

Project area: SuDS, Ecosystem Services, Biodiversity, Nutrient Cycling, Pollution Control  
Intended readership: Practitioners, academics, interest groups

### A natural approach to urban water management - SuDS and their ecosystem services

This research aimed to look at the ecosystem services delivered by SuDS ponds and to provide possible performance indicators. Using a case study in Newcastle (UK), an established SuDS pond was surveyed to evaluate biodiversity, nutrient cycling, pollution control and detoxification services delivery performance.

An increase in impermeable surfaces and surface water runoff can have serious impacts on the hydrology of catchments, and the quality of the habitat in these catchments. SuDS are designed to introduce sustainability into surface water runoff management.

In order to evaluate these ecosystem services performances, two surveys a month apart were undertaken.

### Suggested performance indicators at the Newcastle Great Park (NGP) SuDS Pond

SuDS ecosystem services are highlighted through the publication of *Millennium Ecosystem Assessments* reports. Since these publications, there has been acknowledgement of the knowledge gap in understanding of ecosystem performance, particularly of natural and artificial systems such as SuDS devices. The NGP case study was used to *propose and test effective ecosystem service performance indicators*. Indicators were selected from the range presented in the Millennium Ecosystem Assessment reports (presented in adjacent table).

This case study tested *biotic and entomological ecosystem service parameters* to examine their usefulness in quantifying SuDS pond ecosystem service performance.

Field survey parameters across NGP were: benthic macroinvertebrates; transect vegetation abundance and species; phosphorus, lead, cadmium and zinc concentrations in deposited sediment.

Ecosystem Services	Suggested Performance Indicators	Units
Freshwater	Storage Capacity	m <sup>3</sup>
	Service Provision	m <sup>3</sup> /d
	Evaporation	mm/d
	Precipitation	mm/d
Biodiversity	Species Abundance	%
	Species Richness	No Unit
	Species Diversity	No Unit
	Species Evenness	%
Hydrological Flows	Soil's Infiltration Rate	mm/h
	Storage Capacity	m <sup>3</sup>
	Retention Time	h
Natural Hazards	Storage Capacity	m <sup>3</sup>
	Soil's Infiltration Rate	mm/h
	Soil's Water Storage Capacity	cm
	Retention Time	h
Pollution Control & Detoxification	Heavy Metal conc. in Sediment	mg/kg
	Heavy Metal conc. in Water Body	mg/L
	Retention Time	h
	BMWP - ASPT	No Unit
Recreational	Number of Users	Quantity
	Reduced Level of Mortality	%
Aesthetics	Increase in House Prices	%
Nutrient Cycling	Nutrient Content of Water	mg/L
	Nutrient Content of Sediment	mg/kg
	Nutrient Uptake of Vegetation	mg/d
Pollination	Flowering Plants Abundance	%
	Pollinator MI abundance	%

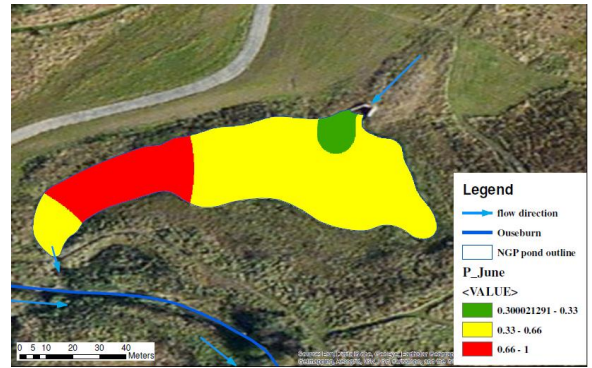
Suggested Performance Indicators for Ecosystem Services of SuDS Ponds

## Biodiversity

Results from the biodiversity sampling of the NGP pond identified that:

- Species richness increased through the pond (greatest species number was close to the SuDS pond outlet)
- Species numbers were higher in heavily vegetated sections of the pond compared to the open water areas
- Species evenness was greater than 0.5, indicating an even distribution of species across the SuDS pond

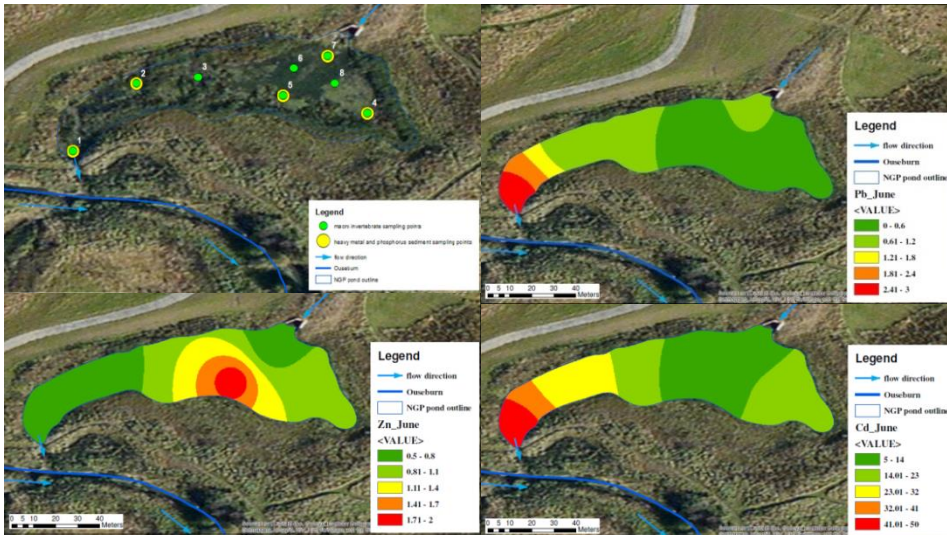
The pond is generally seen to be supporting an acceptable level of vegetation (according to the DAFOR scale) and macroinvertebrate species (BMWP and ASPT scoring) and appears to provide beneficial ecosystem improvement to support increasing species richness (inlet:outlet) while maintaining a relatively even occurrence of each species type.



*P Content of Sediments*

## Nutrient Cycling (P)

UK contaminated land standards indicate that the threshold level for P in the soil is 16 mg/kg; for all sampling points in the NGP SuDS pond, the P content of the sediment is below the threshold level, which indicates that there is no contamination caused by phosphorus.



*Sampling Points and Pb, Zn and Cd Content of Sediments*

SP ID	Cd (mg/kg)	Level of Contamination
1	46	Heavy Contamination
2	24	Heavy Contamination
4	23	Heavy Contamination
5	5	Contamination
7	9	Contamination
SP ID	Pb (mg/kg)	Level of Contamination
1	2.7	Uncontaminated
2	0.7	Uncontaminated
4	0	Uncontaminated
5	0.2	Uncontaminated
7	0.7	Uncontaminated
SP ID	Zn (mg/kg)	Level of Contamination
1	0.5	Uncontaminated
2	0.6	Uncontaminated
4	1.1	Uncontaminated
5	1.9	Uncontaminated
7	0.5	Uncontaminated

*Cd, Zn and Pb contents and contamination level of sediments according to Kelly Guidelines for Classification of Contaminated Soils (1979)*

## Pollution Control & Detoxification

The analysis of the heavy metal content of the sediment in the pond indicates that the pond is actively retaining heavy metals.

- Cadmium (Cd) content is found to increase between the inlet and outlet, with the greatest Cd concentration just upstream from the controlled outflow point.
- Zinc (Zn) concentration was highest within the high density vegetation sections of the pond and decreases along the length of the heavily vegetated flow path.
- Lead (Pb) content displayed a similar trend to Cd and was found across the pond. Pb was found to settle downstream from the open water section of the pond.

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