Environmental Notification Form

Crescent Beach Seawall and Revetment Repair
Hull, Massachusetts

June 30, 2015

Prepared by:

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Prepared for:

Town of Hull Conservation Department
253 Atlantic Avenue
Hull, Massachusetts 02045

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ENF DISTRIBUTION LIST

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Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Department of Environmental Protection
Commissioner's Office
One Winter Street
Boston, MA 02108

DEP/Southeastern Regional Office
Attn: MEPA Coordinator
20 Riverside Drive
Lakeville, MA 02347

Massachusetts Dept. of Transportation
Public/Private Development Unit
10 Park Plaza
Boston, MA 02116

Massachusetts DOT District #5
Attn: MEPA Coordinator
Box 111
1000 County Street
Taunton, MA 02780

Massachusetts Historical Commission
The MA Archives Building
220 Morrissey Boulevard
Boston, MA 02125

Metropolitan Area Planning Council
60 Temple Place/6th floor
Boston, MA 02111

Coastal Zone Management
Attn: Project Review Coordinator
251 Causeway Street, Suite 800
Boston, MA 02114

Division of Marine Fisheries
(North Shore)
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930

DCR
Attn: MEPA Coordinator
251 Causeway St. Suite 600
Boston MA 02114

Board of Selectmen
Town Hall
253 Atlantic Avenue
Hull, MA 02045

Planning Board
Town Hall
253 Atlantic Avenue
Hull, MA 02045

Board of Health
Town Hall
253 Atlantic Avenue
Hull, MA 02045

ENVIRONMENTAL NOTIFICATION FORM

See following pages.

Commonwealth of Massachusetts

Executive Office of Energy and Environmental Affairs
Massachusetts Environmental Policy Act (MEPA) Office

Environmental Notification Form

For Office Use Only

EEA#: ____________________

MEPA Analyst: ______________

The information requested on this form must be completed in order to submit a document electronically for review under the Massachusetts Environmental Policy Act, 301 CMR 11.00.

Project Name: Crescent Beach Seawall and Revetment Repair		
Street Address: Atlantic Avenue		
Municipality: Hull	Watershed: Boston Harbor	
Universal Transverse Mercator Coordinates: 348664.10, 4681051.86, UTM Zone 19T	Latitude: 42.267° Longitude: -70.835°	
Estimated commencement date: Jan 2016	Estimated completion date: Jun 2016	
Project Type: Shore Protection	Status of project design: 70 %complete	
Proponent: Town of Hull, Conservation Department		
Street Address: 253 Atlantic Ave		
Municipality: Hull	State: MA	Zip Code: 02045
Name of Contact Person: John Ramsey		
Firm/Agency: Applied Coastal	Street Address: 766 Falmouth Road, Suite A1	
Municipality: Mashpee	State: MA	Zip Code: 02649
Phone: 508-539-3737	Fax: 508-539-3739	E-mail: jramsey@appliedcoastal.com

Does this project meet or exceed a mandatory EIR threshold (see 301 CMR 11.03)?
☐Yes ☒No

If this is an Expanded Environmental Notification Form (ENF) (see 301 CMR 11.05(7)) or a Notice of Project Change (NPC), are you requesting:

a Single EIR? (see 301 CMR 11.06(8)) ☐Yes ☐No
a Special Review Procedure? (see 301CMR 11.09) ☐Yes ☐No
a Waiver of mandatory EIR? (see 301 CMR 11.11) ☐Yes ☐No
a Phase I Waiver? (see 301 CMR 11.11) ☐Yes ☐No
(Note: Greenhouse Gas Emissions analysis must be included in the Expanded ENF.)

Which MEPA review threshold(s) does the project meet or exceed (see 301 CMR 11.03)?
301 CMR 11.03(3)(b)(1)(e) - New fill or structure or expansion of existing fill or structure
301 CMR 11.03(3)(b)(6) - Construction, reconstruction or Expansion of an existing solid fill structure of 1,000 or more sf base area or of a pile-supported or bottom-anchored structure of 2,000 or more sf base area, except a seasonal, pile-held or bottom-anchored float, provided the structure occupies flowed tidelands or other waterways

Which State Agency Permits will the project require?
MGL Chapter 91 – Waterways License/Permit from Massachusetts DEP
Clean Water Act, Section 401 Federal Water Pollution Control Act and the Massachusetts Clean

Water Act – Section 401 Water Quality Certification from Massachusetts DEP
Massachusetts Wetland Protection Act – Notice of Intent from Massachusetts DEP
Coastal Zone Management Act – MA Coastal Zone Consistency Certification from the MA Office of Coastal Zone Management
Federal Clean Water Act, Section 404 Permit – U.S. Army Corps of Engineers – Massachusetts General Permit

Identify any financial assistance or land transfer from an Agency of the Commonwealth, including the Agency name and the amount of funding or land area in acres: To be determined.

Summary of Project Size & Environmental Impacts	**Existing**	**Change**	**Total**
LAND			
Total site acreage	1.4 ac		
New acres of land altered		0.7 ac	
Acres of impervious area	0	0	0
Square feet of new bordering vegetated wetlands alteration		0	
Square feet of new other wetland alteration		31,500 sf	
Acres of new non-water dependent use of tidelands or waterways		0	
STRUCTURES			
Gross square footage	0	0	0
Number of housing units	0	0	0
Maximum height (feet)	0	0	0
TRANSPORTATION			
Vehicle trips per day	0	0	0
Parking spaces	0	0	0
WASTEWATER			
Water Use (Gallons per day)	0	0	0
Water withdrawal (GPD)	0	0	0
Wastewater generation/treatment (GPD)	0	0	0
Length of water mains (miles)	0	0	0
Length of sewer mains (miles)	0	0	0

Has this project been filed with MEPA before?
☐ Yes (EEA #__________) ☒No

Has any project on this site been filed with MEPA before?
☐ Yes (EEA #__________) ☒No

GENERAL PROJECT INFORMATION – all proponents must fill out this section

PROJECT DESCRIPTION:

Describe the existing conditions and land uses on the project site:

The Project Area is located at the east end of the Town of Hull, west of Nantasket Beach and north of Straits Pond. The Crescent Beach shore protection consists of a 1,600-foot seawall and revetment structure located on the north side of the barrier beach system along Atlantic Avenue. Atlantic Avenue is one of three evacuation routes for the Town of Hull, however the road often becomes overwashed with debris during storms as a result of overtopping water over the seawall. Due to the downward land slope from the seawall to the south, a portion of overtopped water and debris flows into Straits Pond, particularly along the western end. Crescent Beach is bordered by two rocky headlands, Gun Rock to the west and Green Hill Rock to the east. A decaying rubble-mound breakwater extends from the end of Green Hill Rock to halfway across the beach. To a certain degree, the breakwater shelters the east end of Crescent Beach from oncoming waves while the west end is left exposed.

The existing concrete seawall and grouted rubble revetment along Crescent Beach has been damaged and had a series of repairs since they were originally constructed. The success of the repairs has been mixed. The steel sheet pile driven at the toe of the revetment to address slumping and loss of armor stones, did temporarily stabilize the structure. However, the sheet pile is now in an advanced state of decay and failing. The loss of sheet pile is leading to slumping of the rubble revetment and loss of structural integrity across the face of the revetment. Large sections of the revetment have been grouted with concrete. The smooth surface and loss of voids associated with grouting accentuates the wave runup and overtopping causing further damage to the homes and infrastructure that the revetment and seawall are in place to protect. The existing seawall shows areas of cracking, spalling and breakage. Large pieces of broken concrete from the seawall are scattered along the backside of the seawall. Scour on the backside of seawall from overtopping waves nearly exposes the footing at some locations along the seawall, particularly along the west end of Crescent Beach. During periods of coastal flooding, splash-over and wave overtopping transports debris to Atlantic Avenue causing road closures.

Describe the proposed project and its programmatic and physical elements:

The seawall and revetment can be redesigned and rehabilitated to provide a greater level of protection to the homes and infrastructure landward, while not significantly increasing or changing the impacts to adjoining habitats and resources. The proposed rehabilitation plan calls for raising the crest of the seawall from 21 feet MLW to 23 feet MLW over the entire length of the wall. The increase in height will reduce wave overtopping and damage to structures landward. The additional height will be added to the seawall by encapsulating upper profile of the exposed seawall with a concrete veneer. The cap will be cast and anchored over the crest of the existing structure. This approach provides the structural connection to structurally support the extension of the seawall and addresses the spalling, cracking, and breakage along the surface of the existing seawall.

The revetment will be repaired using two structure cross-section configurations. A more substantial section will be placed to the west, where the wave energy reaching the shoreline is greater and hence a more substantial structure is required to minimize the ongoing damage. To the east, the revetment cross-section will approximate the original design section of the revetment. This stretch of shoreline benefits from shallower offshore bathymetry and the breakwater which results in smaller waves and lower wave energy along the shoreline. The west section extends for 950 feet from the western terminus of the existing structure to the east along the same alignment. The existing revetment will be completely deconstructed and the existing stone will be sorted and reused where allowable. The base of the revetment will be constructed using layers of filter fabric and smaller rocks to create a stabile foundation for the armor stone and provide protection to the foundation of the seawall from erosion. The revetment will have a 10-foot wide crest equal in height to the raised seawall. The armor stone will be placed over the rock base on 1V:2H slope from the crest seaward to the bottom. The toe of the revetment will be excavated below grade to protect the structure from erosion at the toe which could destabilize and potentially lead to failure of the revetment.

The east section of revetment will transition in profile from the larger first section over a 25-foot span and then extend 625 feet further to the east; terminating at the end of the existing seawall revetment structure. The existing revetment section will be deconstructed and the material reused where possible. The base of the revetment will be constructed using layers of filter fabric and smaller rocks to create a stabile foundation for the armor stone. The crest of the eastern section is lower than the western section. The crest will match the existing revetment at 17 feet MLW and extend 10 feet horizontally seaward from the seawall. The armor stone will be placed over the rock base on 1V:3H slope from the crest seaward to the bottom. The toe of the revetment will be excavated below grade to protect the structure from erosion at the toe, which could destabilize and potentially lead to failure of the revetment. The offset of the revetment toe from the seawall is determined by the steepness of the nearshore bathymetry. Along the eastern end, the water is shallower allowing the rehabilitated revetment section to remain within the existing structure footprint. At the western end, to achieve the necessary level of storm protection, the toe must be extended approximately 20 to 30 feet seaward from the existing revetment to achieve the required levels of wave energy dissipation.

NOTE: The project description should summarize both the project's direct and indirect impacts (including construction period impacts) in terms of their magnitude, geographic extent, duration and frequency, and reversibility, as applicable. It should also discuss the infrastructure requirements of the project and the capacity of the municipal and/or regional infrastructure to sustain these requirements into the future.

Describe the on-site project alternatives (and alternative off-site locations, if applicable), considered by the proponent, including at least one feasible alternative that is allowed under current zoning, and the reasons(s) that they were not selected as the preferred alternative:

<u>No Action:</u> The No Action alternative would allow natural processes to occur without any form of human intervention to repair, reconstruct or prevent the on-going wave overtopping and the storm damage to existing residences and public infrastructure that regularly occurs during storm events as well as the ongoing collapse of the revetment and decay of the seawall. The No Action alternative would ultimately result in the further damage and decay to the revetment and seawall, resulting in increased damage to the homes and infrastructure along Atlantic Avenue, a public road that provides access to residences both east and west of Crescent Beach. The No Action alternative is not preferable because it does not address the on-going failure of the revetment and seawall nor does it address the recurring damage to the homes and infrastructure located landward of the revetment along Atlantic Avenue. This alternative would place the residential properties and public infrastructure at increasing risk as the revetment and seawall continue to degrade and collapse.

<u>Beach Nourishment:</u> Beach nourishment would add sediment seaward of the revetment and seawall to create a beach across which wave energy is absorbed and dissipated, thereby increasing protection to infrastructure and property currently threatened by overtopping and storm damage. Once nourishment material is in place, coastal processes will rework the nourishment material to create an equilibrated beach profile. The ongoing sediment transport will transport the nourishment material both cross-shore and alongshore. Due to the ongoing transport of sediment to adjacent shorelines as well as offshore, a maintenance plan for re-nourishment and back-passing will be necessary for this alternative to be effective as a long-term management strategy. Nourishment is accompanied with some potential and real

adverse impacts that must be carefully minimized and/or mitigated. For example, the nourishment template would cover inter-tidal and sub-tidal habitats which would affect the benthic community and nearshore resources areas. The nourishment would also encroach upon the mooring field located behind the breakwater and the truck transport of material to the site could have a significant short-term impact to the community. The impacts would have to be thoroughly investigated, documented, and then mitigated for during the planning, permitting and implementation. The impacts to offshore resources might render the project unpermittable or significantly extend the time and cost required to permit the project.

<u>Nearshore Submerged Wave Break</u>: A nearshore submerged wave break would be constructed on the bottom of the ocean close to shore in shallow water to dissipate wave energy before it reaches the Crescent Beach shoreline. The wave break would extend off the bottom into the water column to trigger wave breaking as storm waves approach the shoreline from the Atlantic Ocean. A number of different technologies exist that could be suitable alternatives. The various approaches would have to be evaluated as to their suitability, performance, and potential impacts. An effective nearshore wave break at Crescent Beach would likely require a large emergent rubble-mound breakwater type system. The structure would occupy a large area of the bottom, impacting marine habitat and resources. The structure would also present a navigational hazard to marine traffic transiting in and out of the mooring field at Crescent Beach. Attempting to utilize other technologies is not preferred due to concerns about their effectiveness due to the large tidal range at the site, in addition to significant storm surges and waves encountered during storm events. A wave break structure would also have to be located relatively close to shore due to the steeply sloping offshore bathymetry. Moving the structure into deeper water would substantially increase the size and cost associate with a structure of this type. The conditions and impacts associated with submerged wave breaks at Crescent Beach make this approach not the preferred alternative.

NOTE*: The purpose of the alternatives analysis is to consider what effect changing the parameters and/or siting of a project, or components thereof, will have on the environment, keeping in mind that the objective of the MEPA review process is to avoid or minimize damage to the environment to the greatest extent feasible. Examples of alternative projects include alternative site locations, alternative site uses, and alternative site configurations.*

Summarize the mitigation measures proposed to offset the impacts of the preferred alternative: N/A

If the project is proposed to be constructed in phases, please describe each phase: N/A

AREAS OF CRITICAL ENVIRONMENTAL CONCERN:

Is the project within or adjacent to an Area of Critical Environmental Concern?
☐Yes (Specify: Weir River ACEC)
☒No
If yes, does the ACEC have an approved Resource Management Plan? ___ Yes ___ No;
If yes, describe how the project complies with this plan:
____
Will there be stormwater runoff or discharge to the designated ACEC? ___ Yes ___ No;

RARE SPECIES:

Does the project site include Estimated and/or Priority Habitat of State-Listed Rare Species? (see http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm)
☐Yes (Specify___________________________________) ☒No

HISTORICAL /ARCHAEOLOGICAL RESOURCES:

Does the project site include any structure, site or district listed in the State Register of Historic Place or the inventory of Historic and Archaeological Assets of the Commonwealth?
☐Yes (Specify_________________________________) ☒No

If yes, does the project involve any demolition or destruction of any listed or inventoried historic or archaeological resources? ☐Yes (Specify_________________________________) ☐No

WATER RESOURCES:

Is there an Outstanding Resource Water (ORW) on or within a half-mile radius of the project site?
_X_ Yes ___ No;
If yes, identify the ORW and its location. Weir River ACEC

(NOTE: Outstanding Resource Waters include Class A public water supplies, their tributaries, and bordering wetlands; active and inactive reservoirs approved by MassDEP; certain waters within Areas of Critical Environmental Concern, and certified vernal pools. Outstanding resource waters are listed in the Surface Water Quality Standards, 314 CMR 4.00.)

Are there any impaired water bodies on or within a half-mile radius of the project site? ___ Yes _X_ No;
If yes, identify the water body and pollutant(s) causing the impairment:
____

Is the project within a medium or high stress basin, as established by the Massachusetts Water Resources Commission? ___ Yes _X_ No

STORMWATER MANAGEMENT:

Generally describe the project's stormwater impacts and measures that the project will take to comply with the standards found in MassDEP's Stormwater Management Regulations:
Existing runoff from wave overtopping in the Project Area drains into Straits Pond. The Project results in reduced wave overtopping and runoff to the ACEC.

MASSACHUSETTS CONTINGENCY PLAN:

Has the project site been, or is it currently being, regulated under M.G.L.c.21E or the Massachusetts Contingency Plan? Yes ___ No _X_;
If yes, please describe the current status of the site (including Release Tracking Number (RTN), cleanup phase, and Response Action Outcome classification): __________________

Is there an Activity and Use Limitation (AUL) on any portion of the project site? Yes ___ No _X_;
If yes, describe which portion of the site and how the project will be consistent with the AUL:
_____________________.

Are you aware of any Reportable Conditions at the property that have not yet been assigned an RTN?
Yes ___ No _X_;
If yes, please describe: _________________________________

SOLID AND HAZARDOUS WASTE:

If the project will generate solid waste during demolition or construction, describe alternatives considered for re-use, recycling, and disposal of, e.g., asphalt, brick, concrete, gypsum, metal, wood: Project includes the demolition of the existing concrete and stone revetment. If appropriate, stones will be reused in the construction of the new revetment. Concrete will be recycled at an approved upland facility.

(NOTE: Asphalt pavement, brick, concrete and metal are banned from disposal at Massachusetts landfills and waste combustion facilities and wood is banned from disposal at Massachusetts landfills. See 310 CMR 19.017 for the complete list of banned materials.)

Will your project disturb asbestos containing materials? Yes ___ No _X_;
If yes, please consult state asbestos requirements at http://mass.gov/MassDEP/air/asbhom01.htm

Describe anti-idling and other measured to limit emissions from construction equipment: Vehicles and equipment will be turned off when not in use for more than 5 minutes in accordance with the Massachusetts Anti-Idling Law.

DESIGNATED WILD AND SCENIC RIVER:

Is this project site located wholly or partially within a defined river corridor of a federally designated Wild and Scenic River or a state designated Scenic River? Yes ___ No _X_;
If yes, specify name of river and designation:

If yes, does the project have the potential to impact any of the "outstandingly remarkable" resources of a federally Wild and Scenic River or the stated purpose of a state designated Scenic River? Yes ___ No _X_;
If yes, specify name of river and designation: _____________;
If yes, will the project will result in any impacts to any of the designated "outstandingly remarkable" resources of the Wild and Scenic River or the stated purposes of a Scenic River? Yes ___ No ___;
If yes, describe the potential impacts to one or more of the "outstandingly remarkable" resources or stated purposes and mitigation measures proposed.

ATTACHMENTS:

1.	List of all attachments to this document.	See Table of Contents
2.	U.S.G.S. map (good quality color copy, 8-½ x 11 inches or larger, at a scale of 1:24,000) indicating the project location and boundaries.	See page USGS-1
3.	Plan, at an appropriate scale, of existing conditions on the project site and its immediate environs, showing all known structures, roadways and parking lots, railroad rights-of-way, wetlands and water bodies, wooded areas, farmland, steep slopes, public open spaces, and major utilities.	See Appendix A
4.	Plan, at an appropriate scale, depicting environmental constraints on or adjacent to the project site such as Priority and/or Estimated Habitat of state-listed rare species, Areas of Critical Environmental Concern, Chapter 91 jurisdictional areas, Article 97 lands, wetland resource area delineations, water supply protection areas, and historic resources and/or districts.	See Figure 2.7
5.	Plan, at an appropriate scale, of proposed conditions upon completion of project (if construction of the project is proposed to be phased, there should be a site plan showing conditions upon the completion of each phase).	See Appendix A
6.	List of all agencies and persons to whom the proponent circulated the ENF, in accordance with 301 CMR 11.16(2).	See ENF Distribution List
7.	List of municipal and federal permits and reviews required by the project, as applicable.	See Section 6.0

LAND SECTION – all proponents must fill out this section

I. Thresholds / Permits

A. Does the project meet or exceed any review thresholds related to **land** (see 301 CMR 11.03(1)
___ Yes _X_ No; if yes, specify each threshold:

II. Impacts and Permits

A. Describe, in acres, the current and proposed character of the project site, as follows:

	Existing	Change	Total
Footprint of buildings	___	___	___
Internal roadways	___	___	___
Parking and other paved areas	___	___	___
Other altered areas	1.4	0.7	2.1
Undeveloped areas	___	___	___
Total: Project Site Acreage	1.4	0.7	2.1

B. Has any part of the project site been in active agricultural use in the last five years?
___ Yes _X_ No; if yes, how many acres of land in agricultural use (with prime state or locally important agricultural soils) will be converted to nonagricultural use?

C. Is any part of the project site currently or proposed to be in active forestry use?
___ Yes _X_ No; if yes, please describe current and proposed forestry activities and indicate whether any part of the site is the subject of a forest management plan approved by the Department of Conservation and Recreation:

D. Does any part of the project involve conversion of land held for natural resources purposes in accordance with Article 97 of the Amendments to the Constitution of the Commonwealth to any purpose not in accordance with Article 97? ___ Yes _X_ No; if yes, describe:

E. Is any part of the project site currently subject to a conservation restriction, preservation restriction, agricultural preservation restriction or watershed preservation restriction?
___ Yes _X_ No; if yes, does the project involve the release or modification of such restriction? ___ Yes ___ No; if yes, describe:

F. Does the project require approval of a new urban redevelopment project or a fundamental change in an existing urban redevelopment project under M.G.L.c.121A? ___ Yes _X_ No; if yes, describe:

G. Does the project require approval of a new urban renewal plan or a major modification of an existing urban renewal plan under M.G.L.c.121B? Yes ___ No _X_; if yes, describe:

III. Consistency

A. Identify the current municipal comprehensive land use plan
Title: Hull Community Development Plan
Date: June 2004

B. Describe the project's consistency with that plan with regard to:
1) economic development – N/A
2) adequacy of infrastructure – consistent with goal to reduce flooding in high repetitive areas and reduce road storm damage
3) open space impacts – N/A
4) compatibility with adjacent land uses – N/A

C. Identify the current Regional Policy Plan of the applicable Regional Planning Agency (RPA)

RPA: MAPC – Metropolitan Area Planning Council
Title: MetroFuture Date: May 2008

D. Describe the project's consistency with that plan with regard to:
1) economic development – N/A
2) adequacy of infrastructure - consistent with goal for the region to be prepared for and resilient to natural disasters and climate change
3) open space impacts – N/A

RARE SPECIES SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **rare species or habitat** (see 301 CMR 11.03(2))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

(NOTE: If you are uncertain, it is recommended that you consult with the Natural Heritage and Endangered Species Program (NHESP) prior to submitting the ENF.)

B. Does the project require any state permits related to **rare species or habitat**? ___ Yes _X_ No

C. Does the project site fall within mapped rare species habitat (Priority or Estimated Habitat?) in the current Massachusetts Natural Heritage Atlas (attach relevant page)? ___ Yes _X_ No

D. If you answered "No" to all questions A, B and C, proceed to the **Wetlands, Waterways, and Tidelands Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Rare Species section below.

II. Impacts and Permits

A. Does the project site fall within Priority or Estimated Habitat in the current Massachusetts Natural Heritage Atlas (attach relevant page)? ___ Yes ___ No. If yes,

1. Have you consulted with the Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP)? ___Yes ___No; if yes, have you received a determination as to whether the project will result in the “take” of a rare species? ___ Yes ___ No; if yes, attach the letter of determination to this submission.

2. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes ___ No; if yes, provide a summary of proposed measures to minimize and mitigate rare species impacts

3. Which rare species are known to occur within the Priority or Estimated Habitat?

4. Has the site been surveyed for rare species in accordance with the Massachusetts Endangered Species Act? ___ Yes ___ No

4. If your project is within Estimated Habitat, have you filed a Notice of Intent or received an Order of Conditions for this project? ___ Yes ___ No; if yes, did you send a copy of the Notice of Intent to the Natural Heritage and Endangered Species Program, in accordance with the Wetlands Protection Act regulations? ___ Yes ___ No

B. Will the project "take" an endangered, threatened, and/or species of special concern in accordance with M.G.L. c.131A (see also 321 CMR 10.04)? ___ Yes ___ No; if yes, provide a summary of proposed measures to minimize and mitigate impacts to significant habitat:

WETLANDS, WATERWAYS, AND TIDELANDS SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wetlands, waterways, and tidelands** (see 301 CMR 11.03(3))? _X_ Yes ___ No; if yes, specify, in quantitative terms:
301 CMR 11.03(3)(b)(1)(e) - New fill or structure or expansion of existing fill or structure
301 CMR 11.03(3)(b)(6) - Construction, reconstruction or Expansion of an existing solid fill structure of 1,000 or more sf base area or of a pile-supported or bottom-anchored structure of 2,000 or more sf base area, except a seasonal, pile-held or bottom-anchored float, provided the structure occupies flowed tidelands or other waterways

B. Does the project require any state permits (or a local Order of Conditions) related to **wetlands, waterways, or tidelands**? _X_ Yes ____ No; if yes, specify which permit:

- MGL Chapter 91 – Waterways License/Permit from Massachusetts DEP
- Clean Water Act, Section 401 Federal Water Pollution Control Act and the Massachusetts Clean Water Act – Section 401 Water Quality Certification from Massachusetts DEP
- Massachusetts Wetland Protection Act – Notice of Intent from Massachusetts DEP
- Coastal Zone Management Act – MA Coastal Zone Consistency Certification from the MA Office of Coastal Zone Management
- Federal Clean Water Act, Section 404 Permit – U.S. Army Corps of Engineers – Massachusetts General Permit

C. If you answered "No" to both questions A and B, proceed to the **Water Supply Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wetlands, Waterways, and Tidelands Section below.

II. Wetlands Impacts and Permits

A. Does the project require a new or amended Order of Conditions under the Wetlands Protection Act (M.G.L. c.131A)? _X_ Yes ___ No; if yes, has a Notice of Intent been filed? ___ Yes _X_No; if yes, list the date and MassDEP file number: ______; if yes, has a local Order of Conditions been issued? ___ Yes ___ No; Was the Order of Conditions appealed? ___ Yes ___ No. Will the project require a Variance from the Wetlands regulations? ___ Yes ___ No.

B. Describe any proposed permanent or temporary impacts to wetland resource areas located on the project site: See Project Narrative.

C. Estimate the extent and type of impact that the project will have on wetland resources, and indicate whether the impacts are temporary or permanent:

Coastal Wetlands	Area (square feet) or Length (linear feet)	Temporary or Permanent Impact?
Land Under the Ocean	16,100 sf	Permanent
Designated Port Areas		
Coastal Beaches	15,300 sf	Permanent
Coastal Dunes		
Barrier Beaches	15,300 sf	Permanent
Coastal Banks		
Rocky Intertidal Shores		
Salt Marshes		
Land Under Salt Ponds		

Land Containing Shellfish	________	________
Fish Runs	________	________
Land Subject to Coastal Storm Flowage	81,100 sf	31,500 sf Permanent

Inland Wetlands

Bank (lf)	________	________
Bordering Vegetated Wetlands	________	________
Isolated Vegetated Wetlands	________	________
Land under Water	________	________
Isolated Land Subject to Flooding	________	________
Bordering Land Subject to Flooding	________	________
Riverfront Area	________	________

D. Is any part of the project:

1. proposed as a **limited** project? ___ Yes _X_ No; if yes, what is the area (in sf)?____
2. the construction or alteration of a **dam**? ___ Yes _X_ No; if yes, describe:
3. fill or structure in a **velocity zone** or **regulatory floodway**? _X_ Yes ___ No
4. dredging or disposal of dredged material? _X_ Yes ___ No; if yes, describe the volume of dredged material and the proposed disposal site:
   Approximately 2,500 CY to be dredged and the beach compatible material to be placed at the new revetment toe.
5. a discharge to an **Outstanding Resource Water (ORW)** or an **Area of Critical Environmental Concern (ACEC)**? ___ Yes _X_ No
6. subject to a wetlands restriction order? ___ Yes _X_ No; if yes, identify the area (in sf):
7. located in buffer zones? ___Yes _X_ No; if yes, how much (in sf) ______

E. Will the project:

1. be subject to a local wetlands ordinance or bylaw? ___ Yes _X_ No
2. alter any federally-protected wetlands not regulated under state law? ___ Yes _X_ No; if yes, what is the area (sf)?

III. Waterways and Tidelands Impacts and Permits

A. Does the project site contain waterways or tidelands (including filled former tidelands) that are subject to the Waterways Act, M.G.L.c.91? _X_ Yes ___ No; if yes, is there a current Chapter 91 License or Permit affecting the project site? ___ Yes _X_ No; if yes, list the date and license or permit number and provide a copy of the historic map used to determine extent of filled tidelands:

B. Does the project require a new or modified license or permit under M.G.L.c.91?_X_ Yes ___ No; if yes, how many acres of the project site subject to M.G.L.c.91 will be for non-water-dependent use? Current _0_ Change _0_ Total _0_
If yes, how many square feet of solid fill or pile-supported structures (in sf)? 31,500 sf

C. For non-water-dependent use projects, indicate the following:
Area of filled tidelands on the site:____________________
Area of filled tidelands covered by buildings:____________
For portions of site on filled tidelands, list ground floor uses and area of each use:
____
Does the project include new non-water-dependent uses located over flowed tidelands?
Yes ___ No ___
Height of building on filled tidelands________________

Also show the following on a site plan: Mean High Water, Mean Low Water, Water-dependent Use Zone, location of uses within buildings on tidelands, and interior and exterior areas and facilities dedicated for public use, and historic high and historic low water marks.

D. Is the project located on landlocked tidelands? ___ Yes _X_ No; if yes, describe the project's impact on the public's right to access, use and enjoy jurisdictional tidelands and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

E. Is the project located in an area where low groundwater levels have been identified by a municipality or by a state or federal agency as a threat to building foundations? ___ Yes _X_ No; if yes, describe the project's impact on groundwater levels and describe measures the project will implement to avoid, minimize or mitigate any adverse impact:

F. Is the project non-water-dependent **and** located on landlocked tidelands **or** waterways or tidelands subject to the Waterways Act **and** subject to a mandatory EIR? ___ Yes _X_ No;
(NOTE: If yes, then the project will be subject to Public Benefit Review and Determination.)

G. Does the project include dredging?_X_ Yes ___ No; if yes, answer the following questions:
What type of dredging? Improvement _X_ Maintenance ___ Both ____
What is the proposed dredge volume, in cubic yards (cys) _2,500_
What is the proposed dredge footprint _1,000_ length (ft) _20_ width (ft) _3_ depth (ft);
Will dredging impact the following resource areas?
Intertidal Yes _X_ No__; if yes, ___ sq ft
Outstanding Resource Waters Yes__ No _X_; if yes, ___ sq ft
Other resource area (i.e. shellfish beds, eel grass beds) Yes__ No _X_; if yes __ sq ft
If yes to any of the above, have you evaluated appropriate and practicable steps to: 1) avoidance; 2) if avoidance is not possible, minimization; 3) if either avoidance or minimize is not possible, mitigation?
If no to any of the above, what information or documentation was used to support this determination? MassGIS data layers, see Project Narrative
Provide a comprehensive analysis of practicable alternatives for improvement dredging in accordance with 314 CMR 9.07(1)(b). Physical and chemical data of the sediment shall be included in the comprehensive analysis.
Sediment Characterization
Existing gradation analysis results? __Yes _X_ No: if yes, provide results.
Existing chemical results for parameters listed in 314 CMR 9.07(2)(b)6? ___Yes _X_ No; if yes, provide results.
Do you have sufficient information to evaluate feasibility of the following management options for dredged sediment? If yes, check the appropriate option.

Beach Nourishment _X_
Unconfined Ocean Disposal ___
Confined Disposal:
Confined Aquatic Disposal (CAD) ___
Confined Disposal Facility (CDF) ___
Landfill Reuse in accordance with COMM-97-001 ___
Shoreline Placement ___
Upland Material Reuse____
In-State landfill disposal____
Out-of-state landfill disposal ____
(NOTE: This information is required for a 401 Water Quality Certification.)

IV. Consistency:

A. Does the project have effects on the coastal resources or uses, and/or is the project located within the Coastal Zone? _X_ Yes ___ No; if yes, describe these effects and the projects consistency with the policies of the Office of Coastal Zone Management: The Project complies with the Massachusetts Coastal Zone Management program policies and will be conducted in a manner consistent with said program. CZM consistency review will be required as part of the Army Corps Section 404 review of this Project as well.

B. Is the project located within an area subject to a Municipal Harbor Plan? _X_ Yes ___ No; if yes, identify the Municipal Harbor Plan and describe the project's consistency with that plan:
The Crescent Beach seawall is identified as a structure requiring reconstruction and repair in Section IV(2) of the Harbor Management Plan for the Town of Hull (December 1999).

WATER SUPPLY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **water supply** (see 301 CMR 11.03(4))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **water supply**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Wastewater Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Water Supply Section below.

II. Impacts and Permits

A. Describe, in gallons per day (gpd), the volume and source of water use for existing and proposed activities at the project site:

	Existing	Change	Total
Municipal or regional water supply	________	________	________
Withdrawal from groundwater	________	________	________
Withdrawal from surface water	________	________	________
Interbasin transfer	________	________	________

(NOTE: Interbasin Transfer approval will be required if the basin and community where the proposed water supply source is located is different from the basin and community where the wastewater from the source will be discharged.)

B. If the source is a municipal or regional supply, has the municipality or region indicated that there is adequate capacity in the system to accommodate the project? ___ Yes ___ No

C. If the project involves a new or expanded withdrawal from a groundwater or surface water source, has a pumping test been conducted? ___ Yes ___ No; if yes, attach a map of the drilling sites and a summary of the alternatives considered and the results. ______________

D. What is the currently permitted withdrawal at the proposed water supply source (in gallons per day)? ______Will the project require an increase in that withdrawal? ___Yes ___No; if yes, then how much of an increase (gpd)? ____________________

E. Does the project site currently contain a water supply well, a drinking water treatment facility, water main, or other water supply facility, or will the project involve construction of a new facility? ___ Yes ___No. If yes, describe existing and proposed water supply facilities at the project site:

	Permitted Flow	Existing Avg Daily Flow	Project Flow	Total
Capacity of water supply well(s) (gpd)	_______	________	________	________
Capacity of water treatment plant (gpd)	_______	________	________	________

F. If the project involves a new interbasin transfer of water, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or proposed?

G. Does the project involve:

1. new water service by the Massachusetts Water Resources Authority or other agency of the Commonwealth to a municipality or water district? ___ Yes ___ No
2. a Watershed Protection Act variance? ___ Yes ___ No; if yes, how many acres of alteration?
3. a non-bridged stream crossing 1,000 or less feet upstream of a public surface drinking water supply for purpose of forest harvesting activities? ___ Yes ___ No

III. Consistency

Describe the project's consistency with water conservation plans or other plans to enhance water resources, quality, facilities and services:

WASTEWATER SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **wastewater** (see 301 CMR 11.03(5))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **wastewater**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Transportation -- Traffic Generation Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Wastewater Section below.

II. Impacts and Permits

A. Describe the volume (in gallons per day) and type of disposal of wastewater generation for existing and proposed activities at the project site (calculate according to 310 CMR 15.00 for septic systems or 314 CMR 7.00 for sewer systems):

	Existing	Change	Total
Discharge of sanitary wastewater	________	________	________
Discharge of industrial wastewater	________	________	________
TOTAL	________	________	________

	Existing	Change	Total
Discharge to groundwater	________	________	________
Discharge to outstanding resource water	________	________	________
Discharge to surface water	________	________	________
Discharge to municipal or regional wastewater facility	________	________	________
TOTAL	________	________	________

B. Is the existing collection system at or near its capacity? ___ Yes ___ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

C. Is the existing wastewater disposal facility at or near its permitted capacity? ___ Yes___ No; if yes, then describe the measures to be undertaken to accommodate the project's wastewater flows:

D. Does the project site currently contain a wastewater treatment facility, sewer main, or other wastewater disposal facility, or will the project involve construction of a new facility? ___ Yes ___ No; if yes, describe as follows:

	Permitted	Existing Avg Daily Flow	Project Flow	Total
Wastewater treatment plant capacity (in gallons per day)	_______	________	________	________

E. If the project requires an interbasin transfer of wastewater, which basins are involved, what is the direction of the transfer, and is the interbasin transfer existing or new?

(NOTE: Interbasin Transfer approval may be needed if the basin and community where wastewater will be discharged is different from the basin and community where the source of water supply is located.)

F. Does the project involve new sewer service by the Massachusetts Water Resources Authority (MWRA) or other Agency of the Commonwealth to a municipality or sewer district? ___ Yes ___ No

G. Is there an existing facility, or is a new facility proposed at the project site for the storage, treatment, processing, combustion or disposal of sewage sludge, sludge ash, grit, screenings, wastewater reuse (gray water) or other sewage residual materials? ___ Yes ___ No; if yes, what is the capacity (tons per day):

	Existing	Change	Total
Storage	________	________	________
Treatment	________	________	________
Processing	________	________	________
Combustion	________	________	________
Disposal	________	________	________

H. Describe the water conservation measures to be undertaken by the project, and other wastewater mitigation, such as infiltration and inflow removal.

III. Consistency

A. Describe measures that the proponent will take to comply with applicable state, regional, and local plans and policies related to wastewater management:

B. If the project requires a sewer extension permit, is that extension included in a comprehensive wastewater management plan? ___ Yes ___ No; if yes, indicate the EEA number for the plan and whether the project site is within a sewer service area recommended or approved in that plan:

TRANSPORTATION SECTION (TRAFFIC GENERATION)

I. Thresholds / Permit

A. Will the project meet or exceed any review thresholds related to **traffic generation** (see 301 CMR 11.03(6))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

C. Does the project require any state permits related to **state-controlled roadways**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Roadways and Other Transportation Facilities Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Traffic Generation Section below.

II. Traffic Impacts and Permits

A. Describe existing and proposed vehicular traffic generated by activities at the project site:

	Existing	Change	Total
Number of parking spaces	_______	________	________
Number of vehicle trips per day	________	________	________
ITE Land Use Code(s):	________	________	________

B. What is the estimated average daily traffic on roadways serving the site?

Roadway	Existing	Change	Total
1. ____________________	________	________	________
2. _____________________	________	________	________
3. _____________________	________	________	________

C. If applicable, describe proposed mitigation measures on state-controlled roadways that the project proponent will implement:

D. How will the project implement and/or promote the use of transit, pedestrian and bicycle facilities and services to provide access to and from the project site?

C. Is there a Transportation Management Association (TMA) that provides transportation demand management (TDM) services in the area of the project site? ____ Yes ____ No; if yes, describe if and how will the project will participate in the TMA:

D. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation facilities? ____ Yes ____ No; if yes, generally describe:

E. If the project will penetrate approach airspace of a nearby airport, has the proponent filed a Massachusetts Aeronautics Commission Airspace Review Form (780 CMR 111.7) and a Notice of Proposed Construction or Alteration with the Federal Aviation Administration (FAA) (CFR Title 14 Part 77.13, forms 7460-1 and 7460-2)?

III. Consistency

Describe measures that the proponent will take to comply with municipal, regional, state, and federal plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services:

TRANSPORTATION SECTION (ROADWAYS AND OTHER TRANSPORTATION FACILITIES)

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **roadways or other transportation facilities** (see 301 CMR 11.03(6))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **roadways or other transportation facilities**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Energy Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Roadways Section below.

II. Transportation Facility Impacts

A. Describe existing and proposed transportation facilities in the immediate vicinity of the project site:

B. Will the project involve any

1. Alteration of bank or terrain (in linear feet)? ____________
2. Cutting of living public shade trees (number)? ____________
3. Elimination of stone wall (in linear feet)? ____________

III. Consistency -- Describe the project's consistency with other federal, state, regional, and local plans and policies related to traffic, transit, pedestrian and bicycle transportation facilities and services, including consistency with the applicable regional transportation plan and the Transportation Improvements Plan (TIP), the State Bicycle Plan, and the State Pedestrian Plan:

ENERGY SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **energy** (see 301 CMR 11.03(7))?
___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **energy**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Air Quality Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Energy Section below.

II. Impacts and Permits

A. Describe existing and proposed energy generation and transmission facilities at the project site:

	Existing	Change	Total
Capacity of electric generating facility (megawatts)	________	________	________
Length of fuel line (in miles)	________	________	________
Length of transmission lines (in miles)	________	________	________
Capacity of transmission lines (in kilovolts)	________	________	________

B. If the project involves construction or expansion of an electric generating facility, what are:

1. the facility's current and proposed fuel source(s)?
2. the facility's current and proposed cooling source(s)?

C. If the project involves construction of an electrical transmission line, will it be located on a new, unused, or abandoned right of way? ___Yes ___No; if yes, please describe:

D. Describe the project's other impacts on energy facilities and services:

III. Consistency

Describe the project's consistency with state, municipal, regional, and federal plans and policies for enhancing energy facilities and services:

AIR QUALITY SECTION

I. Thresholds

A. Will the project meet or exceed any review thresholds related to **air quality** (see 301 CMR 11.03(8))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

B. Does the project require any state permits related to **air quality**? ___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Solid and Hazardous Waste Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Air Quality Section below.

II. Impacts and Permits

A. Does the project involve construction or modification of a major stationary source (see 310 CMR 7.00, Appendix A)? ___ Yes ___ No; if yes, describe existing and proposed emissions (in tons per day) of:

	Existing	Change	Total
Particulate matter	________	________	________
Carbon monoxide	________	________	________
Sulfur dioxide	________	________	________
Volatile organic compounds	________	________	________
Oxides of nitrogen	________	________	________
Lead	________	________	________
Any hazardous air pollutant	________	________	________
Carbon dioxide	________	________	________

B. Describe the project's other impacts on air resources and air quality, including noise impacts:

III. Consistency

A. Describe the project's consistency with the State Implementation Plan:

B. Describe measures that the proponent will take to comply with other federal, state, regional, and local plans and policies related to air resources and air quality:

SOLID AND HAZARDOUS WASTE SECTION

I. Thresholds / Permits

A. Will the project meet or exceed any review thresholds related to **solid or hazardous waste** (see 301 CMR 11.03(9))? ___ Yes _X_ No; if yes, specify, in quantitative terms:

C. Does the project require any state permits related to **solid and hazardous waste**?
___ Yes _X_ No; if yes, specify which permit:

C. If you answered "No" to both questions A and B, proceed to the **Historical and Archaeological Resources Section**. If you answered "Yes" to either question A or question B, fill out the remainder of the Solid and Hazardous Waste Section below.

II. Impacts and Permits

A. Is there any current or proposed facility at the project site for the storage, treatment, processing, combustion or disposal of solid waste? ___ Yes ___ No; if yes, what is the volume (in tons per day) of the capacity:

	Existing	Change	Total
Storage	________	________	________
Treatment, processing	________	________	________
Combustion	________	________	________
Disposal	________	________	________

B. Is there any current or proposed facility at the project site for the storage, recycling, treatment or disposal of hazardous waste? ___ Yes ___ No; if yes, what is the volume (in tons or gallons per day) of the capacity:

	Existing	Change	Total
Storage	________	________	________
Recycling	________	________	________
Treatment	________	________	________
Disposal	________	________	________

C. If the project will generate solid waste (for example, during demolition or construction), describe alternatives considered for re-use, recycling, and disposal:

D. If the project involves demolition, do any buildings to be demolished contain asbestos?
___ Yes ___ No

E. Describe the project's other solid and hazardous waste impacts (including indirect impacts):

III. Consistency

Describe measures that the proponent will take to comply with the State Solid Waste Master Plan:

HISTORICAL AND ARCHAEOLOGICAL RESOURCES SECTION

I. Thresholds / Impacts

A. Have you consulted with the Massachusetts Historical Commission? ___ Yes _X_ No; if yes, attach correspondence. For project sites involving lands under water, have you consulted with the Massachusetts Board of Underwater Archaeological Resources? ____Yes _X_ No; if yes, attach correspondence

B. Is any part of the project site a historic structure, or a structure within a historic district, in either case listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? ___ Yes _X_ No; if yes, does the project involve the demolition of all or any exterior part of such historic structure? ___ Yes ___ No; if yes, please describe:

C. Is any part of the project site an archaeological site listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth? ___ Yes _X_ No; if yes, does the project involve the destruction of all or any part of such archaeological site? ___ Yes ___ No; if yes, please describe:

D. If you answered "No" to all parts of both questions A, B and C, proceed to the **Attachments and Certifications** Sections. If you answered "Yes" to any part of either question A or question B, fill out the remainder of the Historical and Archaeological Resources Section below.

II. Impacts

Describe and assess the project's impacts, direct and indirect, on listed or inventoried historical and archaeological resources:

III. Consistency

Describe measures that the proponent will take to comply with federal, state, regional, and local plans and policies related to preserving historical and archaeological resources:

CERTIFICATIONS:

1. The Public Notice of Environmental Review has been/will be published in the following newspapers in accordance with 301 CMR 11.15(1):

   (Name) Hull Times (Date) July 3, 2015

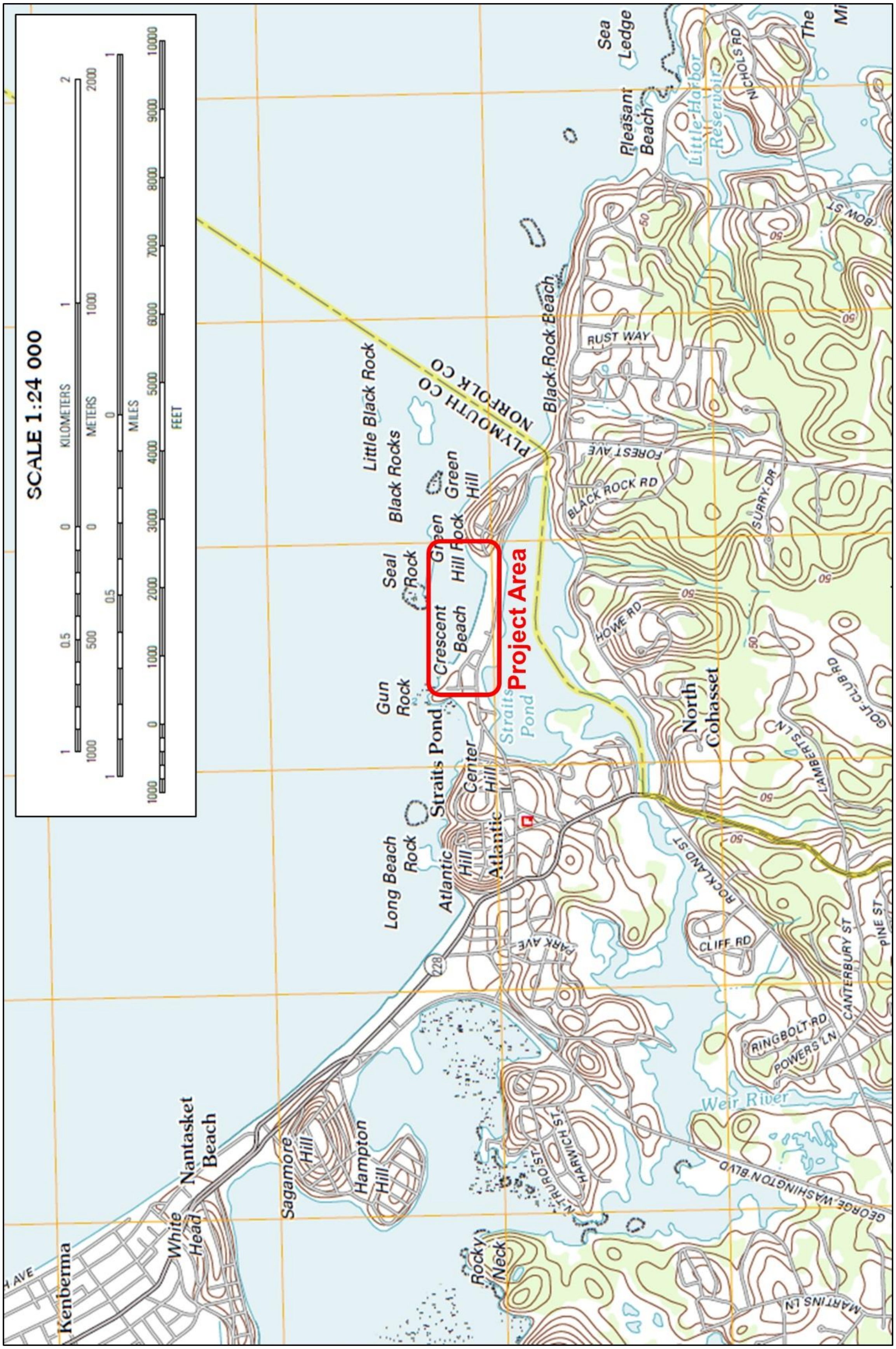
2. This form has been circulated to Agencies and Persons in accordance with 301 CMR 11.16(2).

Signatures:

June 30, 2015	June 30, 2015
Date Signature of Responsible Officer or Proponent	Date Signature of person preparing MPC (if different from above)
Anne Herbst	John Ramsey
Name (print or type)	Name (print or type)
Town of Hull	Applied Coastal Research and Engineering, Inc.
Firm/Agency	Firm/Agency
253 Atlantic Avenue	766 Falmouth Road, Suite A-1
Street	Street
Hull, MA 02045	Mashpee, MA 02649
Municipality/State/Zip	Municipality/State/Zip
781-925-2000	508-539-3737
Phone	Phone

USGS MAP

See following page.


SCALE 1:24 000
KILOMETERS
METERS
MILES
FEET
Project Area
Crescent Beach
Green Hill Rock
Green Hill
Seal Rock
Gun Rock
Straits Pond
Black Rocks
Little Black Rock
NORFOLK CO
PLYMOUTH CO
Black Rock Beach
Pleasant Beach
Sea Ledge
Little Harbor Reservoir
North Cohasset
Center Hill
Atlantic Hill
Atlantic
Long Beach Rock
Nantasket Beach
White Head
Kenberma
Sagamore Hill
Hampton Hill
Rocky Neck
Weir River
RUST WAY
FOREST AVE
BLACK ROCK RD
HOWE RD
SURRY DR
NICHOLS RD
BOW ST
ROCKLAND ST
CLIFF RD
PARK AVE
LAMBERTS LN
GOLF CLUB RD
RINGBOLT RD
POWERS LN
CANTERBURY ST
PINE ST
GEORGE WASHINGTON BLVD
MARTINS LN
TRURO ST
HARWICH ST

1.0 PROJECT OVERVIEW

1.1 Introduction

This document is an Environmental Notification Form (ENF) for the Crescent Beach Seawall and Revetment Repair Project (the Project) in the Town of Hull, Massachusetts. The location of the Project is shown on the MassGIS Statewide Basemap shown in Figure 1.1. This ENF is submitted on behalf the Town of Hull Conservation Department to the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) under the Massachusetts Environmental Policy Act (MEPA), in accordance with 301 Code of Massachusetts Regulations (CMR) 11.00 and with General Laws Chapter 30, Sections 61 through 62H. In accordance with 301 CMR 11.05(4), this ENF includes a concise and accurate description of the Project and its alternatives, identification of review thresholds and agency actions, and an assessment of potential environmental impacts and mitigation measures.

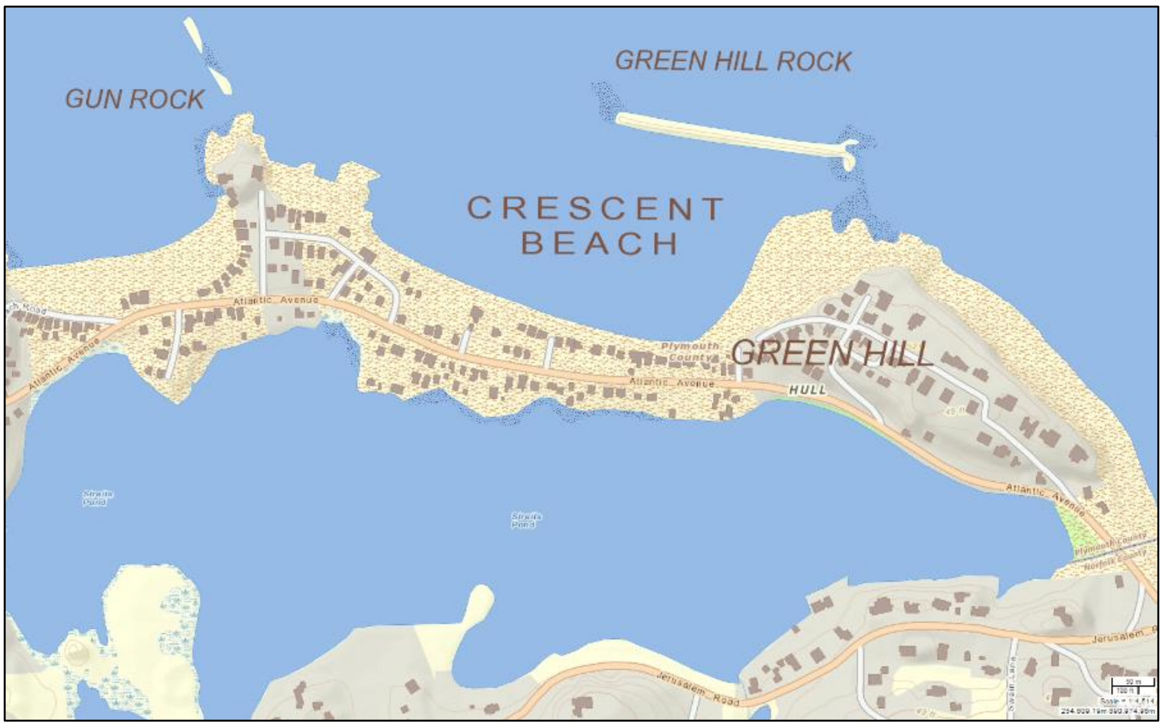


Figure 1.1. Project area vicinity showing Gun Rock, Green Hill Rock and Straits Pond (map from MassGIS Statewide Basemap).

1.1 Description of Project Area

The Project Area is located at the east end of the Town of Hull, east of Nantasket Beach and north of Straits Pond. The Crescent Beach shore protection consists of a 1,600 ft seawall and revetment structure located on the north side of the barrier beach system along Atlantic Avenue. Atlantic Avenue is one of three evacuation routes for the Town of Hull, however the road often becomes overwashed with sediment and debris during storms as a result of overtopping water over the seawall. Due to the downward land slope from the seawall to the south, a portion of overtopped water and debris flows into Straits Pond, particularly along the western end. Crescent Beach is bordered by two rocky headlands, Gun Rock to the west and Green Hill Rock to the east. A decaying rubble-mound breakwater extends from the end of Green Hill Rock to halfway across the beach. To a certain degree, the breakwater shelters the east end of Crescent Beach from oncoming waves while the west end is left exposed.

1.2 Project Area History

The Project Area has a long history of storm damage. Repair plans dating back to June 1939 state that seawall and revetment have been replaced and/or reinforced several times. The most recent plans from May 1966 call for steel sheet piling at the toe of the revetment and 2 feet of concrete grout for the stone revetment. The Northeastern Blizzard of 1978 affected Crescent Beach significantly, resulting in FEMA buyout of four homes on along the west side of the beach. Figure 1.2, from the Town on Hull, shows the damage caused by the blizzard at Crescent Beach. The damage caused by the blizzard was repaired by FEMA in 1979 as per the 1966 plans. The fixed structure of the revetment prevents the armor stones from naturally settling and, as a result, prevents the revetment from adapting to the lower beach elevation when toe scour occurs. While the grouting prevent the revetment from being destroyed during storms, the wave-dissipation ability of the revetment is reduced and wave overtopping is intensified. As mentioned, Atlantic Avenue is one of three evacuation route for the Town. Emergency response time to the Hull homes east of Crescent Beach is quadrupled when the road is impassable due to flooding. Clearing Atlantic Avenue for emergency vehicles generally takes a minimum of 5 hours and the road is closed to citizens for more than a day. According to the Town, the road is often flooded during minor storms several times each winter. Figure 1.3 and Figure 1.4 show road flooding and sediment and debris overwash during a storm on October 23, 2014. While the storm was considered minor (high water levels of ~12 ft MLW, offshore waves of 16 ft, and 20-30 mph winds), the Project Area experienced a significant amount of damage.

The Crescent Beach seawall and revetment is in need of immediate improvements to ensure the long-term viability of this structure that protects the infrastructure along Atlantic Avenue. The Project will provide immediate potential flood protection to the residents along Atlantic Avenue in the event of a storm. Of the 73 homes in the Project Area: 42 have received flood reimbursements from FEMA, 19 are repetitive loss properties, and 8 are severe repetitive loss properties. \$3.5 million in federal claims have been paid out since 1978 with an average of \$83,000 per claim. During Winter Storm Nemo in February 2013, the Town spent \$75,000 on debris removal, purchase and backfilling of material for the scoured seawall, and seawall repair. Generally, the Town spends \$7,000 to \$10,000 for road repair after a typical storm.

In recent years, some progress has been made to increase the resiliency of the Project Area. This progress includes 10 properties elevated on pilings, buildings relocating from the seawall, and flow-through decking installed to reduce storm damage.

In 2010, the Department of Conservation and Recreation (DCR) funded a condition survey and engineering design for repairs to the shore protection infrastructure along Crescent Beach. A Notice of Intent (NOI) was prepared; however the project was withdrawn, as significant concerns remained regarding potential impacts of the proposed project on the barrier beach resource. In 2014, an engineering evaluation and design effort received a Massachusetts Coastal Zone Management (MCZM) Coastal Resiliency Grant. This ENF represents the results of this updated alternatives and design evaluation to reduce storm overwash and the associated adverse impacts.

Figure 1.2. Flood damage during the Blizzard of 1978 (photo from the Town of Hull).

Figure 1.3. Overwashed sediment on Atlantic Avenue after a minor storm on October 23, 2014 (photo from the Town of Hull).

Figure 1.4. Damaged asphalt and overwashed sediment and debris after a minor storm on October 23, 2014 (photo from the Town of Hull).

1.3 MEPA Review Thresholds

Under current MEPA review thresholds the Project triggers an ENF and other MEPA review, if the Secretary so requires, as it is an expansion of an existing structure in a velocity zone [301 CMR 11.03(3) (b) (1) (e)] and it is a reconstruction of an existing solid fill structure of 1,000 or more sf base area provided the structure occupies flowed tidelands or other waterways [301 CMR 11.03(3) (b) (6)].

2.0 EXISTING CONDITIONS

2.1 Existing Seawall and Revetment

The existing concrete seawall and grouted rubble revetment along Crescent Beach has been damaged and has had a series of repairs since they were originally constructed. The repair efforts may have provided short-term stability for the structure; however, this type of stabilization generally is not effective in the long term. The steel sheet pile driven at the toe of the revetment to address slumping and loss of armor stones did temporarily stabilize the structure failure. However, the sheet pile is now in an advanced state of decay and failing at many locations. The failure of the sheet pile is leading to slumping of the rubble revetment and loss of structural integrity across the face of the revetment, shown in Figure 2.1. Large sections of the revetment have been grouted with concrete. The smooth surface and loss of voids associated with grouting accentuates the wave runup and overtopping, causing further damage to the homes and infrastructure that the revetment and seawall are designed to protect. In Figure 2.2, the existing seawall shows areas of cracking, spalling, and breakage. Scour on the backside of seawall from overtopping waves nearly exposes the footing at some locations along the seawall, particularly along the west end of Crescent Beach.

During periods of coastal flooding, splash-over and wave overtopping transports sediment and debris to Atlantic Avenue causing road closures as shown in Figure 2.3. Figure 2.4 shows that Gunrock Avenue, located in between the west end of the seawall and Atlantic Avenue, has been washed out by wave overtopping.

Figure 2.1. Slumping of rubble and grouted revetment (photo by Applied Coastal – June 3, 2015). Note the loss of armor stones into the offshore area and sheet piling used to prevent slumping.

Figure 2.2. Spalling, cracking and breakage of the existing seawall (photo by Applied Coastal – March 26, 2015).

Figure 2.3. Splash-over and wave overtopping at Crescent Beach during the Patriot's Day Storm of 2007 (photo from the Town of Hull).

Figure 2.4. Washed out road on Gunrock Avenue (photo by Applied Coastal – March 26, 2015).

2.2 Wave Overtopping

Straits Pond is a 92 acre salt pond located south of Crescent Beach as shown in Figure 2.5. The land elevation on the south side of Atlantic Avenue is approximately 3 feet lower than that on the north side. Figure 2.6 shows a Cross-sections taken from Crescent Beach to the north boundary of Straits Pond. The slope towards the pond varies from 1:30 to 1:40. As a result of the slope towards the pond, overtopped water and overwash from Crescent Beach flows into Straits Pond. From aerial photos, overwash fans at the north boundary of Straits Pond and the absence of vegetation from the houses north and south of Atlantic Avenue suggests that severe overwash occurs along a length of approximately 650 feet on the west end of Crescent Beach. The water level in Straits Pond is controlled by a tidal gate at the southwest end of the pond.

During the January 2015 North American Blizzard on January 27, 2015, the tidal gate was closed before the morning and afternoon high tide. Overtopping from Crescent Beach increased the water levels in Straits Pond and was recorded by a water level gage. Average overtopping rates, calculated by the rise in pond water level, were estimated to be approximately 0.50 to 0.80 $ft^3/s/ft$ (0.05 to 0.08 $m^3/s/m$). According to the USACE (2002), the overtopping rates greater than 0.54 $ft^3/s/ft$ (0.05 $m^3/s/m$) can damage to unpaved revetment crests.

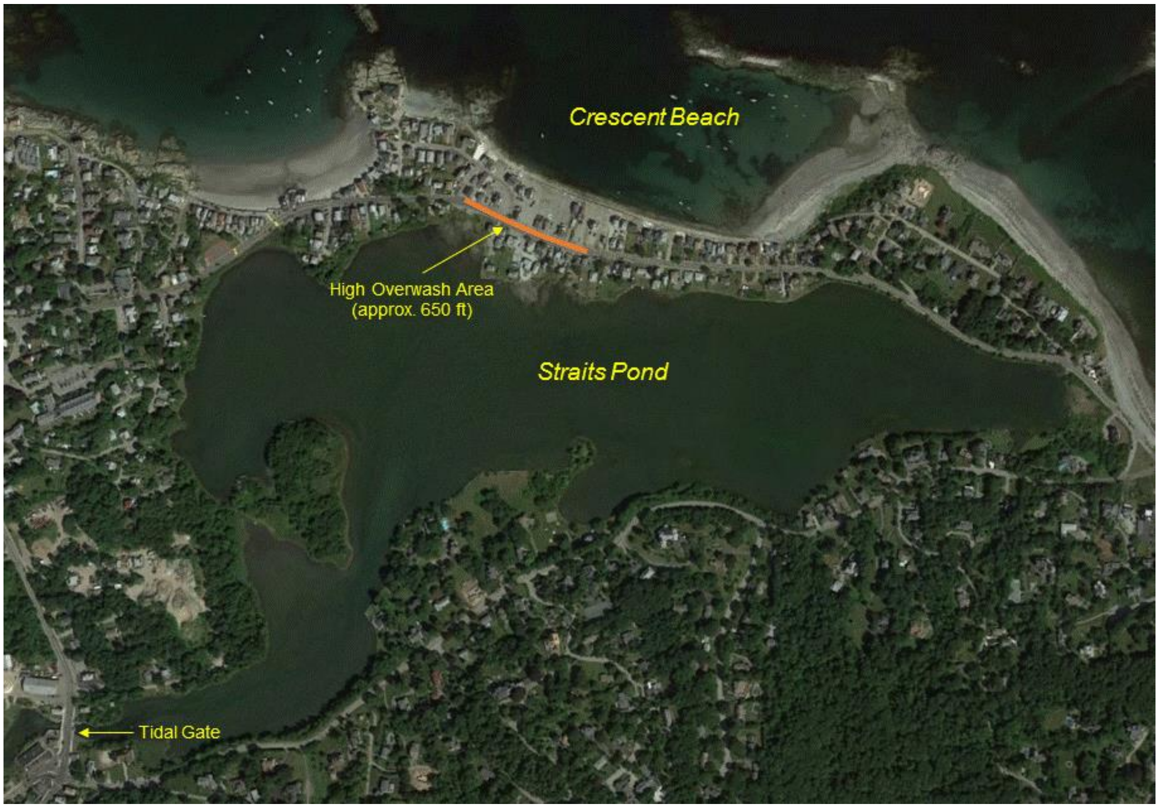


Figure 2.5. Straits Pond and estimated high overwash area along Atlantic Avenue. Overwash fans and lack of vegetation suggests that overwash is severe along the 650 ft area on the west end of Crescent Beach.

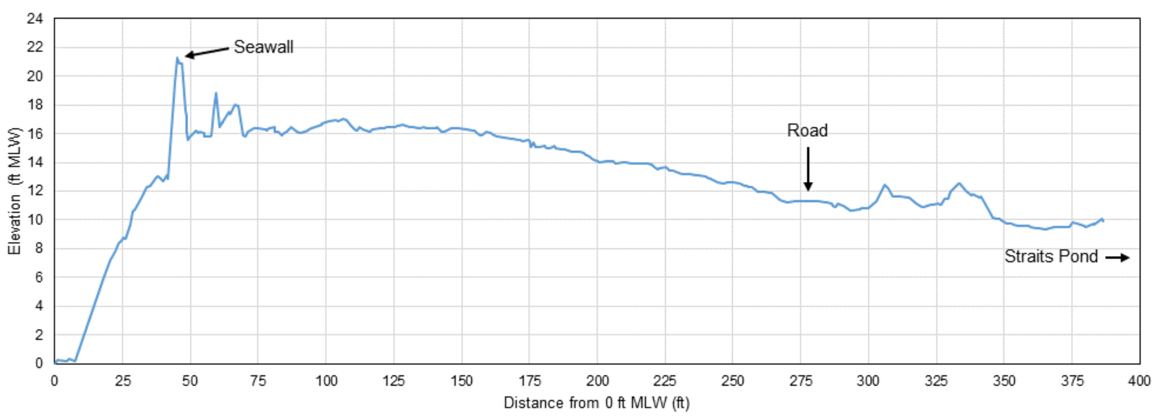


Figure 2.6. Cross-section from Crescent Beach to Straits Pond showing a 1:30 to 1:40 slope towards the pond.

2.3 Area of Critical Environment Concern

The Project Area is located within a half-mile radius of the Weir River Area of Critical Environment Concern (ACEC), which is also an Outstanding Water Resource (OWR), due to its close proximity to Straits Pond, see Figure 2.7.

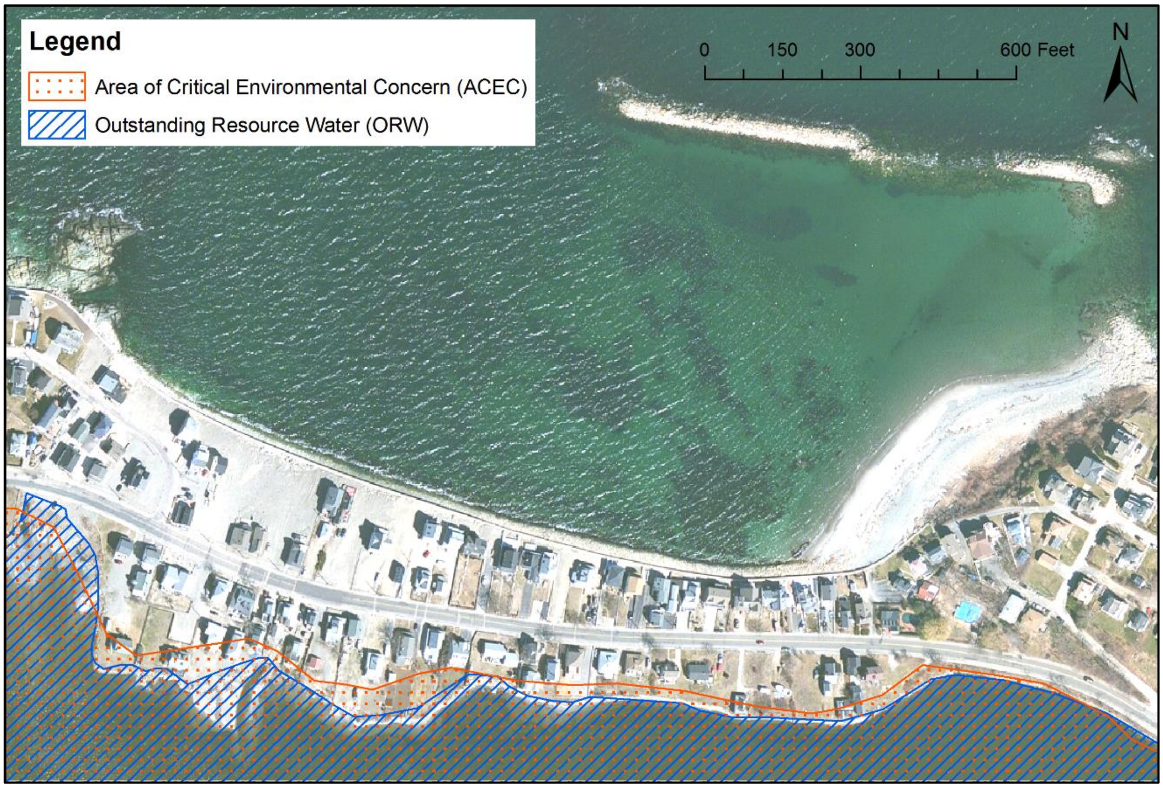


Figure 2.7 Area of Critical Environment Concern (ACEC) and Outstanding Resource Water (ORW) in the vicinity of the Project Area.

2.4 Rare Species

The Project Area is not located within the Estimated Habitat of Rare Wetlands Wildlife or within Priority Habitat as identified by information provided by the Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program effective October 1, 2008 available on MassGIS.

3.0 ALTERNATIVES ANALYSIS

A number of potential project options were considered to develop a concise yet representative list of alternatives to be evaluated. The development of this list of alternatives included consideration of previous design work by Bayside Engineering for DCR, as well as wave modeling to evaluate how a revised design would meet the stated Project goals of reducing wave overtopping and associated coastal flood damage shown in Figure 3.1 and Figure 3.2.

Figure 3.1. Overwash and flooding of Atlantic Avenue (photo from the Town of Hull).

Figure 3.2. Damage to asphalt caused by wave overtopping and overwash (photo from the Town of Hull).

3.1 Development of Alternatives

The previous revetment/seawall redesign work had focused on reconstructing and/or modifying the various breakwaters, revetments, and seawalls fronting Crescent Beach. In addition, the previous design recommended a concrete apron landward of the existing seawall to dissipate overtopping storm wave energy. Understanding that engineering calculations were not developed to fully justify either the increase in structure height or the need for a concrete apron to reduce overtopping/erosion, initial public and environmental regulatory response indicated that a more detailed analysis of potential options to mitigate coastal flood damage associated with wave overtopping was warranted.

With potential environmental concerns identified with the previous design, additional alternatives were considered to develop options that would reduce storm wave overtopping volumes, while minimizing adverse environmental impacts to wetland resources. Within this context, it is important to assess each alternative against the base line “No Action” alternative. Based on input from an inter-agency meeting attended by MCZM, Department of Environmental Protection (DEP), Division of Marine Fisheries (DMF), National Marine Fisheries Service (NMFS), Environmental Protection Agency (EPA), the Town of Hull Conservation Department, and the Town of Hull Harbormaster, a list of potential alternatives was developed for further evaluation:

- Alternative 1 - No Action
- Alternative 2 – Beach Nourishment
- Alternative 3 – Submerged Wave Break
- Alternative 4 – Rehabilitation of Existing Seawall and Revetment

3.2 Description of Alternatives

3.2.1 Alternative 1 – No Action

The No Action alternative would allow existing coastal processes to continue without human intervention to inhibit or prevent the on-going wave overtopping and the storm damage to existing residences and public infrastructure that regularly occurs during storm events. In addition, this alternative assumes continued lowering of the fronting beach, as well as continued degradation of the revetment and seawall.

The existing rubble revetment and concrete seawall along Gunrock Beach have been damaged several times since the original construction, requiring a series of repairs beginning in the 1930s. While the added concrete to the face of the revetment provided short-term stability to the revetment, the smooth face of the structure created by this grout placement has exacerbated wave overtopping volumes during significant northeast storm events. In the long-term, both the grout placed over the face of the revetment and the sheet pile fronting portions of the revetment have led to instability of the structure fronting the concrete seawall. The grout temporarily held the revetment together; however, ongoing lowering of the beach has led to failure of the revetment toe along much of the structure. In addition, the steel sheet pile driven at the toe of the revetment to address slumping and loss of armor stones, only temporarily stabilized the structure. At present, the sheet pile is now in an advanced state of decay and failing. The loss of sheet pile is leading to slumping of the rubble revetment and loss of structural integrity across the face of the revetment.

The No Action alternative would allow further damage and decay to the revetment and seawall, resulting in increased property and infrastructure damage along Atlantic Avenue, a public road that provides access to residences both east and west of Crescent Beach. As shown in Figure 3.1 and Figure 3.2, the No Action alternative allows substantial overwash during typical northeast storm events, leading to substantial damage to both paved and unpaved surfaces. Over time, continued lowering of the beach will allow storm wave overtopping of the seawall to increase, leading to an increase in both the severity and frequency of storm damage to this area. Figure 3.3, from the South Shore Coastal Hazards Characterization Atlas published by the Massachusetts Office of Coastal Zone Management (CZM), shows properties with multiple federal flood insurance claims from Nantasket Beach to Cohasset Harbor. The dense cluster of affected properties shows that the homes on both sides of Atlantic Avenue are highly susceptible to storm damage. The storm wave overtopping is directly responsible for the significant repetitive loss FEMA claims for this neighborhood. In addition to damage to private dwellings, roadway damage also occurs during major storm events. Public sewers servicing the properties in this region also are in jeopardy as result of the severe wave overtopping and related pavement scour. As the No Action alternative does not accomplish the project goals of reducing wave overtopping and associated coastal flood damage, this alternative was not considered a viable long-term option. Moreover, this alternative would place the residential properties and public infrastructure at increasing risk as the revetment and seawall continue to degrade.

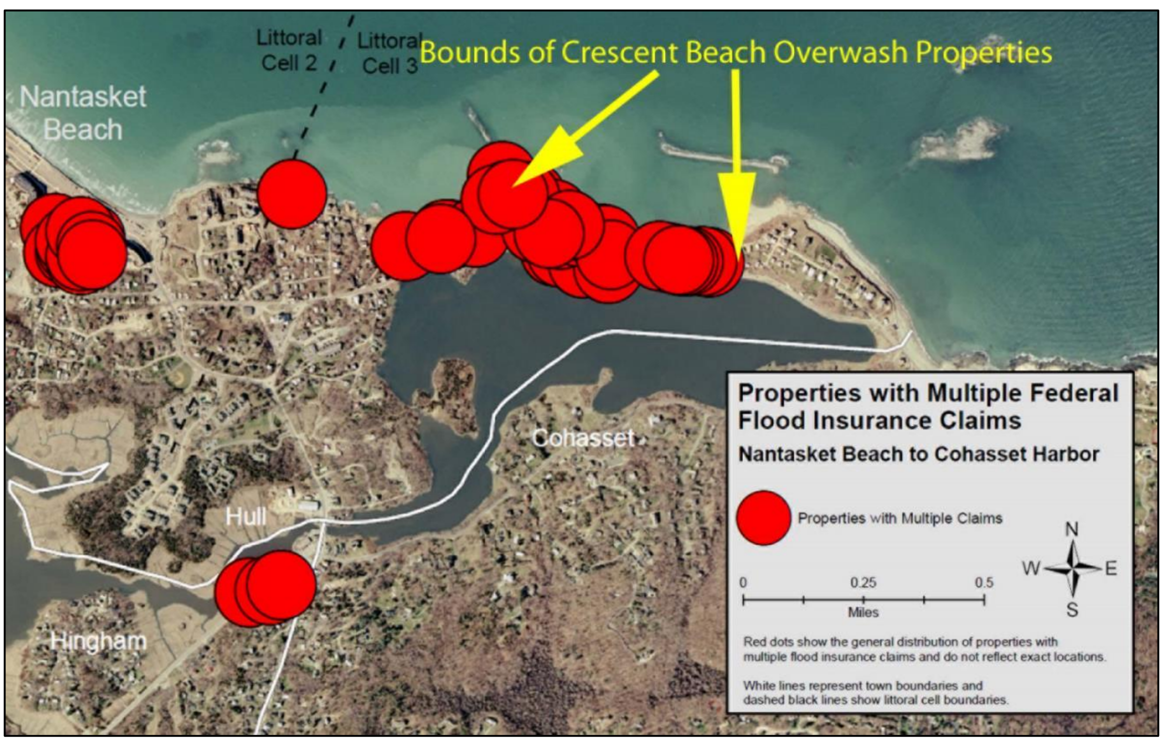


Figure 3.3. Properties with multiple federal flood insurance claims from Nantasket Beach to Cohasset Harbor. Many homes on the north and south side of Atlantic Avenue behind the Crescent Beach revetment have been damaged repeatedly.

3.2.2 Alternative 2 – Beach Nourishment

Beach nourishment would add an appropriate volume of beach compatible sediment seaward of the revetment and seawall to dissipate storm wave energy and reduce or eliminate wave overtopping, thereby increasing protection to threatened infrastructure and property. Once nourishment material is in place, coastal processes will rework the nourishment material to create an equilibrated beach profile. The ongoing sediment transport processes will cause the nourishment material to migrate both cross-shore and alongshore directions. Due to the ongoing transport of sediment to adjacent shorelines as well as offshore, a maintenance plan for re-nourishment and possibly back-passing back to the original design template will be necessary for this alternative to be effective as a long-term management strategy.

The majority of the shoreline along Crescent Beach is currently devoid of a fronting beach, except at low water, where a narrow beach exists along the revetment toe. To construct a nourishment with a reasonable design life (on the order of 5-10 years), the nourishment would require on the order of 100,000 to 170,000 cubic yards of material or approximately 60-to-100 cubic yards/ft of beach. For this scale of project, the nourished beach crest would be approximately 60-to-100 feet wide with a berm height on the order of 18 feet above MLW. The seaward extent of the nourishment crest would be located roughly above the toe of the existing stone revetment. The seaward face of the nourishment would then slope downward on roughly 1V:6H slope to meet the existing bottom. For longevity, the nourishment likely would be composed of a mix of cobble, gravel, and sand to enhance the stability of the beach. An approximate 'footprint' of this large-scale nourishment is shown in Figure 3.4.

Figure 3.4. Approximate footprint of a potential large-scale nourishment project.

Due to the orientation of the shoreline and incoming wave energy, as well as the influence of both the Gun Rock Point and Green Hill Breakwaters, the alongshore sediment transport direction will cause nourishment material to migrate generally in a southeasterly direction. Similar to transport patterns that have existed since the construction of the Green Hill Breakwater, the wave-induced currents will move nourishment material from the west to east behind the offshore breakwater section that extends off Green Hill Rock and deposit this material along this stretch of better protected shoreline, as well as within the mooring basin. As the sediment accumulates behind the breakwater and on the beach at the eastern extent of the littoral cell, regular maintenance will be required to back-pass material to the west to ensure a stable shore protection project along the most impacted western end of the littoral cell. Without this back-passing, the nourishment material likely would infill the mooring basin, converting a large expanse of Land Under the Ocean to Coastal Beach. Regardless, wave protection afforded by the Green Hill Breakwater provides a 'sink' for littoral sediments and adding a large-scale nourishment can be anticipated to accumulate material in the lee of this structure (similar to the low tide tombolo at Winthrop Beach, shown in Figure 3.5). Periodic re-nourishment will also be required to account for sediment transported offshore. Maintenance should also be anticipated after significant storm events to replenish eroded sections of the beach to ensure stability and provide wave dissipation during future storm events.

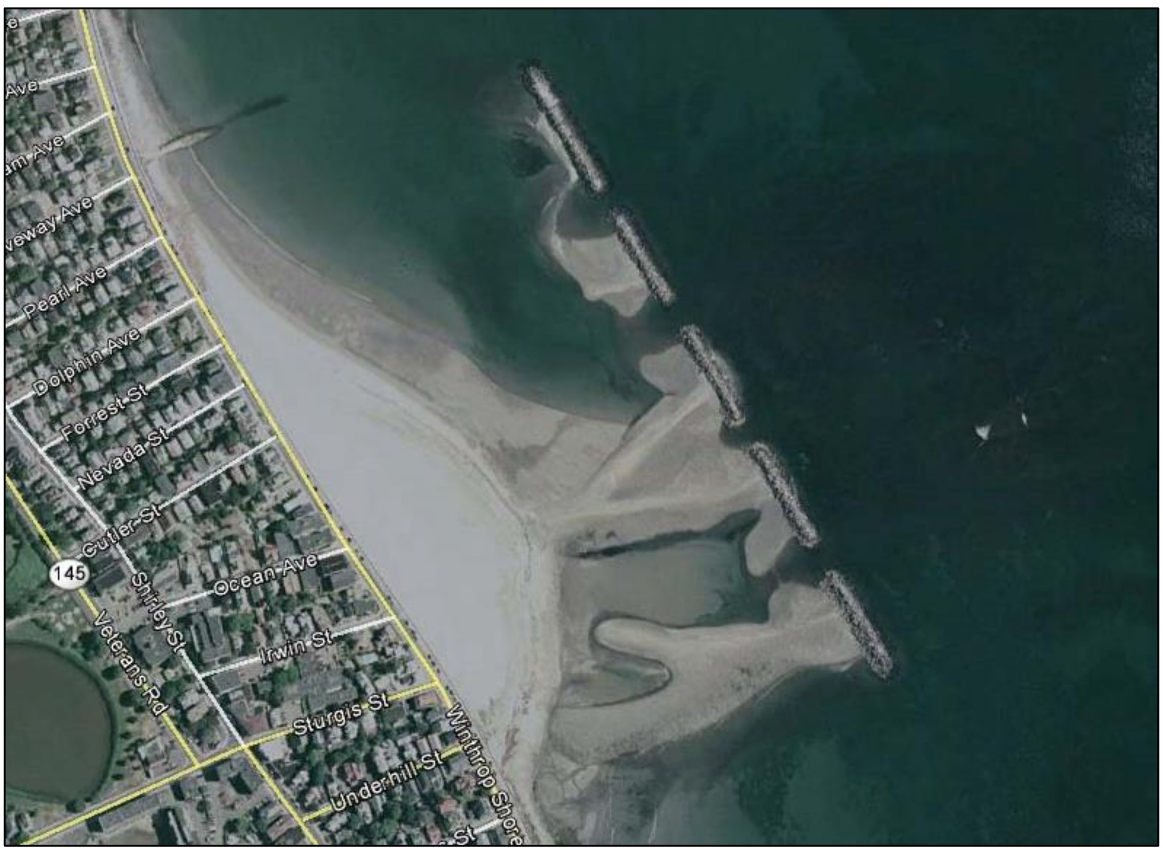


Figure 3.5. Accumulation of nourishment material behind breakwaters at Winthrop Beach (photo from Google Earth).

The nourishment project would require a large volume of sediment that would likely have to come from an upland source. Constructing the nourishment would most likely require the material to be transported by truck to the site. With the volumes anticipated for the nourishment, it would require a substantial number of daily truck-trips (i.e. a total of approximately 4,500 to 7,800 truck-trips for the project) to meet production rate requirements for beach nourishment. Therefore, trucking routes, frequency, and impacts would need to be analyzed and addressed as part of the shore protection design and environmental permitting process.

Large-scale beach nourishment would restore the historic beach along the Crescent Beach shoreline. The nourishment would enhance storm protection for the homes and infrastructure landward of the existing revetment and seawall. The beach nourishment alternative considered herein would have a design life of approximately of 5-to-10 years, but would require periodic and regular maintenance and re-nourishment to remain a viable shore protection alternative.

Nourishment is accompanied with some potential adverse environmental impacts that must be carefully minimized and/or mitigated. For example, the nourishment template would cover inter-tidal and sub-tidal habitats which would affect the benthic community and nearshore resources areas. In the long-term, through the use of beach compatible material, the nearshore benthic communities on the beach face would become re-established further seaward. In addition to potential environmental impacts, the nourishment would also encroach upon the mooring field located behind the breakwater, and the truck transport of material to the site could have a significant short-term impact to the community.

The longevity of the project also is a consideration, as the observed sediment transport regime is strongly unidirectional to the southeast. The more exposed northwesterly stretch of the shoreline that requires the most wave attenuation. Due to the existing longshore sediment transport regime, maintaining a beach nourishment at the most needed location will be difficult and require frequent maintenance to back-pass material from the more protected southeast end of the beach back to the northwest. The combination of potential adverse impacts associated with beach construction and frequent maintenance, initial construction cost (estimated at between $3,800,000 and $6,500,000 at $38 per cubic yard), and limited longevity cause this alternative to receive a low overall ranking.

3.2.3 Alternative 3 – Nearshore Submerged Wave Break

A nearshore submerged wave break could be constructed in the nearshore region to dissipate wave energy before it reaches the Crescent Beach shoreline. The wave break would extend off the seafloor into the water column to trigger wave breaking as waves approach the shoreline from the Atlantic Ocean. A number of different wave-break technologies exist, including, but not limited to, reef-type breakwaters, Reef Balls™, wave attenuation devices (WADs™, see Figure 3.6 for an example), and rubble/rock dump mounds.

Figure 3.6. Photograph of the Shark Island WAD™ project completed in New Iberia, Louisiana *(www.livingshorelinesoultions.com)*.

To provide an effective wave break, a structural wave breaking system must meet a few criteria to ensure an appropriate level of wave energy dissipation. The wave break must be designed with a large enough profile (vertical height) off the bottom, as well as sufficient crest width relative to wave length (width in cross-shore direction), to cause storm waves break. A low and/or narrow structure will not trigger wave breaking; therefore, not be a viable shore protection alternative as a stand-alone option. The profile height of the structure becomes an issue with large tide ranges and/or substantial storm surges. Optimally, the crest of the structure must be set at a height to cause wave breaking during storms when the water levels are elevated and can be further amplified by the water level coinciding with the time of high tide.

Crescent Beach has a mean tidal range of approximately 10 feet (MLW = 0 ft MLW, MHW = +9.8 ft MLW), with storm surges predicted by FEMA reaching approximately 4.5 feet above high tide for the 10-year return period event (approximately +14.3 ft MLW). In this example, a 12-ft wave approaching the shoreline during the peak of a 10-year storm event would require a wave break crest elevation of approximately +4.2 ft MLW to induce wave breaking. With a crest height of +4.2 ft MLW, the structure would be emergent for roughly half of the tide cycle. In addition, the crest width at this elevation would be relatively large (~30 feet) to ensure adequate wave breaking. Lowering the crest of the structure would greatly reduce the effectiveness of the structure to perform as wave break during storm events. To accomplish the project goals of reducing wave overtopping volume, it is likely that the wave break would need to have a higher crest width than described above for the 10-year event. Another consideration is the porosity of many structure designs (e.g. Reef Balls™ and WADs™), as these are often designed with holes and/or gaps which are intended to create habitat, sometimes at the expense of wave attenuation characteristics.

An effective nearshore wave break at Crescent Beach would require a large emergent (at least for much of the time) rubble-mound breakwater type system. The structure would occupy a large area of the bottom, likely having a large-scale adverse impact on marine resources. The structure would also present a navigational hazard to marine traffic transiting in and out of the mooring field in the lee of the Green Hill Breakwater. Attempting to utilize other technologies is not preferred, primarily due to concerns about their effectiveness due to the large tidal range with added storm surge at the site. A wave break structure would also have to be located relatively close to shore due to the steeply sloping offshore bathymetry. The combination of potential adverse impacts associated with wave break construction and limited applicability in the high tide range and storm surge environment cause this alternative to receive a low overall ranking.

3.2.4 Alternative 4 – Rehabilitation of the Existing Revetment and Seawall

Several different approaches for rehabilitating the existing seawall and revetment were investigated for potential effectiveness of reducing wave overtopping and providing long-term shore protection along the project area. The investigation has considered several different treatments and design modifications for the revetment and seawall to reduce the overtopping and storm damage. Details regarding the development of the proposed design and the explored sub-options are described in Section 4.2. By rehabilitating/reconstructing the existing structures utilizing better construction methodologies and appropriate design wave parameters, the level of shore protection can be increased while minimizing impacts to nearshore resources.

As discussed previously, the existing seawall and revetment are decaying and failing. Repairs have been attempted with mixed results. Additional repairs to stabilize the structures might prolong their design life but will not increase their ability to provide storm damage protection. The seawall and revetment can be redesigned and rehabilitated to provide a greater level of protection to the homes and infrastructure landward, while not significantly increasing potential adverse impacts to adjacent coastal resources. To enhance the existing structures, a series of design modifications were evaluated and tested to decrease wave overtopping and enhance the shore protection. The evaluation and testing included incrementally raising the seawall height, changes in revetment height and slope, carrying the revetment over the seawall, and various toe designs to enhance stability. The proposed rehabilitation plan calls for raising the crest of the seawall from 21 ft MLW to 23 ft MLW over the entire length of the wall. The increase in height will reduce wave overtopping and damage to structures landward. The additional height will be added to the seawall by encapsulating the upper portion of the exposed seawall with a concrete veneer. The cap will be cast and anchored into the crest of the existing structure. This approach provides the structural connection to support the extension of the seawall and addresses the spalling, cracking, and breakage along the surface of the existing seawall. Plans and cross-section details for the proposed design described herein are presented in Appendix A.

The revetment will be repaired using two different cross-section configurations, dependent on the level of wave protection needed. A more substantial section will be placed to the northwest, where the wave energy reaching the shoreline is greater and hence a more substantial structure is required to minimize the ongoing damage to private development and public infrastructure. To the southeast, the revetment cross-section will approximate the original design section of the revetment. This stretch of shoreline benefits from shallower offshore bathymetry and the Green Hill Breakwater, which attenuates wave energy along this portion of shoreline. The northwest section extends for approximately 950 feet from the western terminus of the existing structure to the southeast along the same alignment. The existing revetment will be completely dismantled and the existing stone will be sorted and reused where allowable. The base of the revetment will be constructed using layers of filter fabric and smaller rocks to create a stable foundation for the armor stone and provide protection to the foundation of the seawall from erosion. The revetment will have a 10-foot wide crest equal in height to the raised seawall section (i.e. 23 ft MLW). The armor stone will be placed over the rock base on 1V:2H slope from the crest seaward to the bottom. The toe of the revetment will be excavated below grade to protect the structure from erosion at the toe which could destabilize and potentially lead to failure of the revetment. Therefore, the toe of the revetment along this section will extend seaward of the existing structure; however, the proposed revetment slope of 1V:2H is typically the steepest slope for a large-scale revetment.

The east section of revetment will transition in profile from the larger first section over a 25 foot span and then extend approximately 625 feet further to the east; terminating at the end of the existing seawall revetment structure. The existing revetment section will be dismantled and the material reused where possible. The base of the revetment will be constructed using layers of filter fabric and smaller rocks to create a stabile foundation for the armor stone. The crest of the eastern section is lower than the western section. The crest will match the existing revetment at 17 ft MLW and extend 10 feet horizontally seaward from the seawall. The armor stone will be placed over the rock base on 1V:3H slope from the crest seaward to the bottom. The toe of the revetment will be excavated below grade to protect the structure from erosion at the toe, which could destabilize and potentially lead to failure of the revetment. The offset of the revetment toe from the seawall is determined by the slope of the nearshore bathymetry. Along the southeastern end, the water is shallower allowing the rehabilitated revetment section to remain within the existing structure footprint. At the northwestern end, to achieve the necessary level of storm protection, the toe must be extended seaward from the existing revetment to achieve the required levels of wave energy dissipation.

Seawalls and revetment generally result in interruptions of natural sand supply and transport. However, Crescent Beach is situated between two rocky headlands. The headlands prevent material from adjacent shoreline reaches from being effectively transported into or out of the Crescent Beach littoral cell. The site does not contain a natural supply of sediment; therefore, the rehabilitation of the existing structures will not result in additional environmental impacts relative to sediment supply. The redesigned revetment will be able to absorb and dissipate wave energy more effectively than the current structure and thus reduce the wave overtopping and damage occurring to the landward homes and public infrastructure. To achieve the necessary level of storm protection, approximately 950 feet of the revetment at the northwest end will require the toe to be extended further offshore than the existing structure. Due to the location of development landward of the seawall, no potential landward extension is possible. The steepness of the offshore bathymetry prevents the toe of the structure from being constrained within the existing limits, based on the design needs for the structure. The extension of the toe will be approximately 20 to 30 feet seaward of the existing revetment limit, depending on the slope of the nearshore bathymetry. While extending the structure seaward is generally not recommended, the increase in footprint is minor, likely negligible, compared to the other alternatives that could potential mitigate the storm damage that is occurring along this shoreline stretch. Furthermore, landward expansion of the structure is not a viable option due to the close proximity of the existing buildings to the seawall. The combination of limited adverse impacts associated with revetment and seawall rehabilitation and the ability for the design to provide appropriate shore protection with a substantial reduction in wave overtopping cause this alternative to receive a high overall ranking. Based on the review of the alternatives evaluated, this option was determined to be the preferred alternative. More details regarding the design analysis and potential environmental impacts are detailed in Section 4.0 and 5.0, below.

4.0 PROJECT DESCRIPTION

Alternative 4, rehabilitation of the existing seawall and revetment, was determined to be the preferred alternative due to its ability to protect the homes and infrastructure in the vicinity of the Crescent Beach and repair the failing seawall and revetment while minimizing the project footprint.

4.1 Design Storm Conditions

The design conditions for the seawall and revetment were based on the 100-year storm. The SWAN wave model was used to propagate waves to the Project Area. Wave model output is presented in Figure 4.1 for a 26.3 ft wave with 15 s period from the northeast. Water level is assumed to be at 14.9 ft MLW, which is the 1% annual chance still water elevation based on the Plymouth County Flood Insurance Study (FEMA, 2012). Waves reaching the Crescent Beach revetment are approximately 9 ft or less in height. In the plots the color contours indicate wave height and vectors are used to indicate the direction of wave propagation.

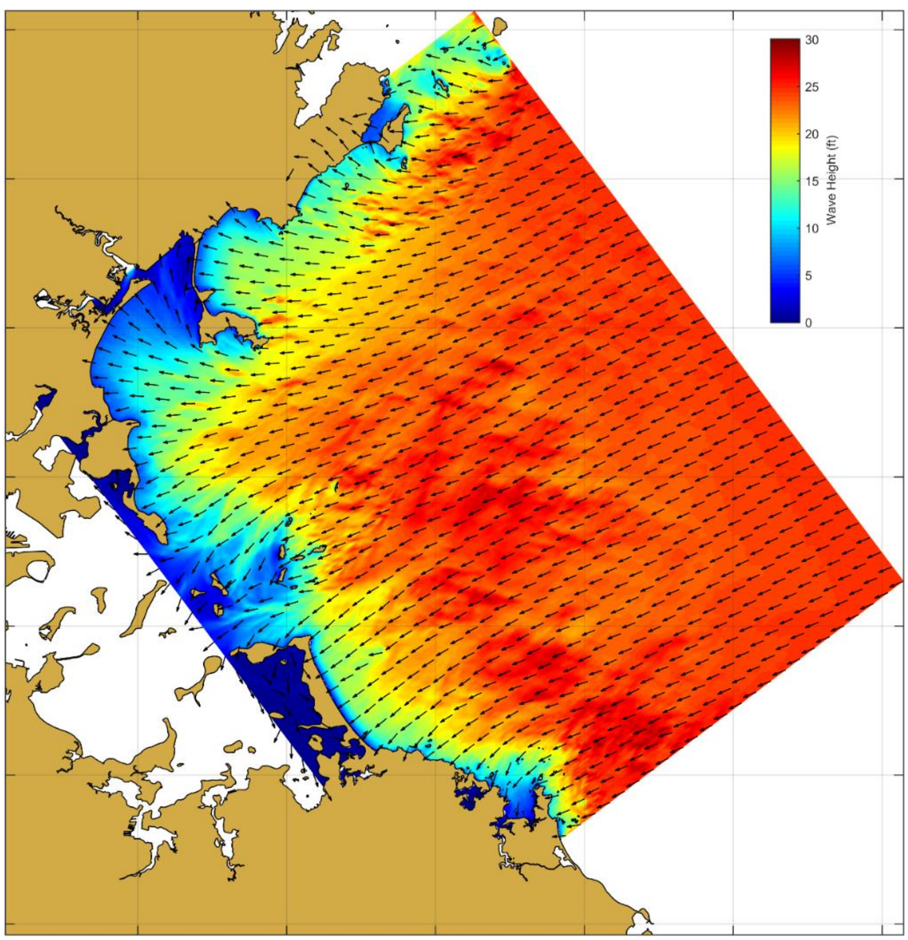


Figure 4.1. Model output for the 100-year return period wave condition (26.3 ft and 15 s waves from the northeast). Colors indicate wave heights and vectors show peak wave direction.

4.2 Development of Proposed Design

Average overtopping discharge for the proposed revetment and seawall designs were estimated using the empirical equations by Pedersen (1996). Pedersen is valid for rock-armored permeable slopes with a berm in front of the seawall and irregular, head-on waves. The Pedersen equation for average overtopping discharge, Q, is:

$$Q = 3.2 \cdot 10^{-5} \left(\frac{L_{om}^2}{T_{om}}\right)\left(\frac{H_s}{R_c}\right)^3 \frac{H_s^2}{A_c B cot\alpha}$$

where L_{om} is the deep water wave length with respect to T_{om}, T_{om} is the mean deep water wave period, H_s is the significant wave height at the revetment toe, R_c is the distance between the seawall elevation and still water level, A_c is the distance between the berm elevation and the still water level, B is the berm width, and $cot\alpha$ is the revetment slope.

Figure 4.2 shows the critical values of average overtopping discharge in regards to traffic and structural safety from USACE (2002). Damage to the revetment promenade (area landward the seawall) is prevented when average overtopping discharge is less than 0.54 $ft^3/s/ft$ (0.05 $m^3/s/m$).

Design of the proposed seawall and revetment includes raising the existing seawall elevation and removing the existing grouted revetment sections. The existing revetment will be replaced with larger armor stones to increase wave energy dissipation. The revetment slope may range from 1:1.5 to 1:3 to best match to the seaward extent of the existing revetment toe. Seven design options were considered:

1. Increase the elevation of the seawall to 23 ft MLW and revetment crest to 17 ft MLW;
2. Increase the elevation of the seawall to 25 ft MLW and revetment crest to 17 ft MLW;
3. Increase the elevation of the seawall to 26 ft MLW and revetment crest to 17 ft MLW;
4. Increase the elevation of the seawall and revetment crest to 23 ft MLW;
5. Increase the elevation of the seawall to 25 ft MLW and revetment crest to 23 ft MLW;
6. Increase the elevation of the seawall to 26 ft MLW and revetment crest to 23 ft MLW; and
7. Increase the elevation of the seawall and revetment crest to 25 ft MLW.

Figure 4.3 shows the stationing along the Crescent Beach seawall used in the overtopping analyses (1 station = 100 feet). Figure 4.4, Figure 4.5, and Figure 4.6 show the results of the overtopping analysis for design options 1 through 7 which have a revetment elevation of 17, 23, and 25 ft MLW, respectively. The black dashed line shows the critical value of average overtopping discharge for revetments. Overtopping volume sensitivity is reasonably small relative to revetment slope, giving the design flexibility along the beach to stay within the existing footprint of the revetment by using a steeper slope.

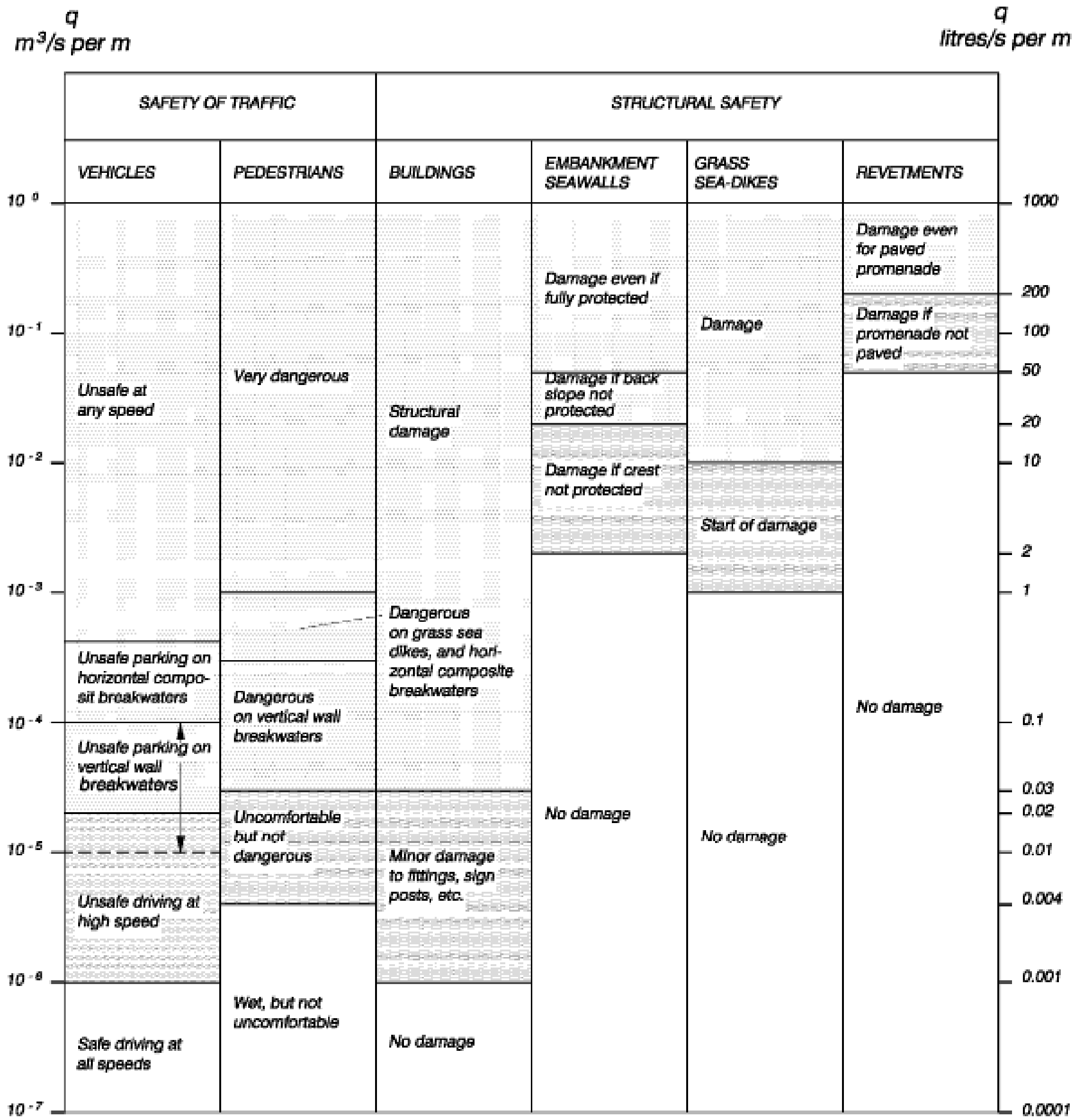


Figure 4.2. Critical values of average overtopping discharges (USACE, 2002).

Figure 4.3. Stationing along the Crescent Beach seawall (1 station = 100 feet).

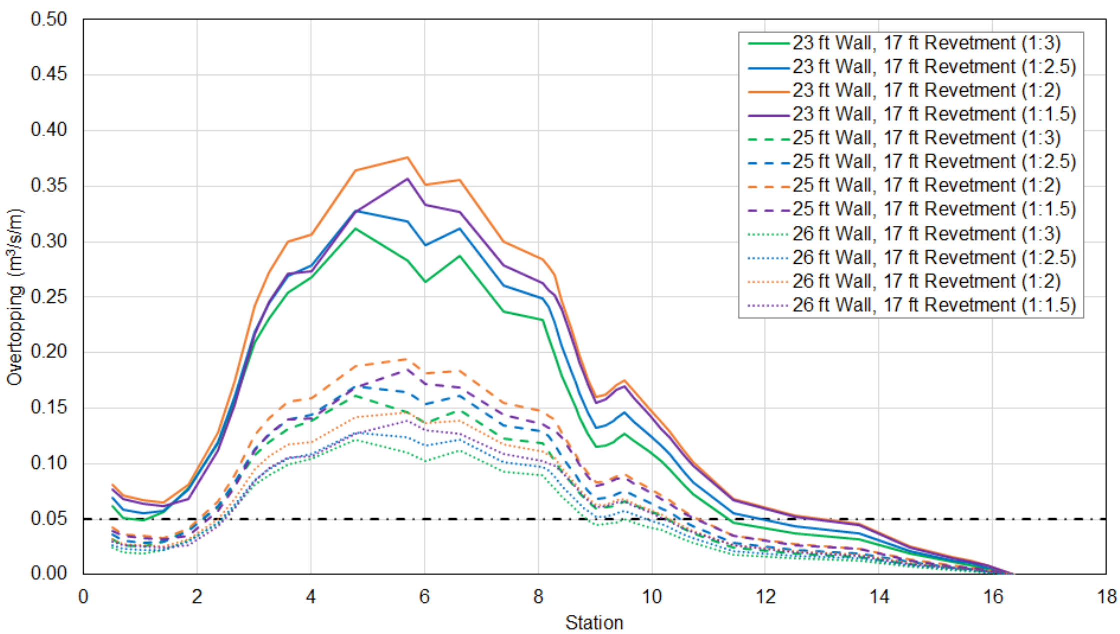


Figure 4.4. Average overtopping discharge along the length of the seawall where the revetment elevation is raised to 17 ft MLW. Black dash-dot line shows the critical value of average overtopping discharges for revetments backed by unpaved surfaces.

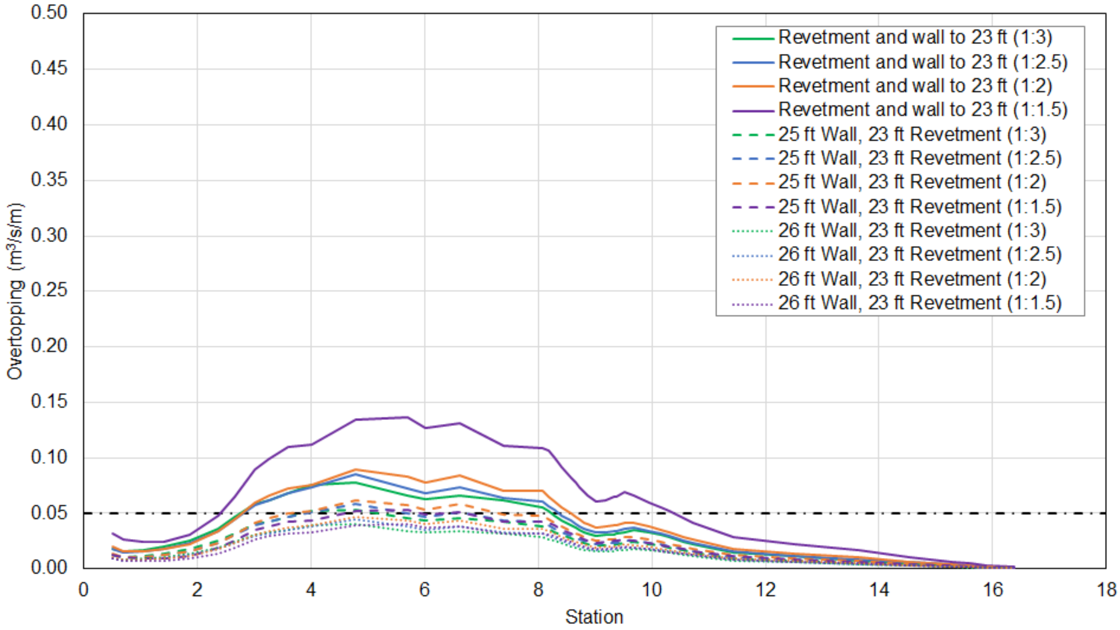


Figure 4.5. Average overtopping discharge along the length of the seawall where the revetment elevation is raised to 23 ft MLW. Black dash-dot line shows the critical value of average overtopping discharges for revetments backed by unpaved surfaces.

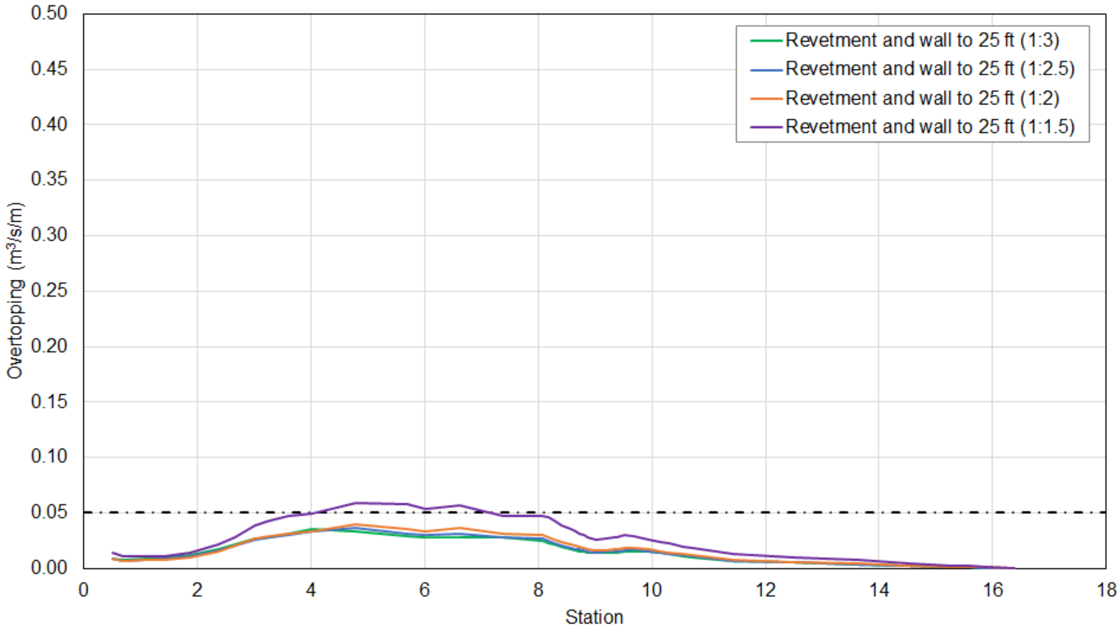


Figure 4.6. Average overtopping discharge along the length of the seawall where the revetment elevation is raised to 25 ft MLW. Black dash-dot line shows the critical value of average overtopping discharges for revetments backed by unpaved surfaces.

Using LIDAR survey data, the revetment toe was located for the design options based on the proposed revetment elevations and slopes. Figure 4.7, Figure 4.8, and Figure 4.9 show the revetment toe for revetment with elevations at 17, 23, and 25 ft MLW. In all figures, a berm approximately two stones wide is used which extends from the seaward face of the existing seawall. The dotted yellow line represents the existing revetment toe. As expected, the higher the revetment, the larger the structure footprint.

Figure 4.7 represents the extents of the revetment toe from Options 1, 2 and 3. On the east end of the structure, at approximately Station 10+25 and greater, the 1:3 revetment slope matches up with the existing revetment toe while steeper slopes will allow the structure footprint to be smaller than the existing. For example, using a 1:1.5 slope with a 17 ft MLW revetment elevation, the existing revetment toe may be pushed back, on average, 26 ft on the east end. With a sufficient increase of the seawall elevation, the overtopping on the east end may be reduced to acceptable volumes with respect to revetment stability. On the west end of the beach, a revetment slope of 1:2 or less will stay within the existing extents, however a 17 ft MLW revetment does not reduce overtopping sufficiently in any of the options to prevent revetment damage regardless of slope.

Figure 4.8 shows the extents of revetment toe from Options 4, 5 and 6 and Figure 4.9 represents the revetment toe for Option 7. With a revetment elevation of 23 or 25 ft MLW, the revetment toe always falls beyond the existing toe regardless of the slope with the exception of the 1:1.5 slope on the 23 ft MLW revetment. Of all the designs, Option 7 that minimizes the overtopping the most, however Option 7 requires the largest structure footprint.

Figure 4.7. Seaward extent of revetment toe for a 17 ft MLW revetment with 1.5, 1:2, 1:2.5 and 1:3 revetment slope. Extents are representative for Option 1, 2 and 3.

Figure 4.8. Seaward extent of revetment toe for a 23 ft MLW revetment with 1.5, 1:2, 1:2.5 and 1:3 revetment slope. Extents are representative for Option 4, 5 and 6.

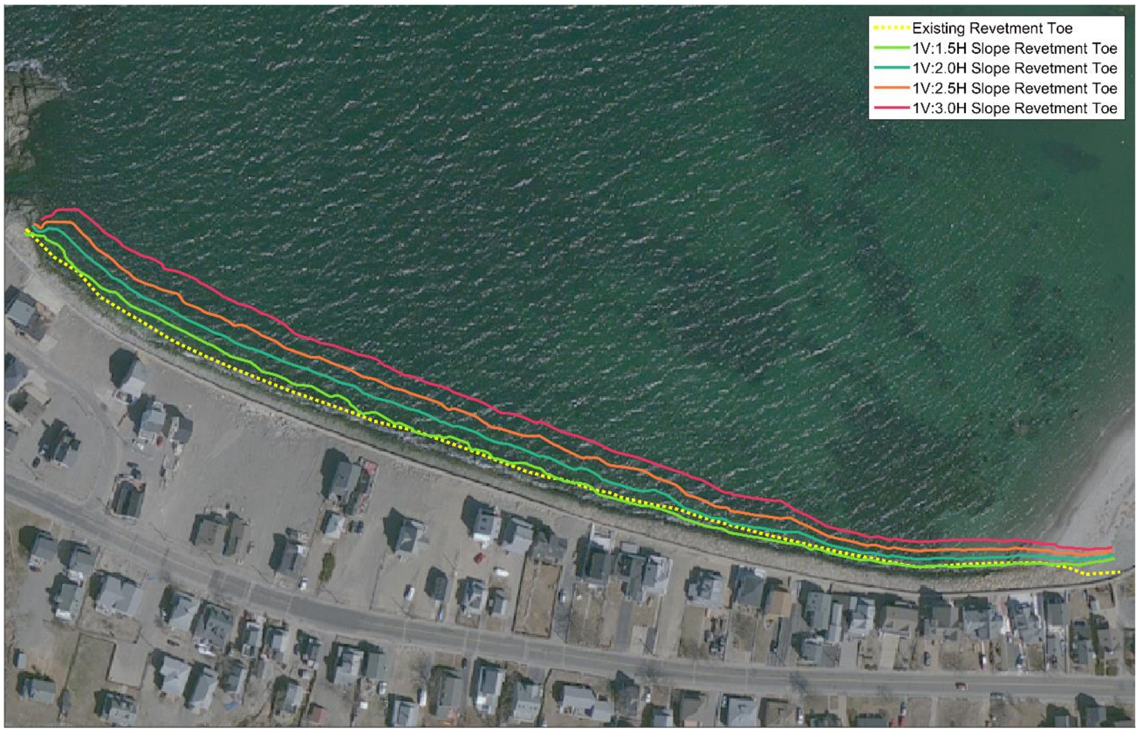


Figure 4.9. Seaward extent of revetment toe for a 25 ft MLW revetment with 1.5, 1:2, 1:2.5 and 1:3 revetment slope. Extents are representative for Option 7.

4.3 Proposed Design

As described in Section 3.2.4, the seawall is to be reinforced with a concrete cap to increase the elevation from 21 ft to 23 ft MLW. The concrete cap serves to reinforce the existing failing seawall and to also provide greater overtopping protection. Excavation behind the wall is required to set the cap in place. Design and installation of the concrete cap will require further study to determine the best method of “tying-in” the cap to the existing wall.

The existing grouted revetment will be removed and filter fabric shall be installed, where shown on the drawings, prior to placing the bedding layer. Each width of filter fabric shall be overlapped in accordance with manufacturer’s recommendations. Filter fabric shall be installed in 2 layers and with staggered seams between the top and bottom layers.

The proposed design calls for 6 to 7 ton “rough-face” armor stones that will increase wave energy dissipation. Stones shall be placed by equipment suitable for lifting, manipulating, and placing stones of the size and shape specified. Placing efforts shall insure that each stone is firmly set and supported by underlying materials and adjacent stones. Loose stones shall be reset or replaced. Each stone shall be placed with its longest axis perpendicular to the armor slope. Placing of stones in layers or by dumping into chutes or by other similar methods likely to cause segregation will not be permitted. Stones shall be placed and distributed such that there will be no large accumulation of either the larger or smaller stones in any given area.

From station 0+50 to 10+00 (west end), the revetment is extended to the top of the seawall (design option 4) and from station 10+25 to 16+50 (east end), the revetment elevation is 17 ft MLW (design option 1). A transition zone of 25 ft will be used between the two sections. Figure 4.10 to Figure 4.13 show representative cross-sections of the existing and proposed revetment and seawall.

Using the equation from Pedersen, overtopping along the proposed seawall and revetment is approximately 0.5 $ft^3/s/ft$. Overtopping is slightly less on the eastern end of the beach due to the protection from the Green Hill Breakwater. While the proposed seawall and revetment is designed to reduce wave overtopping to below critical levels to prevent revetment damage during a 100-year design storm, it should be noted that overtopping will persist although the frequency and overtopping volume are expected to decrease. Wave overtopping runoff and debris that flows into Straits Pond is expected to be reduced by proposed design. The amount of overtopping expected from the proposed design is equal or less than the overtopping estimated for the January 2015 North American Blizzard, as described in Section 2.2, which had milder wave and surge conditions than the 100-year design storm.

The proposed west end revetment toe will extend approximately 20 to 30 feet from the existing revetment footprint, depending of the bathymetry at the revetment toe. On the east end, the proposed revetment generally stays within the extents of the existing footprint. The total increase in revetment footprint is approximately 31,500 ft^2 (~0.7 acre).

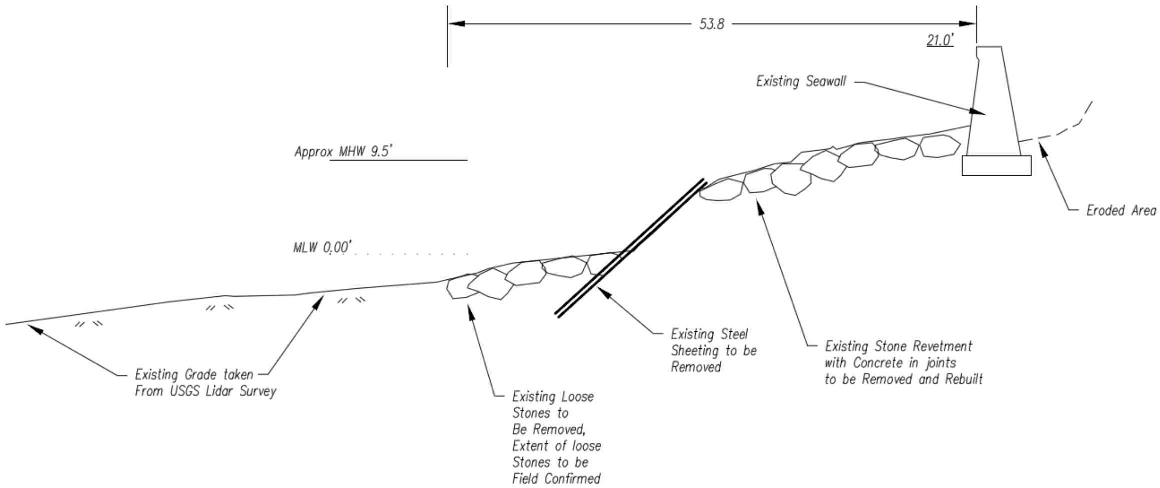


Figure 4.10. Typical existing seawall and revetment profile for station 0+50 to 10+00.

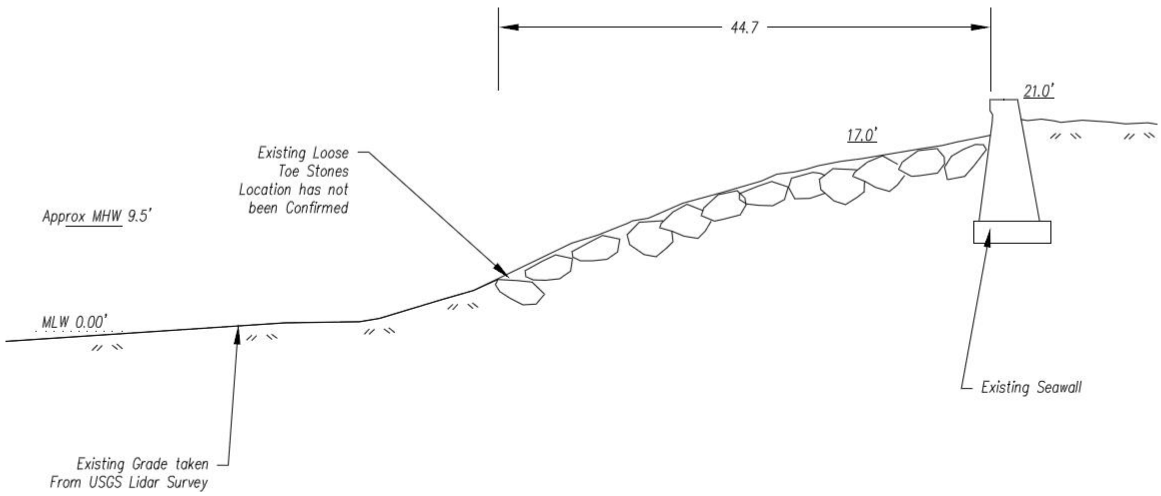


Figure 4.11. Typical existing seawall and revetment profile for station 10+25 to 16+50.

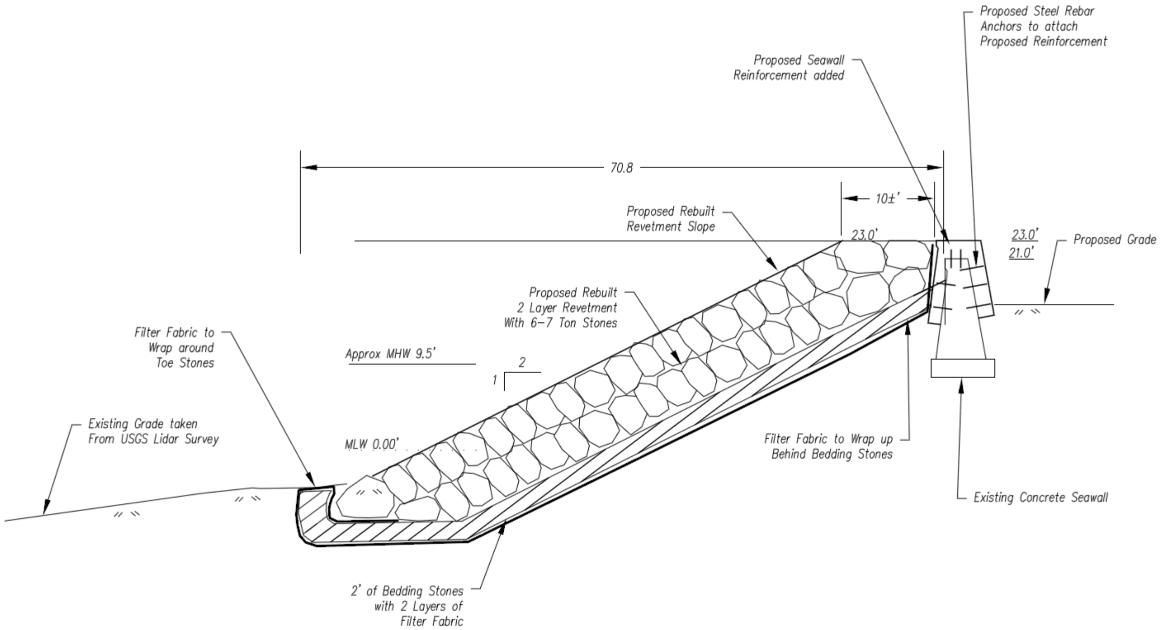


Figure 4.12. Typical seawall and revetment profile for station 0+50 to 10+00 with proposed 23 ft MLW seawall and revetment.

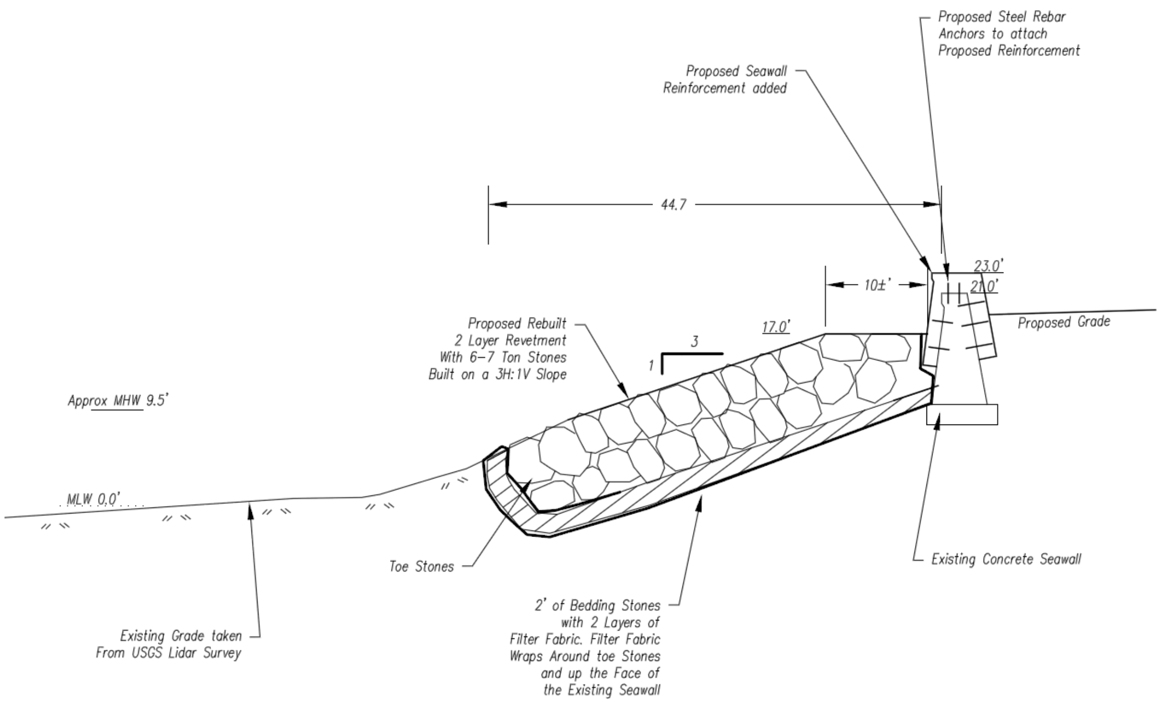


Figure 4.13. Typical seawall and revetment profile for station 10+25 to 16+50 with proposed 23 ft MLW seawall and 17 ft MLW revetment.

4.4 Relative Sea Level Rise

Separate from the daily rise and fall of the tide, the average elevation of the ocean changes over time with respect to the land. This average position is called relative sea level (RSL), and different geologic and atmospheric processes contribute to changes in RSL. Some of the causes include glacial ice melt, thermal expansion of the ocean as the global temperature increases, and the rising or sinking of the earth's crust itself. While the specific causes of RSL change are the topic of much scientific and political debate, historical evidence indicates that over the past 90+ years, the relative sea-level in Boston, Massachusetts has been rising generally in a linear fashion, shown in Figure 4.14. Depending on the time period of the analysis and/or the tidal datum selected (e.g. Monthly Mean Sea Level or Annual Mean Sea Level), the long-term range varies from 2.63 mm per year or 0.86 feet per century (NOAA, 2013) to 2.97 mm per year (0.97 feet per century).

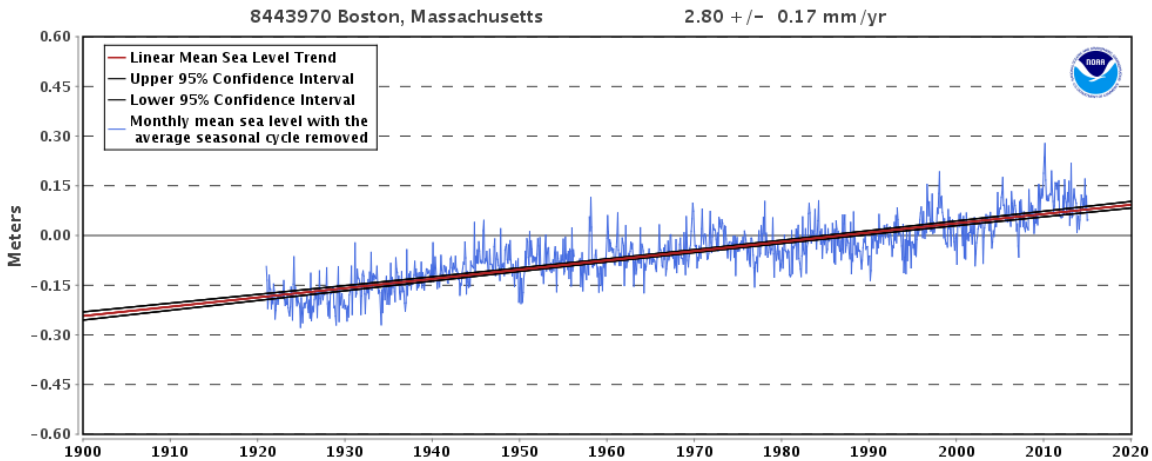


Figure 4.14. Monthly mean water levels recorded in Boston, Massachusetts between 1921 and 2013 indicate a linear trend in sea-level rise over the past 90+ years of approximately 2.80 mm per year (NOAA, 2013).

In addition to the concerns of general sea level rise on making infrastructure more susceptible to the influence of storm surge, a number of climate scientists have indicated that the frequency of severe weather events will increase as the planet continues to warm. However, there does not appear to be any scientific consensus regarding an increase in storm activity in the northeastern U.S. that will potentially cause an increase in extra-tropical storm frequency. For this reason, the evaluation of RSL rise on storm frequency described for the project includes the influence of projected increases in sea level on storm surges and does not address any issues related to potential increased (or decreased) future storm intensity.

The current amount of storm destruction is significant at Crescent Beach; nor'easters regularly cause damage to the homes and public roadways. Increased storm surge due to RSL rise will cause waves to break further inland and result in even more overtopping and overwash. The waves dissipate energy over the sloped face of the revetment and are, to some extent, reflected by the vertical seawall. A rise in storm surge will reduce the energy dissipation capacity of the revetment and can cause the waves to crash against the wall, sending splash-over towards the infrastructure. The proposed design of the west end of the wall (Station 0+00 to 10+00) is expected to be better able to handle increases in storm surge as the revetment crest is higher in elevation. The wall and revetment design of the east end (Station 10+25 to 16+50) will be more sensitive to changes in storm surge, especially as the water level approaches or becomes higher than the revetment elevation. It was not possible to incorporate RSL projections into the proposed design, as extensive structure enlargement (higher seawall, higher revetment crest, larger footprint, etc.) would be required to further mitigate storm damage for all but the lowest future sea level rise projections. This larger structure would have substantially higher construction costs, as well as significantly greater environmental impacts to adjacent Land Under the Ocean resources. The primary purpose of the Project is to reduce the current severe wave overtopping and storm damage along Atlantic Avenue. In the future, the seawall and revetment may require additional armoring and/or other shore protection solutions to reduce overtopping to acceptable volumes depending on the magnitude of RSL rise; however, it does not appear that the substantial costs and expanded environmental impacts are warranted at this time.

5.0 POTENTIAL ENVIRONMENTAL EFFECTS OF PREFERRED DESIGN

The proposed project has been designed and will be constructed using the best available measures to minimize adverse impacts to coastal resource areas as defined by the Massachusetts Wetlands Protection Act (WPA). The proposed project is located within and/or abutting the following coastal resource areas:

- Coastal Land Subject to Coastal Storm Flowage (310 CMR 10.04)
- Land Under the Ocean (310 CMR 10.25)
- Coastal Beach (310 CMR 10.27)
- Barrier Beach (310 CMR 10.29)
- Coastal Bank (310 CMR 10.30)

The following presented below provide definitions of coastal resource areas that will be affected by the proposed project, a description of the proposed work to occur within each resource area and how the project meets performance standards.

5.1 Land Subject to Coastal Storm Flowage

Pursuant to 310 CMR 10.04, Land Subject to Coastal Storm Flowage (LSCSF) means “land subject to any inundation caused by coastal storms up to and including that caused by the 100-year storm, surge of record or storm of record, whichever is greater”. The areas mapped by the Federal Emergency Management Agency (FEMA) on community Flood Insurance Rate Maps (FIRM) as the 100-year flood plain within the coastal zone are included within LSCSF. LSCSF may be significant to the interests of storm damage prevention, flood control, pollution prevention, and wildlife habitat. LSCSF in this area contains other jurisdictional resource areas which are important for storm damage prevention and flood control.

The current Flood Insurance Rate (FIRM) maps for this area, depicted as Figure 5.1 indicate that the 100-year storm encompasses the entire Project Area. There are currently no performance standards for work in LSCSF. The rehabilitation of the existing revetment and seawall will affect approximately 81,100 ft^2 of LSCSF of which 31,500 ft^2 will be permanently impacted with the expansion of the revetment footprint. The proposed project is not anticipated to alter the existing drainage patterns of the site and will enhance the storm damage prevention capacity of the site.

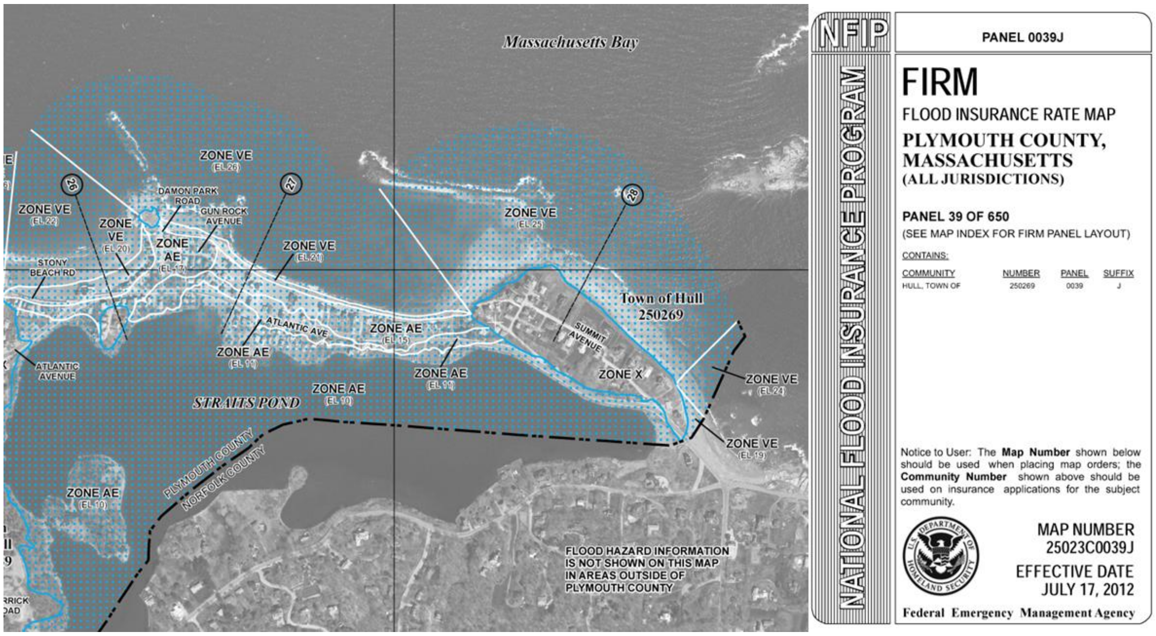


Figure 5.1. FEMA flood insurance rate map.

5.2 Land Under the Ocean

Land Under the Ocean (LUO) is defined at 310 CMR 10.25(2) as "land extending from the mean low water line seaward to the boundary of the municipality's jurisdiction and includes land under estuaries". This resource area is presumed significant to provide feeding areas, spawning and nursery grounds and shelter for coastal organisms, to reduce storm damage and flooding by diminishing and buffering the high energy effects of storms, provide a source of sediment for seasonal rebuilding of coastal beaches and dunes, and to provide important food for birds and invertebrates. Massachusetts Geographic Information System (MassGIS) data layers and information from the Town of Hull harbormaster indicates that there are no shellfish beds in the project area.

The proposed revetment will extend seaward of the existing revetment footprint on the west end of the beach. The revetment on the west end will also rise higher and steeper (1V:2H) resulting in a loss of LUO of approximately 16,100 ft^2 in area of Coastal Beach resource. Dredging of approximately 2,500 cubic yards of sediment is required in LUO and Coastal Beach to place the toe stones of the proposed revetment to a sufficient depth to minimize toe scour. The dredging would primarily occur along the western 1,000 feet of the proposed revetment. Based on input from DMF and NMFS during a pre-application meeting, it was suggested that a survey be conducted to characterize the resources in the current LUO area.

5.3 Coastal Beach

Pursuant to 310 CMR 10.27(2), Coastal Beach means unconsolidated sediment subject to wave, tidal, and coastal storm action which forms the gently sloping shore of a body of salt water and includes tidal flats. Coastal beaches extend from the mean low water line to the coastal bank or the seaward edge of existing man-made structures.

Coastal beaches dissipate wave energy, serve as sediment source, serve the purposes of storm damage prevention and flood control by dissipating wave energy, and provide habitats for shellfish, marine fisheries, birds and marine mammals.

Approximately 15,300 ft^2 of Coastal Beach in the Project Area will be filled by construction of the proposed revetment. The performance standards for Coastal Beach state that any project on a Coastal Beach shall not have an adverse effect by increasing erosion, decreasing the volume or changing the form of any such coastal beach or an adjacent downdrift coastal beach.

The proposed project meets the performance standards for Coastal Beaches (310 CMR 10.27(1)) as follows:

a. Volume (quantity of sediments) and form: *The proposed revetment, which is to be placed within 30 ft of the existing revetment footprint on the west end and within the existing footprint on the east end of the beach, is not expected to impede the transport of beach sediments along the Project Area.*
b. Ability to respond to wave action: *The proposed revetment will include a “rough face” of armor stones. Compared to the existing grouted revetment, the proposed design will have a greater ability to dissipate wave energy.*
c. Distribution of sediment grain size: *The proposed revetment will not change sediment grain size of the beach. Excavation to place the revetment toe stones will be performed in a fashion to ensure sediment excavated from the beach is returned to the beach fronting the revetment.*
d. Water circulation: *The proposed revetment will be placed in the same footprint as the existing revetment and will not affect water circulation.*
e. Water quality: *Only minimal excavation of beach material will be performed and the in situ material is granular in nature; therefore, no impacts to water quality will be caused by the revetment reconstruction.*
f. Relief and elevation: *The revetment repair will not alter the relief or elevation of the existing beach.*

5.4 Barrier Beach

Barrier Beach is defined at 310 CMR 10.29(2) as "a narrow low-lying strip of land generally consisting of coastal beaches and coastal dunes extending roughly parallel to the trend of the coast. It is separated from the mainland by a narrow body of fresh, brackish or saline water or a marsh system. A barrier beach may be joined to the mainland at one or both ends". Crescent Beach is located on the seaward side of a barrier beach, identified as H1-8 in the Massachusetts Barrier Beach Inventory Project (Massachusetts Office of Coastal Zone Management, 1982), where this feature includes a Coastal Beach resource area.

During storm conditions, water and sediment overwash the existing revetment, seawall, homes, and roads into Straits Pond. The proposed revetment and seawall will continue to encounter overwash to the pond but at a lower frequency and volume. The function of the barrier beach in regards to acting as a flood and storm buffer for Straits Pond will be enhanced with the proposed project.

5.5 Coastal Bank

The Act defines Coastal Bank (310 CMR 10.30(2)) as “the seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach, land subject to tidal action, or wetland”. The Coastal Bank is determined to be significant to storm damage prevention because it is a vertical buffer to storm waters. Therefore 310 CMR 10.30(7) applies: *Bulkheads, revetments, seawalls, groins, or other coastal engineering structures may be permitted on such a Coastal Bank except when such bank is significant to storm damage prevention or flood control because it supplies sediment to coastal beaches, coastal dunes, and barrier beaches*. The proposed revetment will be placed within 30 feet of the existing footprint of the revetment on the west end of the beach and within the existing limits of the revetment footprint on the east end. The proposed revetment is not expected to impede the wave and wind transport of beach sediments along the Project Area.

It also should be noted that the existing revetment is smooth-faced, where concrete was utilized to infill the gaps between the armor stones of the original structure. It was noted by Dr. Kathryn Ford of Massachusetts DMF that there was no algae able to grow along the face of the existing revetment, despite the existence of algae on the local bedrock and even the offshore breakwater. Based on the updated design, the new revetment will not be smoothed-faced and the armor stones will be fitted together without concrete. Therefore, the structure will create interstitial spaces that will serve as habitat, thereby improving the overall habitat value of the structure.

6.0 REGULATORY PERMITTING

The following federal, state, and local permits and reviews are anticipated to be required for the Project:

- Federal Clean Water Act, Section 404 Permit – U.S. Army Corps of Engineers – Massachusetts General Permit
- MGL Chapter 91 – Waterways License/Permit from Massachusetts DEP
- Clean Water Act, Section 401 Federal Water Pollution Control Act and the Massachusetts Clean Water Act – Section 401 Water Quality Certification from Massachusetts DEP
- Coastal Zone Management Act – MA Coastal Zone Consistency Certification from the MA Office of Coastal Zone Management
- Massachusetts Wetland Protection Act – Notice of Intent from Hull Conservation Commission
- MA Historical Commission – Project Notification
- MA Underwater Archaeological Research Board – Project Notification

7.0 REFERENCES

Federal Emergency Management Agency. 2012. "Flood Insurance Study, Plymouth County, Massachusetts, All Jurisdictions, Volume 1".

NOAA, 2013. “Mean Sea Level Trend 8443970 Boston, Massachusetts.” Retrieved from http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8443970.

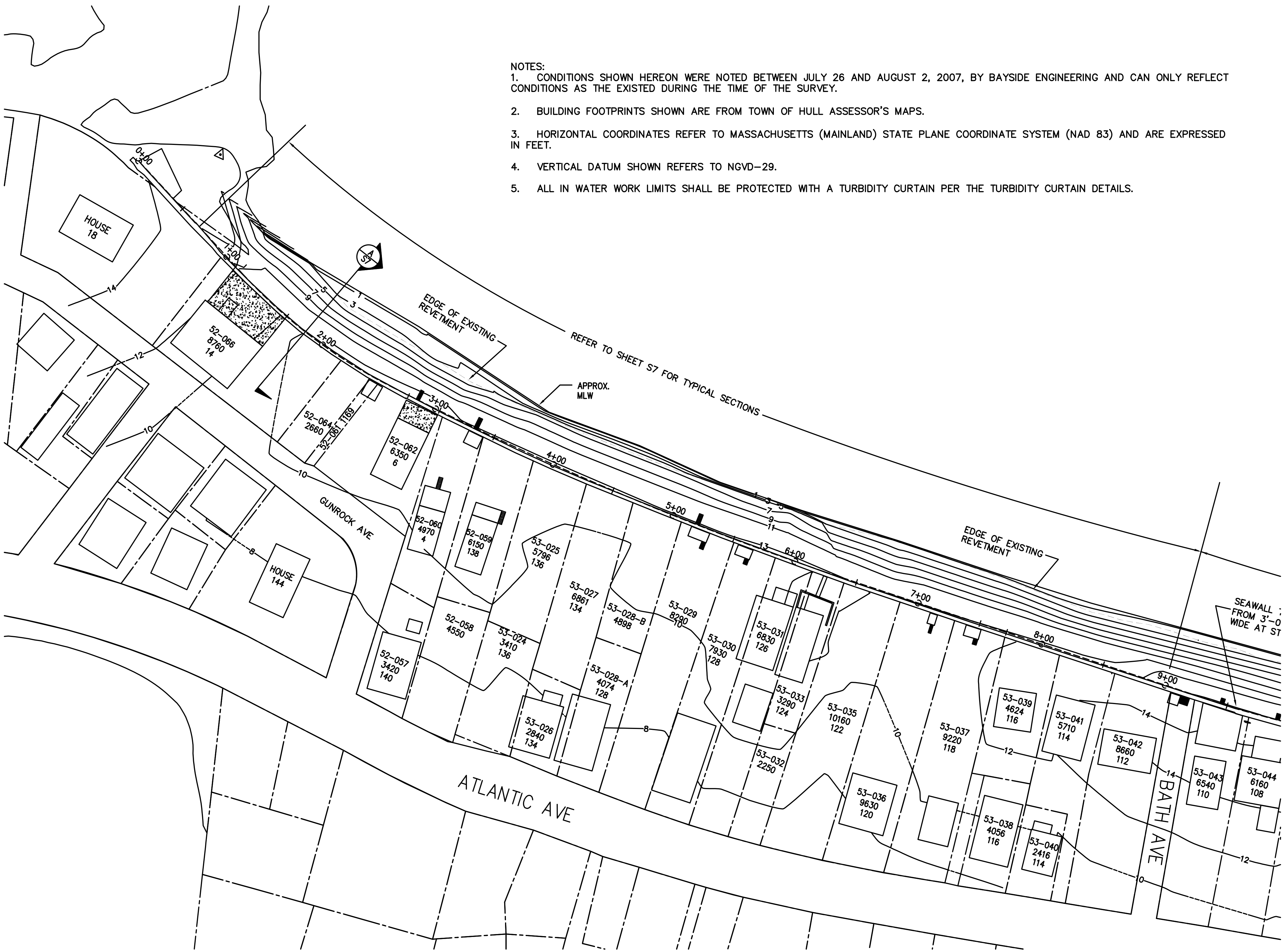
Pedersen, J. 1996. “Experimental Study of Wave Forces and Wave Overtopping on Breakwater Crown Walls,” Series paper 12, Hydraulics & Coastal Engineering Laboratory, Department of Civil Engineering, Aalborg University, Denmark.

U.S. Army Corps of Engineers. 2002. Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).

APPENDIX A – PERMITTING PLANS

See attached plans.

NOTES:
1. CONDITIONS SHOWN HEREON WERE NOTED BETWEEN JULY 26 AND AUGUST 2, 2007, BY BAYSIDE ENGINEERING AND CAN ONLY REFLECT CONDITIONS AS THE EXISTED DURING THE TIME OF THE SURVEY.
2. BUILDING FOOTPRINTS SHOWN ARE FROM TOWN OF HULL ASSESSOR'S MAPS.
3. HORIZONTAL COORDINATES REFER TO MASSACHUSETTS (MAINLAND) STATE PLANE COORDINATE SYSTEM (NAD 83) AND ARE EXPRESSED IN FEET.
4. VERTICAL DATUM SHOWN REFERS TO NGVD–29.
5. ALL IN WATER WORK LIMITS SHALL BE PROTECTED WITH A TURBIDITY CURTAIN PER THE TURBIDITY CURTAIN DETAILS.



EXISTING SEAWALL AND REVETMENT PLAN

SCALE: 1"=40'-0"

HOR. SCALE IN FEET
0 40 80 160
40 SCALE

PROPOSED REVETMENT REBUILD AND SEAWALL REPAIRS

GUNROCK SEAWALL
HULL, MASSACHUSETTS

SEAWALL EXISTING PLAN

DECEMBER 2009	SHEET 2
DRAWING S1	CONTRACT NO. 3688D

NOTES:

1. CONDITIONS SHOWN HEREON WERE NOTED BETWEEN JULY 26 AND AUGUST 2, 2007, BY BAYSIDE ENGINEERING AND CAN ONLY REFLECT CONDITIONS AS THE EXISTED DURING THE TIME OF THE SURVEY.
2. BUILDING FOOTPRINTS SHOWN ARE FROM TOWN OF HULL ASSESSOR'S MAPS.
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4. VERTICAL DATUM SHOWN REFERS TO NGVD–29.
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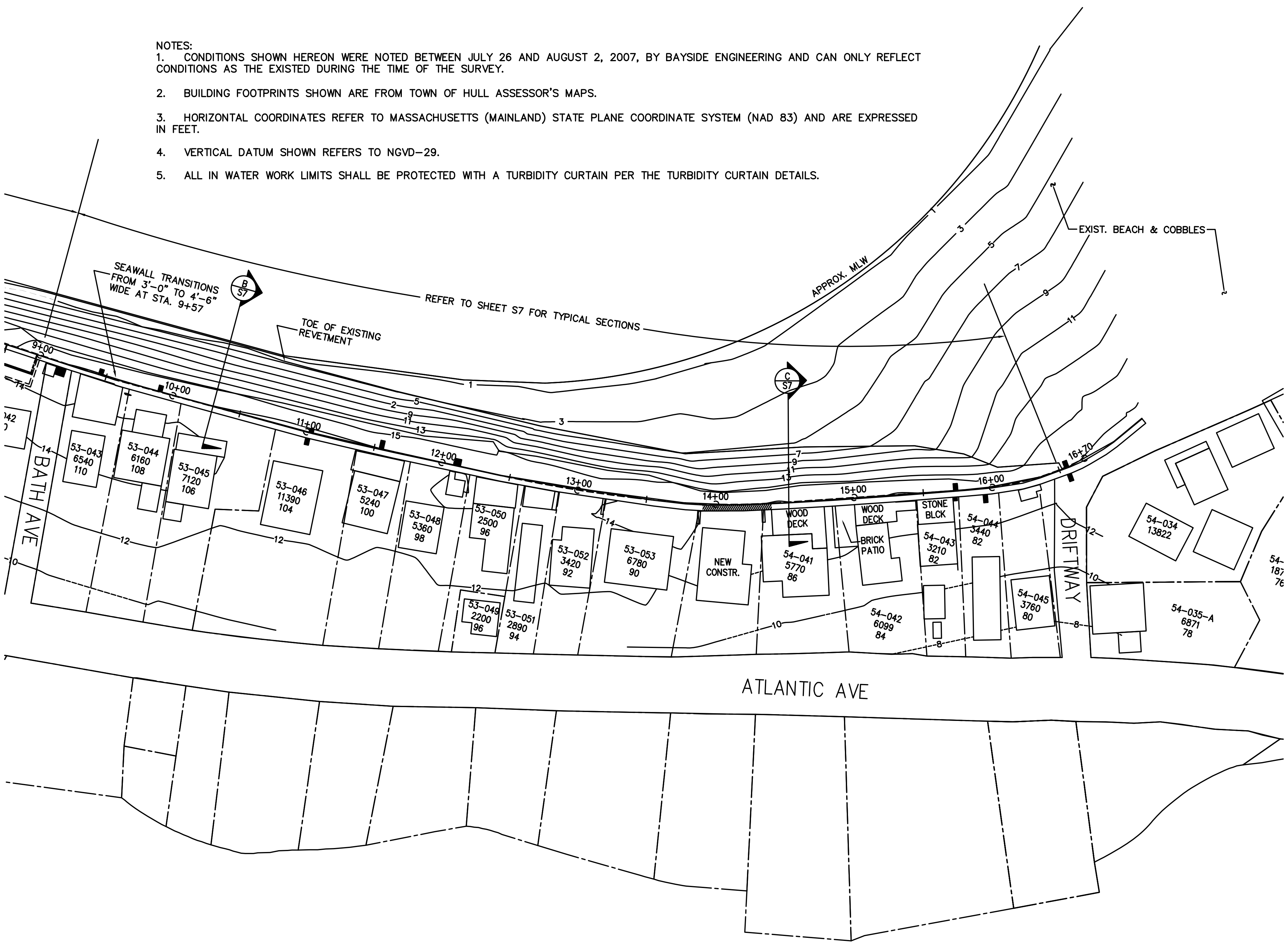


EXISTING SEAWALL AND REVETMENT PLAN

SCALE: 1"=40'-0"

HOR. SCALE IN FEET

0 40 80 160

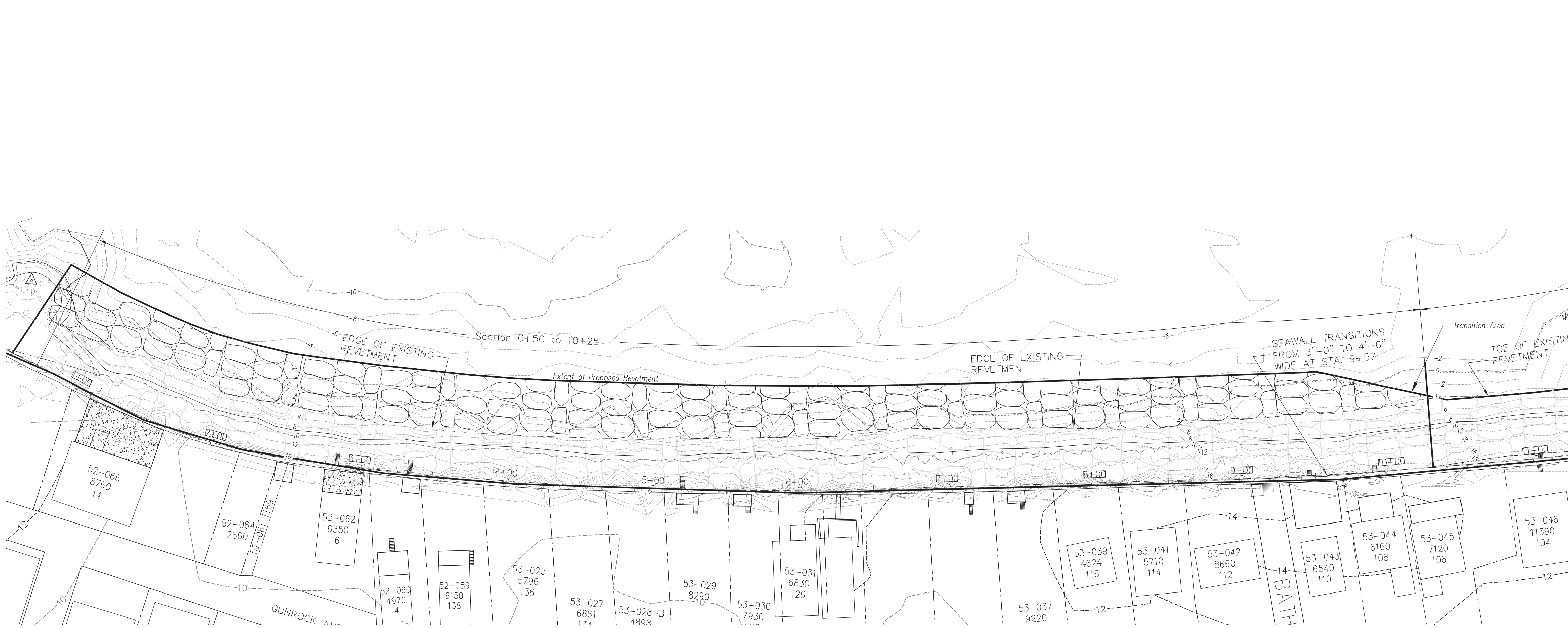
40 SCALE

PROPOSED REVETMENT REBUILD AND SEAWALL REPAIRS

GUNROCK SEAWALL
HULL, MASSACHUSETTS

SEAWALL EXISTING PLAN

DECEMBER 2009	SHEET 3
DRAWING S2	CONTRACT NO. 3688D

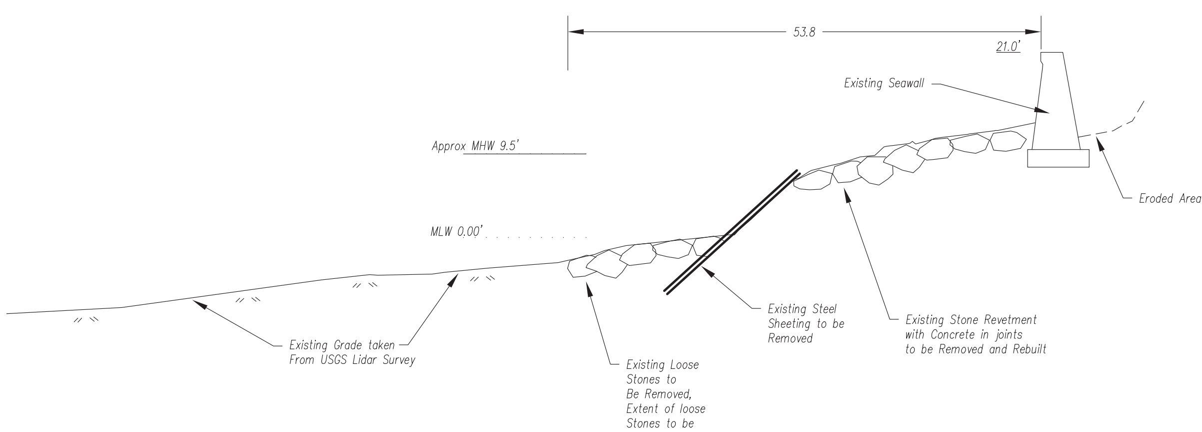


Resource Areas Station 0+50 to 10+25

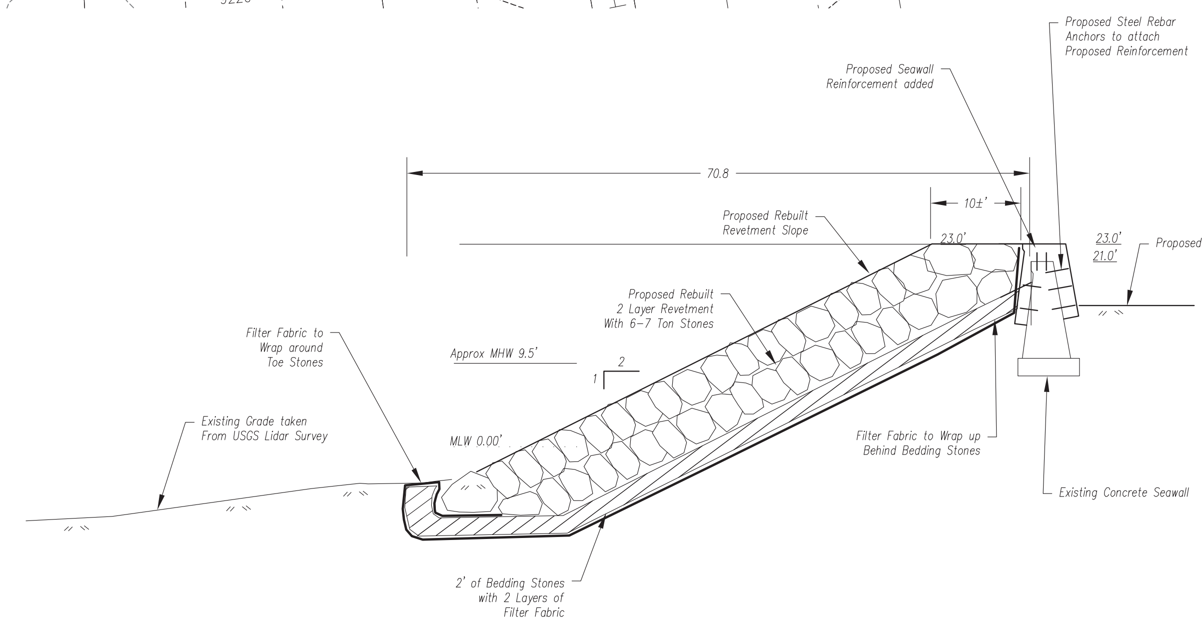
Coastal Bank 36,911 SF, 975 LF
Coastal Beach 11,695 SF
Land Under Ocean 16,138 SF
Land Subject to Coastal Storm Flowage 64,744 SF

Existing Footprint to Wall 36,911 SF
Proposed Revetment Expansion 27,833 SF

Existing Seawall & Proposed Revetment Plan
For Station 0+50 to 10+25
Section Shown Approx. 5+00
Scale 1"=40'



Existing Cross Section
For Station 0+50 to 10+00
Section Shown Approx. 5+00
Scale 1"=10'



Proposed Cross Section
For Station 0+50 to 10+00
Section Shown Approx. 5+00
Scale 1"=10'

For Permitting Only

NOTES:

1.) Building footprints and property lines shown are from town of Hull Assessor's Maps.

2.) The datum used is MLW supplied by Applied Coastal.

3.) Horizontal coordinates refer to Massachusetts state plane coordinate System NAD83.

4.) Contours are from Lidar Data supplied by others

PREPARED FOR:

Town of Hull

10_CROSSSECT 0 5 10 20 40
40_PLANVIEW 0 20 40 80 160

PREPARED BY:

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Draft:	JOD	Field:	RRL/MML
Review:	PS	Comp.:	RRL
Project:	30012	Project #	C291

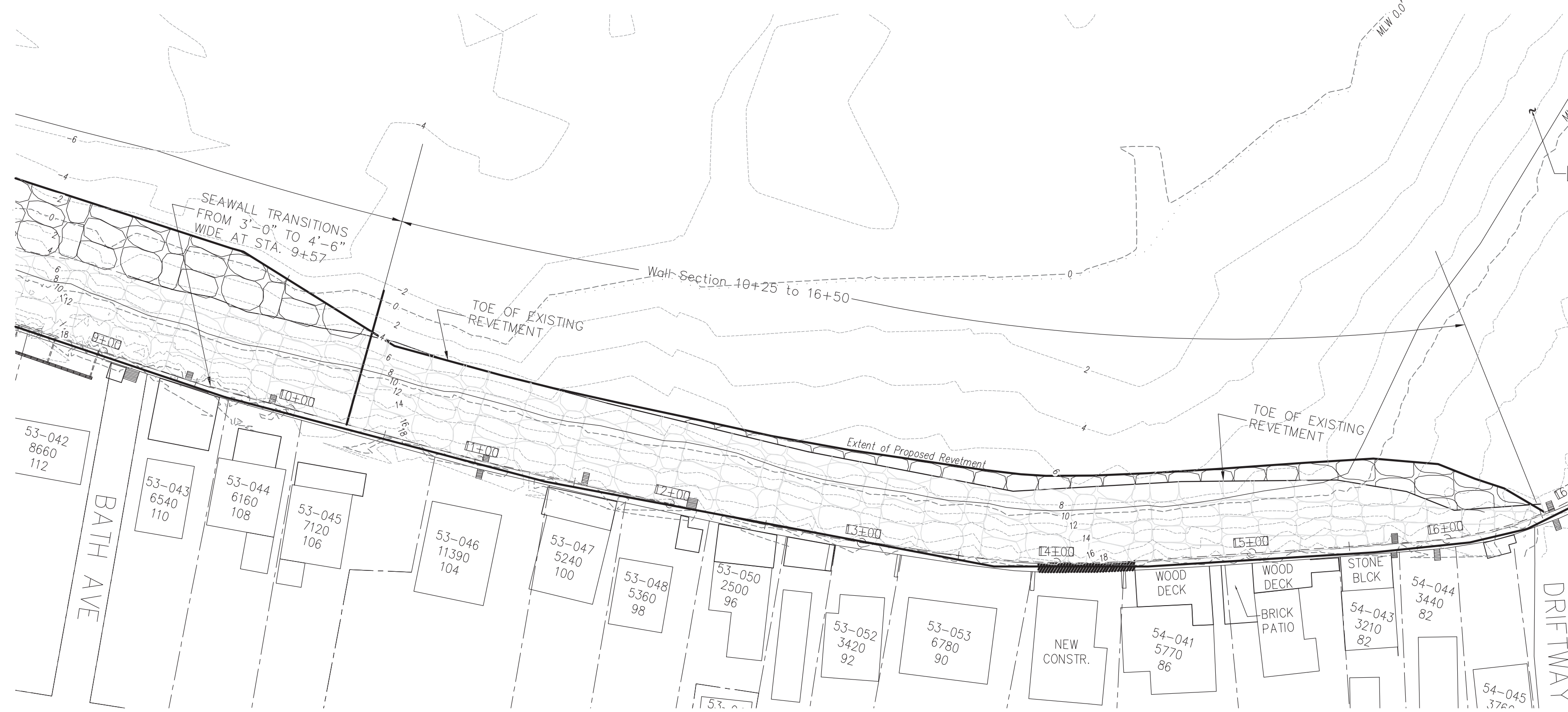
TITLE:

Site Plan
Proposed Revetment Rebuild & Seawall Repairs Station 00+50 - 10+25 At Crescent Beach Seawall Hull, Massachusetts

DATE: June 29, 2015

SCALE: As Noted

SHEET 1 OF 2

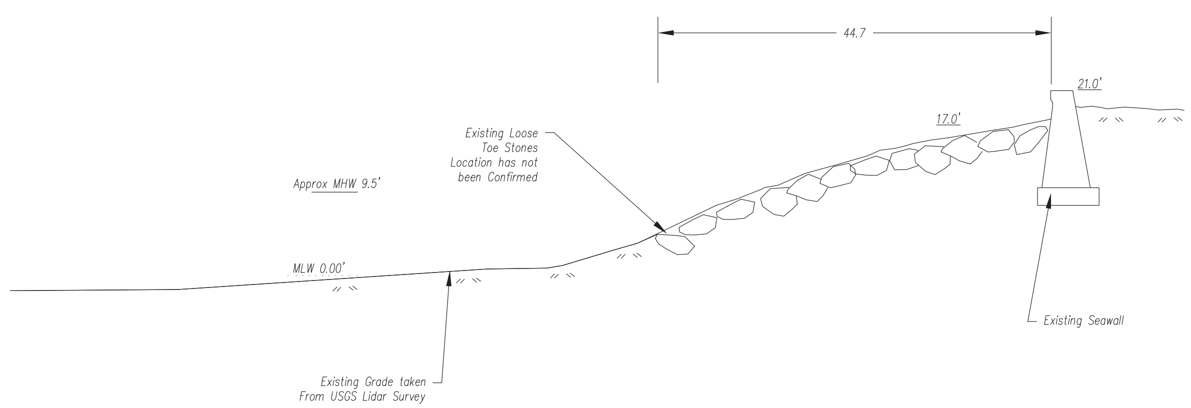


Resource Areas Station 10+25 to 16+50

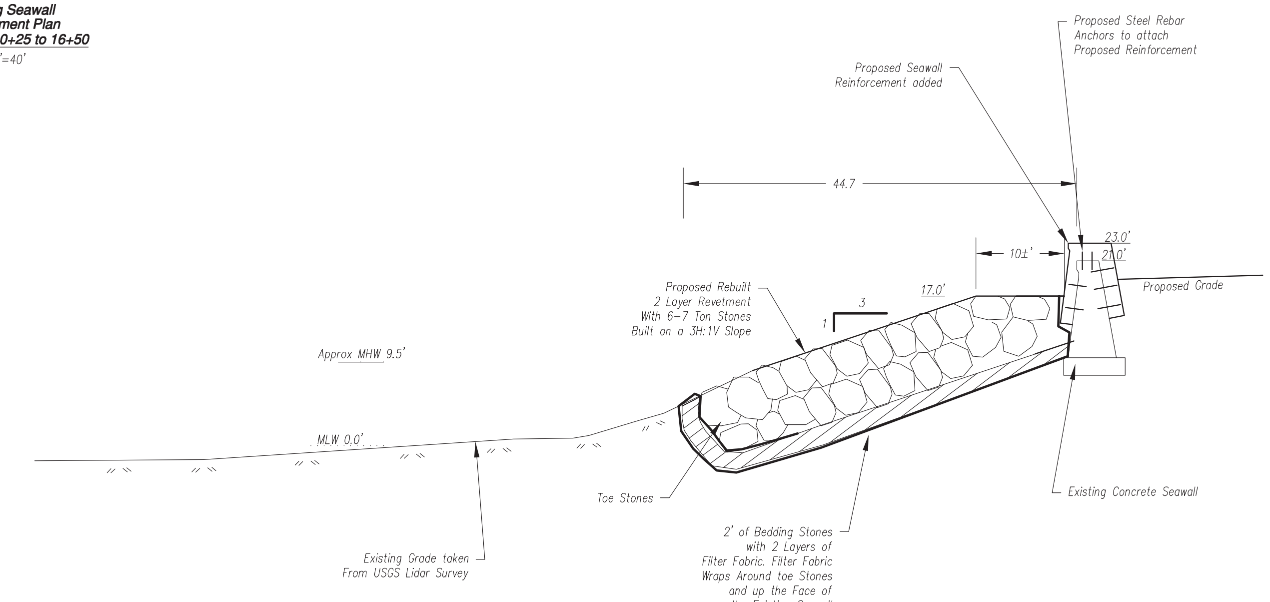
Coastal Bank 22,695 SF, 625 LF
Coastal Beach 3,618 SF
Land Subject to Coastal Storm Flowage 26,313 SF

Existing Footprint to Wall 22,695 SF
Proposed Revetment Expansion 3,618 SF

Existing Seawall & Revetment Plan
For Station 10+25 to 16+50
Scale 1"=40'



Existing Cross Section
For Station 10+25 to 16+50
Section Shown Approx. 12+00
Scale 1"=10'



Proposed Cross Section
For Station 10+25 to 16+50
Section Shown Approx. 12+00
Scale 1"=10'

For Permitting Only

NOTES:

1.) Building footprints and property lines shown are from town of Hull Assessor's Maps.

2.) The datum used is MLW supplied by Applied Coastal.

3.) Horizontal coordinates refer to Massachusetts state plane coordinate System NAD83.

4.) Contours are from Lidar data supplied by others.

PREPARED FOR:

Town of Hull

10_CROSSSECT	0	5	10	20	40
40_PLANVIEW	0	20	40	80	160

PREPARED BY:

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www.appliedcoastal.com

Draft:	JOD	Field:	RRL/MML
Review:	PS	Comp.:	RRL
Project:	30012	Project #	C291

TITLE:

Site Plan
Proposed Revetment Rebuild & Seawall Repairs Station 10+25 - 16+50 At Crescent Beach Seawall Hull, Massachusetts

DATE: June 29, 2015

SCALE: As Noted

SHEET 2 OF 2