











Water Sensitive Urban Design
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Verb

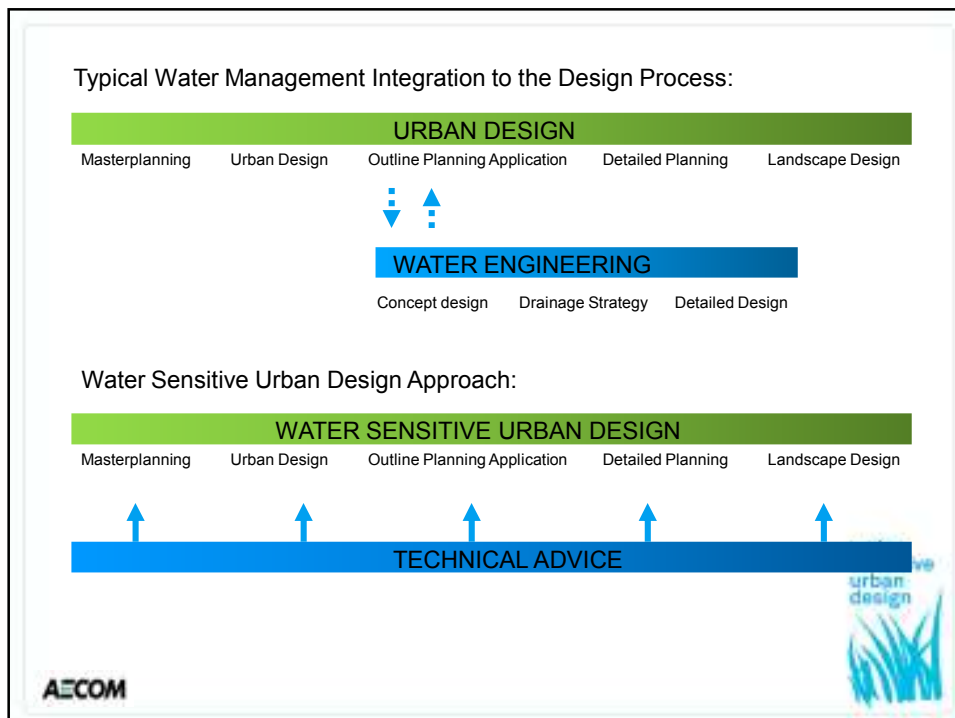
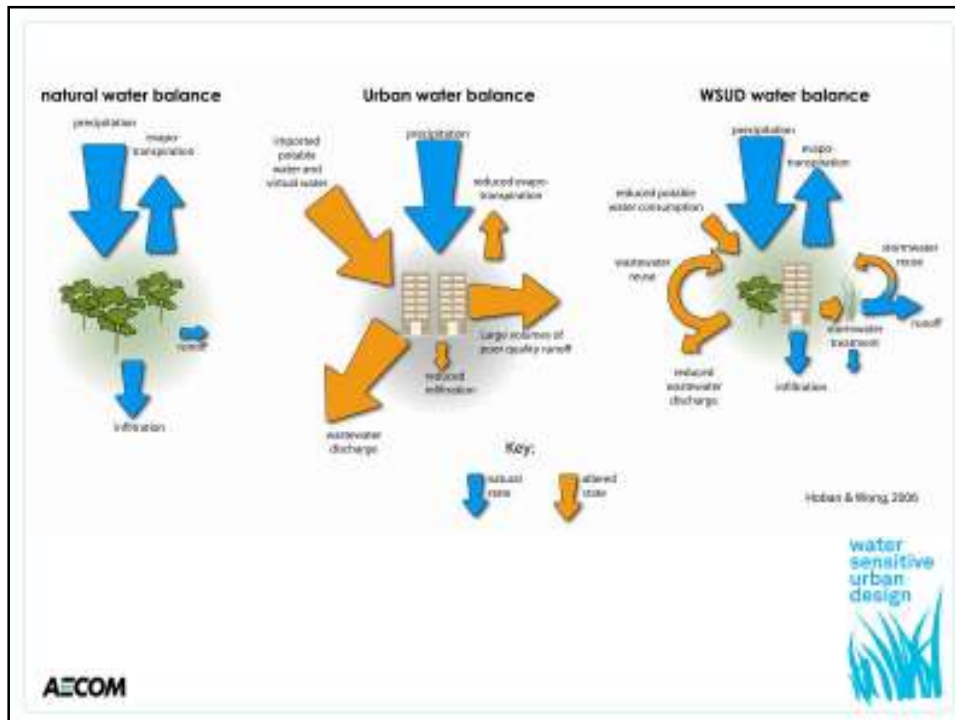
Water Sensitive Urban Design (WSUD) is the process of integrating water cycle management with the built environment through planning and urban design.

Sustainable Drainage Systems (SuDS) are the component elements that build up to deliver a WSUD approach:

- **At Best** they form a train to convey, cleanse and store surface water for local reuse through multifunctional green infrastructure
- **At worst** they should reduce peak flow to alleviate pressure on the surface water sewer system

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- **NPPF – “priority to the use of SuDS”**
- **Flood and Water Management Act 2010 and SAB’s**
- **National SuDS Standards?**

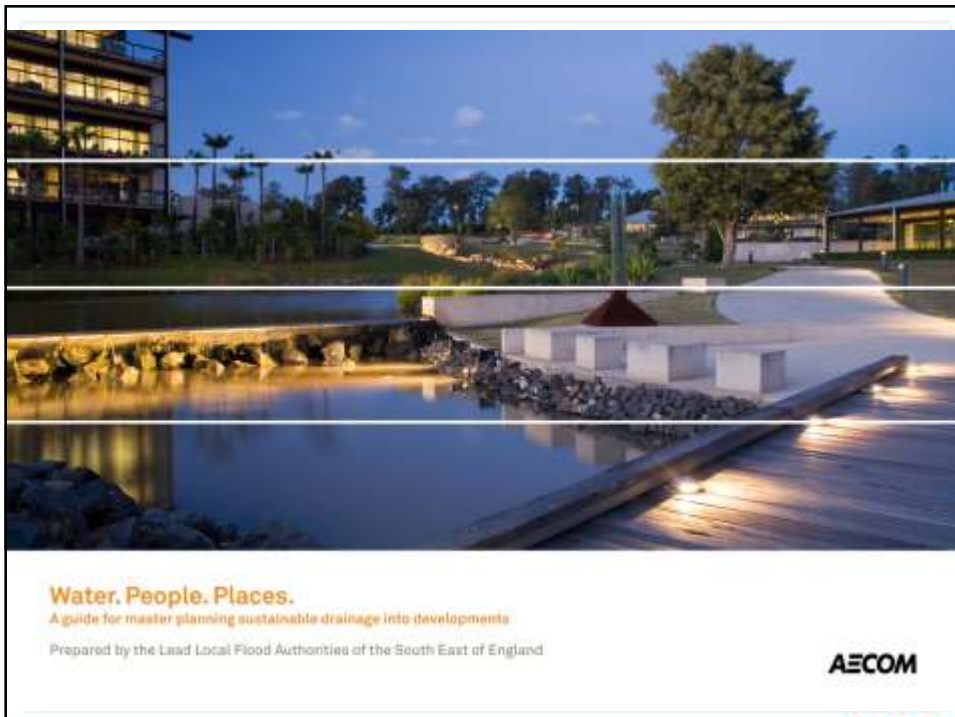


Objective:

to respond in a positive manner...

...and create a tool for placemaking

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1. Design framework



INTEGRATION INTO THE MASTERPLANNING PROCESS

Prepare.
Define.
Design.

- ① Buildings and built form
- ② The street network
- ③ Open spaces and landscape areas

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A	AIMS AND OBJECTIVES	document aspirations
	OUTLINE BUSINESS CASE	viability, feasibility, pragmatic
B	CONTEXT APPRAISAL	understanding the baseline and how a place works
	SPATIAL FRAMEWORK	opportunities and constraints
	ASSEMBLE MASTER PLANNING TEAM	the right range of skills for the team
INITIAL TESTING		
	LAND USE & DESTINATION	land use distributions and relationships
C	KEY CONNECTIONS	strategic connections between destinations
	OPEN SPACES	connected green infrastructure
MASTER PLAN OPTION TESTING		
PREFERRED STRATEGY		
	BLOCK STRUCTURE	patterns of blocks and density areas
D	MOVEMENT FRAMEWORK	street hierarchies and the character of routes
	OPEN SPACE NETWORK	functions and characters of open space
BUSINESS CASE		
DESIGN REFINEMENT		
	CONCEPT ARCHITECTURE	character areas and building typologies
E	CONCEPT STREET DESIGN	highways and streets
	CONCEPT LANDSCAPES	open spaces and public realm
DEVELOPER BRIEF OR GUIDELINES		

A

Prepare.

1. Aims and objectives
 - Set out water management objectives
 - Run-off rates
 - Water quality issues
 - Water supply and demand
2. Developing the business case
 - Identify synergies and challenges
 - Wider catchment flood risk
 - Open space requirements
 - Ecological networks
 - Contamination containment



B

Define.

1. Context appraisal
 - SuDS baseline
2. Spatial framework
 - Identify flow paths / low points
 - Identify discharge points
 - SuDS opportunities and constraints diagram
3. Assemble the right team



SuDS Opportunities and Constraints Diagram


- High point
- Low Point
- Direction of flows
- Flood risk zone
- Biodiversity areas

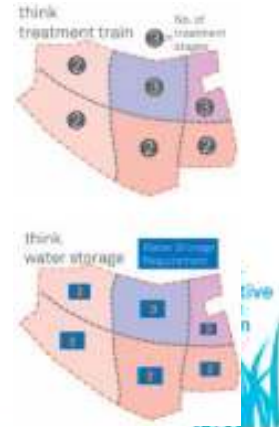
C

Design.

Initial Testing – the relationship between development area and water

- Identify SuDS catchments
- Allocate treatment stages
- Estimate attenuations volumes




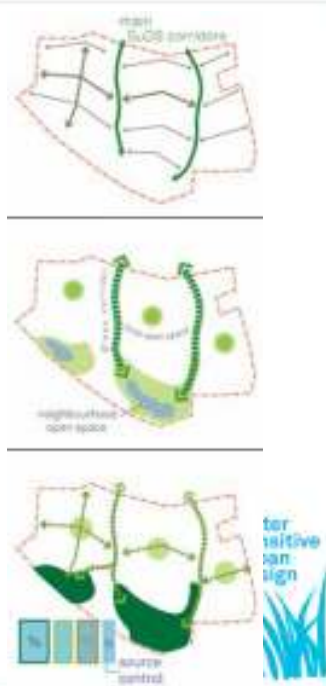


C

Design.

- Structures and conveyance paths
- Green and open space
- Outline water management diagram

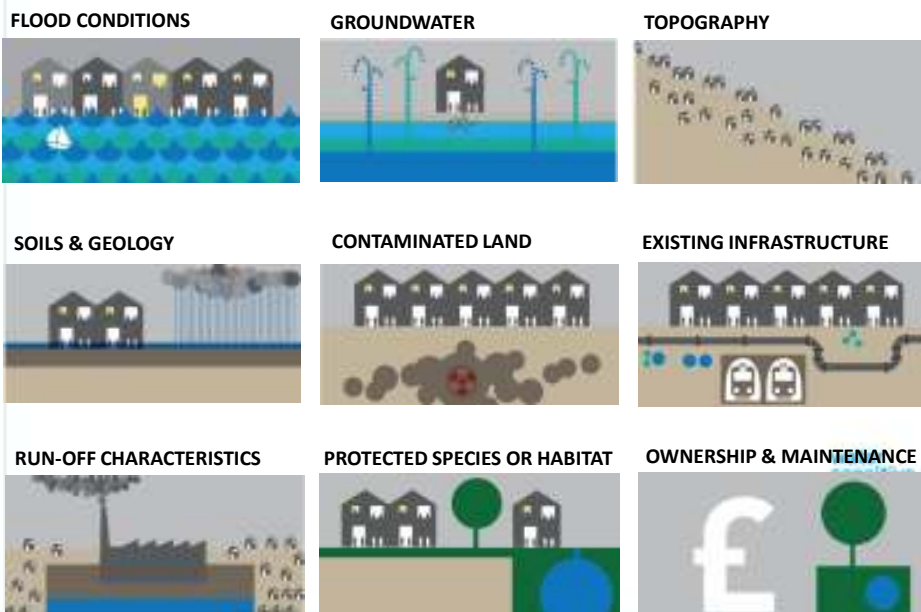
















2. Reflect local conditions



OUTLINE STRATEGIES FOR COMMON SITE CONDITIONS



SETS OUT AVAILABLE SUDS OPTIONS

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	 Building	Building integrated.
 Rainwater harvesting	Rainwater is collected from either paved surface, overground or underground and re-use locally. Water is flushing and irrigation.		
 Soakaway	A soakaway is designed to soak into permeable layer like a dry well, an underground with gravel or rubble. Water soaks away where it will be gradually ever into the ground.	 Soakaway	Soakaway are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.
 Filter Strip	Filter strips are grassed or run-off is allowed to run over vegetative and cleaning.	 Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.
 Permeable paving	Paving which allows water to flow through the joints between paving blocks or pavers. Water filters through the joints and is stored in the sub-base infiltrate into ground below.	 Pond/ Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.
 Bioswath area	A vegetated area with grasses designed to absorb water vertically. Water can be conveyed below or drain to be conveyed elsewhere. It can be integrated with the	 Wellhead	Wellheads are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wellheads can be integrated with a natural or landscape environment.
		 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.

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SUDS SELECTION MATRIX FOR SITE CONDITIONS

Site Condition	Green Roof	Rainwater Harvesting	Soakaway	Permeable Paving	Filter Strip	Bioswath Area	Basin	Hardscape Storage	Pond	Wellhead	Underground Storage
Flood Plain Is located in the floodplain?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Groundwater Is located less than 2 metres below ground surface?	Yes	Yes	Yes	Yes (With liner and underdrain for treatment)	Yes	Yes (With liner and underdrain)	Yes (With liner)	Yes (If above ground)	Yes	Yes	Yes
Topography Is site on a flat site with gradient? / Is site on a steep slope (> 10% gradient)? / Is site on a very steep slope (> 20% gradient)?	Yes (Slope control)	Yes (Slope control)	Yes (Slope control)	Yes (Slope control)	Yes (Slope control)	Yes (With short walls or fill trough)	Yes (Control to provide stable water gradient)	Yes	Yes (By to land gain)	Yes	Yes
Soils and Geology Is permeable soil layer by clay below? / Is site on a hard rock?	Yes	Yes	Yes	Yes (With underdrain for treatment)	Yes	Yes	Yes	Yes	Yes	Yes	
Contaminated land Are there contaminated soils on site?	Yes	Yes	Yes	Yes (With underdrain for treatment)	Yes (With liner)	Yes (With liner and underdrain)	Yes (With liner)	Yes (With liner)	Yes	Yes	
Existing infrastructure Are there underground services in the catchment area?	Yes	Yes	Yes	Yes (If location-restricted take is marked on plan for future maintenance)	Yes	Yes (Protect with structural grid in pit)	Yes	Yes	Yes	Yes	
Space constraints Is there space for SuDS implementation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes (With or channel bank suitable)	Yes	Yes	Yes	
Runoff Is runoff to be treated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

3. Maximising benefits



1. Attenuation
2. Water Treatment
3. Infiltration
4. Water Reuse
5. Biodiversity
6. Amenity
7. Education
8. Open Space
9. Character
10. Microclimate

SUDS SELECTION MATRIX FOR BENEFITS

	Green Roof	Rainwater Harvesting	Swamp	Permeable Paving	First Flush	Retention area	Swale	Hardscape/ Mulch Storage
Attenuation	○	○	●	●	○	●	●	●
Water Treatment	○	○	●	●	●	●	●	
Infiltration			●	○	●	○	○	
Water Reuse	○ <small>Permeable treatment</small>	●		○ <small>Permeable treatment</small>		○ <small>Permeable treatment</small>	○ <small>Permeable treatment</small>	○ <small>Storage</small>
Biodiversity and Habitat	●		○		○	●	●	
Education	●	○	○	○	○	●	●	○ <small>if appropriate</small>
Amenity	●	○	○	○	○	●	●	○ <small>if appropriate</small>
Open Space	○			○	○	○	○	○

4. Creating great places

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