

**Integrated computational model for assessing and improving  
the performance of the stormwater system in urban catchments,  
in the context of spatial planning.**

**Abstract**

Progressive urbanization and climate change are exerting increasing pressure on stormwater systems, reducing their reliability and limiting the capacity for effective performance forecasting. The growing extent of impervious surfaces, combined with the rising frequency of extreme rainfall events, often results in the overloading of drainage networks. Consequently, there is a pressing need to implement advanced analytical tools that can support the planning, design, and optimization of such infrastructure.

The objective of this dissertation was to develop an integrated computational model for evaluating and enhancing the performance of stormwater systems in urban catchments, with explicit consideration of spatial planning conditions. A holistic approach was adopted, integrating hydrodynamic modelling with machine learning techniques.

The research resulted in the development of an original computational application designed to support the planning and design of green infrastructure elements, including rain gardens, infiltration trenches, and retention tanks with controlled outflow. The tool is particularly suited to small urban catchments, where local topographic characteristics and land-use patterns exert a significant influence on stormwater management efficiency. By incorporating key physical and geographical data, the application enables rapid analysis and facilitates informed decision-making in the design and modernization of stormwater systems.

As an extension of this research, simplified predictive models were developed to identify sewer overflows and forecast peak flows in small, heterogeneous urban catchments using machine learning methods. These models allow the assessment of stormwater system performance based on rainfall data, sewer network topology, and both surface and channel retention, providing an alternative to commonly used mechanistic approaches such as the Storm Water Management Model (SWMM).

This dissertation makes a substantive contribution to the advancement of planning and management methodologies for stormwater systems in urbanized environments. The proposed approach lays the groundwork for designing infrastructure that is both resilient to the impacts of climate change and aligned with the principles of sustainable spatial development.

