Modelling the impact of soakaway retrofits on combined sewage overflows in a 3km² urban catchment in Copenhagen, Denmark

Stormwater infiltration measures such as soakaways are expected to be part of future urban drainage systems. However, few studies exist on the effect of extensive stormwater infiltration through soakaways on the overall urban water system, including sewers and groundwater, at city catchment scale. In particular such estimates have not been made in real urban settings with multiple physical and structural constraints. This paper presents a methodology for conducting such an analysis, and provides quantitative estimates of the effects on the urban water flows. Using an interdisciplinary, three-step approach that employed GIS analyses and physically distributed, dynamic pipe flow modelling in an iterative manner, this study estimates the impact of infiltration on combined sewage overflows (CSOs) in a 3km² urban catchment in Copenhagen. The first step was the creation of a baseline scenario. The second step led to a potential infiltration scenario where 65% of the total impervious area was connected to soakaways, and resulted in an estimated reduction in annual sewage overflow volume of 68%. This scenario was then further developed in the third step by adding groundwater constraints, which formed a more realistic scenario where only 8% of the impervious area was connected to soakaways and the reduction in CSO volume was 24%. The potential and realistic scenarios were modelled both with hydraulic coupling between soakaway and sewer, and as fully disconnected. Results show that infiltration is constrained mainly by the quality of the stormwater runoff from roads and limited land availability in the potential infiltration scenario, and by low-permeable soils and a problematically high groundwater level in the realistic infiltration scenario. The hydraulically coupled model gives higher CSO volume than the fully disconnected model for the potential infiltration scenario, whereas no difference is seen between these two models in the realistic infiltration scenario. The effect of infiltration on combined sewer overflows is thus expected to be limited in the case study area. General conclusions are that groundwater constraints are important to consider when evaluating the potential of infiltration-based stormwater management, and that it is important to include the hydraulic coupling between soakaways and sewers in models if soakaways are expected to give overflow to the sewers.

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