Best Management Practice (BMP) Principles for the Management of Stormwater

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Generic BMP Principles

- **Reduce impermeable surface area**
- **Reduce pollution and flooding**
- **Improve Surface water drainage**
- **Increase Stormwater storage volumes**
- **Reduce drainage system costs**
- **Increase Biodiversity and landscape**

Roles of BMP types

BMP type	Drinking water supply	Irrigation	Wastewater treatment	Improved Landscape & Biodiversity	Social, Amenity & Education
Green roofs	No	Yes	No	Yes	Yes
Soakaways	No	Yes	No	No	Yes
Water butts	Yes	Yes	No	No	Yes
Rainwater harvesting	Yes	Yes	No	No	Yes
Filter strips	No	No	No	No	Yes
Infiltration trenches	Yes	No	No	No	Yes
Swales	No	Yes	No	Yes	Yes
Bioretention	No	No	No	Yes	Yes
Pervious pavements	No	No	No	No	Yes
Geocellular systems	No	No	No	No	Yes
Sand filters	Yes	No	Yes	No	Yes
Infiltration basins	No	Yes	Yes	Yes	Yes
Detention basins	No	Yes	Yes	Yes	Yes
Ponds	Yes	Yes	Yes	Yes	Yes
Stormwater wetlands	No	Yes	Yes	Yes	Yes

(Collated from Woods Ballard *et al.*, 2007)

Categories of BMP principles

- **Technical**
- **Environmental**
- **Operation & maintenance**
- **Social**
- **Economic**
- **Legislation and Regulation**

Hierarchy of BMP technical principles

- **Prevention**: minimising impermeable surfacing; road sweeping
- **Source control**: rainwater harvesting; pervious paving; green roofs
- **Site control**: runoff routing to soakaway; infiltration basin; wetland
- **Regional control**: detention pond; wetland

Drainage roles of BMP types

BMP type	Source control	Conveyance	Site system	Regional System
Green roofs	Yes	No	No	No
Soakaways	Yes	No	Yes	No
Water butts	Yes	No	No	No
Rainwater harvesting	Yes	No	No	No
Filter strips	Yes	No	Yes	No
Infiltration trenches	Yes	Yes	No	No
Swales	Yes	Yes	Yes	No
Bioretention	Yes	No	Yes	No
Pervious pavements	Yes	No	Yes	No
Geocellular systems	Yes	Possible	Yes	Yes
Sand filters	No	No	Yes	Yes
Infiltration basins	No	No	Yes	No
Detention basins	No	No	Yes	Yes
Ponds	No	No	Yes	Yes
Stormwater wetlands	No	No	Yes	Yes

(Collated from Woods Ballard *et al.*, 2007)

Advantages and disadvantages of BMP types

BMP type	Advantage	Disadvantage
Green roofs	Use in high density developments	Maintenance of roof vegetation
Soakaways	Groundwater recharge	Not for poor drainage soils
Water butts	Easy to construct, install and operate	Limited water quality benefits
Rainwater harvesting	Reduce demand on mains water	Potential risk to public health
Filter strips	Effective pre-treatment option	Large land-take required
Infiltration trenches	Can significantly reduce runoff rates and volumes	High clogging potential without effective pre-treatment
Swales	Reduce runoff rates and volumes	Risks of blockage in connecting pipe work
Bioretention	Reduce runoff rates and volumes	Clogging if poor maintenance of surrounding landscape
Pervious Pavements	Significantly reduces runoff rates and volumes	Not with high sediment loads
Geocellular systems	High storage volume capacity (up to 90% void ratios)	No water quality treatment
Sand filters	Flexibility of design	Not with high sediment loads
Infiltration basins	Reduce runoff volumes	Potential failure if no appropriate pre-treatment
Detention basins	Cater for wide range of rainfall events	Little reduction in runoff volumes
Ponds	Cater for all storms	Little or no reduction in runoff volume
Stormwater Wetlands	Good removal capability of urban pollutants	Large land-take required

(Collated from Woods Ballard *et al.*, 2007)

BMP Environmental Principles

- Maintain water volumes in receiving water bodies
- Facilitate water storage in water scarce areas
- Provide wildlife habitats in urban areas
- Provide an aesthetic benefit where possible

London Olympic Park

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Water reuse. Irrigating parklands. 300,000 wetland plants.
Reedbeds1.8 ha, 4 ponds each of minimum area 50m^2
Olympic Village water consumption 105 litres pcpd (160 L pcpd UK)
4000 properties will have significantly reduced risk of flooding

BMP Operation and Maintenance Principles

- **Establish stakeholder responsibility at the planning stage**
- **Clarify responsibilities and costs between stakeholders**
- **Prepare an O&M management plan**
- **Consider major remedial activities and its funding in the long term.**
- **Determine frequency of maintenance activity**

Maintenance activities and frequencies for DEX ponds
(Duffy et al., 2008)

Activity	Frequency
Inspection	Monthly (from year 3)
Litter Picking	Monthly
Grass Cutting	3 per year
Weeding	1 per year
Prune / Trim	1 every 3 years
Algae Removal	Seasonal in first 3-5 years
Silt Removal	Regularly during construction. Intermittently once construction complete. Frequency depends on catchment conditions (soil type etc)
Aquatic Plant Aftercare	Seasonal in first 2 years
Fence/ Sign Maintenance	Seasonal – winter danger signs. Reactionary – usually related to vandalism
In/ Outlet Maintenance	Reactionary – clearing blockages
Filter Drain Maintenance	Reactionary – if structure becomes overwhelmed from overland runoff

BMP Social Principles

- Develop community education, information and training programmes
- Improve public perception and acceptability of water reuse
- Assess and inform public of H&S risks
- Mitigate H&S risks at the planning

Pocket wetland and signboard, Richmond, Australia (www.wsud.org)

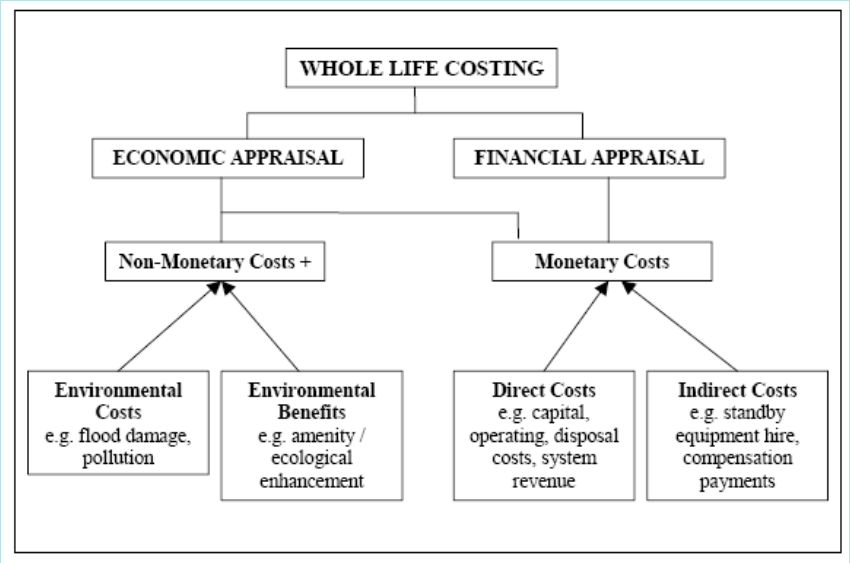
Constructed wetland and signboard, London

Wastewater treatment Constructed wetland, Shenzhen, S China

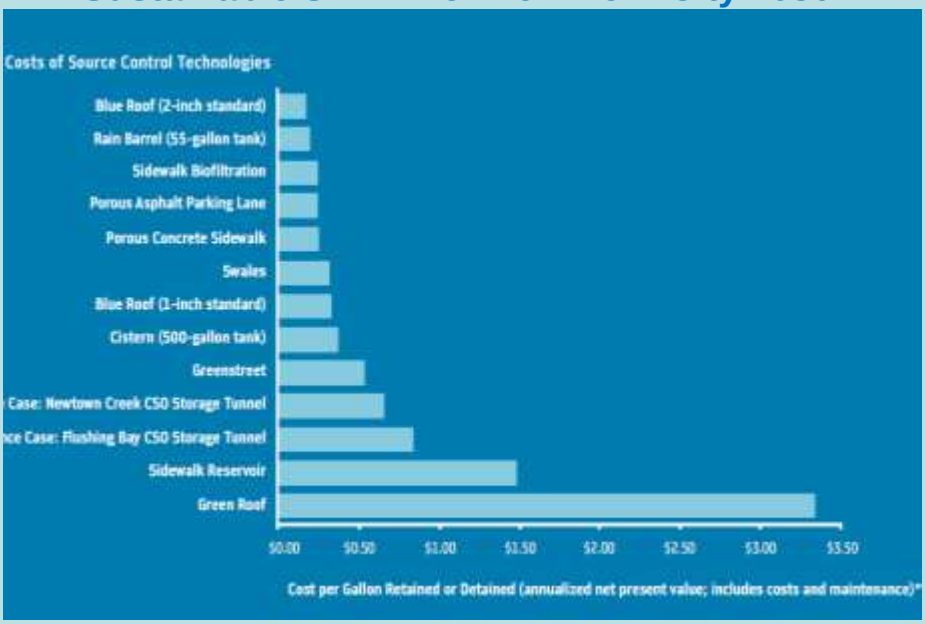
BMP Economic Principles

- Apply Whole-life costing (WLC) to BMP systems
- Consider level of maintenance in WLC assessments
- Provide incentives to developers to adopt BMPs
- Charge commercial properties for surface water drainage
- Include insurance indemnity in WLC

Different approaches to whole life costing (WLC) (Hydraulics Research, 2004)



Sustainable SWMP for New York City 2030



Cost-benefit analysis of BMPs in the UK

	Benefits (£'000)	Costs (£'000)	Benefits minus costs (£'000)	Benefit to cost ratio
Permeable paving	515,217	-896,603	1,411,820	Very positive
Rainwater harvesting	8,647,965	13,702,282	-5,054,317	Neutral
Water butt	733,075	325,824	407,251	Very positive
Swale	60,392	610,134	-549,742	Negative
Infiltration trench	105,687	8,739,055	-8,633,368	Very negative
Filter drain	60,392	7,212,069	-7,151,676	Very negative

(Gordon-Walker et al, 2007)

BMP Legislation and Regulation Principles

- **Introduce new legislation for BMP development and maintenance.**
- **Include BMPs in landscape and flood management planning**
- **Advise new developments to use surface water drainage systems**
- **Develop a GIS approach to identify BMP location and type**

IUWM benefits of BMP drainage systems

Technical	Environmental	Community	Costs	Planning
↓Pollution and flooding ↓Runoff volumes to CSOs, WWTPs ↓Impermeable surface area ↑Stormwater storage volumes	↑Maintain receiving water volumes ↑ Water quality ↑Wildlife habitats ↑ Biodiversity and landscape	↑Environmental education, information and training ↑Stakeholder Consultation ↑Community participation	↓Drainage system costs ↓O&M costs ↓WWTP runoff treatment costs ↓Retrofit costs	↑Landscape & flood management planning ↑Control of impermeable surfaces ↑Surface water drainage

Key: ↑= increase; ↓= decrease

Integrated Urban Water Management (IUWM) and Sustainable Stormwater Management

- Directly reduces the impact on the volume and quality of generated stormwater runoff
- Indirectly impacts on sanitation (through reduction in flows to wastewater treatment plants)
- Conserves drinking quality water supplies (by using the lowest quality of water for lowest quality needs)
- Stormwater reused for landscape irrigation, groundwater recharge, toilet flushing, car washing