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Quantifying the potential of local stormwater infiltration measures in western Copenhagen

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Introduction and problem definition

Frequent combined sewer overflows (CSOs) to the Harrestrup river in western Copenhagen lead to poor water quality in the estuary Kalvebo-derne. To solve this we need to greatly reduce the number of annual CSOs to the Harrestrup river, from today's 15 to 1 CSO per year and structure.

Copenhagen Municipality (2007), in: "Vision for the Harrestrup river system and Kalveboderne"

Local stormwater solutions are important in adaptation to climate change.

Copenhagen Municipality (2010), in: "Climate Adaptation Plan (Københavns Klimatilpasningsplan)"

Case study area: Husum in western Copenhagen

- 300 ha in the upstream part of Harrestrup river catchment
- Mainly residential area: single family houses and a few apartment blocks
- Restrictions for infiltration: drinking water interests, low permeability soils (glacial till), high groundwater table

How can we make a realistic estimate of the amount of stormwater that can be infiltrated in Husum?

Methodology: A cross-disciplinary and iterative approach

Environmental engineer ⟷ **Physical planner** ⟷ **Hydrologist**

Input: Estimate from Copenhagen municipality:

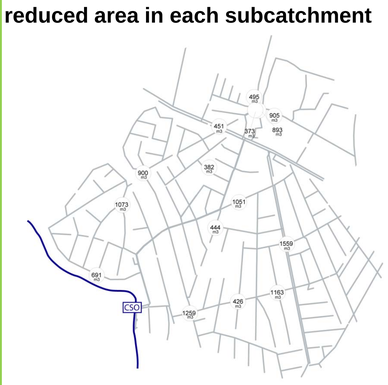
13 900 m3 of extra storage volume needed in Husum to reach our goal

First estimate of necessary infiltration trench volume in each subcatchment.

15 subcatchments selected based on:

- Should drain to structures with the most CSO's
- At least 2 ha reduced area

Estimated total needed volume is partitioned between selected subcatchments relative to reduced area in each subcatchment



GIS analysis: How much infiltration trench volume is realistic, and where?

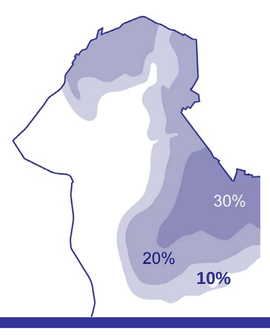
Principal conditions:

- > 2 m distance to buildings
- > 25 m distance to drinking wells
- > 5 m distance to streams
- No infiltration in contaminated soils

Red areas show infiltration trenches with buffer zones

Groundwater model: How much of the precipitation can be infiltrated?

Fraction of total precipitation that can be infiltrated with acceptable rise in groundwater level



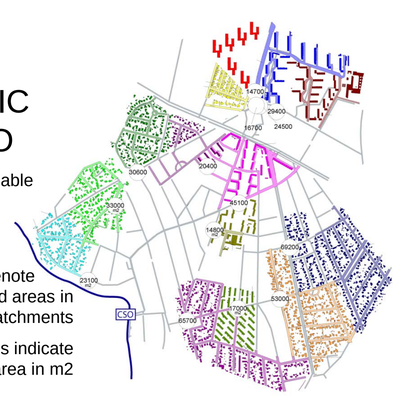
GIS analysis:

Areas complying with

- Principal conditions
- Groundwater conditions

OPTIMISTIC SCENARIO

(only considers available area)

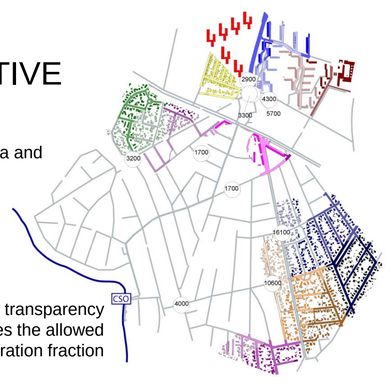


Colours denote disconnected areas in different subcatchments

Values in circles indicate disconnected area in m2

CONSERVATIVE SCENARIO

(Considers available area and groundwater level)



Level of transparency idicates the allowed infiltration fraction

Catchment and urban drainage model: Simulation of trenches, runoff, pipe flow and overflows. Result evaluation

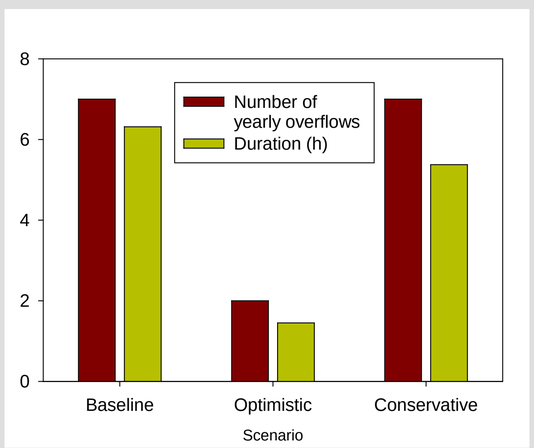
Rainfall series for year 1997 (representative for average runoff and overflow volume and frequency) used in simulations.

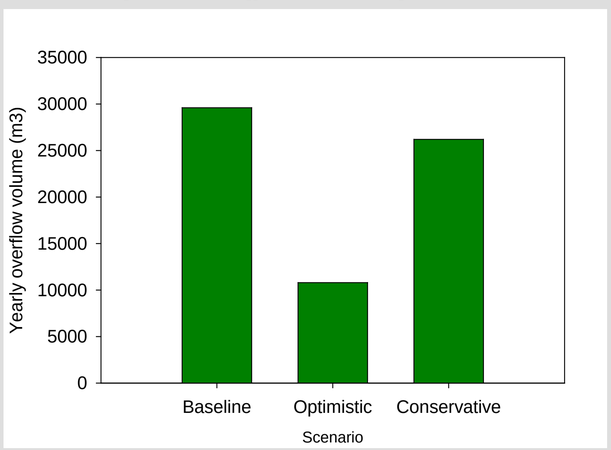
Input: Catchment and urban drainage network model of Husum:

60 subcatchments, 116 ha reduced area

Results and evaluation

Estimated effects of infiltration trenches in Husum on CSO discharges to Harrestrup River (year 1997)





Conclusions and future challenges

Conclusion:

- Our methodology can be used to estimate the amount of stormwater that can be infiltrated locally
- The estimated reduction in overflow volume is between 10% (conservative scenario) and 67% (optimistic scenario)

Suggested future improvements:

- Integrate groundwater model with runoff/pipe flow model
- Extend model with more types of local stormwater management structures (e.g. green roofs, permeable pavements etc.)