



COLUMBUS AVENUE SEAWALL

PROJECT REVIEW MEETING FEBRUARY 3, 2021

Proactive By Design.
Our Company Commitment



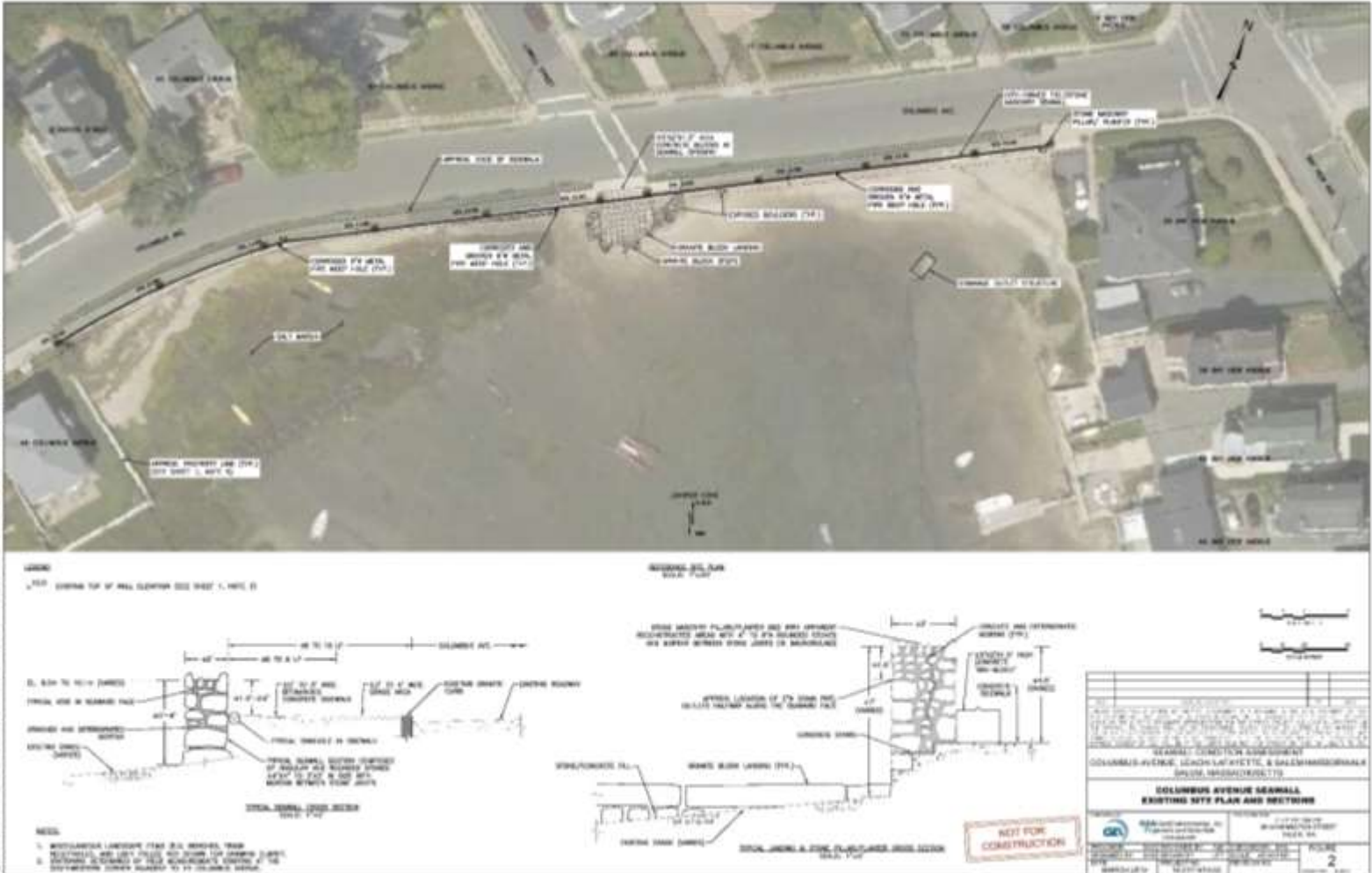
GZA GeoEnvironmental, Inc.



Meeting Agenda

- **Introduction**
- **Prior Columbus Ave Seawall Assessment Work**
- **GZA's Current Project Scope**
- **Project Summary/Progress To Date Since Last Meeting**
- **Revised Project Schedule**
- **Submitted Questions**
- **Discussion**

Columbus Avenue Seawall





Columbus Avenue Seawall

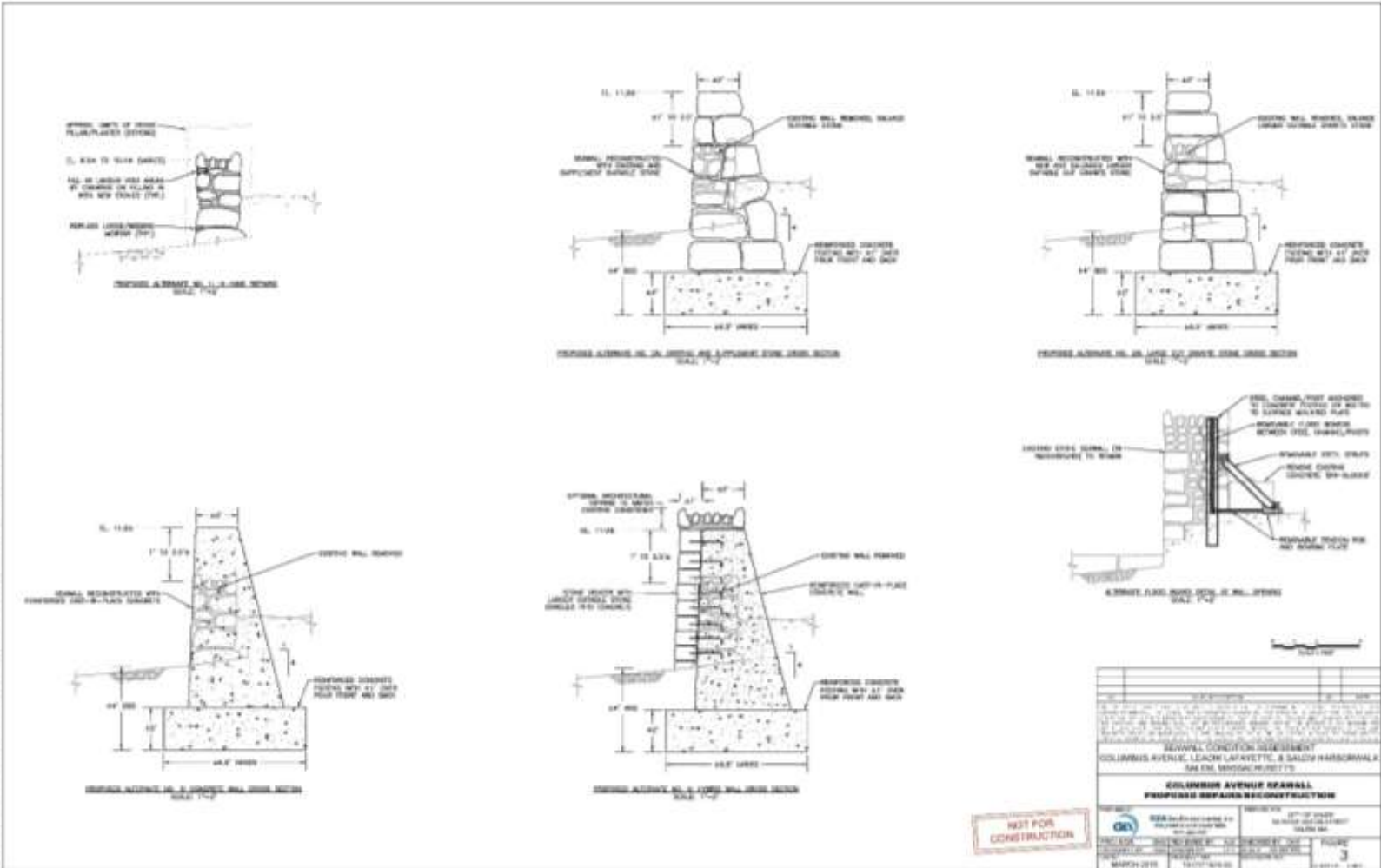
- **No Historic Information Found (pre-1938)**
- **Seawall is approximately 474 ft long**
- **Stone/Masonry Construction**
- **Elevation Varies from 10.1 to 8.5 in North American Vertical Datum 1988 (NAVD88)**
- **“B”, Good Condition, per Massachusetts Coastal Infrastructure Inventory and Assessment Project, by the Massachusetts Department of Conservation and Recreation, North Shore 2009**

Columbus Avenue Seawall

- Observed to be in overall FAIR to POOR Condition
 - Loose/missing stones,
 - Deteriorated and missing mortar/cracks



Columbus Avenue Seawall



Columbus Avenue Seawall

➤ Alt No. 2B – Reconstruct with Large Cut Granite Stone

Pros

- Medium upfront cost
- Increased flood protection
- Aesthetics- stone masonry

Cons

- Routine maintenance/upkeep
- Material availability



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- **EOEEA Dams and Seawall Grant submitted July 2019**
- **March 2018 Storm Damage Seawall Assessment Report Letter – Oct 2019**
- **Award Notice January 2020**
- **GZA's Scope of Services/Task Order March 2020**



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GZA's Scope of Services

- Task 1 – Project Review
- Task 2 – Survey/Ecological Work
- Task 3 – Design Development
- Task 4 – Permitting
- Task 5 – Final Design/Bid Documents
- Task 6 – Bid Phase Services



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Living Shoreline – Marsh Enhancement Area



JUNIPER COVE - SALEM, MA
 Design Layout Concept
 Contours referenced to NAVD88 (feet)

0 25 50 75 100 Feet

CHESTER ENGINEERS

Columbus Avenue Seawall



JUNIPER COVE LIVING SHORELINE RENDERING
SALEM, MA

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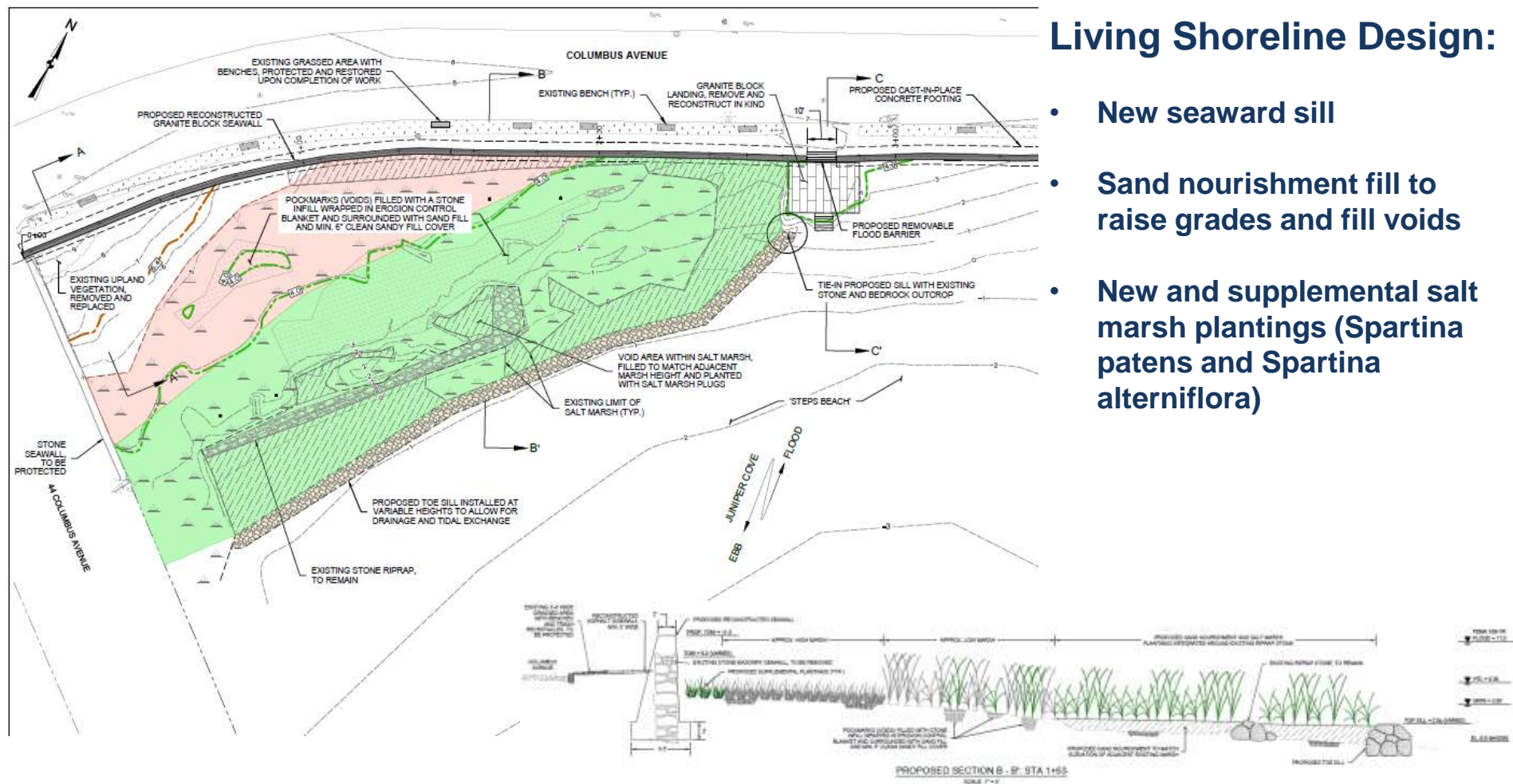
- Partly desiccated with “pockmark” voids throughout
- Erosion and undermining along seaward edge



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Living Shoreline Design:

- New seaward sill
- Sand nourishment fill to raise grades and fill voids
- New and supplemental salt marsh plantings (*Spartina patens* and *Spartina alterniflora*)



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➤ Toe Sill – Coir Roll

Pros

- Natural and biodegradable material
- Promotes vegetation growth – plant directly into coir roll
- Absorbs wave energy with minimal reflection
- Easy installation

Cons

- Temporary protection (2-5 years)
- Minimal protection against waves and ice impacts
- Additional maintenance (resetting, anchoring, or replacement)



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➤ Toe Sill – Stone Sill

Pros

- Long-term protection
- Increased protection against waves and ice impacts
- Easy to moderate installation



Cons

- Less natural- hard armoring
- Possible wave reflection and scour



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ALTERNATE DESIGN



Living Shoreline Design:

- Improve/Repair Existing
- Minimal Inter-Tidal Impacts



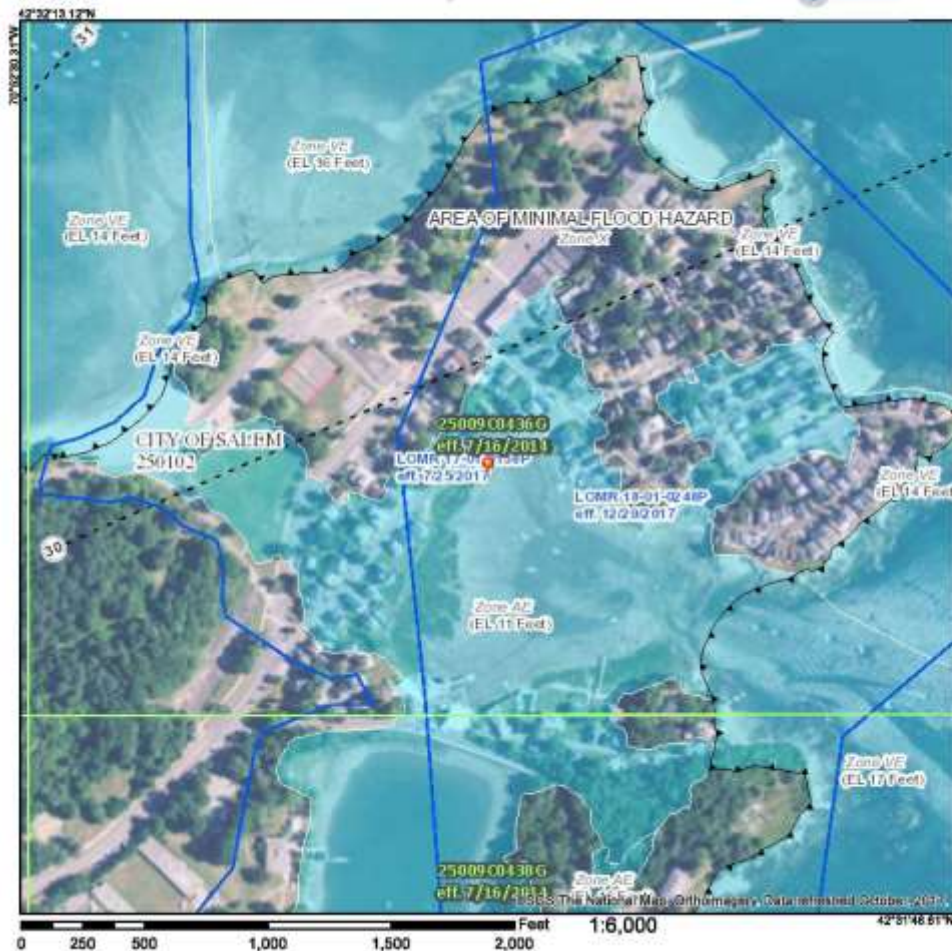
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GZA's Scope of Services

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National Flood Hazard Layer FIRMette



Legend

SEE FIRM REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, C, XSE
- With BFE or Depth Zone A1, A2, A3, A4, XE, AP
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage area of less than one square mile Zone F
- Future Conditions 1% Annual Chance Flood Hazard Zone F
- Area with Reduced Flood Risk due to Levee, Sea Wall, etc. Zone F
- Area with Flood Risk due to Levee Zone F

OTHER AREAS

- Area of Minimal Flood Hazard Zone F
- Area of Undetermined Flood Hazard Zone F

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Traverset
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Traverset Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps. If it is not valid as described below, the basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was reported on 1/31/2019 at 12:12:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is valid if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifier, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

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COASTAL MODELING – INTENT

1. Wave heights in the Cove/at the Columbus Ave seawall
2. Wave effect/wave run-up at NE end of seawall
3. Wave overtopping at seawall
4. Effects of Breakwater



Columbus Avenue Seawall

COASTAL MODELING – PARAMETERS

Return Period	FEMA		USACE ³					
	Stillwater Elevation ¹ (ft, NAVD88)	Base Flood Elevation ² (ft, NAVD88)	Stillwater Elevation (ft, NAVD88)			Wave Height (ft)		
			#10709	#10710	#69	#10709	#10710	#69
1-year			6.1	6.1	6.1	8.7	7.0	9.7
2-year			6.7	6.7	6.7	12.8	9.8	13.8
5-year			7.3	7.4	7.3	14.4	11.3	15.3
10-year	8.4		7.7	7.8	7.7	15.0	11.8	15.8
50-year	9.4		8.7	8.7	8.6	15.6	12.6	16.4
100-year	10.0	11	9.1	9.1	9.0	15.8	12.8	16.5
500-year	11.4		9.9	9.9	9.8	15.9	13.2	16.7

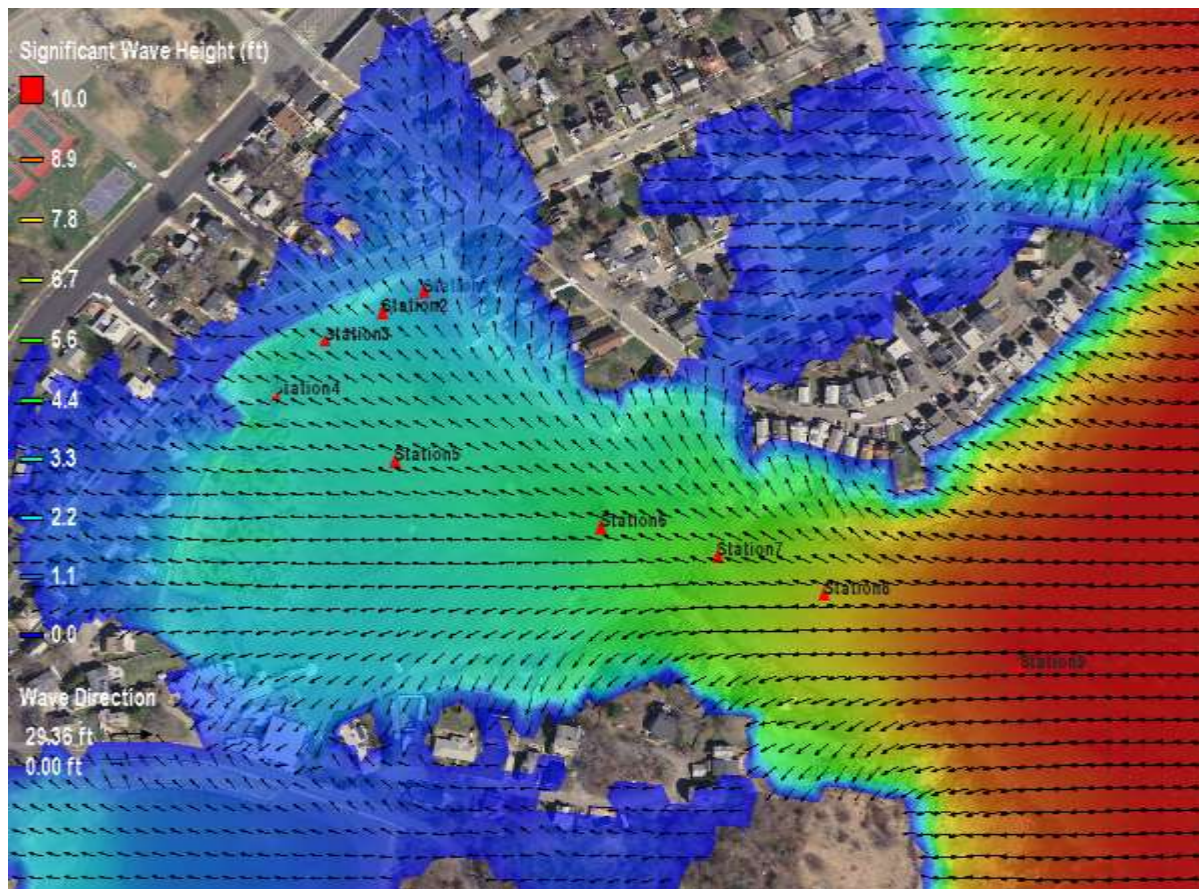
Analysis	Wind Speed (mph) Statistics			
	10-year	50-year	100-year	500-year
ASCE 7-16	61	75	80	--
GZA Statistical Analysis	56	68	74	87

Time	Water Level ² (ft, NAVD88)	Storm Type
1/4/2018	9.7	Nor'Easter
2/7/1978	9.6	Nor'Easter
3/2/2018	9.1	Nor'Easter
1/2/1987	8.7	Nor'Easter
10/30/1991	8.6	Nor'Easter
1/25/1979	8.5	Nor'Easter
12/12/1992	8.5	Nor'Easter
12/29/1959	8.5	Nor'Easter
2/19/1972	8.4	Nor'Easter
1/3/2014	8.3	Nor'Easter

Scenario 1 – Due East/Scenario 2 - NE

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COASTAL MODELING – WAVE HEIGHTS SCENERIO 1



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COASTAL MODELING – WAVE HEIGHTS SCENERIO 1



	Stations	Scenario 1	Scenario 2
SWAN Model Output ⁴ of Significant Wave Height (ft)	Output Station 1	1.6	1.2
	Output Station 2	2.3	1.8
	Output Station 3	2.7	2.3
	Output Station 4	2.9	3.2
	Output Station 5	3.1	3.2
	Output Station 6	4.4	4.2
	Output Station 7	6.0	5.8
	Output Station 8	7.4	7.1
	Output Station 9	10.0	9.6
	Output Station 10	1.4	1.2
	Output Station 11	2.2	1.7
	Output Station 12	2.6	2.2
	Output Station 13	2.0	1.8

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COASTAL MODELING – WAVE HEIGHT/WAVE RUNUP





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COASTAL MODELING – WAVE HEIGHT/WAVE RUNUP

Output Station ¹	Wall Height (ft, NAVD88)	Bed Condition		Stillwater Condition			Wave Condition				Wave Runup ²		Overtopping Flowrate ²
		Sand Removal	Bed Level ¹ (ft, NAVD88)	Stillwater Elevation (ft, NAVD88)	Water Depth (ft)	Freeboard (ft)	Significant Wave Height ¹ (ft)	Peak Wave Period ² (s)	Wave Crest Elevation ³ (ft, NAVD88)	Wave Breaking?	Wave Runup on Seawall (ft)	Wave Runup Height (ft, NAVD88)	per linear foot (gallon/min)
Northeast Corner	11	No Sand Removal	7	10	3	1	1.4	11.1	11.0	No	2.7	12.7	41
		After Sand Removal	4	10	6	1	1.1	11.1	10.8	No	2.1	12.1	17
	12	No Sand Removal	7	10	3	2	1.4	11.1	11.0	No	2.7	12.7	6
		After Sand Removal	4	10	6	2	1.1	11.1	10.8	No	2.1	12.1	2
Station 11	11	N/A	2.7	10	7.3	1	2.2	11.1	11.5	No	4.2	14.2	157
	12	N/A	2.7	10	7.3	2	2.2	11.1	11.5	No	4.2	14.2	48
Station 12	11	N/A	3.6	10	6.4	1	2.6	11.1	11.8	No	5.0	15.0	243
	12	N/A	3.6	10	6.4	2	2.6	11.1	11.8	No	5.0	15.0	89
Station 13	11	N/A	8.3	10	1.7	1	2.0	11.1	11.4	Yes	3.9	13.9	121
	12	N/A	8.3	10	1.7	2	2.0	11.1	11.4	Yes	3.9	13.9	33

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COASTAL MODELING – BREAKWATER EFFECTS



Columbus Avenue Seawall

COASTAL MODELING – BREAKWATER EFFECTS

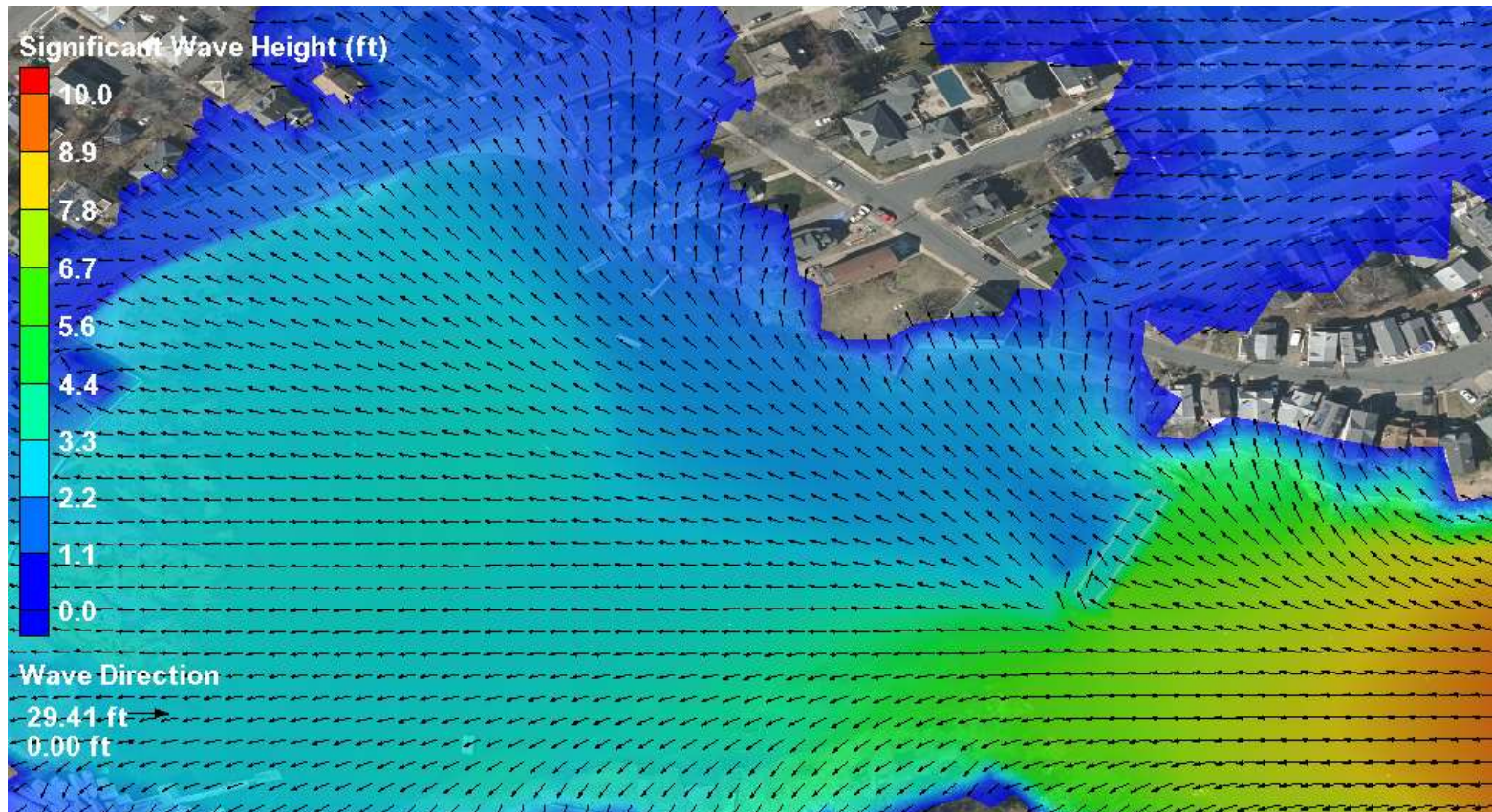


Figure 8. Revetment height: El. 8' – Scenario 1



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COASTAL MODELING – BREAKWATER EFFECTS

Output Stations	Revetment Height based on LiDAR		Revetment Height El. 0'		Revetment Height El. 5'		Revetment Height El. 8'		Revetment Height El. 10'	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
	#1	1.6	1.2	1.7	1.3	1.7	1.1	1.5	0.7	1.4
#2	2.3	1.8	2.3	1.9	2.3	1.6	2.1	0.9	2.0	0.8
#3	2.7	2.3	2.7	2.4	2.5	2.0	2.1	1.1	2.1	1.1
#4	2.9	3.2	2.9	3.1	2.5	2.8	2.3	1.7	2.3	1.9
#5	3.1	3.2	3.1	3.2	2.6	2.6	2.7	1.9	2.8	2.1
#6	4.4	4.2	4.2	4.0	3.3	3.2	2.2	2.0	2.6	2.4
#7	6.0	5.8	6.2	6.0	6.7	6.4	3.0	3.0	N/A	N/A
#8	7.4	7.1	7.4	7.1	7.4	7.1	7.4	7.1	7.4	7.1
#9	10.0	9.6	10.0	9.6	10.0	9.6	10.0	9.6	10.0	9.6
#10	1.4	1.2	1.5	1.3	1.4	1.2	1.0	0.7	0.8	0.6
#11	2.2	1.7	2.3	1.8	2.2	1.6	1.8	0.8	1.7	0.7
#12	2.6	2.2	2.6	2.3	2.4	1.9	1.9	0.9	1.8	0.8
#13	2.0	1.8	1.9	1.8	1.6	1.5	1.3	1.2	1.4	1.3



Columbus Avenue Seawall

COASTAL MODELING – SUMMARY

1. Wave heights at seawall generally range from 2' to 2.4' except at the NE corner at 1.5'.
2. Additional wave runup contributing to wall overtopping at NE corner with sand build-up, however $\leq 0.5'$.
3. Overtopping of seawall at El. 11 and 12 due to wave runup.
4. Existing breakwater only minimally attenuates incoming waves at the seawall.



Work Status

1. WORK SINCE PRIOR MEETING:

- Submitted Preliminary Design Summary Letter and Summary
- Investigated Wall Opening/Barrier Types
- Alternate Salt Marsh Improvement Plan
- Investigated Ramp/Access Alternates
- Pre-Application Review Meeting November 17, 2020

2. REVIEW REMAINING ITEMS WITH THE CITY

- Salt Marsh Alternate
- Wall Opening Size/Barrier Type
- Access/Landing Improvements
- Wall Construction at Ends/Easements

3. ADDITIONAL SERVICES PROPOSALS

4. REVISED SCHEDULE (PERMITTING-POSTED)

5. IDENTIFY FUNDING OPPORTUNITIES



Review Questions and Discussion