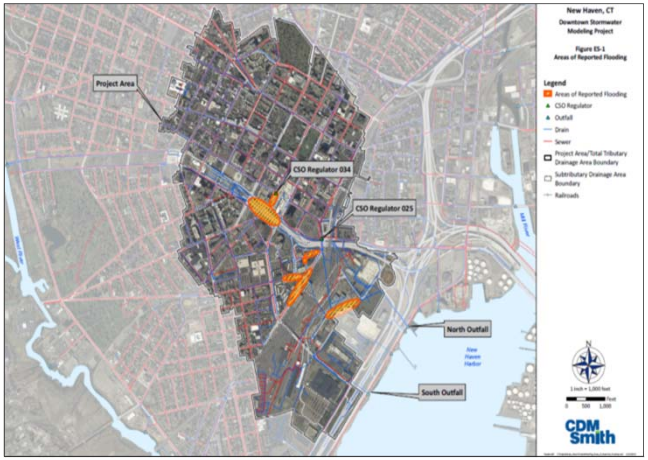
Assessing Impacts of Tides and Precipitation on Downtown Storm Sewer System Through Use of Real-Time Depth and Flow Monitoring

Connecticut Institute for Resilience and Climate Adaptation
Science, Planning, Policy & Law Forum

Problem Definition

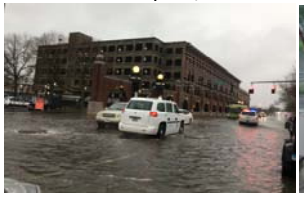
The City of New Haven experiences frequent flooding at several locations in the heart of downtown during high intensity, short duration rainfall events. These locations- Route 34, Union Avenue, Temple Street- are not only crucial to the functioning of the City but support regional transportation systems as well. The flooding is exacerbated during high tide events such that a small storm (less than a one year occurrence) can lead to flooding of critical facilities such as the City's main post office and Union Station. Precipitation volumes and intensities are expected to increase throughout the Northeast due to climate change, greatly increasing the need for strategic resiliency planning.



Map above shows downtown sewershed area and problem flood areas

Above and below: April 16, 2018 storm

Above and below: June 13, 2014 storm

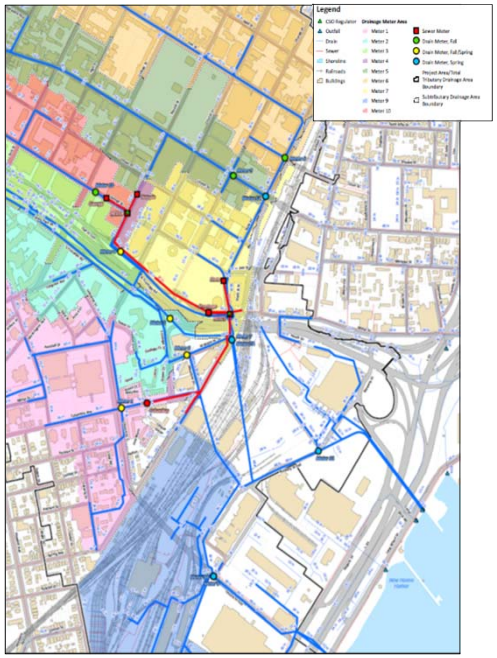


Project Description and Purpose

This project will create a low-cost "smart city" stormwater sensor network that uses Internet of Things (IoT) techniques to reduce the cost of sensor networks and provide a granular, detailed record of the interaction of rainfall, tides, green stormwater infrastructure, and sewer conveyance systems on the hydrology of New Haven's urban core. A better understanding of system response during a range of hydrologic conditions will allow the City to value engineer cost-effective and resilient solutions.

The purpose of this project is to:

- Reduce impact of flooding on the Long Wharf, Hill, and Downtown neighborhoods through a better understanding of the hydrology of New Haven's urban core
- Improve the resiliency of our storm sewer system in light of increasing sea levels and precipitation events.
- Reduce the cost of acquiring real-time data on stormwater system performance by strategically mixing sensor types, installing and maintaining equipment in-house, and creating a platform to wirelessly transmit, process, and display collected data



Meter locations from the monitoring study conducted as part of the Downtown Storm Sewer Modeling Study (March 2017)

Project Components

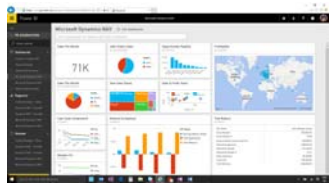
Phase 1: Procurement and Deployment of Monitoring Equipment

- Determine monitoring locations.
- Purchase rain gages, ultrasonic level sensors, Doppler flow meters, and associated equipment including dataloggers, power source, communications, and mounting equipment.
- Select and monitor 5 green infrastructure installations.

Clockwise from left: Doppler flow meter, Ultrasonic level sensor, and level logger

Phase 2: Development of Dashboard Interface

- Adapt ready-to-use applications from ESRI GIS and Microsoft Power BI to integrate real-time data feeds into a user friendly dashboard



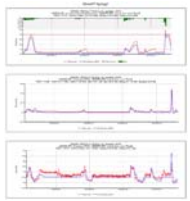
Example output from Microsoft Power BI that will be adapted to display collected storm data

Phase 3: Collection of Data and Troubleshooting

- Document any troubleshooting activities taken

Phase 4: Data Analysis

- Perform statistical analysis on rainfall, tide, and level/flow data to identify any correlations and linkages
- Use data to validate SWMM model



Comparison of observed and modeled data from SWMM

Timeline

Phase 1 June 30 | Phase 2 Aug 31 | Phase 3 Oct 31 | Phase 4* Dec 31

*The real-time monitoring system developed during this project will continue to be operational and collect data beyond grant project period.

Partnerships

- Yale School of Forestry and Environmental Studies, Professor Gaboury Benoit
- Quinnipiac University, Civil Engineering, Professor Kim DiGiovanni-White, P.E.