

More for less: Retrofitting surface water management measures

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ABSTRACT

Interest in managing surface water to deal with urban flood risk and pollution control has grown substantially. Many Water and Sewerage Companies (WaSCs) are investigating this further. Economic stress, big society, localism and legislation are likely to increase the need to manage surface water differently, particularly over the long term.

CIRIA guidance to help overcome the significant challenge of retrofitting surface water management measures (SWMM) in urban areas is nearly complete. This paper provides an outline of the guidance's key aspects and its practical application. Importantly, it highlights the need for integration with urban design, and explores methods that enable the wider benefits of retrofitting to be quantified.

WHY RETROFIT SURFACE WATER MANAGEMENT MEASURES & WHAT ARE THE BENEFITS?

There is growing recognition that traditional surface water management approaches are unsustainable. Existing drainage systems can no longer achieve the necessary performance standards. Flooding and water quality drivers continue to create the need for infrastructure improvement. Our current approach increases the conveyance or storage capability below ground, and is unaffordable in the long term.

SWMM include SuDS, proprietary devices, dual use functional systems (e.g. for exceedance) and where appropriate traditional measures such as pipes. Ideally many retrofit measures will be on the surface and be more visible to the public. This will require greater engagement with communities to help them accept and understand the benefits and operation of these drainage measures. For the best results, measures should complement the existing urban environment and improve the urban landscape. When this is done, it can transform areas into being more attractive places to live, work and play. In some places this may be relatively easy, when urban areas undergo redevelopment, regeneration, or renovation (e.g. housing stock, in public or private ownership). The spatial planning of these aspects is key, with guidance available in CIRIA's *C687 Planning for SuDS - making it happen* (Dickie *et al.*, 2010).

SWMM can provide wider environmental benefits compared with more traditional systems. They can manage the quantity of water and improve the quality, e.g. through source control, and improve the quality of water being discharged. Many measures feature vegetation, and may be referred to as green infrastructure (GI). These measures have the potential to enhance biodiversity and create new habitats.

Managing water on the surface also provides a more visible and smoother transition to surface flooding in extreme events. Using measures that make best use of the existing urban infrastructure provides a low cost and yet effective way to manage extreme events.

THE CIRIA GUIDANCE

Over the last two years, CIRIA has been developing guidance to help practitioners implement SWMM. This guidance focuses on the approach and key issues to consider for retrofitting SWMM. The following sections outline key aspects of the guidance.

RETROFITTING FRAMEWORK & APPROACH

An overarching framework with 6 phases sets out the approach for retrofitting SWMM (Figure 1). This aligns with many common delivery processes for surface water management (for example Defra, 2010). The structure allows the user to dip in and out as appropriate. It takes a hierarchical approach to generate solutions and focus on areas of greatest need.

The framework uses three spatial scales; plot, neighbourhood and catchment, and two retrofitting approaches; strategic and opportunistic. *Strategic* retrofitting aims to address a specific driver(s), and should readily be understood by the drainage designers and planners. The second approach is “nibbling” (Kellagher, 2010) or *opportunistic* retrofitting, which picks up individual plots. Examples of this include downspout disconnection in the City of Portland (Foster *et al.*, 2011) and 1 million street trees in New York (City of New York, 2008). The guidance recommends that whenever opportunistic retrofitting occurs, it should still form part of a wider strategic approach to ensure measures join up and create the desired benefit.



Figure 1 The retrofitting surface water management framework

THE IMPORTANCE OF GOOD URBAN DESIGN

The guidance recognises the importance for SWMM to fit into the existing urban environment. It dedicates a chapter that sets out a number of principles and questions for the practitioner to consider. The key principles to follow are:

1. Understand the context and scale of the retrofit?
2. Design for people first
3. No space is useless
4. Create diversity at the place
5. Improve connections and cohesion between places
6. Connect and integrate resource flows
7. Good places are never finished! Design to accommodate change

To help practitioners, the guidance includes a number of sketches to show what may be possible for different land-use contexts. Figure 2 and Figure 3 show terraced housing, and the possible transformation from a bland street to a more vibrant place to live by keeping water on the surface, both within the private and public realm.



Figure 2 Typical terraced street predominantly with hard surfaces



Figure 3 (courtesy of CIRIA) Managing water on the surface with shallow above ground channels, planters & bio-retention areas

UNDERSTANDING THE PROBLEM

Whatever the approach to retrofitting SWMM (opportunistic or strategic) the *Preparation* phase of the project involves establishing partners and stakeholders (whether on an individual plot or catchment wide scale). The level of engagement will be commensurate with the scale of the problem or opportunity. Within this, data specific to retrofitting will be

necessary. However, most data requirements will not differ from those commonly needed for the development of any traditional drainage design.

It is vital to fully understand the problem and establish the needs. This forms part of the *Feasibility* phase. Here the source of the flows, how they move through the area and where they end up need to be fully understood. This applies whatever the underlying driver is. Recent retrofit projects show the benefits of a more detailed model to help understand the problem to be addressed, which in turn provides greater confidence in any potential solution. This has been seen in Bridlington, where Yorkshire Water is assessing the potential for retrofitting SWMM and may form part of a solution to address bathing water quality discharges.

It is particularly important to understand network interactions. In a catchment where a problem exists downstream, the retrofit solution may not be easy, unless flows can be managed and controlled. It is vital to create the benefit at the target location through retrofitting and not allow flow from another area to take up the available capacity. Where this does happen the costs are likely to substantially increase.

ESTABLISHING WHAT MAY BE POSSIBLE

The *Feasibility* phase also identifies the opportunities that exist, and provides an early assessment as to the potential benefits. Here opportunities are split into 3 different types in the following preference:

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| <p>1. Target opportunities - easy wins, focusing where large disconnections are achievable (e.g. surface water systems) or large areas of land, prioritising public ownership</p> | <p>2. Common opportunities - are areas that are similar throughout and so a consistent approach and use of measures are applicable</p> | <p>3. Future opportunities - may result from regeneration or redevelopment works. Alternatively may occur whilst other infrastructure improvements take place.</p> |
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To assess the potential benefit of these opportunities, it is possible to apply a range of strategic measures and test different scenarios. Strategic measures describe a particular approach to manage water within one or more contributing areas and opportunities. This can quickly establish the potential effectiveness of each strategic measure and how to apply it for each opportunity. As with any drainage project, a screening approach can be applied to help prioritise which strategic measures should be taken forward to develop options from.

DEVELOPING OPTIONS

Retrofitting can make use of a wide range of measures which create different levels of benefits in different land uses. The *Develop Options* phase outlines these; however it is important to remember that most often it is the availability of space that will dictate the type and most definitely the size of each measure. The context for retrofitting these measures links back to the principles of urban design.

A series of tables provide guidance as to the types of measures most applicable to different land uses. This includes highways (e.g. access and distributor, with and without verge) properties and their curtilage, whether private or public, residential or non residential. In most cases, but not all, it is important to delineate the sources of flow and types of measures between the highway and property/curtilage. This provides a simple way to model and establish the hydraulic and water quality benefits.

ASSESSING THE COSTS AND MULTI-VALUE BENEFITS

The *Appraisal* phase provides guidance on the approach to assess costs and benefits. This starts with the confirmation of the appraisal approach such as Net Present Value or Benefit Cost Ratio. Costing information for some of the measures are limited, but available in some form, such as the UKWIR and WERF (2005) guidance, or developed from first principles.

Assessing the hydraulic and water quality benefits is relatively straightforward, particularly where a particular standard has to be met. Where a risk based approach is taken, this can

still be costed. For example, with flooding it may be appropriate to consider average annualised damages (FHRC, 2010).

Becoming more important is costing the 'multi value' benefits. Until recently this has been difficult. However in the US the Center for Neighbourhood Technology online assessment green valuation tool (CNT2010) and in the UK, a spreadsheet tool (GINW, 2011) now allow monetary values to be determined for certain intangible benefits. This will recognise the wider benefits of SWMM in comparison to their traditional counterparts.

IMPLEMENTING THE MEASURES

The *Implementation Activities* phase includes important detail design aspects to consider. It references specific guidance for the design of individual measures such as C697 *The SuDS Manual* (Woods-Ballard et al, 2007) and various publications by the Center for Watershed Protection, such as *New York State Stormwater Management Design Manual* (2010).

Although the approach to retrofitting follows a very similar process to any conventional drainage design, it will require far greater interaction with the public. Effective engagement with homeowners, landowners, communities and some institutional players and politicians will be necessary to successfully retrofit SWMM. An example of this is where retrofitting is to take place within the curtilage on private properties. Here there may be the need for the property owner to accept the measure, as well as potentially the mortgage company and compliance with Building Regulations.

PERFORMANCE MONITORING

The final phase, *Performance Monitoring*, outlines the benefits of monitoring, why it can be required and how to do it. Guidance is limited, particularly on SuDS, and the collection of data on retrofit systems will be very important to provide greater confidence to the industry.

SUMMARY

The CIRIA guidance provides a structure and approach to retrofit SWMM to meet a wide range of drivers. It identifies other guidance that is needed to help retrofitting to happen, such as the detailed design aspects. It recognises the key aspects of ensuring SWMM fit into the existing urban environment and the importance of calculating the multi value benefits.

ACKNOWLEDGEMENTS

The authors wish to thank the support of the CIRIA Project Steering Group and UK funders. The views expressed are those of the authors and do not necessarily reflect those of our organisations or funders.

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