SWMMing with Updates

Preparing Bridgeport WPCA's Hydraulic Model for Facilities Planning

Lauren McBennett Mappa, PE, WPCA
Laurie Kellndorfer Locke, PE, CDM Smith

2/4/2021

NEWEA – 2021 Annual Conference & Exhibit

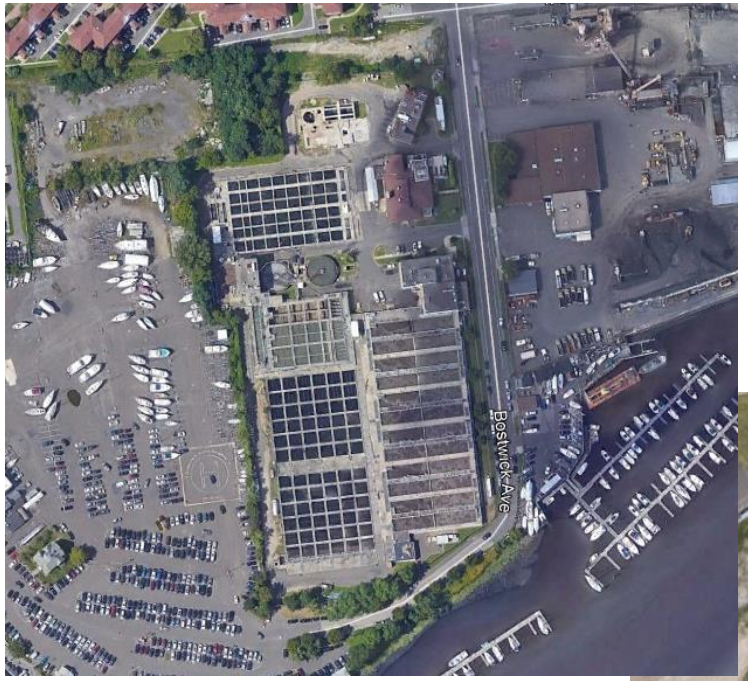
Presentation Outline

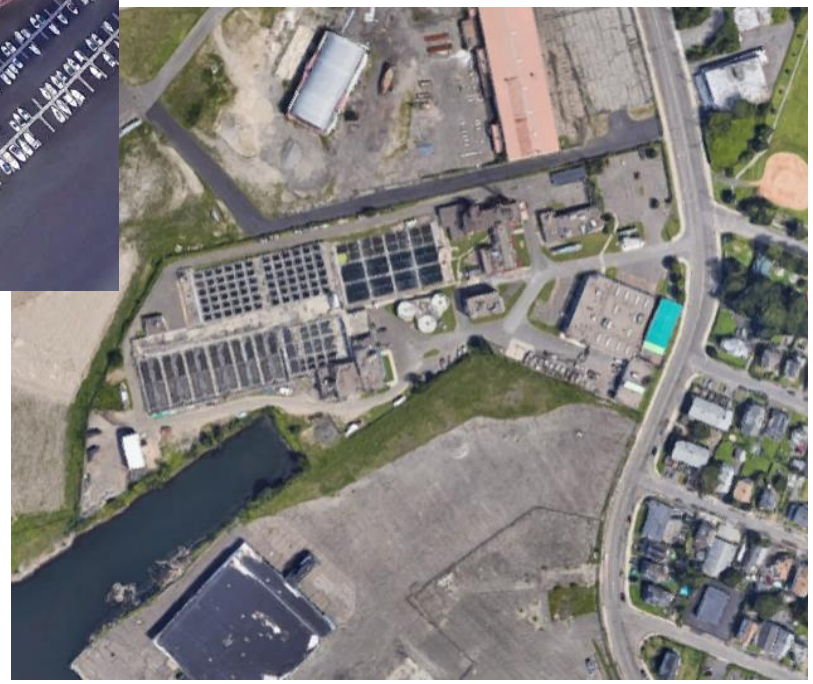
- Background
- Starting model
- Model updates
  - Hydrology
  - Hydraulics
  - Dry weather flow
  - Climatology
  - Validation
- Facilities plan

Background

Water Pollution Control Authority (WPCA)

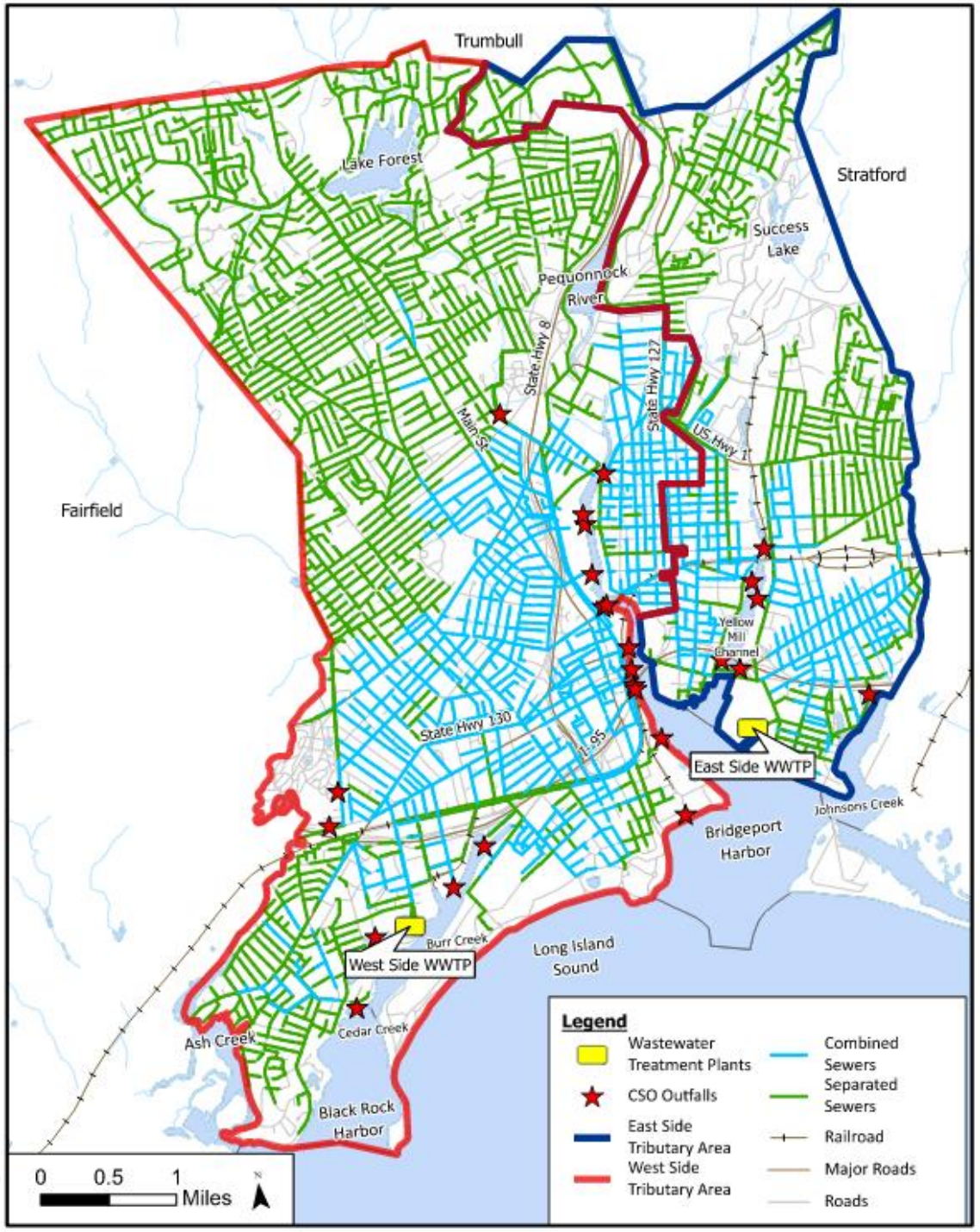
- Collects and treats wastewater generated by residents of Bridgeport, CT and neighboring communities
- Operates two wastewater treatment plants (WWTPs)
  - East Side – 40 mgd designed wet weather capacity
  - West Side – 90 mgd designed wet weather capacity
- Maintains the sewer system





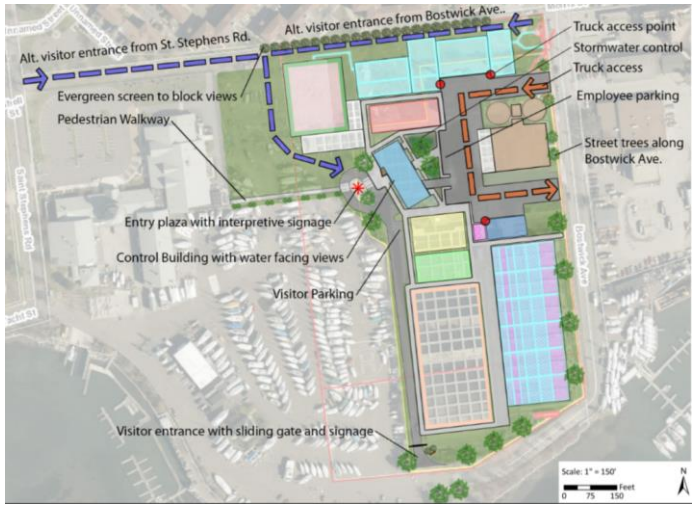
WPCA Collection System

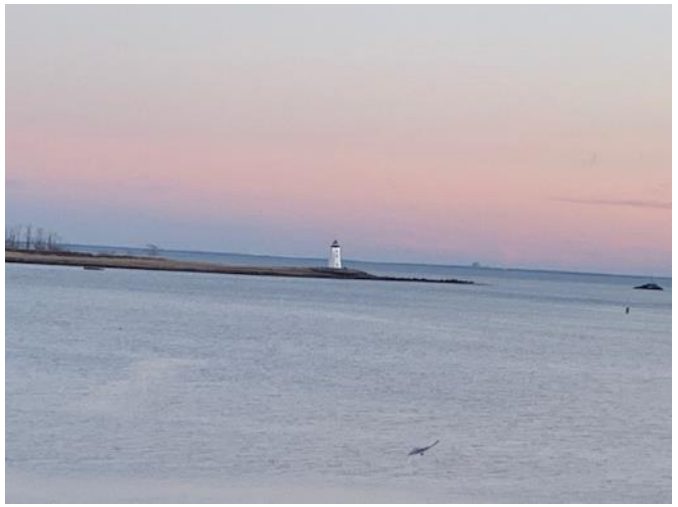
- Two WWTPs
  - East Side
  - West Side
- City of Bridgeport, most of Trumbull, small portion of Fairfield and Stratford
- 26 CSO regulators
  - 20 West Side
  - 6 East Side
- 113 miles combined sewer
- 170 miles separated sewer
- Aging system in need of upgrades



WWTP Facility Plan and Project Implementation Goals

- Move plants into 21st century
- Address nitrogen discharges and permit violations
- Meet CTDEEP resilience requirements (100 year + 3')
- Look to incorporate sustainable features
  - Green infrastructure, wind turbine, solar, water reuse, energy efficiency
- Develop visitor/educational center
- Help address CSO
  - Used SWMM to evaluate





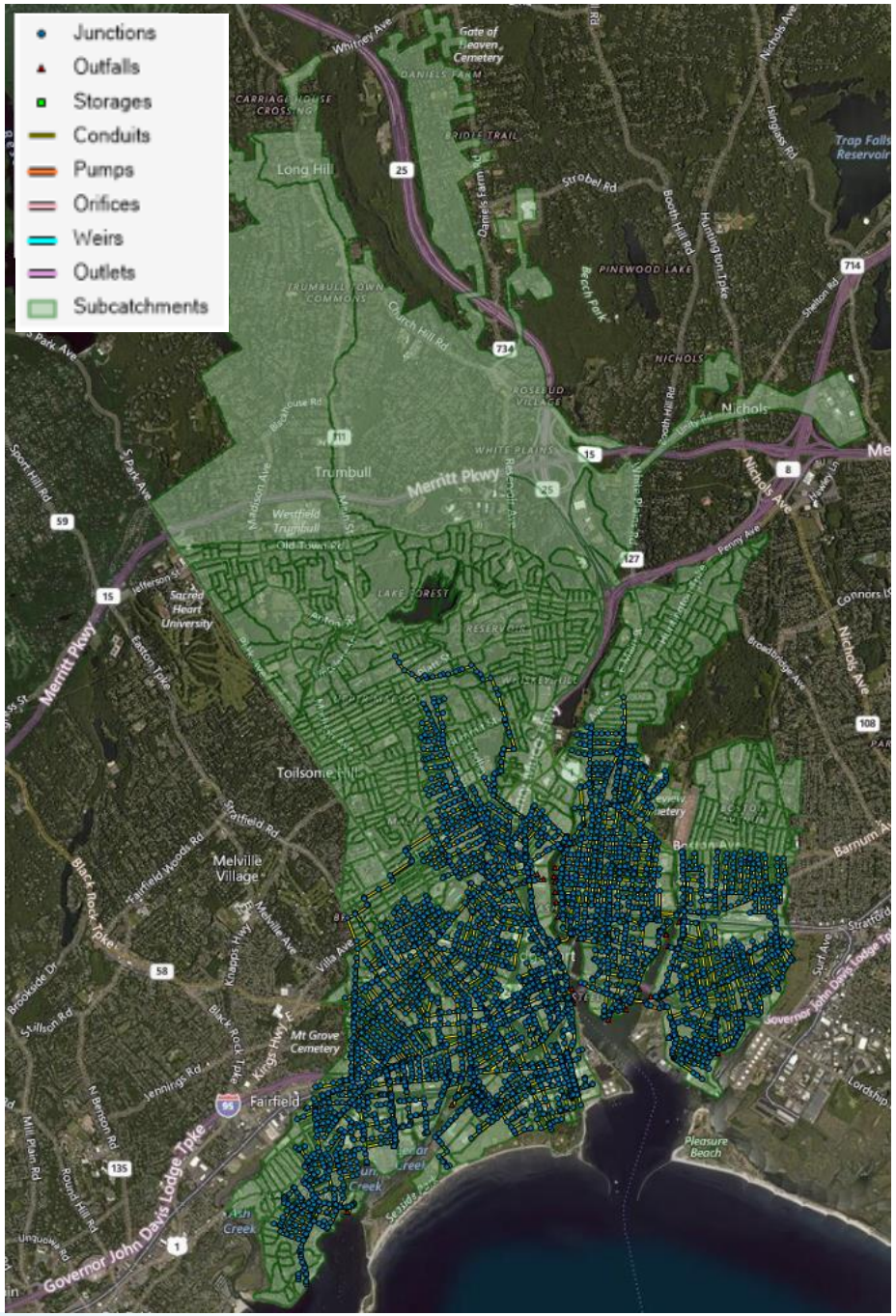
SWMM Model Updates

Starting Model

- Built for Long-Term Control Planning
- Calibrated to flow monitoring data
  - 21 meters in 1999
  - 6 meters 2009
- Validated against 8 overflow meters 2016-2017
- Detailed hydraulics in combined areas
- Limited hydrology
  - Dry pipes
  - No subcatchment geometry
  - Calibrated input parameters
- No seasonality

Subcatchments

- All-new subcatchments
  - Refined from census blocks
  - Split census blocks as needed to avoid dry pipes
  - DEEP 1998 sewered areas for Trumbull
- New hydrologic properties
  - Area from GIS
  - Width
  - Imperviousness
  - Percent Routing
  - Slope
  - Soils
- Sewer separation based on info from WPCA



CDM Smith

Pipe Network

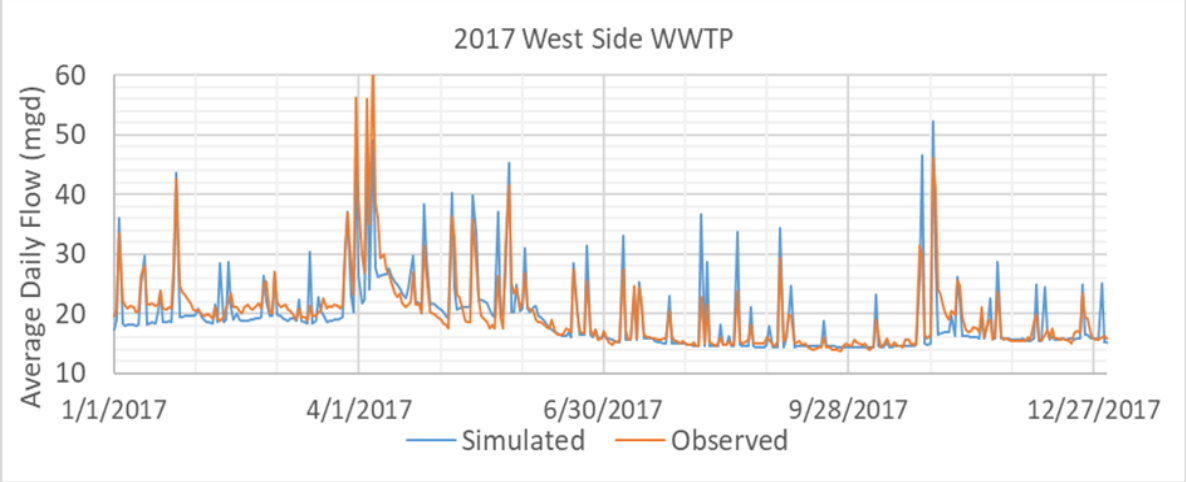
- Keep existing pipe network
- Extend major sewers into separated areas
- Update with new improvements
  - Two pump station upgrades
  - Multiple separation projects
- Simplify WWTP configuration
  - East Side flow limit = 35 mgd
  - West Side flow limit = 80 mgd
- Confirm CSO regulator hydraulics

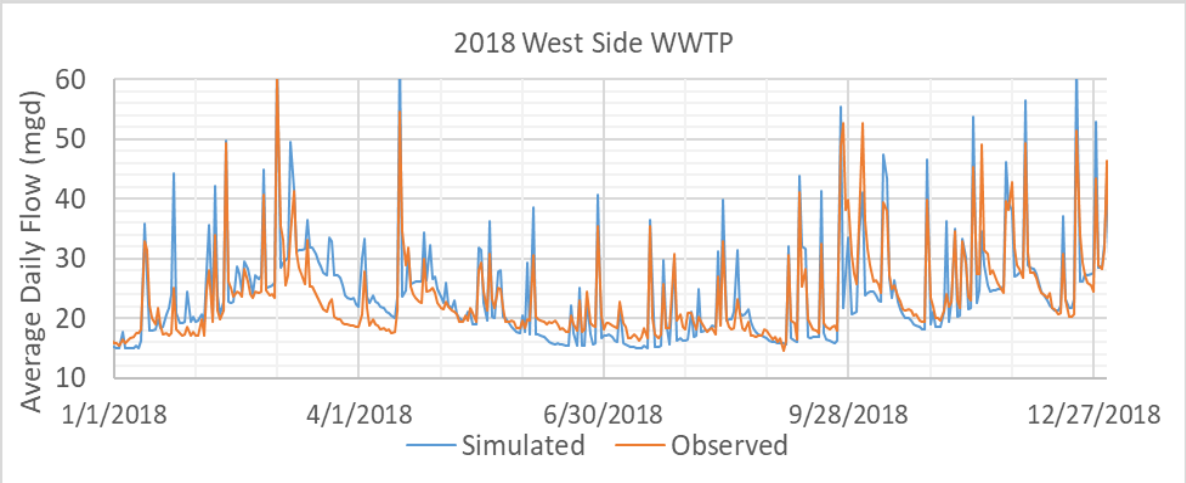
Tide Gates and Tidal Boundary Condition

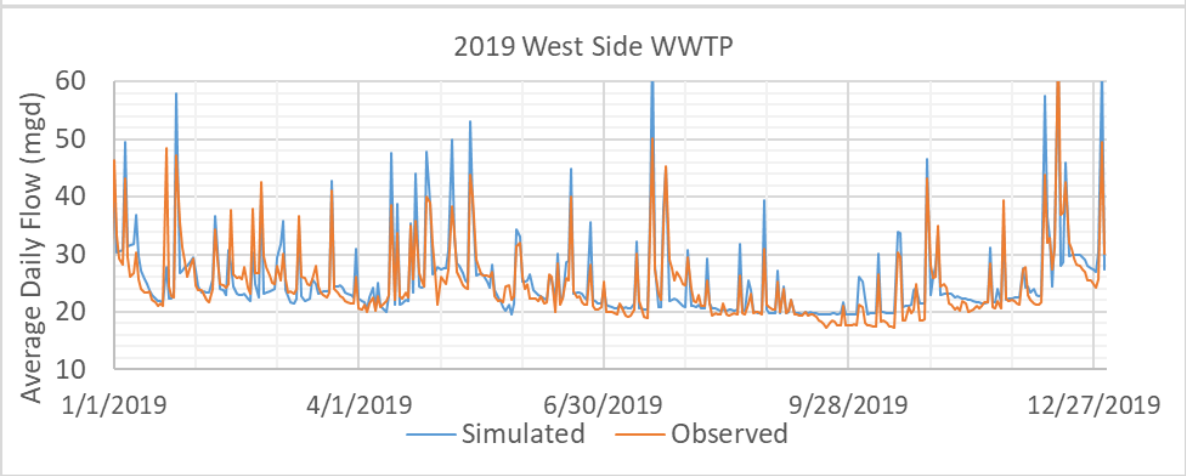
- Boundary condition from NOAA Bridgeport tide gage
- Added tide gates to most CSO outfalls
- Confirmed presence of tide gates with WPCA
- Verified tide gate performance against block testing

Dry Weather Flow (DWF)

- 3 distinct components
  - Daily sanitary pattern
  - Constant groundwater infiltration to deep sewers below mean sea level
  - Seasonal groundwater infiltration to all sewers
- Calibration focused on WWTP performance



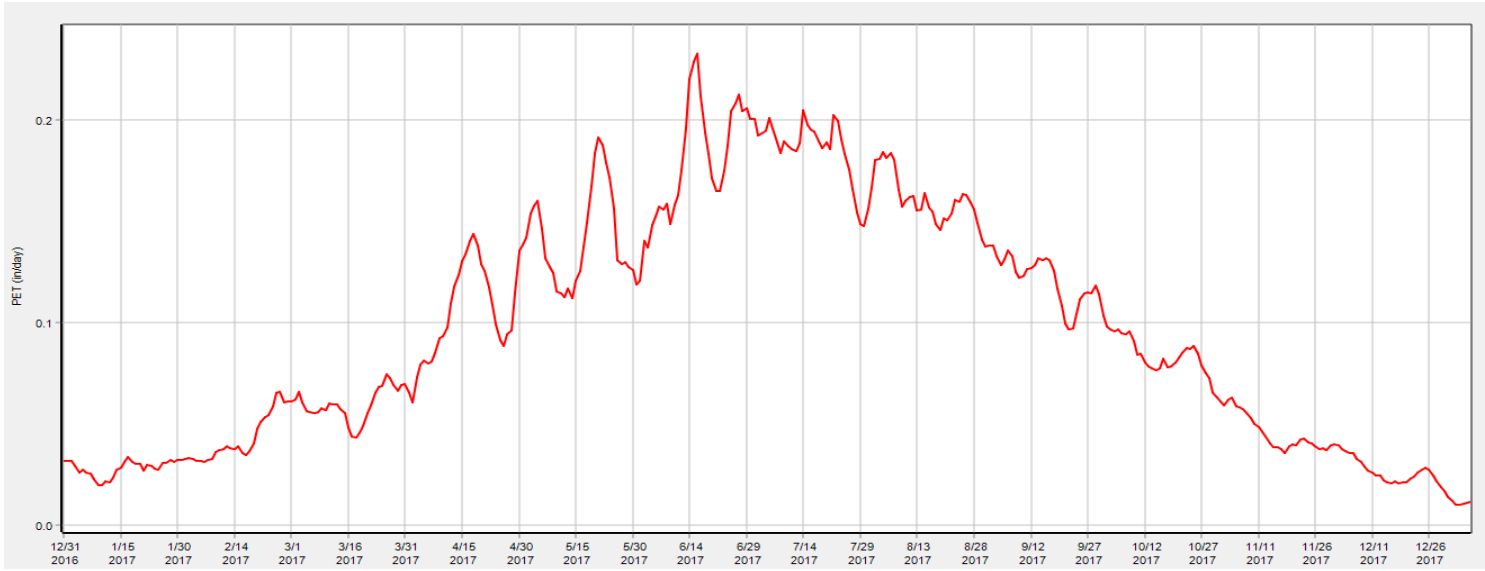




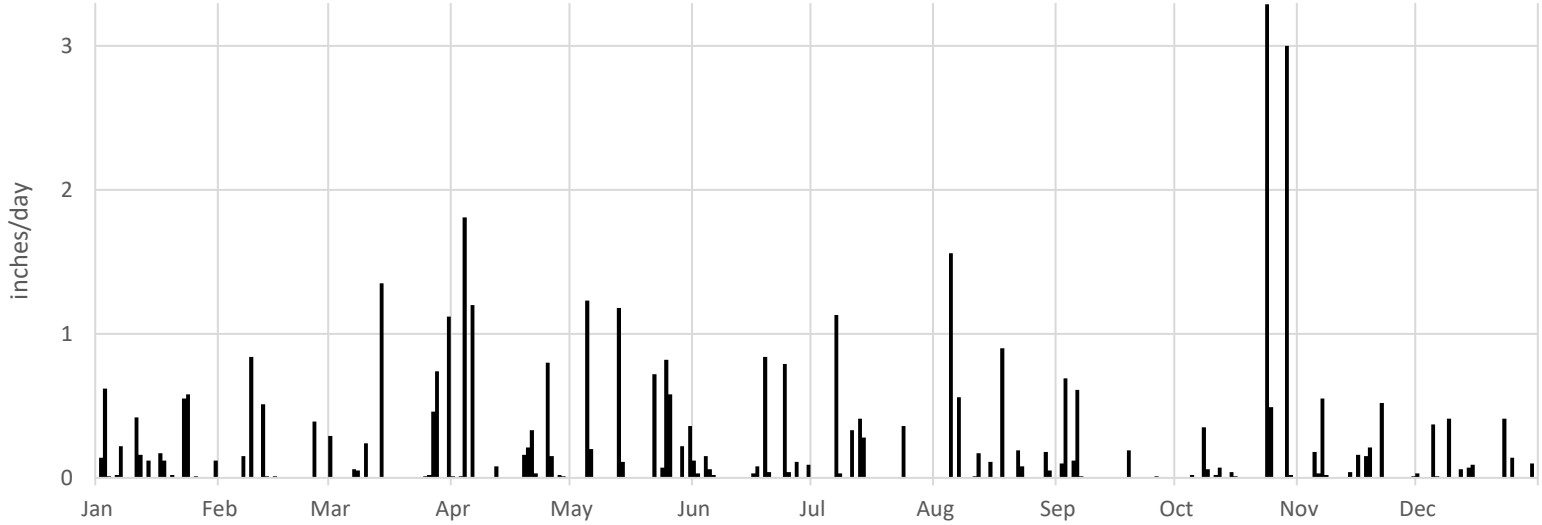
Climatology

- Temperature input for evaporation and snow process simulation
- 5-min Sikorsky Airport precipitation for 2017 & 2019 validation

Potential Evapotranspiration

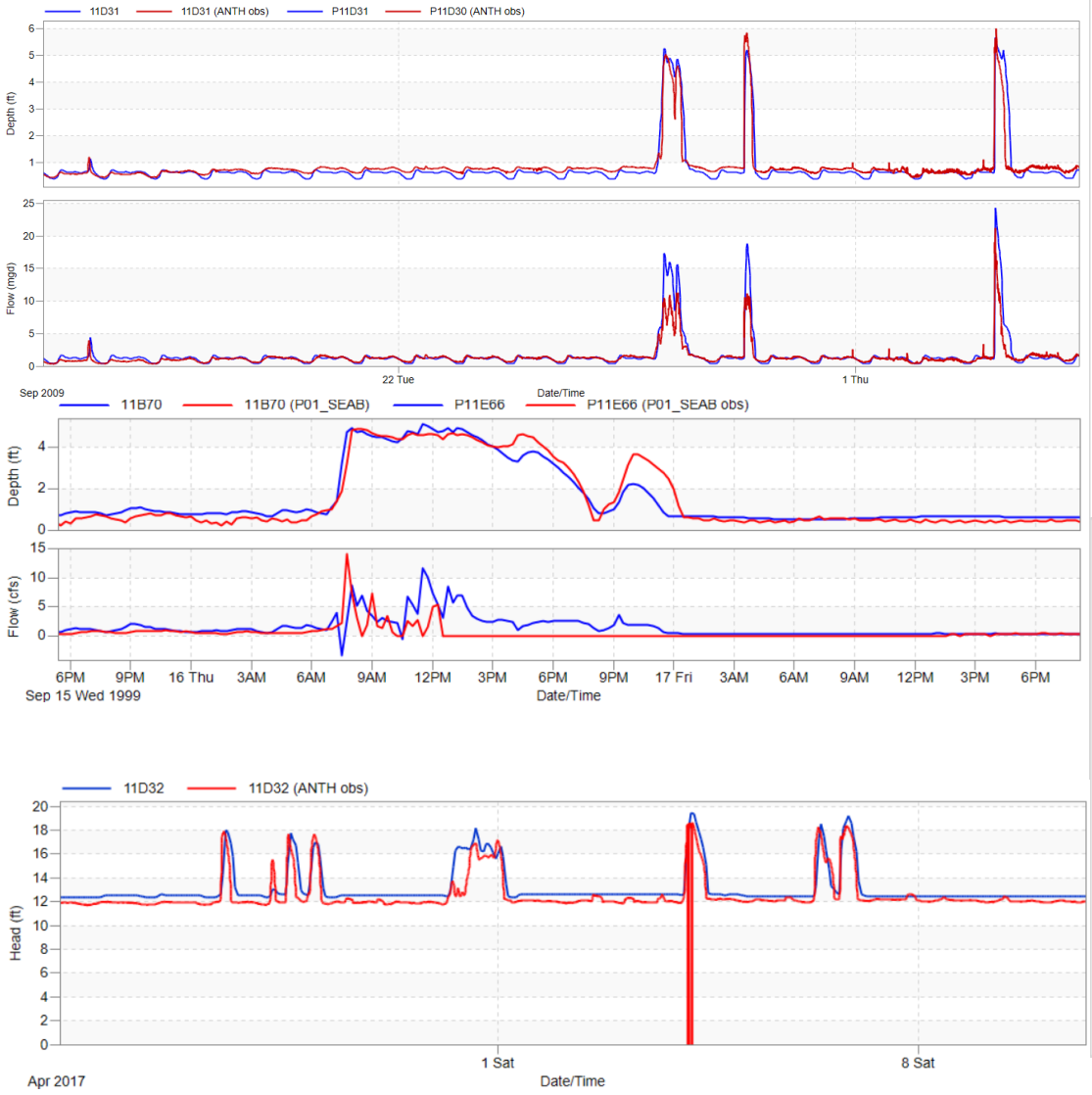


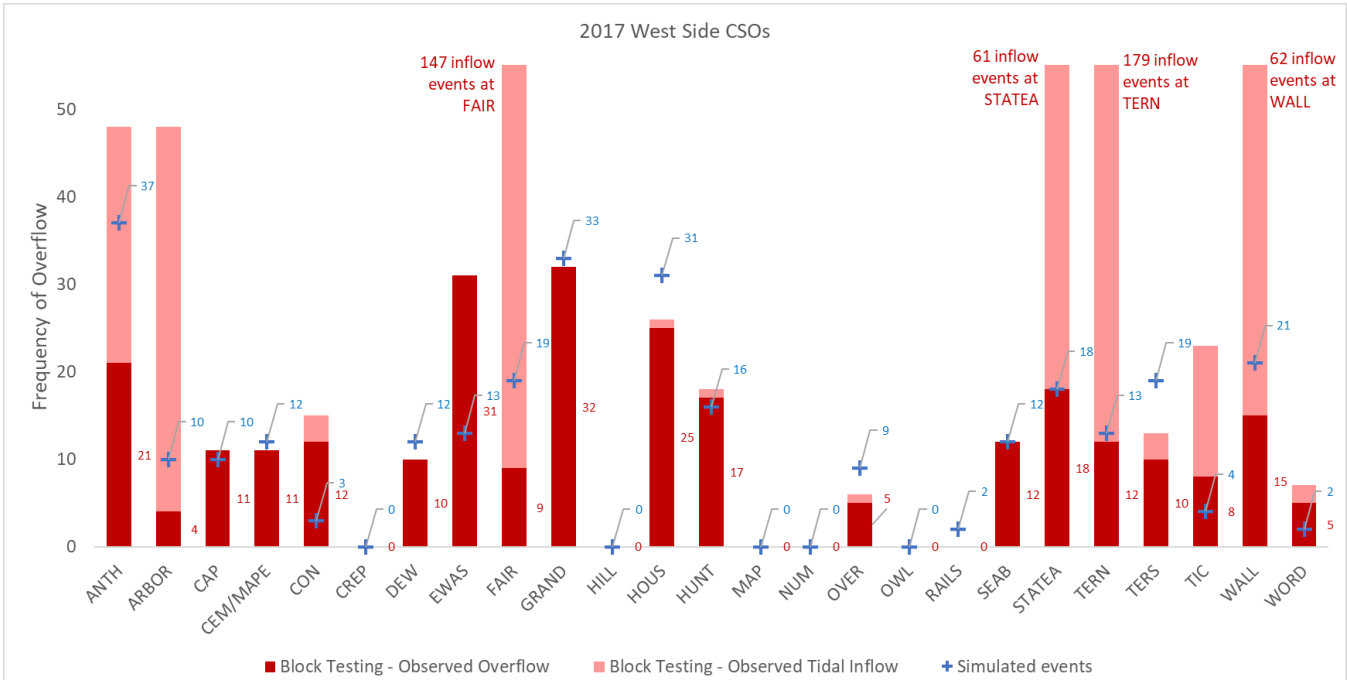
Precipitation

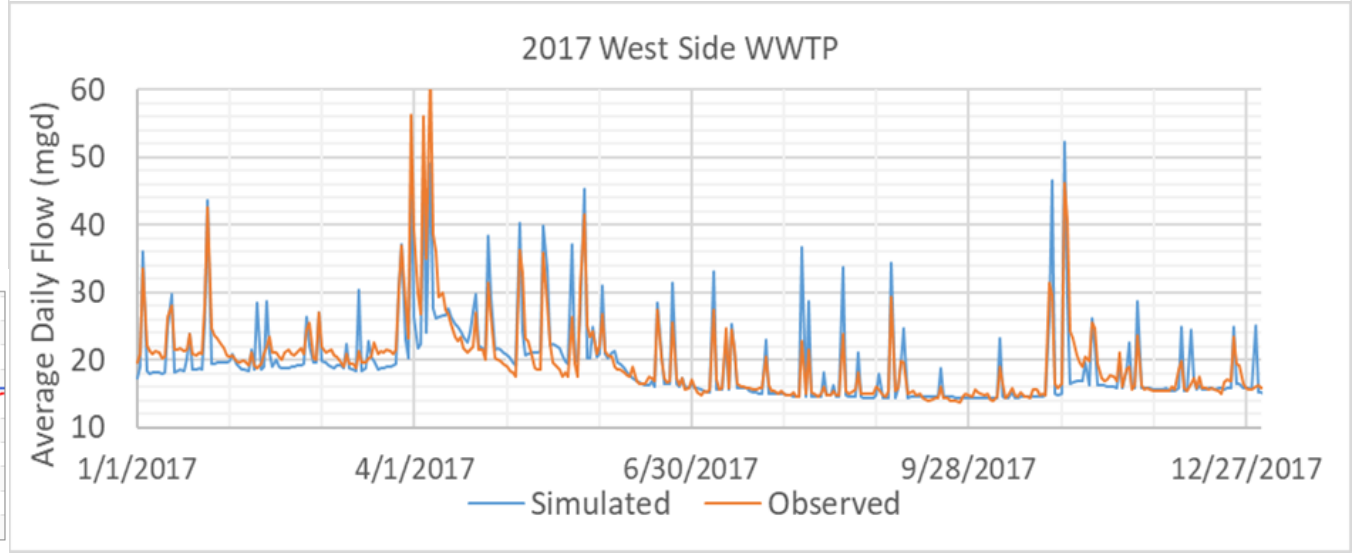


CDM Smith

Validation


11D31
11D31 (ANTH obs)
P11D31
P11D30 (ANTH obs)
Depth (ft)
Flow (mgd)
22 Tue
1 Thu
Sep 2009
Date/Time
11B70
11B70 (P01_SEAB)
P11E66
P11E66 (P01_SEAB obs)
Depth (ft)
Flow (cfs)
6PM 9PM 16 Thu 3AM 6AM 9AM 12PM 3PM 6PM 9PM 17 Fri 3AM 6AM 9AM 12PM 3PM 6PM
Sep 15 Wed 1999
Date/Time
11D32
11D32 (ANTH obs)
Head (ft)
1 Sat
8 Sat
Apr 2017
Date/Time

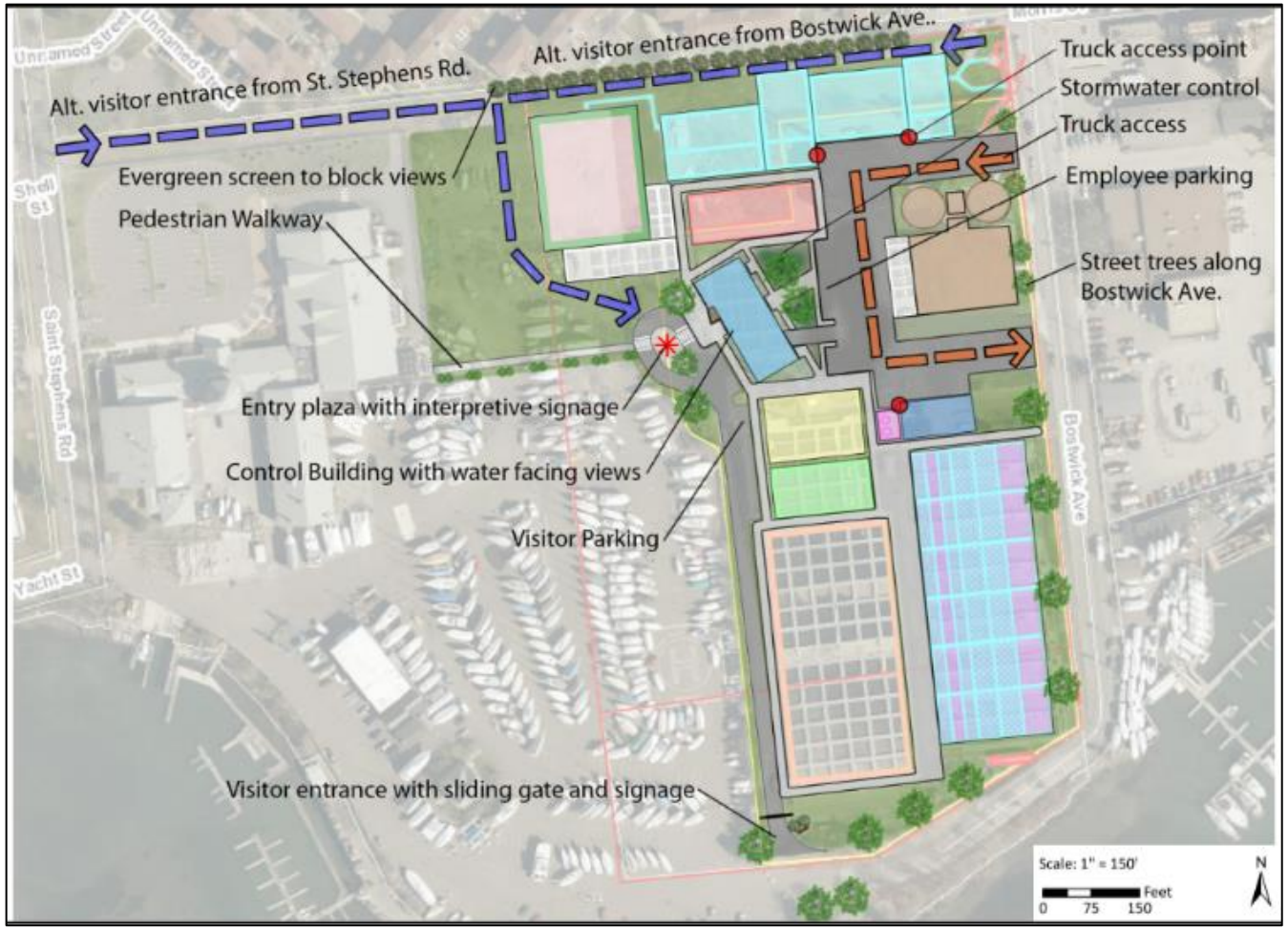

2017 West Side CSOs
Frequency of Overflow
147 inflow events at FAIR
61 inflow events at STATEA
179 inflow events at TERN
62 inflow events at WALL
ANTH ARBOR CAP CEM/MAPE CON CREP DEW EWAS FAIR GRAND HILL HOUS HUNT MAP NUM OVER OWL RAILS SEAB STATEA TERN TERS TIC WALL WORD
Block Testing - Observed Overflow
Block Testing - Observed Tidal Inflow
Simulated events


2017 West Side WWTP
Average Daily Flow (mgd)
1/1/2017
4/1/2017
6/30/2017
9/28/2017
12/27/2017
Simulated
Observed

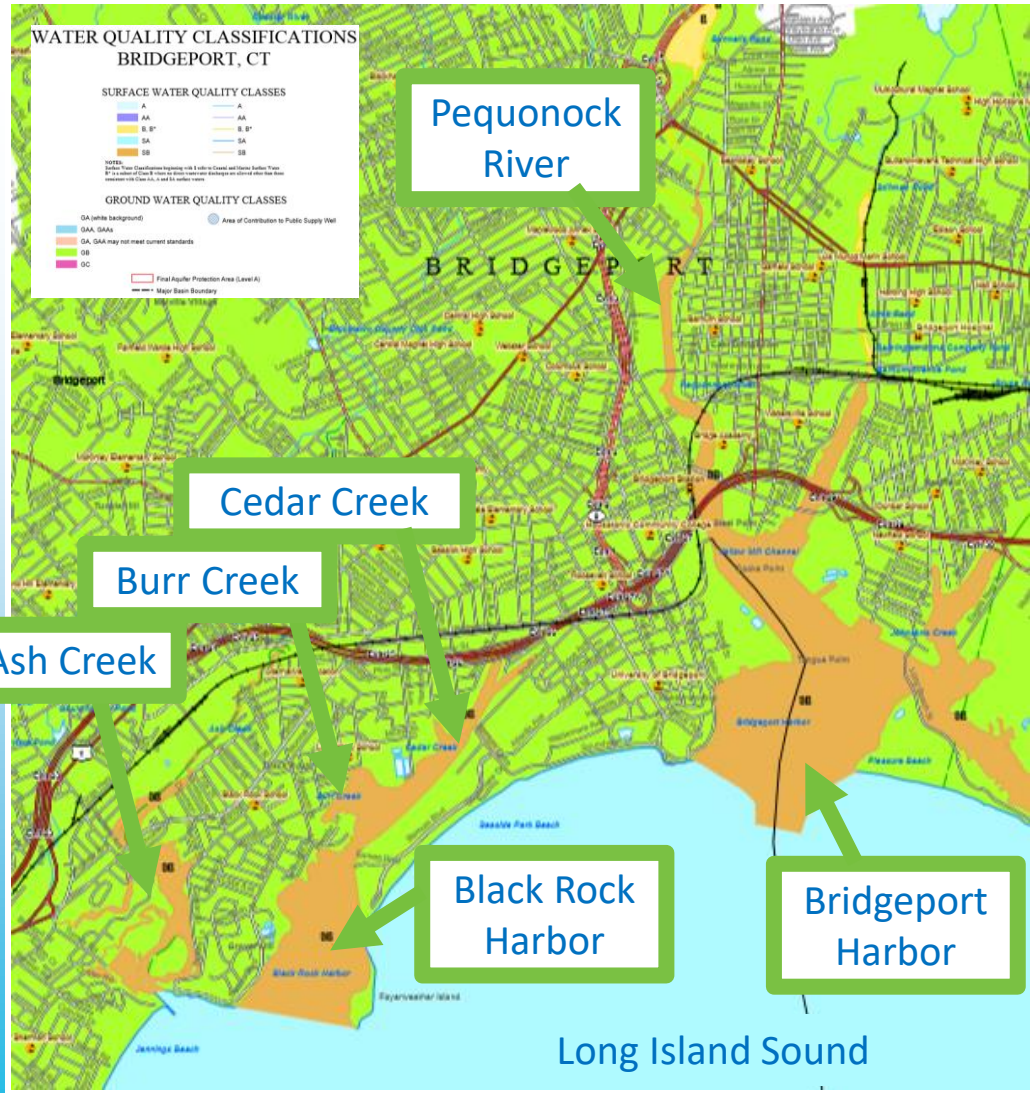
Facilities Planning

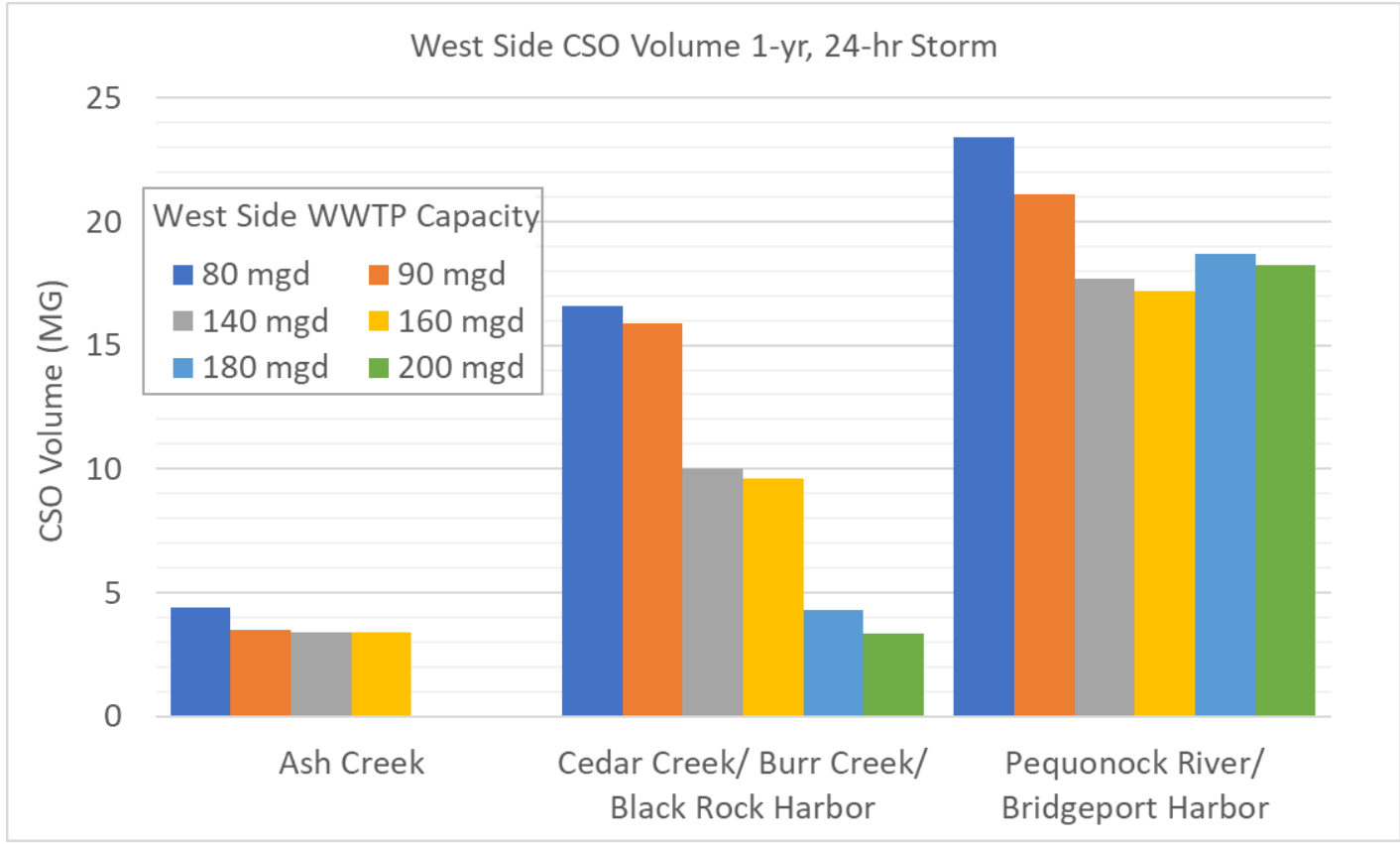
SWMM Model to Support WWTP Facility Plan

- Use SWMM model to increase wet weather capacity at WWTP
- Check CSO volume during 1-year, 24-hour design storm
- Seek opportunities to reduce CSO with planned WWTP upgrade
- Example for West Side



Facilities Plan Alternative Analysis – West Side CSO

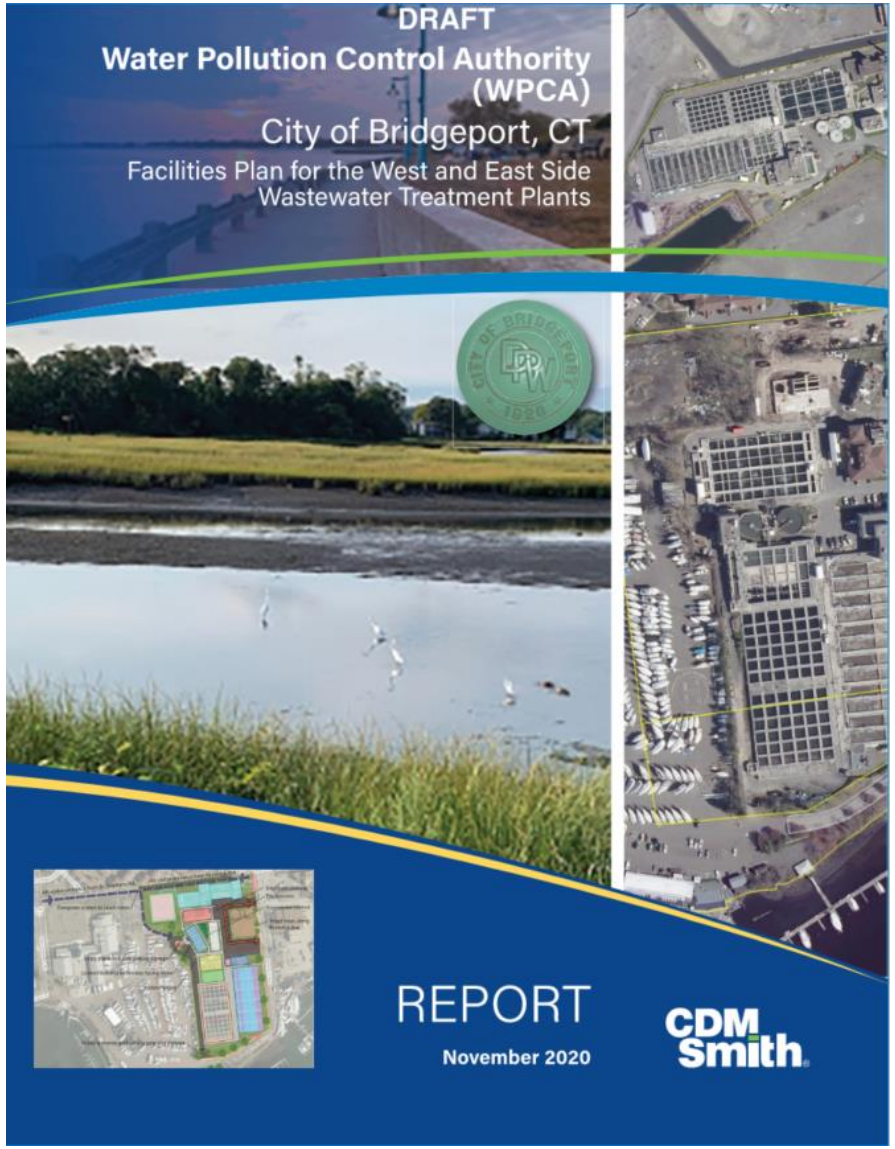




CT DEEP Water Quality Classifications Bridgeport, CT (CT DEEP, 2018)
http://cteco.uconn.edu/maps/town/wtrqualcl/WtrQualCl_Bridgeport.pdf

Conclusions

- Model used to identify synergies between facilities and CSO planning
- Previous model provided good starting point
- Efficient model updates using best-available data
  - US Census
  - CT Impervious & DEM
  - NOAA Tide
  - Sikorsky Airport precipitation and climate
  - Historic metering
  - WPCA records
  - WPCA WWTP flow and water quality



Contact us!

Laurie Kellndorfer Locke, PE
CDM Smith
603-222-8313
LockeL@cdmsmith.com
@Laurie_K_Locke

Lauren McBennett Mappa, PE
Water Pollution Control Authority, City of Bridgeport
203-332-5605
Lauren.McBennettMappa@BridgeportCT.gov

Find more insights through our water partnership at cdmsmith.com/water and @CDMSmith