Sustainable Drainage Systems: Source control to manage water flows and water quality emanating from urban environments

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Current stormwater management

Currently stormwater systems focus on the collection of runoff and channelling it to the nearest watercourse. This is a problem as it results in:

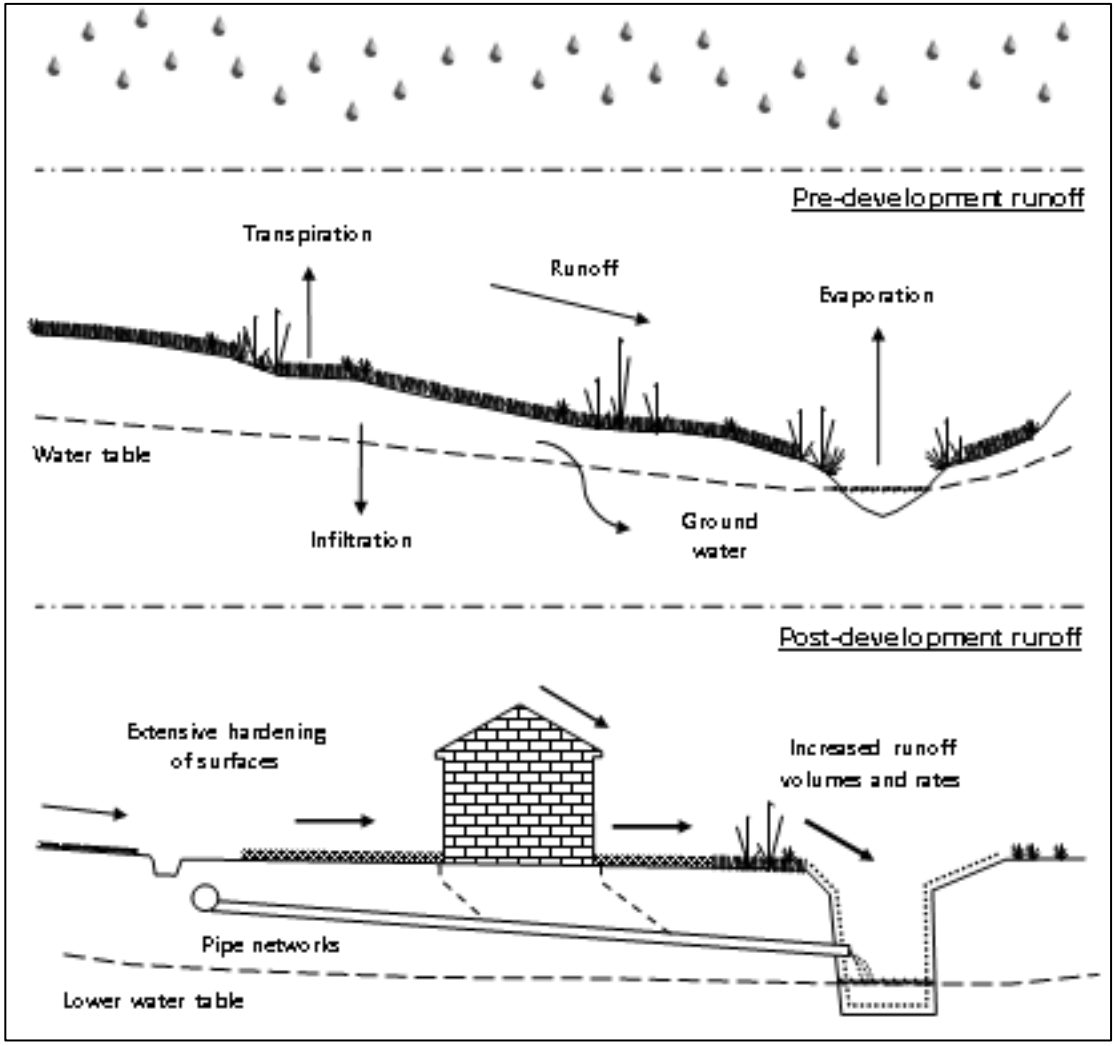
- Loss of biodiversity in the catchment area

- Lowering of local water-tables owing to the reduction of infiltration

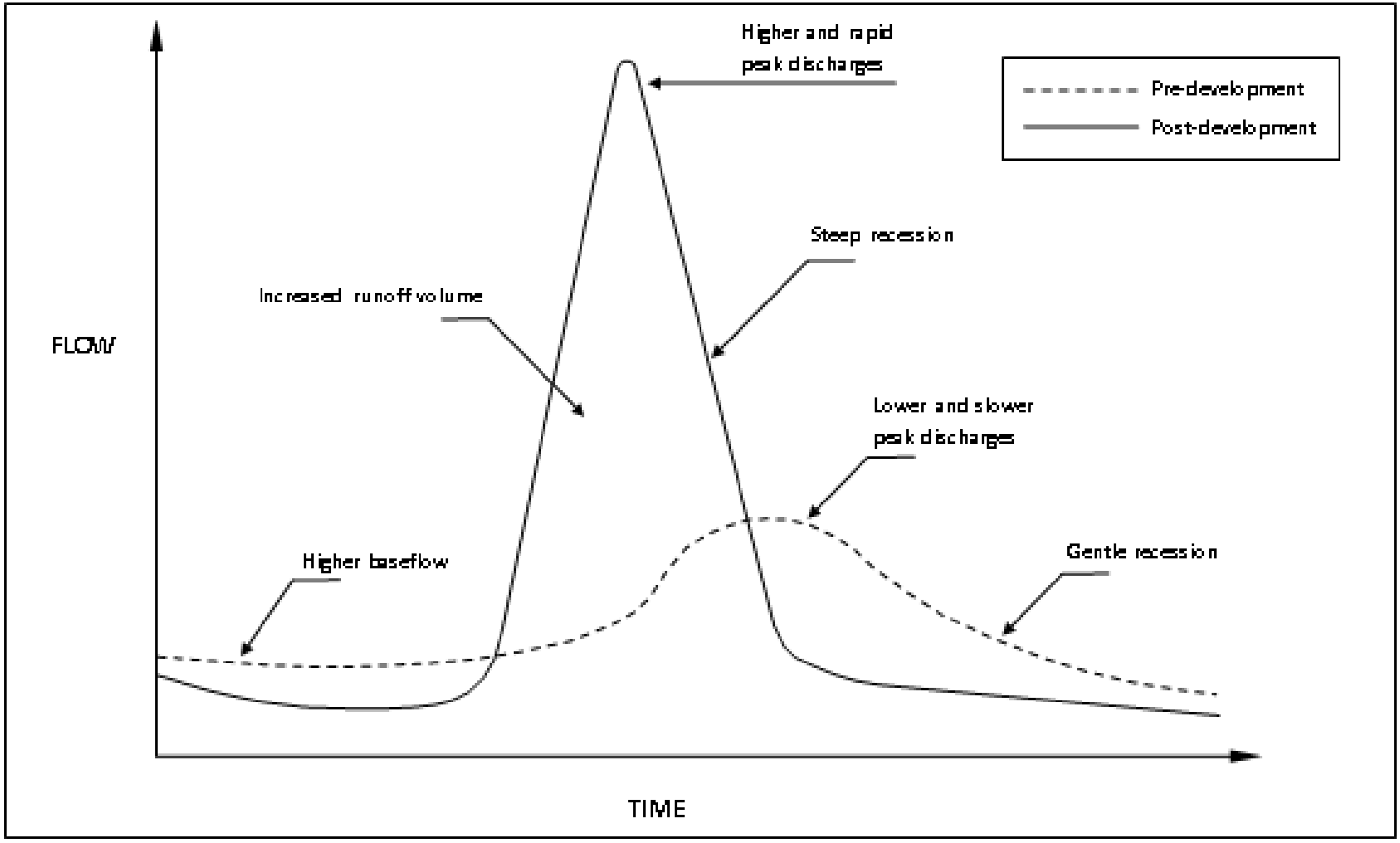
- Raised flood peaks downstream – eroding the natural channels (i.e. rivers and streams) into which the stormwater is discharged

- The drying out of these natural channels during periods without rain owing to reduction in groundwater seepage
- The transfer of pollutants (silt, litter, hydrocarbons, heavy metals, bacteria) to the receiving waters leading to ecological collapse

Current: pre- and post-development



Current: pre- and post development



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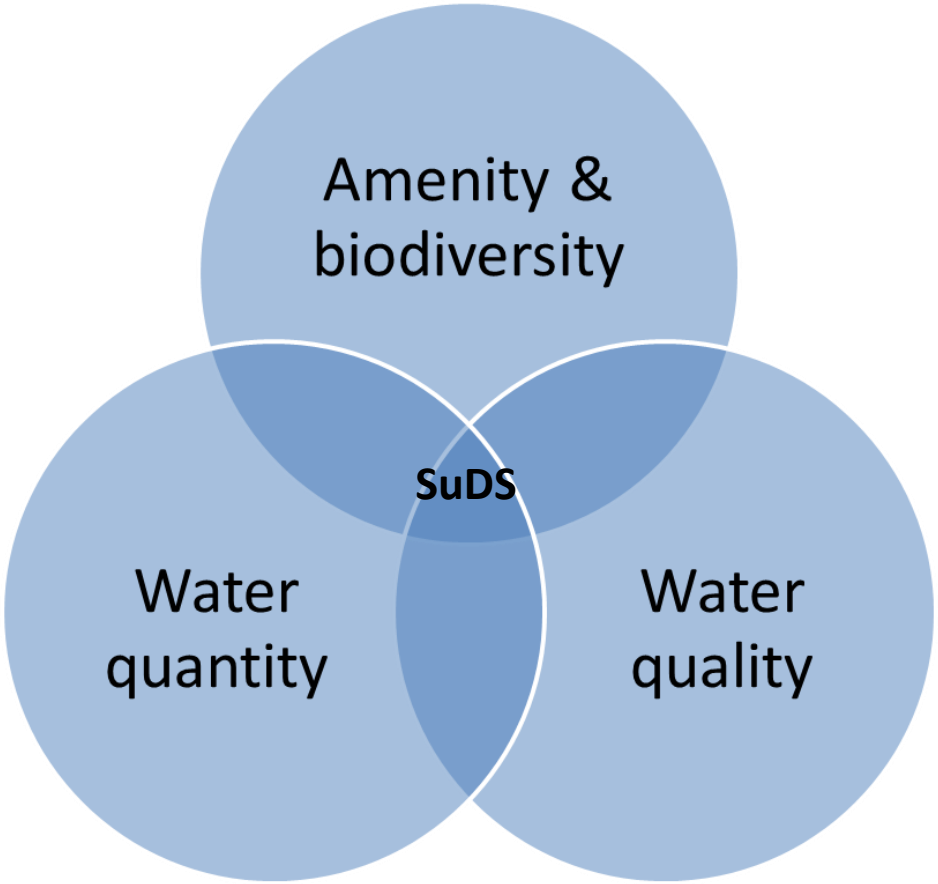
Sustainable Drainage Systems (SuDS)



Holistic approach:

- Mimics natural cycle
- Uses 'treatment train'
- Simultaneously addresses issues of: quantity; quality; and amenity & biodiversity

A: Quantity management

- Rainwater harvesting – capture and use
- Infiltration – put into groundwater
- Long term storage – hold it back
- Evaporation – send it back to where it came from
- Detention – slow it down
- Conveyance – (slowly) move it along





B: Quality management

- Sedimentation
- Filtration
- Adsorption
- Biodegradation
- Volatilisation
- Precipitation
- Plant uptake
- Nitrification
- Photosynthesis





C: Amenity & biodiversity

Considers aspects such as:

- Health & Safety
- Environment risk assessment & management
- Recreation and aesthetics
- Education and awareness
- Ecosystem services…





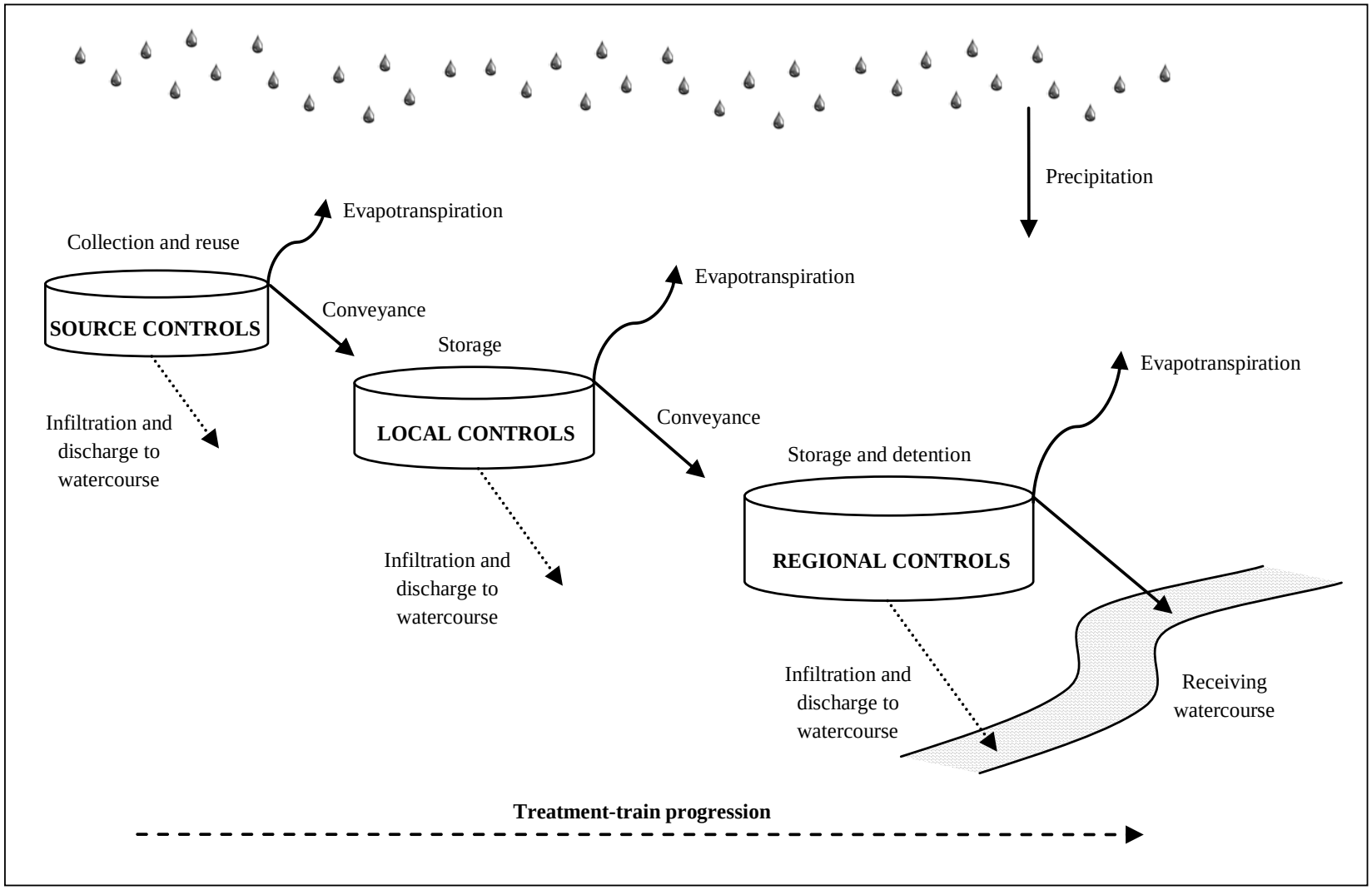
Ecosystem services

- Regulation of climate
- Purification of water and air
- Regulation of water supply
- Erosion and sediment control
- Hazard mitigation
- Provision of wildlife habitats
- Waste treatment
- Human health, well being and cultural benefits





The SuDS treatment train



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Source controls

- Green roofs
- Stormwater collection (harvesting) and re-use
- Soakaways
- Permeable pavements





Green roofs (1)

Green roofs (2)

Source: Michael Vice

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Green roofs (3)

eThekwini Municipal building

- Reduce runoff
- Reduce dust
- Reduce energy usage
- Reduce the urban heat island effect
- Increase biodiversity in the city

Rainwater harvesting (1)

Source: Michael Vice

Another project sponsored by www.wrc.org.za

Rainwater harvesting (2)

The city doesn't charge me for this water!

If storage is a problem – as it frequently is – just put the rainwater into the ground and extract it when it required.

Infiltration (1)

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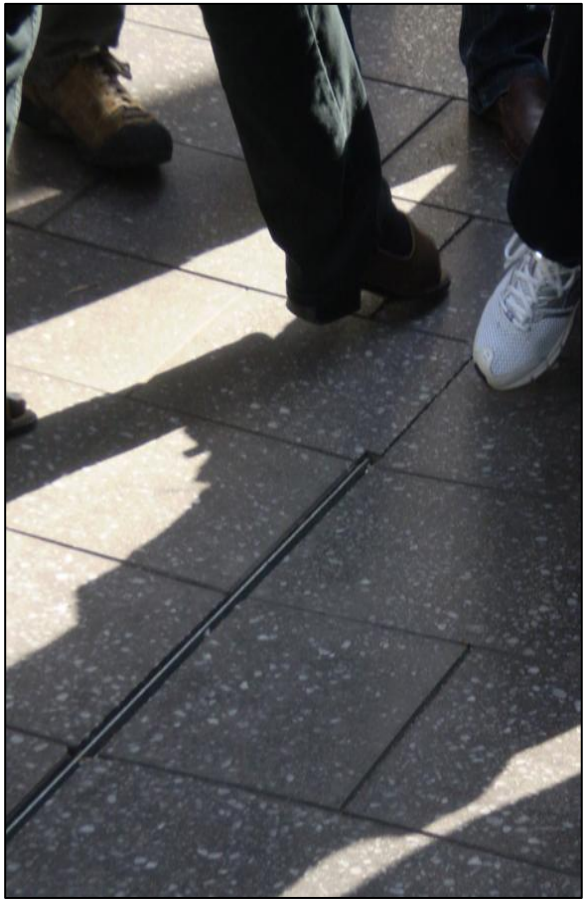
Infiltration (2)

Infiltration (3)



Permeable pavements

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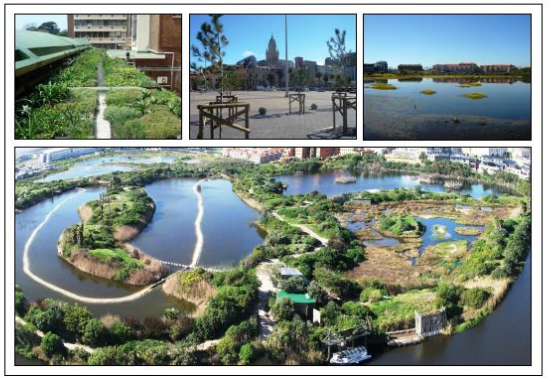
Draft SuDS Guidelines (1)

The South African Draft Guidelines for Sustainable Urban Drainage Systems (SUDS)

Disclaimer:

These draft guidelines are being developed as part of the requirements of the Water Research Commission of South Africa (WRC) project K5/1826: Alternative technology for Stormwater Management. Any use that might be made of the information contained herein is at the risk of the user. Neither the WRC nor the authors take any responsibility for any loss of life or damage of property that might result from the use of these draft guidelines.



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1. Introduction to SUDS

There has been growing interest in the promotion of sustainable development amongst governments and local municipalities throughout the world – and this includes the control of stormwater runoff (Ellis, *et al.* 2006). Sustainable Urban Drainage Systems (SUDS) offer an alternative approach to conventional drainage practices by attempting to manage surface water drainage systems holistically in line with the ideals of sustainable development. They achieve this by mimicking the natural hydrological cycle, often through a number of sequential interventions in the form of a 'treatment train' (Figure 1.4). The key objectives of the SUDS approach are the effective management of stormwater runoff quantity, quality and the associated amenity and biodiversity of the urban drainage system. The relationship between each of these elements is represented in Figure 1.1.

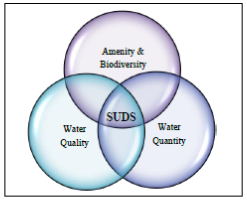

Figure 1.1: Relationship between the different SUDS elements

Prior to the design of any stormwater system there are a number of important considerations including:

- Variations in the hydrological cycle and associated systems;
- Varying geological formations and associated systems;
- Differences in the rational approach to urban drainage within professional teams;
- The different challenges of development on green-field versus brown-field / retro-fitted sites;
- The impact of different types of settlement and social inequality in particular; and
- The influence of any existing laws, ordinances or bylaws.

Whilst each of these will be mentioned in these guidelines they are largely outside the scope of the document which is focused more on the available technology options. Section 1 introduces the notion of sustainable drainage and describes important design and management concepts associated with SUDS. Section 2 describes the basic design approach. Sections 3, 4 and 5 present twelve general SUDS options and technologies in the categories of 'Source Controls', 'Local Controls', and 'Regional Controls' respectively. Appendix A presents a simplified SUDS conceptual design framework. Appendix B presents the expected pollutant removal for various SUDS options. Appendix C presents typical design details for various SUDS options. Appendix D is intended to give a brief introduction to life cycle costing for stormwater management. Appendix E describes a costing model that is available as part of the guidelines. Appendix F provides supplementary data for the aforementioned model. These SUDS Guidelines are intended for use by all practitioners working in the field of stormwater management and promotes the notion of interdisciplinary partnerships at all levels and phases of development.

1.1 The impacts of urbanisation

"The water cycle is one of the most critical processes to supporting life on this planet, and fresh waters are central to all aspects of our lives. Historically, urbanisation has led to the loss and degradation of wetlands, rivers and groundwater resources through pollution, resource depletion and construction within natural flood plains" (Woods-Ballard, *et al.* 2007)

Development normally reduces the natural permeability characteristics of land by replacing free draining surfaces with impermeable surfaces such as roofs, roads and paved areas that are typically drained by 'hard' infrastructure (i.e. pipes and lined channels).

Draft SuDS Guidelines (2)

Contains:

- Introduction to SuDS
- Design criteria and methods
- Source controls
- Local controls
- Regional controls

Plus 6 appendices…





Draft SuDS Guidelines (2)

Appendices:

- SuDS design framework
- Pollutant removal capacities
- General designs for SuDS options
- Life cycle costing of stormwater management
- Description of ‘Simplified Economic Model’ for stormwater management
- Costing fact sheets for stormwater management





SuDS Resources DVD

Contains:

- Principle documentation (including Excel-based 'Simplified Economic Model'
- Design manuals
- Conference proceedings
- Case studies
- Informative websites
- Permeable paving products
- Catchment litter management





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Thank you