the broader region)
 - Development imperatives (e.g. demographic, density, land uses)
2. Interpret the physical setting, including the topography and drainage, geology, soils and groundwater, existing development
3. Establish key desirable outcomes / performance objectives, including objectives for the built and natural environment
4. Collaborate amongst an interdisciplinary team including urban planners, engineers, WSUD specialists and landscape architects to develop urban design and infrastructure solutions responsive to the above.

Who's involved?

Conventional Design Process



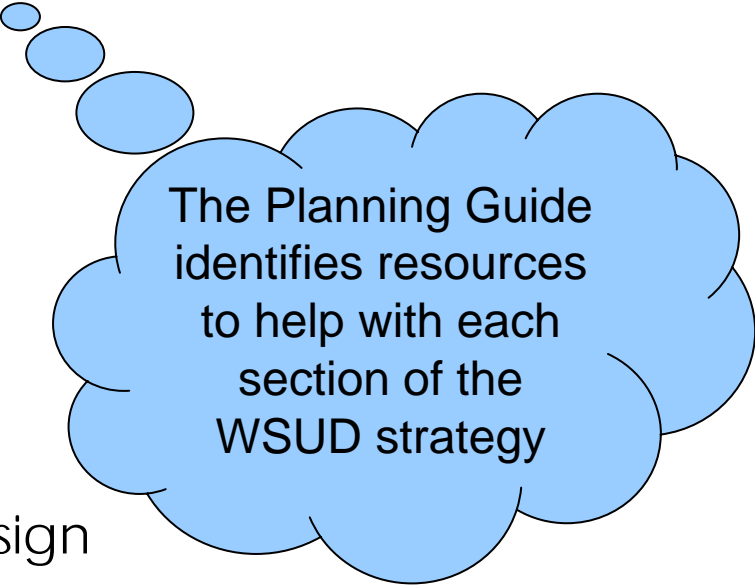
Integrated Design Process



Also:
Architects
Urban designers
Environmental engineers
Ecologists
Land developers

WSUD strategy

- Background information
- Proposed development
- Constraints and opportunities
- WSUD objectives
- Water conservation
- Stormwater quality
- Integration with the urban design
- Monitoring and maintenance
- Costs



The Planning Guide
identifies resources
to help with each
section of the
WSUD strategy

WSUD Strategy Elements

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs

Background Information

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs

- Groundwater, geology and soils
- Drainage and flooding
- Ecology of receiving environments
- Regional planning
- Regional infrastructure (e.g. water supply, wastewater treatment)

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Northern Territory Government

Natural Resources, Environment and The Arts - NRETA Maps

Layers Legend Search Select Find Location Spatial Data Search

Map Legend

- Road Centrelines
 - Highway
 - Other
- Rainfall Station
 - Current
 - Historic
- Telemetered Site
- Gauging Station
 - Current
 - Historic
- Coastline

Scale: 1:124,737 go Map Tool Zoom In

Degrees Longitude/Latitude: 130.828, -12.305 GDA84 © 2004 Northern Territory Government | Disclaimer Privacy and Metadata Statements.

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Proposed Development

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs

- Future water demands at the site
- Future stormwater runoff from each subcatchment at the site
- Potential areas available for stormwater treatment



Constraints and Opportunities

Background information

Proposed Development

Constraints Opportunities

WSUD Objectives

Water Conservation

Stormwater Quality

Integration w Design

Monitoring Maintenance

Costs

- Review available climate data
- Identify natural capital which should be protected and enhanced on site
- Characterise local ecology and receiving environments
- Identify landscape attributes of the site
- Identify existing physical infrastructure in the region
- Summarise development imperatives
- Gather information on the topography, drainage, geology, soils and groundwater
- Map general drainage patterns, natural water courses and flow paths on site, as well as the location of all points/areas of discharge from the site.

WATER SENSITIVE URBAN DESIGN

SITE ASSESSMENT GUIDE

FINAL DRAFT

Prepared for the Northern Territory Department of Planning and Infrastructure
GPO Box 2520
Darwin NT 0801



October 2008

This document has been prepared as part of the Darwin Harbour WSUD Strategy, supported by funding from the Australian Government

WSUD Objectives

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs

- Site specific issues
 - Key water demands
 - Key pollutants
- Protection of specific receiving environments
 - Streams
 - Water bodies
- Site-specific opportunities
 - e.g. rehabilitation of a stream, creation of a water feature

Water Conservation

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

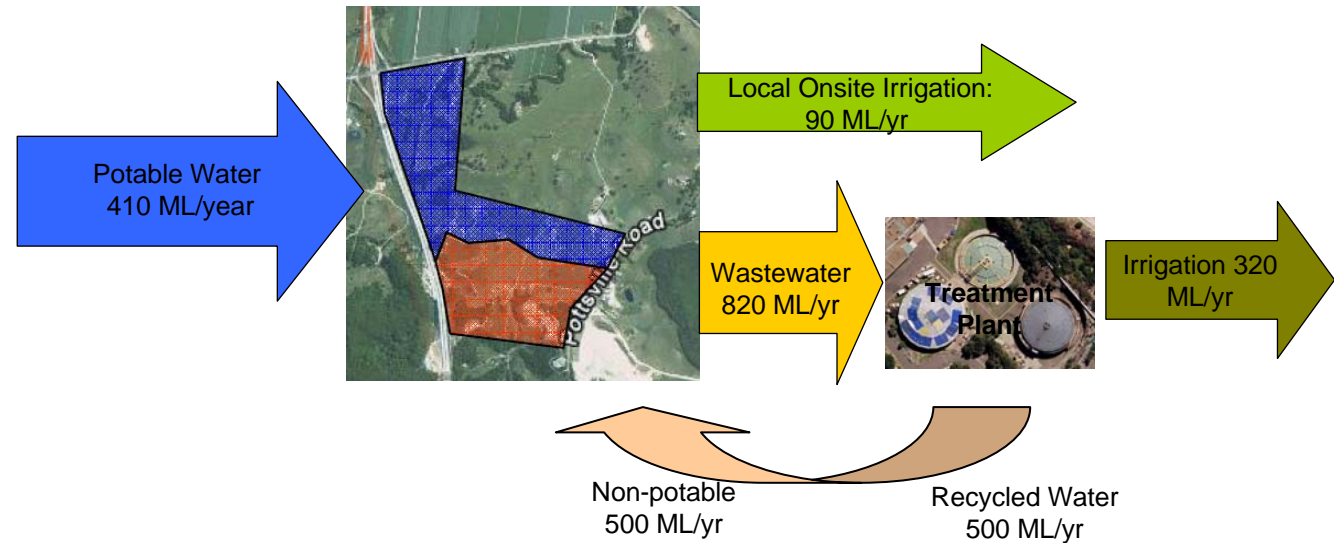
Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs



Potable water conservation

- Concept design guide:
 - Demand management
 - Rainwater tanks
 - Water recycling
 - Stormwater harvesting, storage and reuse
- Other ideas for new development:
 - Demonstration sites, display homes
 - Information packs
 - Incentives for new home owners
 - Discounts on water-efficient fittings, appliances
 - Voucher for native plants

Stormwater Quality

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

Monitoring
Maintenance

Costs

- Location, size and configuration of stormwater treatment elements to meet the appropriate targets.
- Stormwater quality model results demonstrating compliance with the targets
- Details of key assumptions and parameters used in the stormwater quality model.

Stormwater quality

- Concept Design Guide
 - Swales, buffer strips
 - Bioretention systems
 - Wetlands
 - Gross pollutant traps
 - Infiltration
- Stormwater quality modelling guide
- Technical design guidelines

Integration with Urban Design

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

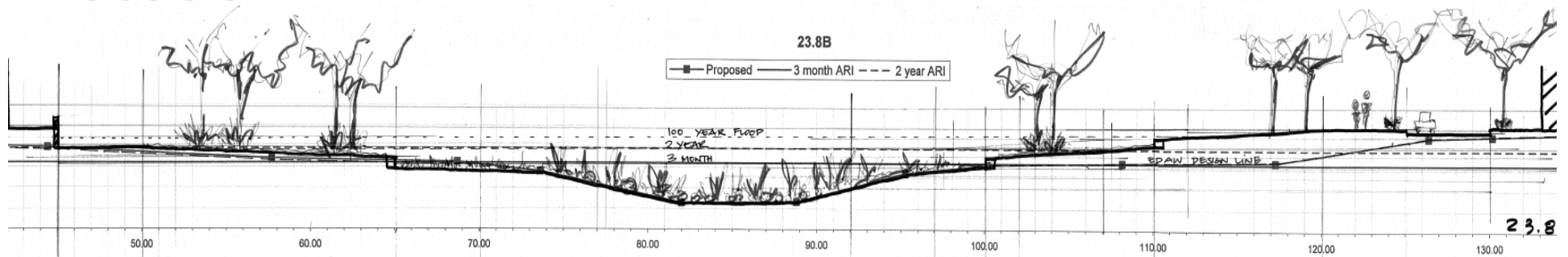
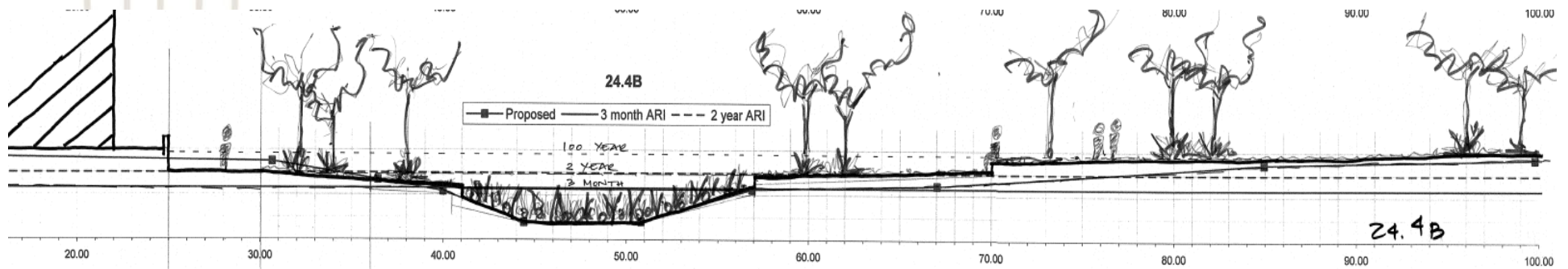
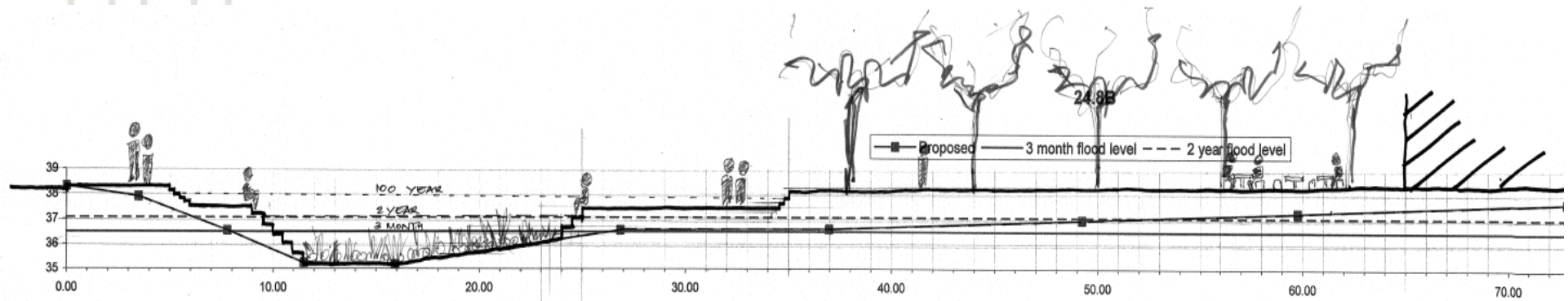
Stormwater
Quality

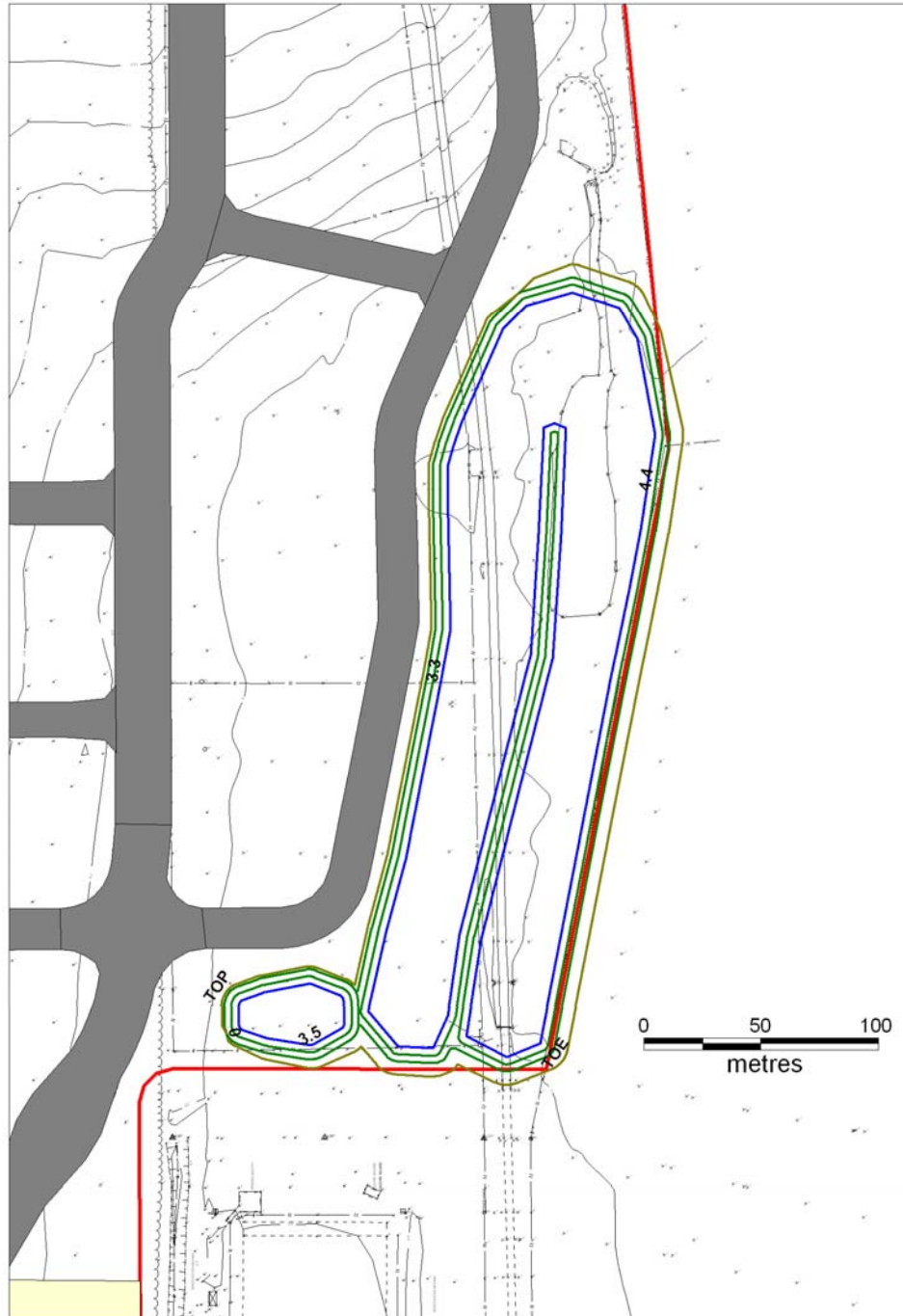
Integration w
Design

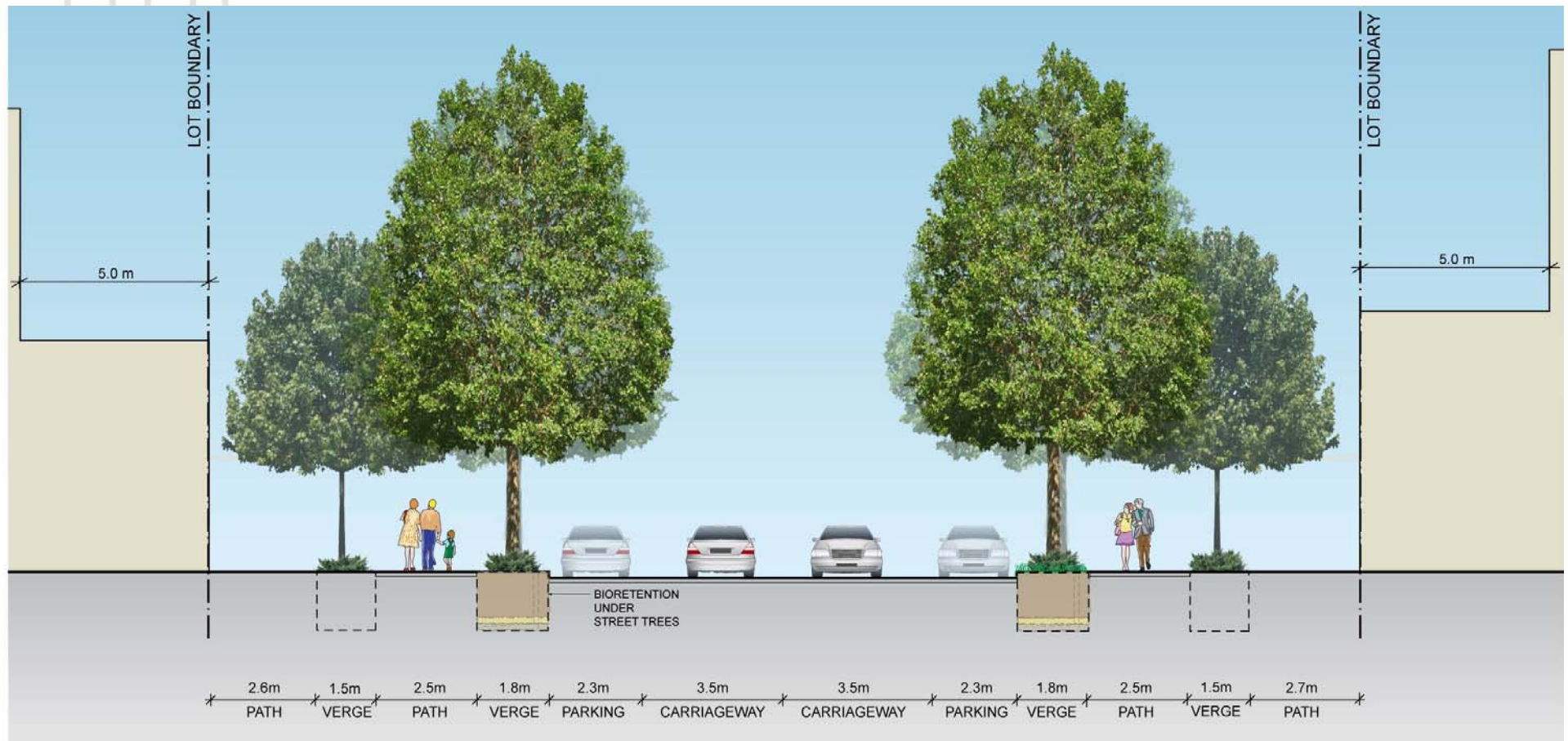
Monitoring
Maintenance

Costs

- Co-ordinate the activities of WSUD specialists, urban designers, engineers and landscape architects to integrate WSUD elements into the development masterplan.
- This section of the WSUD Strategy may include:
 - Site plans (and cross-sections, where relevant) including WSUD elements
 - Drawings to illustrate conceptual layout of WSUD elements within the context of other site features
 - Landscape plan







Monitoring, Maintenance, Costs

Background
information

Proposed
Development

Constraints
Opportunities

WSUD
Objectives

Water
Conservation

Stormwater
Quality

Integration w
Design

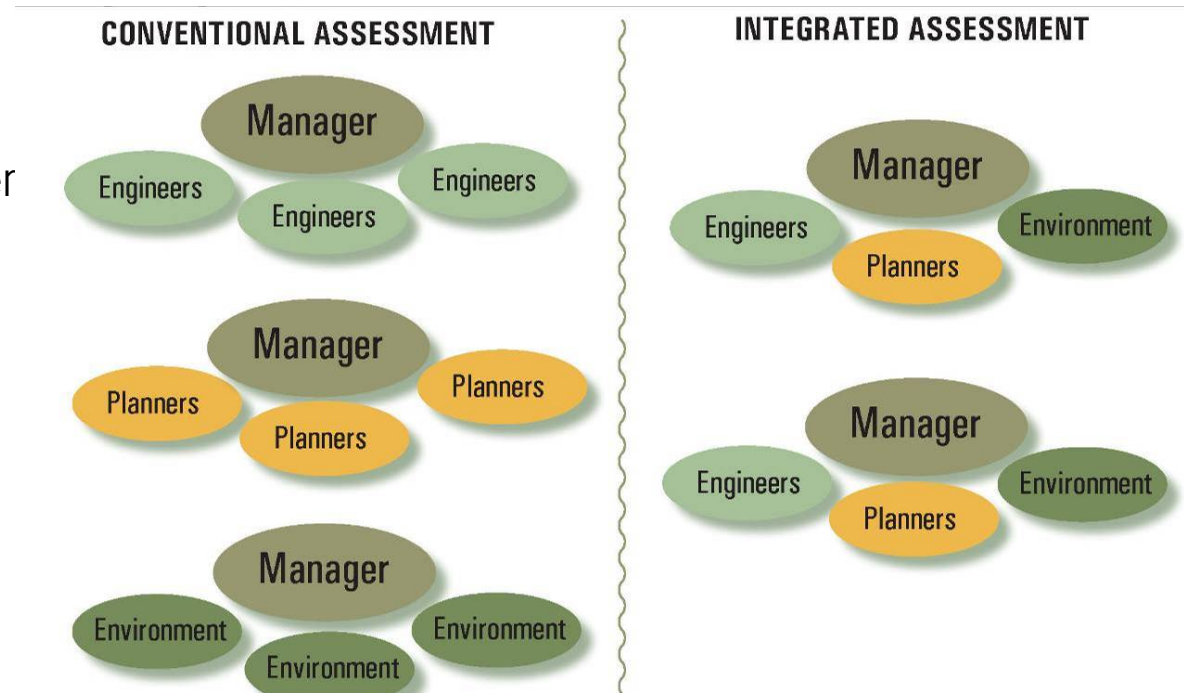
Monitoring
Maintenance

Costs

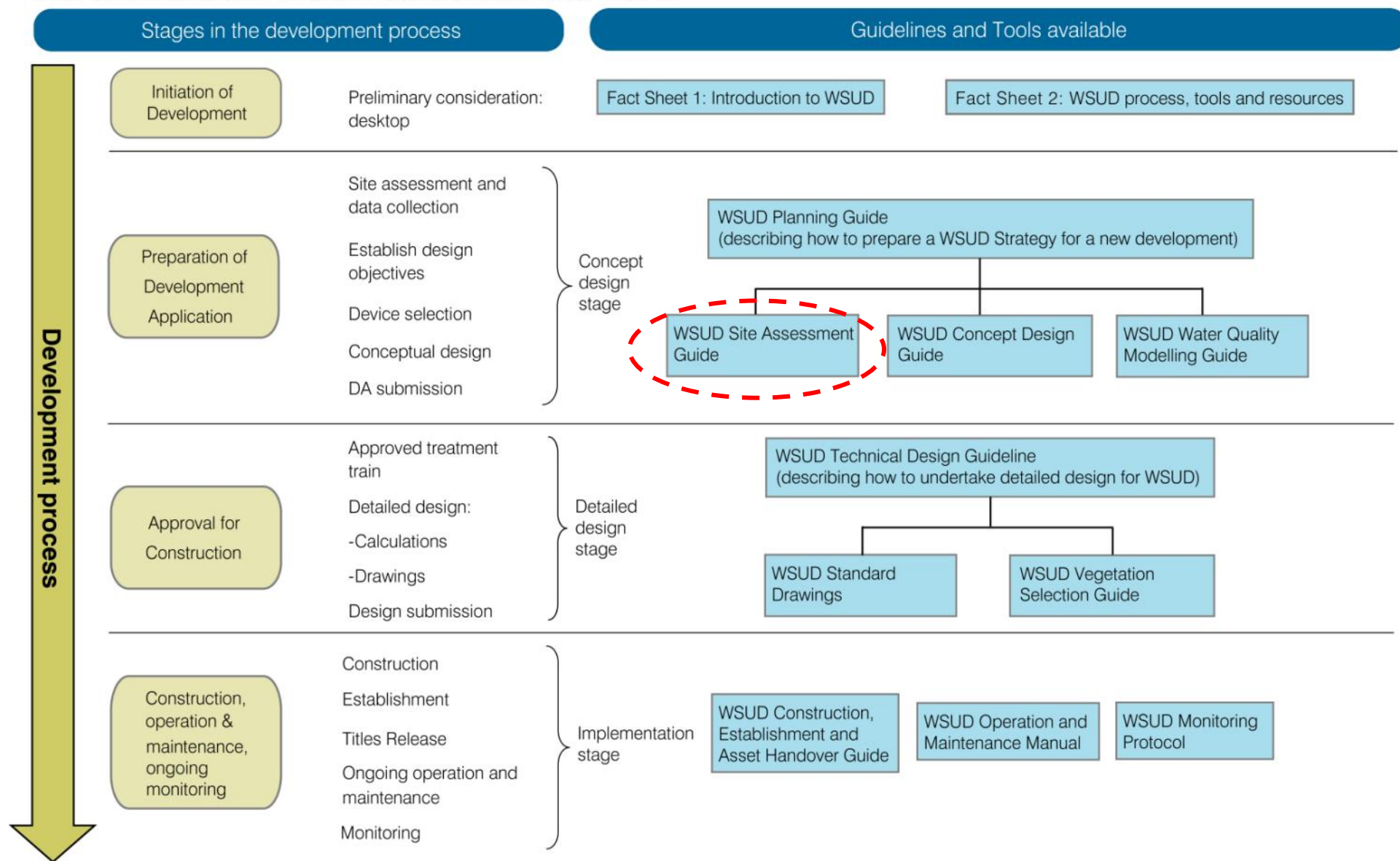
- WSUD operation and maintenance guide
- WSUD monitoring protocol
- MUSIC life cycle costs

WSUD strategy assessment

- Checklists
 - DCA
 - Council
 - NRETAS
 - PowerWater
 - Health



Darwin Harbour WSUD Guidelines and Tools



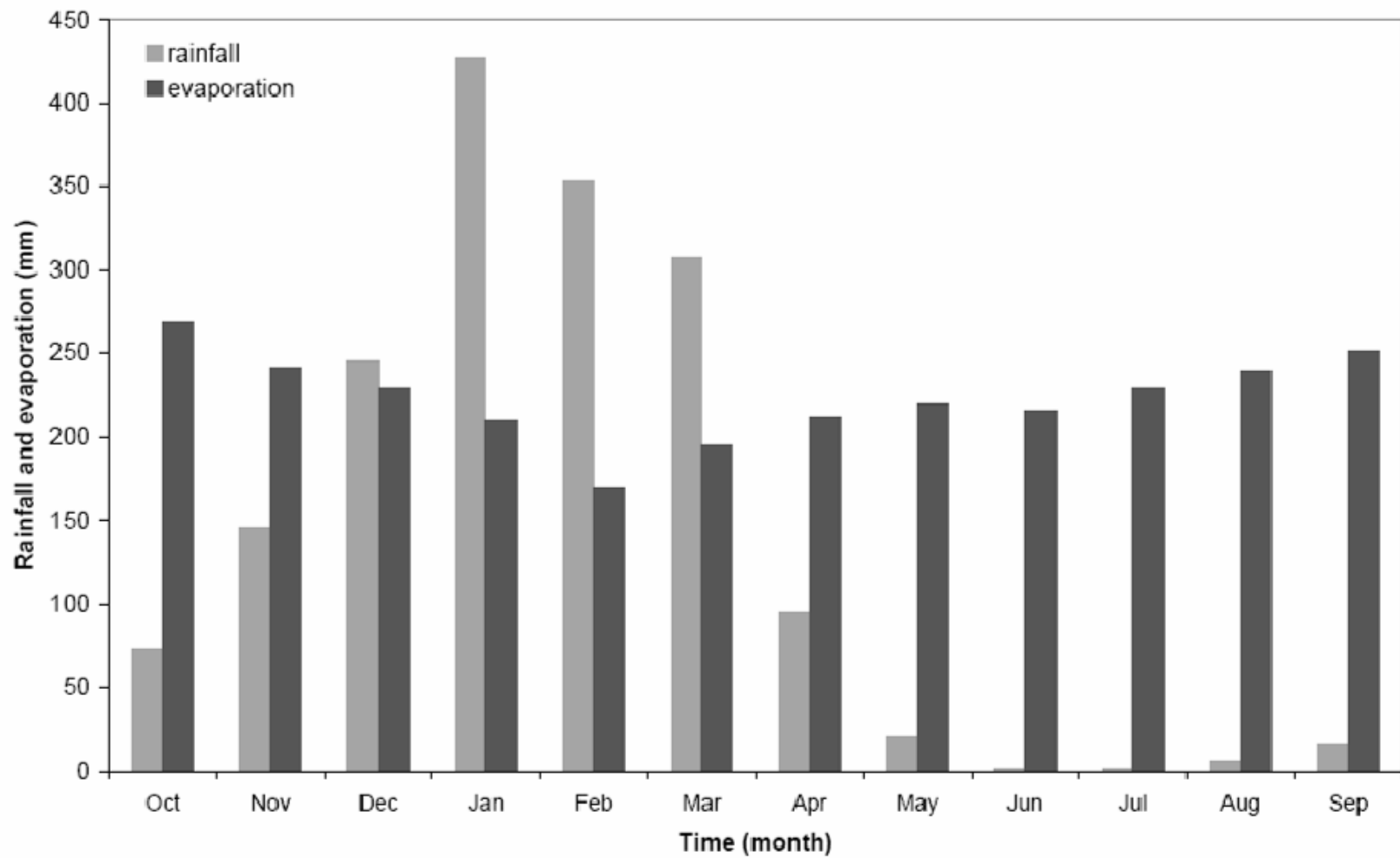
Preparing the WSUD Strategy

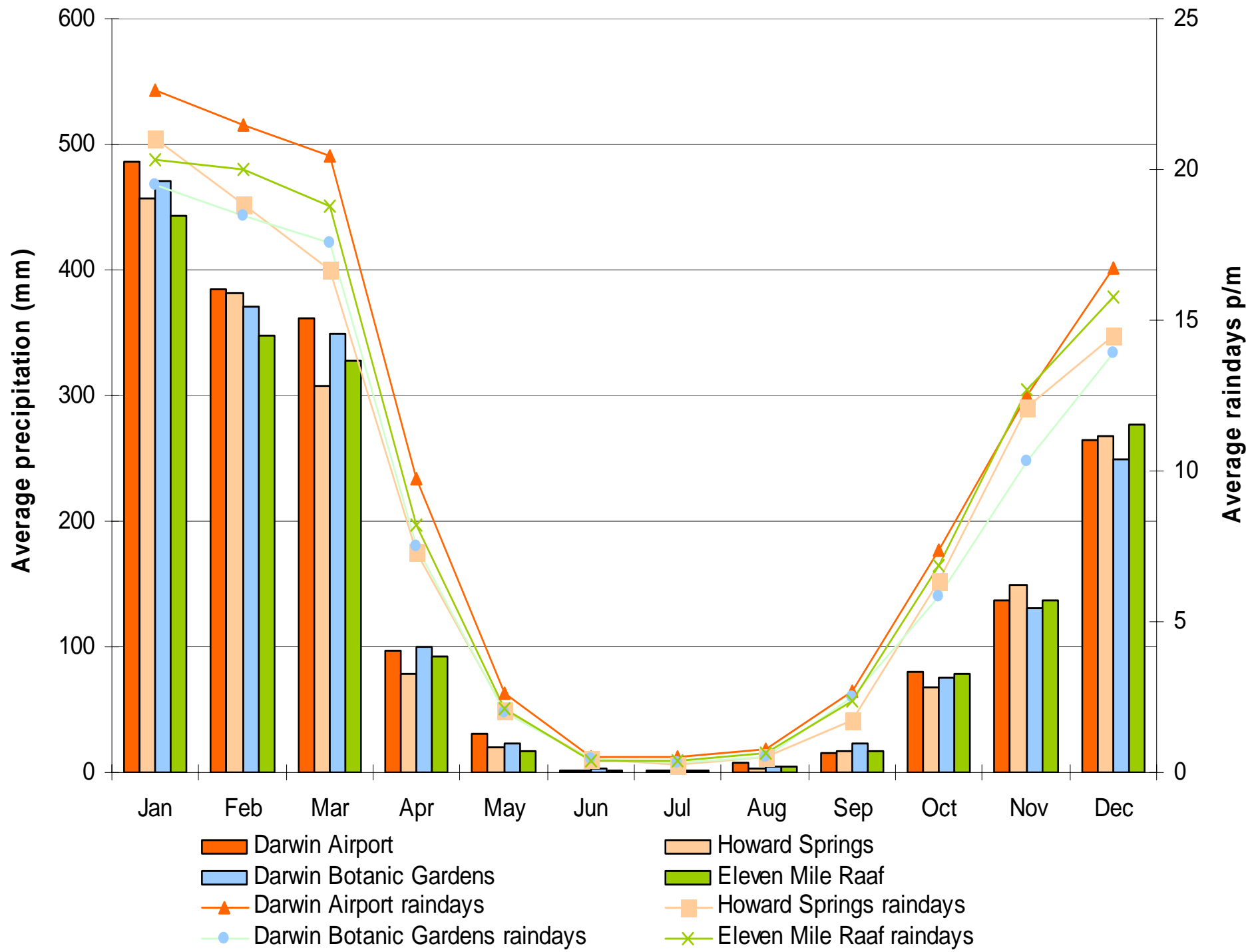
- What do you need to know about the site?

Site Assessment

- Site context – “big picture” things about the site:
 - Climate
 - Natural capital
 - Ecology
 - Landscape attributes
 - Physical infrastructure
 - Development imperatives
- Physical setting – detailed information
 - Topography and drainage
 - Geology, soils and groundwater
 - Existing development

Climate

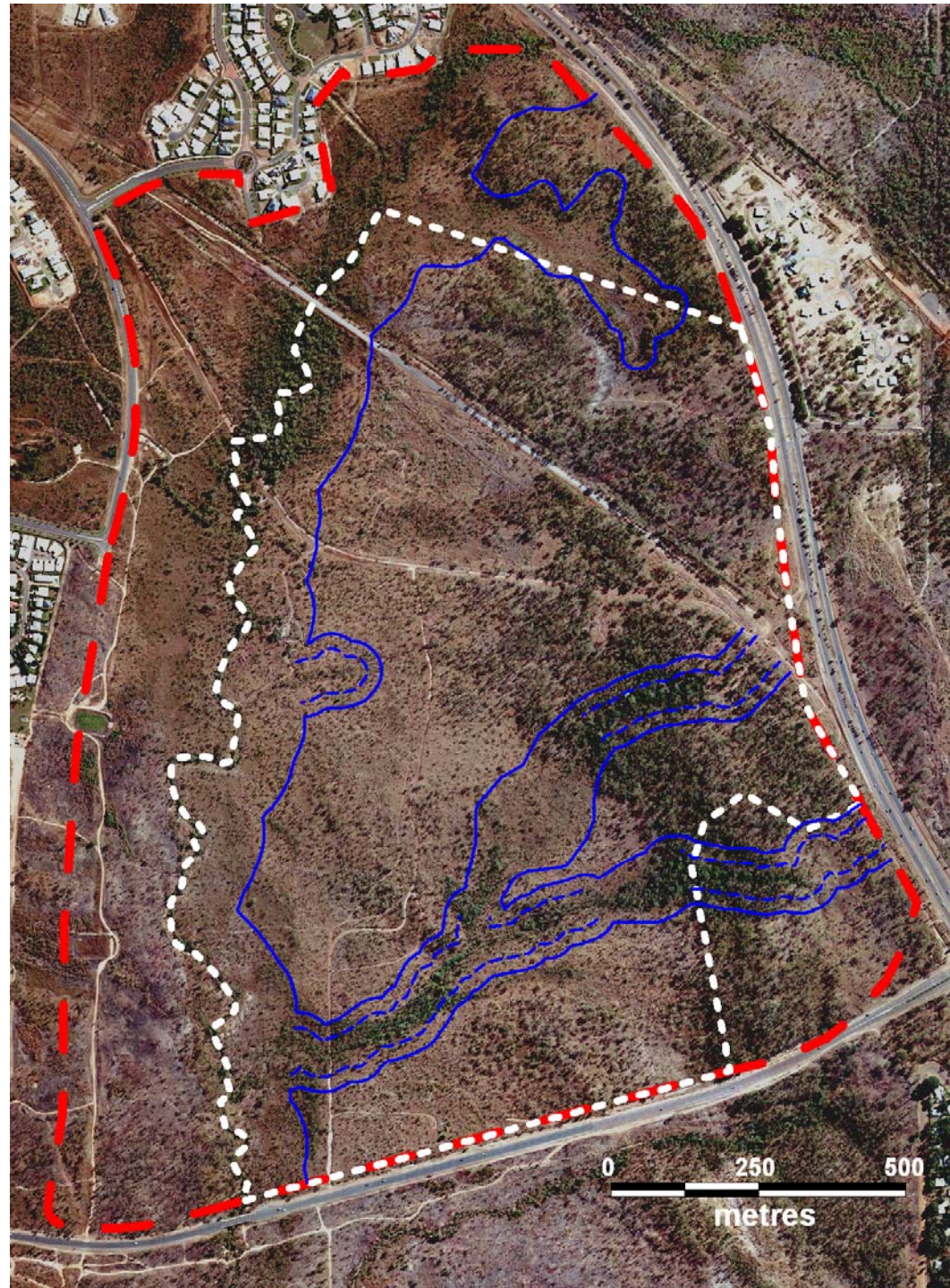




Natural Capital

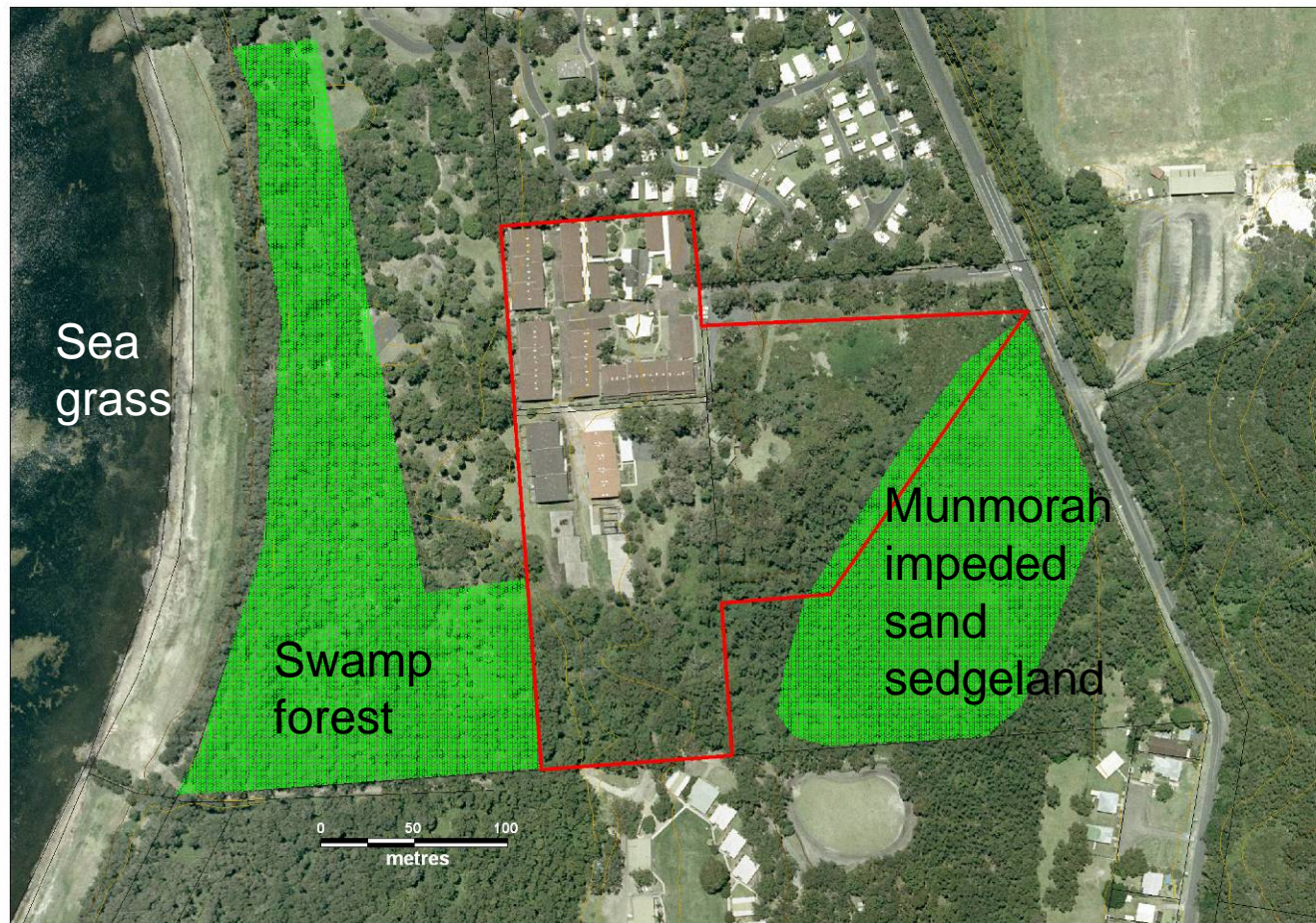
- Native vegetation
- Important habitat/fauna
- Waterways
- Cultural assets



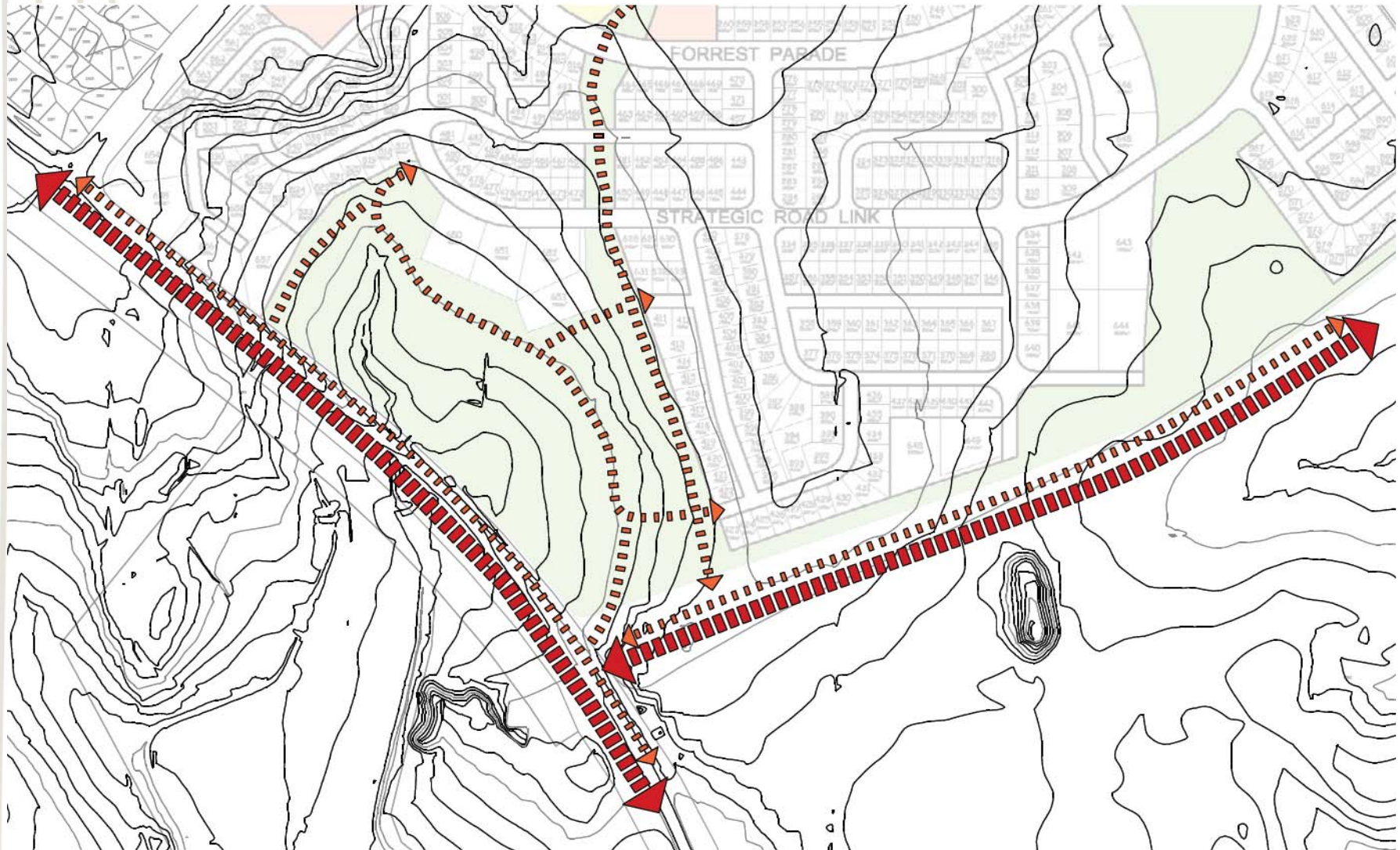


Ecology

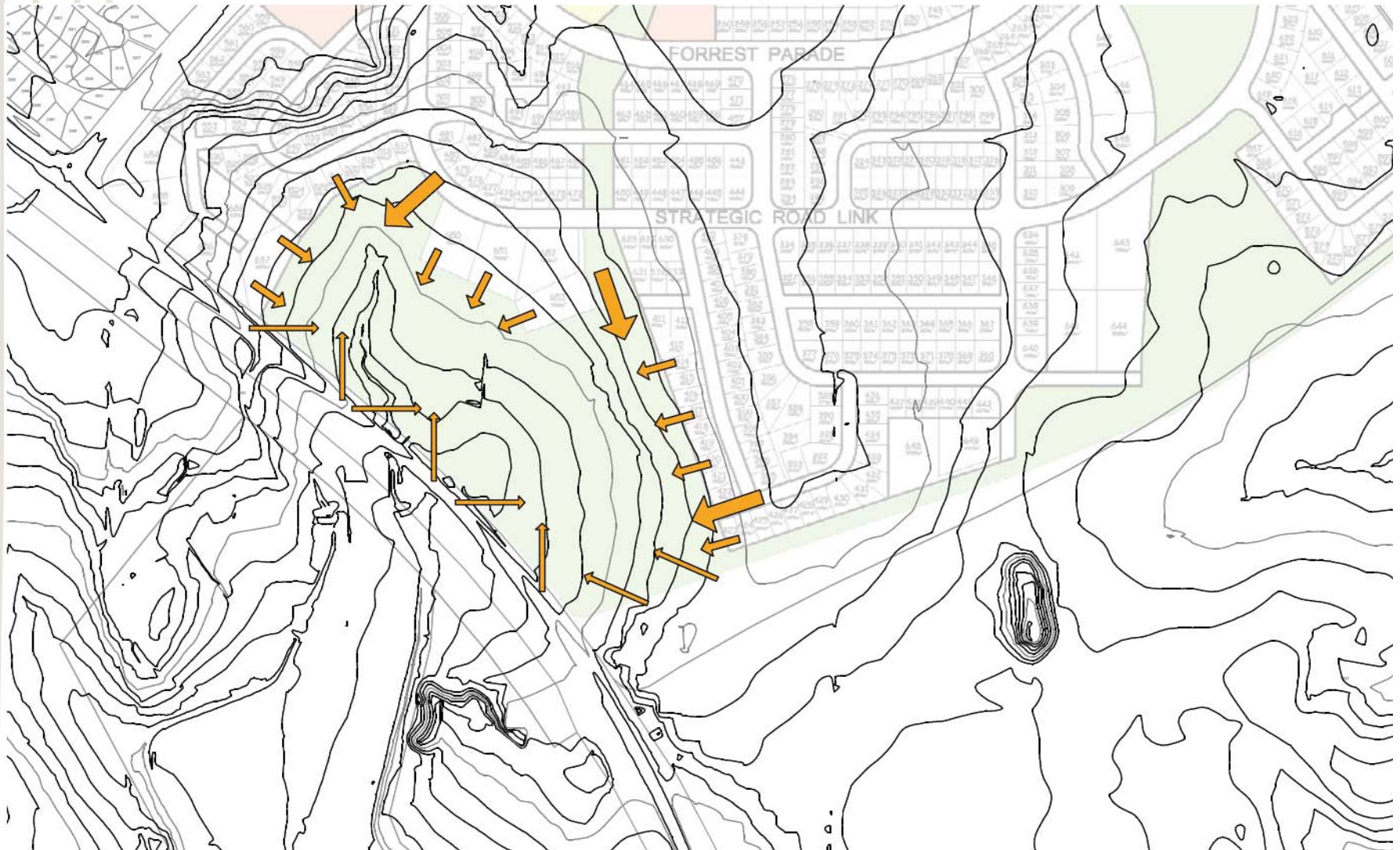
- Aquatic ecosystems, both within and downstream of the site, requiring protection from urban development
- The potential for rehabilitation of any degraded streams on site
- A vegetation template suitable for both stormwater treatment measures and landscaped areas on the site
- Potential links to create biodiversity corridors



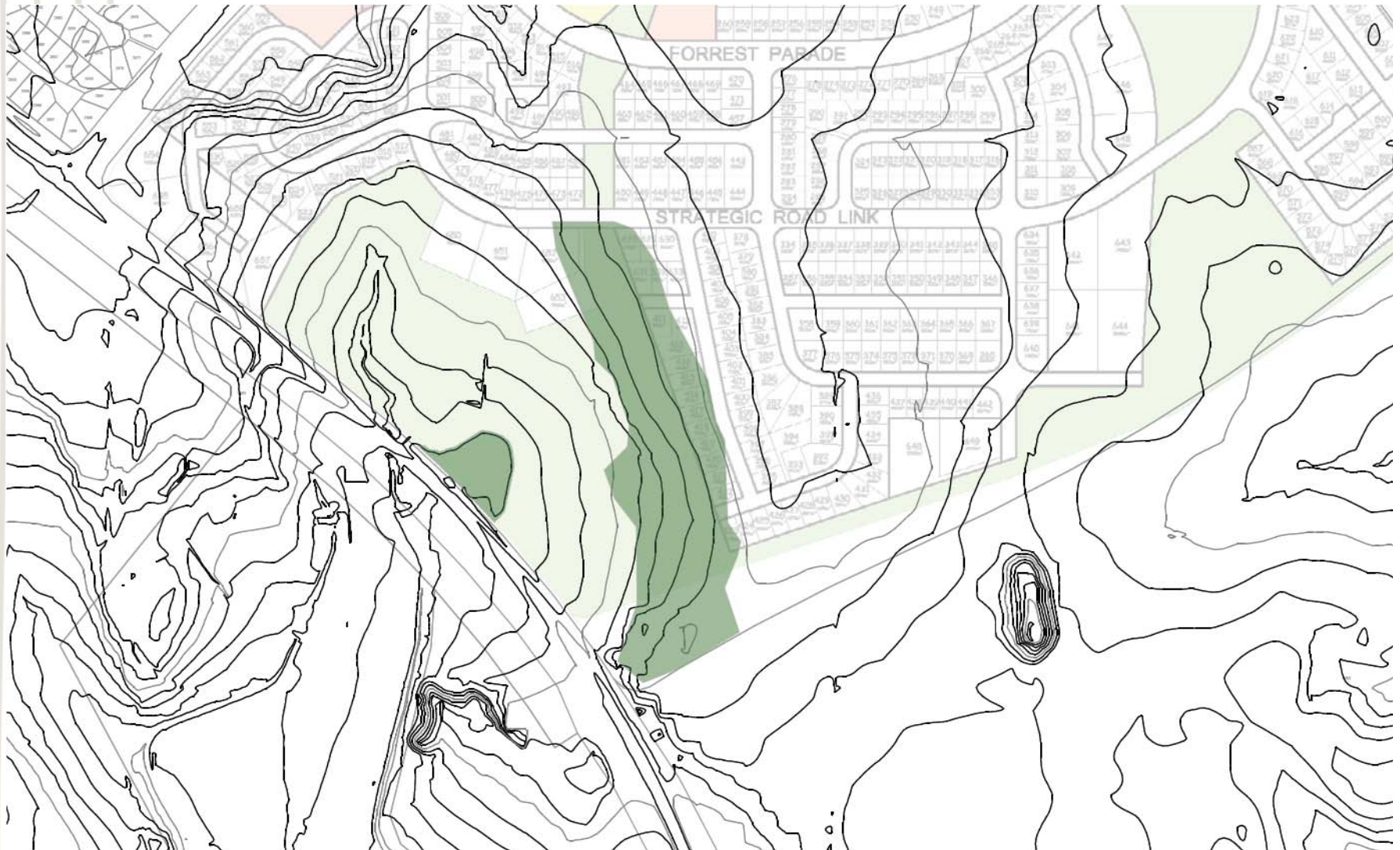
Landscape Attributes



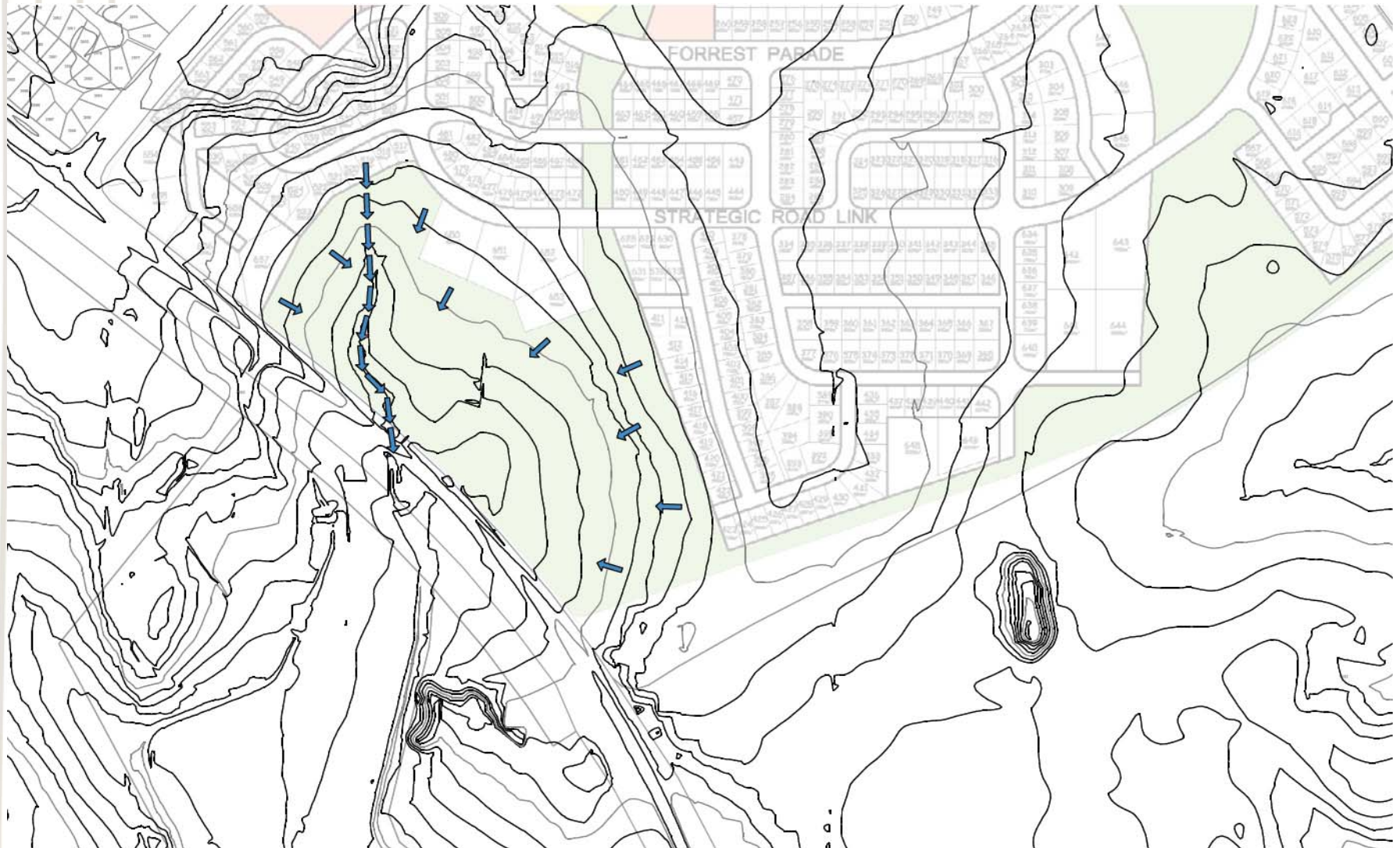
Landscape Attributes



Landscape Attributes



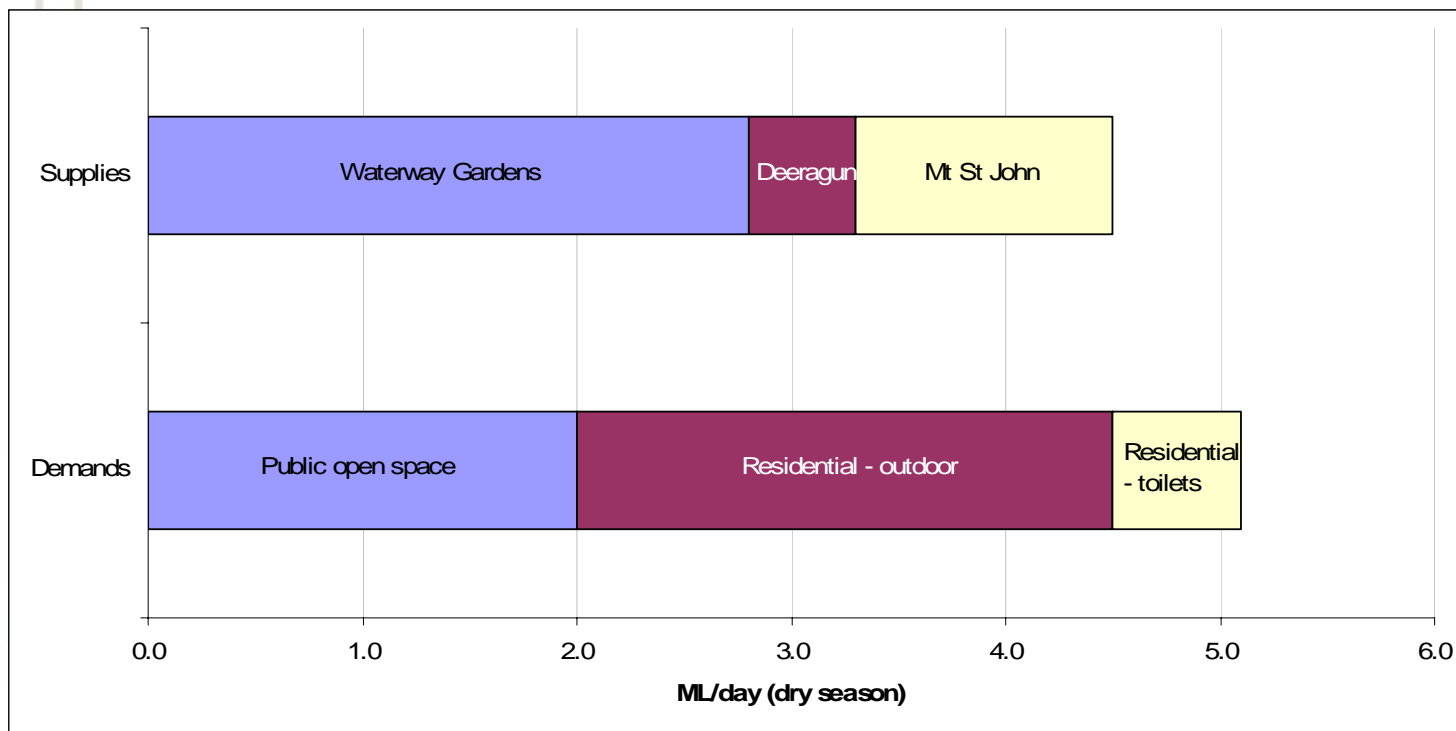
Landscape Attributes



Physical Infrastructure

- Water supply
- Wastewater collection and treatment
- Water recycling
- Major stormwater drainage works





Development Imperatives

- Population and demographic
- Land use and density
- Staging and timing
- Initial development layout



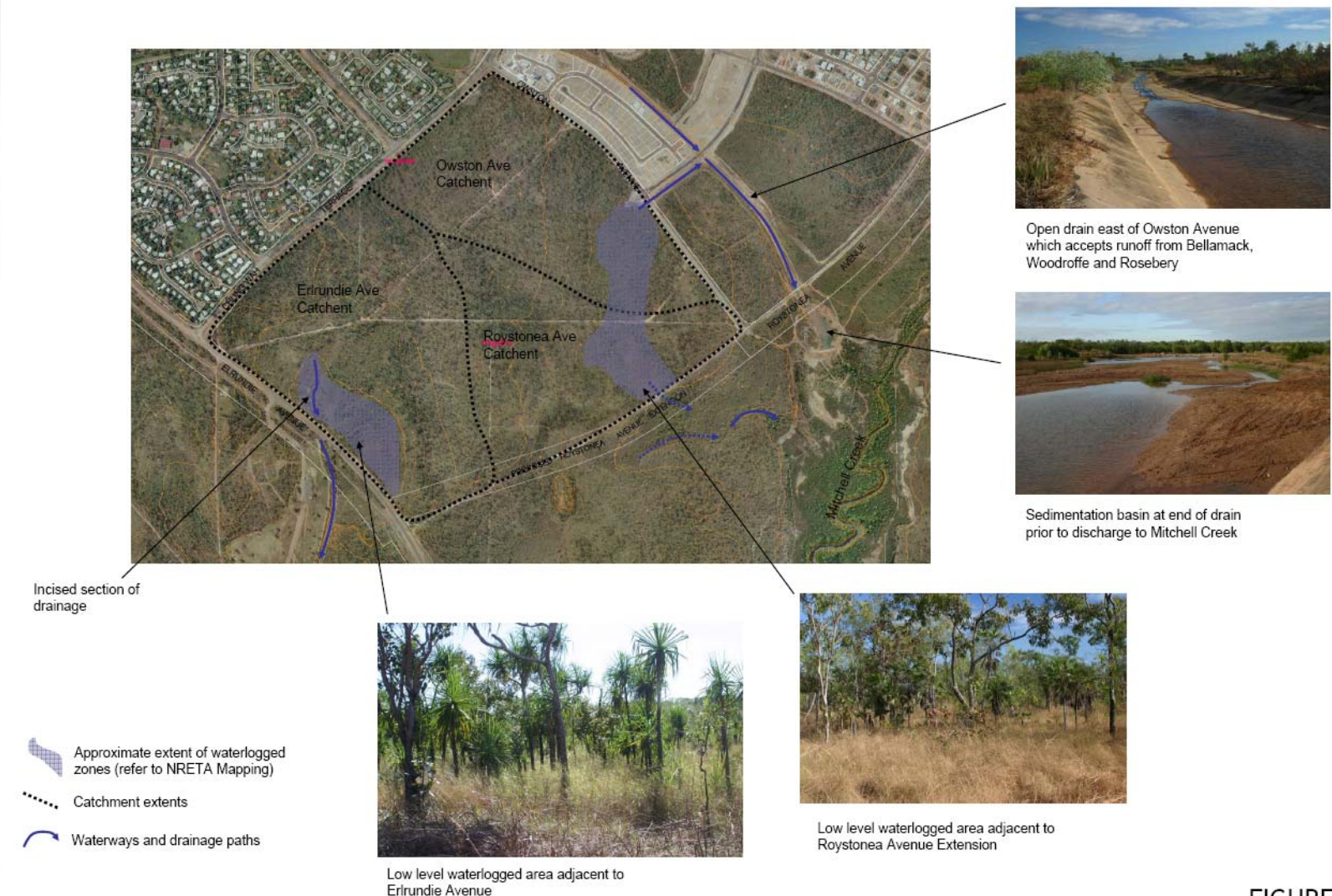
Physical Setting

WSUD Measure	Steep site	Shallow bedrock	Acid Sulfate Soils	Low permeability soil (eg. Clay)	High permeability soil (eg. sand)	High water table	High sediment input	Land availability
Swales and buffer strips	C	D	D	✓	✓	D	D	C
Bioretention Swales	C	C	C	✓	✓	C	D	C
Sedimentation basins	C	✓	✓	✓	✓	D	✓	C
Bioretention basins	C	D	D	✓	✓	C	C	C
Constructed wetlands	C	D	C	✓	D	D	D	C
Infiltration measures	C	C	C	C	✓	C	C	C
Sand filters	D	✓	✓	✓	✓	D	C	✓
Aquifer storage and recovery	C	C	C	C	✓	C	C	C

C – Constraint may preclude use; D – Constraint may be overcome through appropriate design;

✓ - Generally not a constraint

Topography and Drainage

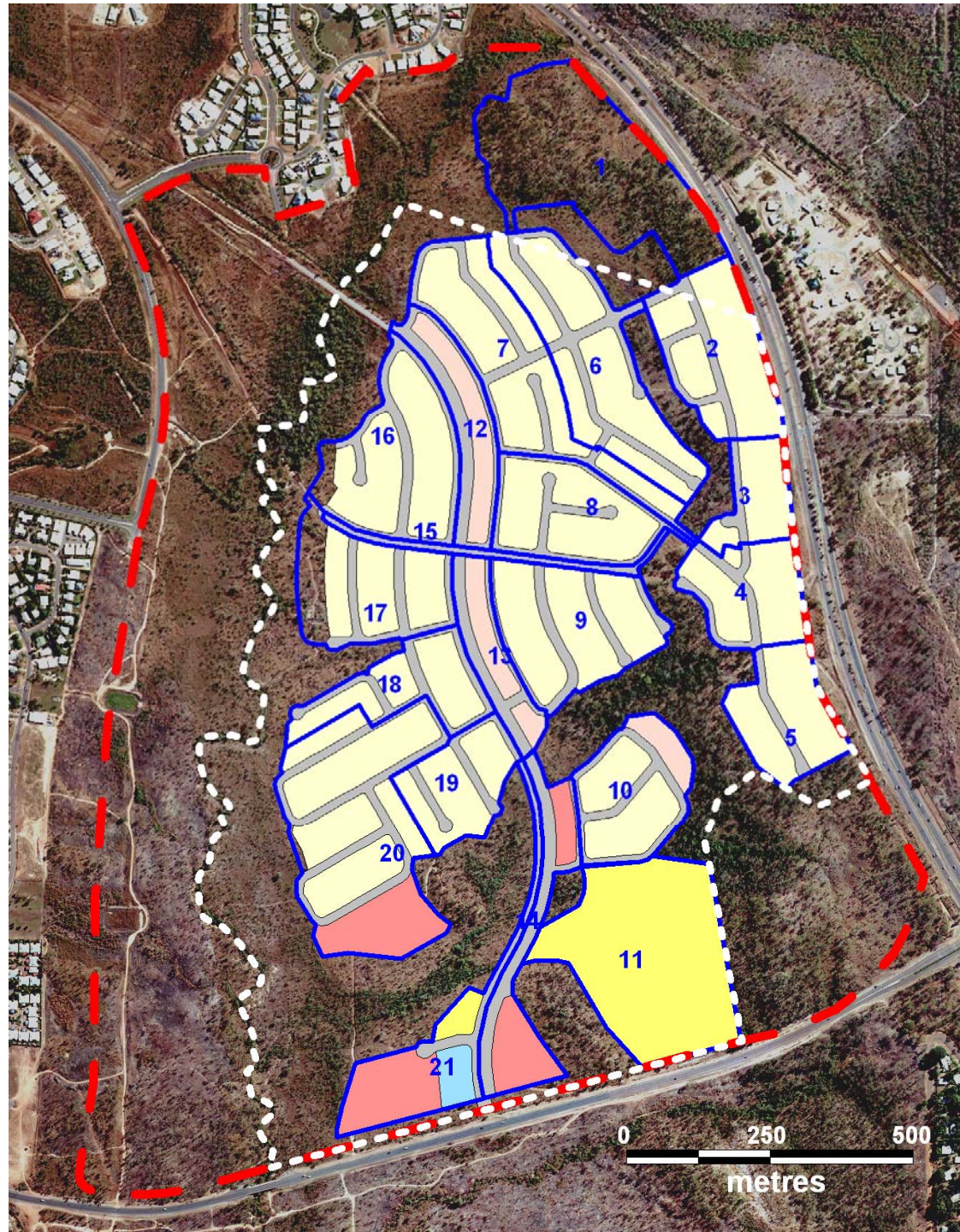


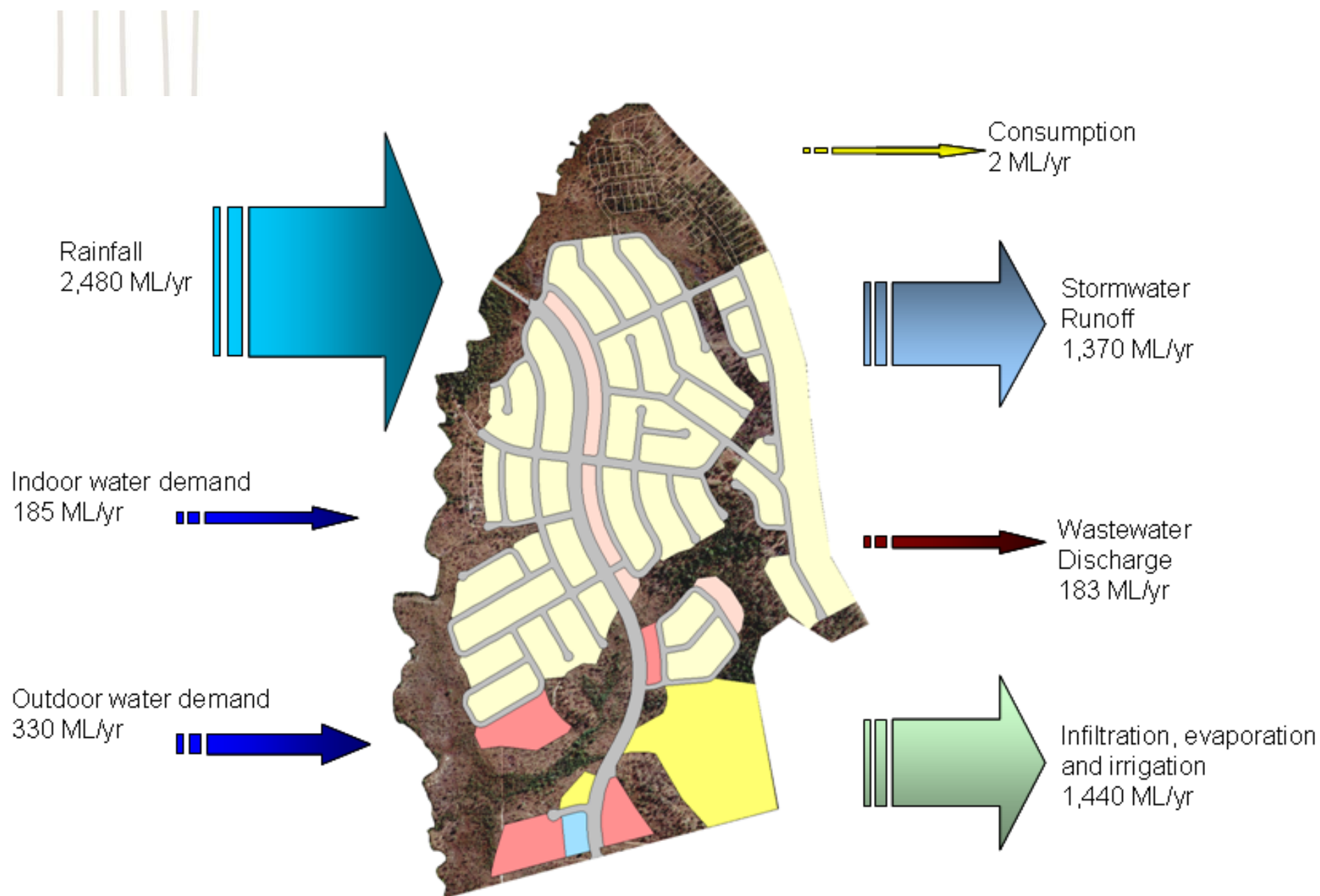
Geology, soils and water

- Depth to bedrock
- Soil permeability
- Groundwater table level (and seasonal variation)
- Management risks, including acid sulfate soils and salinity

Site analysis

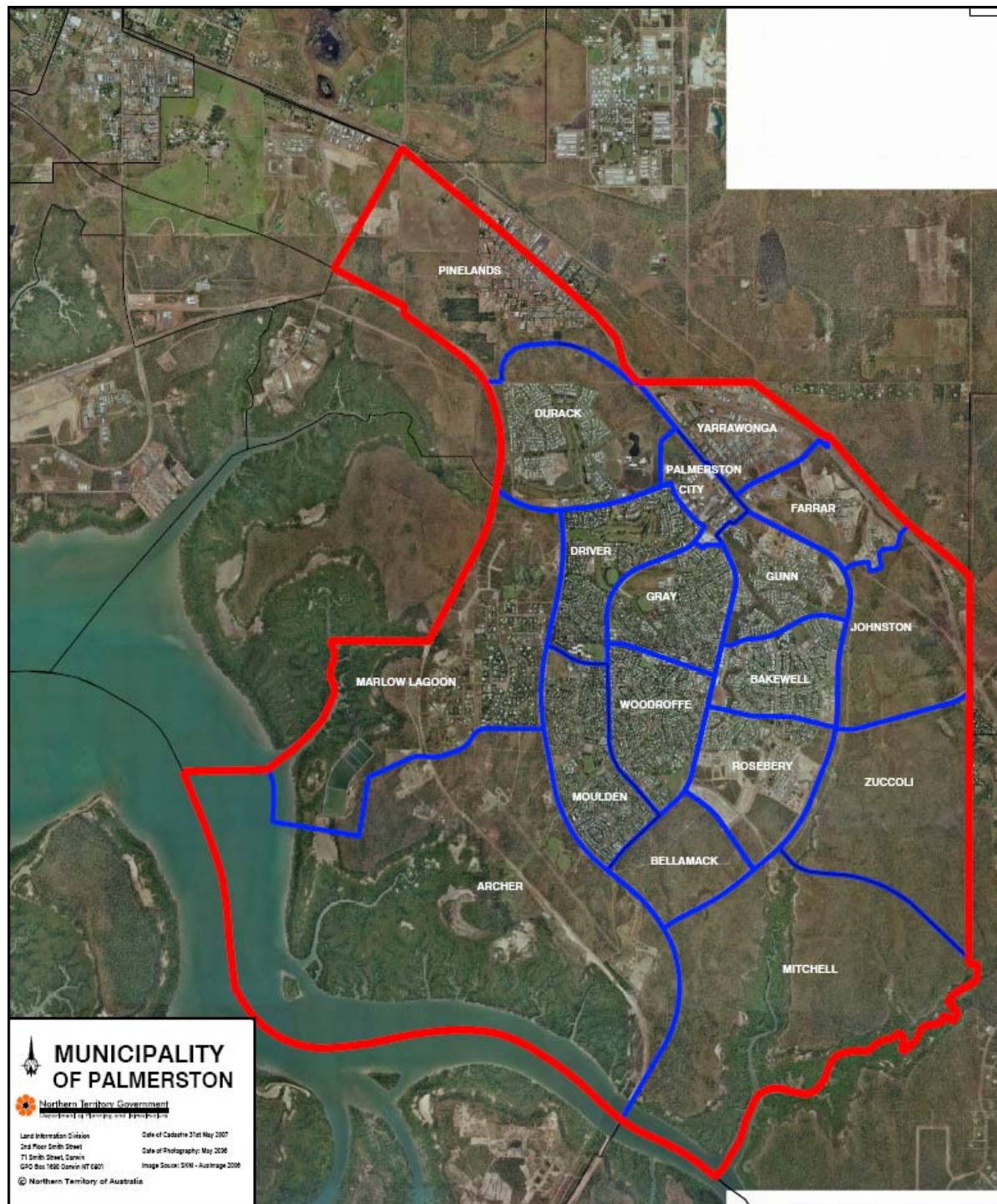
- Waterways, buffers
- Stormwater catchments
- Water balance



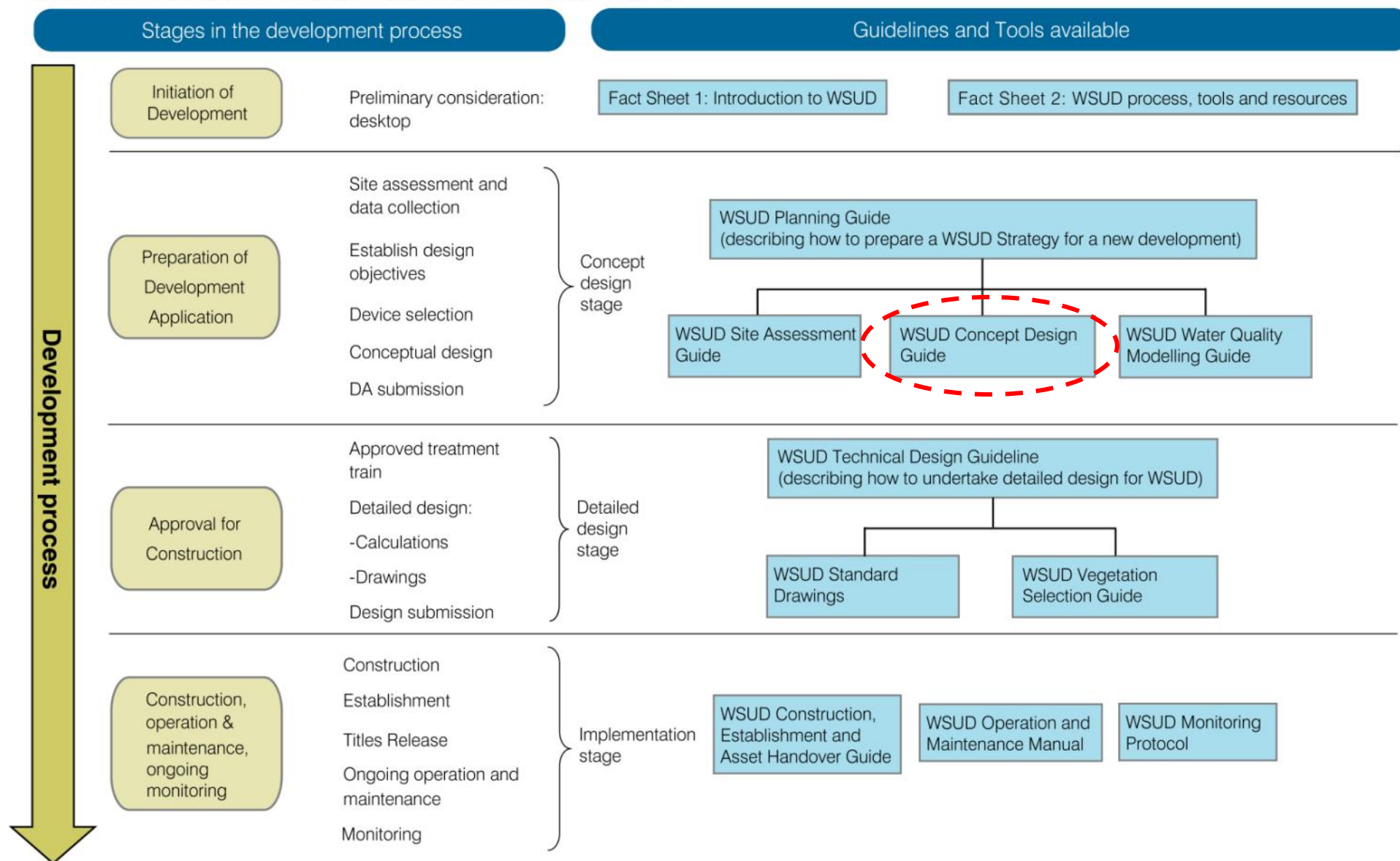


Constraints and Opportunities

- Think of a typical urban development in the Palmerston Eastern Suburbs...
- What are the key site constraints?
- What sort of WSUD opportunities may arise?



Darwin Harbour WSUD Guidelines and Tools



WSUD measures

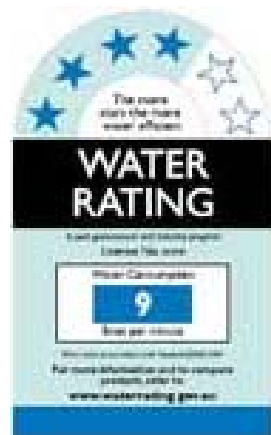
Objectives	Water cycle management measure
Water conservation	Demand management
	Rainwater tanks
	Water recycling
	Stormwater harvesting, storage and reuse
Stormwater quality	Vegetated swales and buffer strips
	Bioretention systems
	Wetlands
	Gross Pollutant Traps
	Infiltration

Concept design guide contents

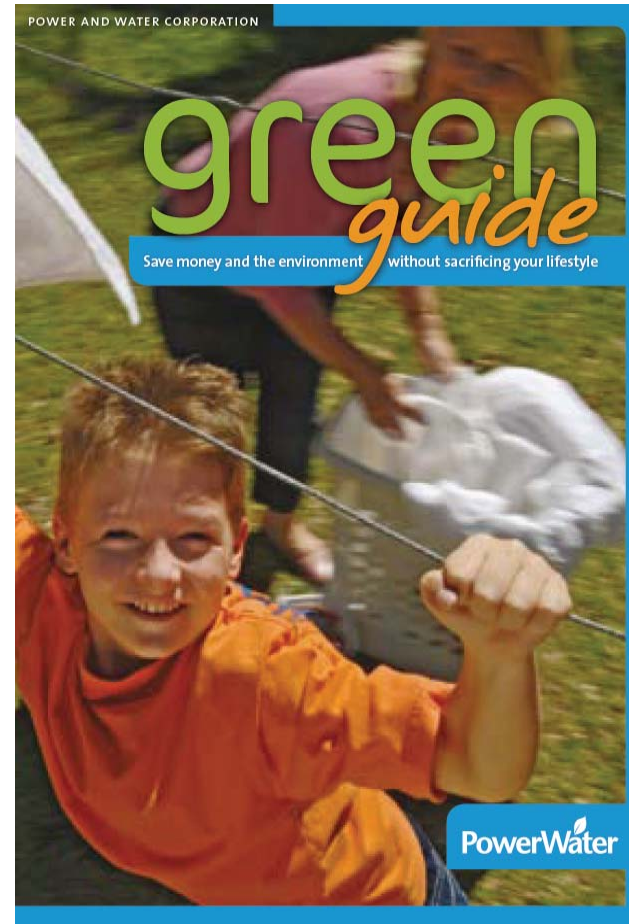
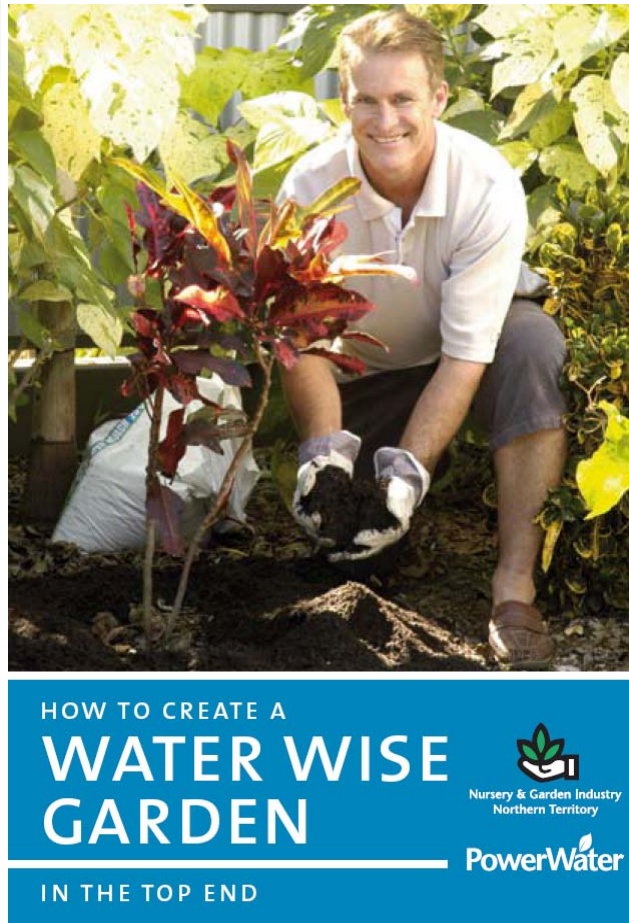
- The purpose of each element and how it works
- Where it would be most appropriately located in the urban landscape
- Important design considerations, including soil and vegetation selection for vegetated stormwater treatment measures. The design considerations point to the advantages and disadvantages, benefits and risks of each WSUD measure
- Basic sizing information suitable for preliminary estimates
- Maintenance requirements
- References to further information are provided where relevant.

Demand Management

- Background information on water demands
- PowerWater's community survey findings
- Design considerations
 - Buildings
 - Open space
- Further information:
 - e.g. WELS



Demand management



Rainwater Tanks

End Use	1 kl Rainwater Tank	2 kl Rainwater Tank
Toilet and Laundry	9% (40 kL)	10% (43 kL)
Toilet, Laundry and Irrigation	13% (59 kL)	14% (63 kL)
Toilet, Laundry and Hot Water	14% (63 kL)	18% (78 kL)
Toilet, Laundry, Hot Water and Irrigation	18% (79 kL)	20% (87 kL)



Rainwater tanks

- Mosquitoes
- First flush diverters
- Potable water top up and backflow prevention
- Appropriate uses
- Australian standards
- Maintenance

Water Recycling

Water type	Source	Quality	Treatment required
Potable mains water	Reticulated (piped) water distribution	High quality	None
Rainwater	From roof during rain, generally stored in rainwater tanks	Reasonable quality	Low. Sedimentation can occur inside rainwater tanks
Stormwater	Catchment runoff, including impervious areas like roads and pavements	Moderate quality	Reasonable treatment needed to remove litter and reduce sediment and nutrient loading
“Light” greywater	Showers, baths, bathroom basins	Cleanest wastewater – low pathogens and low organic content	Moderate treatment required to reduce pathogens and organic content
Greywater	As above, plus laundry water, including basin and washing machine	Low quality – high organic loading and highly variable depending on how it was used	High level of treatment required to reduce pathogens and organic content
Blackwater	As above, plus kitchen, and toilet. Can also be sourced from sewers	Lowest quality wastewater – high levels of pathogens and organics	Advanced treatment and disinfection required

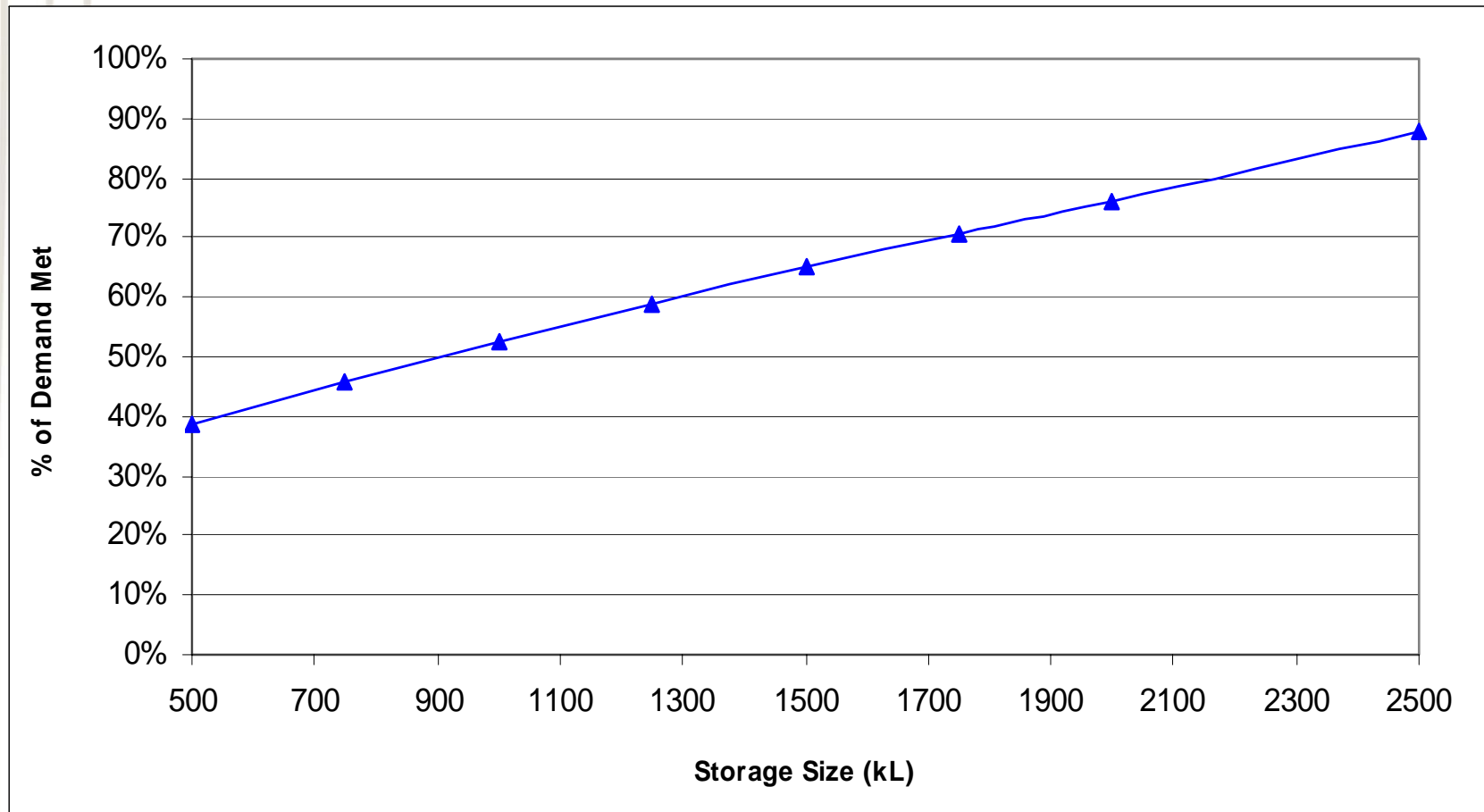
Water recycling

- Greywater and blackwater characteristics and recycling options
- Treatment systems comparison:
 - Suspended growth systems
 - Fixed growth systems
 - Recirculating media filters
 - Media filters
 - Membrane filters
 - Membrane bioreactors
 - Subsurface flow wetlands
- Further information
 - NT guidelines
 - National guidelines
 - Landcom reference document

Stormwater Harvesting, Storage and Reuse

- Treatment options
- Storage options
 - Aquifer storage and reuse
 - Open storage ponds
- Storage sizing and design
- Maintenance
- Further information:
 - National guidelines (stormwater reuse, ASR)

Stormwater storage sizing curve

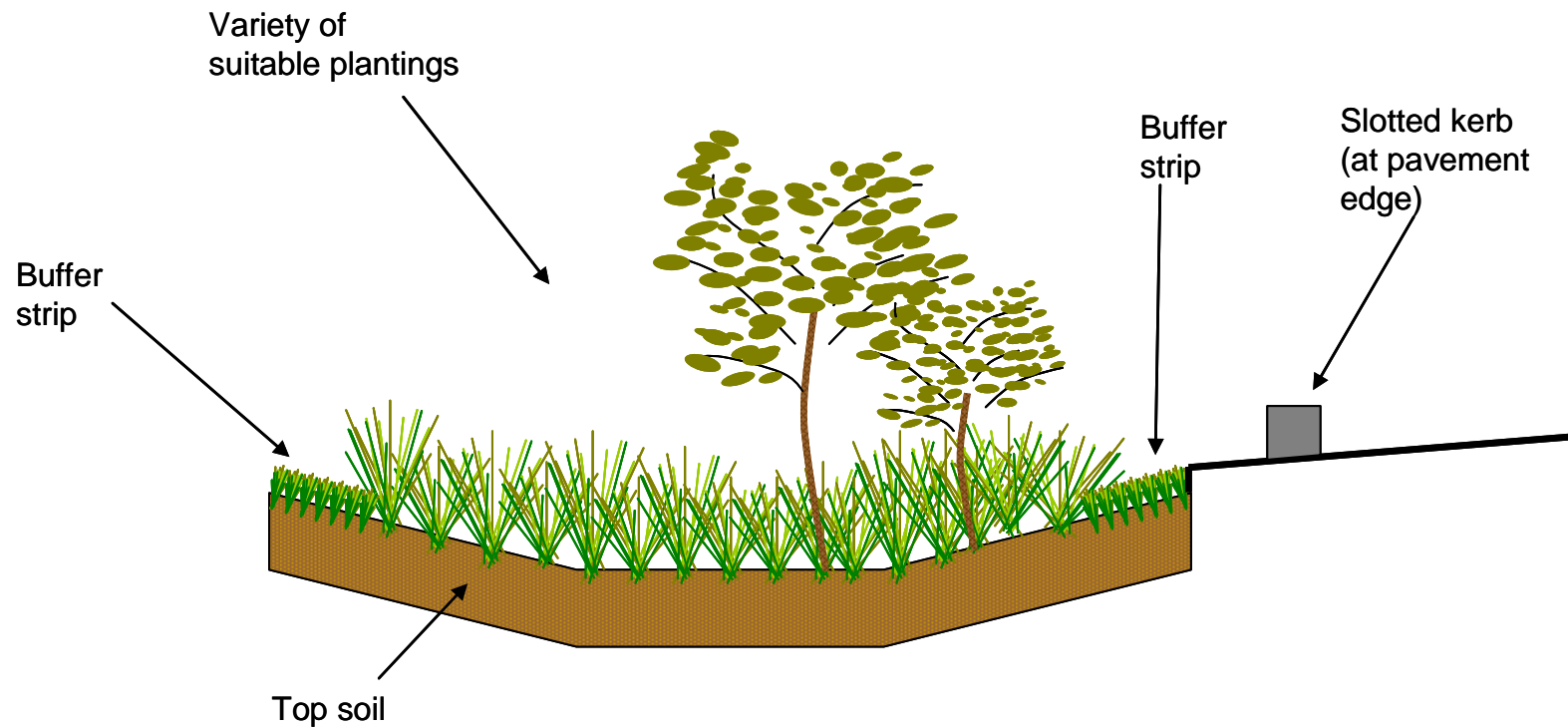


Stormwater Quality

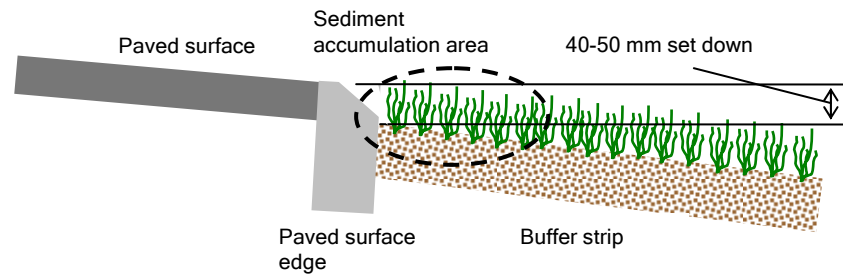
Treatment measure	Potential applications
Vegetated swales	Medium and fine particulate removal, including phosphorus removal Streetscape amenity Wildlife habitat
Buffer strips	Pre-treatment of runoff for sediment removal Streetscape amenity
Bioretention systems	Fine and soluble pollutants removal, including nitrogen and phosphorus Streetscape amenity Frequent flood retardation Wildlife habitat
Sand filters	Medium and fine particulate removal, including phosphorus removal Rapid filtration prior to storage and reuse
Sediment basins	Coarse sediment capture Temporary installation Pre-treatment for other measures
Wetlands	Community asset Medium to fine particulate and soluble pollutant removal, including nitrogen and phosphorus Flood retardation Storage for reuse Wildlife habitat
Gross pollutant traps (GPTs)	Reduces litter and debris, including organic matter Can reduce sediment Pre-treatment for other measures
Infiltration systems	Reduces surface flows Groundwater recharge

Particle Size Grading	Management Issue					Treatment Process
	Visual	Sediment	Organics	Nutrients	Metals	
Gross Solids > 5000 μm	Litter	Gravel	Plant Debris			Screening
Coarse- to Medium- 5000 μm – 125 μm		Silt				Sedimentation
Fine Particulates 125 μm – 10 μm						Enhanced Sedimentation
Very Fine/Colloidal 10 μm – 0.45 μm	Turbidity					Adhesion and Filtration
Dissolved Particles < 0.45 μm						Biological Uptake

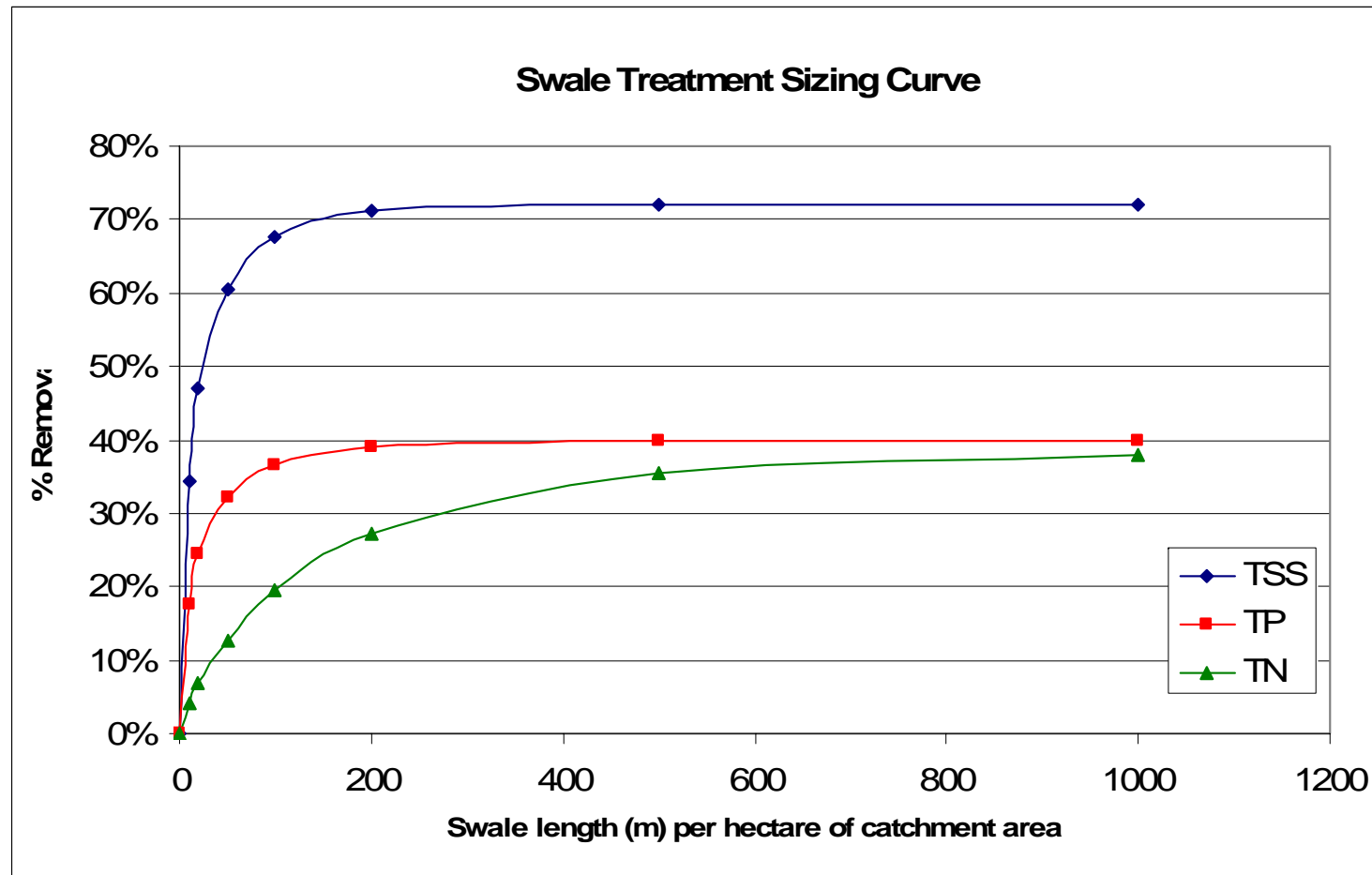
Vegetated swale/buffer strip



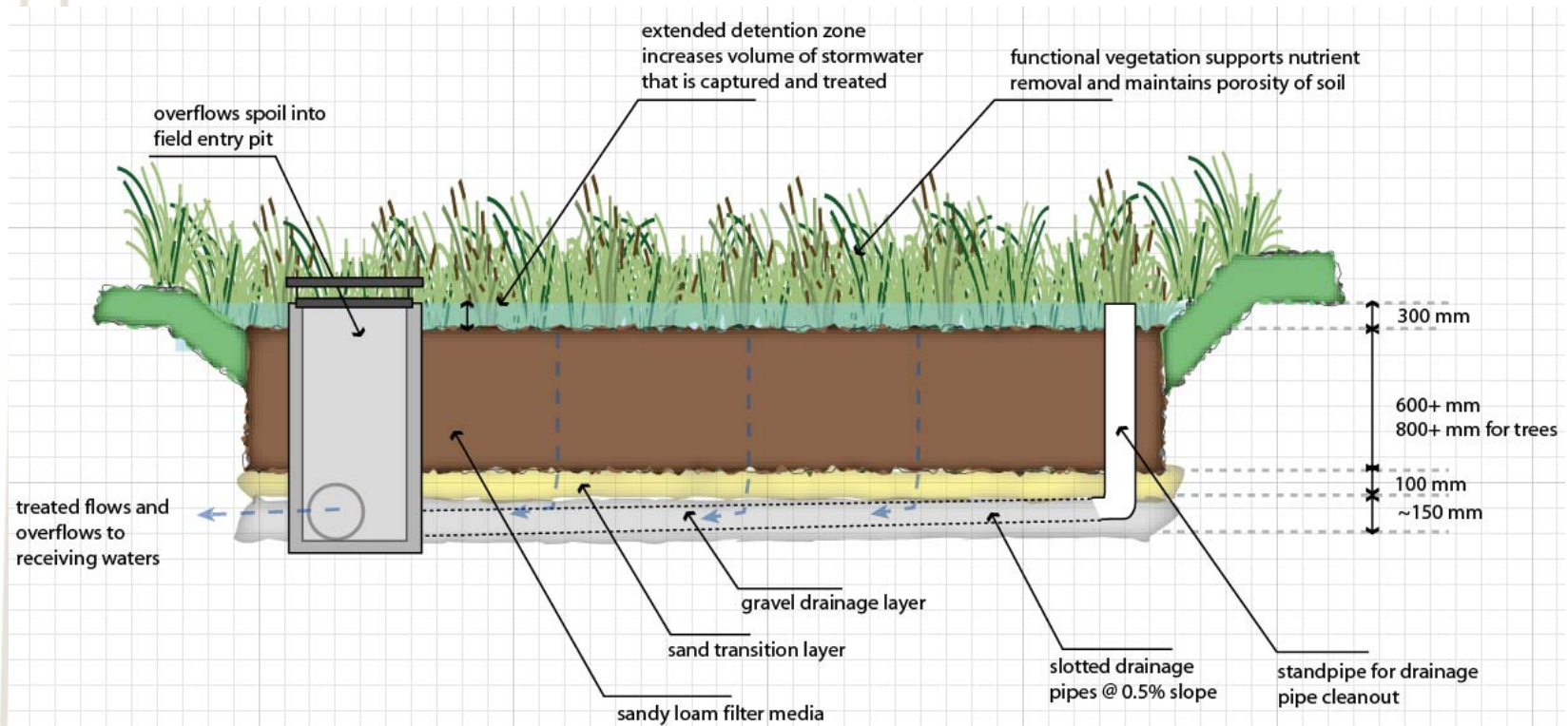
Vegetated Swale / Buffer Strip



Swale Sizing



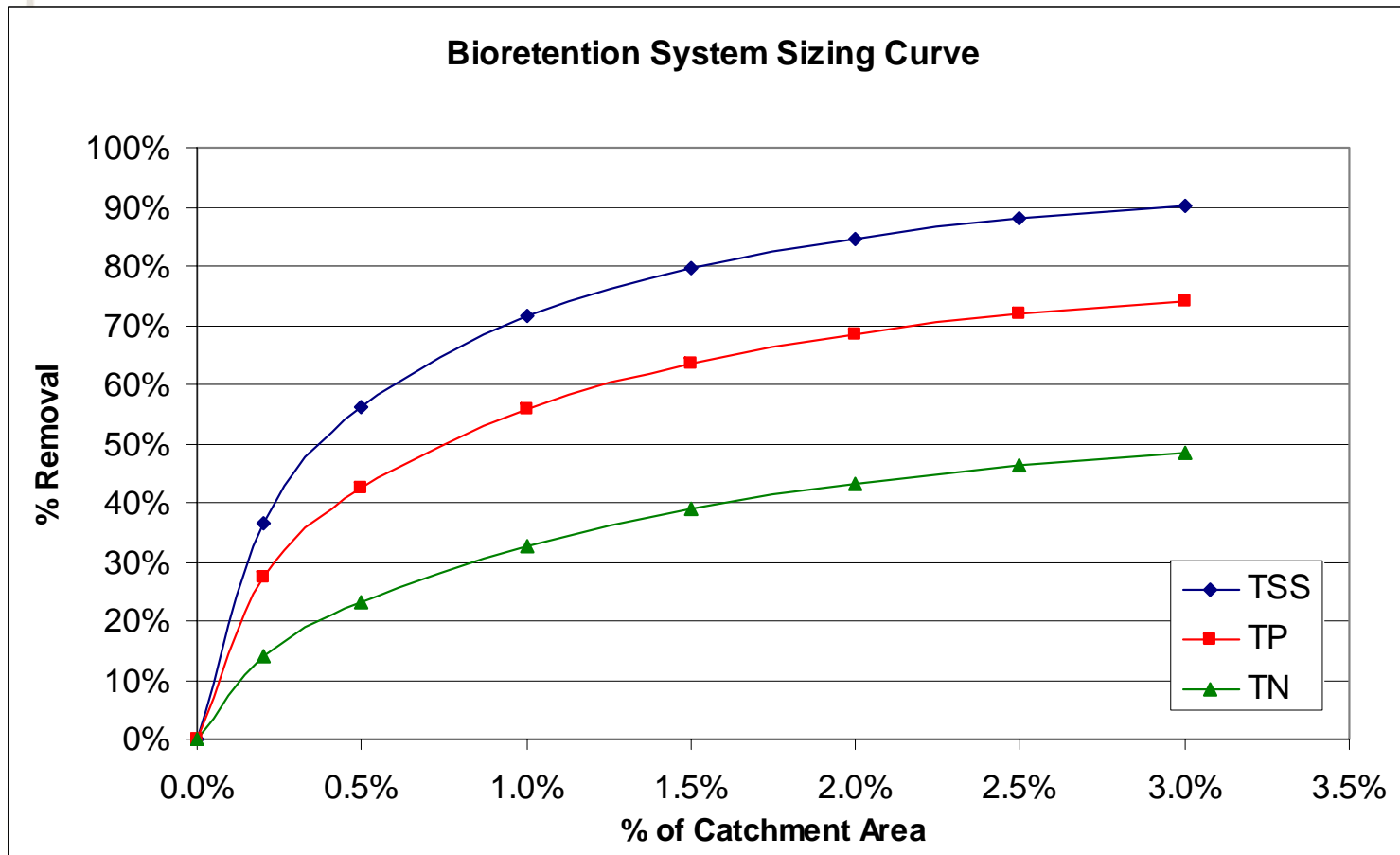
Bioretention Systems



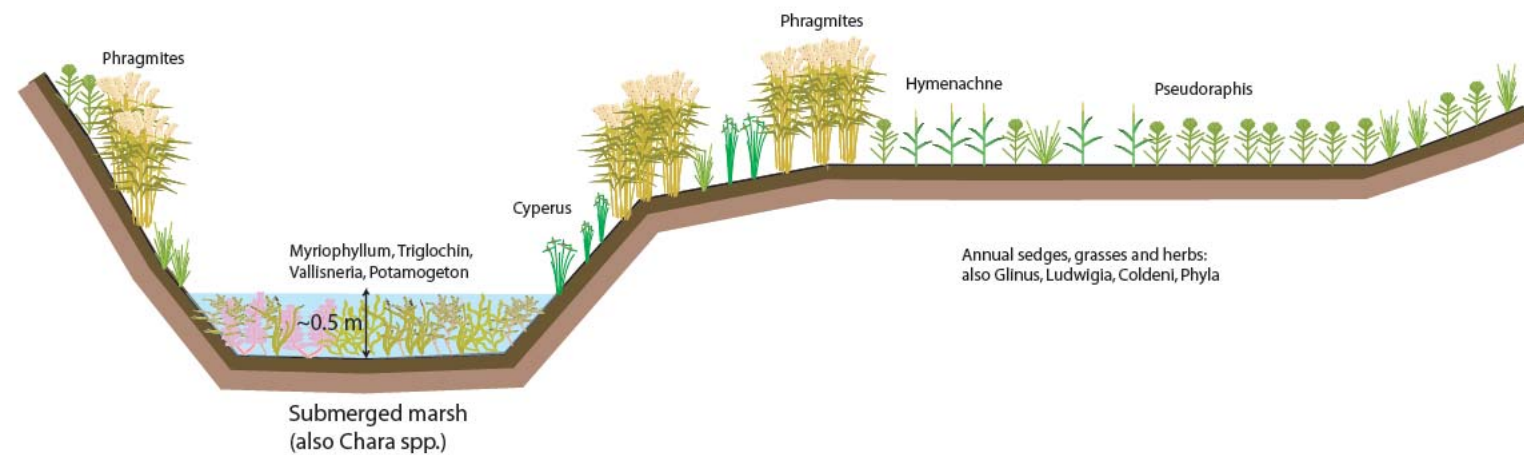
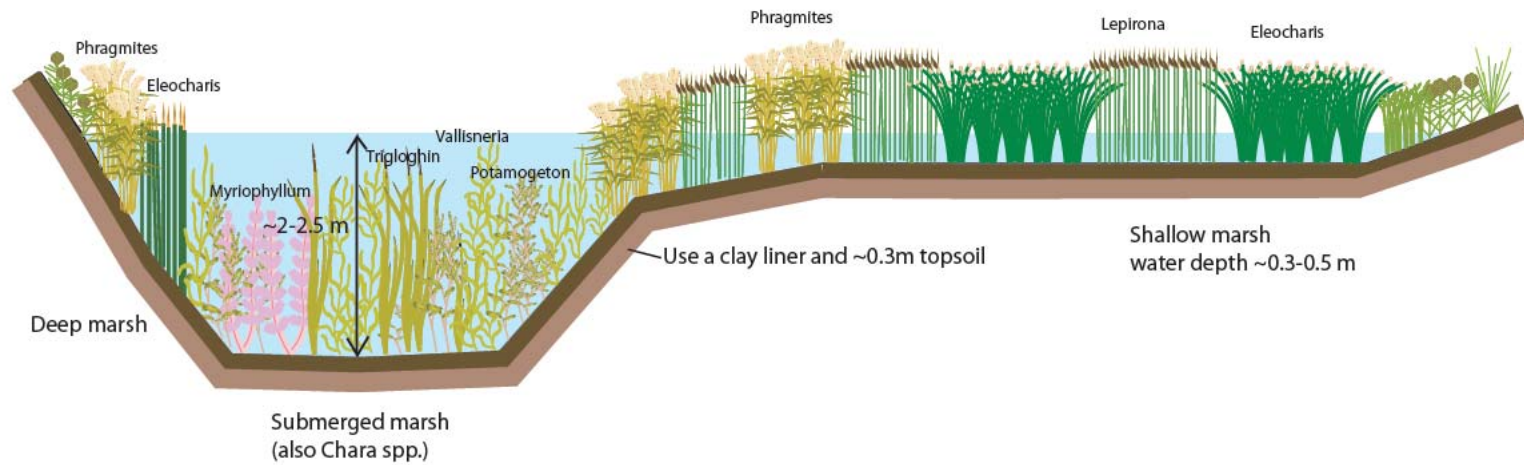
Bioretention systems

- Filter media selection
- Vegetation selection
- Design options for the wet dry tropics:
 - Dry season die off
 - Irrigation
 - Unlined systems connected to groundwater
 - Systems with a saturated zone

Bioretention Sizing



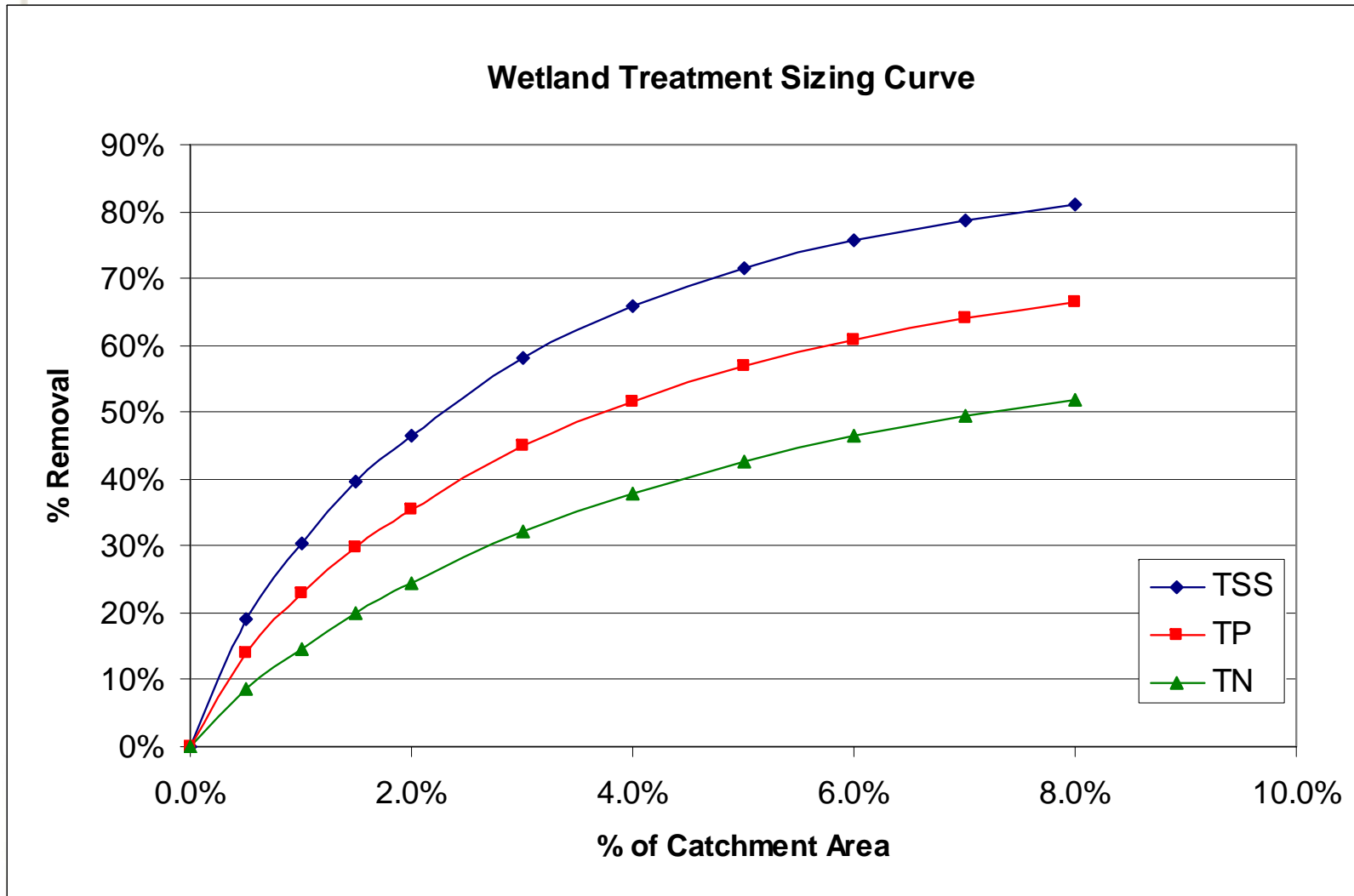
Wetlands



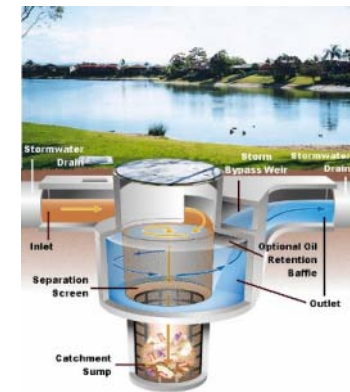
Wetlands

- Role of each component
 - Pre-treatment
 - Inlet zone and bypass structure
 - Macrophyte zone
 - Open water zone
- Design options for the wet dry tropics
 - Permanent water body wetlands
 - Ephemeral wetlands
 - Combined ephemeral areas/permanent water zones
- Mosquitoes

Wetland Sizing



Gross Pollutant Traps



Stormwater Infiltration

- Types of systems
- Site constraints
- Maintenance

