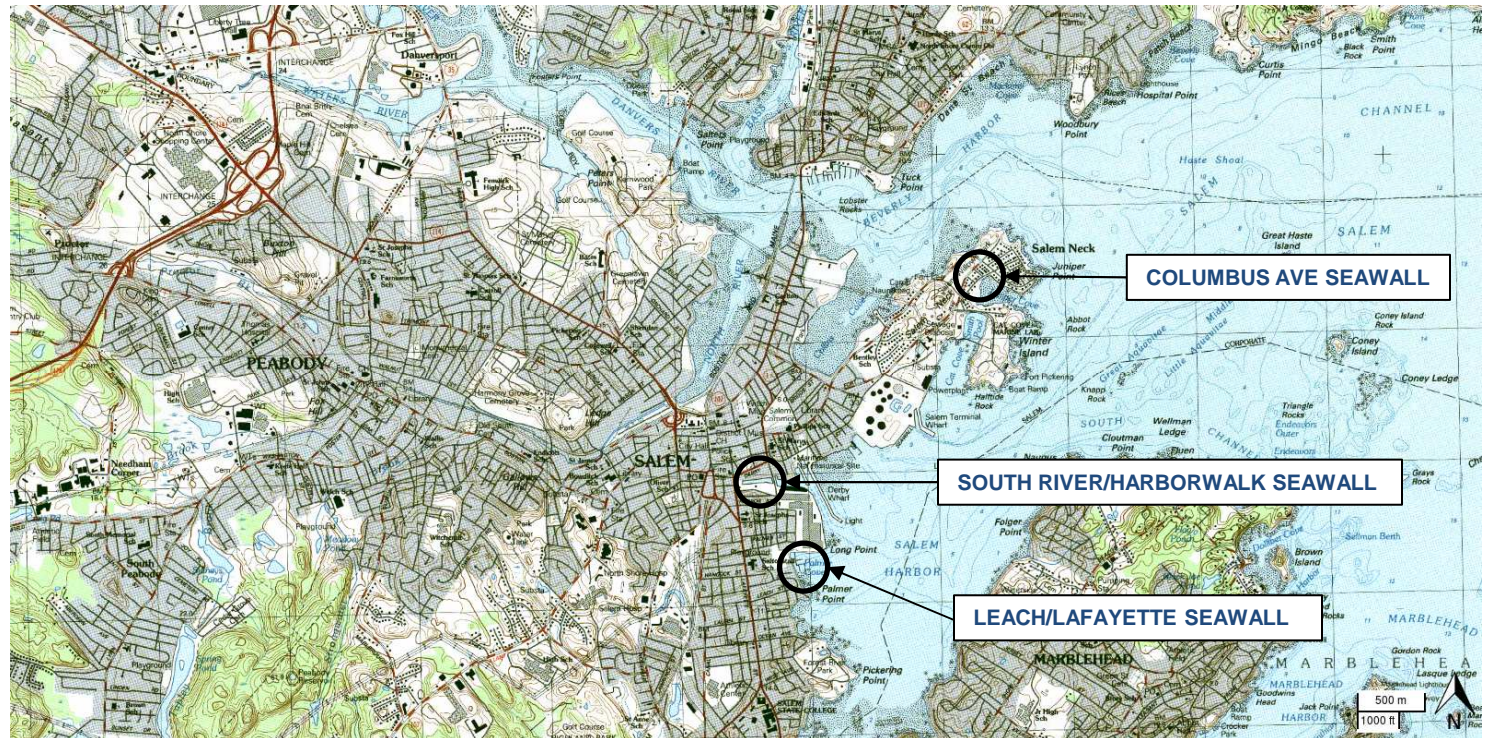


MARCH 2018, NOR-EASTER STORM DAMAGE SEAWALL ASSESSMENTS

Salem, Massachusetts

Proactive By Design.
Our Company Commitment





GEOTECHNICAL

ENVIRONMENTAL

ECOLOGICAL

WATER

CONSTRUCTION
MANAGEMENT



Scope of Services

- **Task 1 - Project Review**
- **Task 2 – Condition Inspection and Survey – Develop Existing Condition Plans**
- **Task 3 - Condition Assessment Letter Report**
- **Task 4 – Conceptual Design**



GEOTECHNICAL

ENVIRONMENTAL

ECOLOGICAL

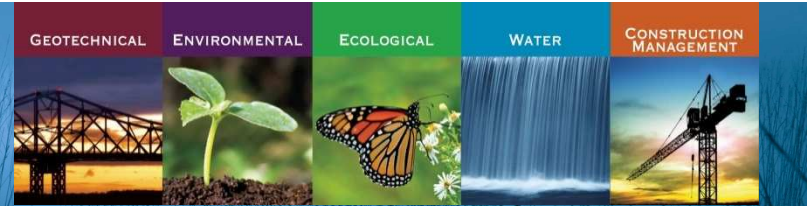
WATER

CONSTRUCTION
MANAGEMENT



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

Typical voids and missing mortar along seaward face.



Missing face stones and typical recent mortar repair.





Columbus Avenue Seawall

Typical voids and deteriorated and missing mortar/cracks in seaward face.



Typical voids and deteriorated and missing mortar/cracks along top of wall.





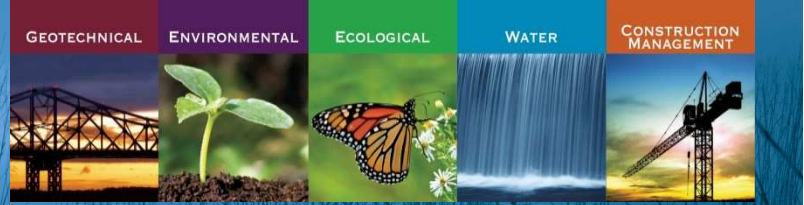
Columbus Avenue Seawall

**Granite block landing
with loss of fill material
below top course.**

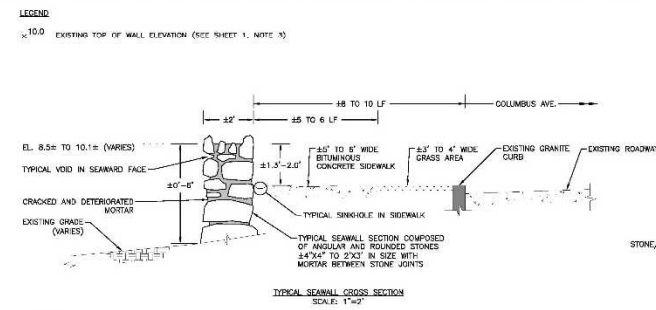


**Typical corroded pipe
weep hole and voids
along seaward face.**

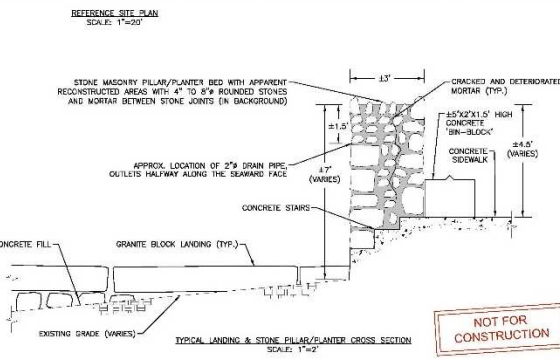




Columbus Avenue Seawall



- NOTES:**
- MISCELLANEOUS LANDSCAPE ITEMS (E.G. BENCHES, TRASH RECEPTACLES, AND LIGHT POLES) NOT SHOWN FOR DRAWING CLARITY.
 - STATIONING DETERMINED BY FIELD MEASUREMENTS STARTING AT THE SOUTHWESTERN CORNER ADJACENT TO 44 COLUMBUS AVENUE.



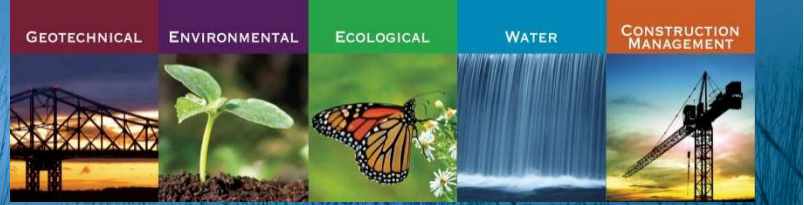
NOT FOR CONSTRUCTION

SEAWALL CONDITION ASSESSMENT
COLUMBUS AVENUE, LEACH LAFAYETTE & SALEM HARBORWALK
SALEM, MASSACHUSETTS

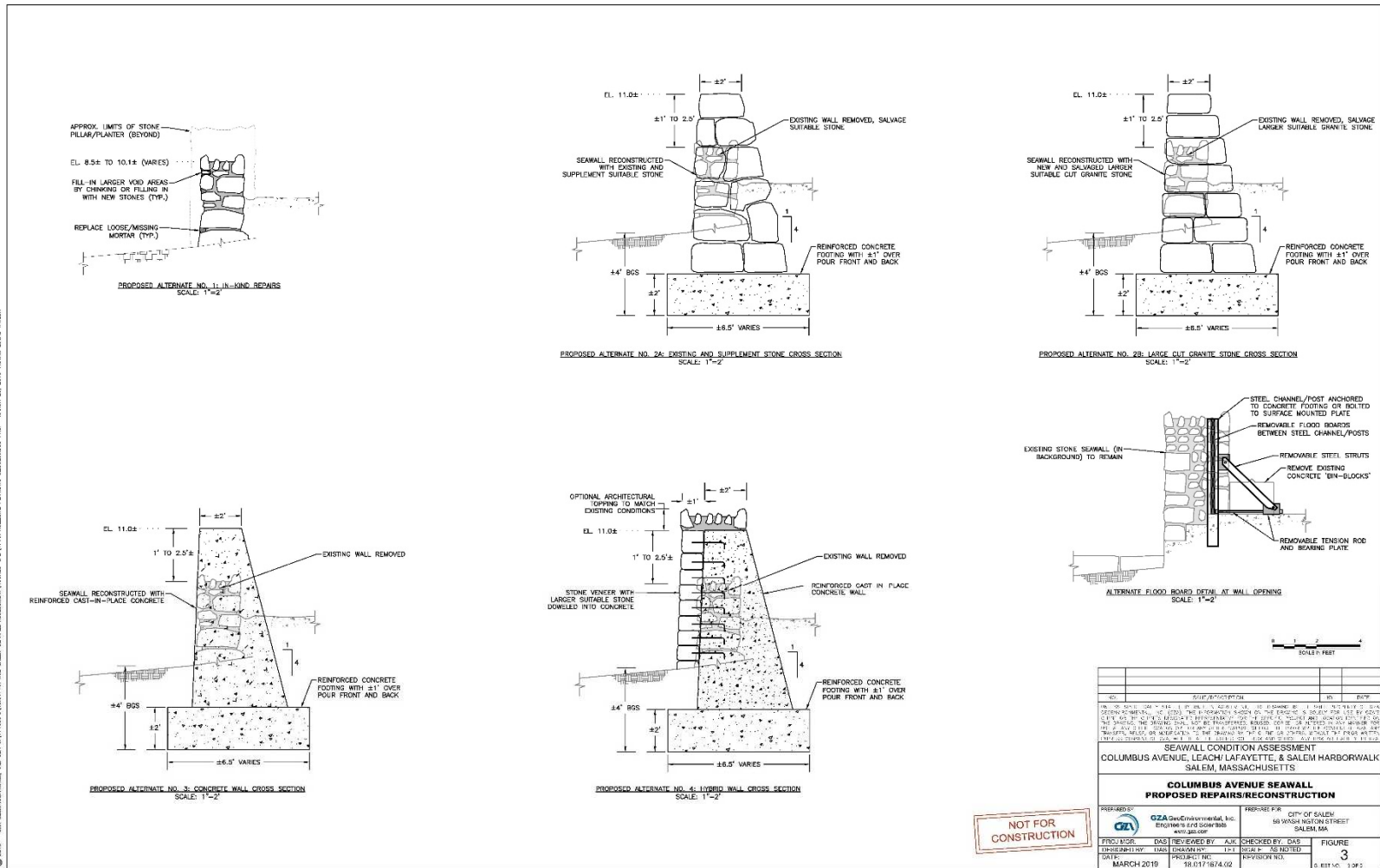
NO.	DATE	BY	CHKD.

COLUMBUS AVENUE SEAWALL EXISTING SITE PLAN AND SECTIONS

PROJECT NO.	DESIGNED BY	DRAWN BY	DATE
024	DVS	DVS	MARCH 2019
THIS IS NOT A CONTRACT DOCUMENT	THIS IS NOT A CONTRACT DOCUMENT	THIS IS NOT A CONTRACT DOCUMENT	THIS IS NOT A CONTRACT DOCUMENT
DESIGNED BY	DRAWN BY	CHECKED BY	FIGURE
DVS	DVS	DVS	2
DATE	PROJECT NO.	REVISED NO.	SHEET NO.
MARCH 2019	18.037.1674.02		2 OF 2



Columbus Avenue Seawall



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Columbus Avenue Seawall

Alt No.	Repair Recommendation	Wall Height	Cost Estimate
Alt No. 1	In-kind Repairs	No Change	\$90k to \$120k
Alt No. 2A	Reconstruct with Existing and Supplemental Stone	+0.9-2.5 ft	\$550k to \$700k
Alt No. 2B	Reconstruct with Large Cut Granite Stone	+0.9-2.5 ft	\$750k to \$900k
Alt No. 3	Reconstruct with Reinforced Concrete Wall	+0.9-2.5 ft	\$1.4m to \$1.7m
Alt No. 4	Reconstruct with Hybrid-Concrete and Stone Veneer Wall	+0.9-2.5 ft	\$1.5m to \$1.8m



Columbus Avenue Seawall

➤ Alt No. 2A – Reconstruct with Existing and Supplemental Stone

Pros

- Less upfront cost
- Increased flood protection
- Aesthetics- most similar to existing

Cons

- Routine maintenance/upkeep
- Less longevity/strength compared to concrete or larger stone





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



Columbus Avenue Seawall

➤ **Alt No. 3 – Reconstruct with Reinforced Concrete Wall**

Pros

- Increased longevity/strength
- Increased flood protection
- Minimal maintenance/upkeep
- Optional form liners for aesthetic face

Cons

- Higher upfront cost
- Aesthetics- least similar to existing



Columbus Avenue Seawall

➤ **Alt No. 4 – Reconstruct with Hybrid-Concrete and Stone Veneer Wall**

Pros

- Increased longevity/strength
- Increased flood protection
- Aesthetics- stone veneer

Cons

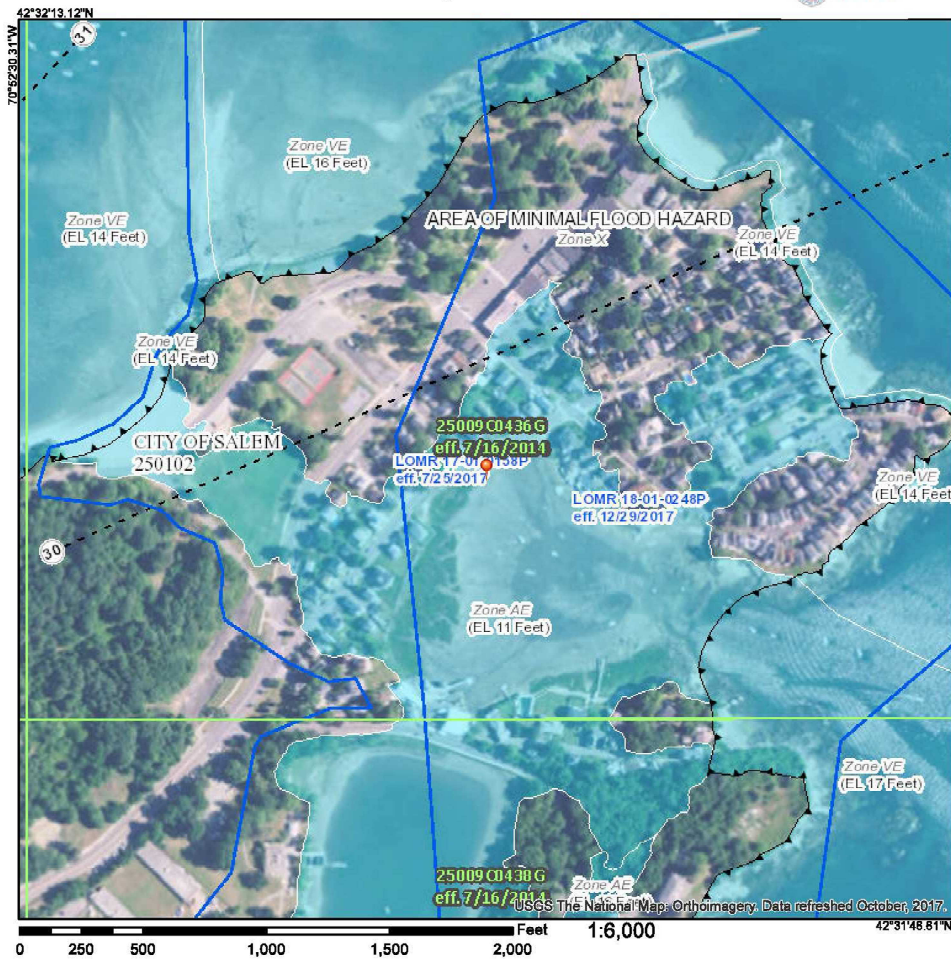
- Higher upfront cost
- Material availability
- Maintenance to stone veneer





Columbus Avenue Seawall

National Flood Hazard Layer FIRMette



Legend

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

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
	With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
	Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
	Area with Reduced Flood Risk due to Levee. See Notes, <i>Zone X</i>
	Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS	Area of Minimal Flood Hazard <i>Zone X</i>
	Effective LOMRs
	Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	Cross Sections with 1% Annual Chance Water Surface Elevation
	Coastal Transect
	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped

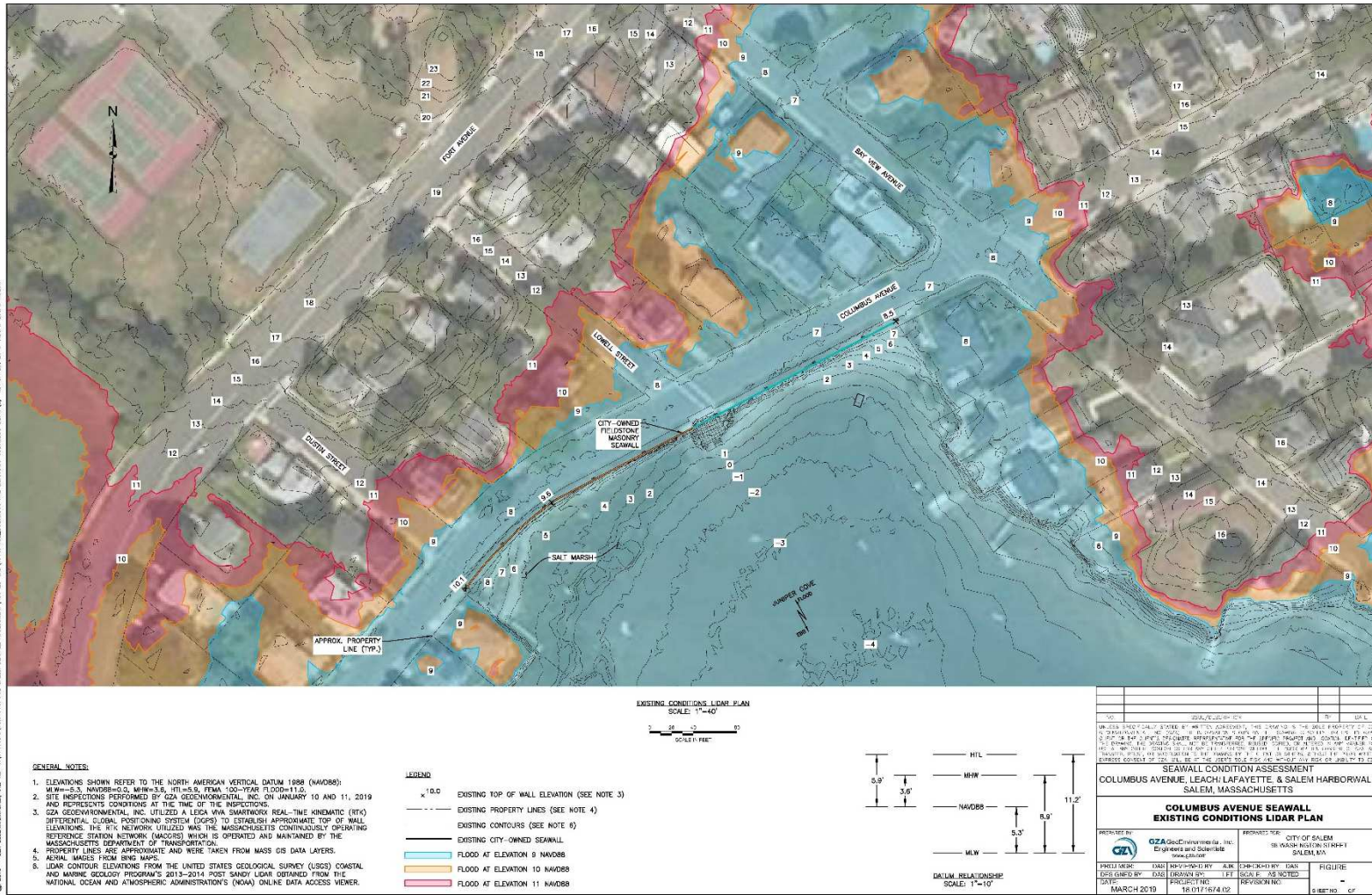
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void 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 exported on 4/31/2019 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 void 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 identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Columbus Avenue Seawall





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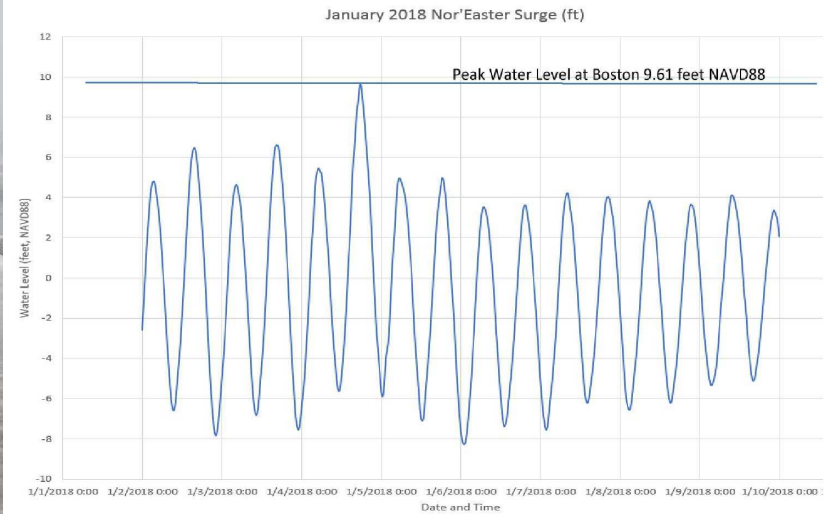
WATER

CONSTRUCTION MANAGEMENT



Columbus Avenue Seawall

January 2018





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WATER

CONSTRUCTION
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In Closing...

- **DRAFT REPORT “WORKING VERSION”**
- **REVIEW WITH THE CITY**
- **PERMITTING/CONSTRUCTION IMPLICATIONS**
- **IDENTIFY FUNDING OPPORTUNITIES**
- **LOOK AT ADDITIONAL SERVICES....**



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Questions