# Heriot-Watt University Retrofitting, monitoring and modelling SUDS: Case Studies from Scotland





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# Part 1

Investigation of the potential for SUDS retrofitting at Houston Industrial Estate

evenswood -

City Electrical Factors

Nkro MultiHire

Google

### Objectives

- 1. Identify the typical barriers to SUDS retrofit.
- Understand what types of SUDS would be suitable within the risks and any constraints presented at a study site;
- 3. Assess the willingness to install and evaluate the role incentives can play;
- Investigate how adequate maintenance plans could be put in place for the long term success of the treatment solutions; and,
- 5. Produce case studies which allow the findings to be easily transferred to other sites.



# Claimed familiarity with SUDS features and their ownership

80



### **Ground Truthing Summary**

SUDS Types	No. premises CLAIMED	No. premises VERIFIED	NOTES
Green roof	0	-	Correct: none seen on visits
Raised bed raingarden	0	-	Correct: none seen on visits
Gully or downpipe Disconnection	2	0	Two gullies diverted into a man-hole in the road [not into greenspace!]
Detention basin	3	0	None seen on visits
Drainage planters	7	0	None seen on visits
Permeable blacktop	7	0	None seen on visits
Grass filter strip	9	0	None seen on visits
Grass swale	11	0	None seen on visits
Gravel filter drain	14	4	Only 4 real examples found. Others refer to gravel surrounding the base of buildings.
Permeable block pavement	20		Ubiquitous on new & redevelopments (but not always recognised by occupiers).

## **Survey Conclusions**

- Most companies were unaware of the GBRs
- The majority of companies which experience flooding did not know the term 'SUDS'
- Most companies claimed familiarity with some SUDS techniques such as e.g. permeable paving and gravel filter drains
- 50 companies claimed familiarity with more than 1 SUDS feature; however, some of that appeared to be 'wishful thinking'
- Many of the potential plot scale techniques were unfamiliar to most companies
- There was a lot of confusion in the companies' understanding of SUDS features

<u>GBR 10</u>: ... runoff from any built developments...after1st April 2007...[is to be] ...drained by a SUD system...to avoid pollution





#### Transcal case study





## Location of boundary 'swale' (Google, 2017)





# Depression with boulders (left) and location of potential detention basin (right)





Total estimated costs for implementation of the Transcal project

Total casts of schoma	Without roundabout	With roundabout
	catchment	catchment
Option 1	£79,343.18	£85,479.60
Option 2	£91,169.65	£97,306.07
Option 3	£48,229.47	£54,365.89

![](_page_10_Picture_2.jpeg)

#### **Public SUDS facility**

![](_page_11_Figure_1.jpeg)

![](_page_11_Picture_2.jpeg)

#### Part 2: BGI Ponds SPM, Water Quality, Biodiversity & Ecosystem Functioning (WP1 and <u>WP2</u>)

![](_page_12_Picture_1.jpeg)

![](_page_12_Picture_2.jpeg)

#### **Objectives and overview**

- This work has an aim to study water quality and suspended sediments (WP1), and the ecosystem functioning and services / benefits provided by BGI (WP2), with a particular focus on SuDS ponds
- 2. One of the aims is characterising suspended sediments and understanding their impact on pond ecology. We are also aiming to study the provision of multiple benefits, including biodiversity and amenity values
- Current progress : regular samples from 9 sites (macroinvertebrates, physical and chemical parameters, suspended sediments, plankton); samples are currently being processed
- 4. Biodiversity surveys, SEM EDX (cooperation with Jim Buckman) and preliminary CityCat modelling for selected sites (cooperation with Newcastle/Steve Birkinshaw)

![](_page_13_Picture_5.jpeg)

#### Locations of the sampling sites

![](_page_14_Picture_1.jpeg)

## Eliburn (left) and Appleton (right) Ponds

![](_page_15_Picture_1.jpeg)

• Eliburn pond has an open plan, and is currently at the early stages of ecological succession. Because of that, and also due to the 'bomb crater' type design, amenity value of the pond is low, and biodiversity value is expected to be low as well.

![](_page_15_Picture_3.jpeg)

## Examples of vegetation at Appleton Pond

![](_page_16_Picture_1.jpeg)

- Appleton pond has a number of established aquatic macrophytes and a pleasant appearance; a considerable biodiversity value is expected for that reason.

- However, there are problems with access.

![](_page_16_Picture_4.jpeg)

## Plant Species Richness at the Studied Sites

![](_page_17_Figure_1.jpeg)

resilience

### Lichen survey – cooperation with R. Yahr (RBGE) and K. Takezawa (SRUC)

![](_page_18_Figure_1.jpeg)

Rescaled factor loadings(C1 and C2) and epiphytic lichen species (C3) at SUDS sites

![](_page_18_Figure_3.jpeg)

![](_page_18_Picture_4.jpeg)

# Example of SEM EDX results (Appleton pond) cooperation with Jim Buckman

![](_page_19_Figure_1.jpeg)

![](_page_19_Picture_2.jpeg)

Both organic and inorganic particles are observed, with organics being predominant, and also coating inorganic particles. Presence of certain elements (e.g. Ti) may be indicative of roadside or industrial pollution

![](_page_19_Picture_4.jpeg)

#### Plankton Diversity and Abundance - Cooperation with Derek Christie (Open University)

![](_page_20_Picture_1.jpeg)

 Examples of commonly encountered planktonic organisms: Nitzschia sigmoidea from Granton and Keratella quadrata from Blackford SuDS ponds

![](_page_20_Picture_3.jpeg)

#### CityCat modelling of a 100 years RP storm at Granton Pond catchment – cooperation with Steve Birkinshaw

![](_page_21_Picture_1.jpeg)

Flow velocities are in red, water depths are in blue. The simulation snapshot is for 60' after the start of the event.

![](_page_21_Picture_3.jpeg)

## **Practical Implications**

- The study will provide enhanced estimates of the ponds' biodiversity thus aiding estimation of secondary multiple benefits and strengthening the case for BGI installations
- The results will be helpful for designing and reassessing maintenance schedules
- Simulation modelling will provide 'What if' scenarios, i.e. what is likely to happen both in the design and in extreme conditions

# Many Thanks for your attention!

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- Jim Buckman, Chris Semple, Juliane Bischoff and A. Sevilla(HW)
- Steve Birkinshaw (Newcastle University)

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![](_page_23_Picture_18.jpeg)

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