CSO Plan Optimization Using SWMM

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CDM Smith

NEWEA – 2018 Annual Conference & Exhibit

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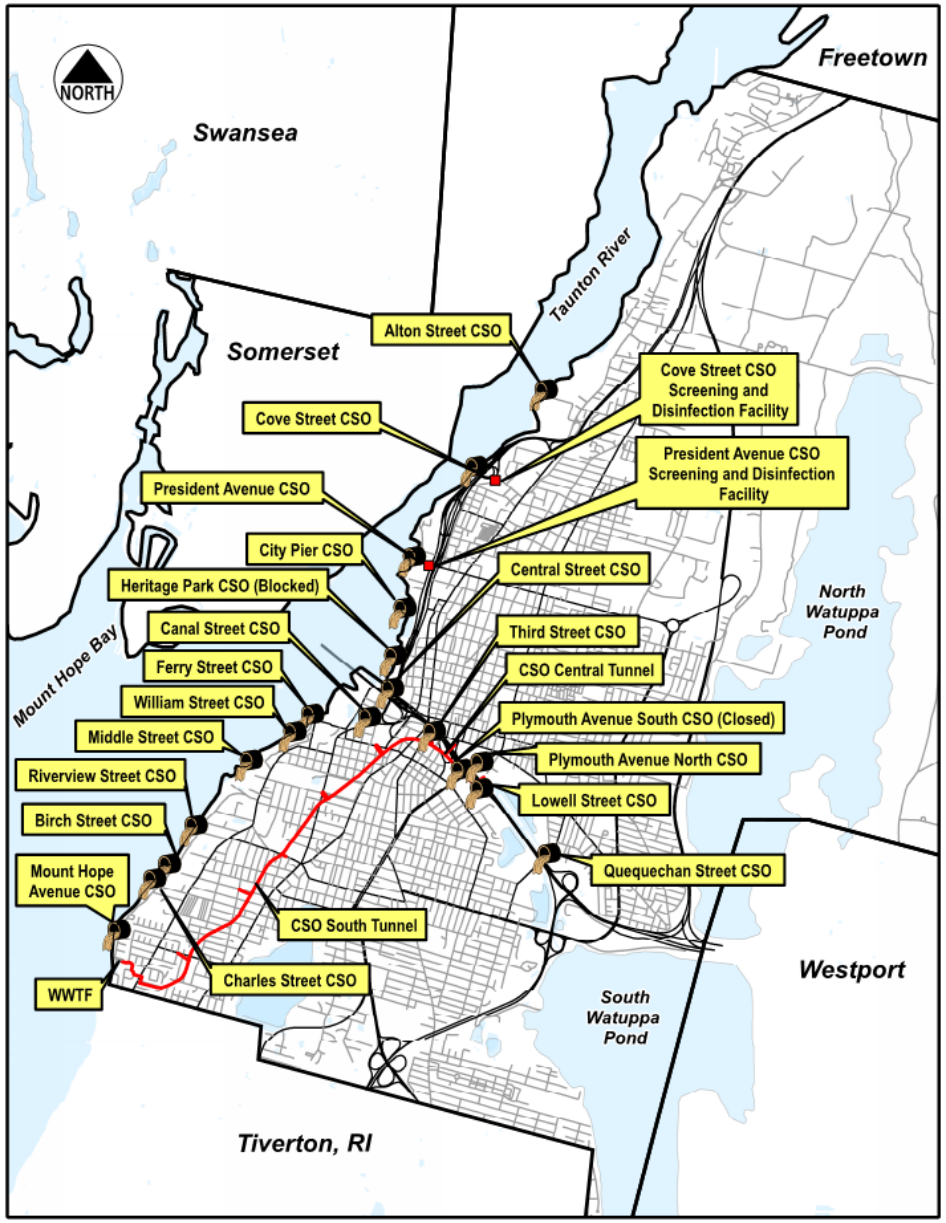
Background

- Federal Court Order – CSO Control
- EPA Administrative Order – CMOM and SSO Control
- $190M+ on CSO controls to date
  - WWTF wet-weather upgrade
  - CSO Storage Tunnel
  - Two CSO screening and disinfection facilities
  - Two pumping station upgrades
  - Quequechan Interceptor



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What Needs to be Done?

- 75% CSO reduction, but more control required in some areas
  - Address uncontrolled CSO Discharges (Alton Street/City Pier)
  - Additional CSO control (tunnel to shoreline)
- Accommodate potential future sanitary flows
- Address street flooding, SSOs, general infrastructure condition

Annual Average Overflow Statistics – Typical Year

CSO Outfall	1994 [1]		2017	
	Number of Events	CSO Volume (MG)	Number of Events	CSO Volume (MG)
North System (Taunton River)				
Alton Street	39	118	44	48
Cove Street (untreated)	43	136	4	16
President Avenue (untreated)	51	87	2	5
City Pier	53	93	53	94
Central System (Quequechan River)				
Quequechan Street	6	2	2	7
Lowell Street	28	29	2	17
Plymouth Avenue North	43	59	2	6
Plymouth Avenue South	blocked	0	sealed	0
Third Street	58	95	1	0.1
Central Street	32	24	4	0.6
Heritage Park	blocked	0	blocked	0
South System (Mt. Hope Bay)				
Canal Street	48	67	35	8
Ferry Street	84	261	49	34
William Street	4	1	2	2
Middle Street	67	53	15	14
Riverview Street	38	155	23	15
Birch Street	25	62	53	31
Charles Street	20	9	2	2
Mt. Hope Avenue	23	44	31	18
Total	**662**	**1294**	**324**	**318**

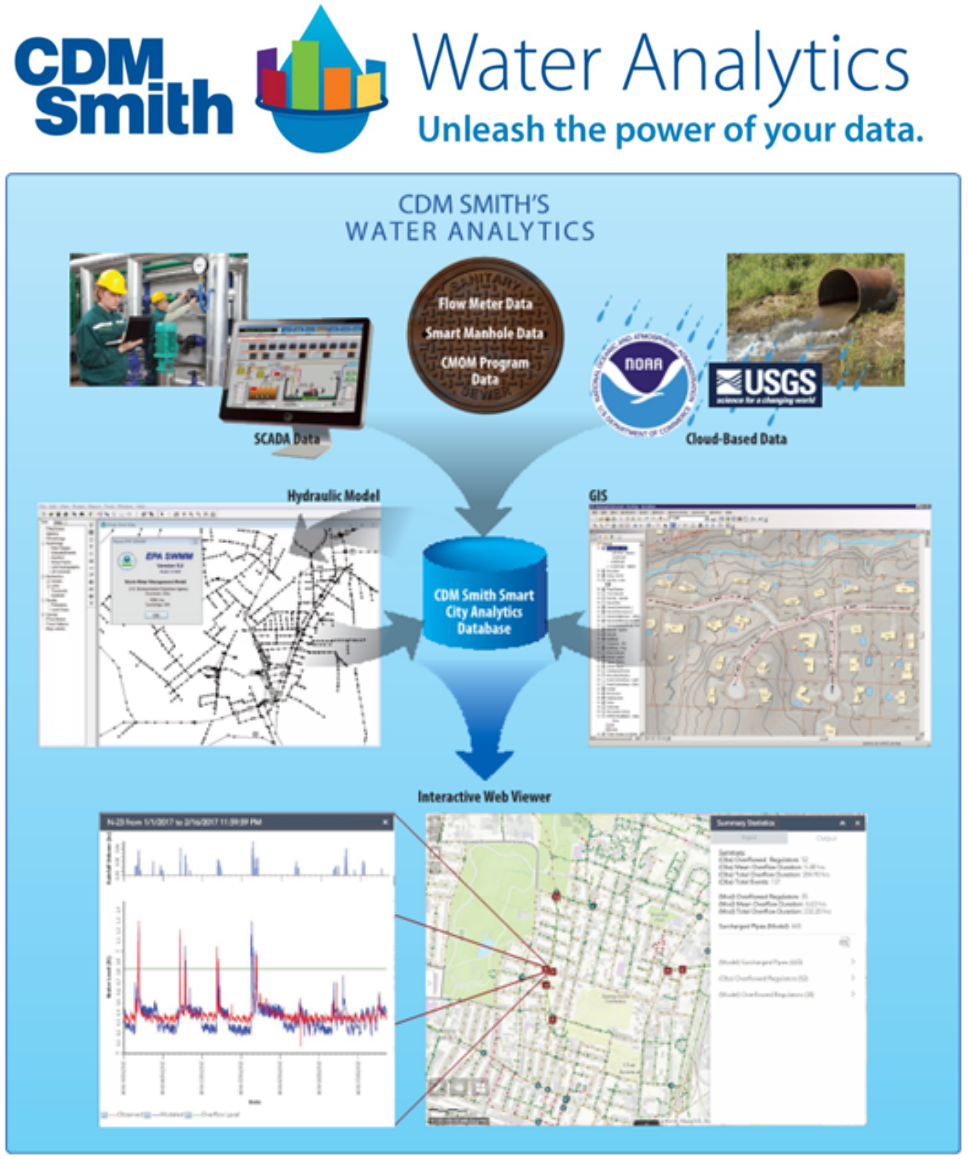
[1] from *Combined Sewer Overflow Abatement Program Final Environmental Impact Report* (CH2MHill/PBG&S Team, 1994)

CSO Facilities Plan – Goals

- Control 3-month storm CSOs to meet federal court order requirements
- Incorporate Integrated Master Plan recommendations
  - CSO Control
  - Infrastructure Renewal (CMOM/SSO)
- Optimize recommended improvements to minimize costs
- Create shovel-ready implementation plan

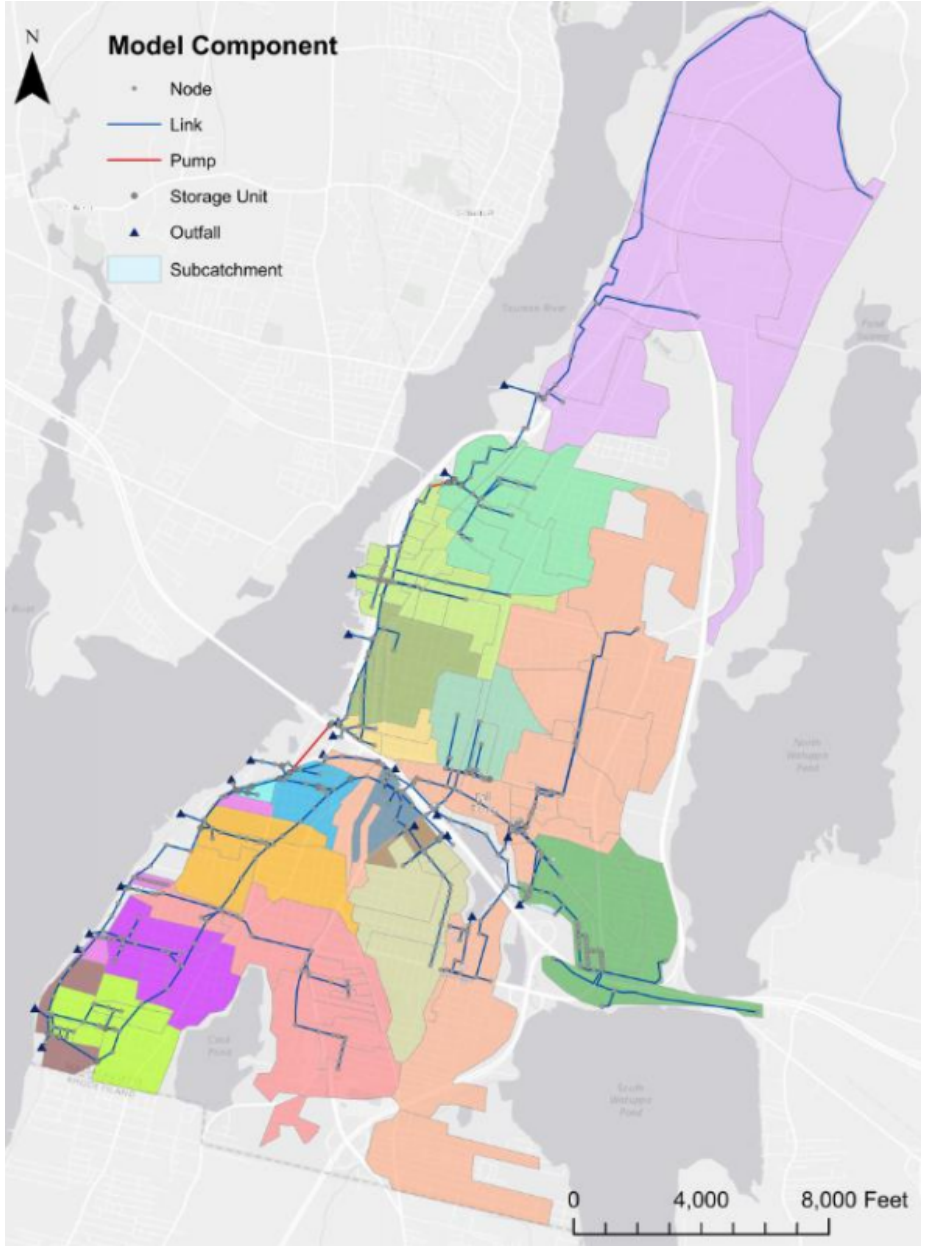
Goal Implementation

- Data Collection
  - CDM Smith's Water Analytics
  - Flow monitoring
  - Detailed aerial survey
  - GIS/Asset Inventory
  - Workshops with City
- Updating SWMM Model
  - Confirming record drawing information
  - Calibration with flow monitoring and other data
- Alternatives Development and Assessment



SWMM Model

- Model Verification
  - Confirm configuration with record drawings
  - Data from CDM Smith's Water Analytics and other sources
  - Compare model vs. real-time data
- Calibration Results
  - Good correlation with real-time statistics
  - Interceptor and pumping stations control in North System
  - CSO Tunnel provides required level of control for Central and upstream portions of South System
  - Limited additional control required for downstream portion of the South System



SWMM Model

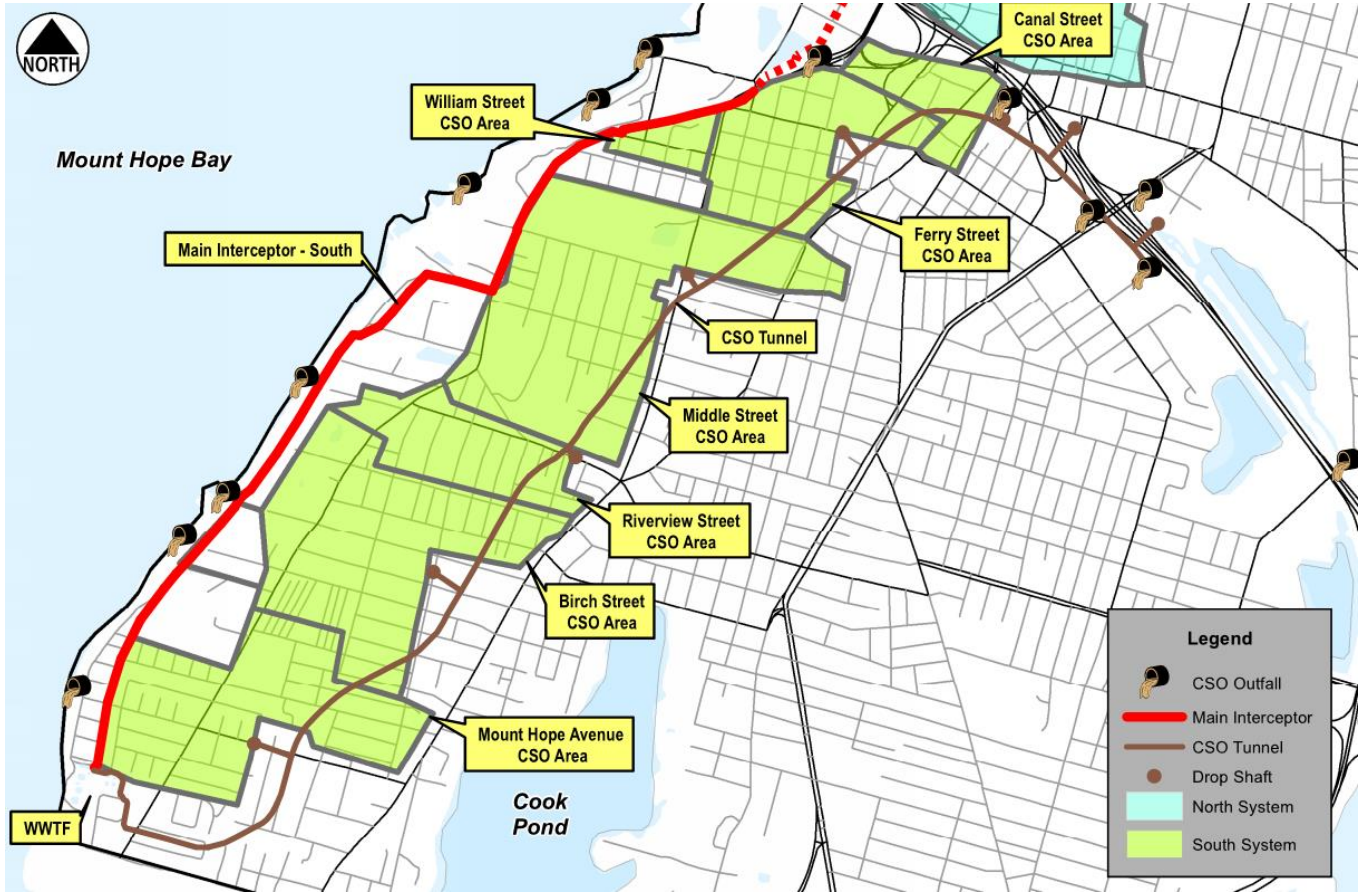
- Use in alternatives development
  - Quickly assess impacts and benefits
  - Provides global system overview
- Lower-cost improvements
  - Cleaning Interceptor of debris
  - Raising regulator weirs
  - Limited infrastructure upgrades
- Infiltration removal ineffective
- Sewer Separation
- Additional Controls
  - Wet-weather Storage
  - Wet-weather/relief sewers
  - Additional pumping capacity
  - Increased pipe capacity

CSO Outfall	Lower-cost Improvements	Infiltration Removal	Sewer Separation	Storage	Wet-weather/ Relief Sewers	Additional Pumping	Increased Pipe Capacity
North System (Taunton River)							
Alton Street	P	X	P	P	P	P	P
Cove Street	*** TREATED ***						
President Avenue	*** TREATED ***						
City Pier	X	X	P	P	P	P	P
South System (Mt. Hope Bay)							
Ferry Street	✓	X					
William Street	✓	X					
Middle Street	✓	X					
Riverview Street	✓	X					
Birch Street	P	X	P	P	P		P
Charles Street	✓	X					
Mt. Hope Avenue	✓	X					

Legend: ✓ Yes; X No; P Partial

South System

- Modeled Conditions
  - Interceptor cleaning
- Improvements Needed
  - Raise weirs at Mt. Hope Ave., Birch St. and Columbia St. regulators to optimize interceptor HGL
  - Larger interceptor connection or minimal sewer separation at Birch St.
  - Sewer separation at Middle St. to address existing flooding issue
- Anticipated Benefits
  - Minimal capital improvements to meet 3-month storm control
  - Increase in Interceptor storage capacity



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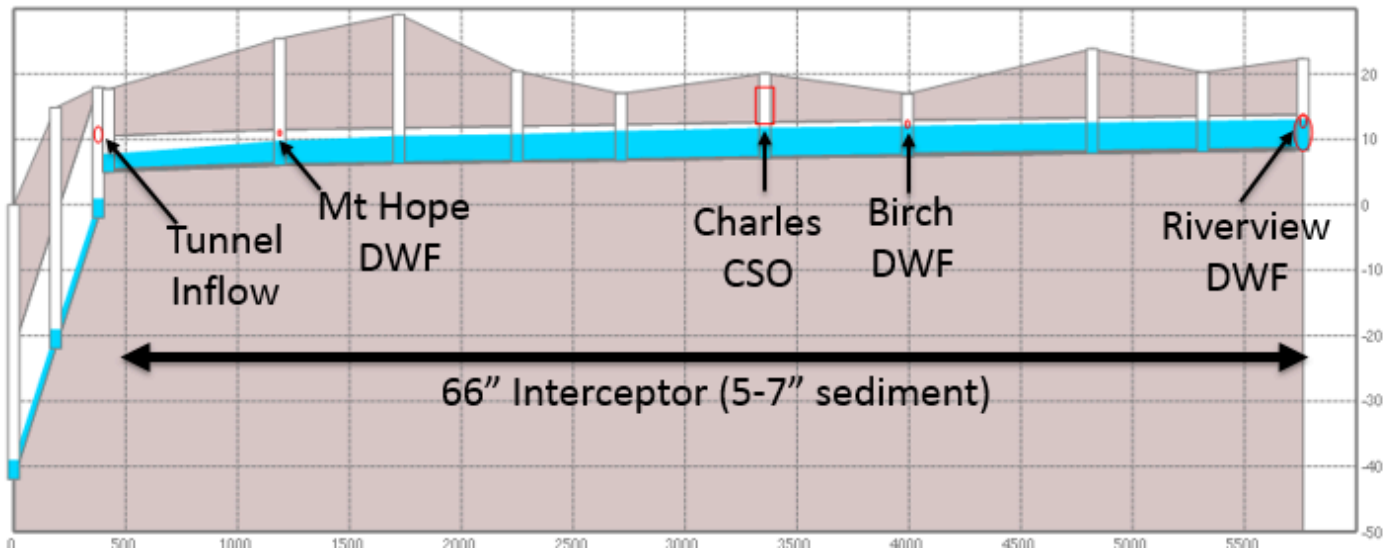
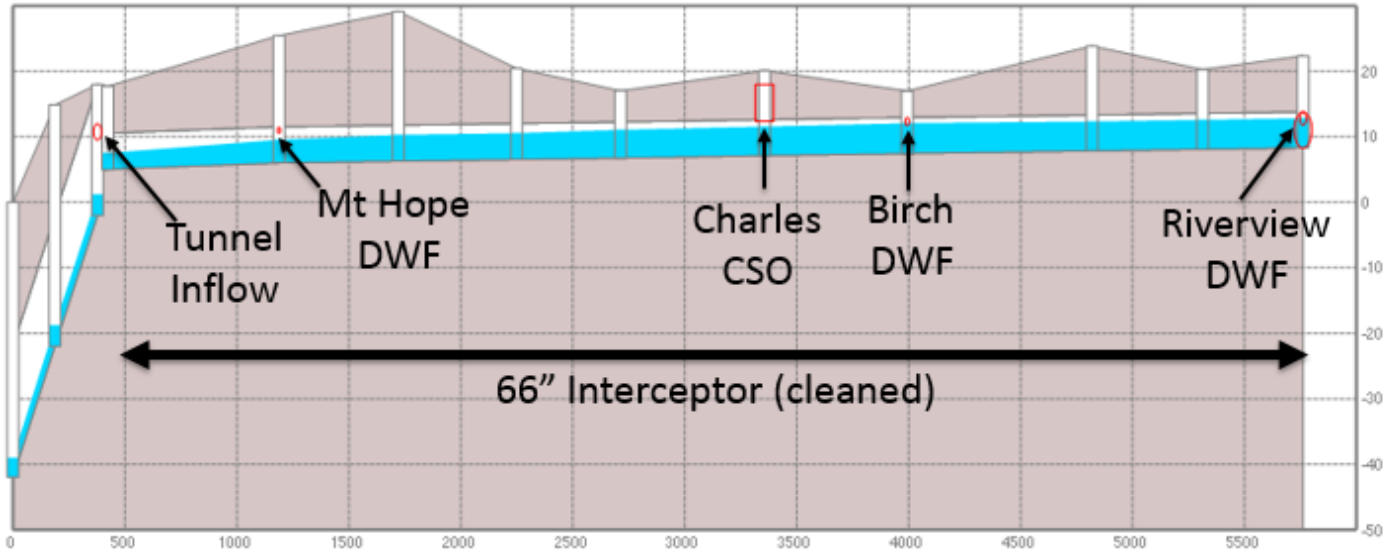
South System

- Minimal work needed

Before



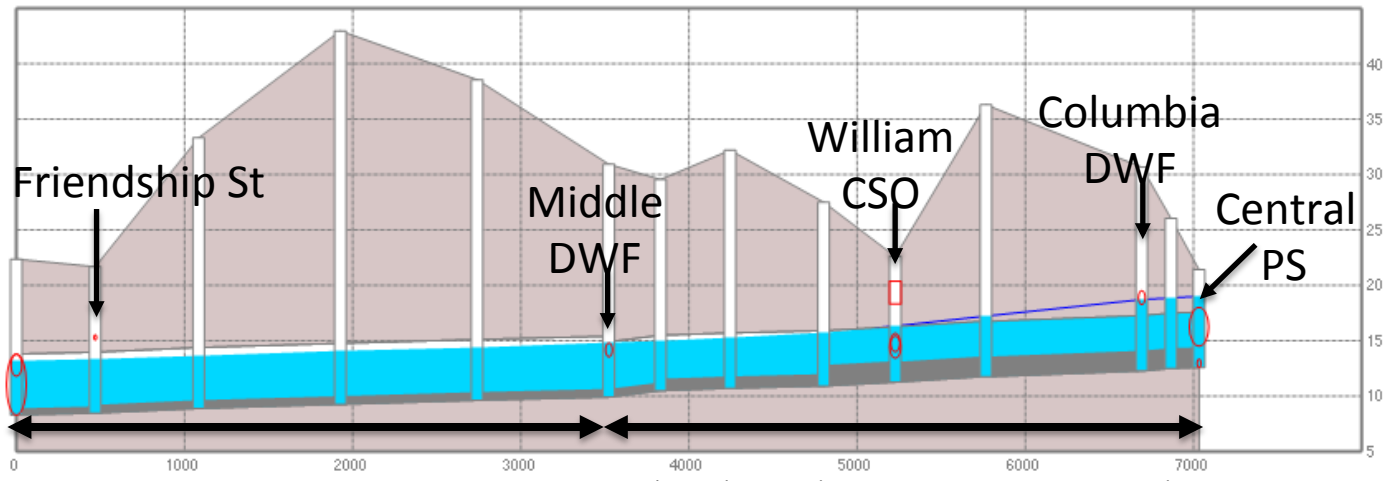
After



South System, continued

- Interceptor cleaning
- Minimal additional work needed

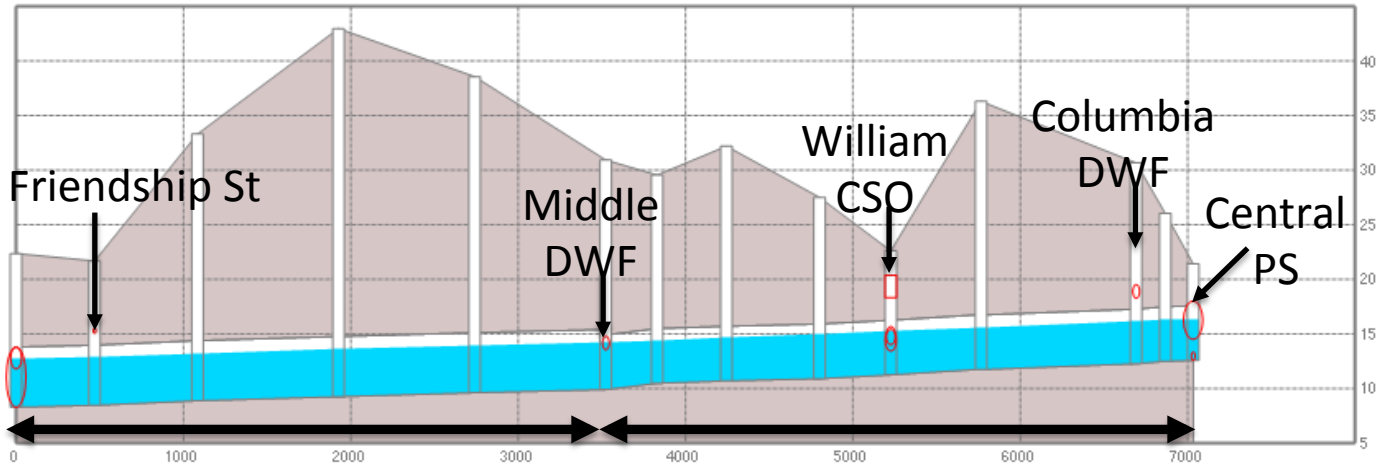
Before



66” Interceptor
(7-8” sediment)

60” Interceptor
(8-23” sediment)

After

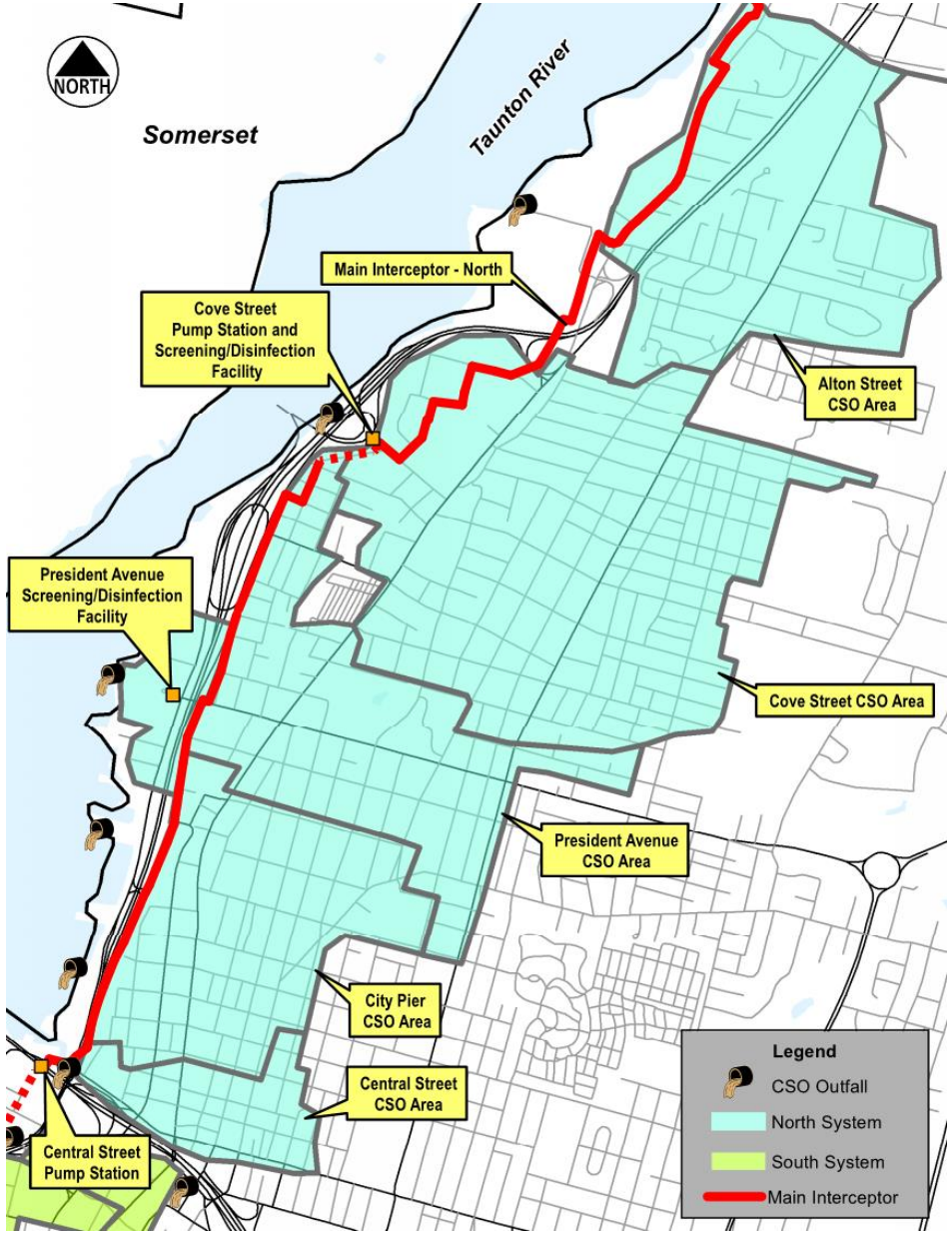


66” Interceptor (cleaned)

60” Interceptor (cleaned)

North System

- Trickier to address!
- Overflows related to interceptor HGL
  - Downstream pump station (tailwater)
  - Interceptor pipe capacity issues in areas
  - Tidal influences
- Less expensive options have limited results
  - Interceptor cleaning, infiltration removal = minimal impacts
  - Raising regulator weirs = negative impacts



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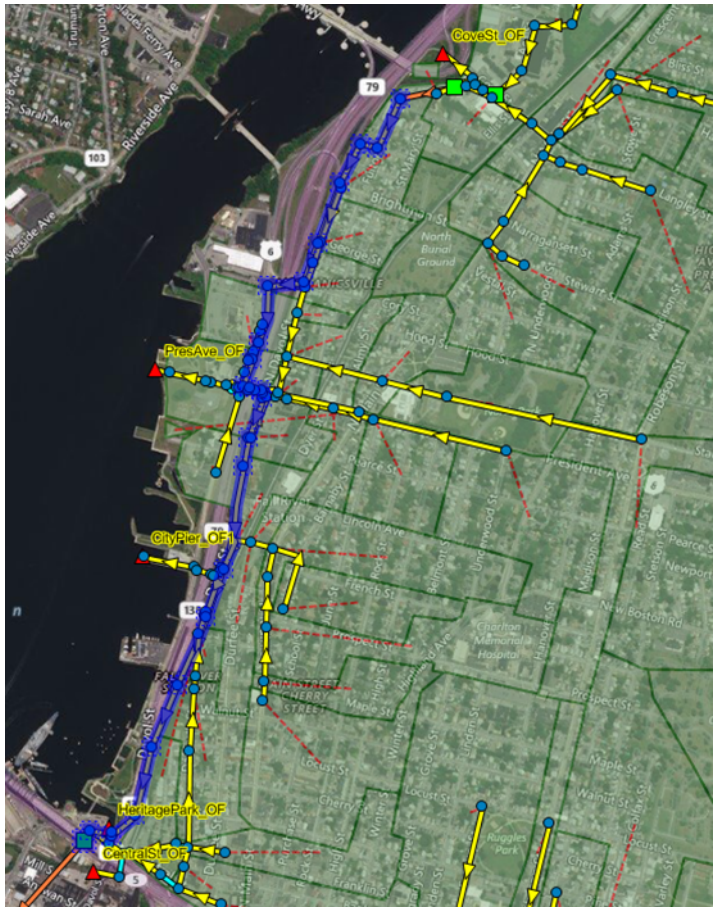
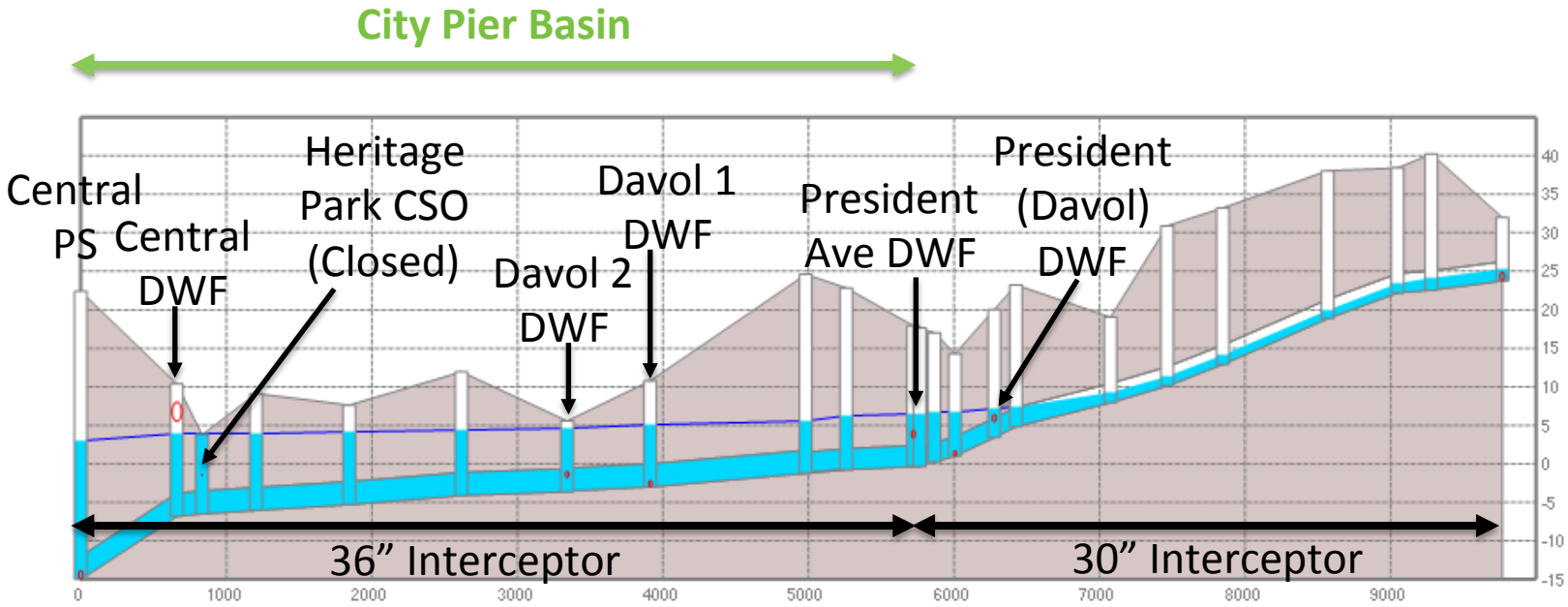
North System



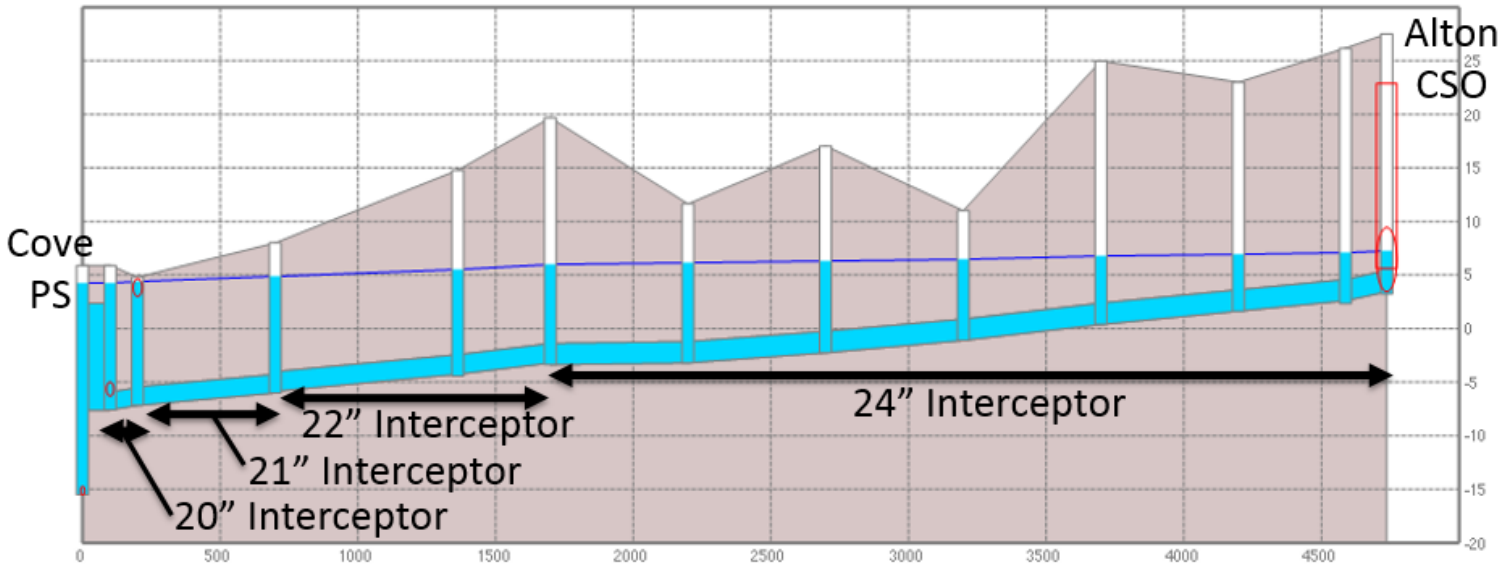
- Tailwater from Central Street pumping station controls interceptor HGL
- Street flooding in low lying areas in larger storms



North System

- Tailwater from Cove Street pumping station/CSO facility controls interceptor HGL
- Interceptor restriction upstream of Cove Street pumping station/CSO facility

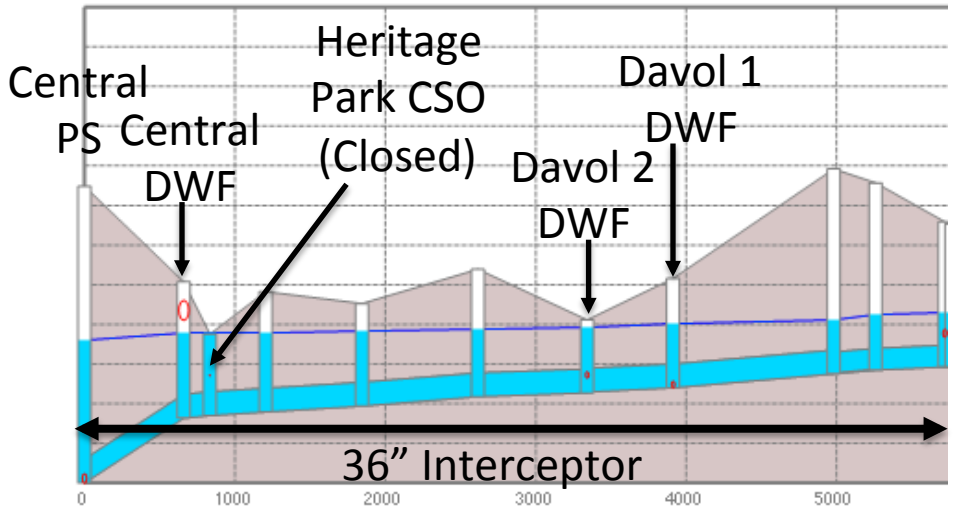
Alton Street Basin



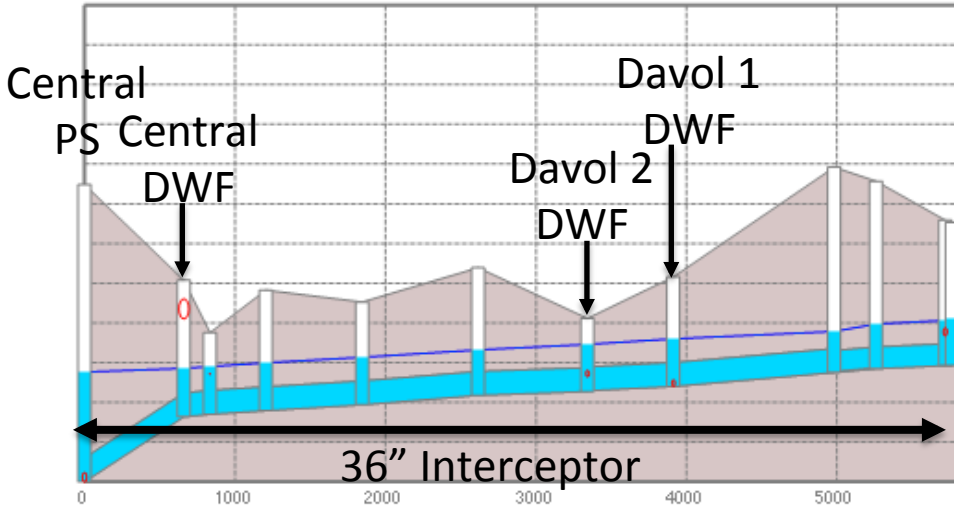
North System

- Sewer Separation
  - Expensive
  - Not enough for CSO control >> requires additional infrastructure
  - Difficult to disconnect private inflow (downspouts/sump pumps)
- Green Infrastructure
  - Limited space/steep slopes/bedrock

City Pier – Existing Conditions



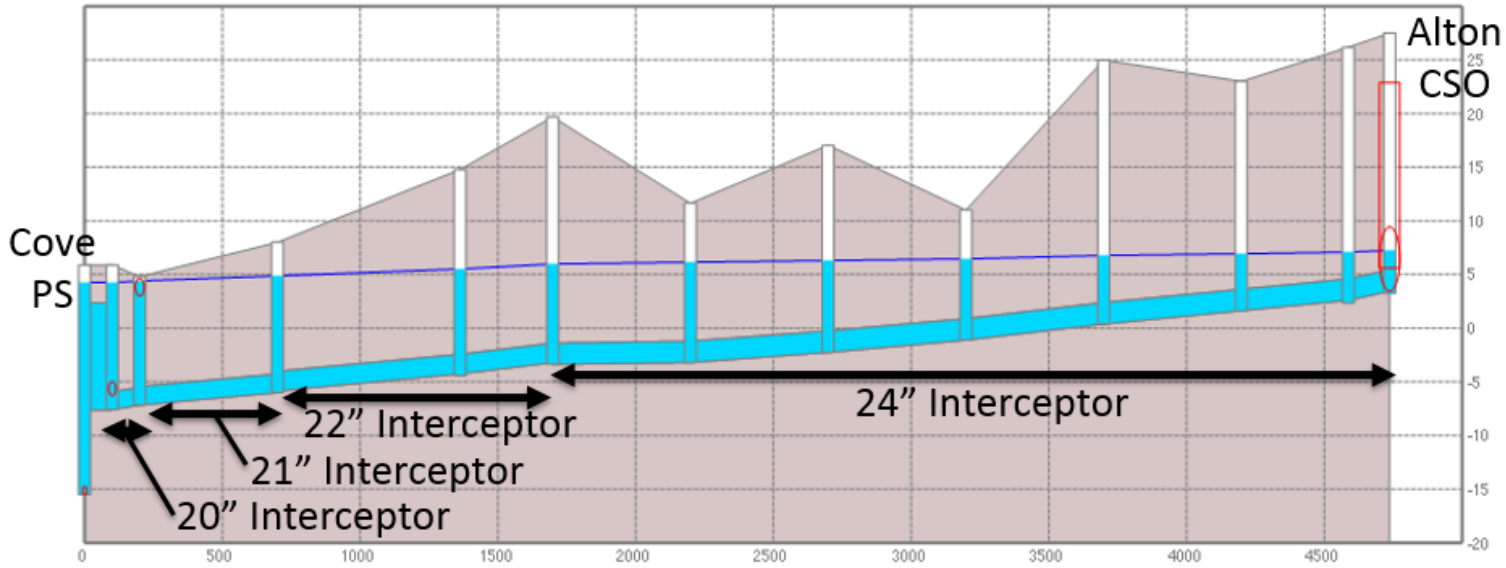
City Pier – Sewer Separation



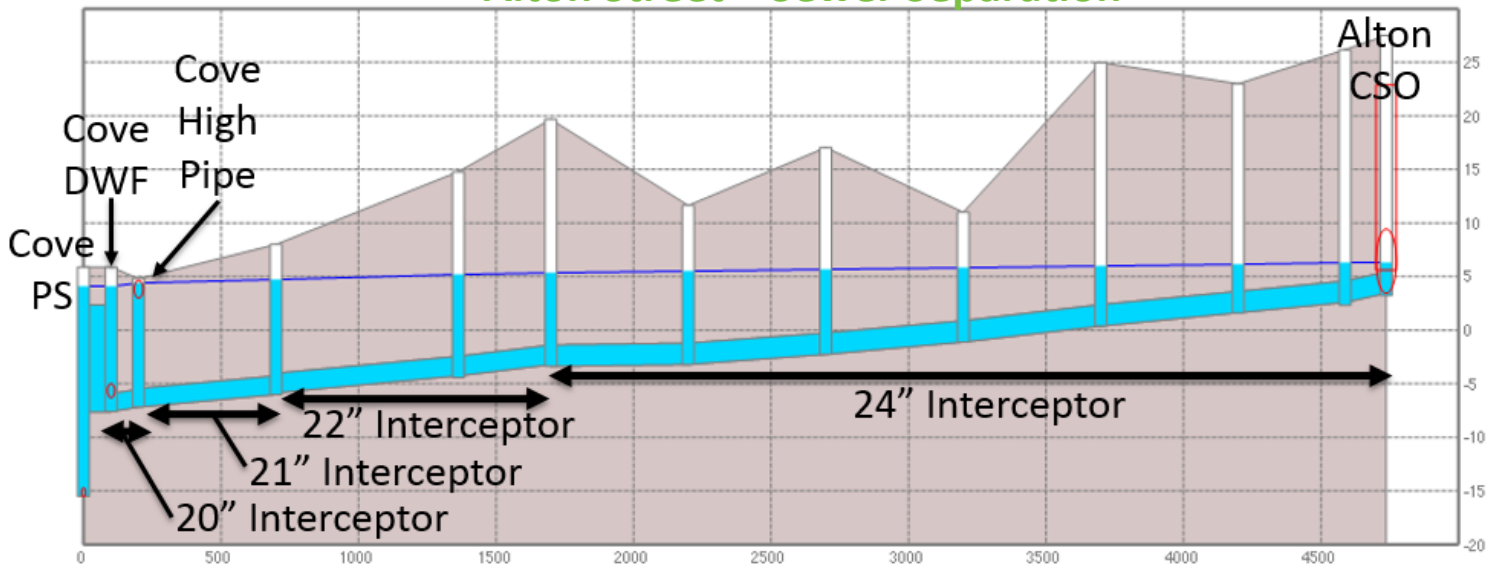
North System, cont.

- Start looking at other options
  - Storage (off line/in line)
  - Pump Station (New or Upgrade)
  - Parallel Relief Sewers

Alton Street – Existing Conditions



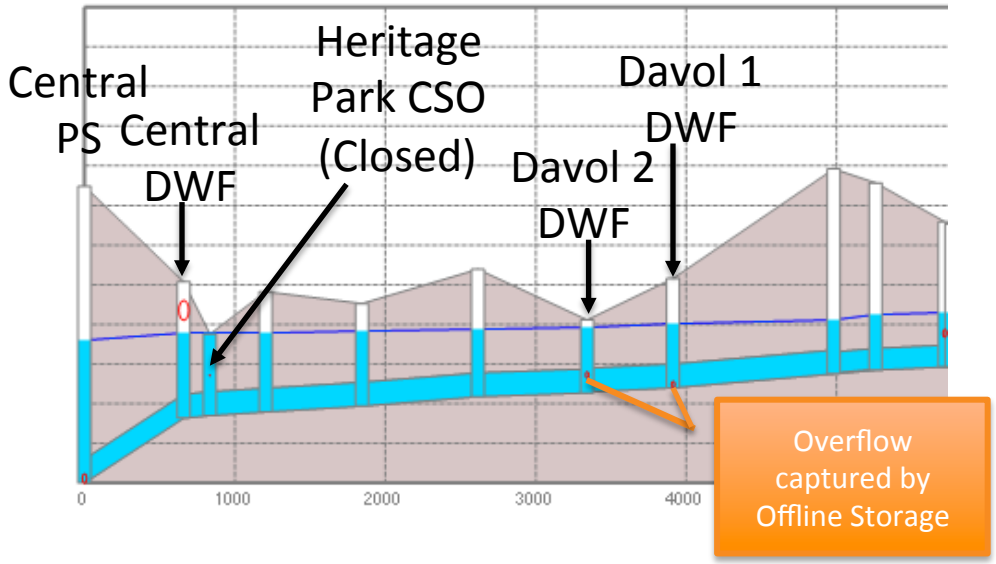
Alton Street – Sewer Separation



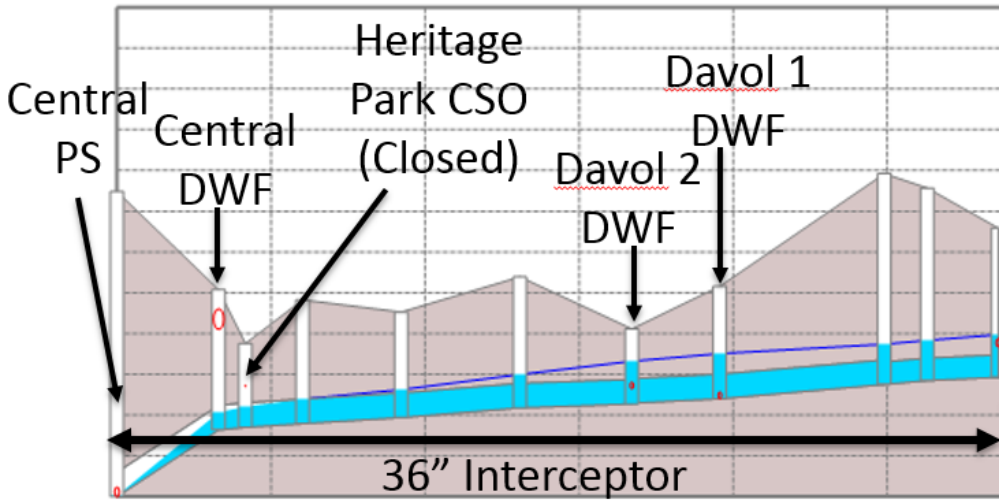
North System – City Pier

- Storage
  - 5.0 MG Storage Only
  - 0.4 MG Full Separation
- Pumping Station Upgrades
  - Upgrade pumping capacity from 15 MGD to 28 MGD
  - Additional Interceptor upgrades still needed

City Pier – Storage



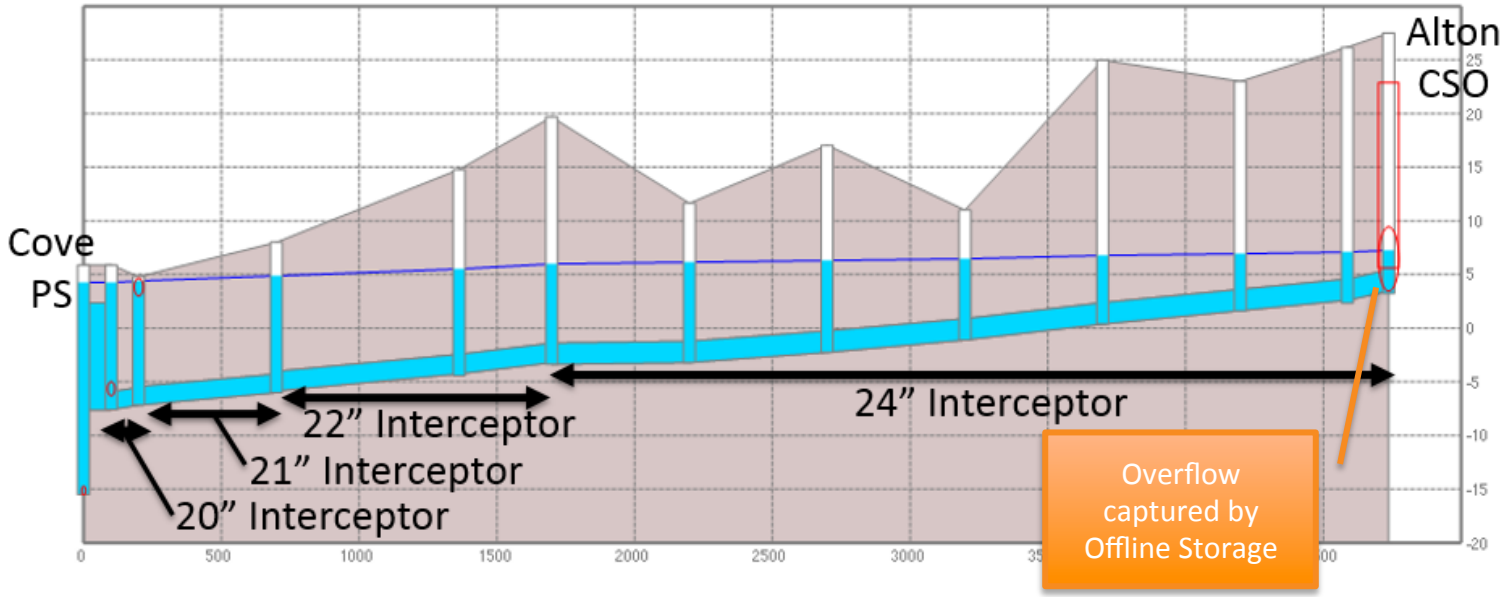
City Pier – Pumping Station Upgrades



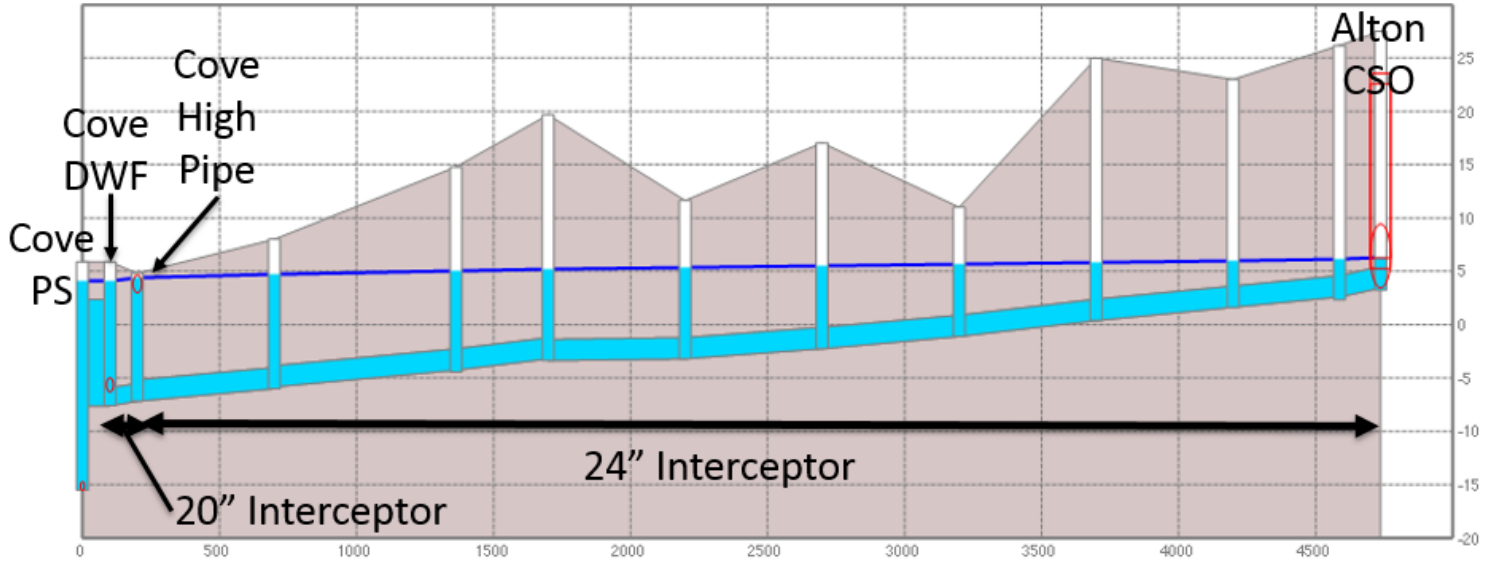
North System – Alton St.

- Storage
  - 1.4 MG Storage Only
  - 0.8 MG Full Sewer Separation
- Pumping Station Upgrades
  - Auxiliary pumping station capacity of 7 MGD
  - Upgrade Interceptor capacity
  - Raise weir 0.5 feet

Alton Street – Storage



Alton Street – Pumping Station Upgrades



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What's Next?

- Use of the SWMM model to:
  - Refine alternatives
  - Look at larger storm impacts
  - Look additional needs (phasing) to address future flows
- Evaluate effectiveness to solve non-CSO issues
  - SSOs/street flooding
  - Infrastructure renewal (I/I removal, tidal influences)
- Find cost-effective balance of multiple CSO controls

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Questions?

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SWMM Model Development Timeline

1993 CH_2M Hill develops XPSWMM model for the City's CSO Facilities Plan.

2006 CDM Smith develops sub-model for Cove Street drainage basin to support design of Cove Street CSO Screening and Disinfection Facility (SDF).

2011 CDM Smith expands Cove Street model to include President Avenue drainage basin for President Avenue SDF design. Model calibrated to monitoring data collected in April and May 2010.

2012 CDM Smith combines models and converts to SWMM5 and calibrates to monitoring data collected July to October 2012. Model used to support *CSO Control Plan Update Report.*

2015 CDM Smith updates and expands the system-wide model to support the *Integrated Wastewater and Stormwater Master Plan*. Model is calibrated to overflow and WWTF monitoring data collected during 2013-2014.

2017 CDM Smith updates and calibrates system-wide model to monitoring data collected August to October 2017.

2018 CDM Smith completes alternative analysis with calibrated model for *Conceptual CSO Plan.*

Alternatives Evaluation

- Only evaluate feasible alternatives
- Evaluation Process
  - Combination of Qualitative and Quantitative Criteria
  - Higher priority criteria given higher weighting
  - Scores range from 2 to -2 for each criteria
- Cumulative score places emphasis on cost-effective alternatives

Environmental

- Water Quality
- Adaptability
- Flooding/SSOs

Social

- Public Health and Recreation
- Neighborhood Improvements/ Economic Development
- Post-Construction Impacts

Economical

- Life Cycle Costs
- Cost per Gallon of CSO Captured
- Infrastructure Renewal

Institutional

- Administration Considerations
- Phasing Flexibility
- Permitting Complexity

Construction Impacts

- Traffic, Noise, Dust, & Odors
- Constructability
- Short-term Environmental Impacts

Contact us!

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- SCADA
- GIS/Asset Data
- Rainfall and Groundwater Data
- Flow Monitoring
- Regulator Investigations
- City CSO Overflow Data
- Record Drawings
- Record Boring information
- Aerial Photography/Topography
- Future Development
- Recent Development

Agenda

- Background
- CSO Facilities Plan
- Model Summary and Updates
  - Development Timeline
  - Data Collection
- CSO Optimization
  - SWMM Model
  - Evaluation Criteria Assessments
  - Cost/Benefit Evaluation
- Plan Preparation