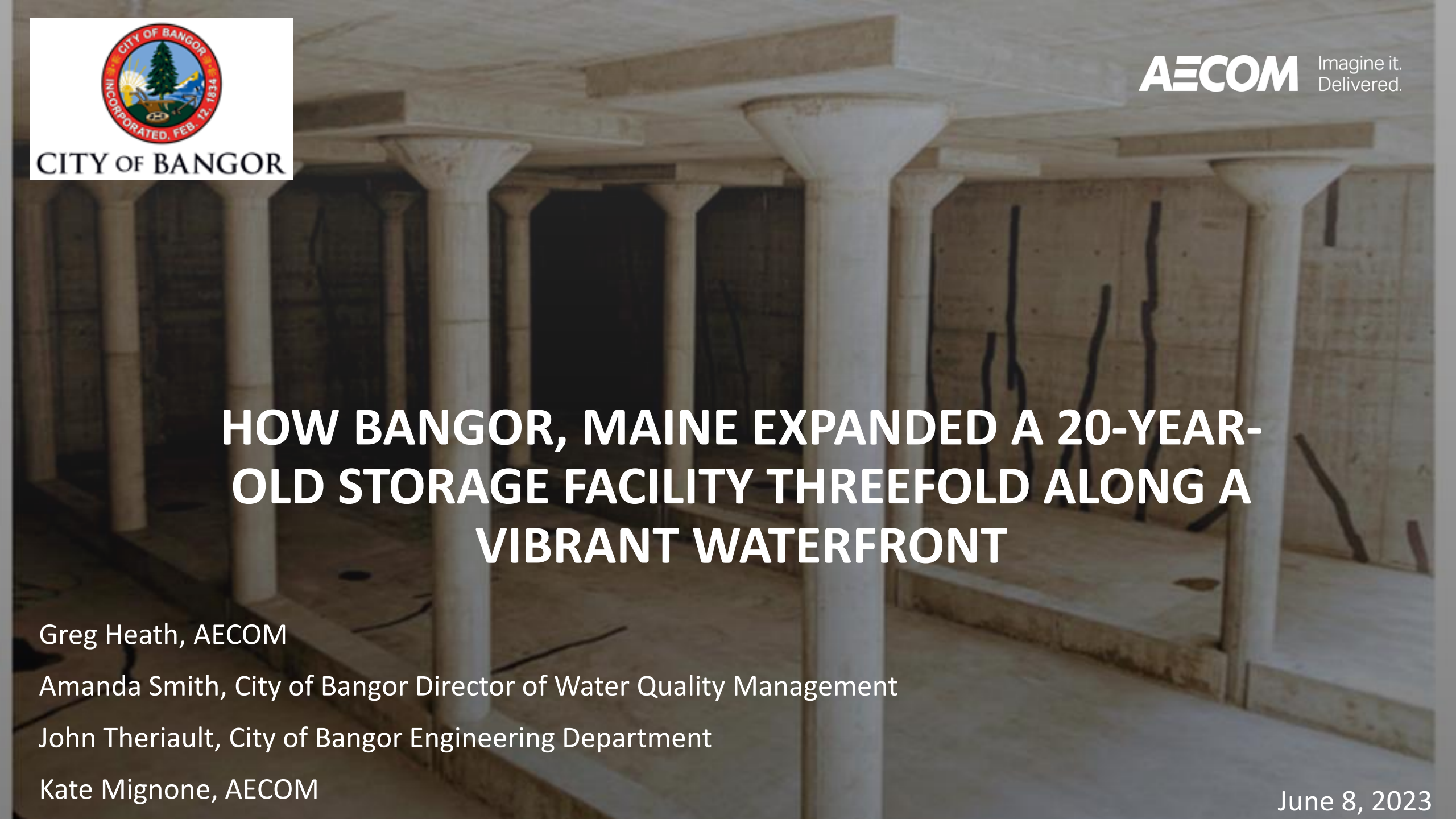

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HOW BANGOR, MAINE EXPANDED A 20-YEAR-OLD STORAGE FACILITY THREEFOLD ALONG A VIBRANT WATERFRONT

Greg Heath, AECOM

Amanda Smith, City of Bangor Director of Water Quality Management

John Theriault, City of Bangor Engineering Department

Kate Mignone, AECOM

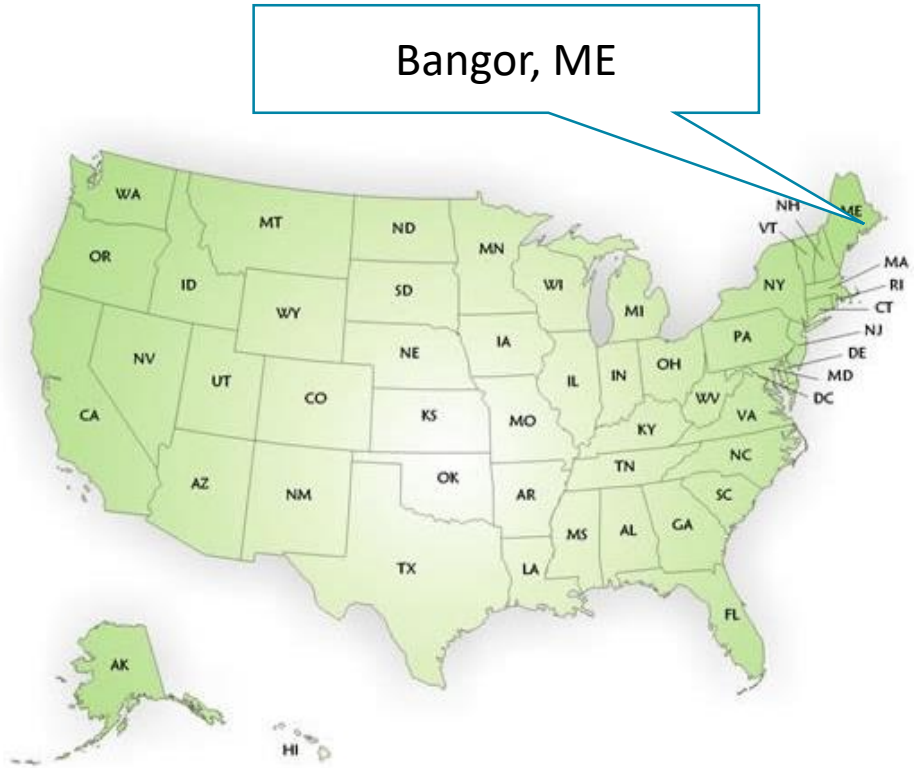
June 8, 2023

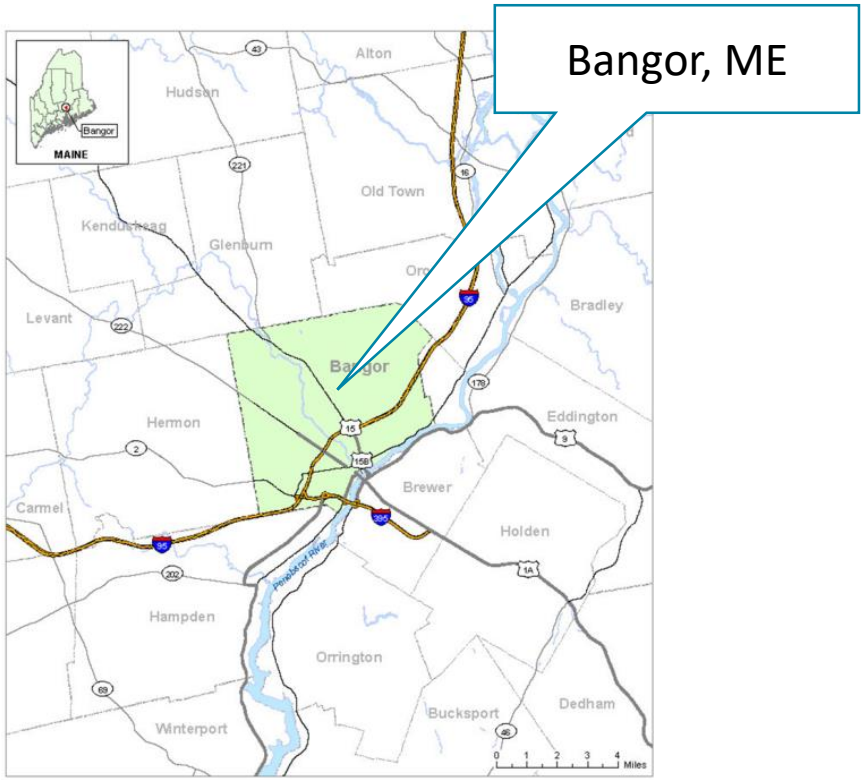
Agenda

- Background
- Davis Brook Storage Tank (DBST)
  - Design
  - Construction
  - Commissioning
- Conclusions

Background

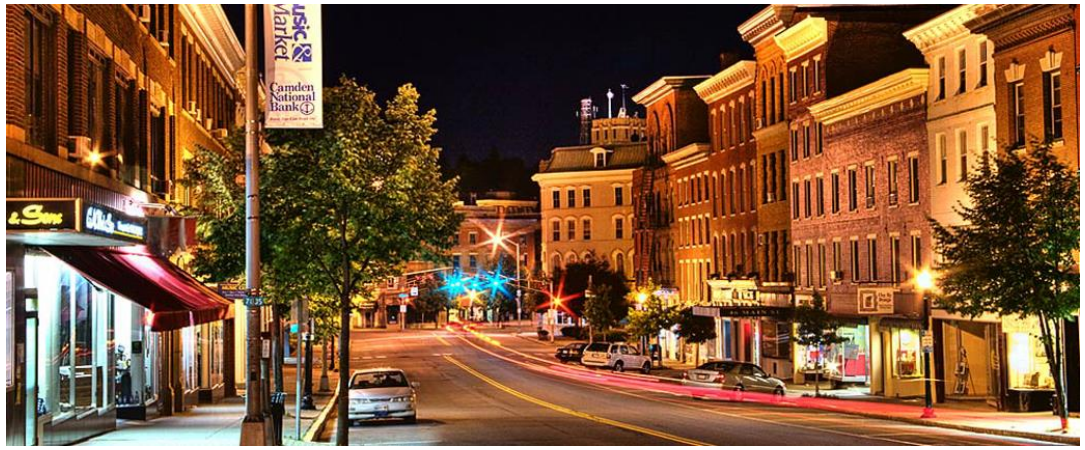
Location Plan





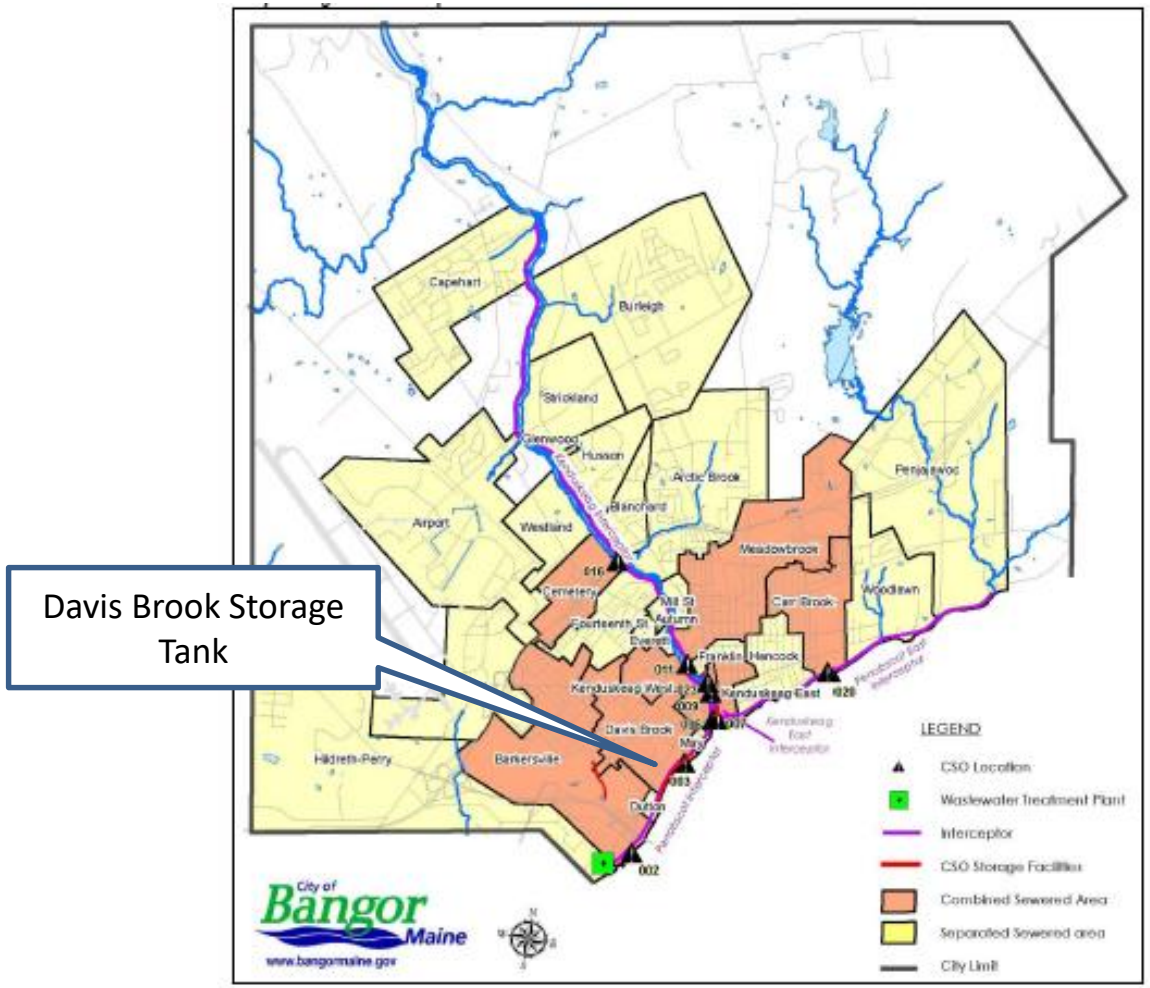
Community Setting

- Located on Penobscot River at confluence with Kenduskeag River
- Older “Working” City with long history in lumber and trade
- Population 31,921 (2021)



Wastewater Collection System

- Service Area: 33 Mi^2
- Population Served:
  - 31,900 in Bangor
  - 8,000 in Connected Communities
- 157 Miles of Gravity Sewer
- 9 Miles of Interceptor
- 4,000 Ft. of Force Main
- 5 Pump Stations
- 8 Siphons
- 9 Permitted CSOs



Clean Water Act Compliance Milestones

30-Year History Working With EPA & ME DEP on CWA Compliance

1987: CD with ME DEP to begin CSO control

1991: CD with EPA for CSO LTCP I

1994: EPA accepts LTCP I

2009: All LTCP I projects complete

2012: DRAFT PHASE 2 LTCP

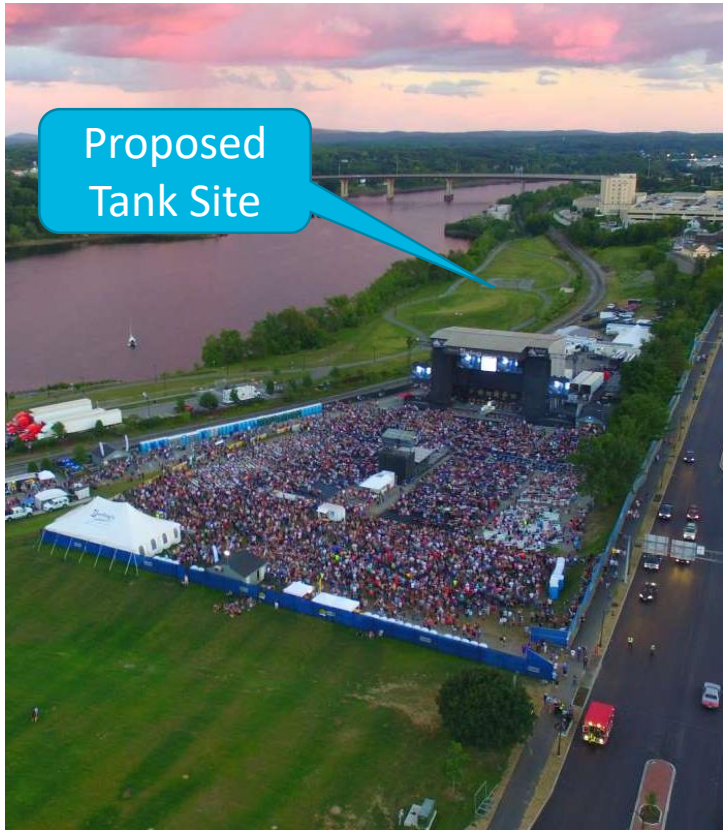
2013: Negotiation begins on new CD

2015: New CD finalized

2017: PHASE II LTCP

First 2017 LTCP Project - Davis Brook Storage Tank

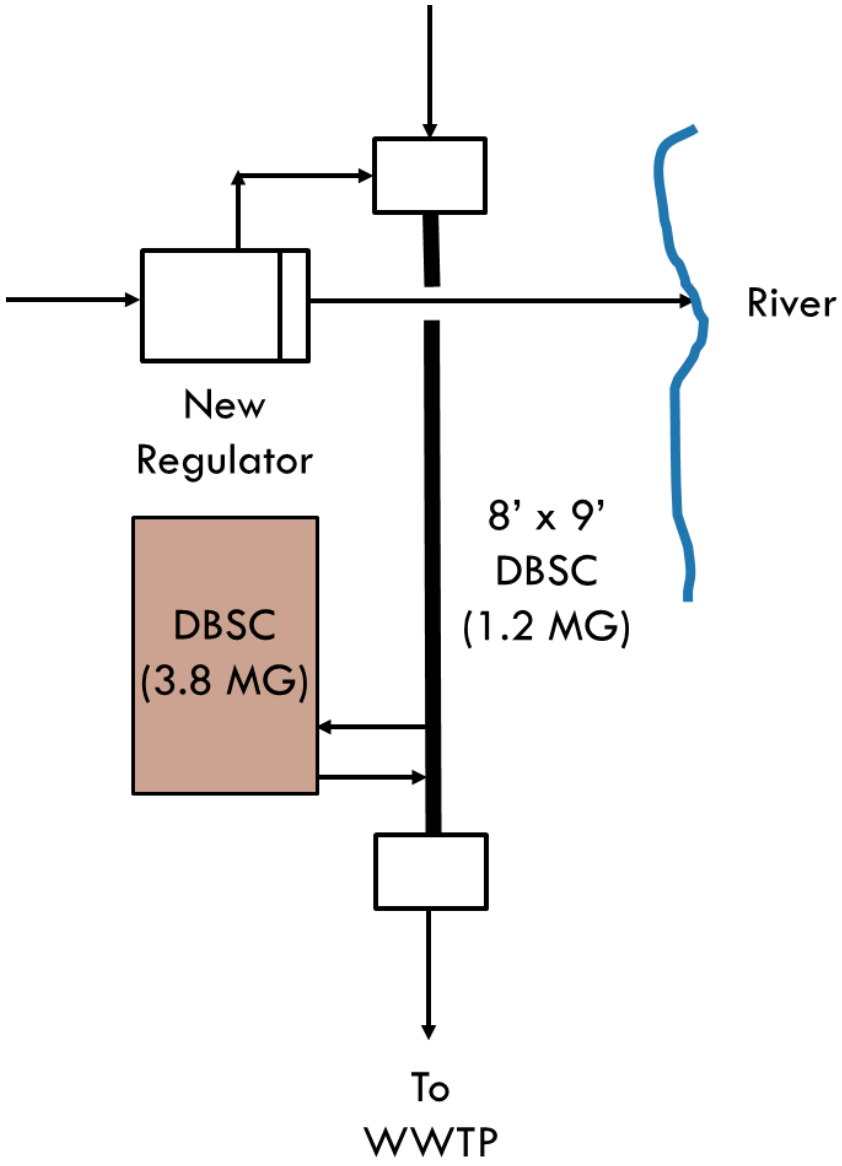
- Project drivers:
  - Frequency and volume of overflows at the Davis Brook CSO
  - Location of the proposed DBST in the vicinity of the Waterfront
  - Coordination with other Waterfront development plans
  - Opportunity to improve hydraulics at the existing Davis Brook CSO regulator structure



Davis Brook Storage Tank Design & Construction

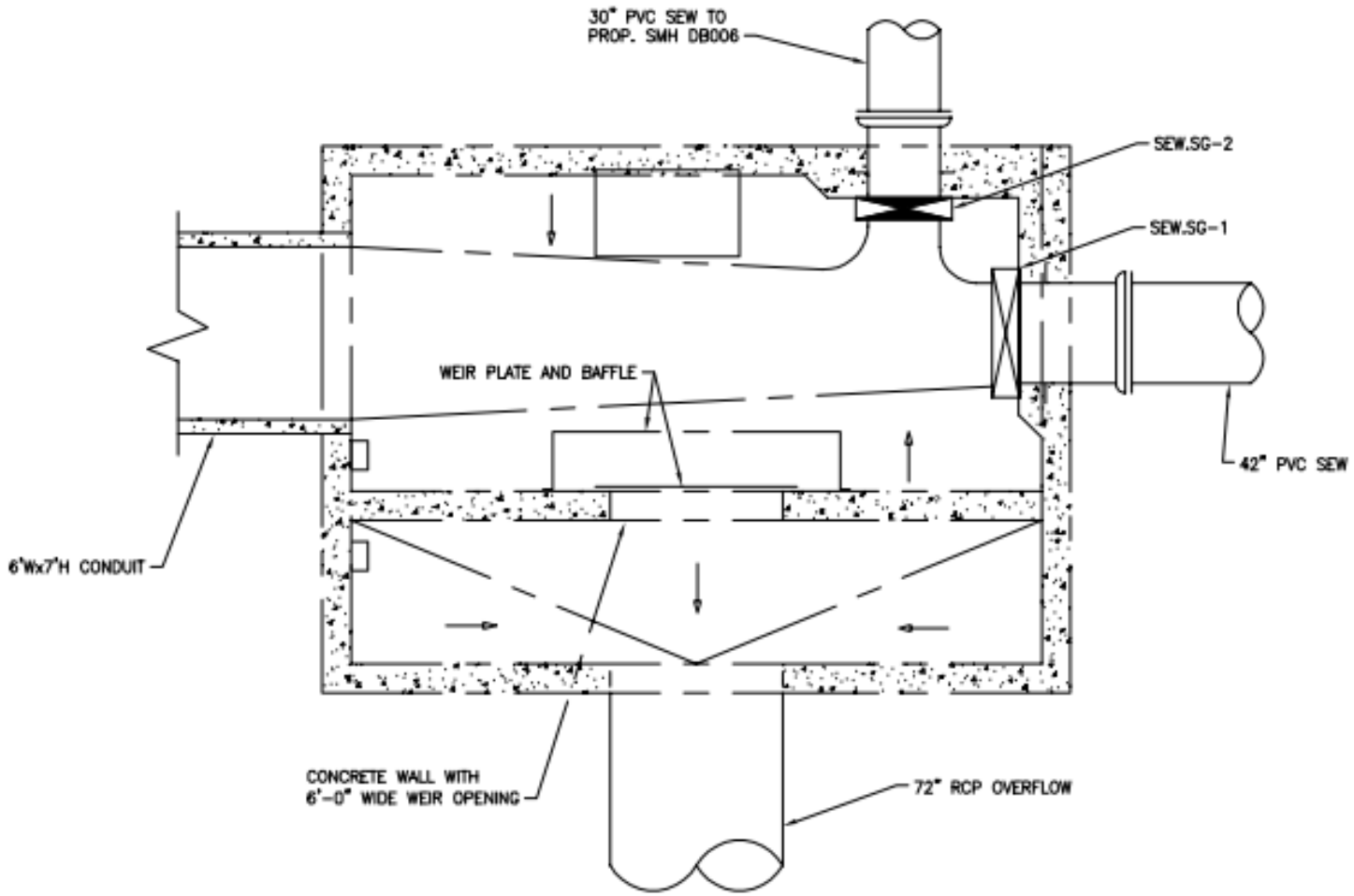
Design Criteria

- O.F. target: 4 per year
- Storage required: 5 MGAL
- Existing conduit: 1.2 MGAL
- Tank storage: 3.8 MGAL
- **TOTAL SYSTEM: 5.0 MGAL**



New Regulator Structure

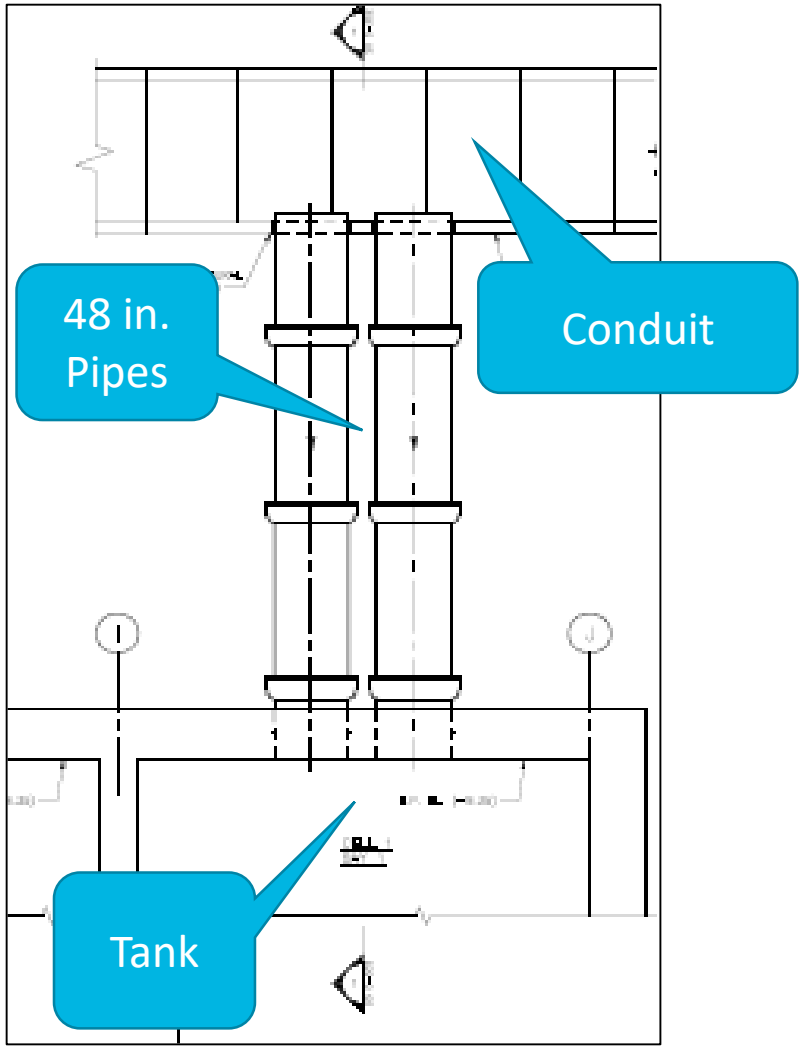
- Separate contract from DBST
- Increased dry weather connection size
  - 30 & 21 inch to 42 inch
- New hydraulically-actuated gates for flow isolation and control
- Detect overflow and measure flow over weir



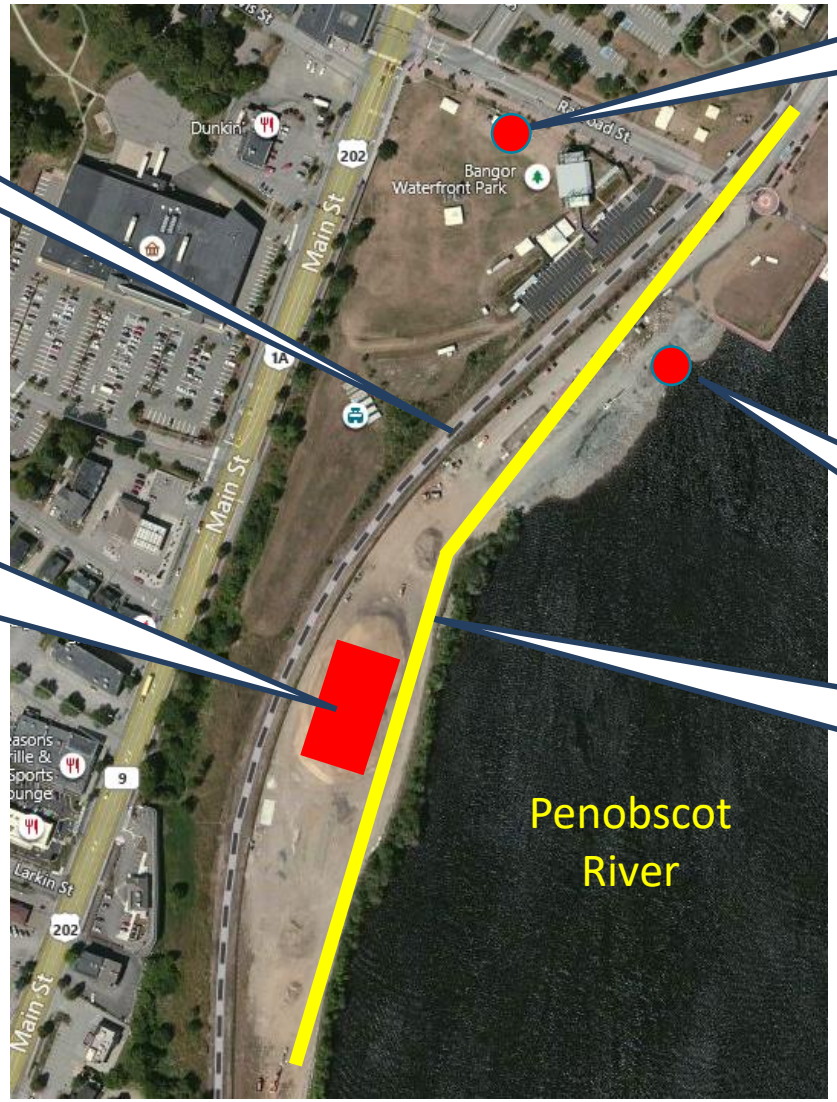
DBST Site Access Challenges

Connection Between Conduit and Tank

- Twin 48-inch ductile iron pipes
- Sized to meet 4 overflow per year level of control
- Included two joints in each pipe to account for potential differential settlement



Siting Considerations



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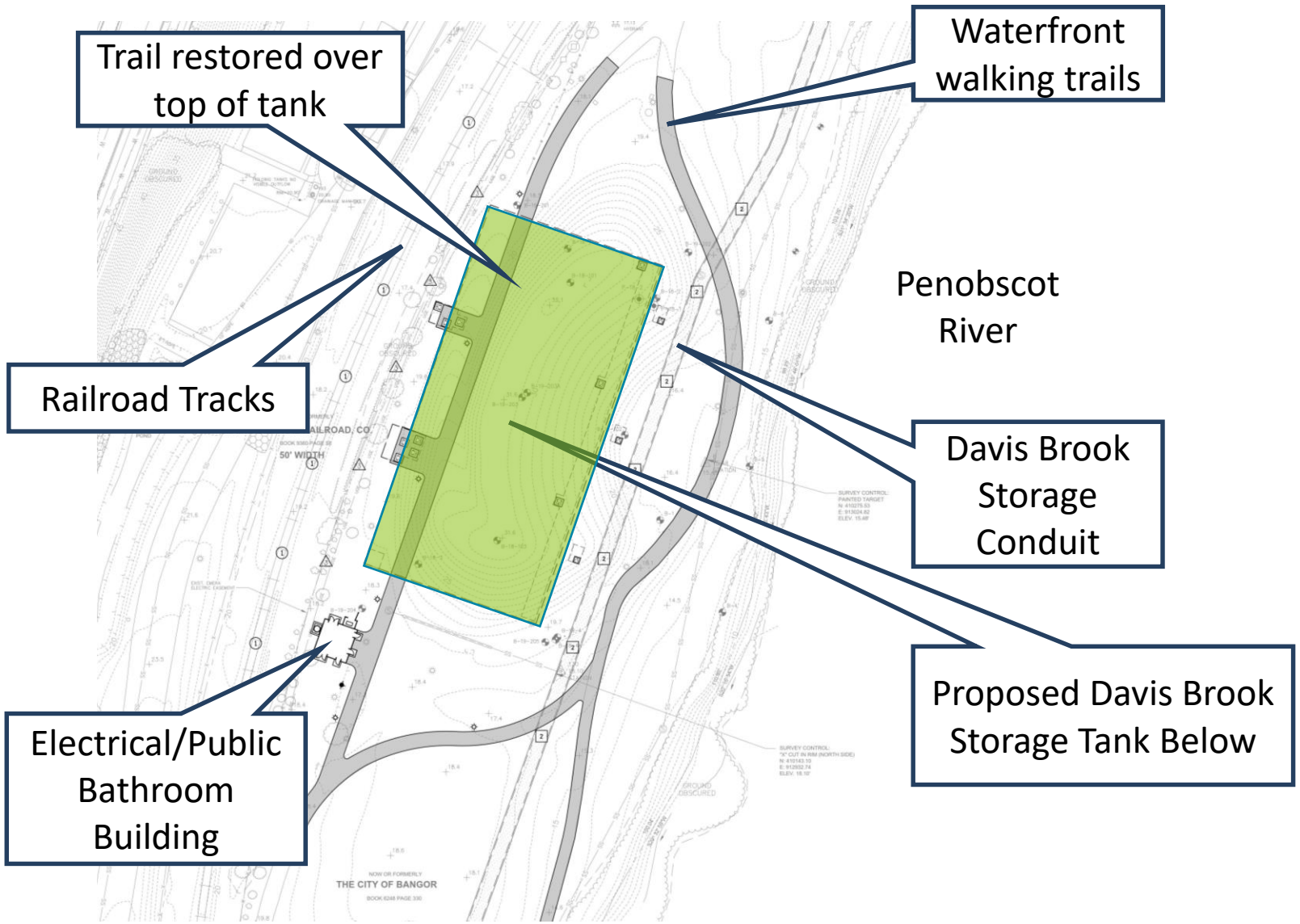
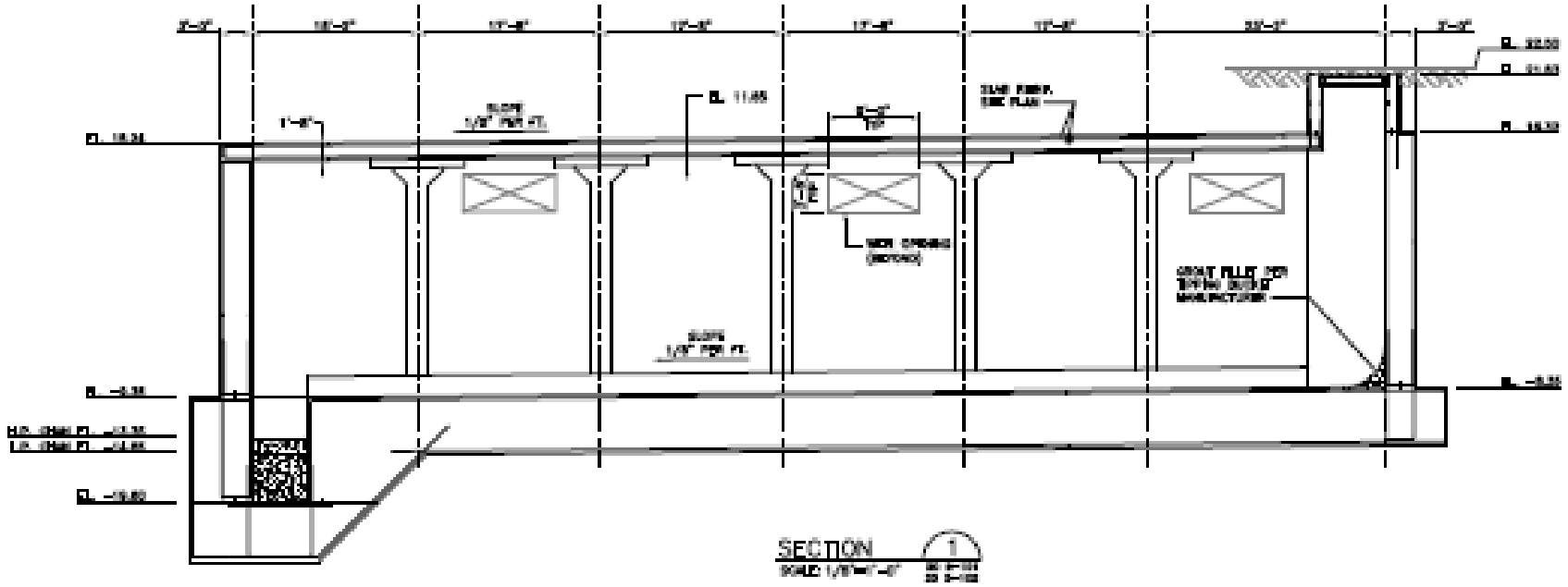
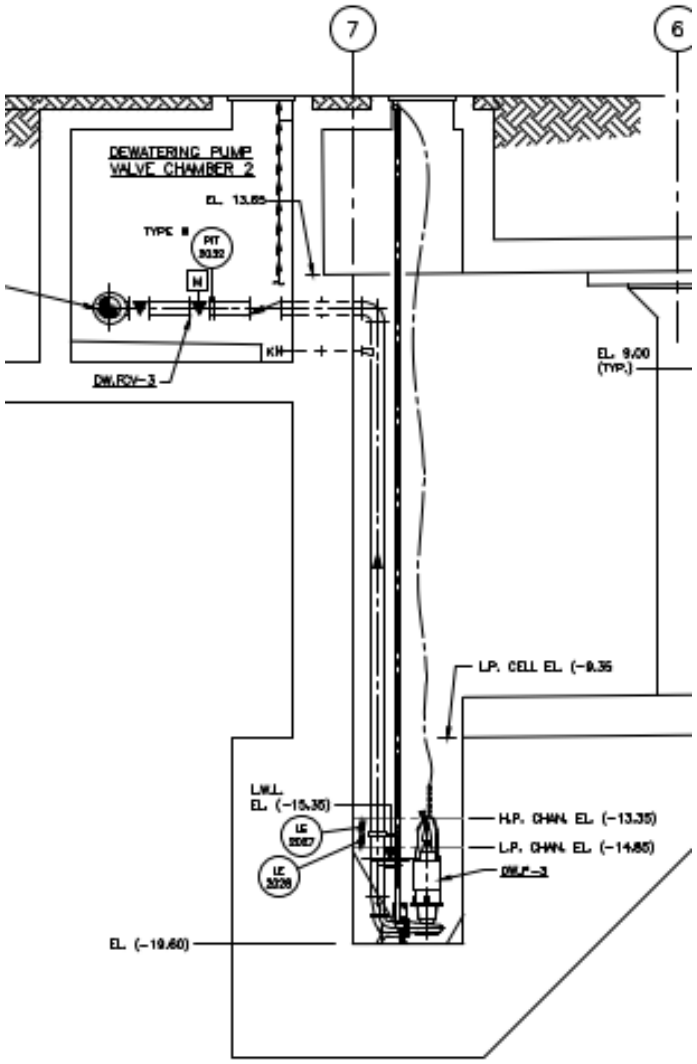


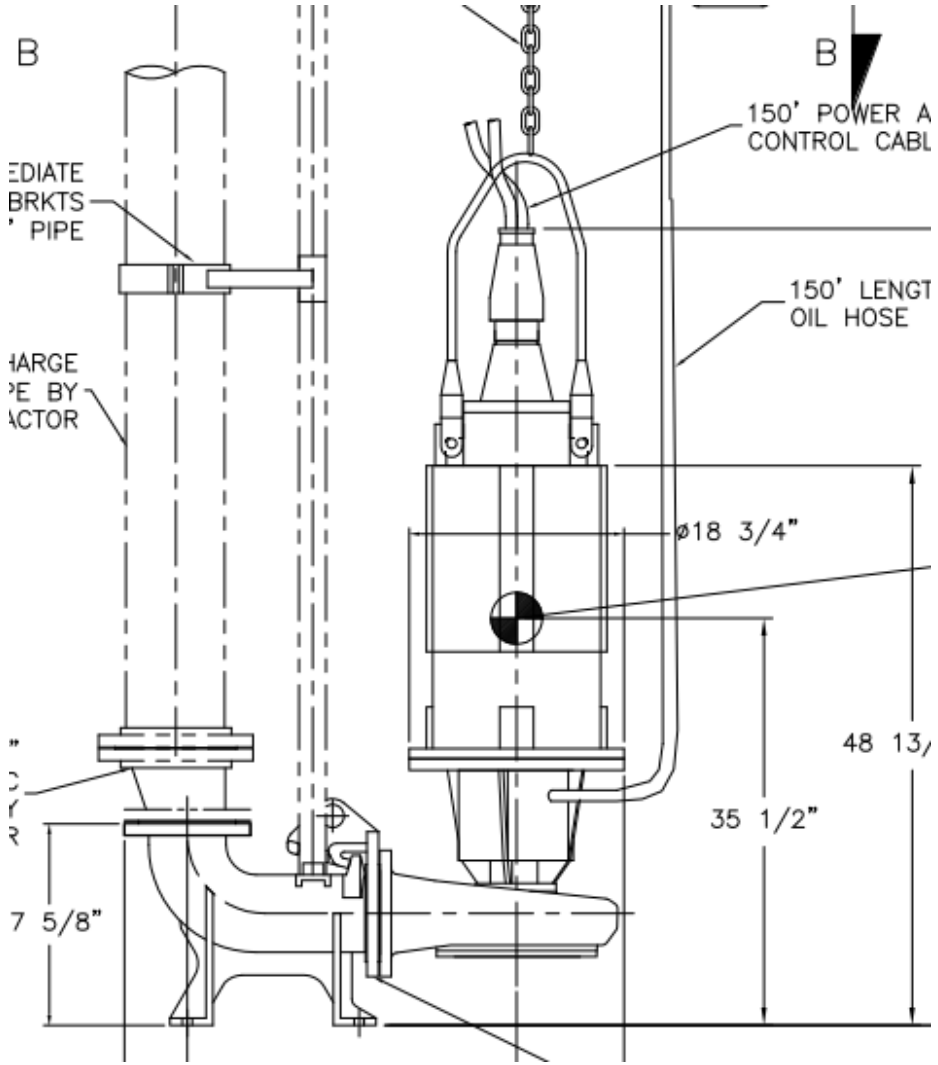
Tank Geometry and Key Features

- Length: 116 ft.
- Width: 242 ft.
- Side water depth: 20.5 ft.
- Freeboard: 3.1 ft.
- Longitudinal slope: 1%
- Gutter cross slope: 2%



Tank Dewatering

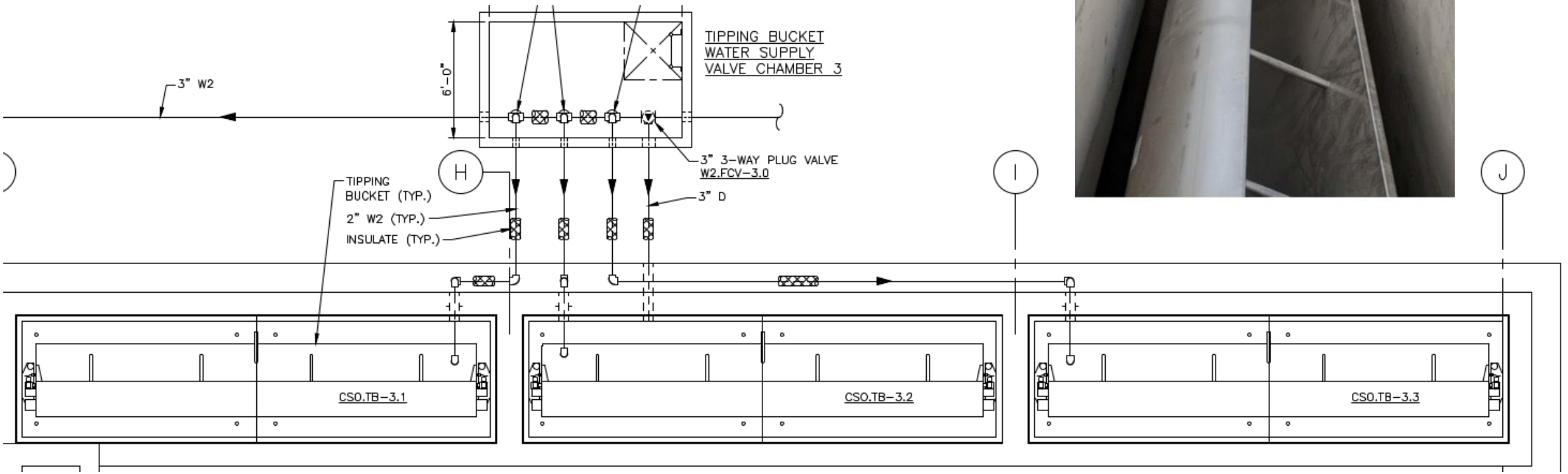




Dewatering Pump Design

- Empty each cell that fills following CSO events
- Empty water from tipping buckets following post-event flushing
- Empty infiltration to maintain low level in each cell between CSO events
- Three installed pumps (one per cell) plus shelf spare
- Part of automated post-event clean-up sequence
- Sized to:
  - Operate over full range of water levels in tank
  - Dewater full tank in 24 hours

Post-Event Cleaning



Tipping Bucket Design

– Clean the floor of the DBST following storm events

– Flush debris to tank sump for removal by dewatering pumps

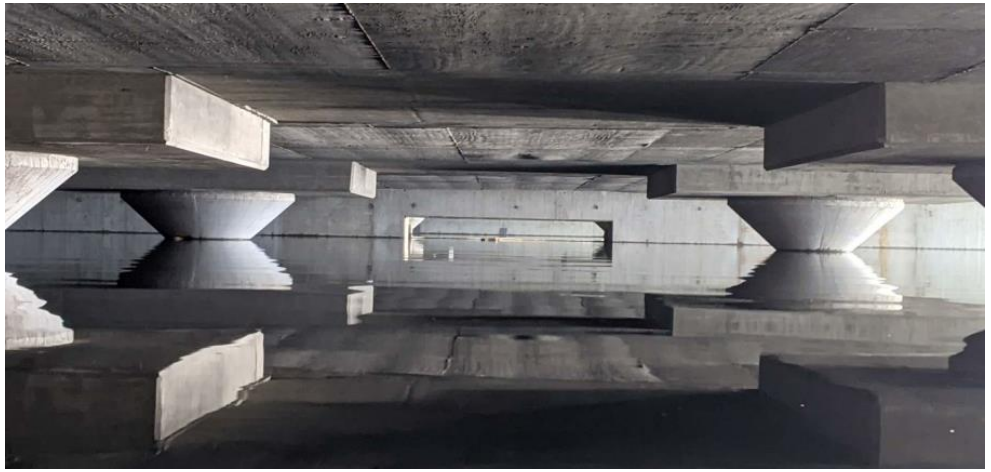
- Three tipping buckets per cell
- Part of automated post-event clean-up sequence:
  - Dewatering pumps empty each cell containing storm flow
  - Tipping buckets sequentially fill and tip
  - Dewatering pumps empty gutter and sump after each tipping bucket tips

Tank Vent

- Capable of exhausting air during tank filling
  - Sized based on peak flow into tank
- Admits air into tank when emptying
- May add odor control in future if warranted

Other Design & Construction Challenges

- Support of excavation
- Groundwater control
- Presence of competent rock
- Contaminated soil
- Construction testing
- Facility start-up and acceptance testing



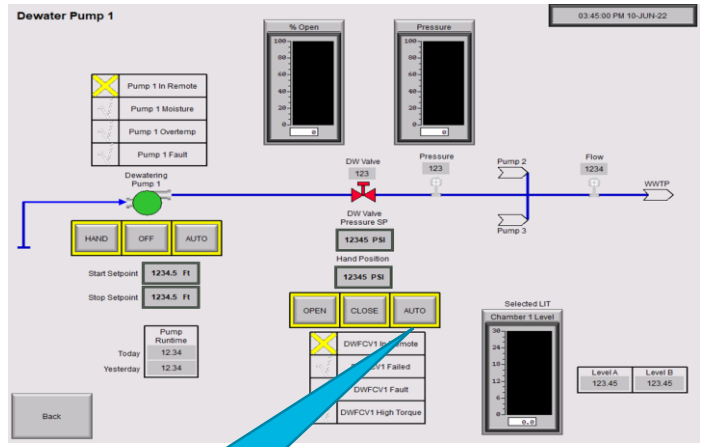

Commissioning

Sequence of Commissioning Activities

- Physical check-out
- Field testing
  - Testing by contractor, with supplier assistance
- Start-up
  - Clean water testing
- Commissioning
  - Process flows – actual CSO

Local/Stop/Remote – Set in REMOTE

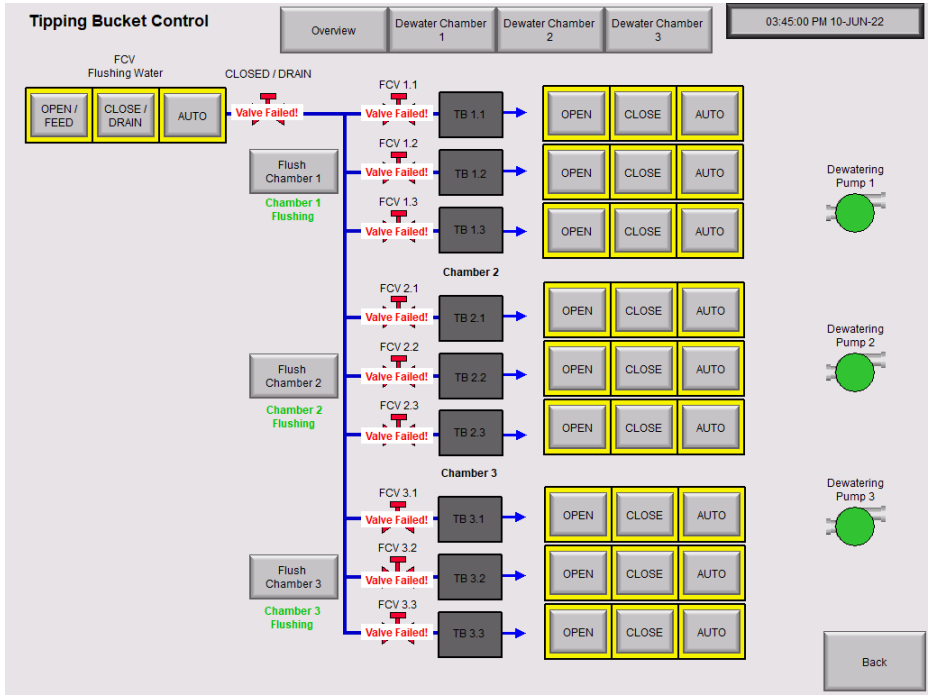
Remote Control Symbol



AUTO selected

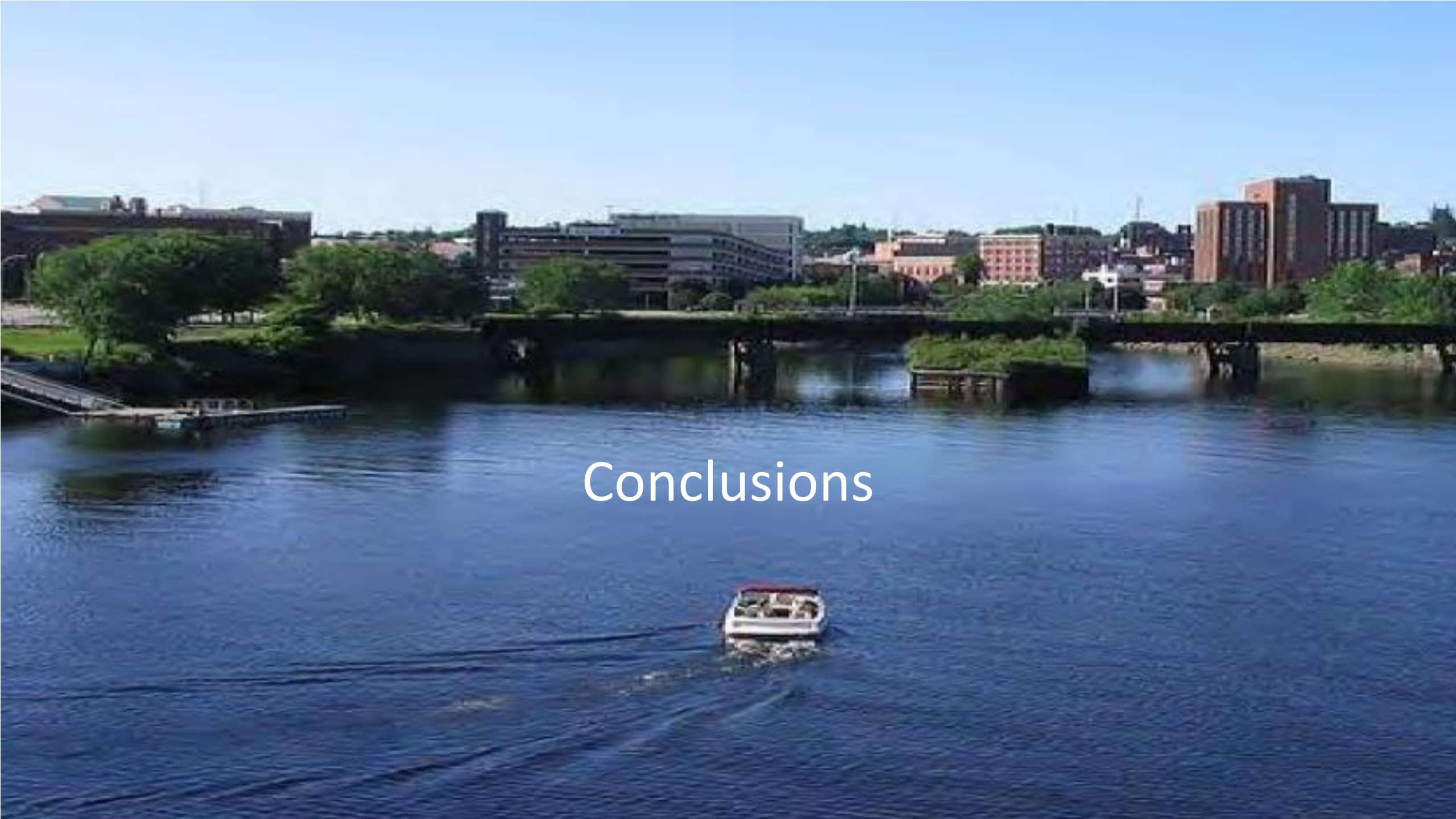
Equipment / Systems

- Chopper pumps
- Slide gates
- Tipping buckets
- Electric actuators
  - Running test in presence of Engineer
  - Run without vibration or jamming
  - At speeds specified
  - Observe / record motor inputs
  - Observe proper valve / gate positioning



Commissioning

- Stage 1
  - HVAC system operates as designed, minimum 5 days continuously
  - SCADA system operates as designed, minimum 5 days continuously
  - Electrical equipment operates as designed, minimum 5 days continuously
  - Dewatering pumps operate as designed to pump infiltration (if required)
  - A qualifying storm event (cell 3 at least half fills) occurs and system operates as designed
- Stage 2
  - HVAC, SCADA, electrical, and dewatering equipment continue to operate as designed until second qualifying storm event occurs
  - Second qualifying storm event (same criteria as first event) occurs, and system operates as designed



Conclusions

Conclusions and Take-Aways

- Importance of designing CSO facilities for future expansion
- Importance of planning for commissioning of intermittent duty wet weather facilities
- Innovative approach for expanding CSO storage with integrated storage solution
- Collaboration within City to meet needs of CSO control and future waterfront expansion

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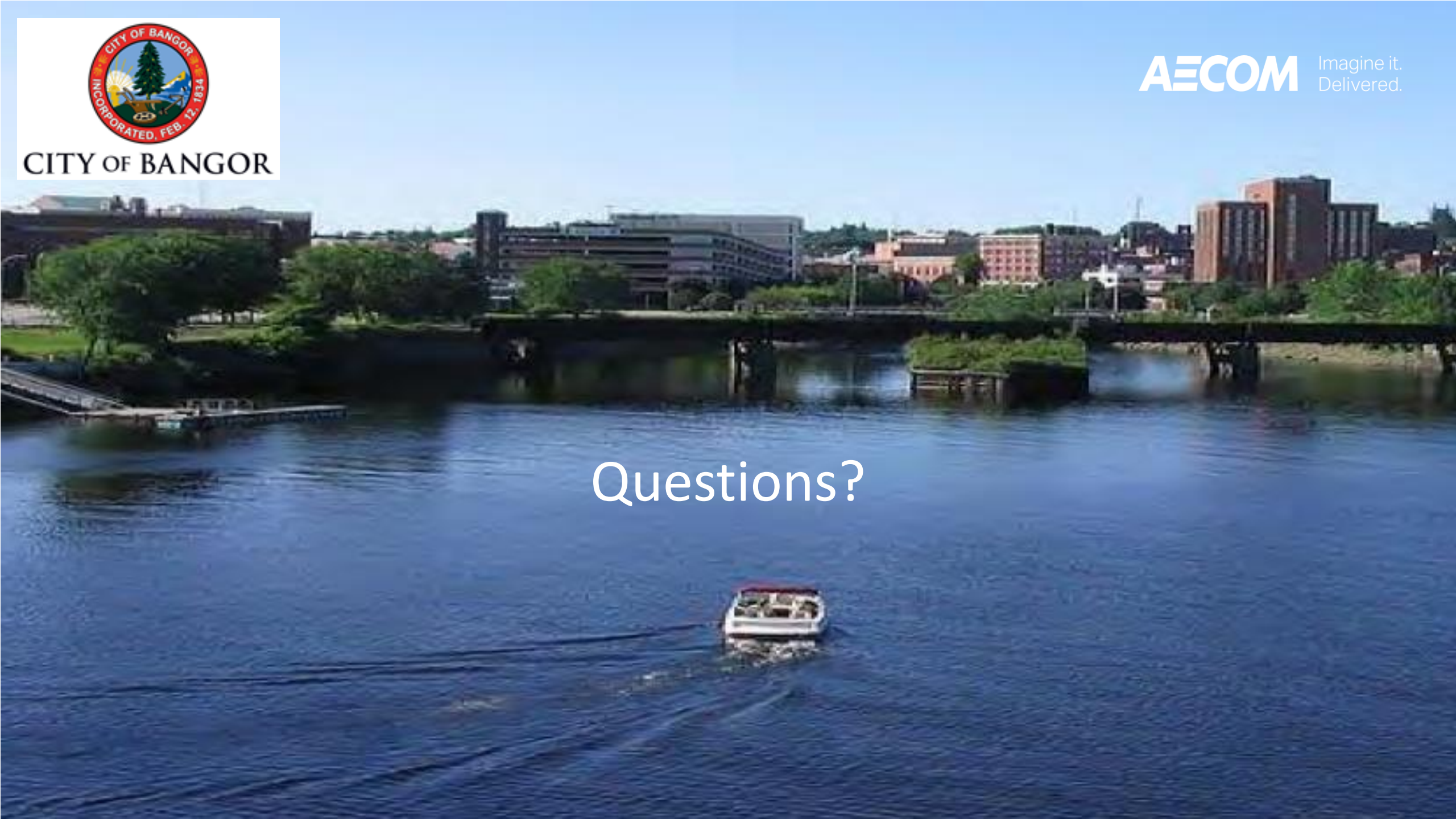

Questions?