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An integrated decision support tool (i-DST) for urban water management: Optimization and co-benefit analysis of grey and green infrastructure for water quality compliance

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The water quality of receiving streams and waterbodies in urban watersheds are increasingly polluted from stormwater runoff. Prioritizing stormwater infrastructure projects to address pollutant loads is challenging. In addition to complying with water quality standards, agencies must also consider factors such as regulating peak flows, life cycle costs, environmental impacts, and co-benefits to the environment and community. The implementation of Best Management Practices (BMPs), can help mitigate pollutant loads, runoff volume, and storm peak flow. Stormwater modeling, generally used to assess the impact of BMPs implemented within a watershed, are useful for determining the optimal suite of BMPs to maximize pollutant load reduction and minimize cost. The suite of BMPs can include small, distributed green infrastructure techniques or larger, centralized grey infrastructure. An integrated decision support tool, called i-DST, that allows for the optimization and comprehensive life-cycle cost assessment of grey, green, and hybrid stormwater infrastructure, is currently being developed. The framework evaluates optimal stormwater runoff management by taking into account the diverse economic, environmental, and societal needs. Watersheds in Southern California are used for initial testing and application of the i-DST tool. The river channels are impaired by heavy metals, including copper, lead, and zinc. However, despite being adjacent to one another, modeling results, using EPA System for Urban Stormwater Treatment and Analysis INtegration (SUSTAIN), found that the optimal path to compliance in tested watersheds differs significantly, based on infrastructure costs, BMPs scenarios, and ancillary benefits. Initial optimization for the Dominquez Channel watershed shows that BMP scenarios with a higher percentage of water being routed to greener infrastructure are more effective at reducing pollutant loading. However, BMP scenarios with a higher percentage of water being routed to greyer infrastructure are more effective at reducing peak flows. After identifying a suite of optimal solutions that vary the percentage of stormwater routed to green vs grey infrastructure, a multi-criteria assessment (MCA) matrix is used to link the different alternatives with their ancillary ecological and social benefits (co-benefits). Decision makers can use the MCA output as a holistic review of infrastructure alternatives and assess the scale of anticipated co-benefits related to each option. Based on the MCA, the best solution for Dominquez Channel routes 75% of stormwater to greener infrastructure while 25% is routed to greyer. Additionally, hybrid solutions are more cost efficient when optimizing for pollutant load and peak flow reduction simultaneously.