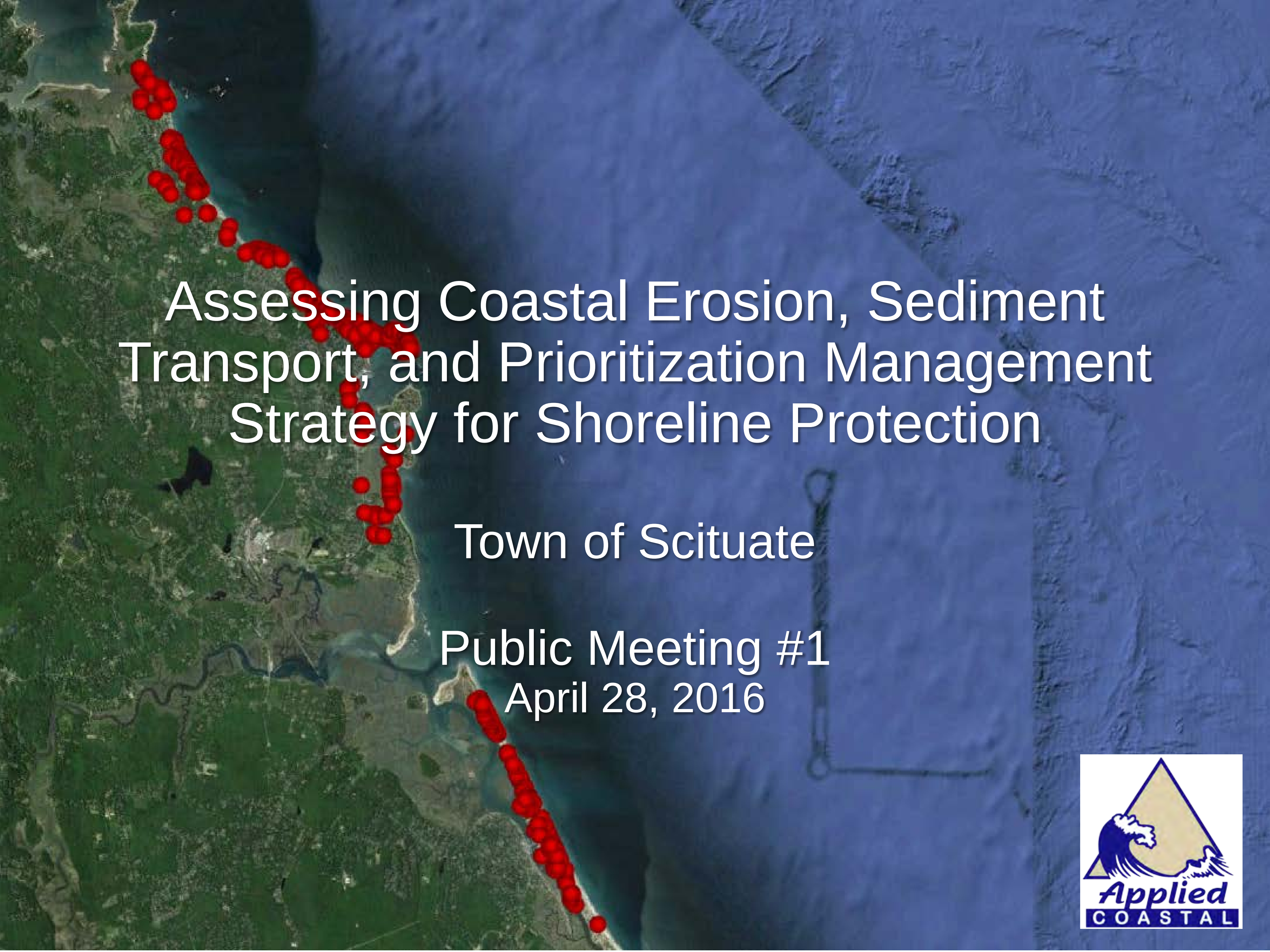


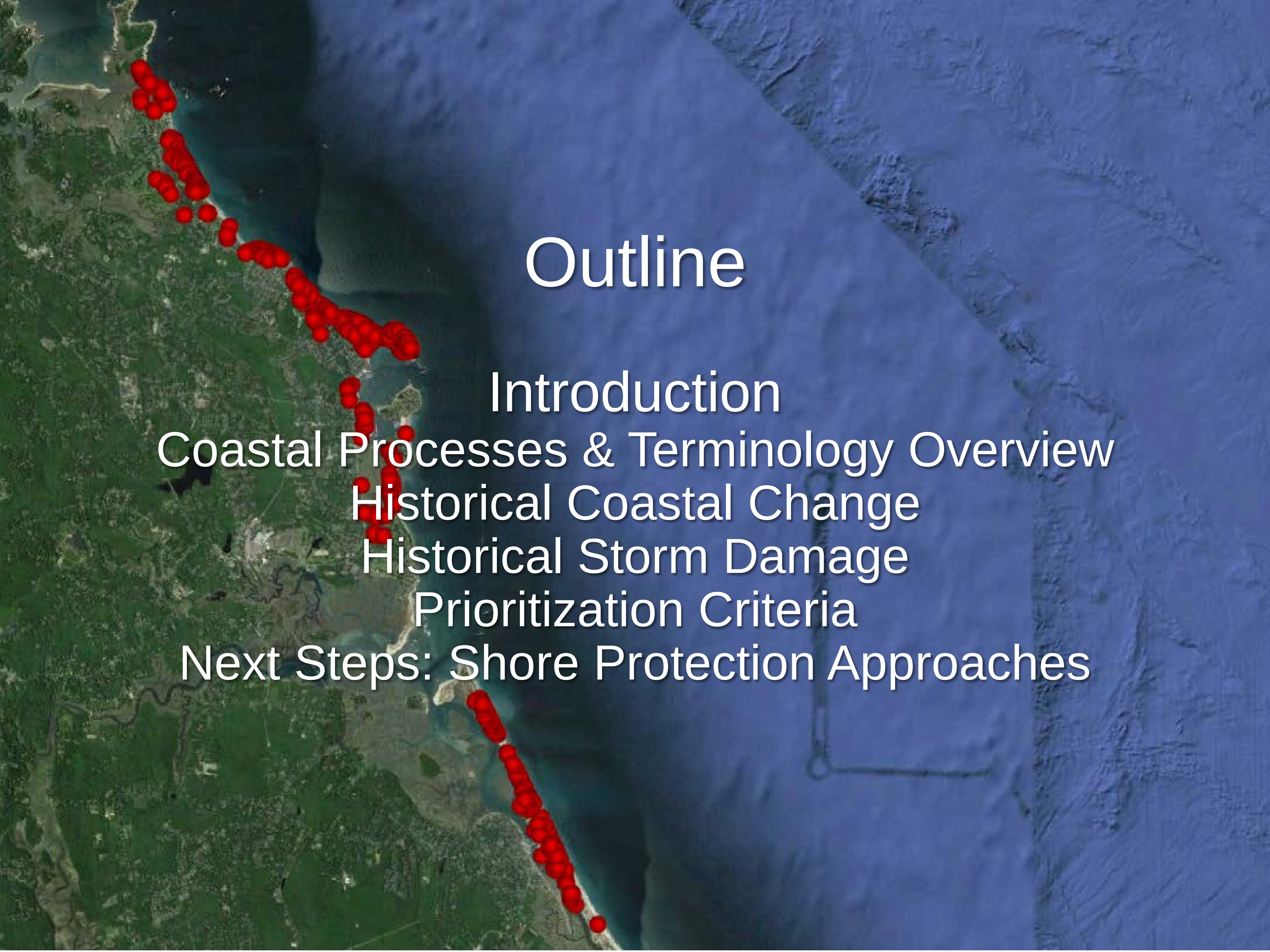
Assessing Coastal Erosion, Sediment Transport, and Prioritization Management Strategy for Shoreline Protection

Town of Scituate

Public Meeting #1

April 28, 2016

Applied COASTAL



Outline

Introduction
Coastal Processes & Terminology Overview
Historical Coastal Change
Historical Storm Damage
Prioritization Criteria
Next Steps: Shore Protection Approaches

Introduction

Background

Over the last several years, the Town has made great strides providing public outreach regarding coastal hazards, as well as the effects of future sea level rise and climate change.

Work continues on upgrading existing seawalls (e.g. Minot Beach) and moving forward on other needed shore protection improvements (e.g. large-scale beach nourishment along North Scituate Beach).

Similar to most communities, implementation has generally been performed in a ***reactive*** manner, with storm damage repairs performed as necessary to maintain the *status quo*.

Introduction (continued)

Study Purpose

To provide for long-term coastal management guidance, the Town of Scituate is proposing preparation of a ***proactive*** planning document to provide a broader town-wide perspective relative to shore protection needs and prioritization of projects.

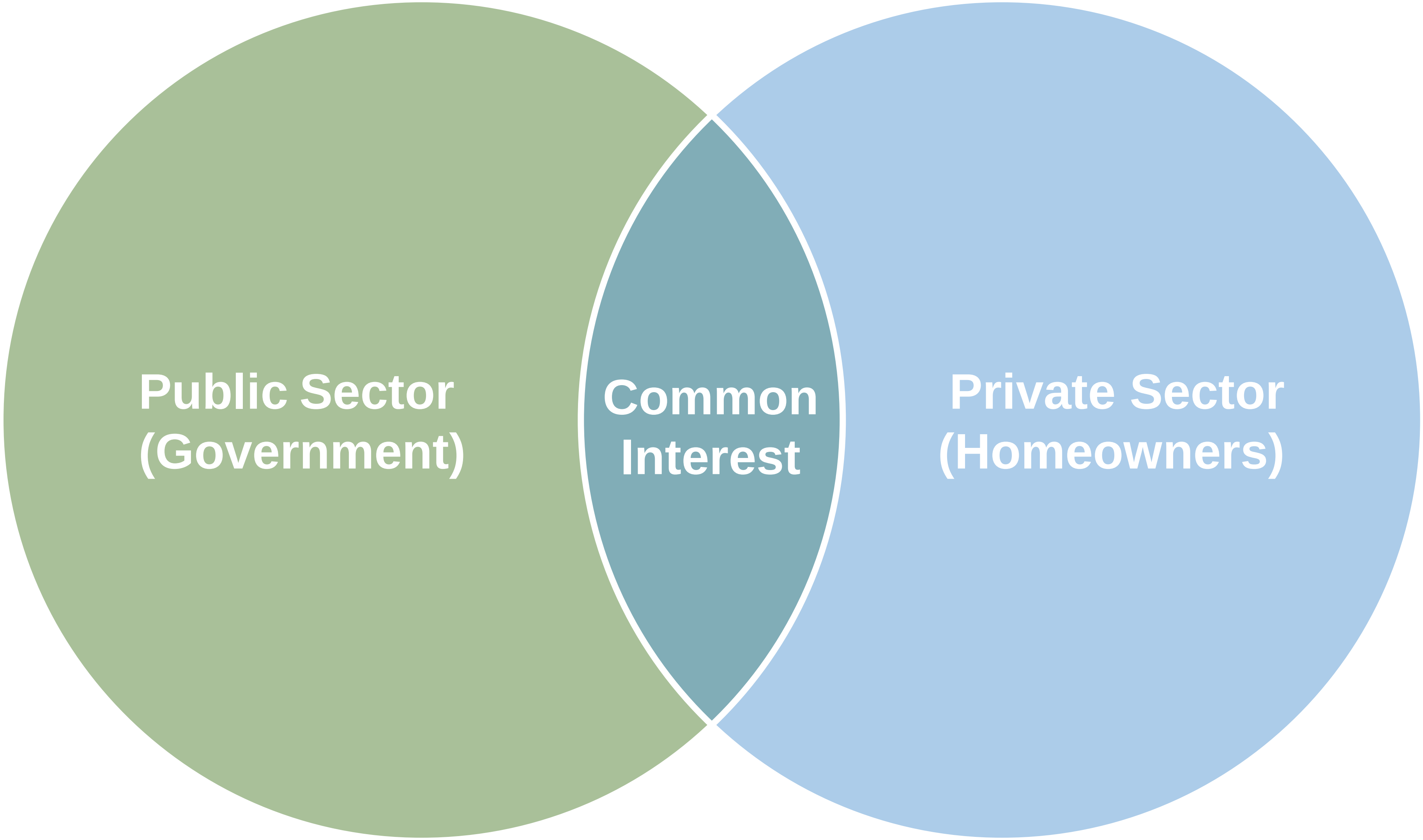
Phase #1 (completed)

- Assess historical coastal change and coastal processes governing erosion
- Quantify historical storm damage
- Develop prioritization criteria to provide a defensible rating system for individual shoreline segments in Scituate

Phase #2 (ongoing)

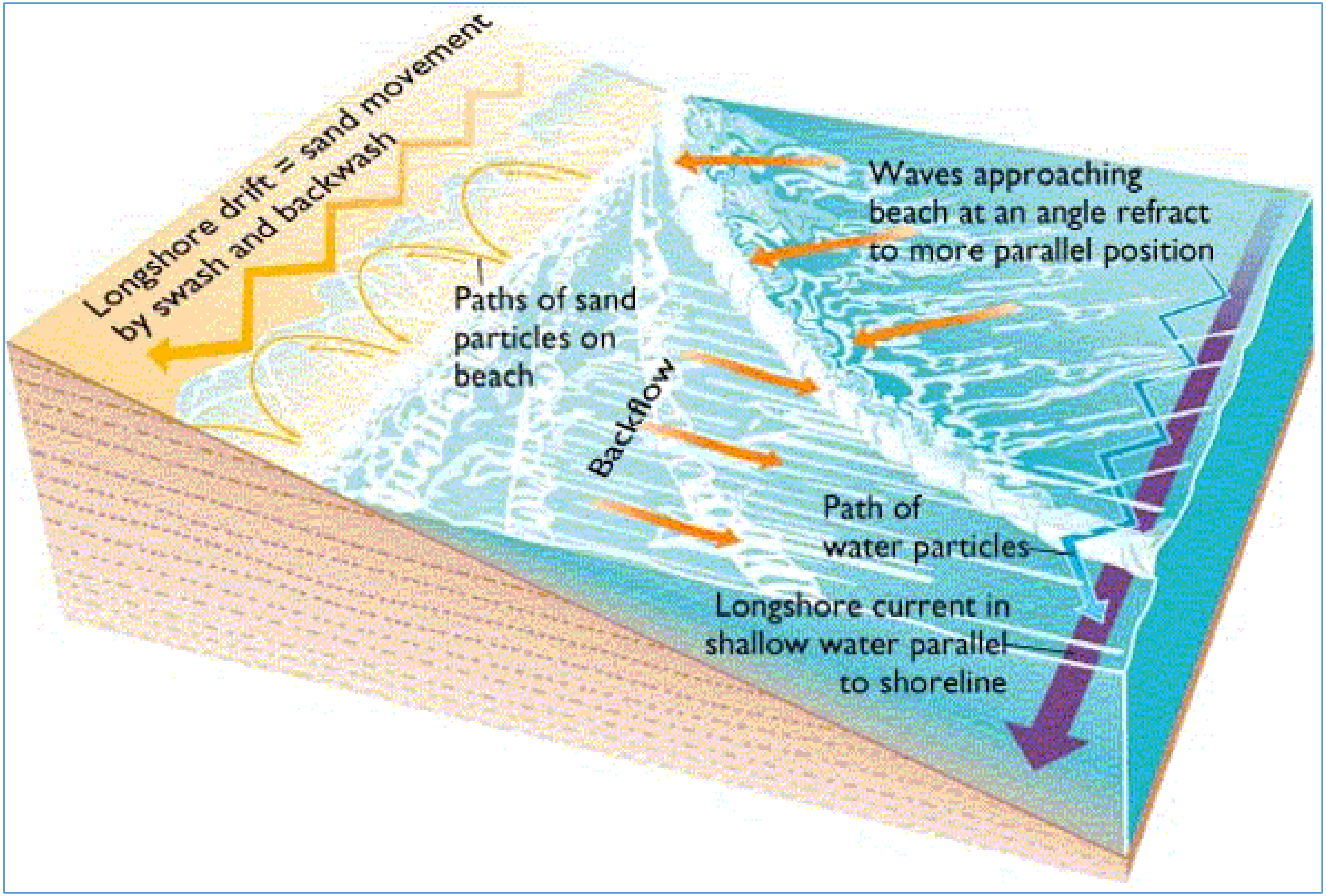
- Assess the impact of the “no action alternative”
- Perform an alternatives analysis to determine the most appropriate shore protection strategies based on engineering and environmental considerations
- Provide general cost information for the various engineering alternatives (construction and maintenance)

Private and Public Partnership
“Shared Responsibility”



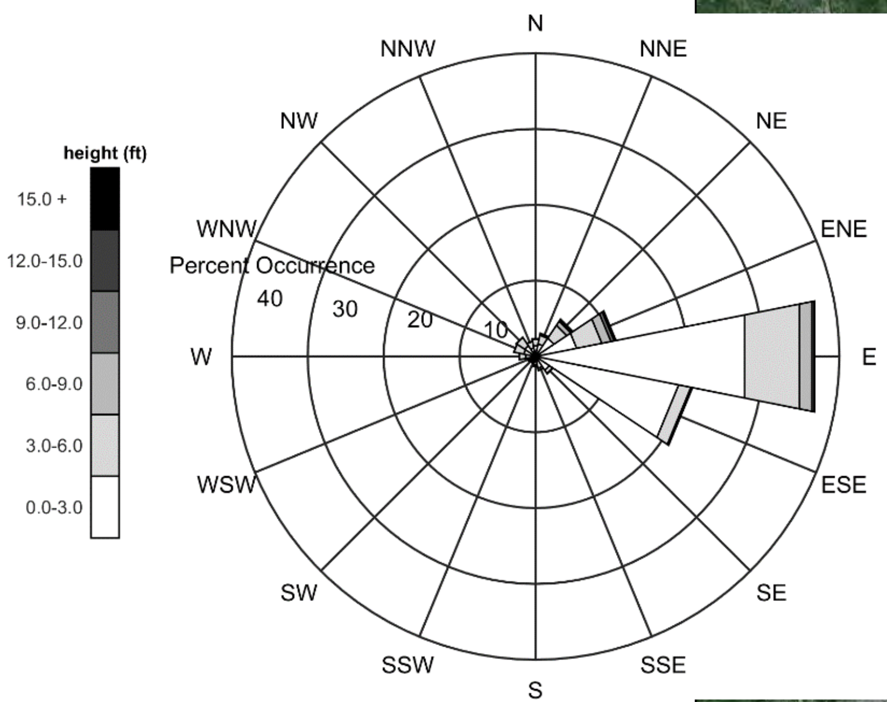
Coastal Processes & Terminology Overview

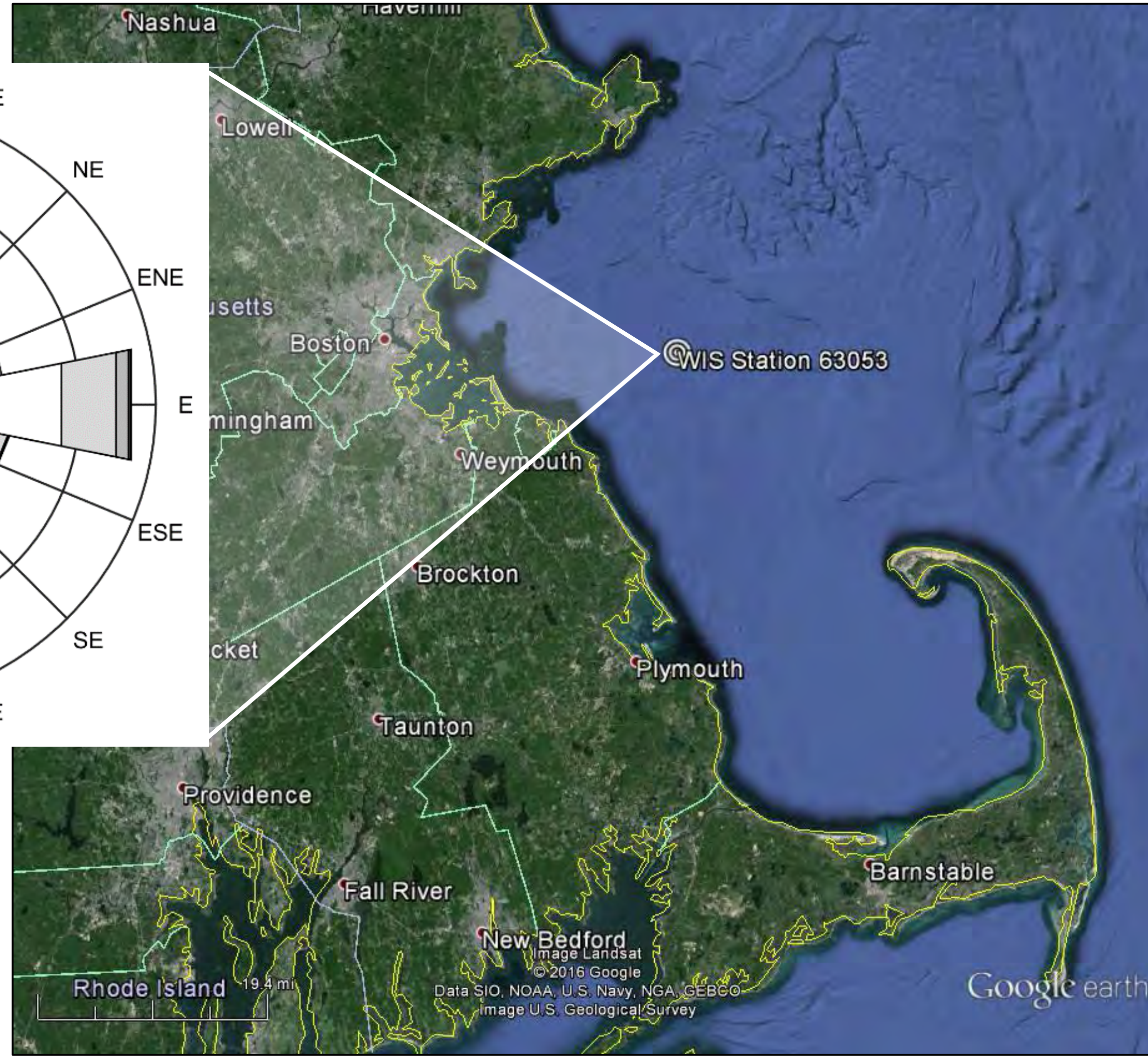
Coastal Processes Overview



Offshore Waves Conditions (1980-2012)

11 miles offshore of Scituate



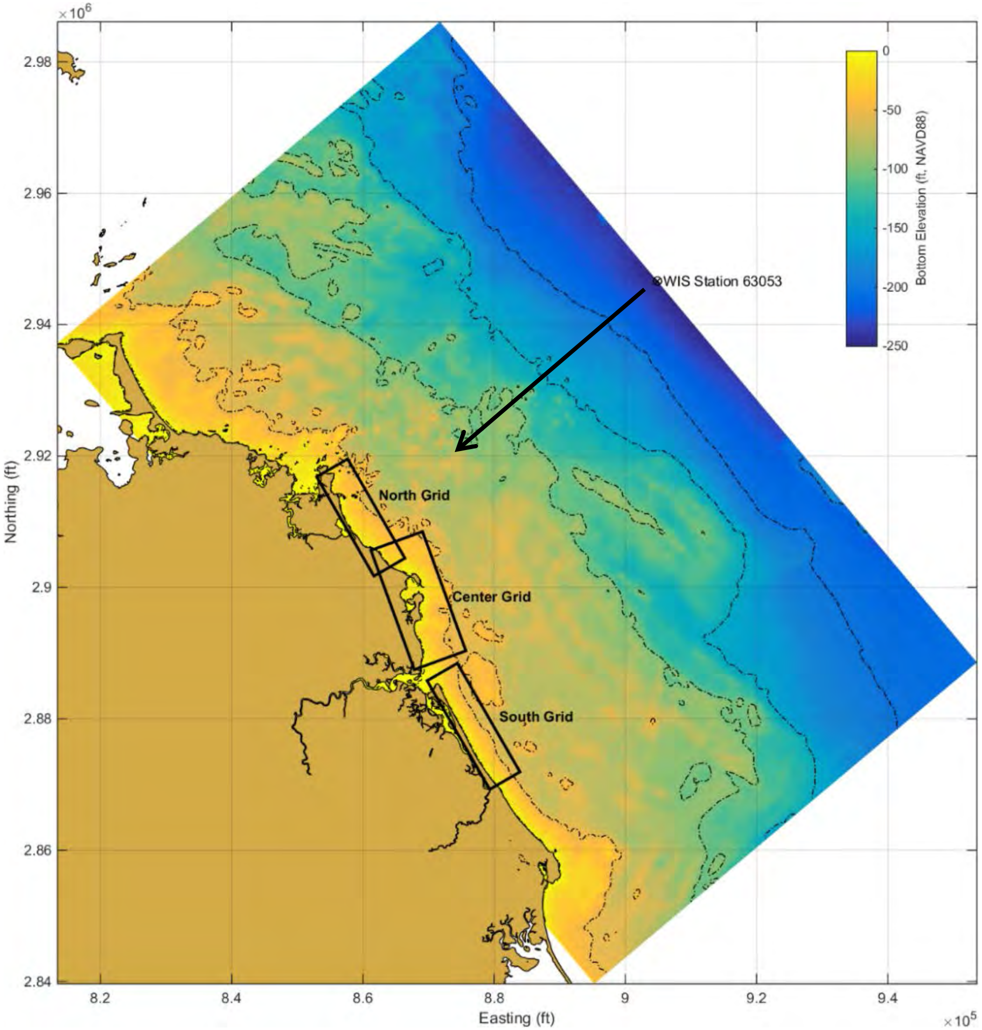


Most common waves are from E and ESE (58.6% of the time).

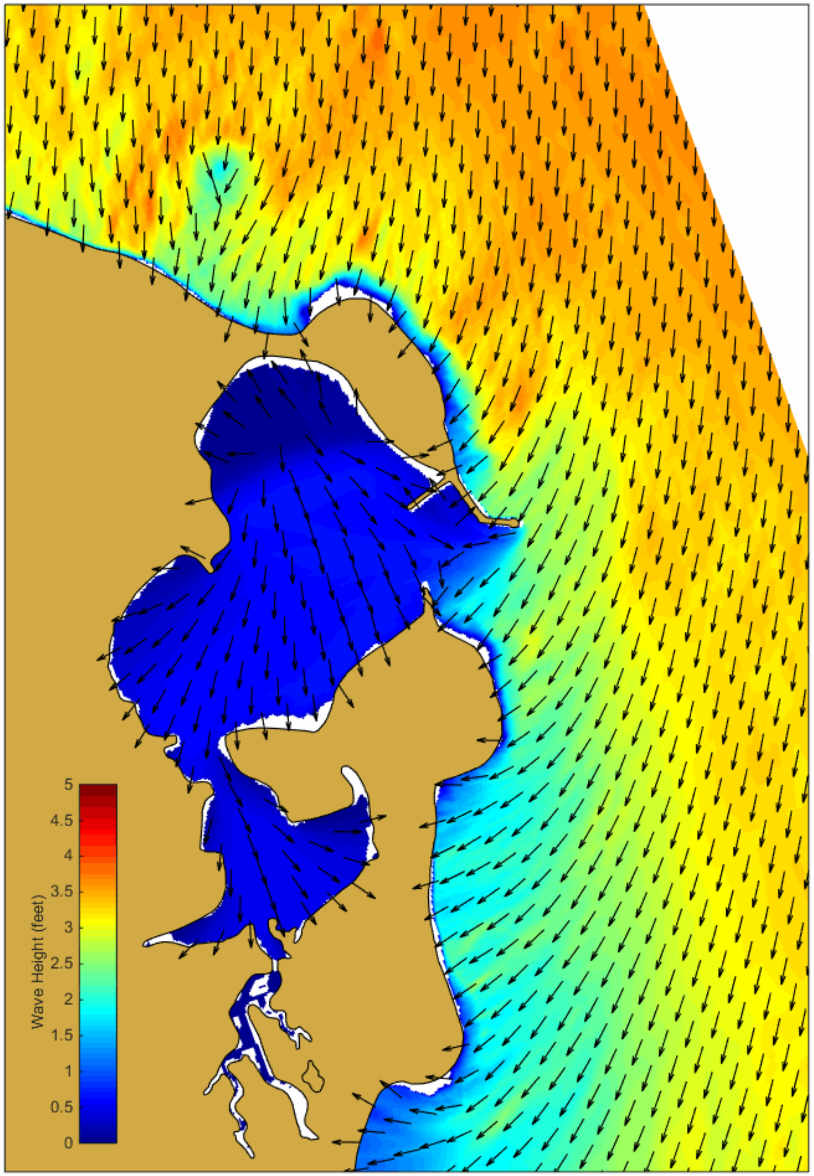
The largest waves (>15 ft) are from the northeast (0.2% of the time).

Transforming Offshore Waves to the Scituate Shoreline

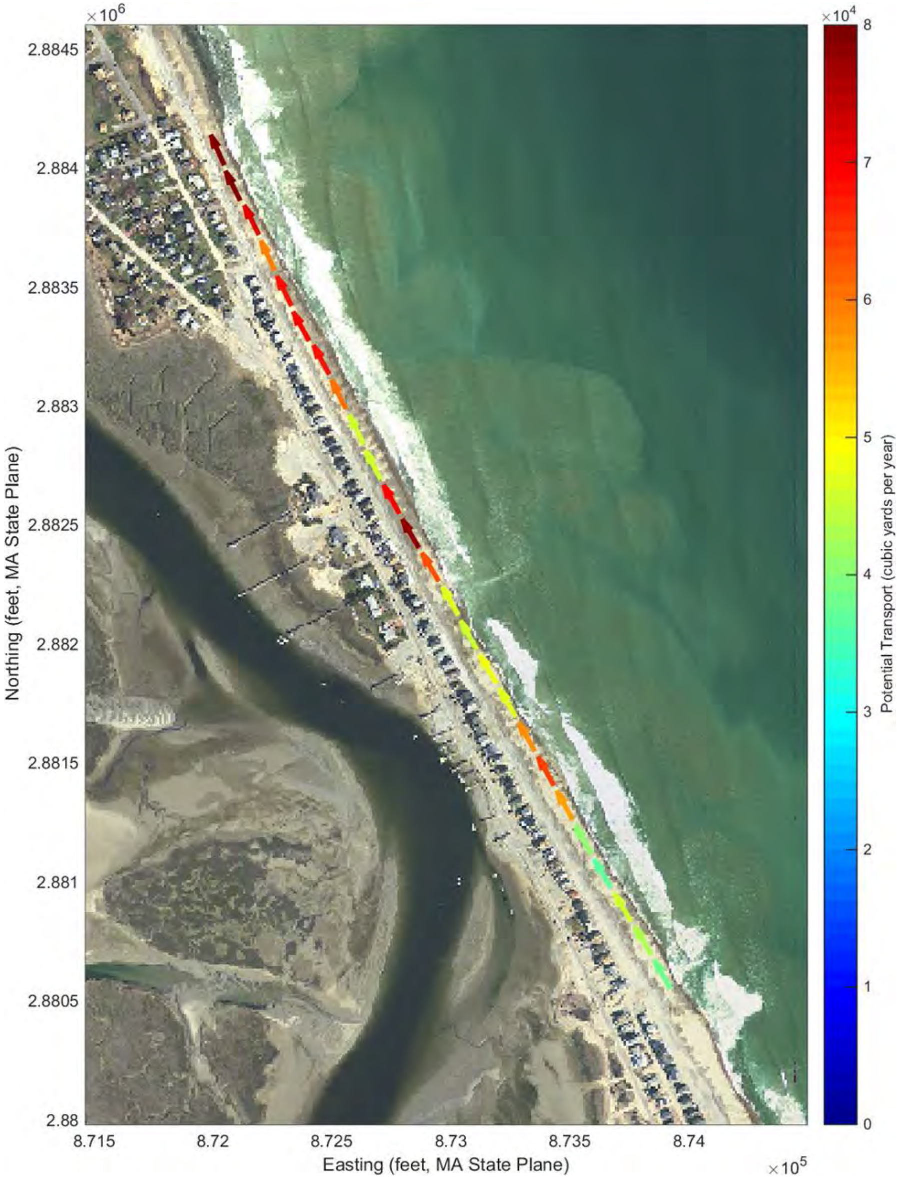
Using the Numerical Model SWAN (Simulating WAves Nearshore)



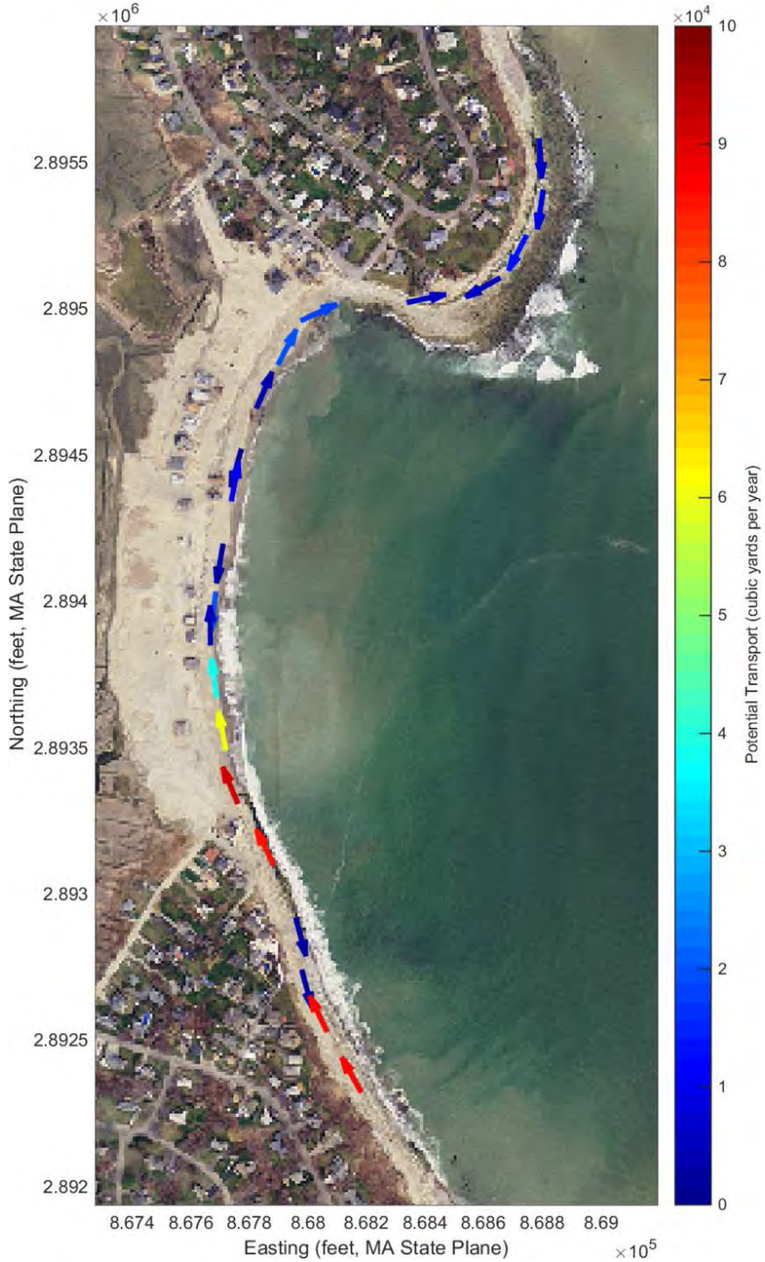
Animation



Sediment Transport



Humarock (north)



Peggotty Beach

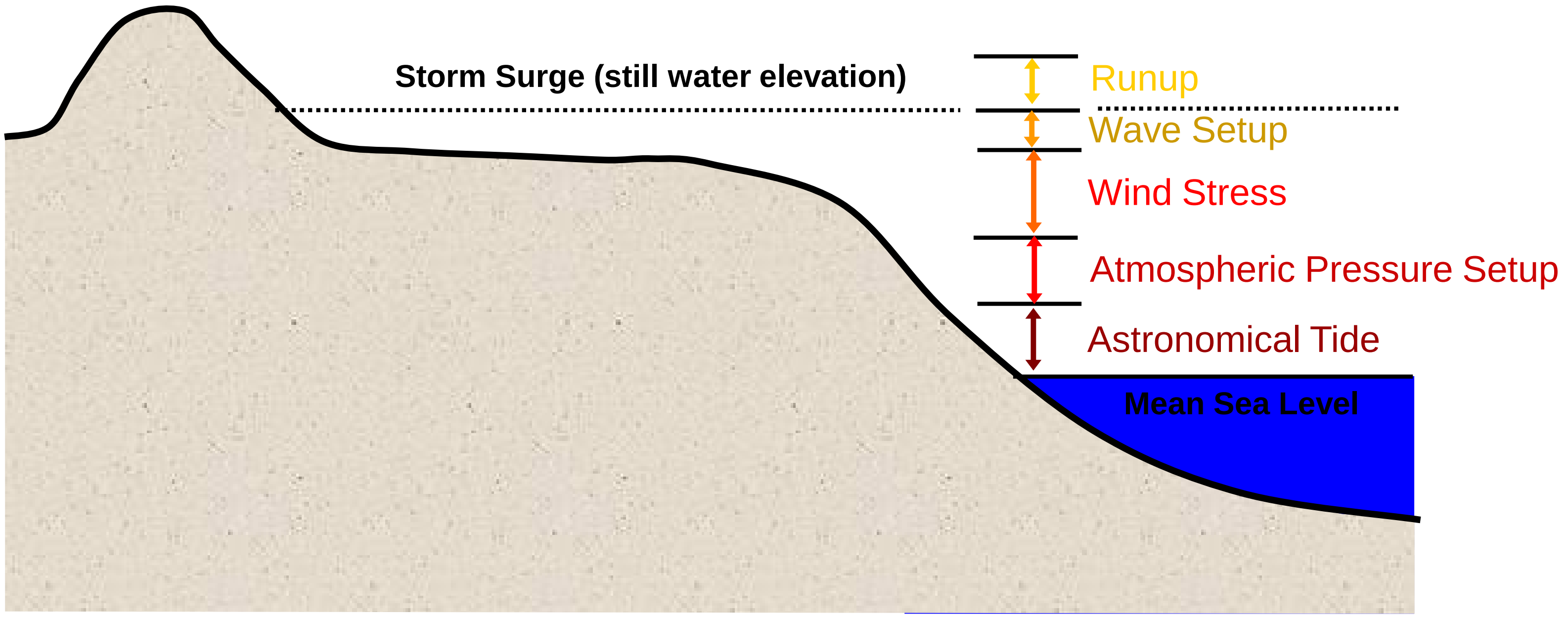
Natural Sediment Supply

Example - Winthrop Beach 1894

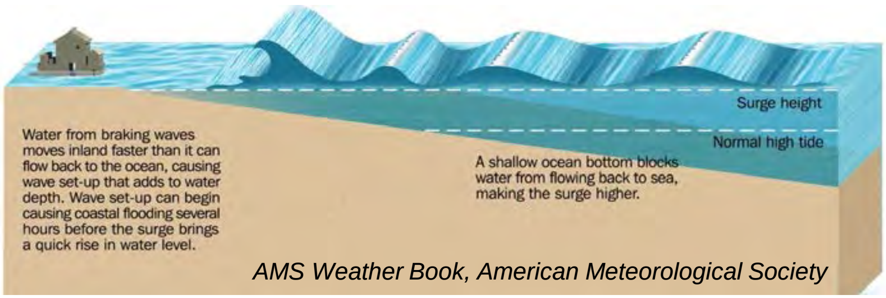
No Natural Sediment Supply

Example - Winthrop Beach 1999

Coastal Processes: Storm Surge



Storm Surge

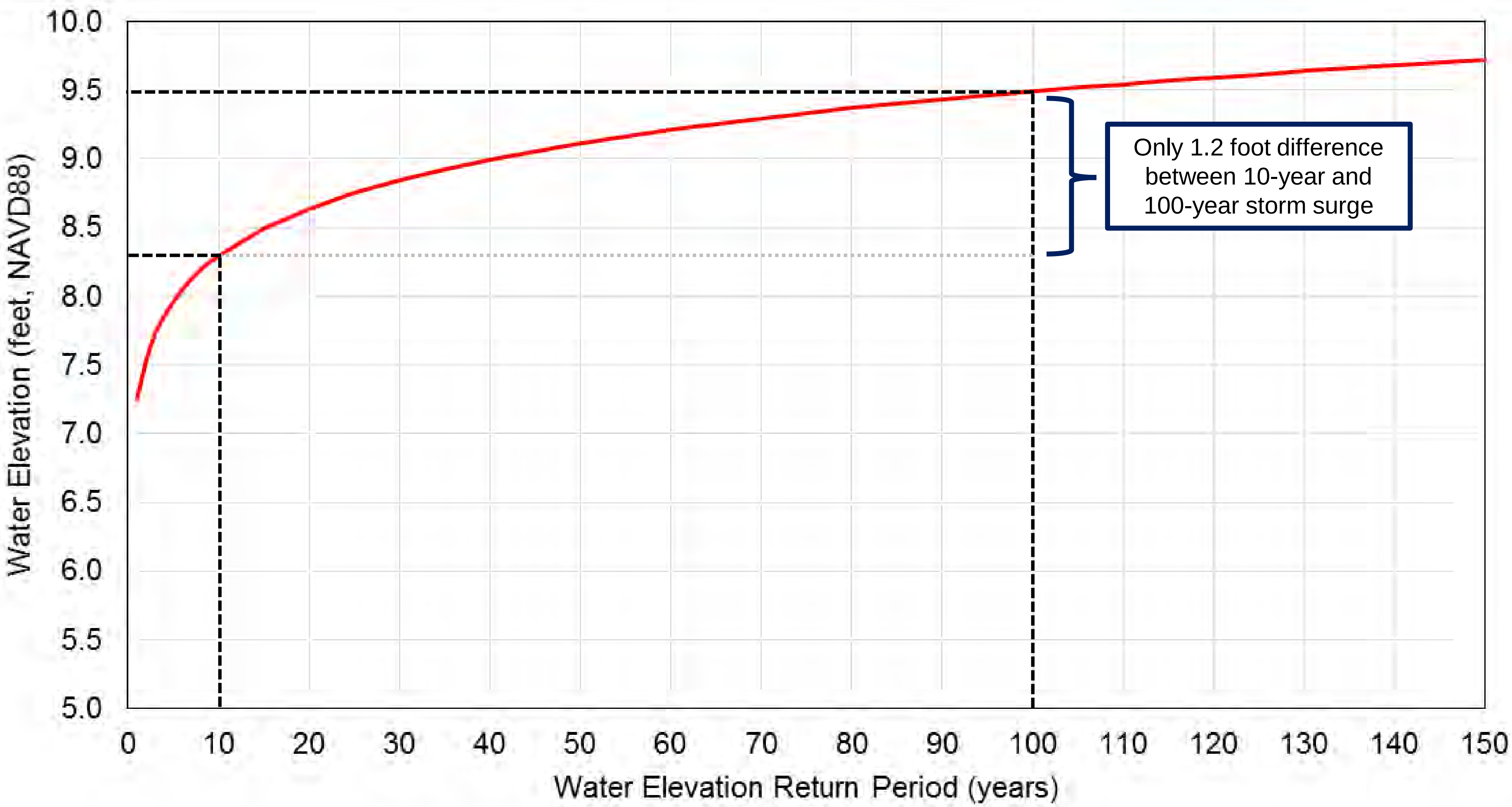


AMS Weather Book, American Meteorological Society

Datum	Elevation (ft, NAVD88)
Mean High Water	4.3
Mean Water Level	-0.3
Mean Low Water	-5.2
10-year Surge	8.3
50-year Surge	9.1
100-year Surge	9.5

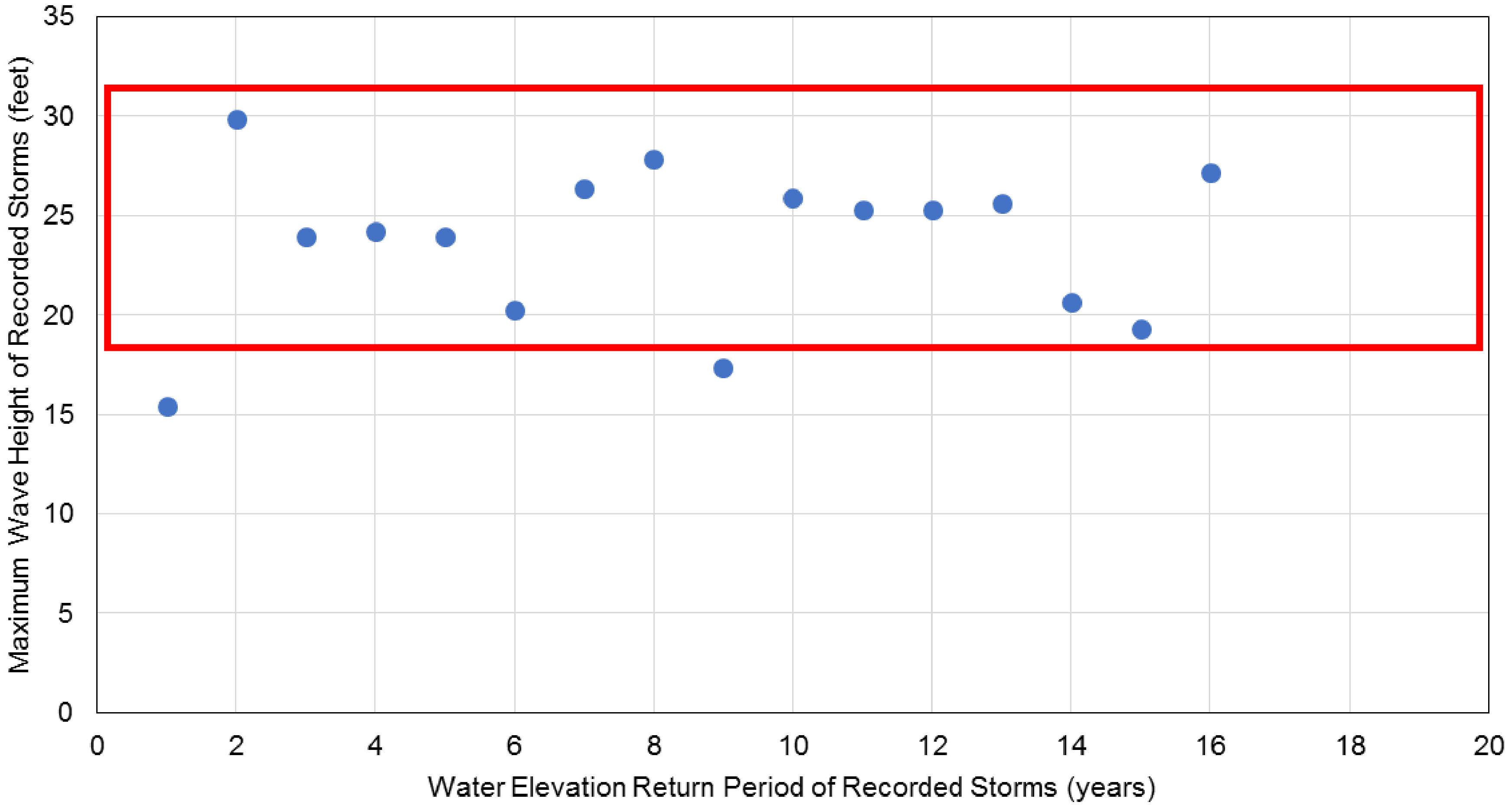
Only 1.2 foot difference between 10-year and 100-year storm surge

Storm Surge

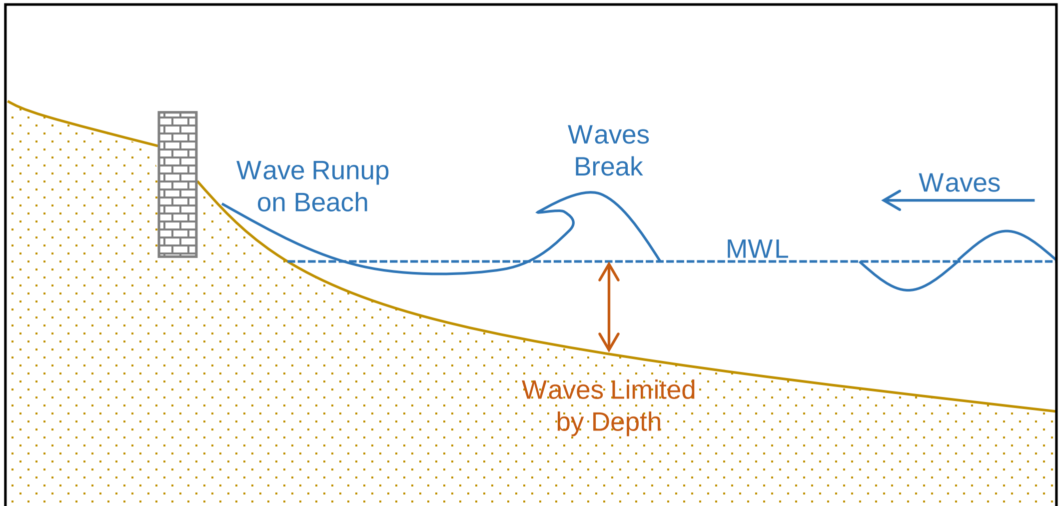

10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Water Elevation (feet, NAVD88)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Water Elevation Return Period (years)
Only 1.2 foot difference between 10-year and 100-year storm surge

Storm Waves

An analysis of notable storms found that offshore waves are approximately 25 feet on average regardless of storm return period.

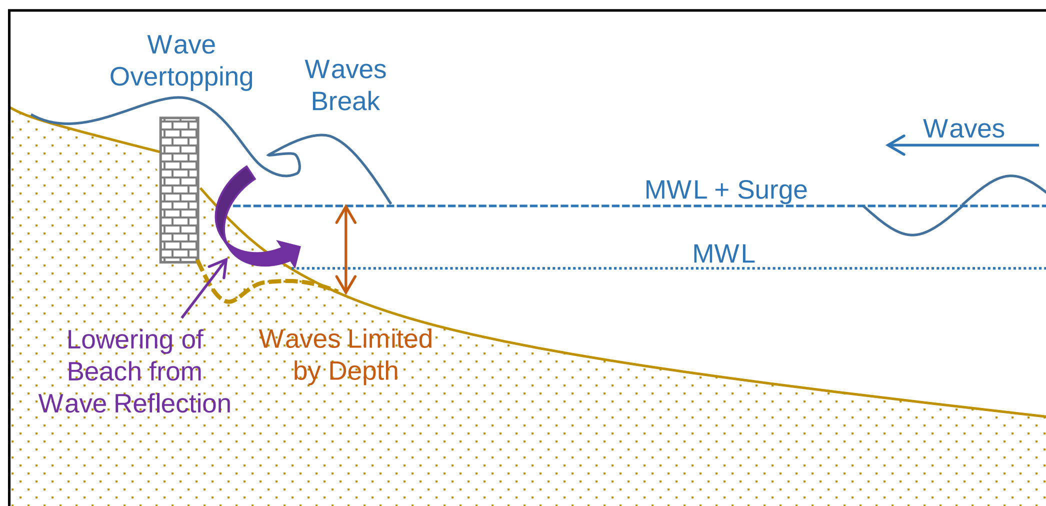


Effect of Storm Surge on Waves (Armored Shorelines)



Waves break further from shore and dissipate over the beach.

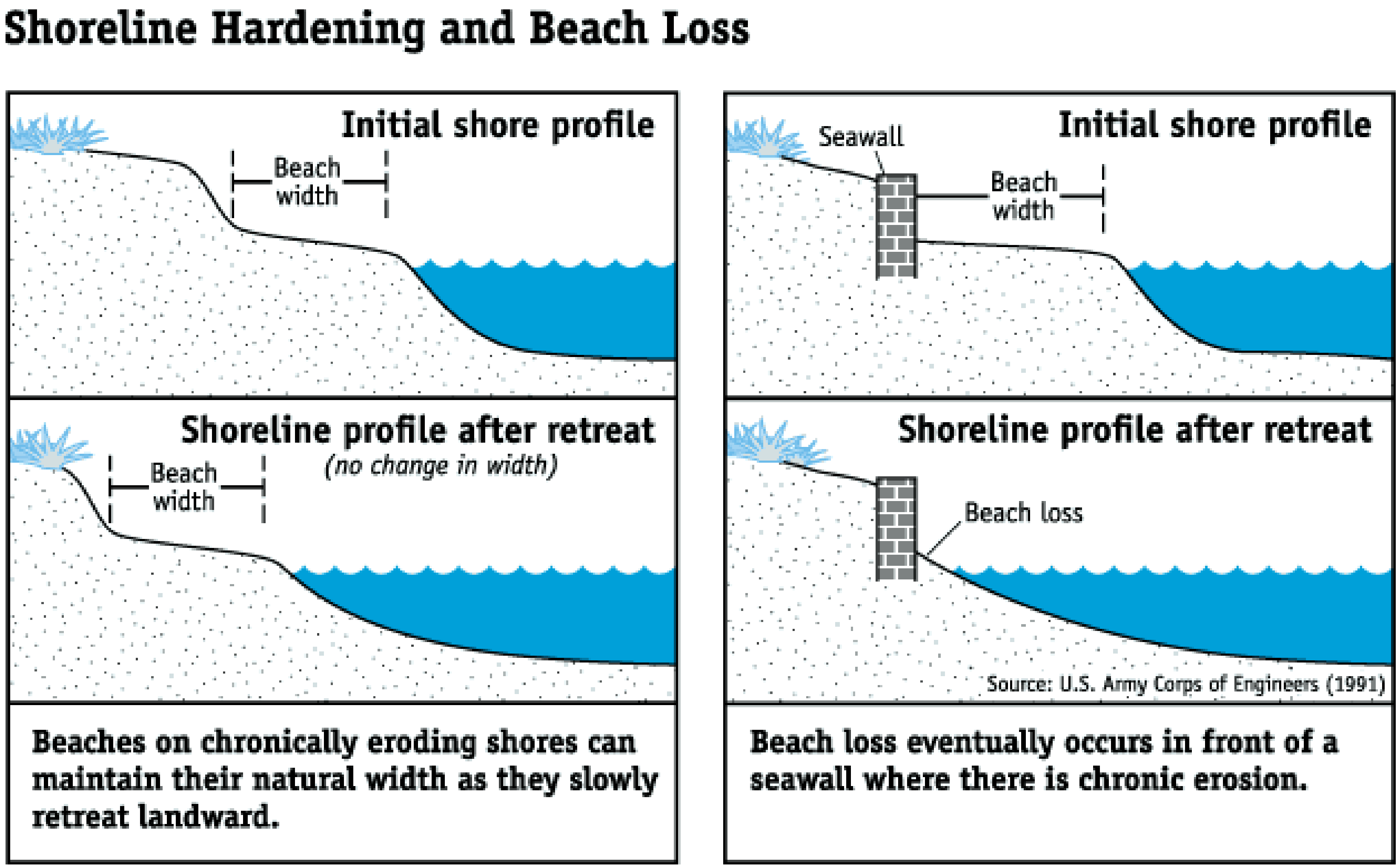
Waves overtopping seawall – Marshfield, MA
(photo from MCZM)



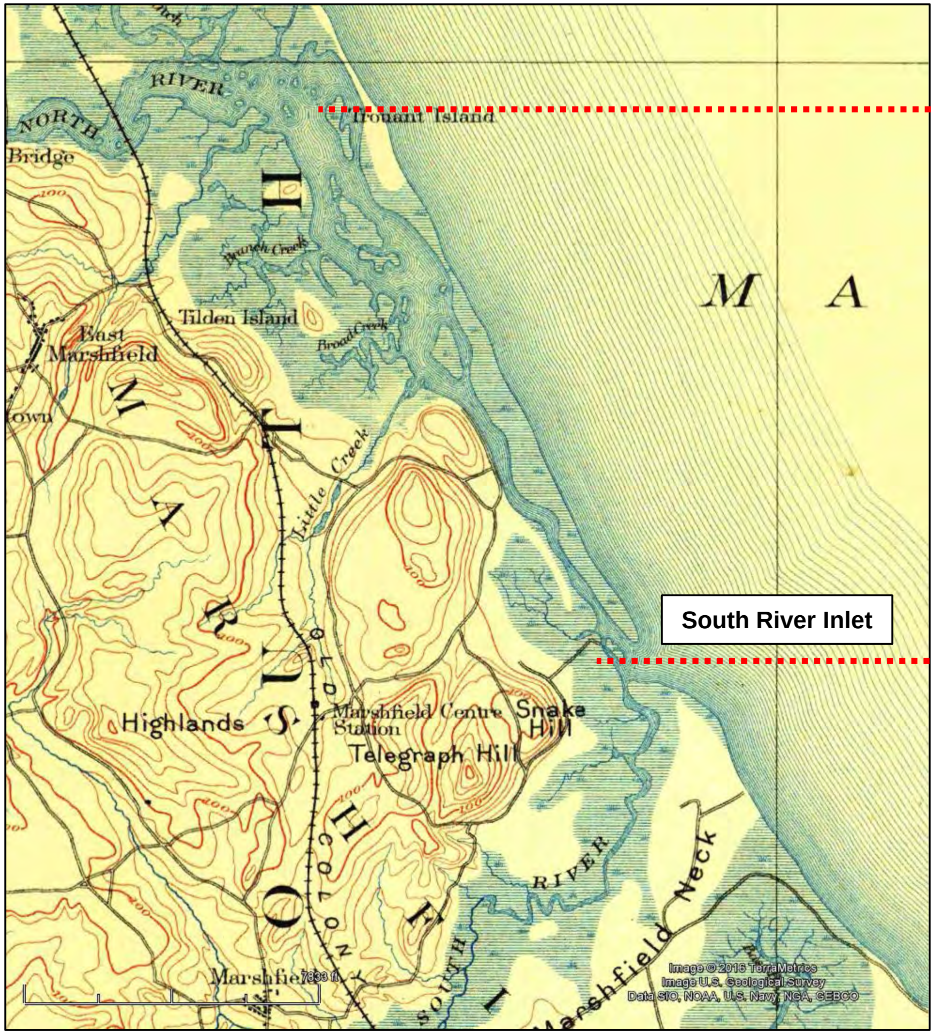
Waves break closer to shore and have less room to dissipate, resulting in waves overtopping the seawall, beach lowering and inland damage.

Long Term Effects of Seawalls on Beaches

Over 4.5 miles of Scituate's shoreline is hardened by seawalls



Humarock Beach – Historical Inlet Positions
Portland Gale Breach - 1898



1888

2016

February 9, 2016 – Peggotty Beach
High Tide After Storm - Overwash

Photos by Peter Miles

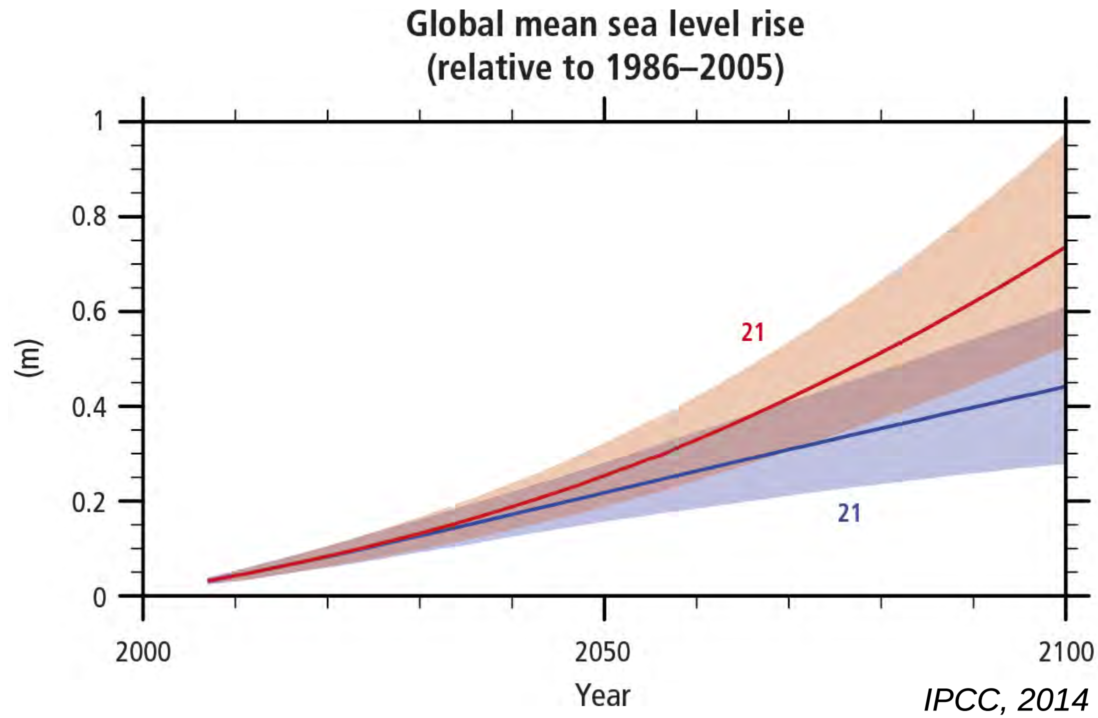
Flow Channelization - Example - Hull, MA

(photos from MCZM)

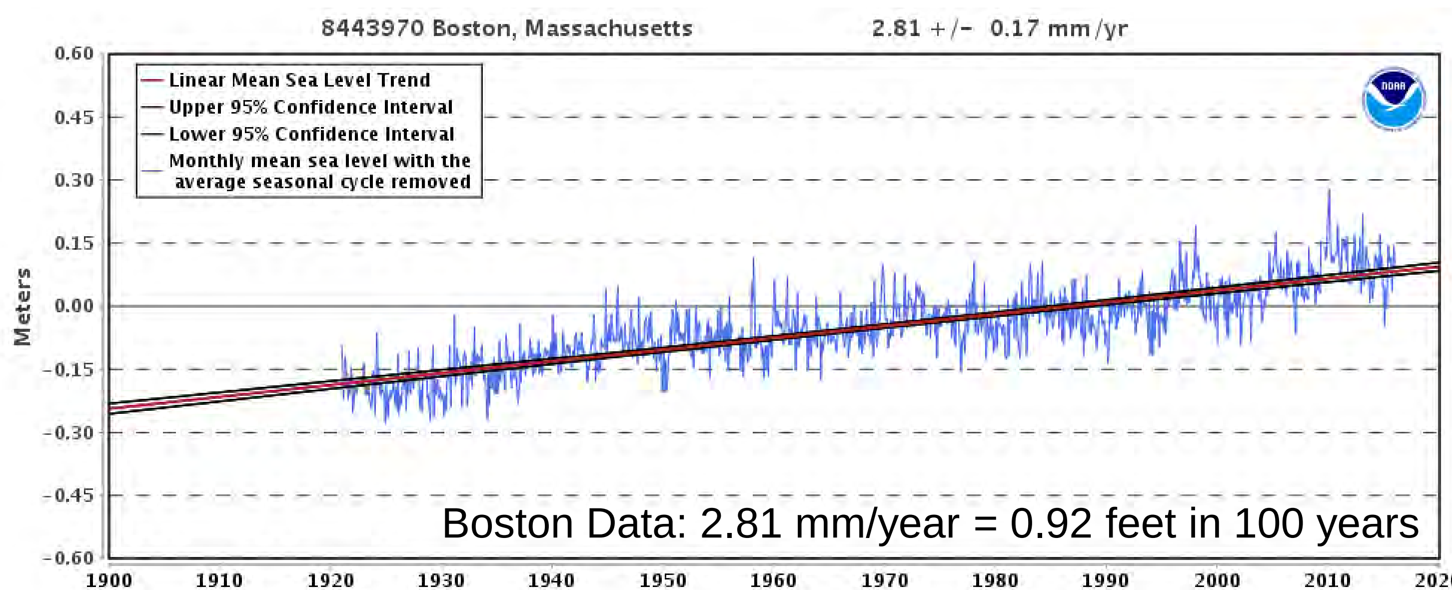
Sea Level Rise

Likely range of global mean sea level rise by 2100:

- Low estimate 0.85 to 1.8 feet (0.26 to 0.55 m)
- High estimate 1.5 to 2.7 feet (0.45 to 0.82 m)



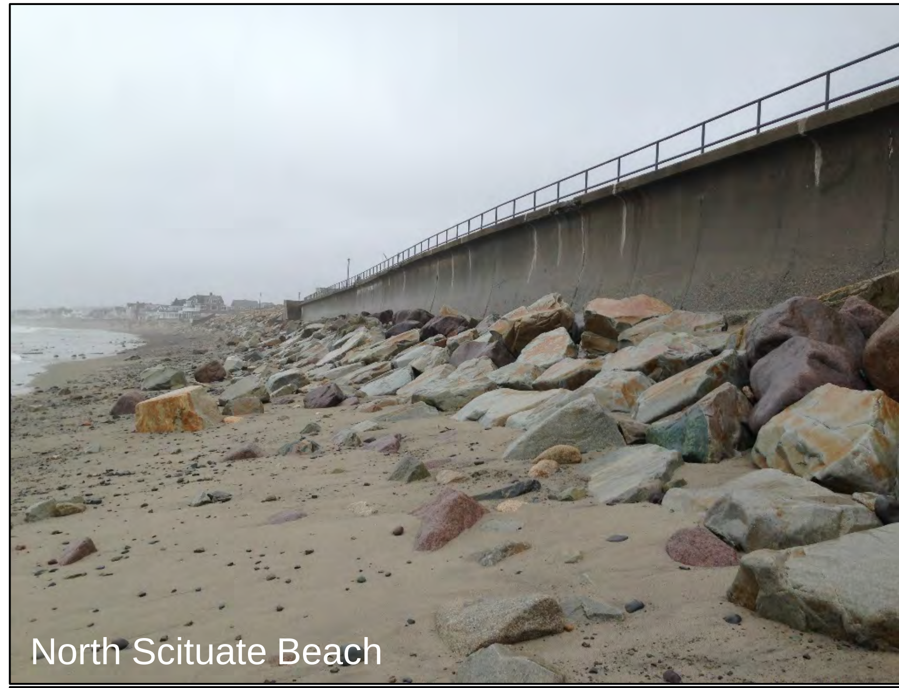
IPCC, 2014




Historical Coastal Change

Historic Coastal Change

- Shoreline change is minimal along stretches of shoreline where coastal structures have been built.
- The heavily armored Scituate shoreline leaves several areas where the beach is not limited by seawalls and revetments: Mann Hill Beach, Peggotty Beach, and Humarock Beach.
- High water shorelines were obtained from 1950/1952 NOAA T-Sheets and 2008 USGS aerial photographs.
- Cross-shore profiles were extracted from 2000, 2010, 2011, and 2014 LiDAR (Light Detection And Ranging) datasets.


North Scituate Beach


Mann Hill Beach

Mann Hill Beach Shoreline Change

The beach berm at the north end gets repaired after major storms to control the overtopping of water into Mushquashcut Pond.

The 2008 high water line approaches the five homes on Stanton Lane.

Adjacent areas show nearly no shoreline change over the 58 year period due to armoring of the shoreline and seawalls.

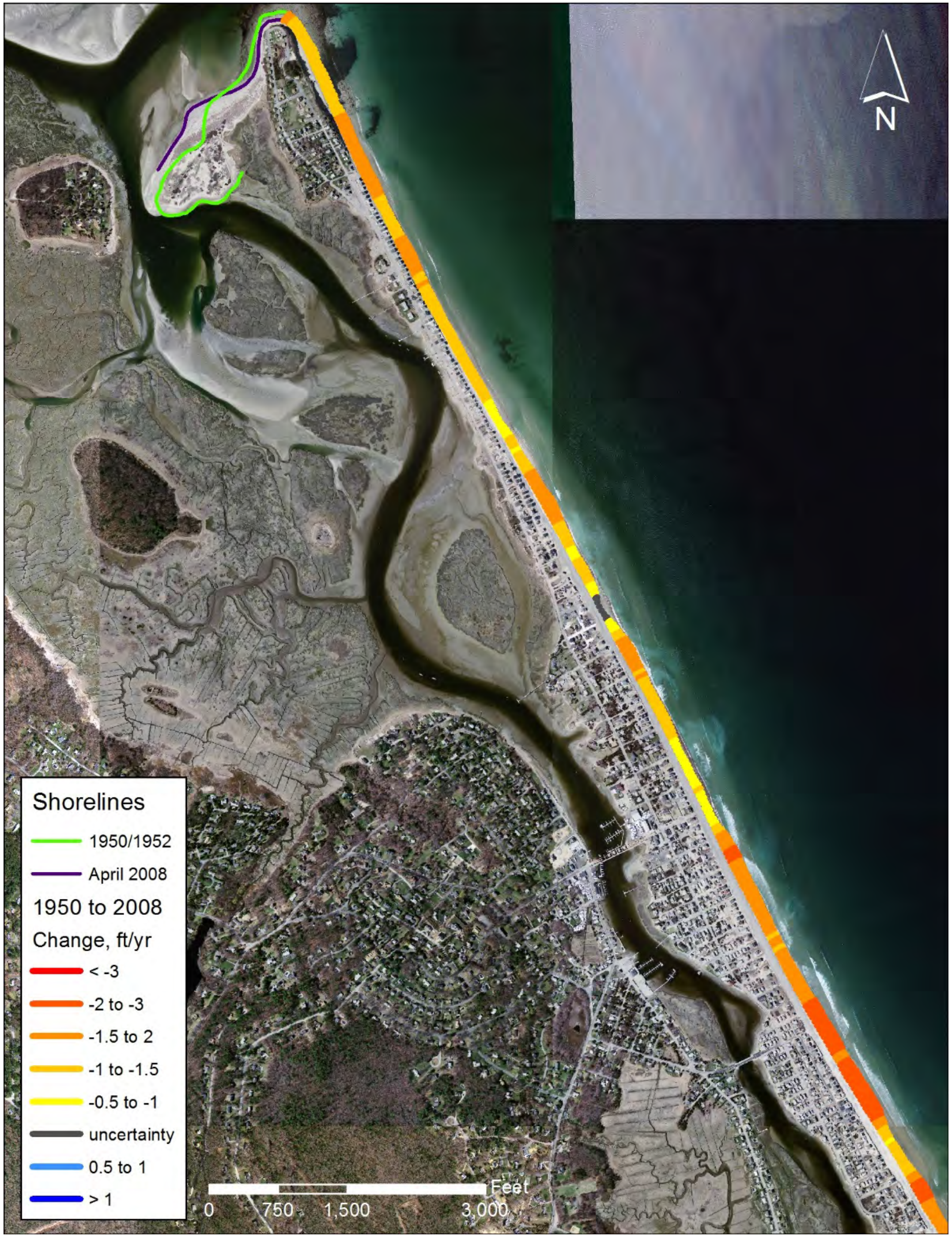
Peggotty Beach Shoreline Change

The 2008 high water line is shown to reach the seaward face of the first row of homes on Town Way Extension.

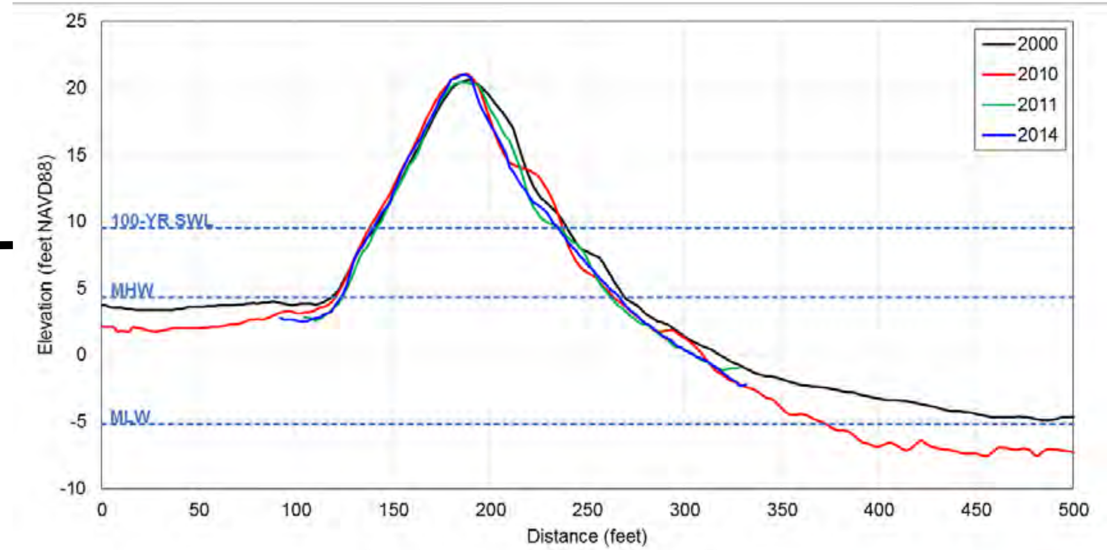
The adjacent cliffs have been armored and show no long-term erosion.

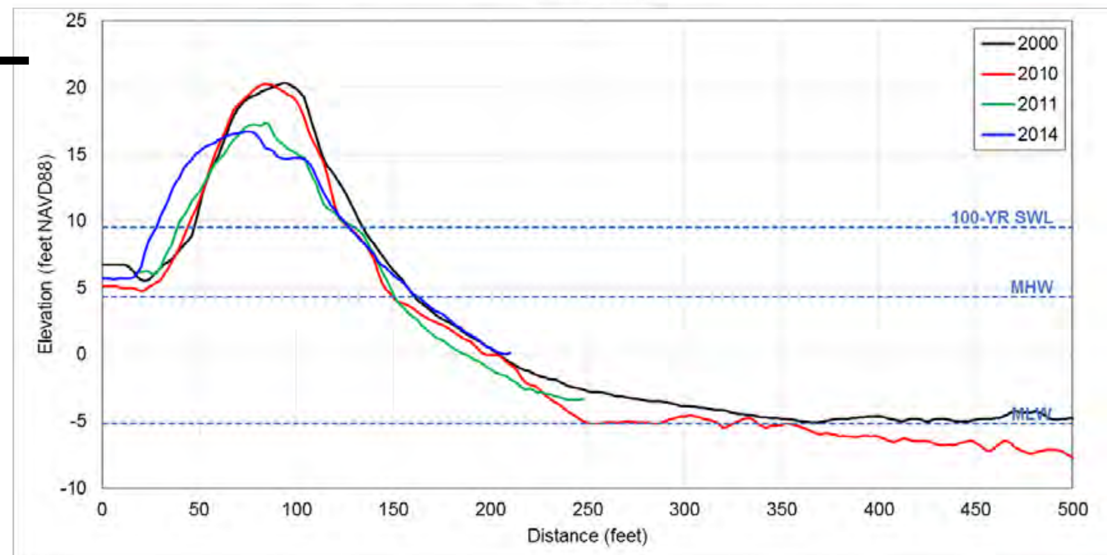
Humarock Beach Shoreline Change

The 2008 high water line is located approximately 50 feet seaward of the public and private coastal structures and the distance increases to 100 feet at the south.

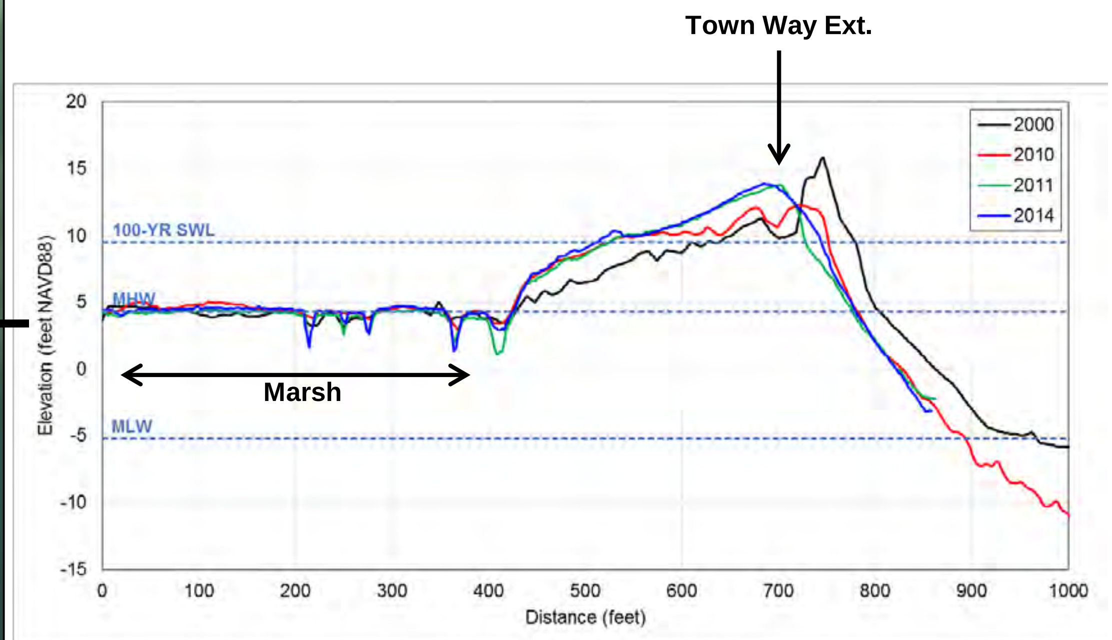


Historic Profile Change – Mann Hill Beach



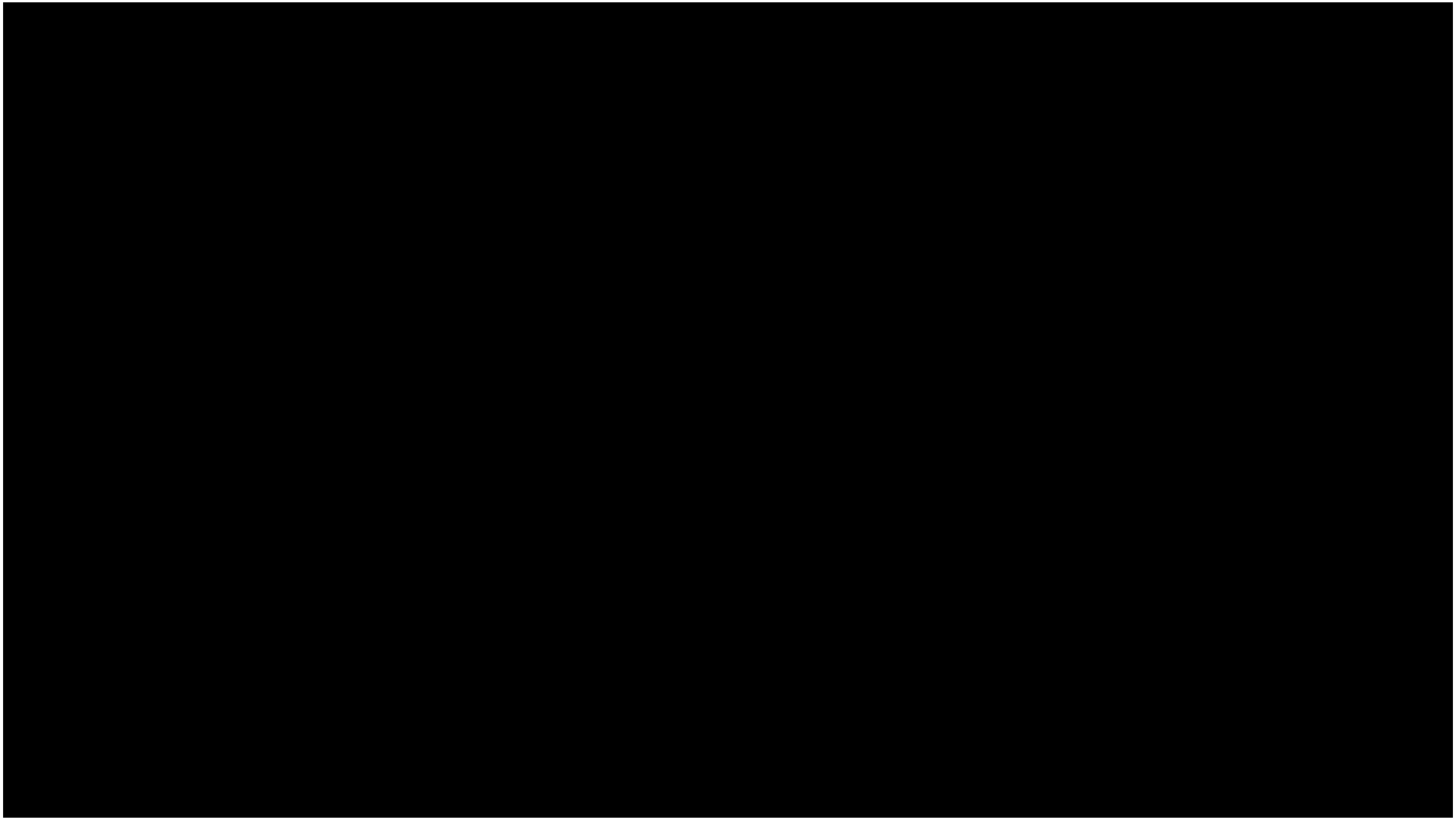


Historic Profile Change – Peggotty Beach

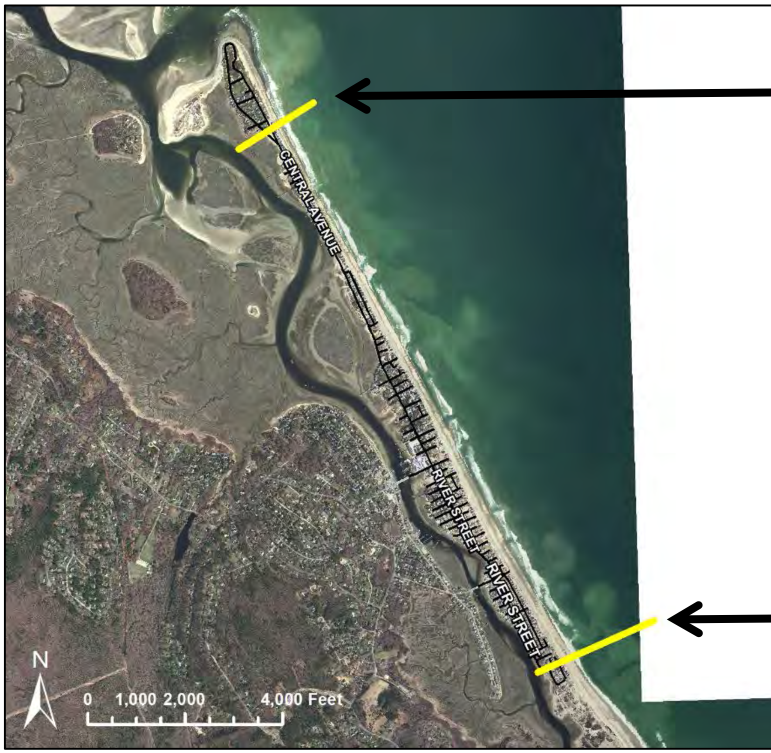


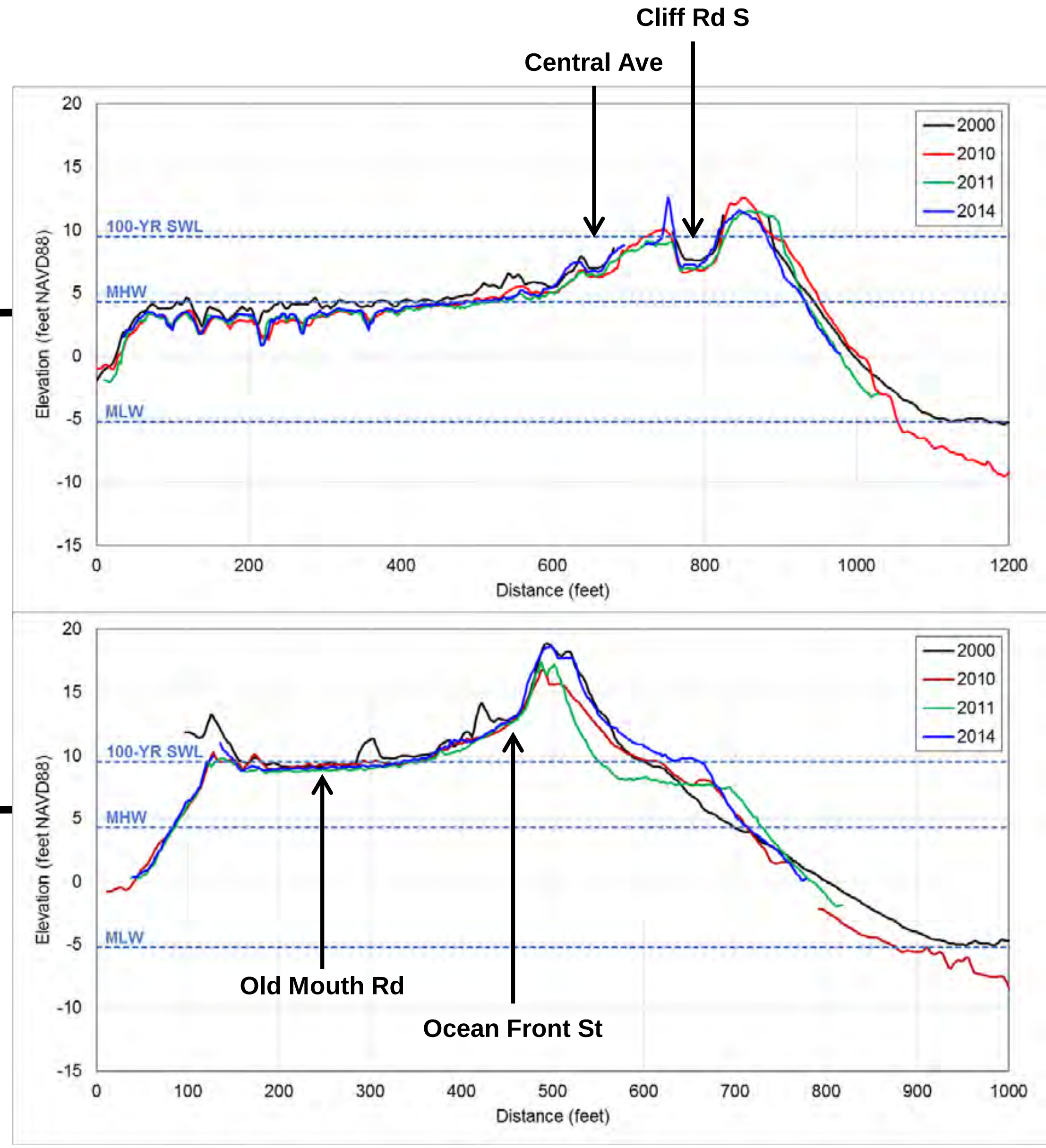
February 9, 2016 – Peggotty Beach
High Tide After Storm – Overwash

Video by Peter Miles



Historic Profile Change – Humarock Beach





Historical Storm Damage

Historic Storm Damage Data Sources

Damage to Residential Properties

Repetitive Loss Property data was obtained from the National Flood Insurance Program (NFIP) from 1978 to 2015.

The dataset included: the location/address of the properties, number of claims, the associated claim dates and claim amounts. Precise locations of the properties have been obscured for confidentiality.

Damage claim data does not include properties that were not insured under the NFIP.

> *A Repetitive Loss property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978.*

Damage to Town Infrastructure and Associated Town Costs

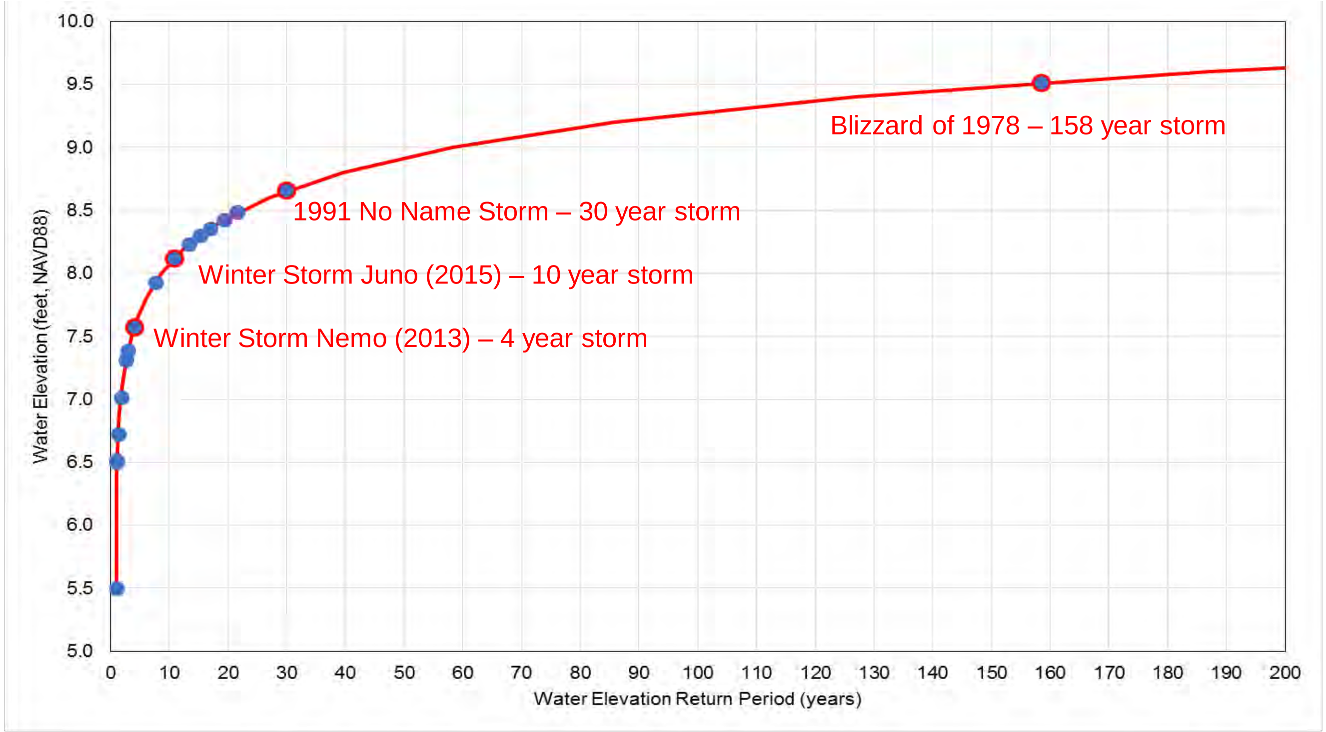
Information from Town of Scituate records and Department of Public Works.

Storms Selected for Detailed Analysis

Blizzard of 1978
Storm of record, however, detailed residential property damage claims are not available.

1991 No-Name Storm
Selected because it has the greatest number of FEMA claims.

Winter Storm Nemo (2013)
Winter Storm Juno (2015)
Lower return periods but were there is recent storm documentation available.



Blizzard of 1978

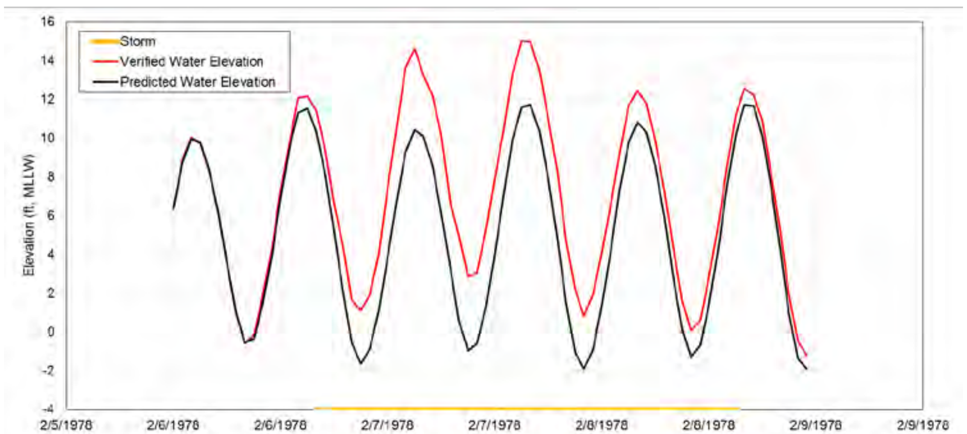
158-year return period

Storm Duration: 74 hours
Maximum Surge: 4.4 feet
Maximum Water Elevation: 9.5 feet NAVD88

From MCZM (1993):

- 189 homes destroyed
- 402 homes with major damage
- 509 homes with minor damage

Over 300 people evacuated



Rebecca Road
blizzardof1978.org

Blizzard of 1978

Cost to Town:

- $6,000,000 in seawall/revetments
- $179,000 in road damage
- $410,000 in debris clearing
- $193,000 in damage to public utilities
- $35,000 in damage to public buildings
- $455,000 for protective measures

- Total: $7,272,000 ($26.4M in 2015)

Figure 2.--Portions of the North Scituate Beach seawall in Massachusetts were destroyed by pounding surf (photograph courtesy of The Boston Globe)

Figure 5.--Floodwaters overtopped the seawall and rock barrier in North Scituate, Mass., and raised the level of Musquashcut Pond, resulting in inundation of homes along Seagate Circle in foreground (photograph by Kevin Cole, Boston Herald American)

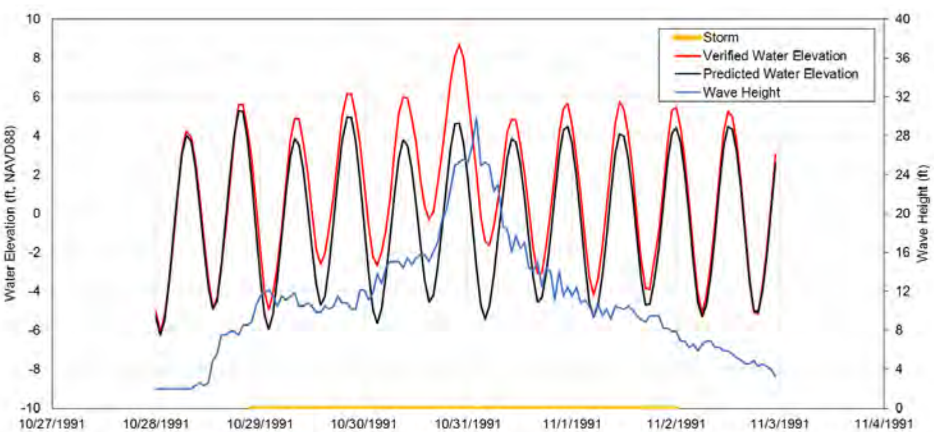
Gadoury, 1979

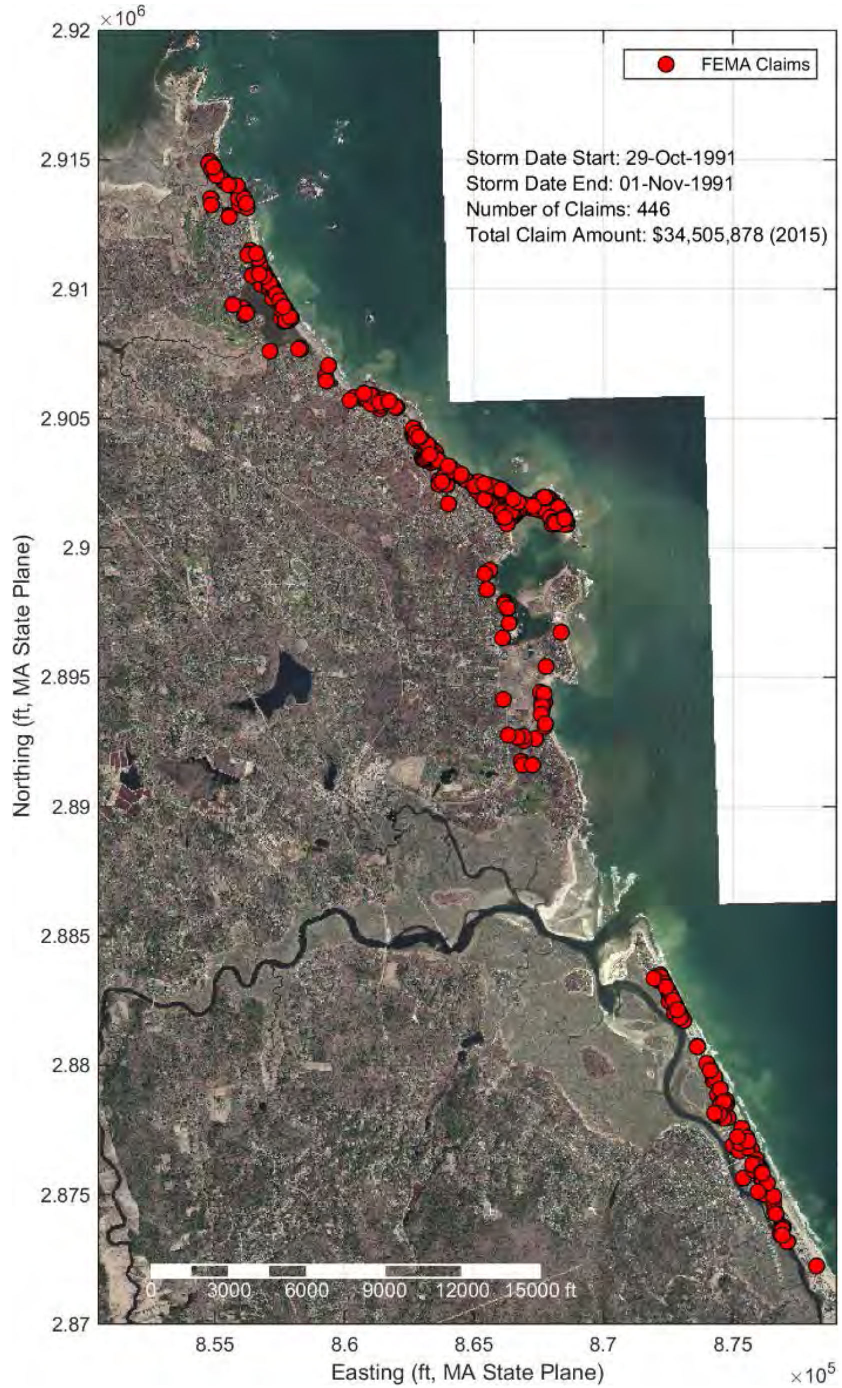
1991 No Name Storm

30-year return period

Storm Duration: 99 hours
Maximum Surge: 4.9 feet
Maximum Wave Height: 29.9 feet
Maximum Water Elevation: 8.7 feet NAVD88

FEMA Claims: 446
Total Claims Amount: $34,505,878 (2015)
Average Claim Amount: $77,367 (2015)





1991 No Name Storm

Cost to Town:

- $1,350,797 in seawall/revetments
- $77,981 in road damage
- $82,511 in debris clearing
- $59,473 in damage to public utilities
- $50,260 in damage to public buildings
- $52,973 for protective measures

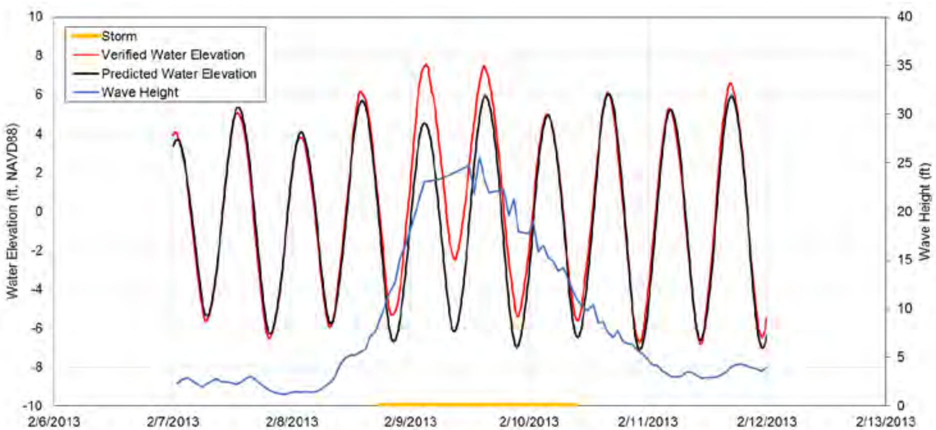
- Total: $1,673,996 ($2.9M in 2015)

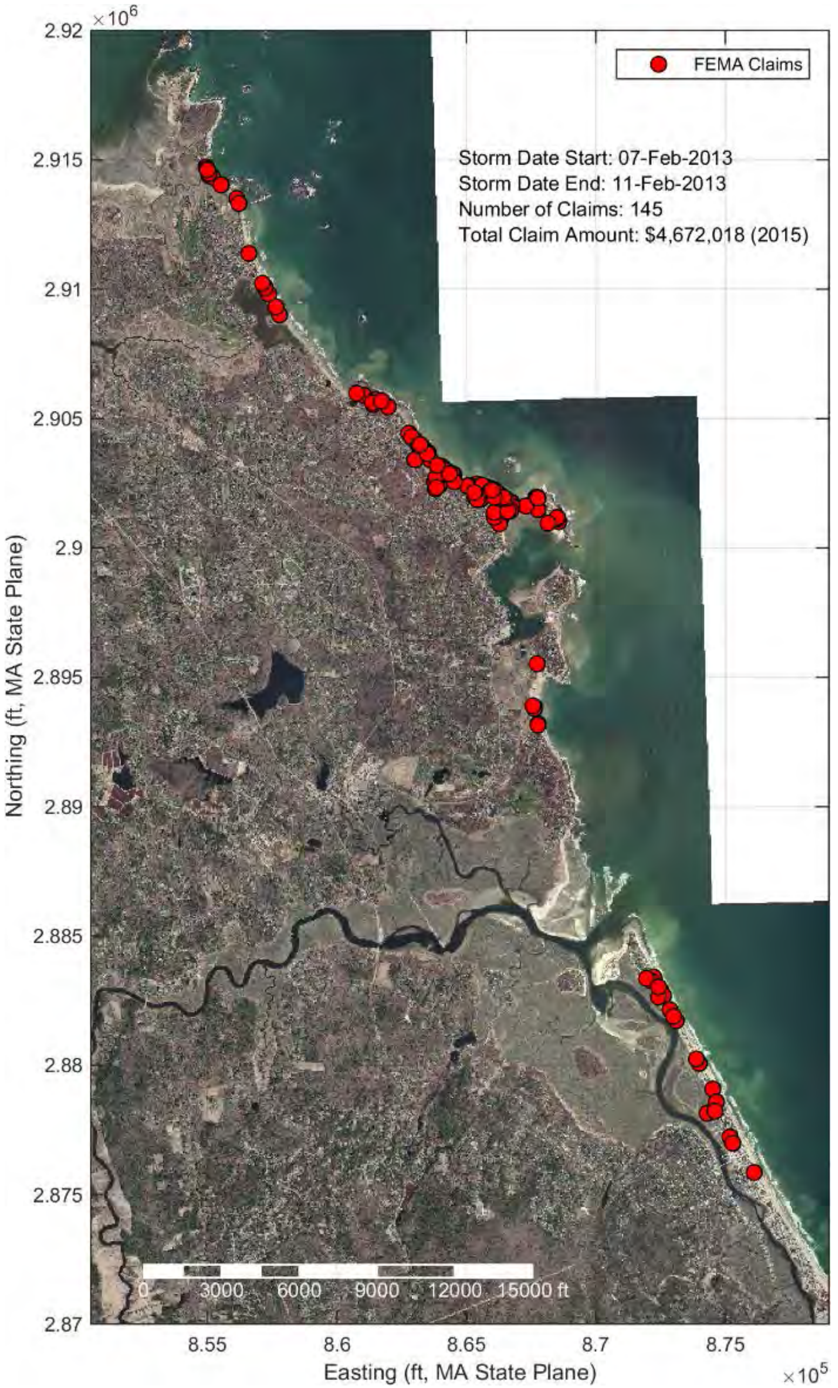
Photo Credit: Scituate Historical Society

Winter Storm Nemo (2013)

Storm Duration: 29.8 hours
Maximum Surge: 4.2 feet
Maximum Wave Height: 25.7 feet
Maximum Water Elevation: 7.6 feet NAVD88
4 year return period

FEMA Claims: 145
Total Claims Amount: $4,672,018 (2015)
Average Claim Amount: $32,221 (2015)





Winter Storm Nemo (2013)

$6.1M in estimated damages to public foreshore structures

Costs for debris clearing (estimated per storm):

- $12,000+ for Surfside Road
- $10,000+ for Peggotty Beach
- $30,000+ for Central Avenue (Humarock)

Oceanside Drive (during storm)
Impassable road due to flooding
(stormreporter.org)

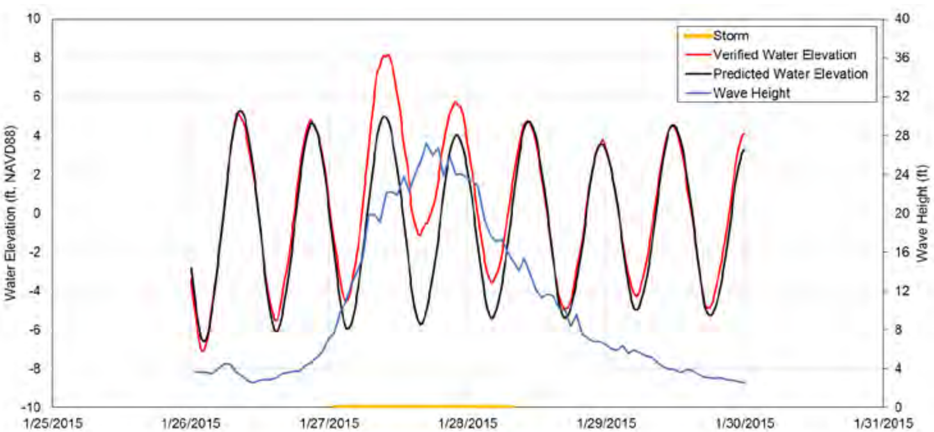
Surfside Road (day after storm)
Impassable road due to debris
(stormreporter.org)

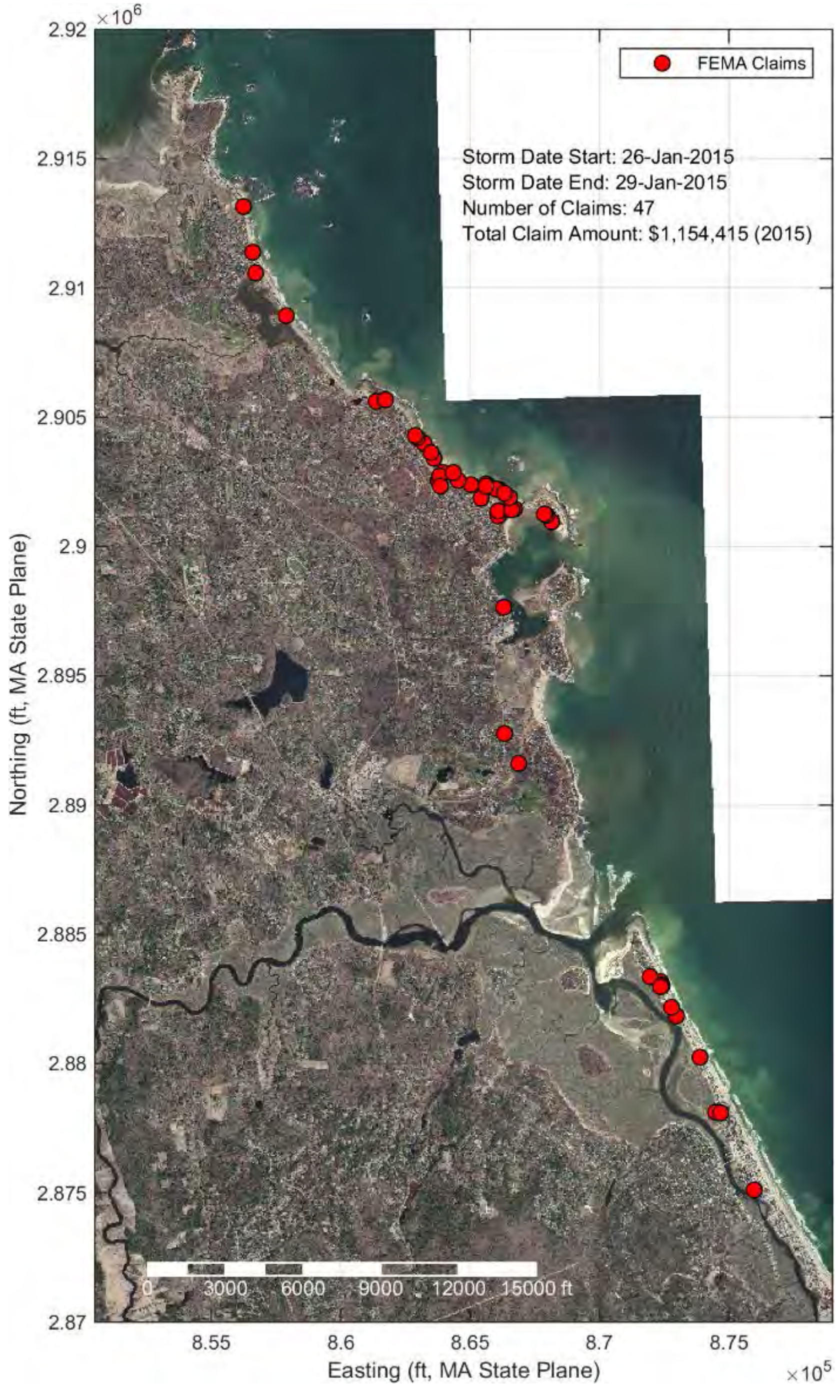
Winter Storm Juno (2015)

10-year return period

Storm Duration: 30.4 hours
Maximum Surge: 4.8 feet
Maximum Wave Height: 27.2 feet
Maximum Water Elevation: 8.1 feet NAVD88

FEMA Claims: 47
Total Claims Amount: $1,154,415
Average Claim Amount: $24,562





Winter Storm Juno (2015)

$5.2M in estimated damages to public foreshore structures

Costs for debris clearing (estimated per storm):

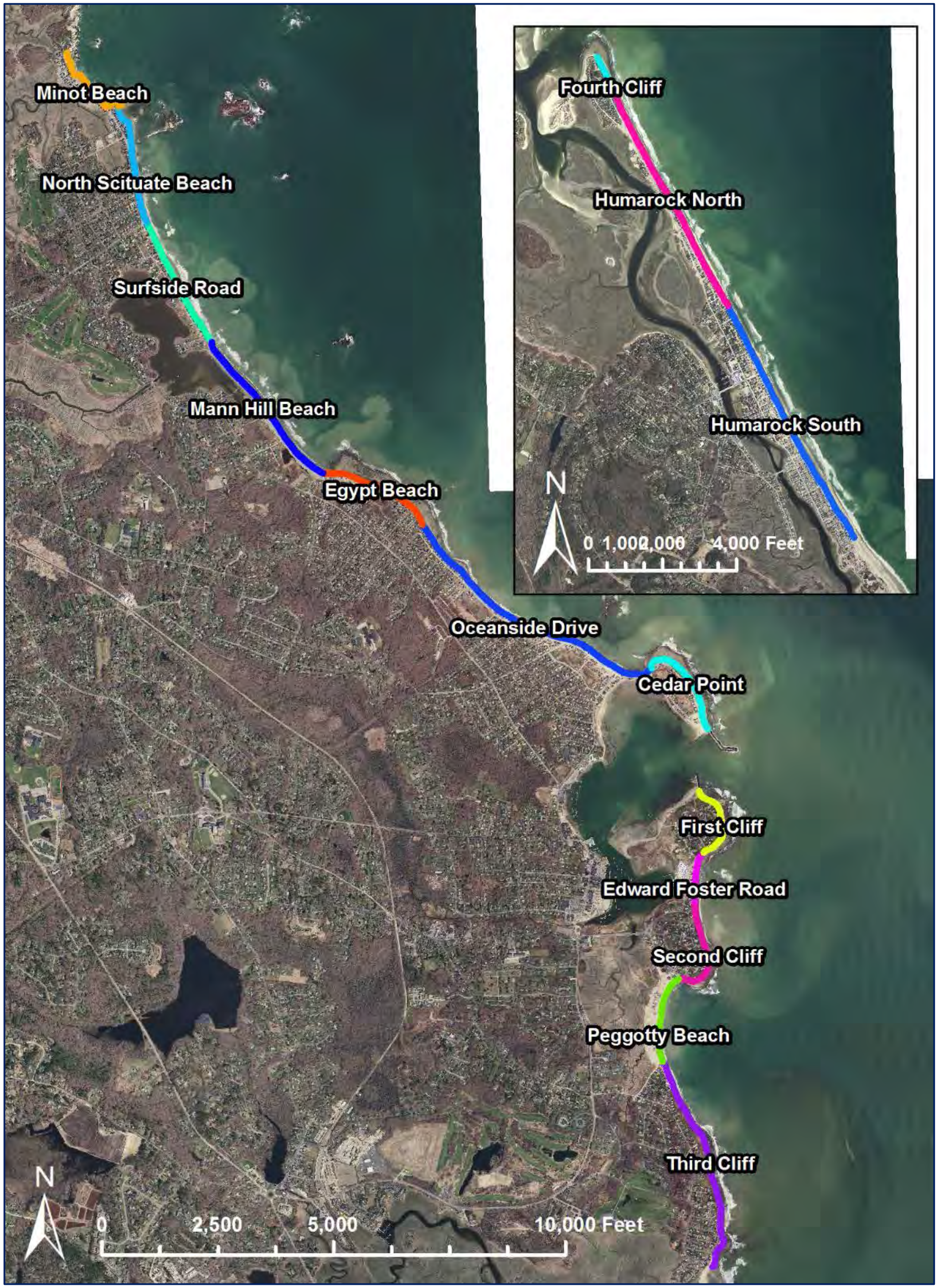
- $12,000+ for Surfside Road
- $10,000+ for Peggotty Beach
- $30,000+ for Central Avenue (Humarock)

Oceanside Road (during storm)
Impassable roads due to downed electrical lines
(photo from Town of Scituate)

Oceanside Drive (day after storm)
Impassable roads due to flooding and ice
(stormreporter.org)

Prioritization Criteria

Study Areas


Minot Beach
North Scituate Beach
Surfside Road
Mann Hill Beach
Egypt Beach
Oceanside Drive
Cedar Point
First Cliff
Edward Foster Road
Second Cliff
Peggotty Beach
Third Cliff
N
0
2,500
5,000
10,000 Feet
Fourth Cliff
Humarock North
Humarock South
N
0 1,000 2,000 4,000 Feet

Prioritization Criteria

1. Damage Susceptibility of Private Properties
    a. Historic Claims per 1000 ft
    b. Historic Claim Value per 1000 ft
    c. Average Claims per Property
2. Landform Elevation
3. Damage Susceptibility of Public Utilities

    Water and gas lines were not considered as they occur throughout the Town

    a. Wastewater
    b. Pump Stations
    c. Electrical Lines
4. Emergency Egress
5. Breach Susceptibility
6. Coastal Engineering Structure Condition

    Applied to areas with coastal engineering structures only

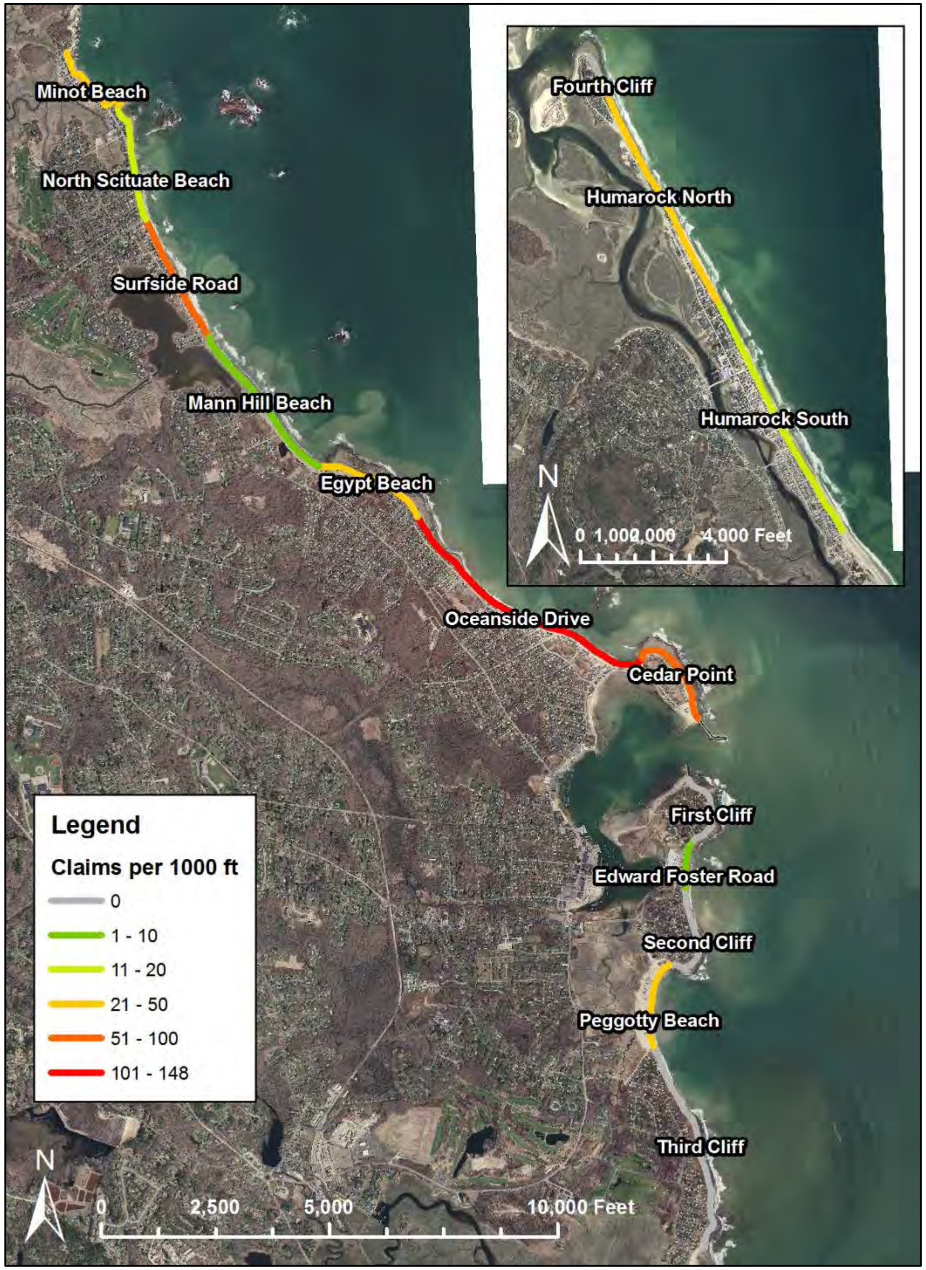
Criteria #1: Damage Susceptibility of Private Properties

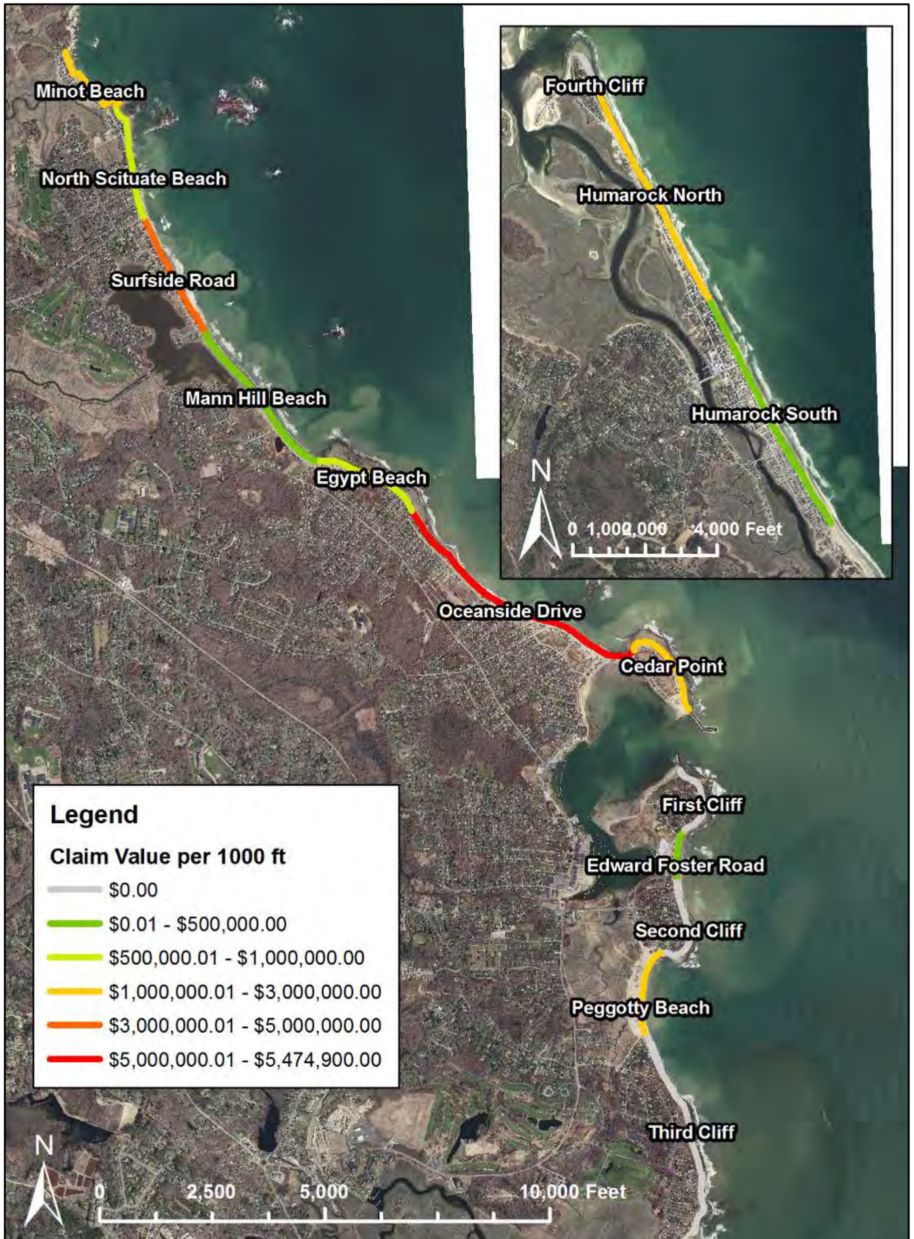
High Priority

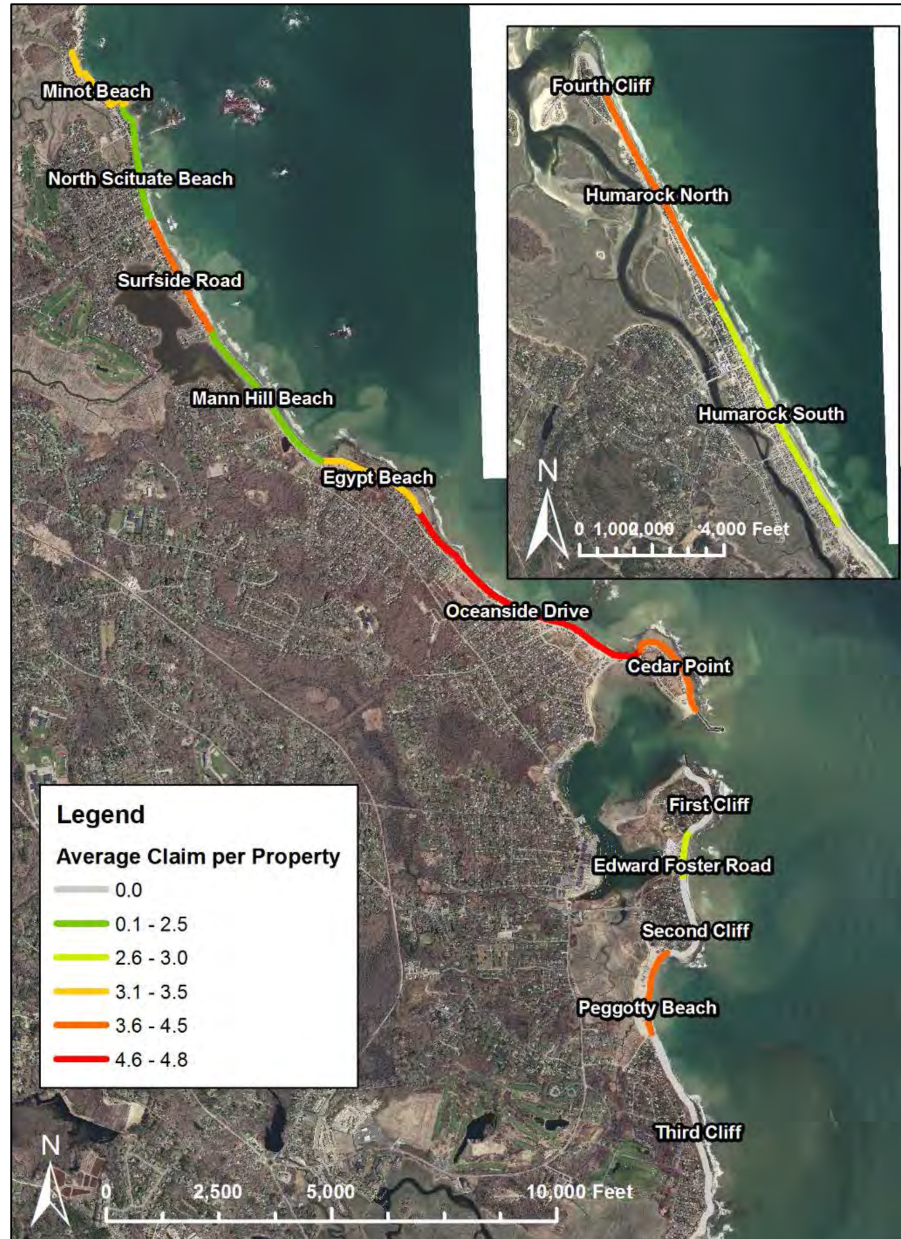
Significant number of damage claims, claim amounts, and high number of claims per property

Low number of damage claims, claim amounts, and low number of claims per property

Low Priority




Fourth Cliff
Humarock North
Humarock South
N
0 1,000 2,000 4,000 Feet
Minot Beach
North Scituate Beach
Surfside Road
Mann Hill Beach
Egypt Beach
Oceanside Drive
Cedar Point
First Cliff
Edward Foster Road
Second Cliff
Peggotty Beach
Third Cliff
Legend
Claim Value per 1000 ft
$0.00
$0.01 - $500,000.00
$500,000.01 - $1,000,000.00
$1,000,000.01 - $3,000,000.00
$3,000,000.01 - $5,000,000.00
$5,000,000.01 - $5,474,900.00
N
0 2,500 5,000 10,000 Feet


Fourth Cliff
Humarock North
Humarock South
N
0 1,000 2,000 4,000 Feet
Minot Beach
North Scituate Beach
Surfside Road
Mann Hill Beach
Egypt Beach
Oceanside Drive
Cedar Point
First Cliff
Edward Foster Road
Second Cliff
Peggotty Beach
Third Cliff
Legend
Average Claim per Property
0.0
0.1 - 2.5
2.6 - 3.0
3.1 - 3.5
3.6 - 4.5
4.6 - 4.8
N
0 2,500 5,000 10,000 Feet

Criteria #2: Landform Elevation

High Priority

Low elevation areas are easily flooded and impacted by waves

High elevation areas are less prone to flooding and wave damage

Low Priority

Criteria #3a: Damage Susceptibility of Public Utilities – Wastewater

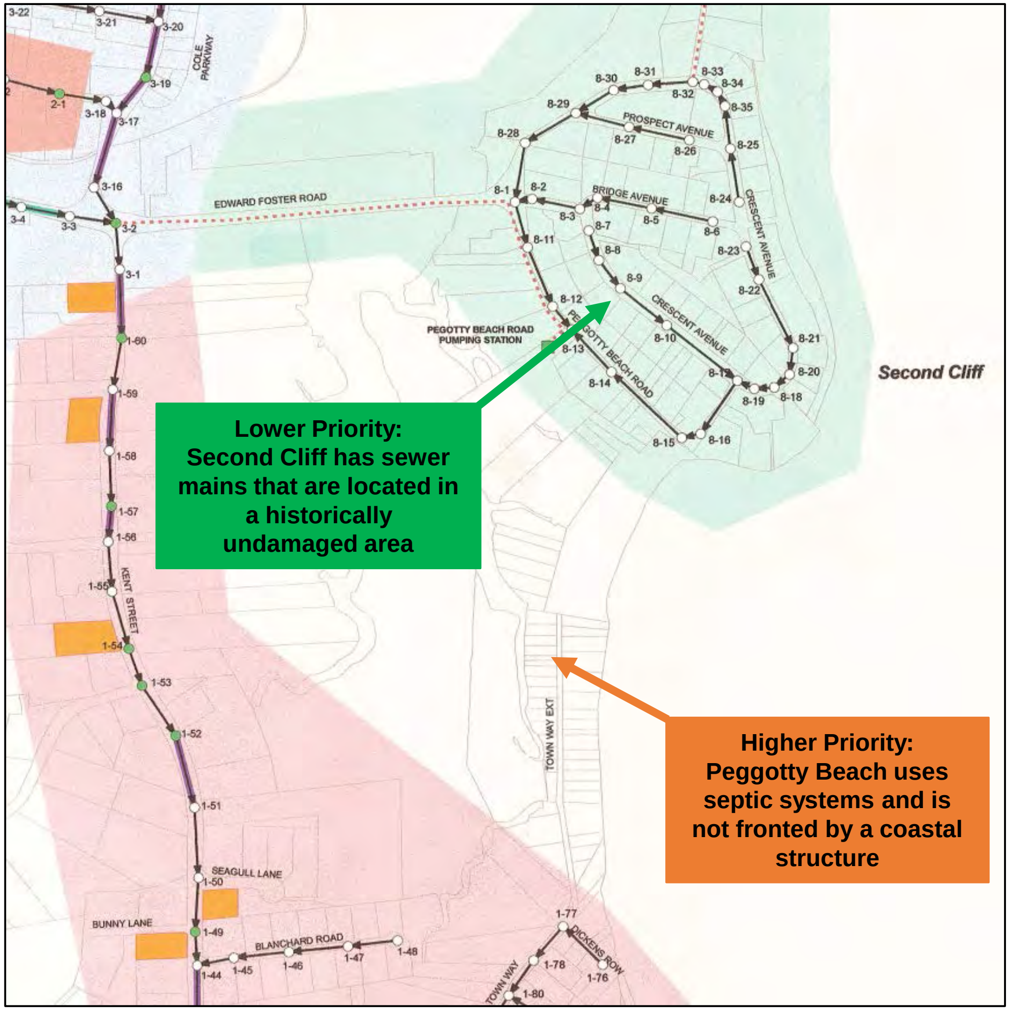
High Priority

Areas with septic systems with no fronting coastal structure

Areas with sewer mains located along a high damage repetitive loss area

Areas with septic systems with fronting coastal structures or sewer mains in historically undamaged areas

Low Priority



Criteria #3b: Damage Susceptibility of Public Utilities – Pump Stations

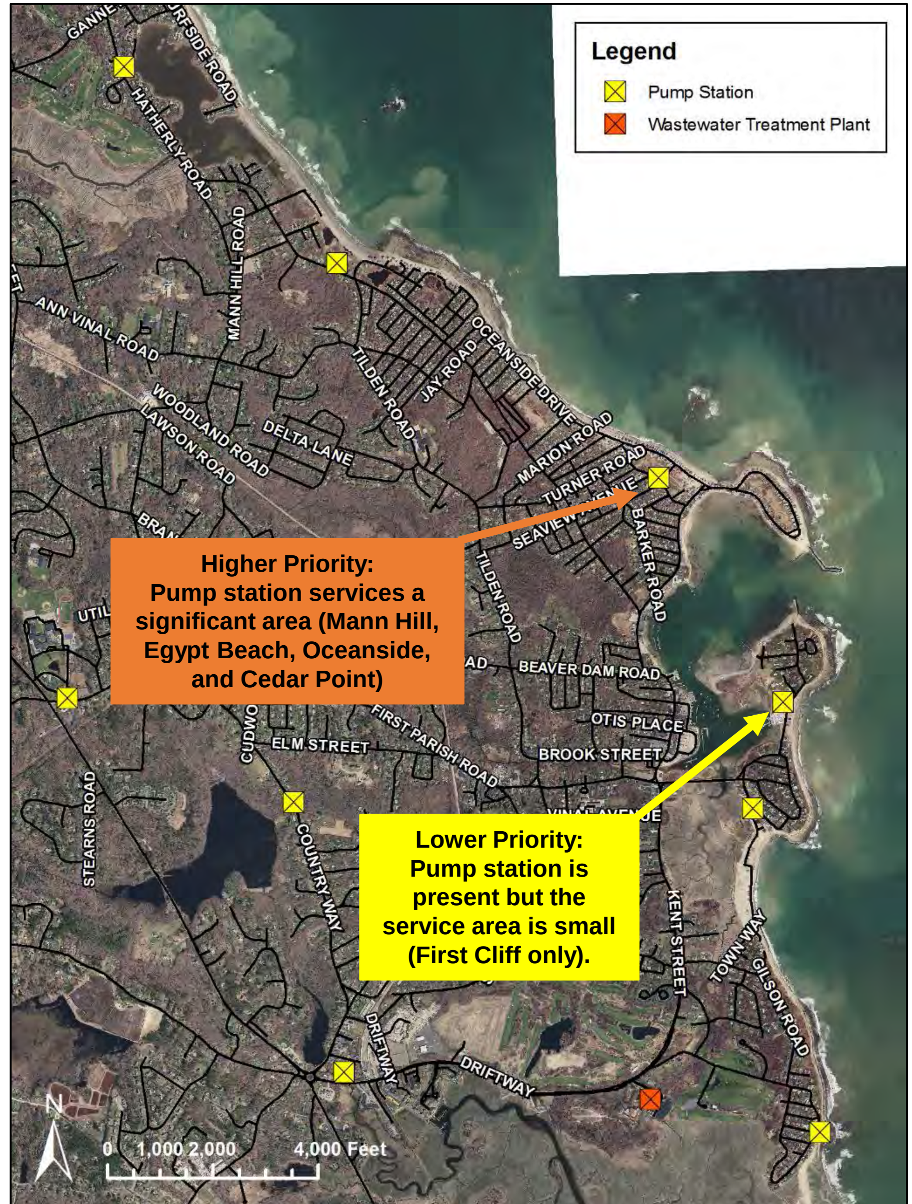
High Priority

Pump station present in a significant service area

Pumps station present

No pump station present

Low Priority



Criteria #3c: Damage Susceptibility of Public Utilities – Electrical

High Priority

Above-ground electrical lines

Higher Priority: Above-ground electrical lines lean and freeze during a storm on Cedar Point.

Buried electrical lines

Lower Priority: Buried electrical lines on Glades Road (south of Bailey's Causeway)

Low Priority

Criteria #4: Emergency Egress

High Priority

Access is through a high damage repetitive loss area

Access is through a historically flooded area

Generally unobstructed access

Low Priority

Criteria #5: Breach Susceptibility

High Priority

Potential for breach (no fronting coastal structure)

Potential for breach (fronting area reinforced with coastal structure)

No potential for breach

Low Priority

Criteria #6: Coastal Engineering Structure Condition

Applied to areas with coastal engineering structures only

High Priority

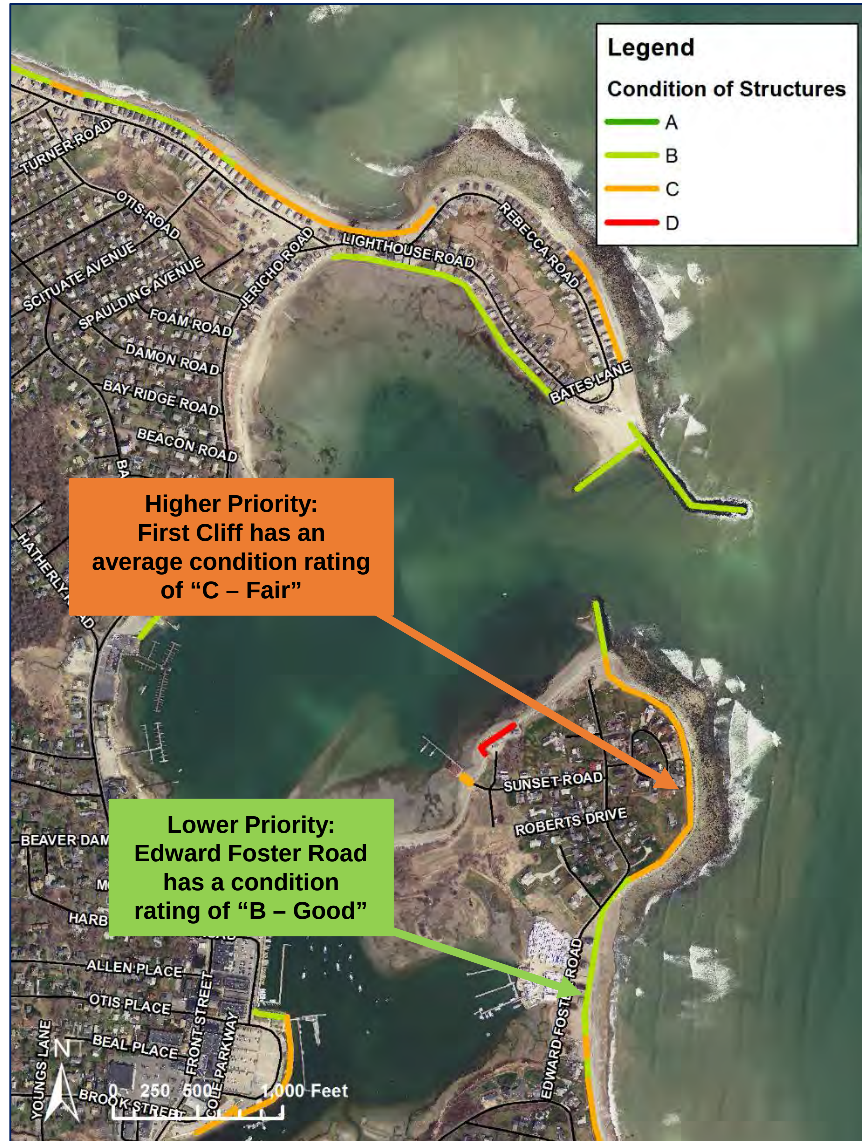
"D - Poor" structure condition (needs to be removed and rebuilt)

"C - Fair" structure condition (major repairs required)

"B - Good" structure condition (minor repairs required)

"A - Excellent" structure condition (little to no repairs required)

Low Priority



Prioritization Results

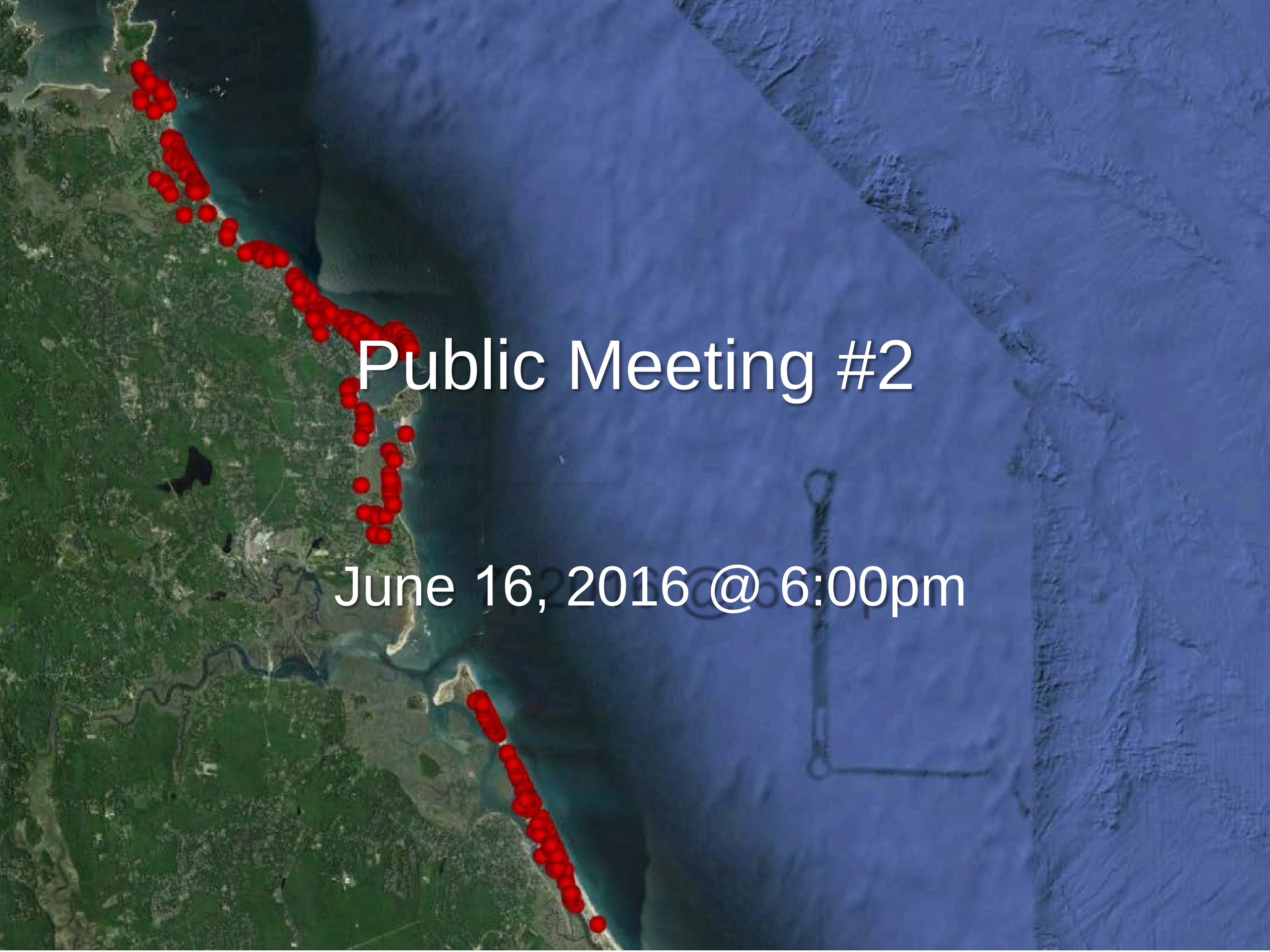
High	Medium	Low
Oceanside Drive	North Scituate Beach	Third Cliff
Humarock North	Humarock South	Edward Foster Road
Cedar Point	Minot Beach	First Cliff
Peggotty Beach	Mann Hill Beach	Second Cliff
Surfside Road	Egypt Beach	Fourth Cliff

Next Steps:
Shore Protection Approaches

To be presented at Public Meeting #2

Next Steps

- Identify risks and challenges of the “Do nothing” approach
- Evaluate existing seawalls and revetments and effectiveness in response to sea level rise
- Identify possible areas for beach nourishment
- Explore options for seawalls, breakwaters, groins, and other standard ‘hard’ shore protection options
- Consider innovative shore protection solutions
- Explore raising road elevations of barrier beaches and causeways
- Explore improved protection of wastewater pump stations
- Assess burial depth and burial location of utilities to prevent damage
- Explore possibility of managed retreat



Public Meeting #2

June 16, 2016 @ 6:00pm

Questions?