Hull Wastewater Treatment Facility (WWTF) Coastal Resiliency Measures

Hull, Massachusetts

Public Informational Meeting

March 11, 2021

Project funded in part through Coastal Resilience Grants from the Massachusetts Office of Coastal Zone Management

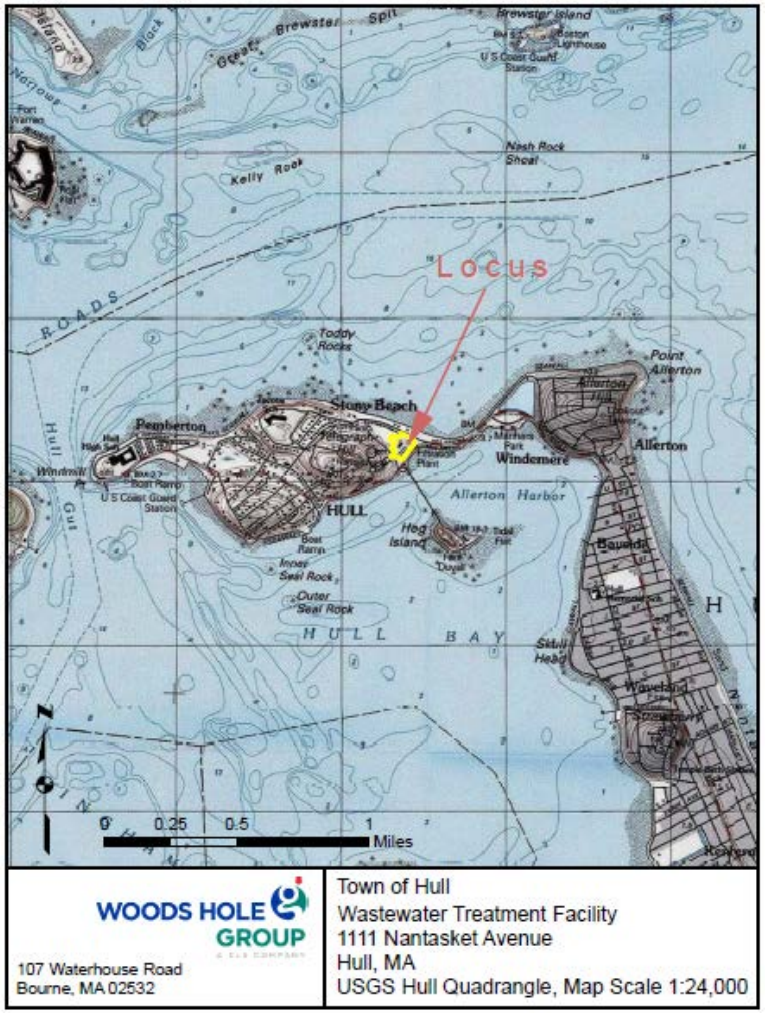
Agenda

1. Project Summary
2. Need for Project
3. Flood Modeling
4. Project Design
5. Regulatory Path
6. Questions

March 11, 2021 Public Meeting

Project Location Background

- Town of Hull is a coastal community on the south shore of Massachusetts with ~10,000 permanent residents and ~15,000 seasonal residents.
- Located between Hingham Bay & Hull Bay on the west and Massachusetts Bay.
- Located adjacent to the Historic Hull Life Saving Museum and Hull Cemetery, part of the Hull Historic District.
- Since 1999, Hull has experienced twenty-two (22) natural hazards that triggered federal or state disaster declarations. NFIP has paid out over $15M to policy holders in town for flood related property damages since 1978.



Wastewater Treatment Facility

Project Need

- WWTF (red outline) is at high risk from storm flooding since the facility is on a low lying, narrow peninsula surrounded by coastal and tidally influenced waters.
- Project funded with a FY 2020 and FY 2021 Coastal Zone Management (CZM) Coastal Resiliency Grants.
- The WWTF received the highest "consequence of failure score" of the Town's critical assets in the Climate Change Vulnerability Assessment and Adaptation Study (Kleinfelder, 2016).
- A 2013 event $7M in damages that the facility has still not completely recovered from.
- January and February 2018 storms caused extensive flooding of the facility as shown by the photos on the following slides.

2018 Storm Events (January and March)

View towards Nantasket Avenue

View towards Hull Cemetery and Lifesaving Museum

View towards Spring Street

Actions Taken To Mitigate Flood Risk By Town of Hull

- The Town of Hull and WWTF recognizes its flood risk and has taken steps to plan for current and future storms.
- In process of moving electrical utilities in the control building to a higher floor out of the regulatory floodway.
- Replaced 40-year-old underground storage tank (UST) with an above ground storage tank (AST) elevated above the design flood elevation factoring in future sea level rise.
- Upgraded an electrical transformer with a CZM Resiliency Grant to a design flood elevation factoring in future sea level rise.
- Currently designing flood protection around the perimeter of the facility.

Wetlands Delineation

- Saltmarsh plants (*Distichlis spicata* and *Juncus gerardii*) and habitat in vicinity of culvert inlet (inside green line)
- Transitions into Bordering Vegetated Wetland (BVW) between green & white lines (majority of the marsh)
- Confirmed boundary of marsh by identifying plants, flooding, & soils
- Observed minimal, intermittent backflow through the primary culvert at high tide
- No wetlands on WWTF facility itself

2019 Wetland Delineation

Project Impacts to Resource Areas

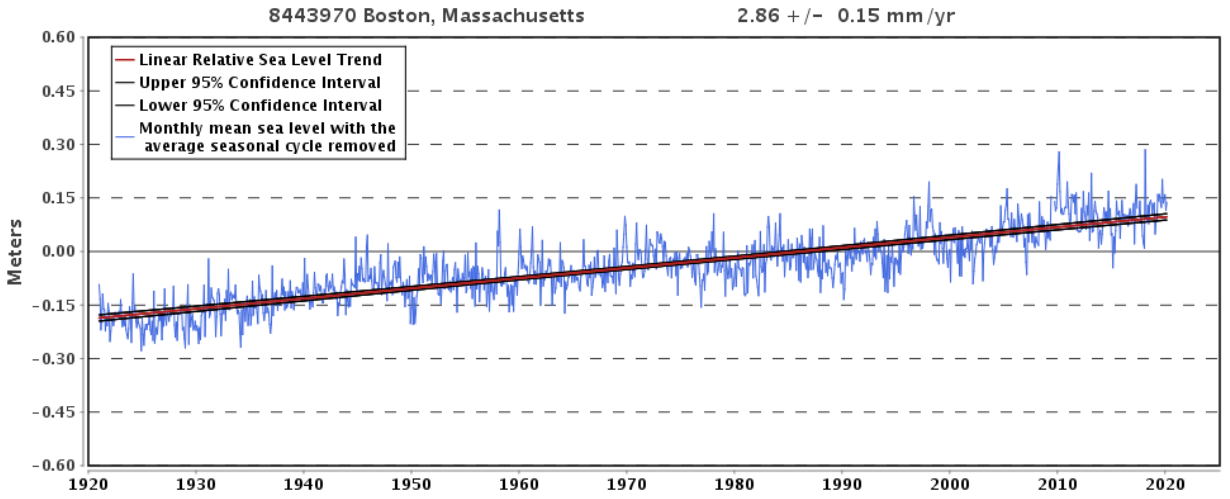
Coastal Resource Area Impacts: February 2021 Update

	Temporary Impacts (sq.ft)	Permanent Impacts (sq.ft)		
Jurisdictional Areas			**Mitigation**	**Net**
100' Wetland Buffer Zone	0	25,274	N/A	N/A
Filled Tidelands (Ch. 91)	0	63,757	N/A	N/A
Landlocked Tidelands (outside of Ch. 91)	0	18,491	N/A	N/A
Resource Areas				
Barrier Beach - Coastal Dune	0	5,732		
BVW	0	0		
Salt Marsh	0	0		
Land Subject to Coastal Storm Flowage	0	118,298		

Future Sea Level Rise (SLR)

Historical measured sea level rise trends at Boston Station 8443970 (top).

Projected future SLR values compared with historical projections (bottom).



Year	Sea Level Rise (feet)	
	RCP 8.5*	NOAA Boston
Present Day	0	0
2030	1.33	0.09
2070	4.48	0.47

*Representative Concentration Pathway (RCP) 8.5 based on greenhouse gas concentration trajectories developed by IPCC specifically for Massachusetts.

Modeling Results

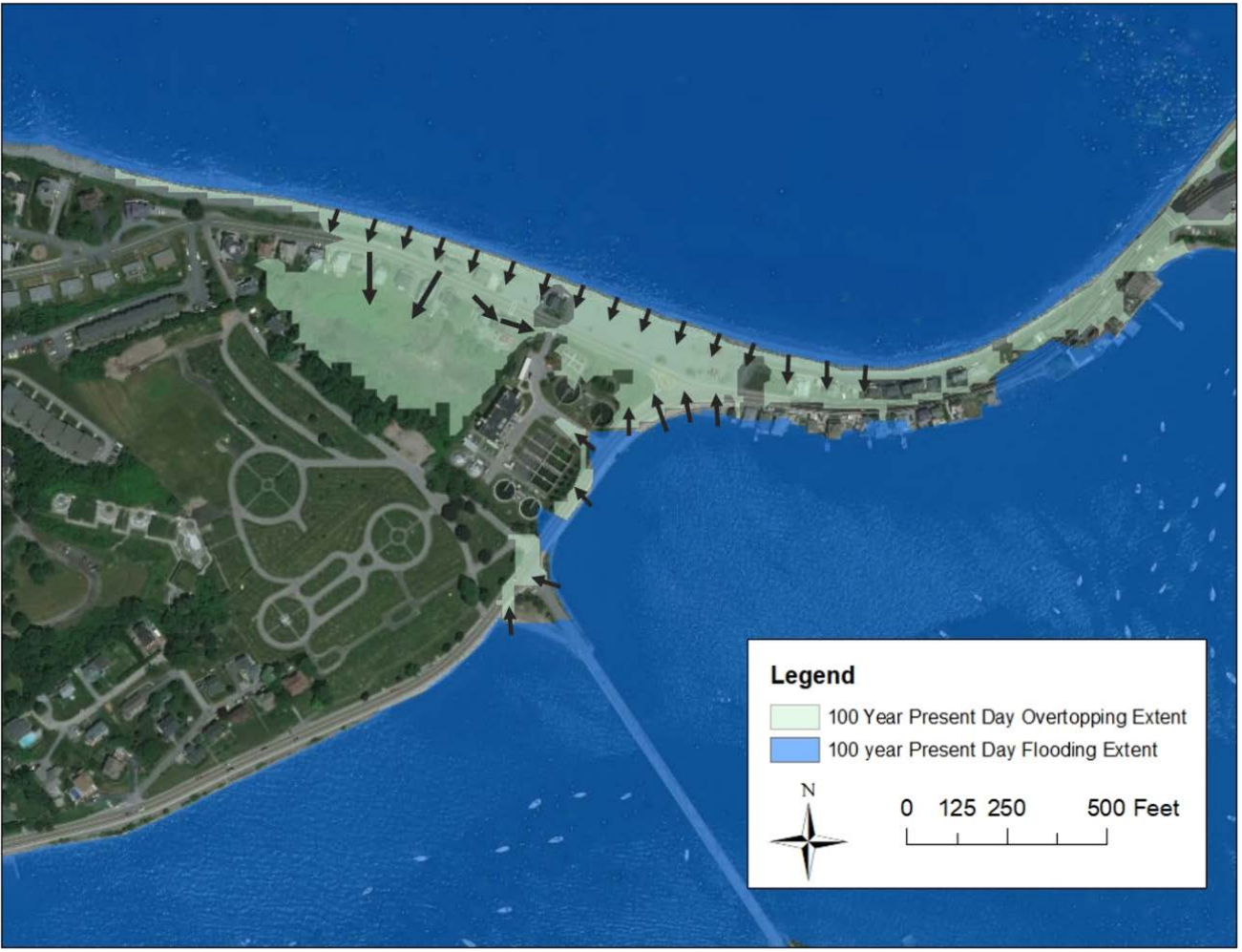
Modeling Methodology

4 Step Modeling Approach

- Coupled ADvanced CIRCulation (ADCIRC) and Simulated WAves Nearshore (SWAN) models were used to transform offshore waves and water levels to the coast.
- The ADCIRC/SWAN waves and water levels at the coast were used to calculate overtopping rates for the structures using the EurOtop Manual (2018).
- Finally, the Coastal Modeling System Flow Model (CMS-Flow) was utilized to model the hydrodynamics of the overland flow of the overtopping.
- There were five storm scenarios considered along with future SLR as shown in the table.

Return Period Storm Scenario (years)	Maximum Stillwater Level Elevation (NAVD88-feet)
100-yr in Present Day	8.97
100-yr in 2030	10.30
100-yr in 2070	13.45
500-yr in Present Day	9.89
500-yr in 2070	14.37

Flooding Inundation Map: Present Day 1% (100 yr) Storm for Existing Conditions



Model Details

- 1% Annual Chance (100 year) Storm Conditions.
- Significant wave overtopping of the oceanside revetment (green), flows into the wetland & along Nantasket Ave.
- Primarily stillwater flooding (blue) on bayside flows onto Spring Street & plant entrance.

Flooding Inundation Map: 1% Chance (100 yr) Storm with Future SLR for Existing Conditions

Year 2030 – Overtopping Flooding Dominate

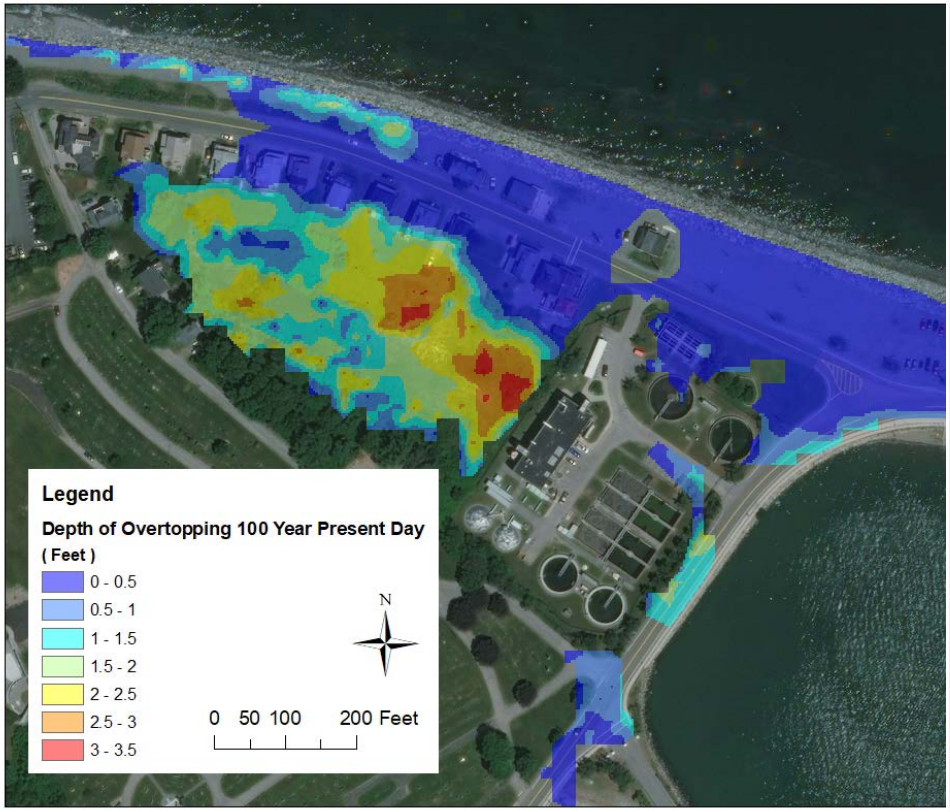
Year 2070 – Surge Flooding Dominate

Flooding Inundation Map: 1% Chance (100 yr) Storm in 2030 for Existing versus Proposed Conditions

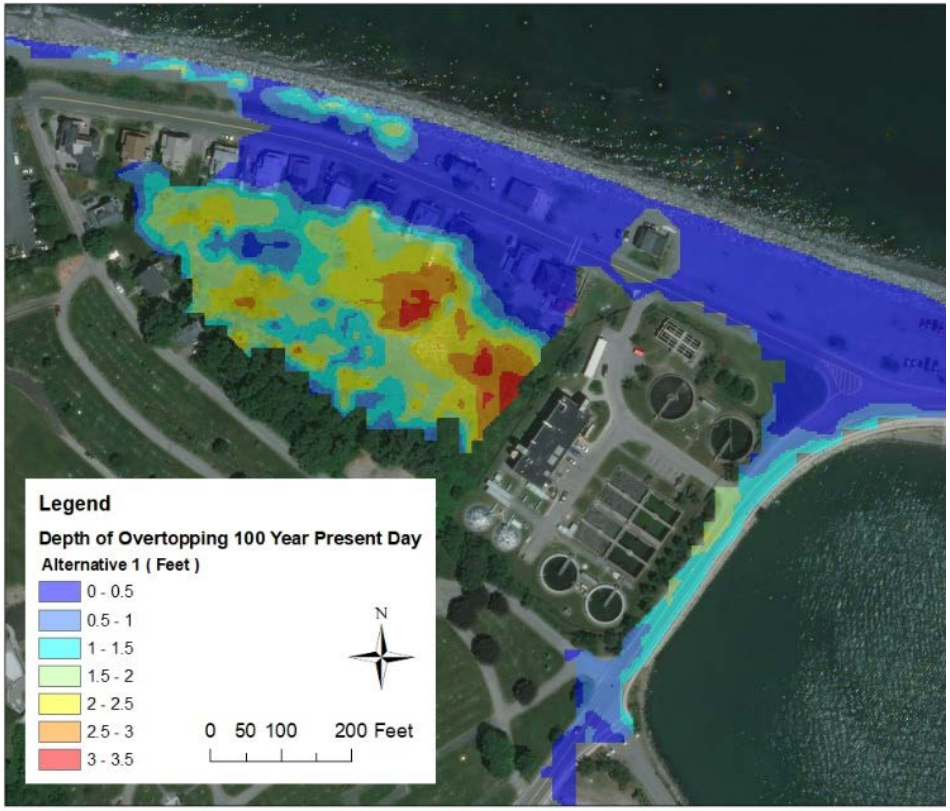
1% Storm in 2030 for Existing Conditions

1% Storm in 2030 for Alternative 1 (Crest 17 ft-NAVD)

Side by Side Comparison: Present Day 1% (100 yr) Storm for Existing and Proposed Conditions



Existing Conditions



Proposed Conditions (Alt. 1)

DFE's and Perimeter Treatment Dimensions

Flooding Difference Map for 100 yr Storm in 2030

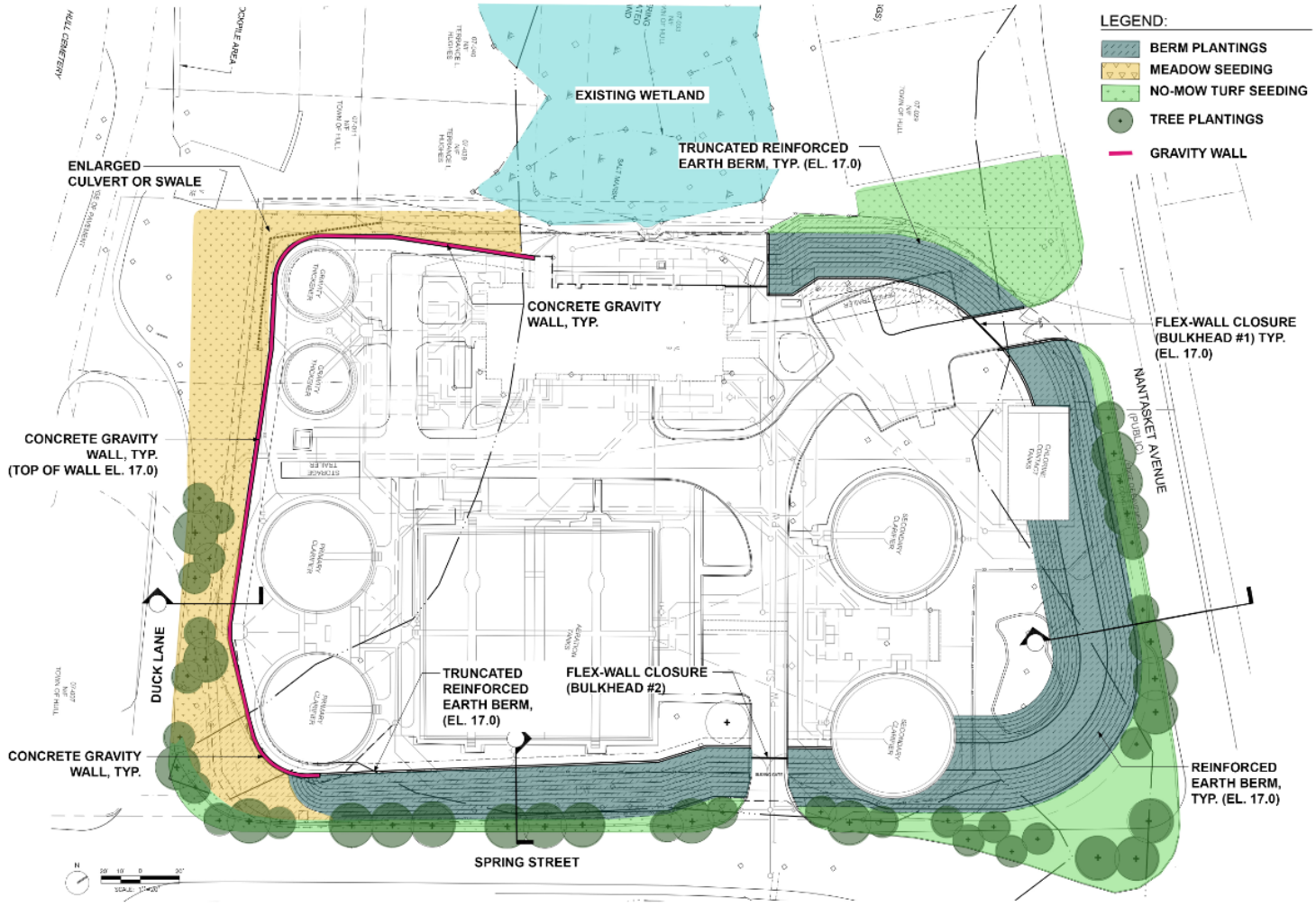
- No additional flooding within the wetland area.
- Reduction of flood on plant property (green).

Refinement of the Design Flood Elevations

Elevation Crest (feet NAVD88)	Elevation Crest (feet NAVD88)	Level of Protection (Return Period)			
		2030 Planning Horizon		2070 Planning Horizon	
		Moderate Overtopping	Significant Overtopping	Moderate Overtopping	Significant Overtopping
13	3	100-yr	1000-yr	2-yr	20-yr
14	4	500-yr	None	10-yr	50-yr
15	5	1000-yr	None	20-yr	100-yr
16	6	Full Protection		50-yr	200-yr
17	7	Full Protection		100-yr	500-yr
18	8	Full Protection		200-yr	None
19	9	Full Protection		500-yr	None
20	10	Full Protection		Full Protection	

Proposed Project

Flood Protection Design: Combination Vegetated Reinforced Berm, Truncated Berm, and Gravity Wall

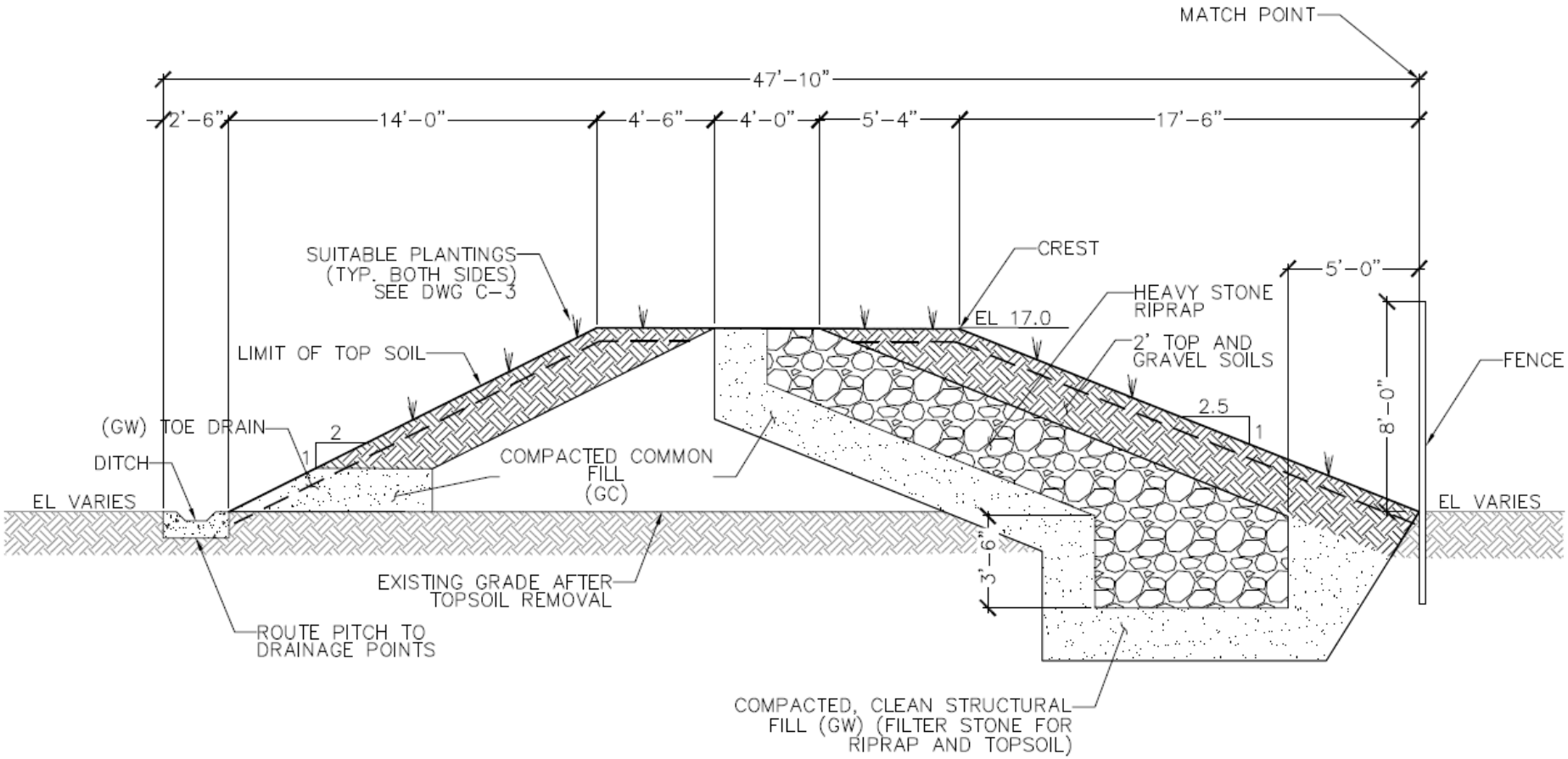


- Vegetated Reinforced Berm along Nantasket Avenue.
- Truncated Reinforced Berm along Spring Street.
- Gravity Wall along Duck Lane and wetland.
- Integration of Control Building Rear Wall into design.
- Wetland impacts avoided.

Wetland Drainage Near WWTF

- A drainage pathway between the plant and the cemetery that currently helps drain the wetland under some flood conditions will be maintained.
- The design team is currently developing a design to increase the existing 12” culvert size or creating a drainage swale to increase surface flow from the wetland to the bay.
- New design of Spring Street catch basins will eliminate flow to wetland during larger storm events.
- An existing culvert that runs from the wetland to Hull Bay will not be changed.
- No adverse flooding impacts are anticipated in the wetland area due to the addition of perimeter flood protection at the facility.

Vegetated Reinforced Berm



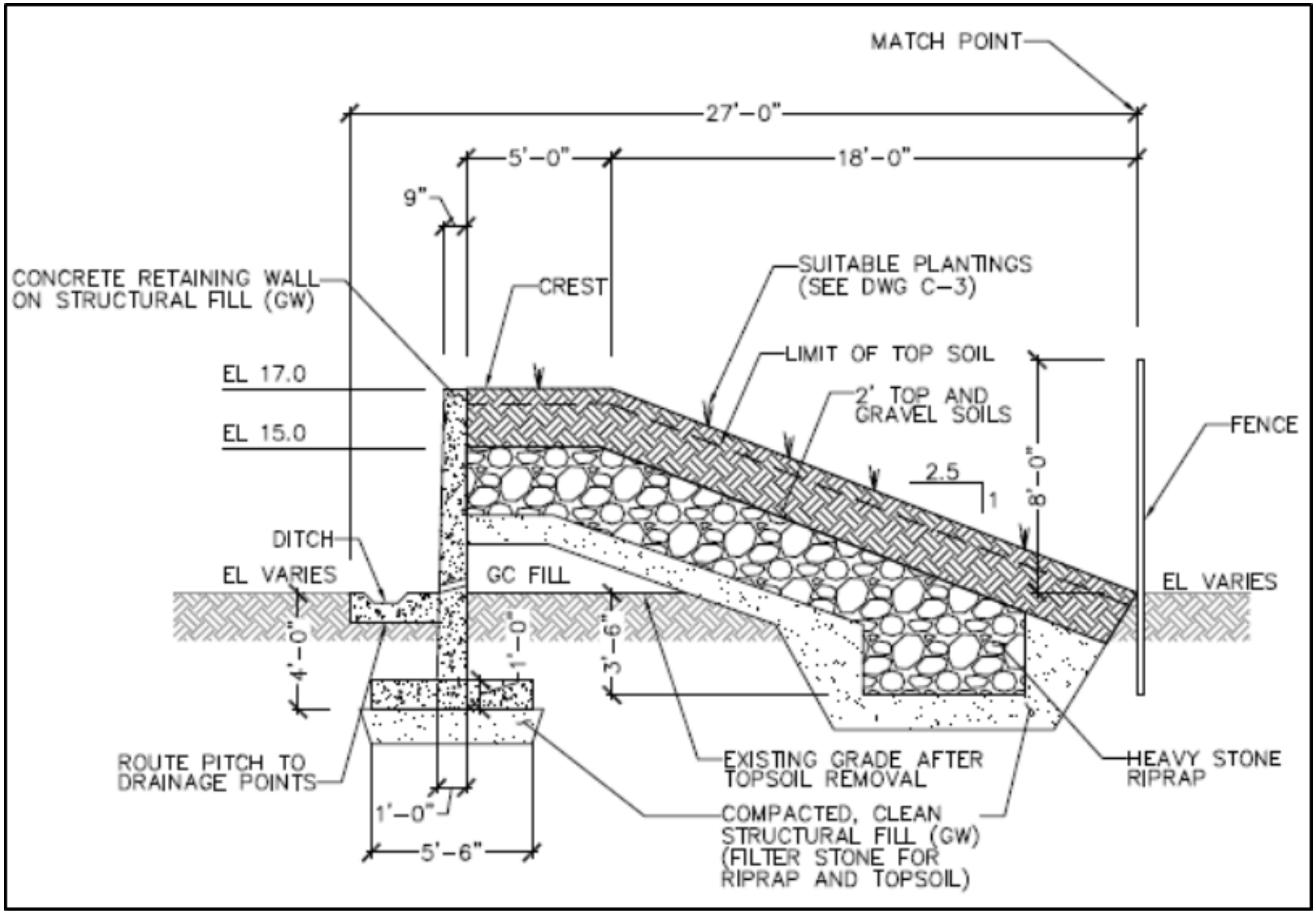
Rendered Section of Vegetated Reinforced Berm

Option 1 – Fence along Nantasket Avenue

Rendered Section of Vegetated Reinforced Berm

Option 2 – Fence at Top of Slope

Truncated Vegetated Reinforced Berm



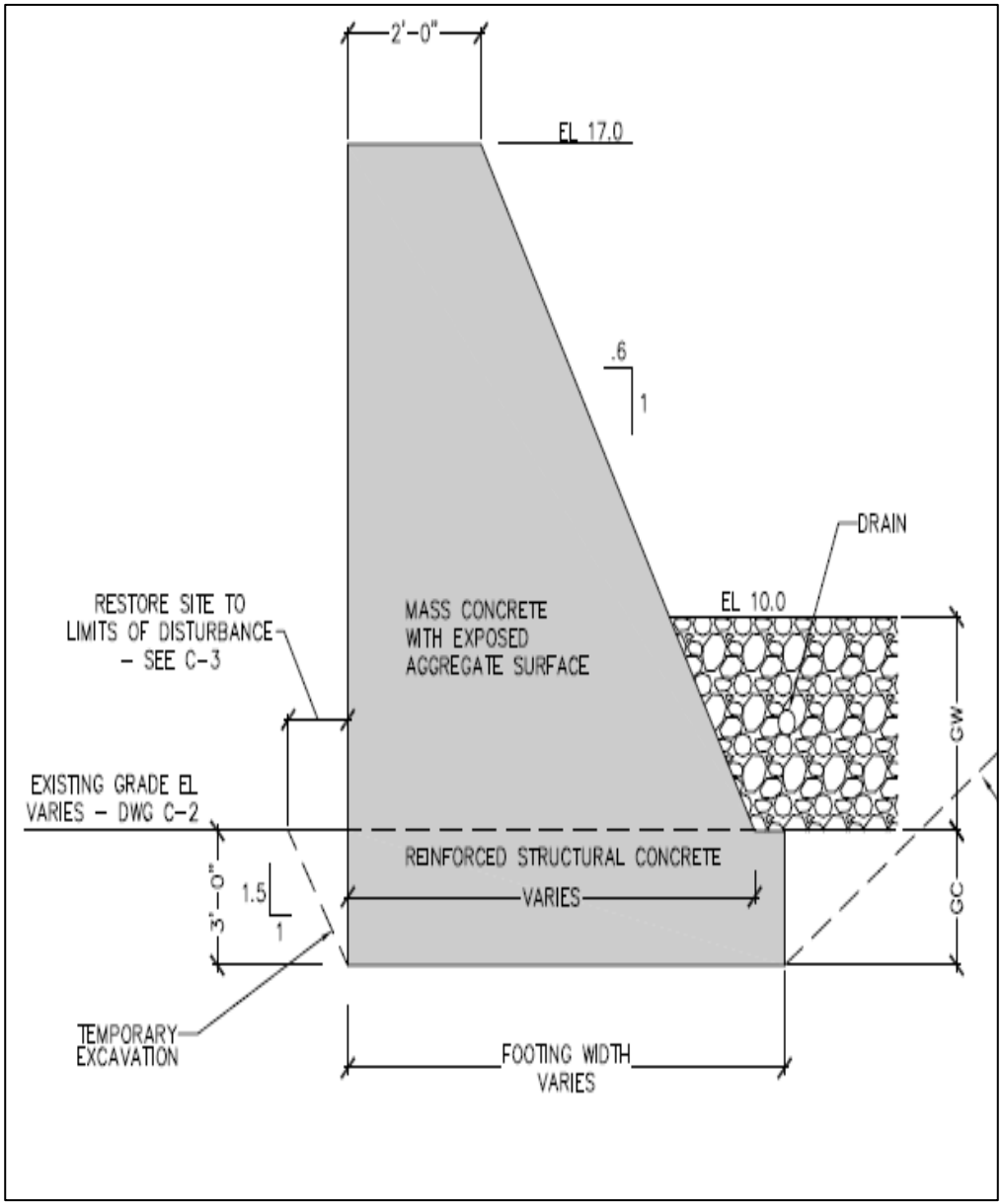
Rendered Section of Truncated Reinforced Berm

Option 1 – Fence along Spring Street

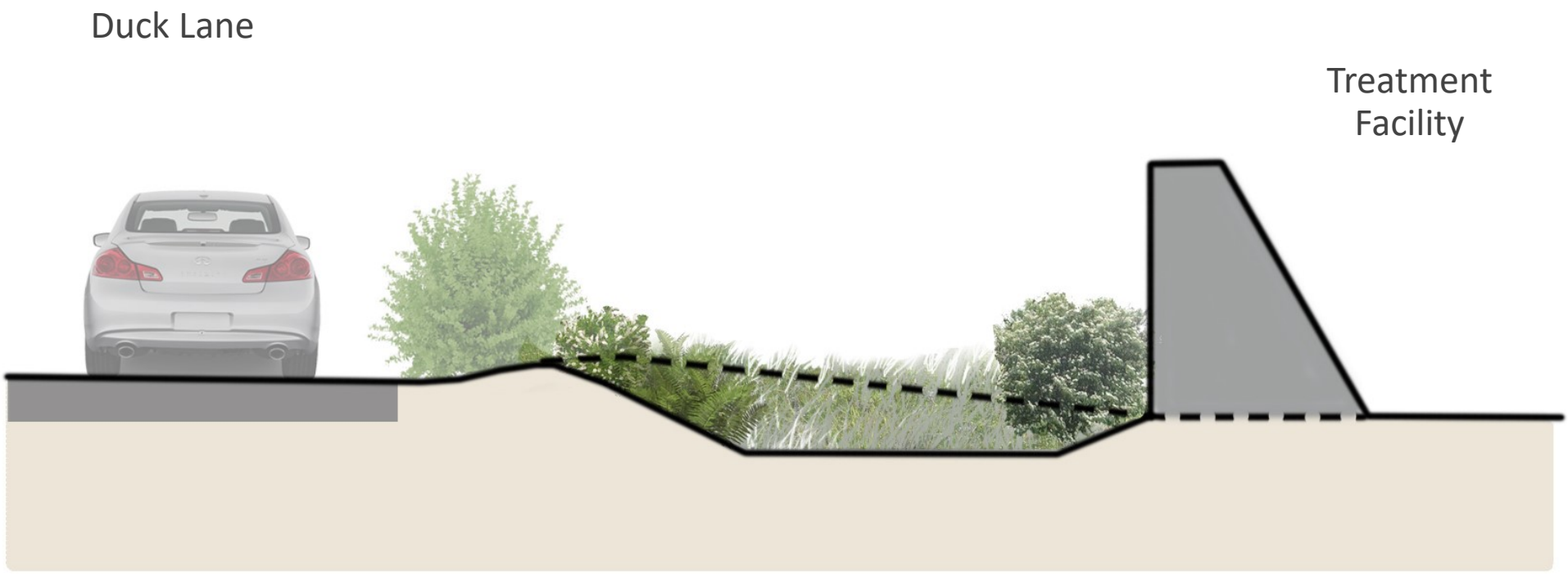
Rendered Section of Truncated Reinforced Berm

Option 2 – Fence at Top of Slope

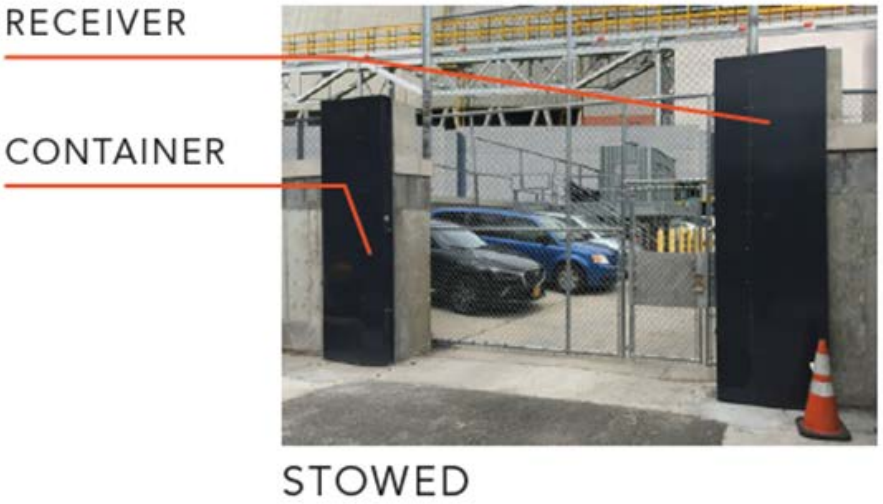
Concrete Gravity Wall



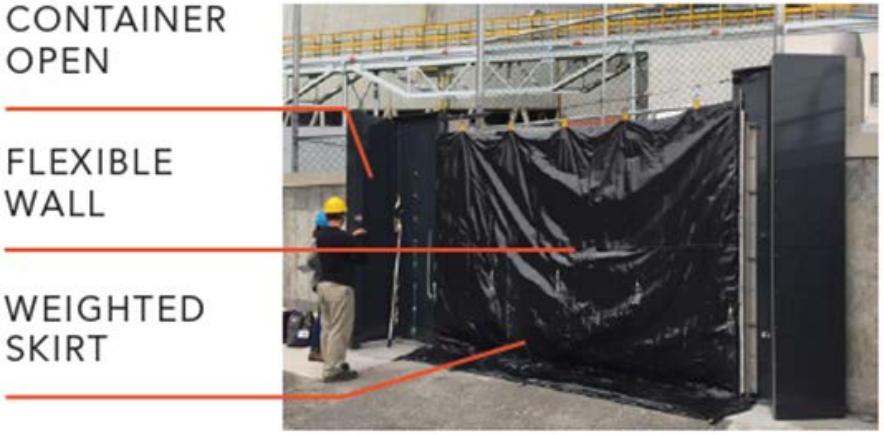
Rendered Section of Concrete Gravity Wall



Rapidly Deployable Access Wall



STOWED



DEPLOYED

Before and After Renderings

View From Lifesaving Museum – Existing Photo

Before and After Renderings

View From Lifesaving Museum – Proposed Truncated Berm

Before and After Renderings

View From Cemetery – Existing Photo

Before and After Renderings

View From Cemetery – Proposed Gravity Wall

Environmental Permitting

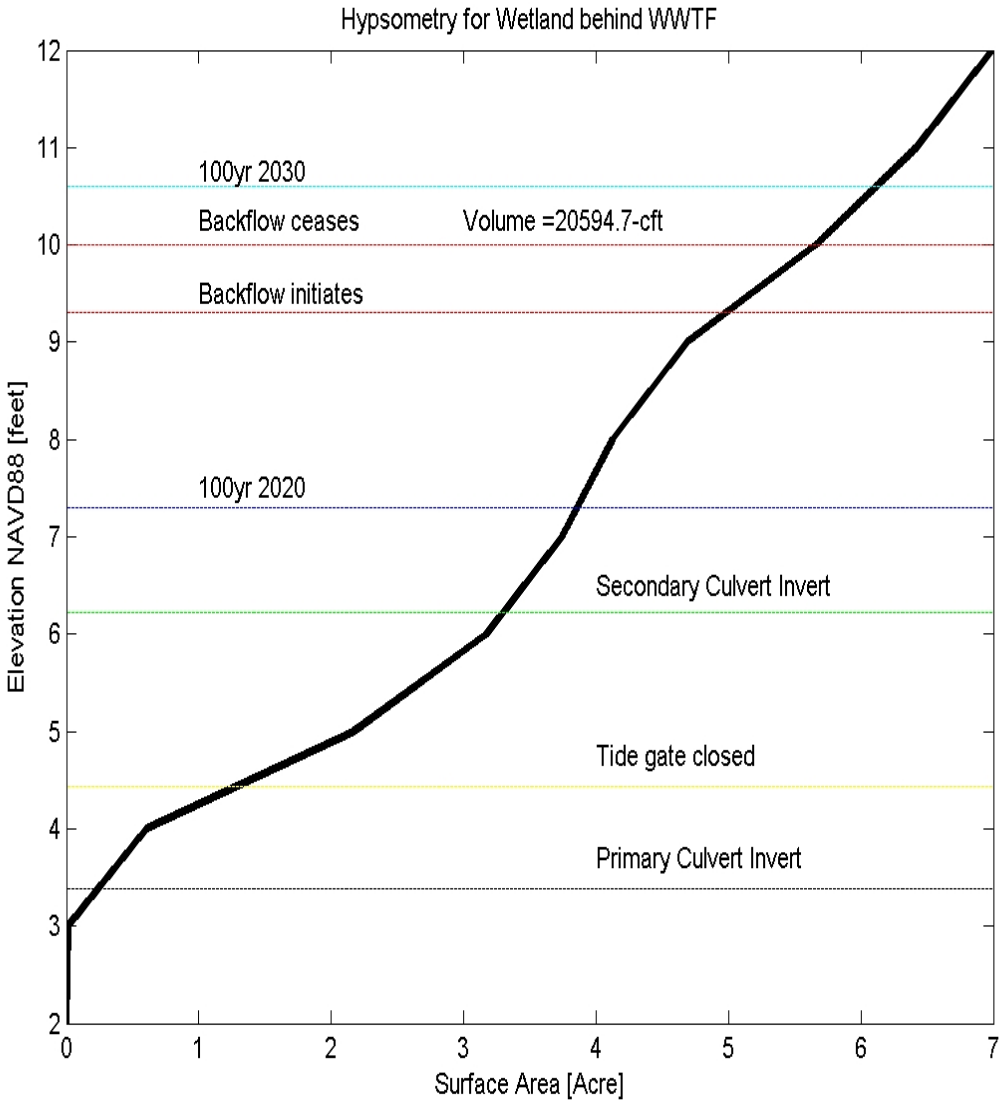
- An Environmental Notification Form was filed with the state Environmental Policy Act (MEPA) office last June. A MEPA Certificate was issued. No Environmental Impact Report (EIR) is required.
- A Notice of Intent (NOI) will be filed with the Hull Conservation Commission on March 31st for a Hearing on April 13th. An Order of Conditions will be sought for the project to proceed.
- A Chapter 91 License application with MassDEP Waterways will be applied for once Order of Conditions has been issued by the Hull Conservation Commission through the NOI process.

Questions?

Extra Slides

Evaluating the Culverts and Water Levels

- Hypsometric Curve demonstrating volume of water in wetland for a given water level condition.
- Also shows the elevation at which the culverts flow.
- Demonstrates narrow elevation range for which backflow occurs down Duck Lane (~9.2 – 10.0' NAVD).



Inundation and the Secondary Culvert

- Majority of homes inundated at SWEL 9’ NAVD (blue) when culvert does not flow.
- Flow pathway along Duck Ln only coherent when flood waters above 9.2’ NAVD.

Flooding Inundation Map: 1% Chance (100 yr) Storm in Present Day for Existing versus Proposed Conditions

1% Storm in Present Day for Existing Conditions

1% Storm in Present Day for Alternative 1 (Crest 17 ft-NAVD)

Modeled **Flooding** Depths and Velocities for Existing and Proposed Conditions

Scenario	Spring Street		Nantasket Avenue	
	Existing	Preferred Alt	Existing	Preferred Alt
100yr Present Day	9.5	9.5	10.8	11.0
100yr in 2030	10.1	9.5	10.8	11.0
100yr in 2070	12.6	12.7	12.7	13.8
500yr Present Day	10.8	10.7	11.1	12.2
500yr in 2070	13.0	13.2	13.1	14.2

	Hull Life Saving Museum			
Storm Scenario	Flow Velocity		Flood Depth	
	Existing	Preferred Alt	Existing	Preferred Alt
	ft/s	ft/s	feet	feet
100yr Present	1.2	1.5	0.17	0.17
100yr 2030	1.6	1.5	0.92	0.17
100yr 2070	2.9	3.1	3.12 / 3.08	5.60
500yr Present	2.4	2.9	1.57	3.23
500yr 2070	3.2	3.3	3.58 / 4.10	6.00