SuDS Awards 2024

“Combining small-scale sustainable drainage systems with real-time control systems”

Submitted by Mott MacDonald

Awards category

Regeneration and retrofit – small scale (less than one hectare)

Lead or collaborating organisation(s)	Mott MacDonald, SDS Limited
Location of SuDS	N/A (research project)

1. SuDS overview

SuDS components used	This is a research project which developed three small-scale SuDS options which allow for the implementation at scale in cities and provide multiple benefits. Whilst previous studies focus on the implementation of property-level smart rainwater harvesting, the objective of this project is to assess the potential benefits, opportunities and challenges of retrofitting enhanced small-scale SuDS combined with real-time control systems within the streets of cities. The principles of these three options are: small-scale, flexible installation, enhanced storage, rapid implementation, biodiversity enhancement and introduction of real-time controls: • **Option 1 Kerb Extension: This system builds upon a common rain garden feature found in existing SuDS retrofitting schemes, incorporating a 750mm deep geocellular sub-base. The main enhancement in this intervention is the integration of real-time control systems, which enables water reuse through passive or active irrigation and optimised attenuation by closing valves and storing surface water (Figure 1)** • **Option 2 Compact kerb extension rain garden with permeable pavement: This typology combines elements from existing SuDS schemes, integrating a small rain garden as part of a kerb extension and incorporating permeable pavement downstream. The rain garden acts as the primary feature for capturing runoff and managing more frequent storms. The permeable pavement serves as an exceedance feature for more extreme events, allowing surface water to percolate through the surface. A 750mm layer of geocellular sub-base replacement manages water captured by the permeable pavement or overflowing by underground storage from the rain garden. Similar to the previous intervention, real-time control systems are incorporated at the outlet chamber (Figure 2)** • **Option 3 'SuDS integrated pocket': This option is suitable for scenarios where parking or active travel routes need to be retained and offers opportunities for incorporating rain gardens and tree pits within the footway. Runoff from highways is captured through a kerb opening into a rain garden, which is interconnected via a trench and perforated pipe to a tree pit located downstream. These two systems manage runoff from more frequent storms. In more extreme storm events, the system overflow via an underground system into a 750mm deep geocellular sub-base replacement under the permeable pavement. Additionally, the permeable pavement helps capture surface water when the rain garden's inlet capacity is exceeded. The principles of real-time control are also applied in this intervention (Figure 3).**

Size of the scheme and its local context	The research project assumes a study area of approximately 150m^2 and a small-scale SuDS implemented in the on-street parking bay (7m long).
Approximate age of scheme (years)	N/A
Benefits of the scheme	This research project demonstrates that the 3 small-scale SuDS solutions can achieve the following benefits when combined with real-time controls: • These systems can achieve a discharge rate reduction of 35% to 100% during the storm peak compared to a traditional 25mm orifice control. This is based on an analysis with historic rainfall data known to have caused flooding. This means that the discharge rate can be either optimised or all the runoff volume stored during the peak with no discharge. This latter approach can help management of the peak flows into the downstream system (e.g. sewer) by using all the SuDS storage before any discharge (Figure 4 and 5) • Real-time controls and the use of geocullular storage can provide opportunities for water reuse (7m^3 in each SuDS). • Groundwater recharge can be promoted with the use of these systems and real-time controls. • Biodiversity: All systems rely on combination on blue/grey infrastructure with green infrastructure to support biodiversity net gain. • Amenity: the different options provide different alternatives to accommodate constraints and opportunities in each of the streets on pedestrian mobility, active travel and parking constraints for the community.
Briefly describe the scheme	This research project, led by Mott MacDonald in collaboration with SDS Limited, explores the advantages of combining small-scale modular Sustainable Drainage Systems (SuDS) with real-time control systems in public areas. Through case studies in the UK and US, the research project demonstrates that small-scale SuDS can enhance the resilience of existing infrastructure through incremental improvements. It proposes three small scale SuDS options that can improve flood mitigation and facilitate large-scale implementation to achieve wider and multiple benefits. A local hydraulic assessment, based on historic rainfall data known to have caused flooding, concludes that implementing real-time controls in SuDS can improve water storage for reuse, promote groundwater recharge, maximise storage utilisation during rainfall to mitigate sewer flooding and overflows, and offer adaptability to climate change. The research also addresses the practical aspects of installing real-time control systems compared to traditional flow control, highlighting the need for further assessment on aspects such as input data, power supply, and network connectivity.

2. SuDS details

No.	Question	Answer
1	What difference has this scheme made to the local community or area?	This research project aims to provide three standardised SuDS interventions which combine current real-time control technologies used mostly in property-level SuDS. The options from this project can support the scalability of SuDS with the community benefits such as: • "Smart management" of surface water and sewer flooding within public areas in cities. • Biodiversity net gain though small incremental improvement. • Improvement of treatment management train and water quality at outfalls. • Amenity: Ability to adapt to community constraints and opportunities on active travel and use/parking of vehicles.
2	What is exceptional about this scheme beyond a standard approach?	The standardisation of options and the use of real-time controls.
3	How much work went into getting this scheme realised?	The research project and the hydraulic analysis to evaluate the solution against historic rainfall took approximately 6 months.
4	Is this scheme part of a masterplan or integrated into other initiatives?	This is a standalone research project (the next step of the research project is ongoing)
5	What value does this scheme provide to the local area and beyond?	This research project offers standardised interventions that are scalable city-wide, are future proofed for current and emerging technologies and address the typical challenges around SuDS implementation and uptake.

6	What challenges/problems needed to be addressed to realise this scheme?	Future research should focus on expanding the scope of the analysis by considering the cumulative impact of this type of SuDS in a catchment to gain a more comprehensive understanding of sewer system performance and associated risk of CSO and flooding downstream under a range of rainfall events. Additionally, investigations into the practical aspects of implementing real-time control systems, such as cost-effectiveness, technological requirements, and maintenance considerations, should be undertaken This should also include aspects such as addressing digital uncertainties and improving data reliability and weather forecasting accuracy
7	How does the scheme address related issues such as water scarcity, nutrient neutrality, or biodiversity net gain?	Water scarcity is addressed as the options consider the opportunity to store water for reuse given its enhanced storage and use of real-time controls. As described above, biodiversity net gain is achieved through scalability of the interventions and incremental improvements they offer.
8	Is learning from the scheme continually captured and communicated? Please give examples.	The research project and its findings were published in Civil Engineering Proceedings in November 2023 Combining small-scale sustainable drainage systems with real-time control systems | Proceedings of the Institution of Civil Engineers - Civil Engineering (icevirtuallibrary.com)
9	What approaches/measures are taken to ensure the scheme is properly managed and maintained?	Not applicable at this stage, but the research gives consideration at the maintainability of the physical and data infrastructure assets.
10	Have you collected any feedback on your scheme? What do people say about it? Can you provide any quotes?	The research project concluded at the end of 2023 and has already generated interest. It has been presented to Local Authorities such as Swansea Council with good feedback. We are actively working to continue the research to quantify the multiple benefits at a catchment scale and exploring partnerships on this innovative research. By future-proofing infrastructure for emerging technologies, this research has the potential to significantly impact the industry's thinking and policy and make a difference in creating more sustainable and resilient communities.

3. Supporting materials

<table>
<tr><th>Image (low resolution)</th><th>Caption</th><th>Image credit</th></tr>
<tr><td>
</td><td>Figure 1. Option 1 Kerb

Extension</td><td>Figure 1. Option 1 Kerb Extension</td></tr>
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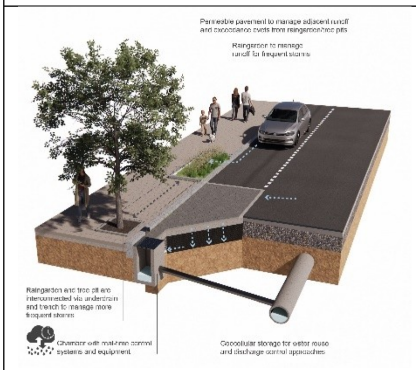
</td><td>Figure 2. Option 2 Compact kerb extension rain garden with permeable pavement</td><td>Figure 2. Option 2 Compact kerb extension rain garden with permeable pavement</td></tr>
<tr><td>
</td><td>Figure 3. Option 3 ‘SuDS integrated pocket’</td><td>Figure 3. Option 3 ‘SuDS integrated pocket’</td></tr>
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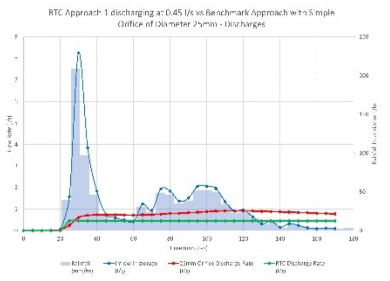
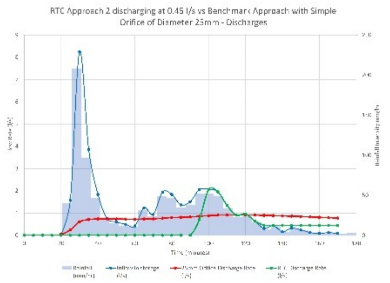
	Figure 4 – Hydrograph for Real-time controls Approach 1 (optimised discharge)	Figure 4 – Hydrograph for Real-time controls Approach 1 (optimised discharge)
	Figure 5 – Hydrograph for Real-time controls Approach 2 (no discharge during storm peak)	Figure 5 – Hydrograph for Real-time controls Approach 2 (no discharge during storm peak)