Designed, signed, sealed..?

The effect of hyetograph shape on the design of urban drainage systems

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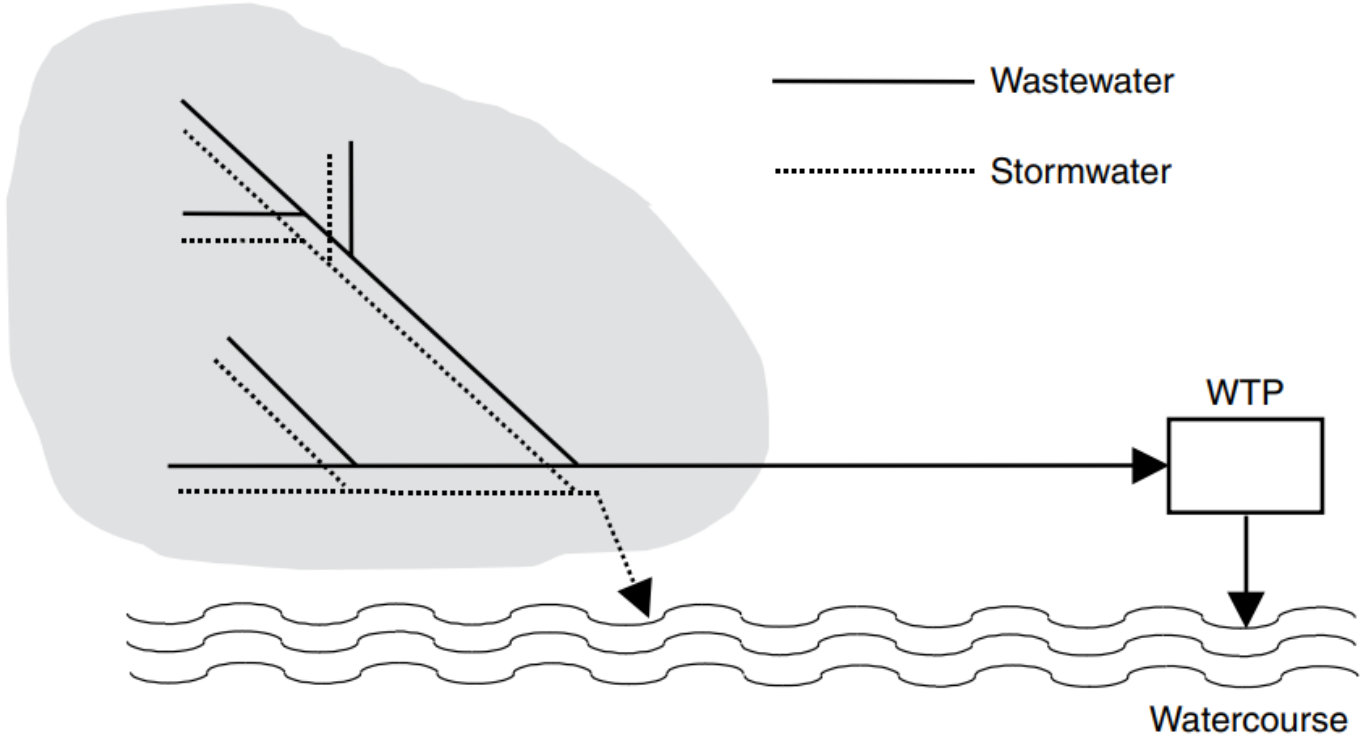
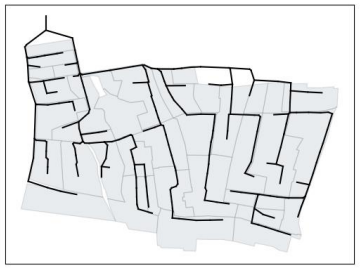
The problem of (re)designing an UDS



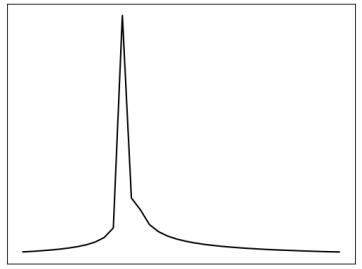
David Butler, Christopher Digman, Christos Makropoulos and John Davies, 2018. Urban Drainage (4th edition), Taylor & Francis.

A common approach for (re)designing an UDS

network design



Design hyetograph



Simulation

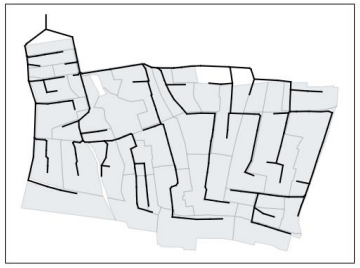
Results

- How influential are the designer's subjective choices on that robustness

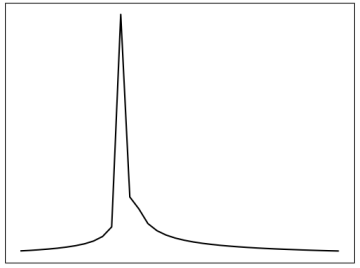
- How robust are the designs produced by this approach

Design exercise

Network layout



Design hyetograph



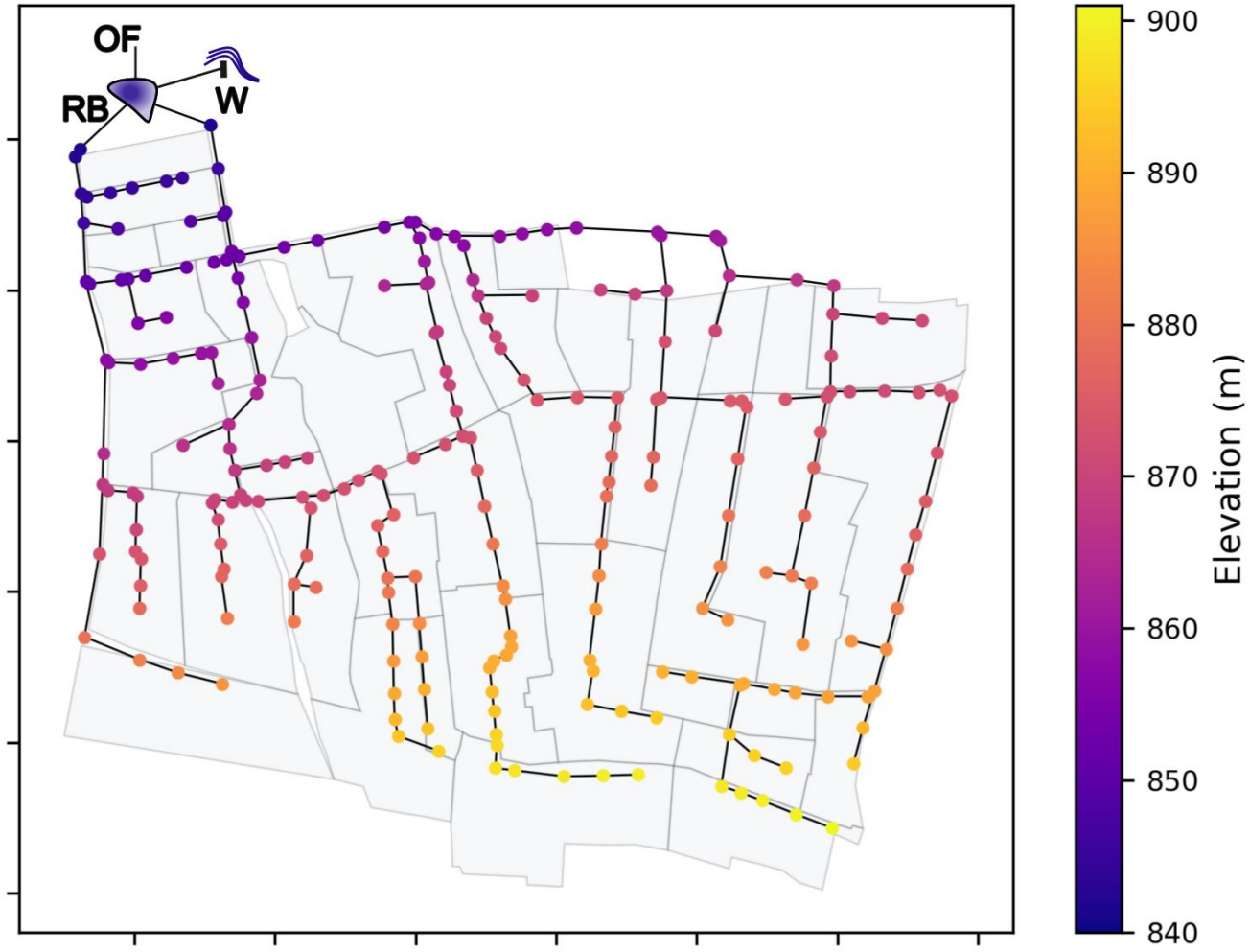
Objectives:

- No flooding
- No overflow
- Minimize cost

41 different students

41 different designs

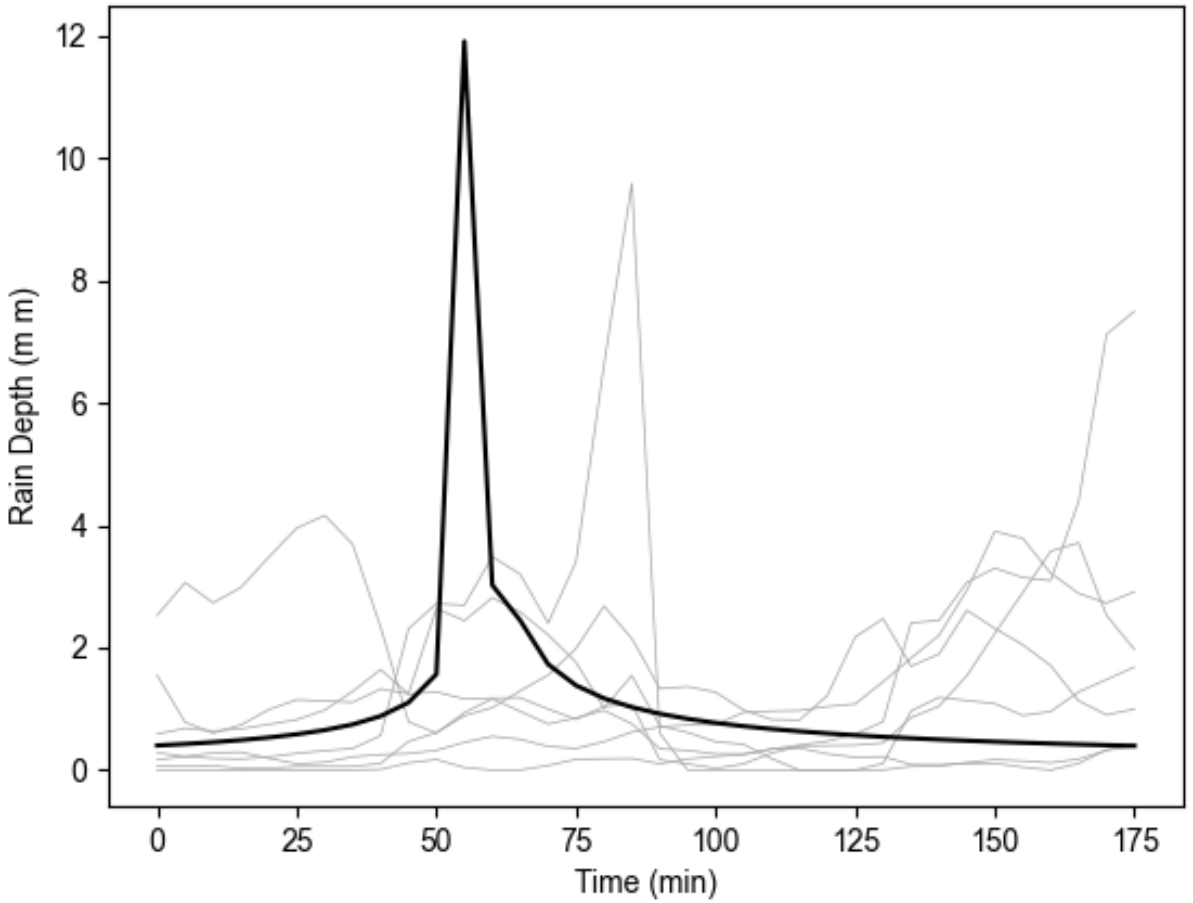
Overview of the study site

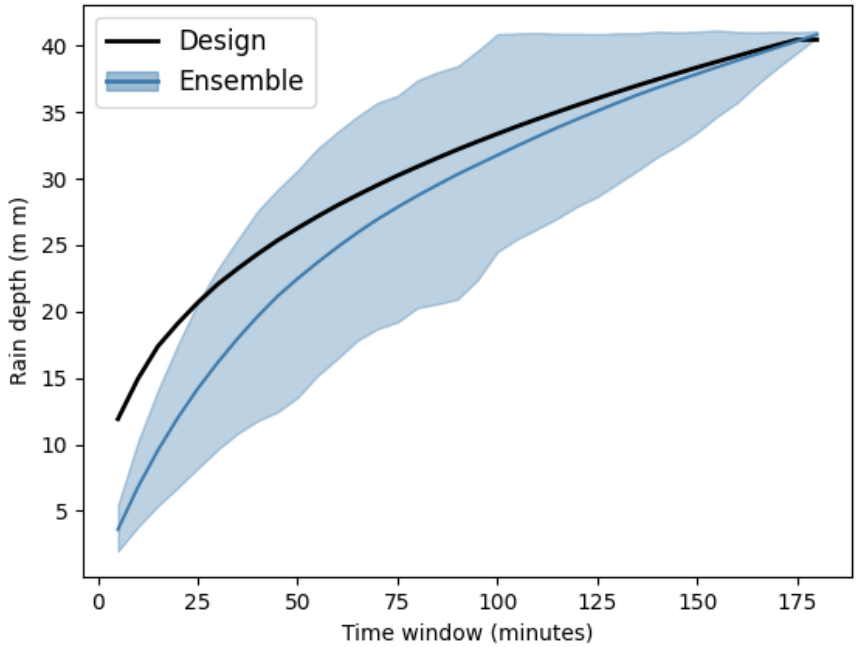


- 55 ha
- 54% impervious
- 12% average slope
- 38 subcatchments

- 235 pipe segments (~5 km)
- 1 retention basin
- 1 overflow weir
- 1 outflow pipe (limited to 250 L/s)

Creating different hyetographs

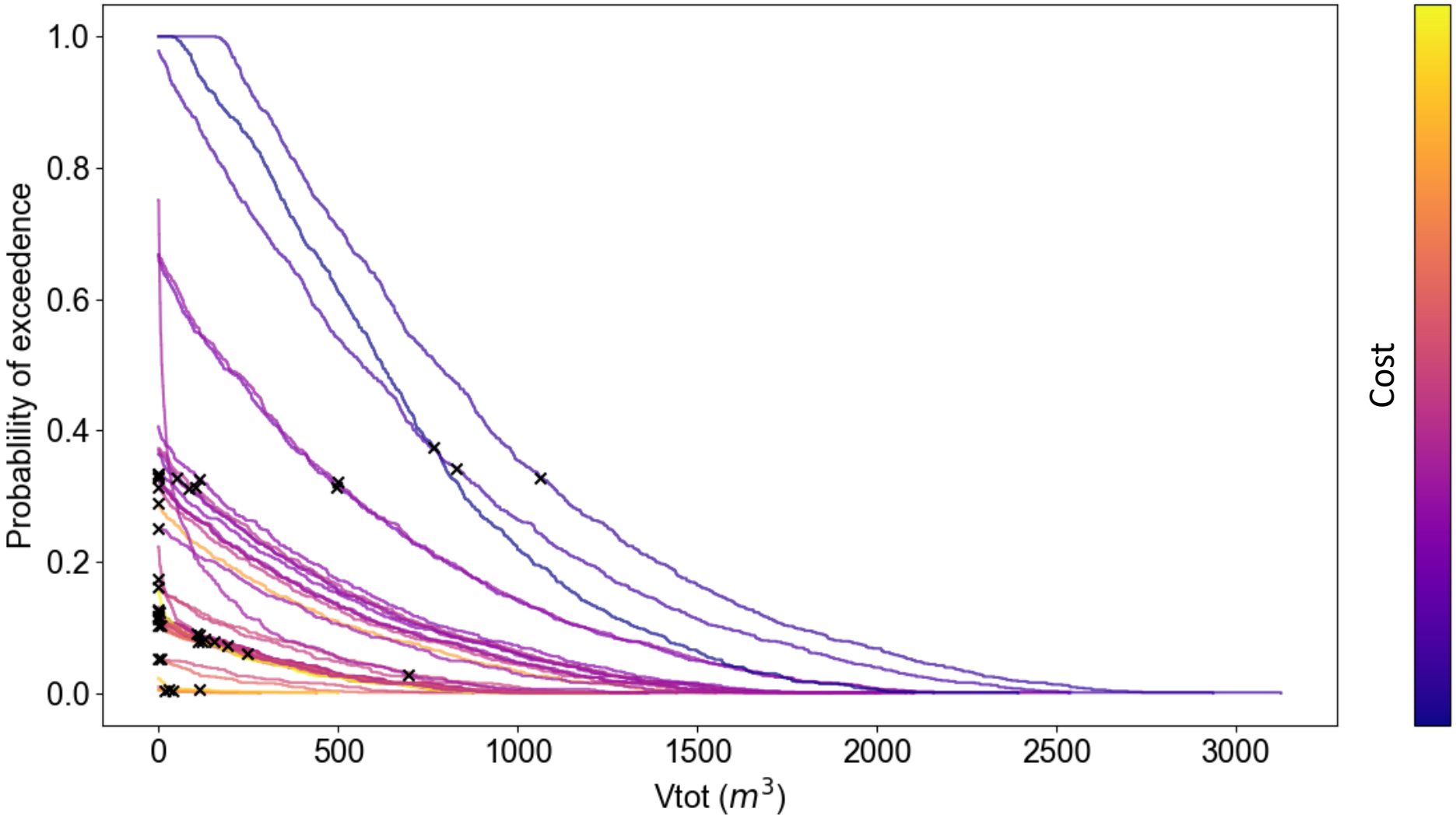




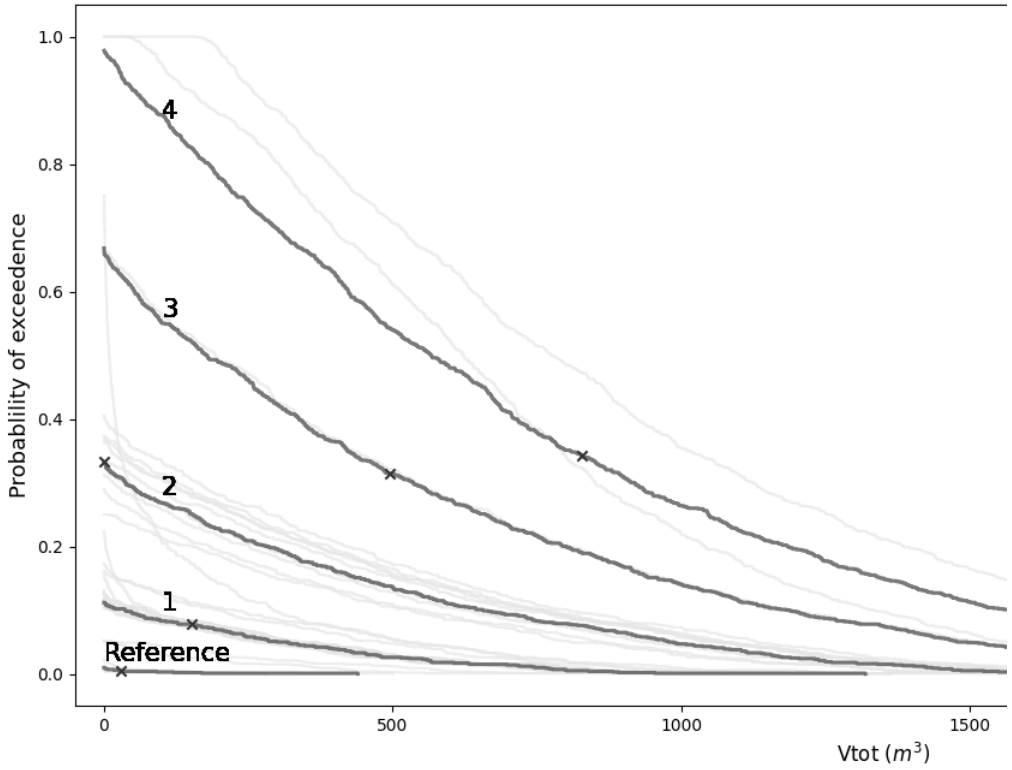
Total rain depth = Constant
Rain duration = Constant

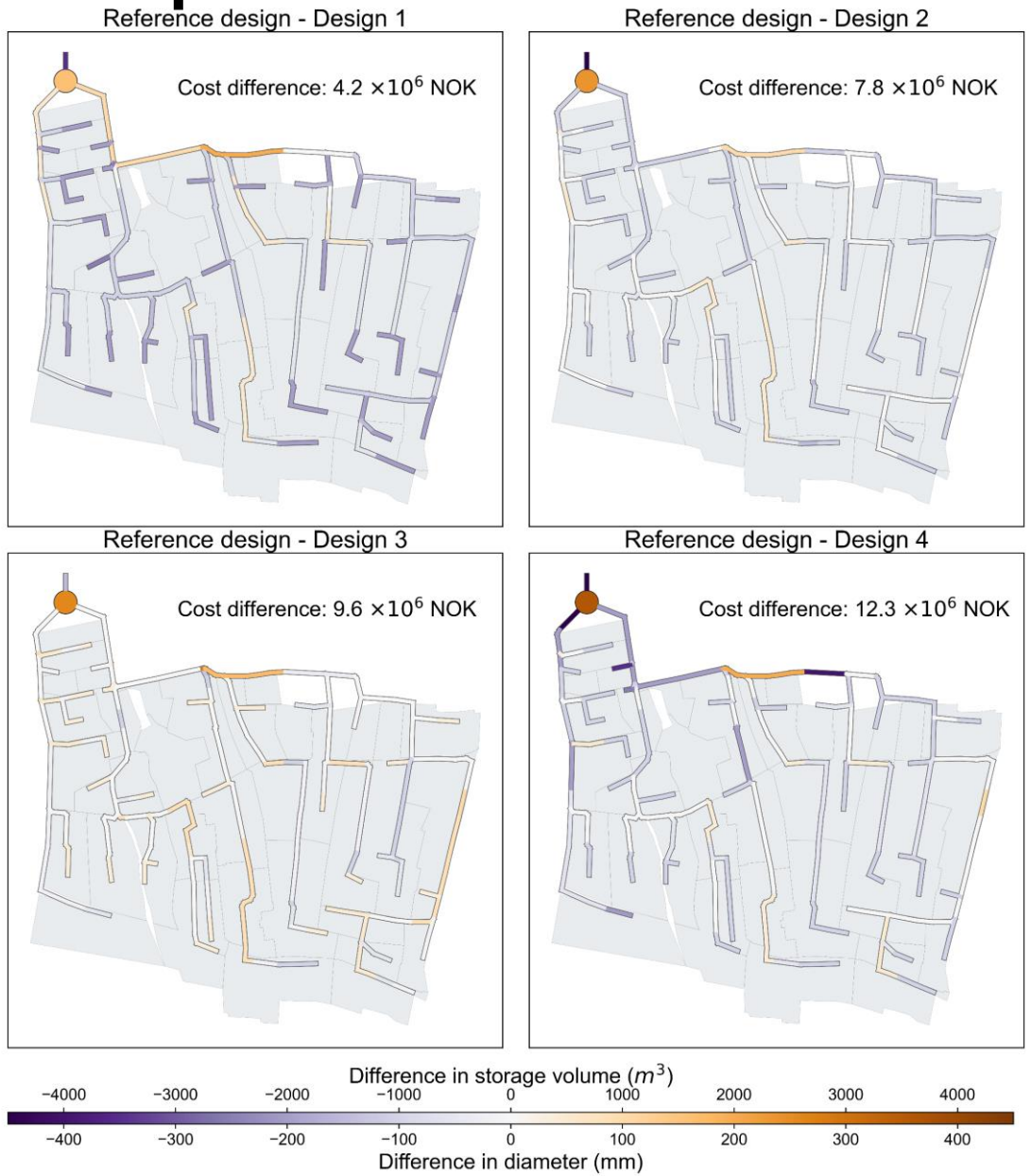
Only difference is:
Temporal distribution of the rain

Results – Survival curves

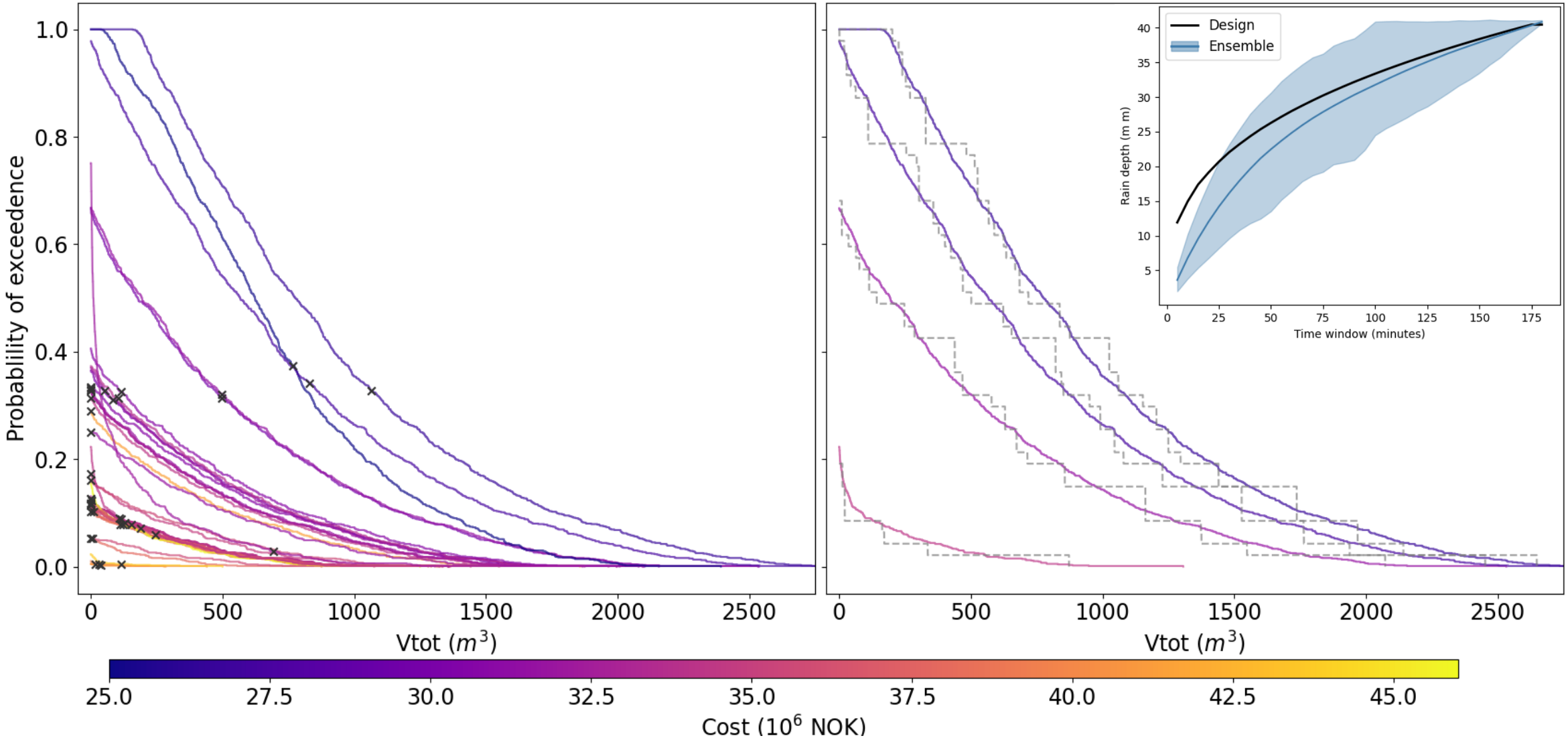


Results – Design comparison





Results – Survival curves approximation



Take home messages

- Designing an UDS using a single design storm does not result in a robust system
- Subjective choices made by the designer can lead to a vulnerable system if the design approach does not aim for robustness
- Using a small ensemble of storms can illuminate the vulnerabilities of a system

Thank you for your attention.