How can we design sponge cities that reduce (micro-)pollutant emissions?

Keywords: stormwater, micropollutant, blue-green infrastructure, modelling, environmental impact

Proposed: November 2023 **Valid until:** October 2024

Background

Growing urban surfaces and climate change increase water scarcity and water quality degradation. There is a need to transition from grey underground infrastructure to more sustainable solutions such as sponge cities and circular stormwater use. However, urban stormwater can be contaminated with potentially toxic pollutants such as heavy metals, total suspended solids and micropollutants (e.g. pesticides, PAHs) due to pollutant wash-off from urban surfaces. A limiting factor for implementing circular urban water management is the unknown risks for human health and the environment of micropollutants. While wastewater treatment plants in Switzerland are being upgraded to enhance the removal of micropollutants, up to half of the overall micropollutant load can be discharged via combined and separate sewer overflows without treatment (Fig 1). Sponge cities can provide a solution by removing urban stormwater flows from the sewer systems and local treatment (e.g. infiltration, biofilter, wet detention ponds, Fig. 2). However, most of the existing blue-green infrastructure treatment systems are not built to remove micropollutants.

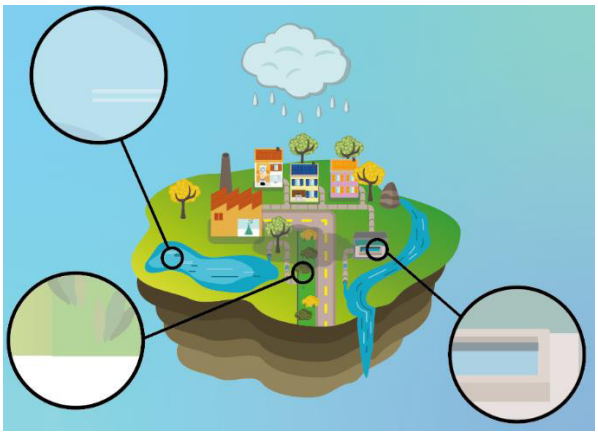

Fig. 1. Sponge city schematic. Blue-green infrastructure treatment systems capture urban stormwater and can remove selected pollutants.

Objectives of the suggested topic

This thesis explores how blue-green systems can be designed to reduce toxic micropollutant emissions to surface waters and groundwater systems.

- Assess current blue-green infrastructure design practice and typical design parameters ranges for selected systems (wet detention pond, biofilter, permeable pavements).

- Identify the most relevant blue-green infrastructure design parameters for water quality by estimating micropollutant concentrations, loads and risks discharged to surface waters, and infiltration to groundwater. This will be done using an existing, hydraulic-validated SWMM model with blue-green infrastructure elements for the Swiss catchment Fehraltorf (Urban Water Observatory).
- Propose an optimised catchment-wide blue-green infrastructure design based on the micropollutant risks for surface waters and groundwater. Potentially include a scenario for stormwater reuse for non-potable purposes (toilet flushing, garden irrigation).

Specific information / Requirements

This project will be performed in the Department of Urban Water Management at Eawag. Office space with a computer will be provided. Motivation for understanding micropollutant occurrence and risks in urban systems and modelling (e.g. R, Python), using SWMM model and data analysis.

Advisors and Supervisors

Advisor: Max Maurer
Supervisors: Lena Mutzner

Contact information

Name: Lena Mutzner
Email: lena.mutzner@eawag.ch