



The Commons: Quantifying the Role of Multiple Green Stormwater Infrastructures as a System

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OVERVIEW

- Green Stormwater Infrastructures (GSI) are an efficient method of minimizing the adverse impacts of urbanization and are widely employed in areas with frequent rainfall.
- Villanova University recently converted 9 acres of parking lot into student housing, "The Commons". This new residence housing project looked to convert an ultra-urban drainage area into a well managed stormwater area by incorporating multiple GSI working together to capture and treat 1.5+ inches of runoff
- GSI: 10 rain gardens (including 3 planters); 3 underground infiltration systems; 2 cisterns; 1 underground detention basin



Figure 1: 9 acres of parking lot converted into student housing with 16 different GSI.

WHAT IS MONITORED?

- Flow at the outlet (2 outlet pipes).
- Ponding depth at all 10 rain gardens and depth in the infiltration system.
- Monthly storm and baseflow water quality (samples from outlet).
- Soil characteristics of all the rain gardens.
- Temperature at different depths at 3 different locations (Grass, GSI, Lot).
- Rain and wind (weather station at the Commons).

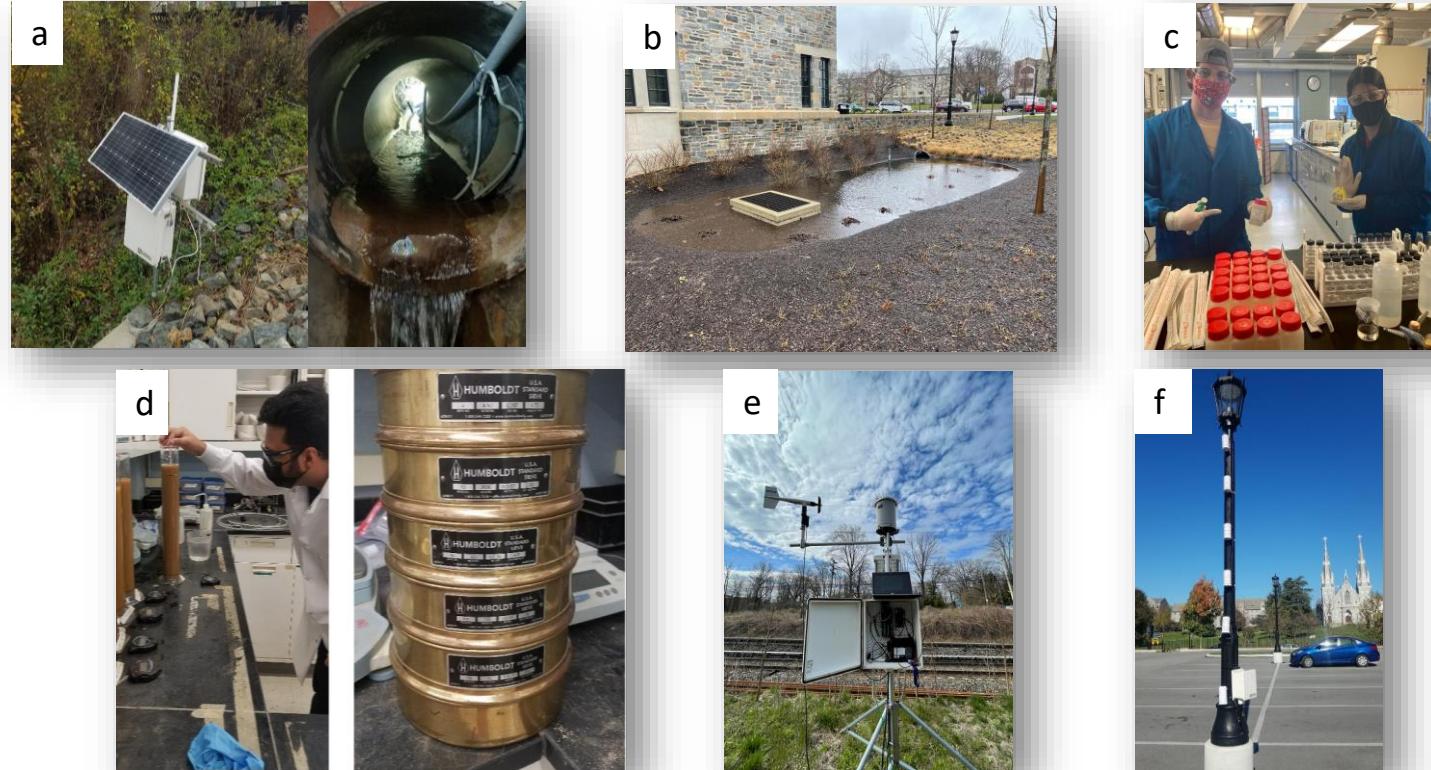
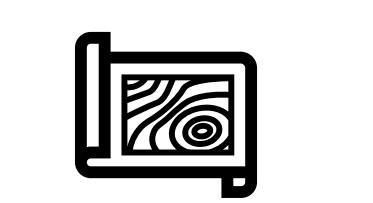


Figure 2: Monitoring of the GSI at Commons.

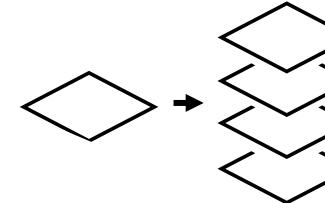
METHODOLOGY



Data collected from the field



Storm and baseflow events are analyzed



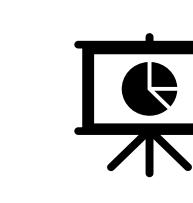
Comprehensive data set created



Lab tests for water quality and soil characteristics.



Data analysis



Results presented

RAIN GARDEN RESULTS

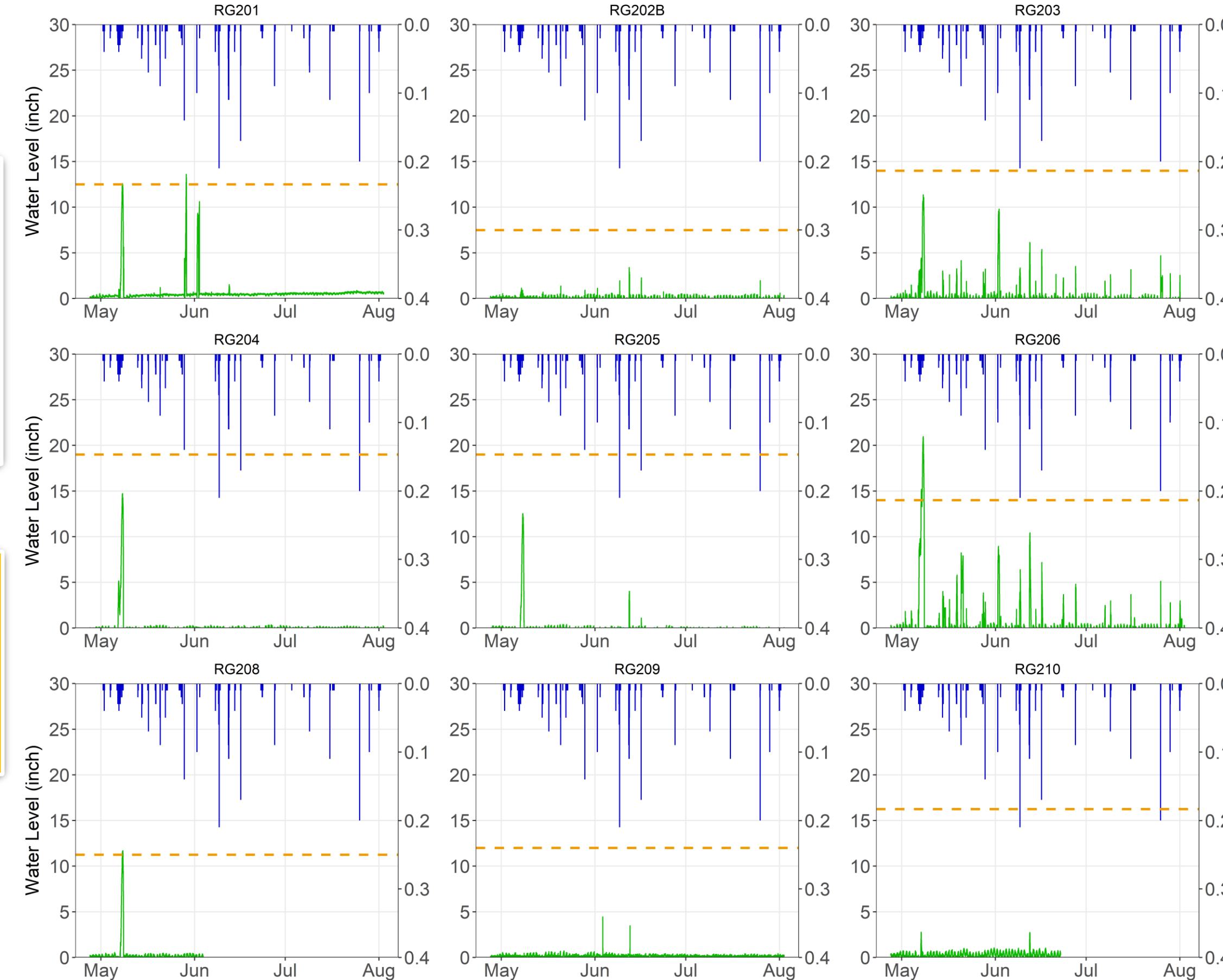


Figure 3: Ponding Depth and Overflow of Rain Gardens.

OUTFLOW RESULTS

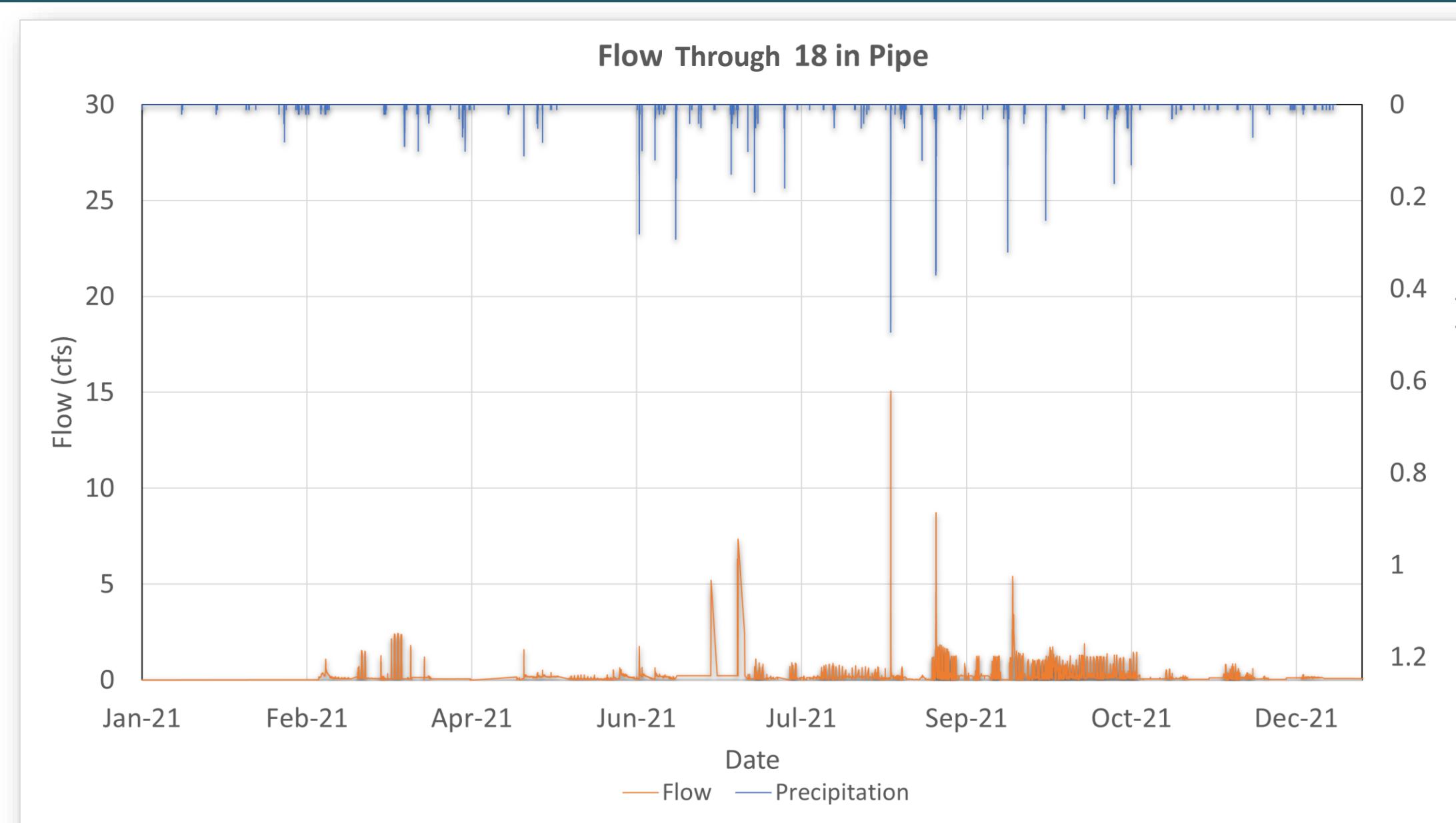


Figure 4: Flow monitoring at the outlet.

$Q_{\text{peak}} > 5\text{cfs}$; 5 events in 2021 - rainfalls with more than 0.35in.

WATER QUALITY RESULTS

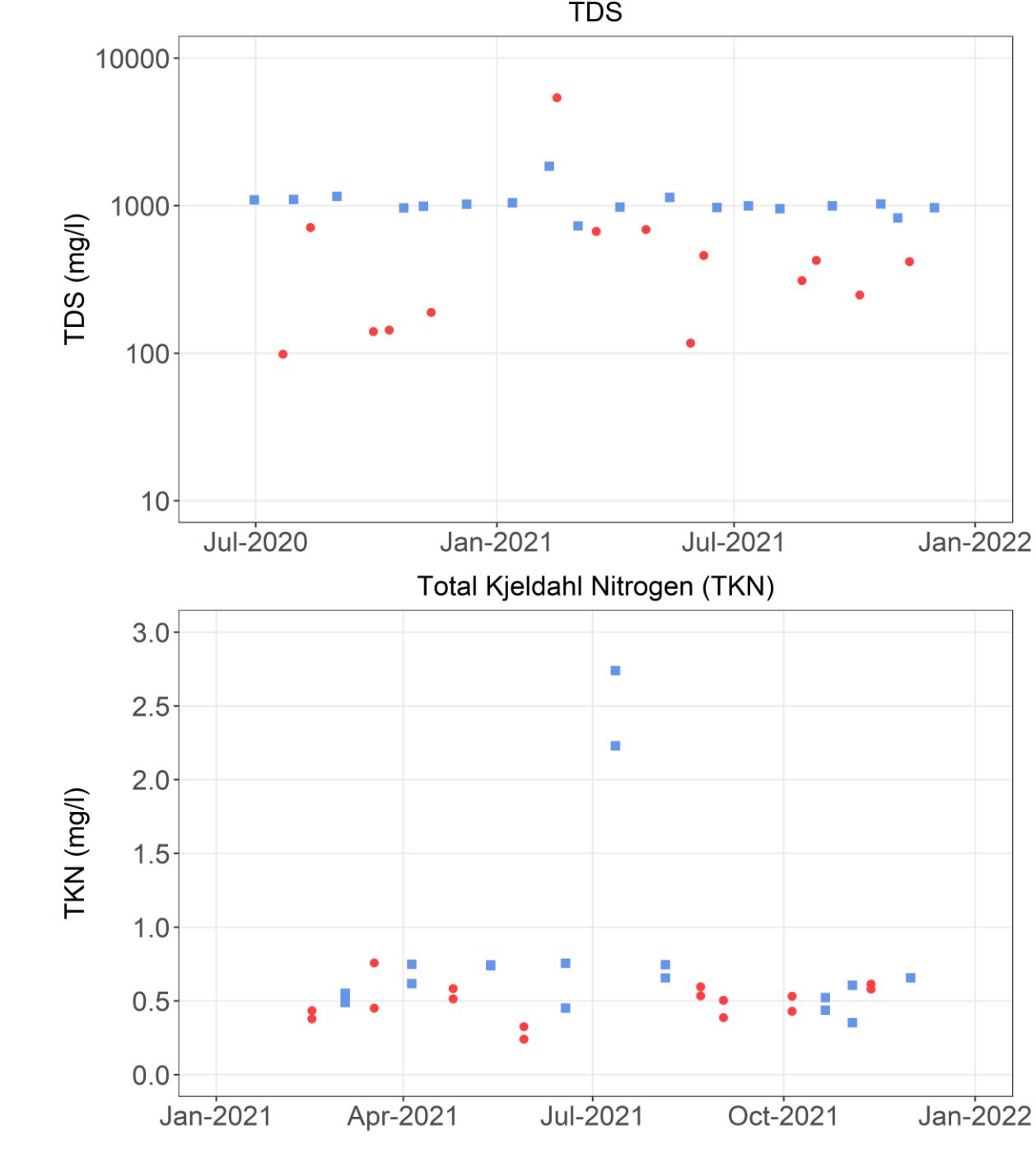


Figure 5: Water Quality Analysis.

The baseflow samples have typically higher concentration than the storm samples.

DISCUSSION

Reduction of peak flow and volume was observed in the post-construction phase.

Improved outflow water quality in post-construction.

Baseflow samples have higher concentration of nutrients than storm samples.

Rain Gardens appear to substantially contribute to flow reduction observed at the outlet.

FUTURE WORK

Modeling the whole research area in SWMM or PCSWMM incorporating all the different types of GSI.

Continue performing water quality tests for both baseflow and storm events.

Continue monitoring the 10 rain gardens and infiltration system and flow at the outlet.

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