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Interoperability and resilient urban water systems

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Flood risk management (FRM) is increasingly expected to be integrated, because flooding affects society and environment in various ways, reaching across multiple sectors, spatial and temporal scales. This is especially the case urban environments, where limited space, competing demands, and strong interdependencies between sectors imply that multifunctional and flexible measures are fundamental to flood resilience. In the past decades, many tools have been developed to move beyond single engineering solutions for FRM, including natural flood risk management (e.g. increasing water infiltration by tree planting), and multifunctional designs in urban environments (e.g. Blue-Green (B-G) infrastructure; sustainable urban drainage systems). Yet, despite the growing number of options, it remains challenging to actually integrate multiple urban infrastructure systems to increase flood resilience at the city-wide scale and to understand how the capacity of B-G infrastructure can be expanded through connection with other urban systems (e.g. transport). For example, suppose we have two options to protect a property from excessive stormwater which work equally well: a small flood defence (e.g. wall) and an infiltration pond (e.g. green space, which has additional environmental and social benefits). When a larger floodwall is build we can estimate how much more properties will be protected, but demonstrating the value and flood risk reduction of more B-G infrastructure is less straightforward. This is because functions of B-G infrastructure are often restricted in space and time, and dependent on other systems (e.g. roads for runoff). Therefore, in moving towards urban flood resilience, there is a need to understand and optimise linkages of B-G infrastructure with other urban systems, i.e. to adopt a system-based approach for urban flood resilience. As part of a UK-based consortium project on Achieving Urban Flood Resilience in an Uncertain Future, we explore the concept of interoperability for FRM, which focuses on trading the function of one system to another (e.g. road to runoff conveyor) as a way to gain in system efficiency and productivity while reducing system costs. The aim of this work is to investigate the interoperability of urban FRM assets with other systems (transport, land-use, drainage) to cost-efficiently expand the capacity of B-G and Grey infrastructure to contribute to wider urban resilience to climate change. To this end, we will develop a framework to identify and assess different interoperable options by (i) conceptualising interoperability to enhance B-G infrastructure with existing urban systems and compile a list of potential interoperable, cost-effective, multifunctional FRM options in urban areas based on existing cases; and (ii) identifying potential connectivity blockages, linkages and intersections between systems to demonstrate the possibilities of expanding the capacity of B-G infrastructure for flood resilience through interoperability based on spatial analysis and engagement with stakeholders at case study sites in Newcastle and Ebbsfleet (UK).