

11^e Conférence internationale

LYON 2023 — L'eau dans la ville | Urban water

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L'eau dans la ville | Urban water

Enhance the performance of stormwater networks using real-time controlled rainwater harvesting systems

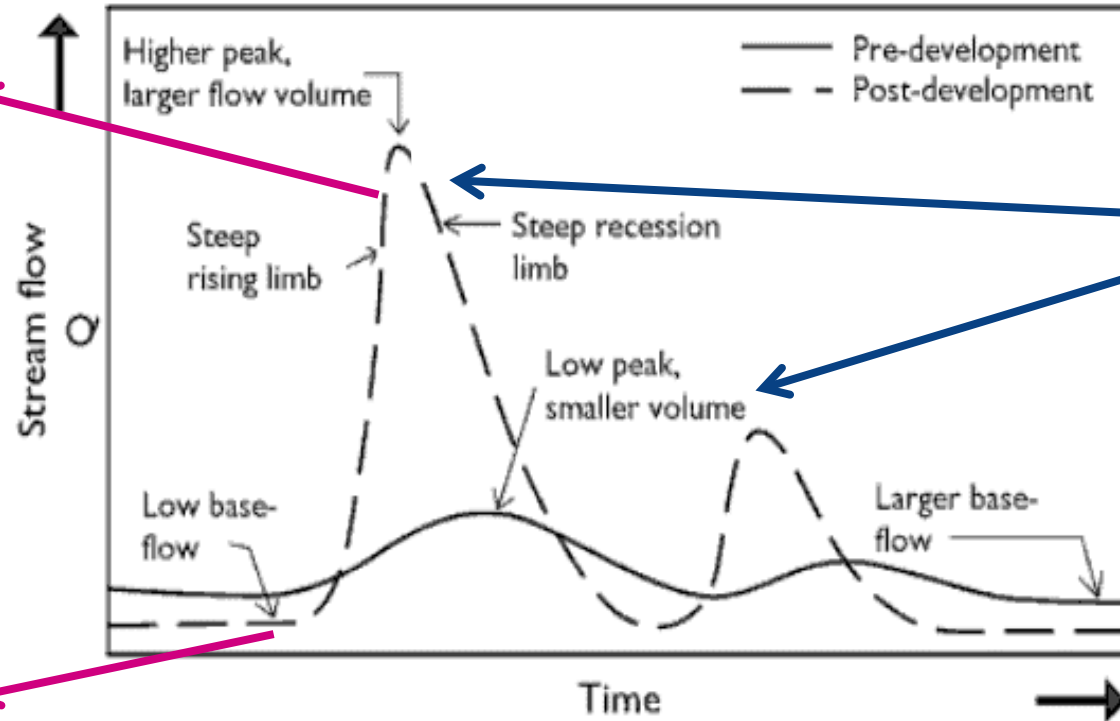
Améliorer la performance des réseaux d'assainissement grâce à la gestion en temps réelle des récupérateurs d'eau pluviale

Wei D. Xu, Matthew J. Burns, Frédéric Cherqui*, Sophie
Duchesne, Geneviève Pelletier, Tim D. Fletcher

Background



Urban Flooding



Can be reduced by rainwater harvesting



Stream Degradation



Can be restored by infiltration

Challenges with Stormwater Control Measures



We are operating static system in a rapidly changing environment



Challenge finding space for SCMs (on private/public land)



Current SCMs are passively operated and not coordinated

...

Emerging use of RTC technology



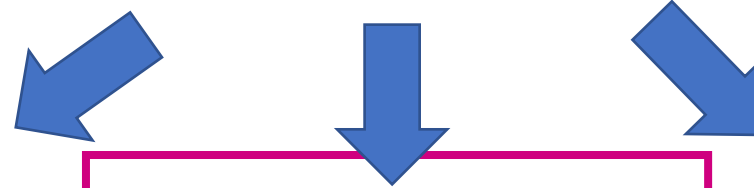
Environmental Monitoring



Real-Time Control



Internet of Things



Detention pond

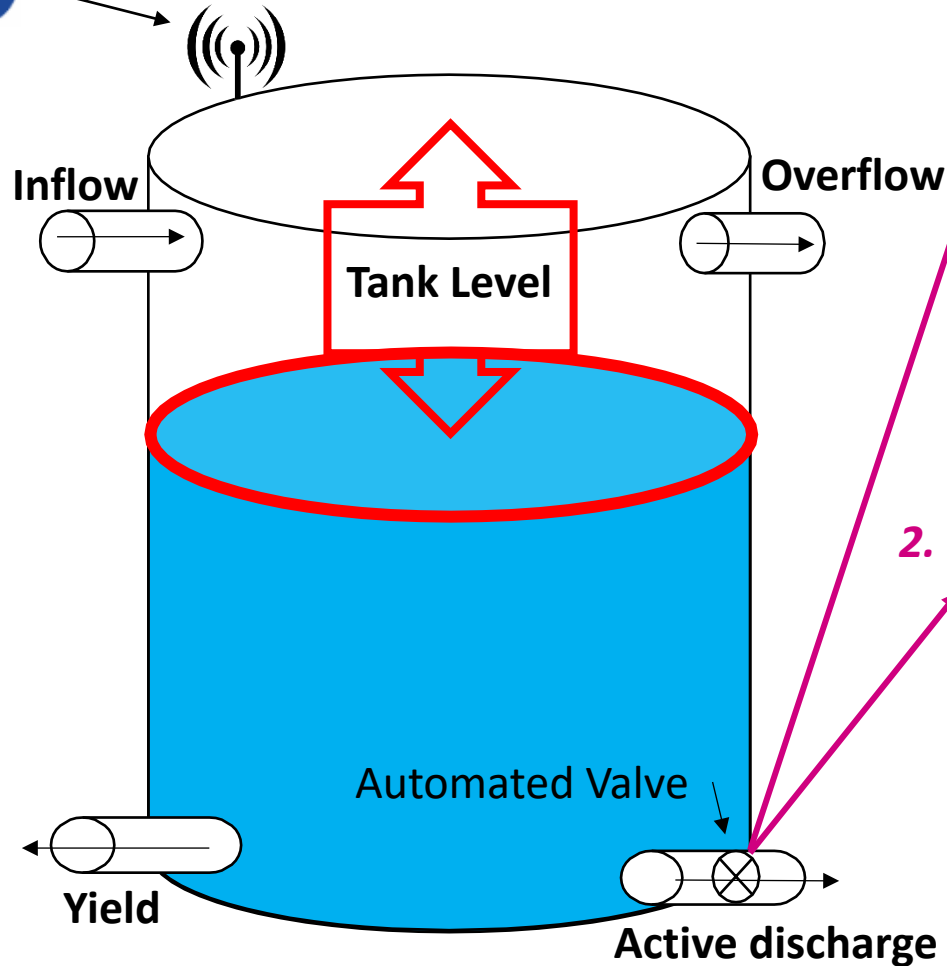


Rainwater Harvesting



Wetlands, etc.

Smart water tank



1. Pre-storm Release: Quick + Daily



2. Baseflow Release: Slow + Persistent



Basic Concept:

1. Create more space in tank before wet weather
2. Supply end-use and baseflow in the rest of time

Reviews forecast rainfall

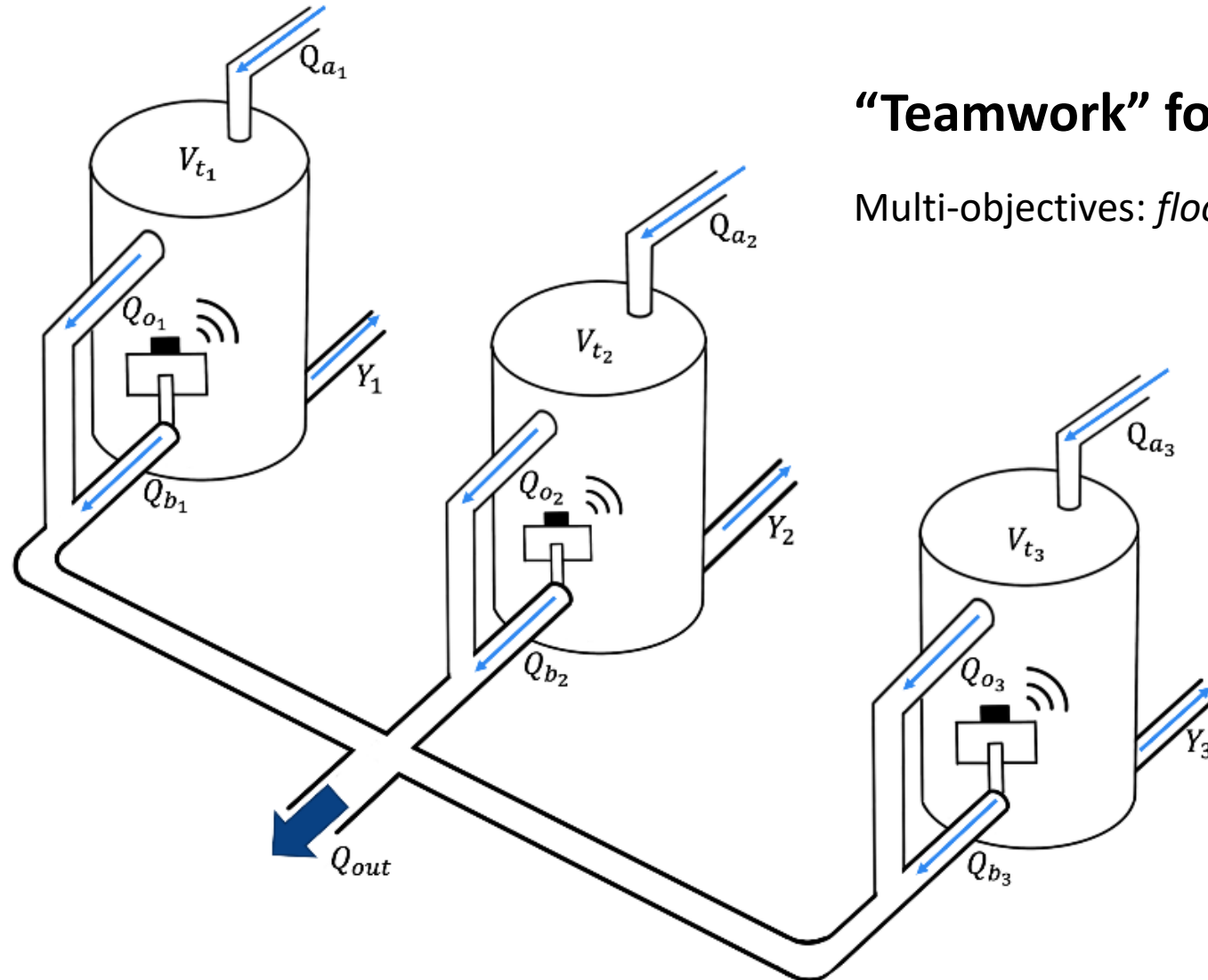
e.g. 70% chance $\geq 5\text{mm}$

Reviews level – will the rainfall fit?

Calculates discharge required

Automatically discharges rainwater from tank at programmed time and rate

Collaboration of multiple storages



“Teamwork” for collective goal(s)

Multi-objectives: *flood + supply + environmental flow*

Research question(s)

What is the impact of real-time controlled rainwater harvesting systems on flood mitigation and water supply, when applied at the drainage network scale?

- (1) RTC impact on **flood mitigation**: conventional vs RTC
- (2) Impact of different tank (storage) capacity?
- (3) Performance in future climate change (resilience)?

Case study



Mid-size municipality in the province of Quebec, Canada

- 7.29 ha residential area
- 1-year simulation
- A range of scenarios (e.g. future climate)
 - 5 - tank sizes
 - 5 - % of RTC
 - Current & Future Climate

Scenarios

- Baseline scenario = no RWH system
- Storage capacities

5 **10** **20** **40** **80** *L/m² of roof*

- RTC application

0 **25** **50** **75** **100** *% of storage with RTC*

- Climate conditions

current **future** *climate*

Approach



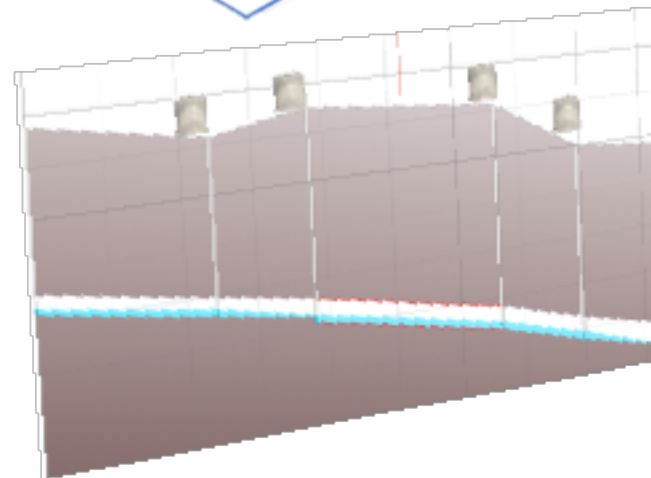
Rainfall-runoff module
6-min catchment runoff,
daily runoff,
forecast as input



RTC module
Outflow from each at-
source RTC system,
Optimization strategy

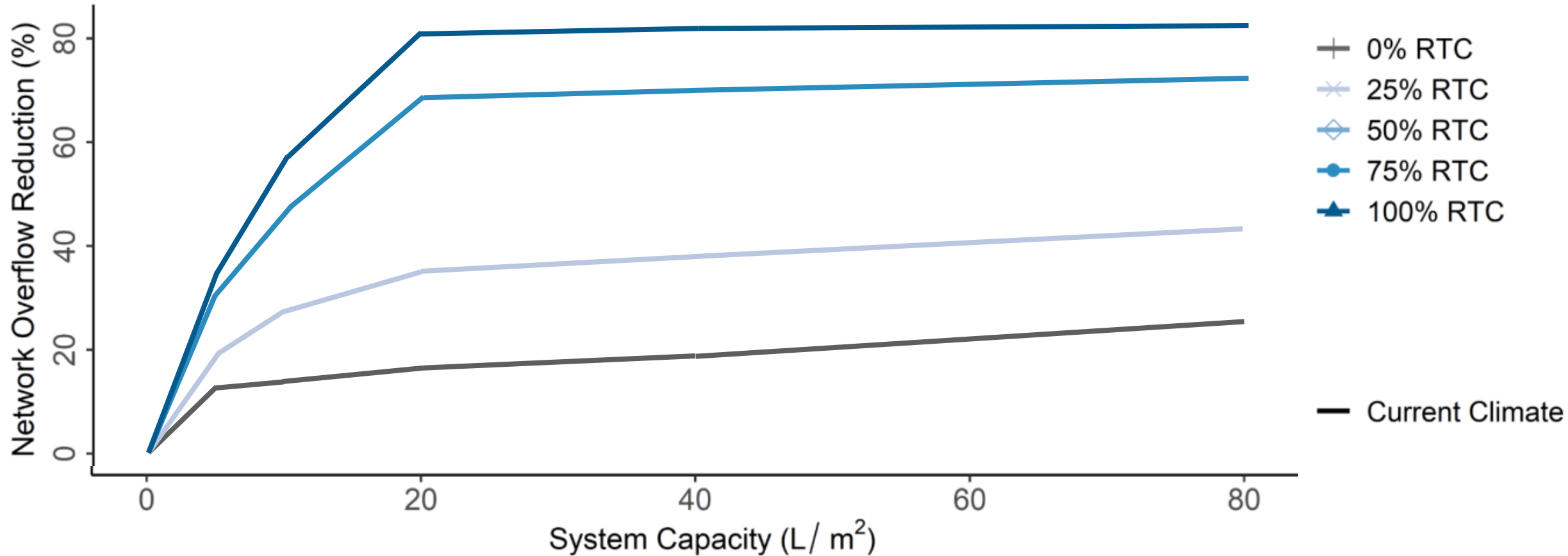


**Drainage simulation
module**
Flow dynamics in the
stormwater network



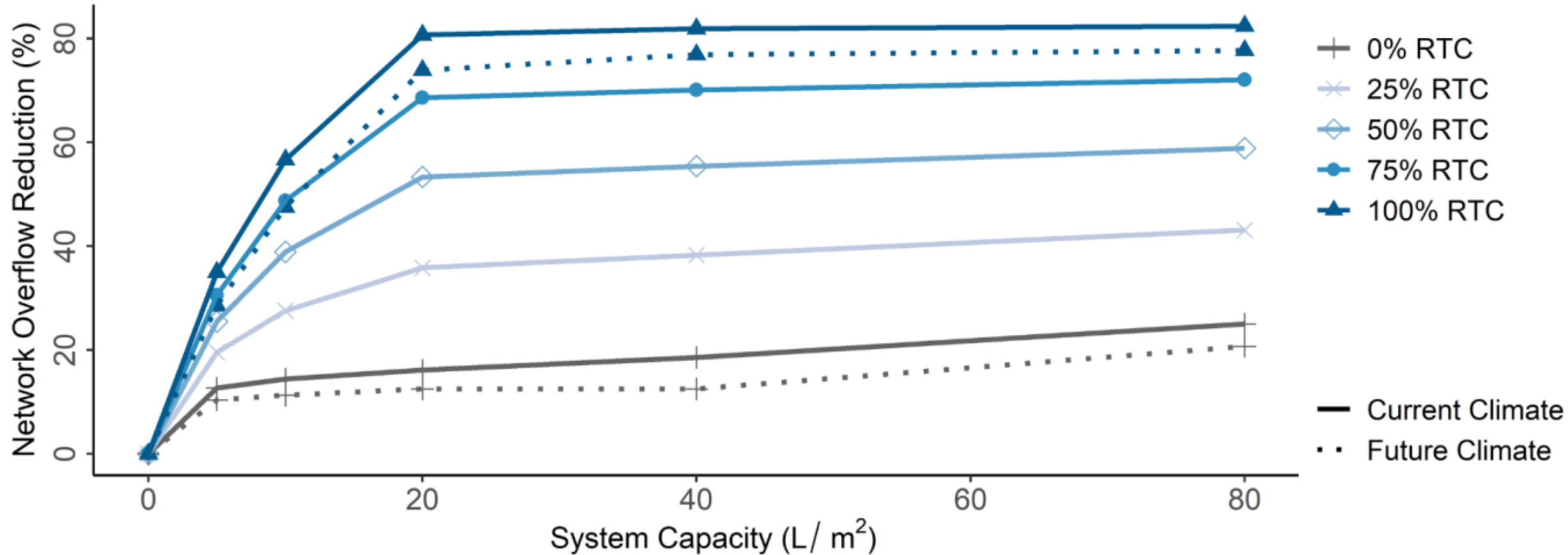
- 7-day forecast
- Optimisation: Flood > Usage > Environmental flow
- Optimized for flood mitigation

RTC performance



(1) RTC > Increase Tank Size

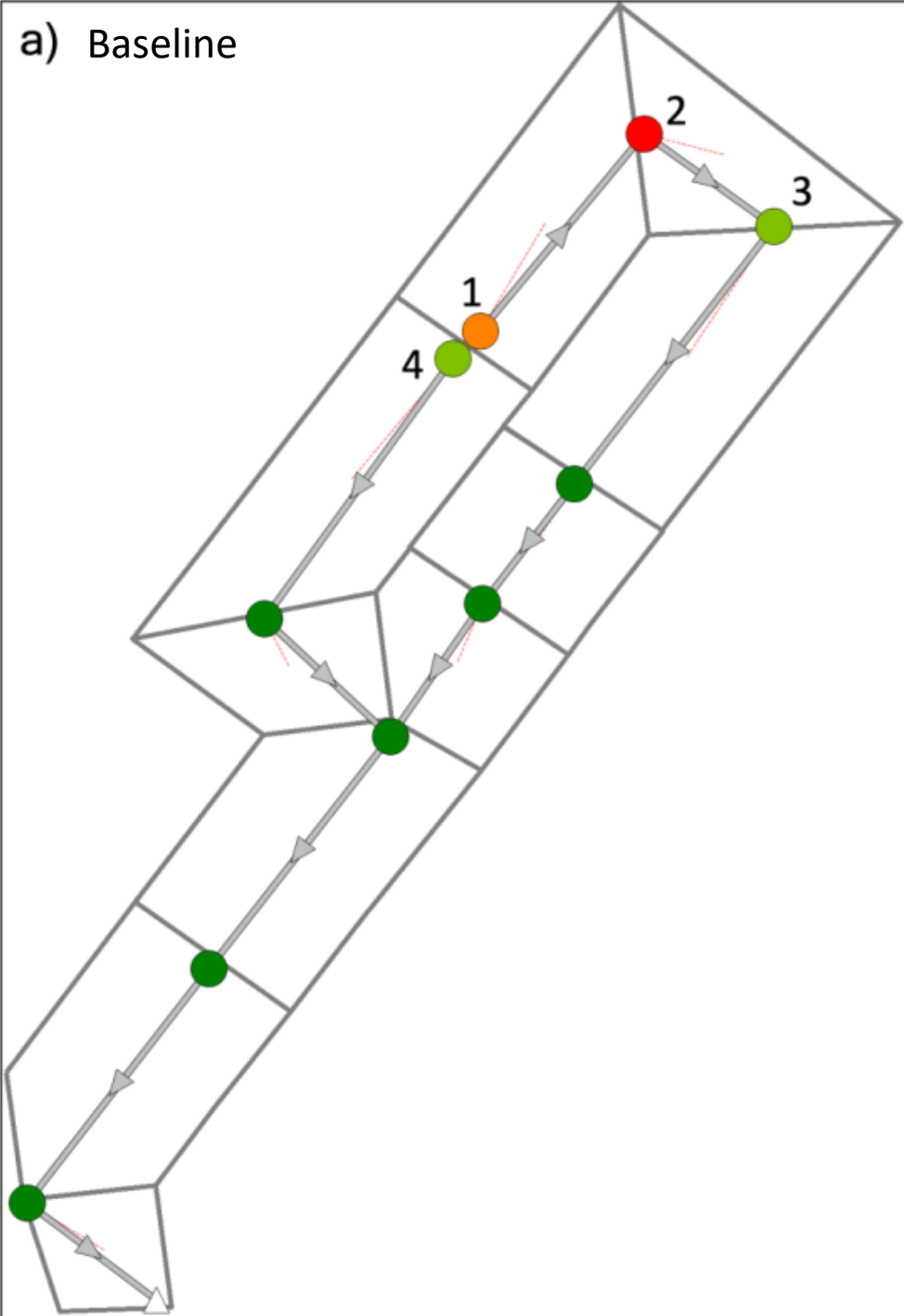
RTC performance



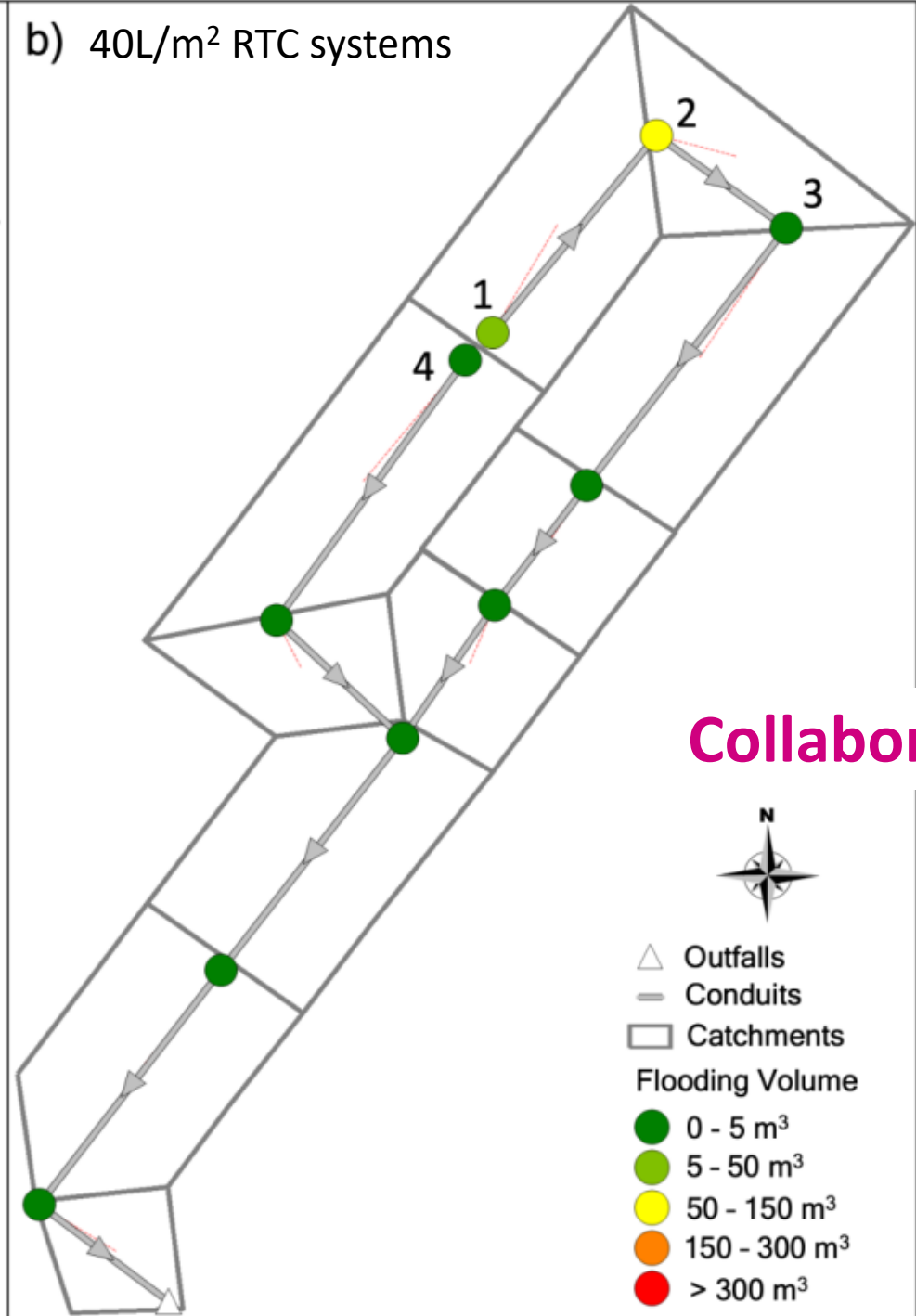
(1) RTC > Increase Tank Size

(2) Resilience under climate change

a) Baseline



b) 40L/m² RTC systems



Collaboration?



- △ Outfalls
- Conduits
- Catchments
- Flooding Volume
 - 0 - 5 m³
 - 5 - 50 m³
 - 50 - 150 m³
 - 150 - 300 m³
 - > 300 m³

Conclusion

- Important potential of RTC and more especially 7-day forecast
- Flood Mitigation: RTC > Conventional, in both current and **future climate**
- Increasing % of RTC > increasing storage capacity

All articles available here:
<http://tiny.cc/Xu>

