NHDOT North Hampton – Rye 42312

NH Rt 1A Coastal Revetment Resilience/Conceptual Design
2022 Climate Summit – NH Coastal Adaptation Workgroup
September 29, 2022

Project Overview – History

January - March 2018	**A series of nor'easters battered the coastal seawall and caused structural damage**
November 2018	**FEMA issues findings from site inspections**
May 2019	**DOT hires GZA to develop revetment restoration alternatives**
June 2021	**GZA issues Conceptual Design Report**

Project Overview – Project is Ongoing

Scope:

- ✓ **Site reconnaissance and existing conditions documented**
  - Nine stone revetment sections
- ✓ **Coastal flood hazards characterization**
  - Metocean Data Analysis
  - Wave Modeling
- ✓ **Risk Based vulnerability assessment**
  - Current conditions
  - 1978 conditions
- ✓ **Conceptual Improvements Report**
  - DOT coordinating with FEMA and evaluating responses to RFP for design

Section 1 – Post Storm Observations – March 5, 2018

Cumulative Road Closures – January & March 2018

Revetment Section	Cumulative Duration of Full Roadway Closure (Hours:Minutes)*	No. of Full Roadway Closures	Typical More Significant Recurring Damage
1	3:52	1	✓
2	3:52	1	✓
3	3:52	1	
4	23:52	4	
5	23:52	4	
6	22:32	5	✓
7	15:55	4	
10	37:36	8	✓
13	37:36	8	✓

* January and March 2018

Section 10
March 3, 2018

Section 10
February 2, 2021

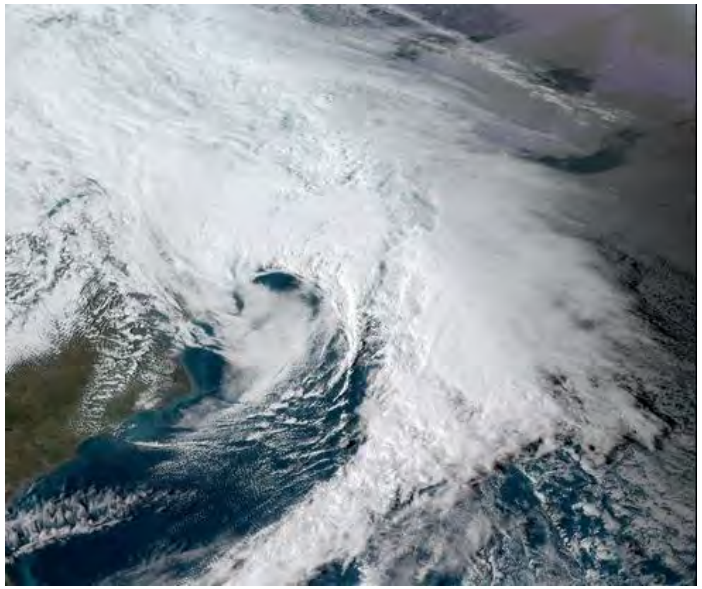
Table 5. Top Ten Highest Water Levels[1] at NOAA Boston and Portland Gage.

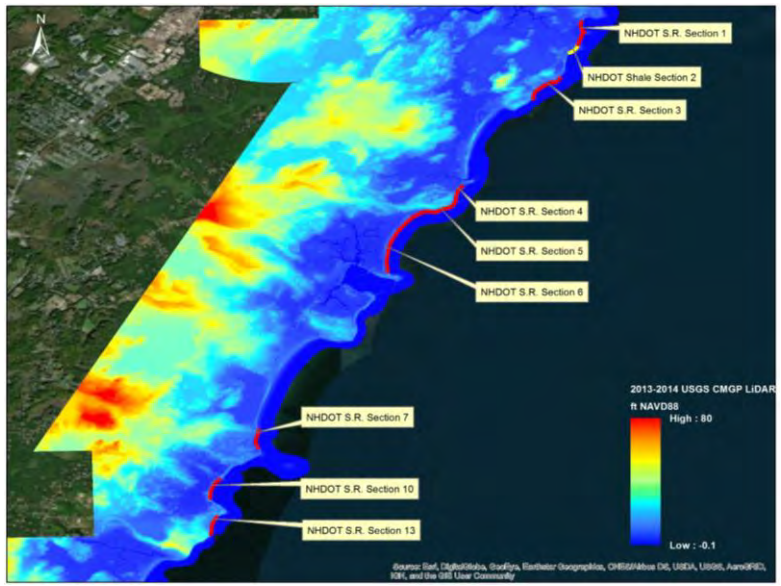
Boston, MA			Portland, ME		
Time	Water Level[2] (ft, NAVD88)	Storm Type	Time	Water Level[2] (ft, NAVD88)	Storm Type
1/4/2018	9.66	Nor'Easter	2/7/1978	8.87	Nor'Easter
2/7/1978	9.59	Nor'Easter	1/9/1978	8.68	Nor'Easter
3/2/2018	9.13	Nor'Easter	1/4/2018	8.26	Nor'Easter
1/2/1987	8.69	Nor'Easter	3/16/1976	8.01	Nor'Easter
10/30/1991	8.63	Nor'Easter	12/4/1990	8.00	Nor'Easter
1/25/1979	8.53	Nor'Easter	11/20/1945	7.99	Nor'Easter
12/12/1992	8.52	Nor'Easter	11/30/1944	7.99	Nor'Easter
12/29/1959	8.47	Nor'Easter	3/2/2018	7.91	Nor'Easter
2/19/1972	8.39	Nor'Easter	4/16/2007	7.91	Nor'Easter
1/3/2014	8.33	Nor'Easter	1/2/1987	7.88	Nor'Easter

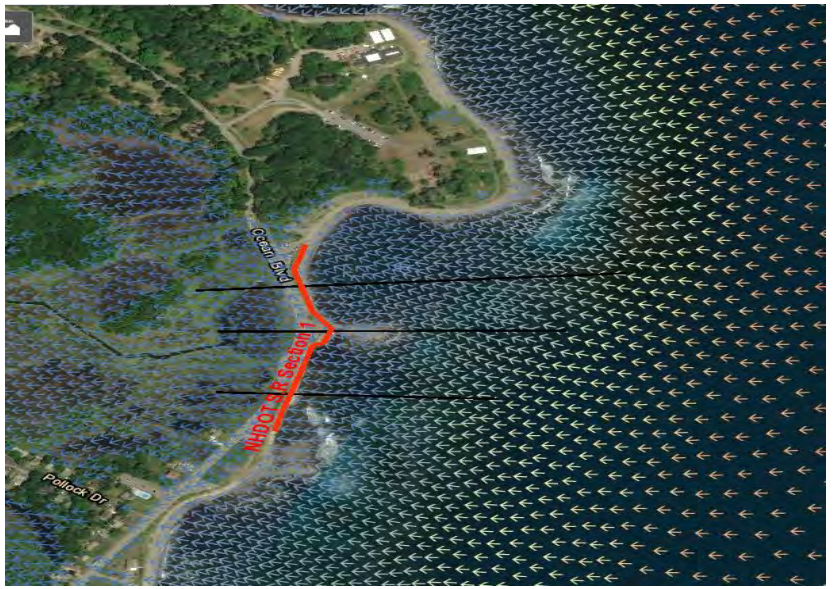
Note:
1. Source data provided by NOAA, available at http://tidesandcurrents.noaa.gov/est/Top10_form_ft.pdf.
2. Water levels were converted to NAVD88 from source data.

Metocean Analysis and Numerical Modeling

- Metocean Data Analysis
- Digital Elevation Model
- Numerical Wave Modeling







Conceptual Design

- Revetement Evaluation (stability, stone size)
- Roadway Vulnerability Evaluation (overtopping, flow rates)

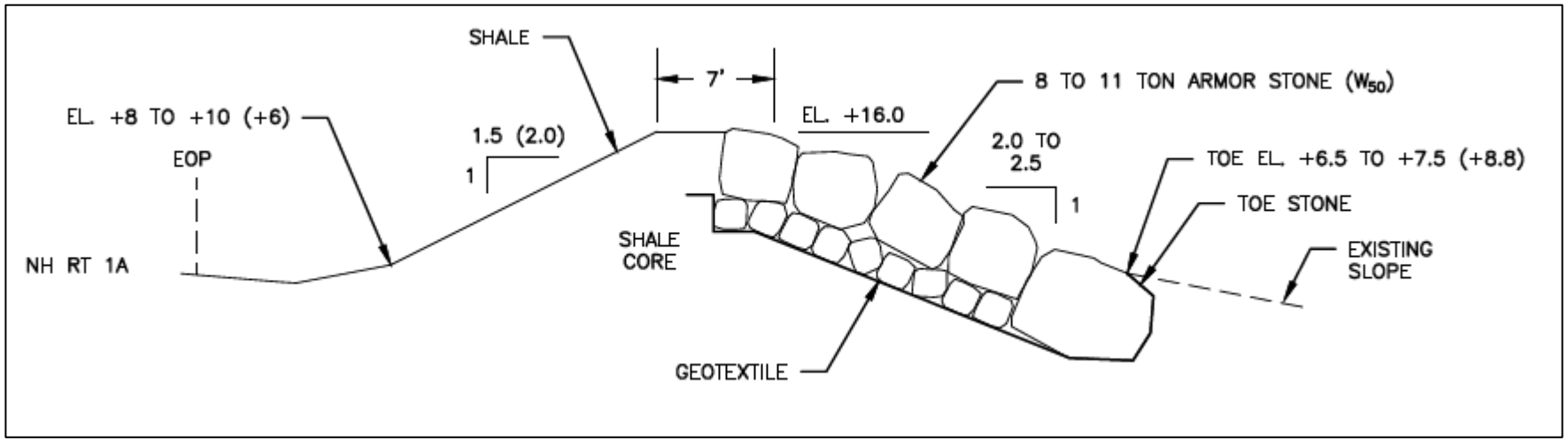
Transect	Stillwater Elevation (feet NAVD88*) 10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance	Total Water Elevation 1-Percent Annual Chance[1]	Zone	Base Flood Elevation* (feet NAVD88**)	NHDOT Section
30	7.24	7.98	8.36	9.43	11.67	VE	21[2]	6
						AE	21[2]	
						AO	3	
						AE	8-10	
31	7.24	7.98	8.36	9.43	11.66	VE	20[2]	
						AE	20[2]	
						AO	3	
						AE	8-10	
43	7.24	7.98	8.36	9.43	11.47	VE	16[2]-18	7
						AE	16[2]	
						AO	3	
44	7.24	7.98	8.36	9.43	11.53	VE	18[2]	
						AE	18[2]	
46	7.24	7.98	8.36	9.43	11.66	VE	20[2]	10
						AE	20[2]	
						AO	3	
						AE	8-9	
47	7.24	7.98	8.36	9.43	11.21	VE	24[2]	
						AE	24[2]	
						AO	3	
						AE	8-9	
48	7.24	7.98	8.36	9.43	11.82	VE	22[2]	13
						AE	22[2]	
49	7.24	7.98	8.36	9.43	11.7	VE	18[2]	
						AE	18[2]	

Coastal Flood Water Levels – FEMA Coastal Transects

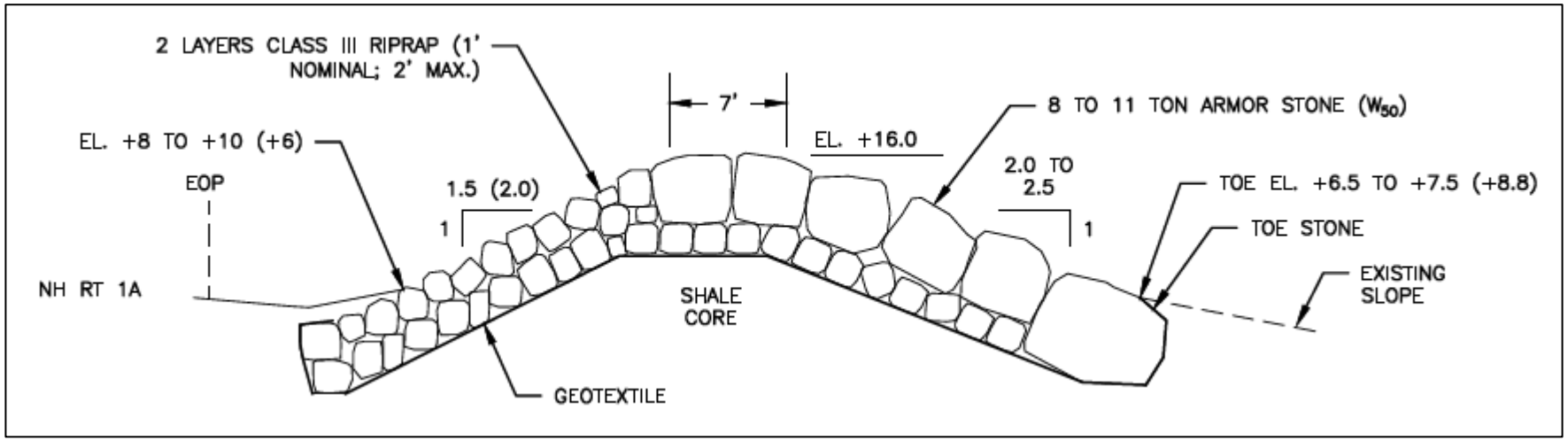
10-yr	Section 1	2	3	4	5	6	7	10	13
Back Water Flood	✓	✓		✓		✓			
NH Rt 1A Flood	✓	✓							
Overtopping	✓	✓	✓	✓	✓	✓			✓
% Length Unsafe Driving - High Speed									
% Length Unsafe Driving - Any Speed	19%	82%	86%	59%	80%	11%	-	-	23%
50-yr									
Back Water Flood	✓	✓		✓		✓			
NH Rt 1A Flood	✓	✓							
Overtopping	✓	✓	✓	✓	✓	✓	✓	✓	✓
% Length Unsafe Driving - High Speed								18%	
% Length Unsafe Driving - Any Speed	48%	100%	86%	100%	80%	47%	66%		44%
100-yr									
Back Water Flood	✓	✓		✓		✓			
NH Rt 1A Flood	✓	✓							
Overtopping	✓	✓	✓	✓	✓	✓	✓	✓	✓
% Length Unsafe Driving - High Speed									
% Length Unsafe Driving - Any Speed	84%	100%	100%	100%	80%	69%	100%	45%	72%
NHDOT Repetitive Damage	✓	✓				✓		✓	✓
Jan & March 2018 Full Closure Time	3:52	3:52	3:52	23:52	23:52	22:32	15:55	37:36	37:36
Jan & March 2018 Full Closure Periods	1	1	1	4	4	5	4	8	8

Existing Conditions Vulnerability Assessment Summary

Conceptual Design – Revetment Reconstruction



Full Reconstruction with Exposed Shale on the Crest and Backslope (Similar to 1978 Design)



Full Reconstruction with Stone Crest and Backslope

Take-Aways and Future Work

- **Wave Overtopping Can Cause Stability Issues**
  - Field measurements of stone/ sediment size is important
- **Fine model resolution needed with a complex nearshore**
  - Carefully choosing the design wave
- **Be aware of permitting/ federal-state-local regulations**
  - Minimum crest elevation: greater of existing and 1978
- **Other Considerations (ex. water use, viewscape)**
- **Reconstruct with an engineered revetment**
  - Core stone, Geotextile, Filter Stone, Armor Stone
  - FEMA cost recovery
- **Two Concepts for Consideration**
  - Include armor stone on the ocean side, crest and backslope
  - Maintain exposed shale on the crest and backslope

Questions?