Adaptation Pathways

for choosing a suitable mix of grey and blue-green solutions to urban flooding

urban flood resilience

FACTSHEET

Project area: *Urban drainage planning*
Intended audience: *Developers, local authorities, planners, asset owners*

Summary

Whilst adaptation pathways have been developed elsewhere for large, engineered infrastructure projects (e.g. the Thames Barrier, Rhine Delta), the applicability of these approaches at other scales and institutional settings has not previously been fully tested. A methodology is developed below for creating adaptation pathways at the smaller scale of an urban sub-catchment and this importantly focusses on extending the criteria by which the pathways are evaluated from a conventional cost benefit approach to one that also takes into account the multiple benefits attainable, ease of implementation and flexibility. A case study of the options to deal with current and expected future flood risk in part of the London Borough of Sutton, is presented to demonstrate the approach. The results show combining future Blue-Green interventions with the existing Grey system are more efficient at dealing with flooding and maximising other benefits. The monetisation of the multiple benefits associated with each pathway shows that their economic co-evaluation alongside infrastructure costs can change the preference for one pathway over another.

Introduction

Adaptation pathways are helpful in creating flexible designs for urban drainage systems that are responsive to future uncertainties, allowing short term problems to be solved whilst being adaptive to future long term needs. Tipping points, often based on meeting specified levels of performance, are identified where a particular option or pathway can no longer meet these requirements. The timing of when a tipping point will occur depends on the expected rates of climate change and urban development being considered (and compared). Adaptation pathways can indicate the phased introduction of new infrastructure over time as well as the potential for technical lock-ins to a single solution, and path dependencies. They have been developed and used extensively in the Netherlands. Pathways can be compared and evaluated based on a wide range of criteria and regularly updated as new information becomes available. Alternative pathways that are not adopted now remain as possible solutions later if future pressures render current plans inadequate. Recent guidance by Water UK on the production of Drainage and Wastewater Management Plans recommends an adaptation pathways approach where longer term drivers of change are evident but uncertain. For example managing surface water flows could involve operational measures (such as real time weather and flow management) as an initial option with residual risks managed by a “blue-green” intervention as and when flow triggers indicate that thresholds are being exceeded.

Proposed Methodology

The steps in the methodological framework (Fig 1) identify future flood location, review possible intervention options (within local catchment constraints), create adaptation pathways and evaluate their hydraulic performance, and asses the implementation and wider benefits of each pathway. Through monitoring of climate change evolution and each option’s performance, the framework allows for the iterative re-assessment of the pathways as new climate information emerges. Performance thresholds for each pathway can be expressed in a variety of ways, for example directly as exceeding the level of flood protection within service delivery targets, or as a limitation on the associated damage cost and loss of business revenue.

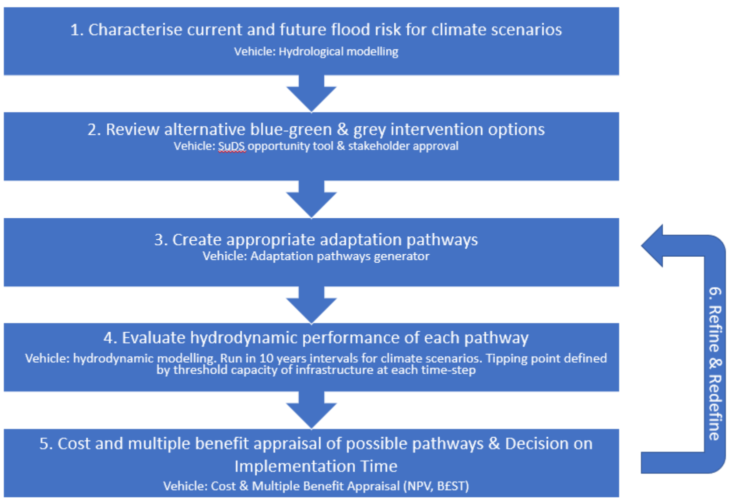

Figure 1: Framework to identify possible options and their combinations into adaptation pathways

Case Study: South London Borough (climate change: high and central emission scenarios to 2070)

Primarily a residential area of terraced houses which is planned to experience future urbanisation, flooding is currently observed for storms of 1 in 5-year return period, upstream of the outfall to a local river.

1. Characterise Flood Risk (vehicle: SWMM 5.1 Model)

	2020	2030	2040	2050	2060	2070
High Emission Scenario	7	13	14	16	19	24
Central Emission Scenario	7	8	8	9	14	14

Table 1: floodable manholes under do-nothing baseline scenario

2. Review intervention options (vehicle: GLA SuDS Opportunity Mapping Tool)

Initial screening of options was performed using the GIS based "SuDS Opportunity Mapping tool", which identifies possible options given physical constraints; this showed feasible sites for bioretention cells (BCs), permeable pavements (PPs), and attenuation storage ponds; grey pipe expansion of up to 2 nominal pipe sizes was also considered.

3/4. Identify adaptation pathways and service performance (vehicle: Deltares Adapatation Pathway Generator)

Once a threshold for one option is exceeded, pathways can be combined and options already implemented can continue to contribute flood control (Figure 2)

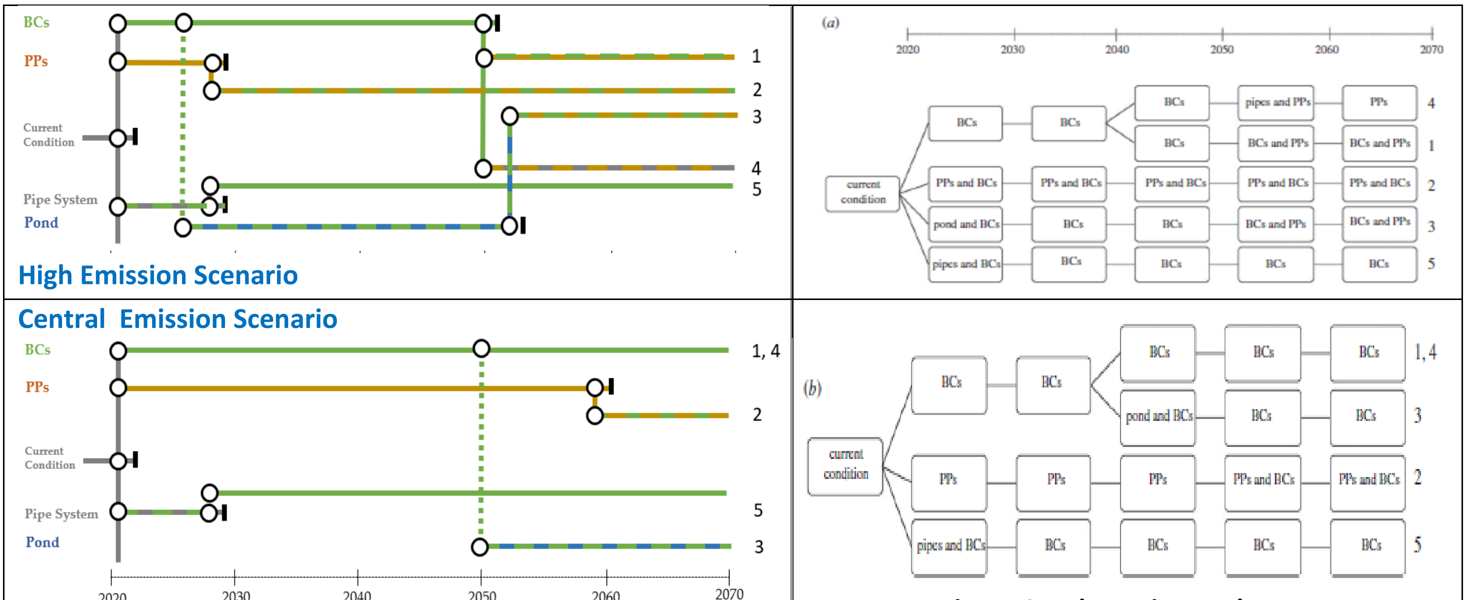

Figure 2: Adaptation Pathways

5. Cost and Multiple Benefit (MB) appraisal (vehicle: CIRIA B£ST tool)

Capital and O&M costs (TOTEX) are based on the NPV for the individual options and compared to the monetised multiple benefits that arise in each pathway. In this example the dominant relevant benefits were amenity, carbon sequestration, groundwater recharge, recreation, health and educational opportunities (Figure 3). For high emissions the preferred pathway identified was BCs until 2025, followed by additional BCs and a pond until 2053, and finally a parallel implementation of PPs.

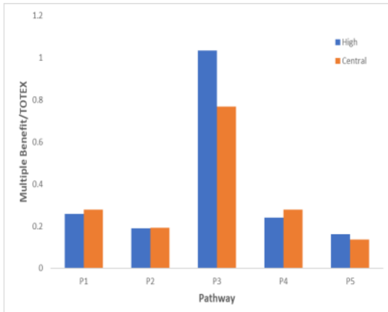

Figure 3: MB to TOTEX ratio for 5 adaptation pathways

Conclusion

The methodology can be repeated for other scenarios (e.g based on varying rates of urban expansion). Performance thresholds do not need to be met before introducing new options if by intervening early additional multiple benefits can be optimised.

This factsheet was produced based on the journal article: Kapetas L., Fenner R.A. (2020). "Integrating blue-green and grey infrastructure through an adaptation pathways approach to surface water flooding" Phil. Trans. R. Soc. A. http://dx.doi.org/10.1098/rsta.2019.024

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