Elevating Roadway Improvements and Dune/Beach Nourishment along North Humarock for Improved Coastal Resiliency

Town of Scituate
Public Informational Meeting

March 28, 2017

Photo by Kevin Ham

Study Purpose

To develop a conceptual plan for elevating a portion of Central Avenue along northern Humarock Beach and optimizing a dune/beach nourishment design to provide storm damage protection for repetitively damaged public and private infrastructure.

Task 1

☑ **Kick-off Meeting**

Task 2

☑ **Initial Engineering Analysis to Screen Potential Alternatives**

→ **Public Informational Meeting #1**

Task 3

Conceptual Design of Recommended Alternative

Task 4

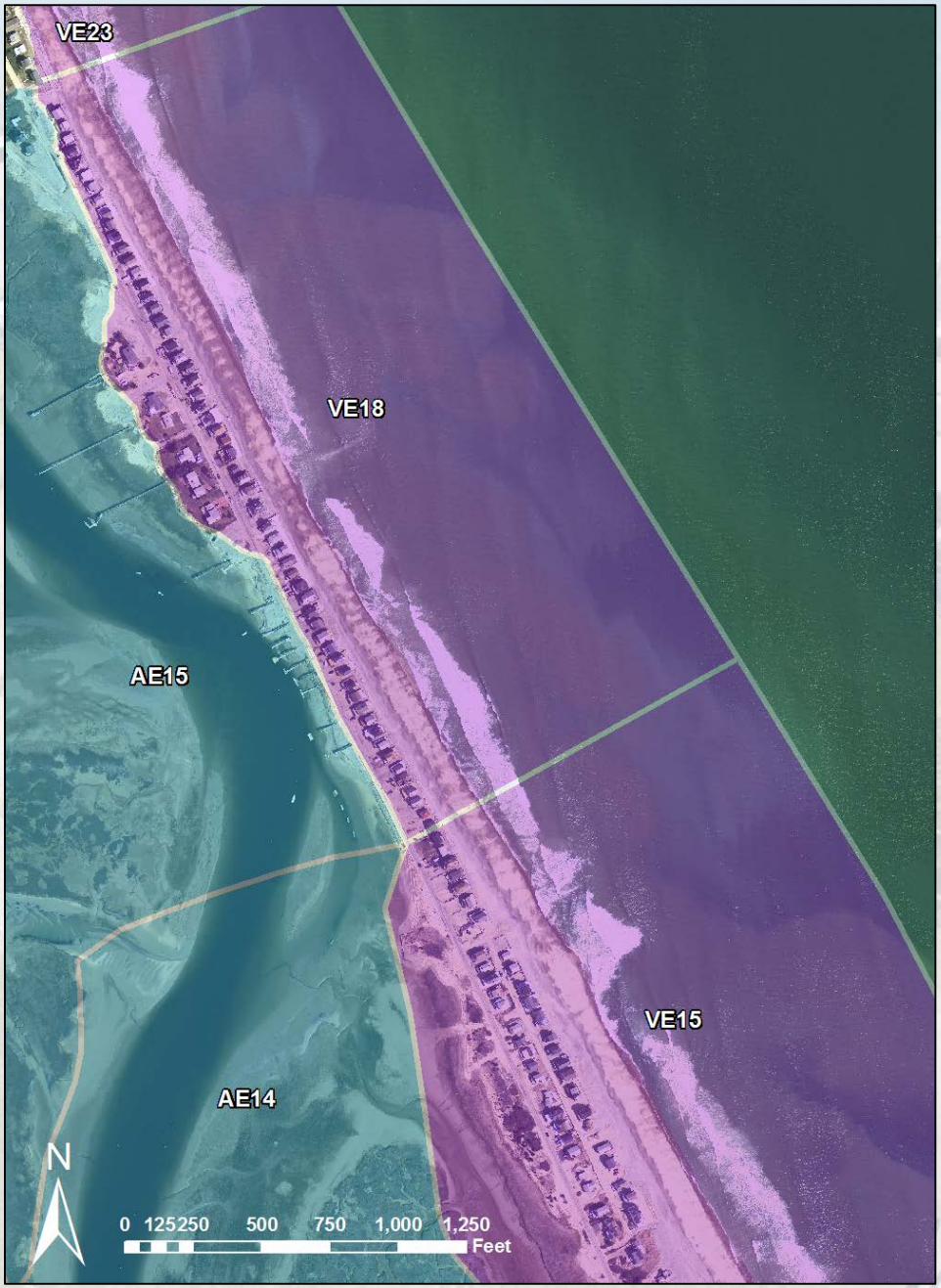
Develop Design Report
Public Informational Meeting #2
Educational Pamphlet

FEMA Flood Map

Effective November 4, 2016

All homes along North Humarock are located in VE zones.

VE Zones are coastal high hazard areas where wave action and/or high-velocity water can cause structural damage during the 1%-annual-chance (100-year) flood.

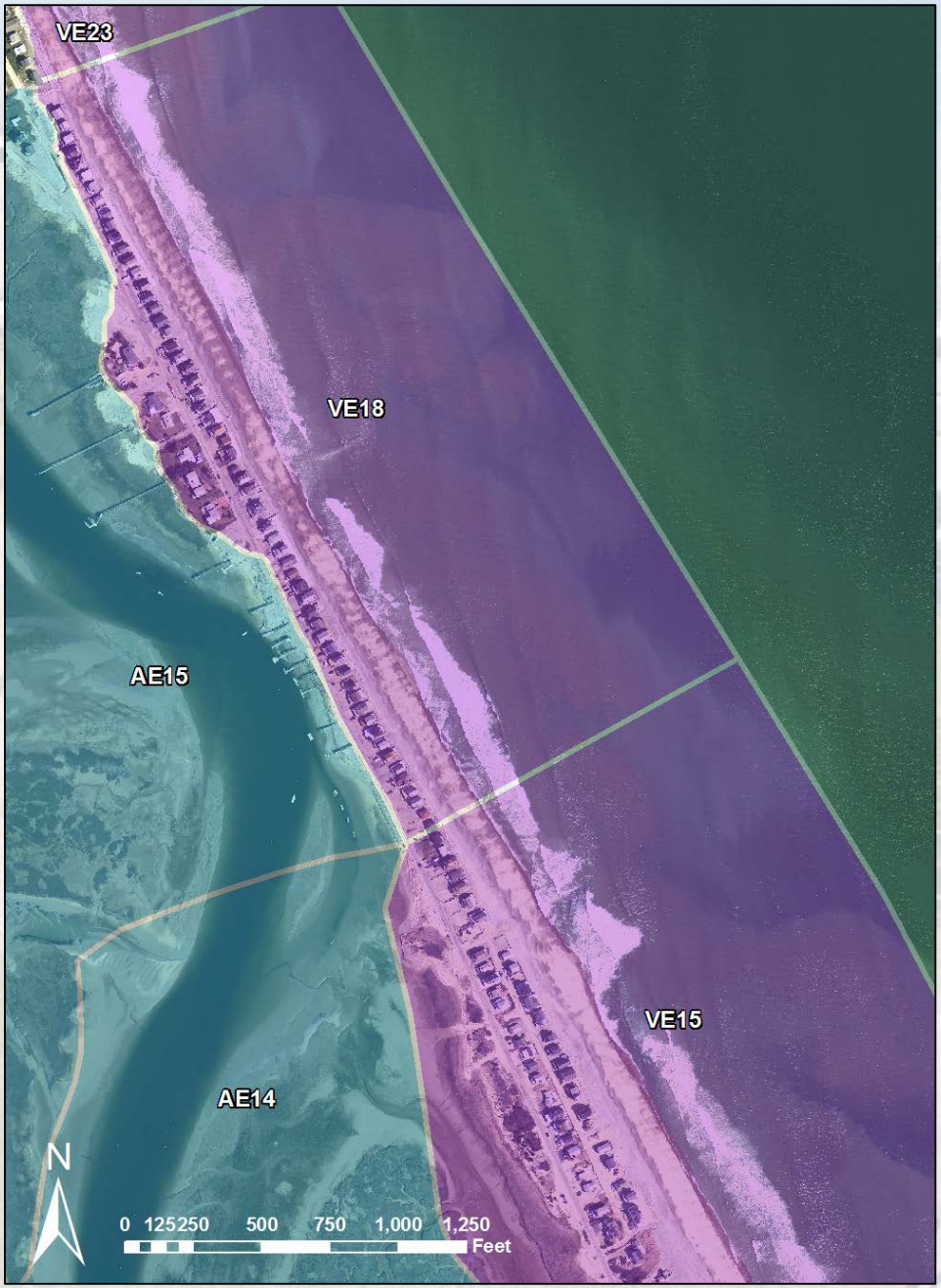


FEMA Flood Map

The purpose of the Flood Insurance Rate Maps (FIRMs) are for assessing flood risk for insurance

Town is in process of developing a Letter of Map Revision (LOMR)

They provide a general guide for flood risk, but should be utilized in conjunction with other site-specific information for other purposes



Storm Damage History


Jason Burtner, March 7, 2013


Nancy Durfee, January 24, 2017


William Schmid, January 24, 2016

Storm Damage History

Storm Date	Repetitive Loss Claims	Total Claims ($)	Return Period (years)
2/6/1978	**-**	**-**	**158**
1/24/1979	4	$30,112	19
3/29/1984	2	$7,927	1
1/2/1987	10	$102,794	22
10/28/1991	**38**	**$3,197,631**	**30**
12/10/1992	32	$591,563	22
3/5/2001	11	$338,139	3
1/1/2003	4	$51,508	8
12/5/2003	2	$29,598	1
1/22/2005	2	$74,573	1
5/22/2005	3	$20,535	11
4/15/2007	8	$49,587	15
2/23/2010	1	$36,204	2
12/16/2010	11	$236,165	13
2/7/2013	**13**	**$445,427**	**4**
3/4/2013	5	$154,052	3
1/2/2014	4	$90,609	17
1/26/2015	**7**	**$509,160**	**11**

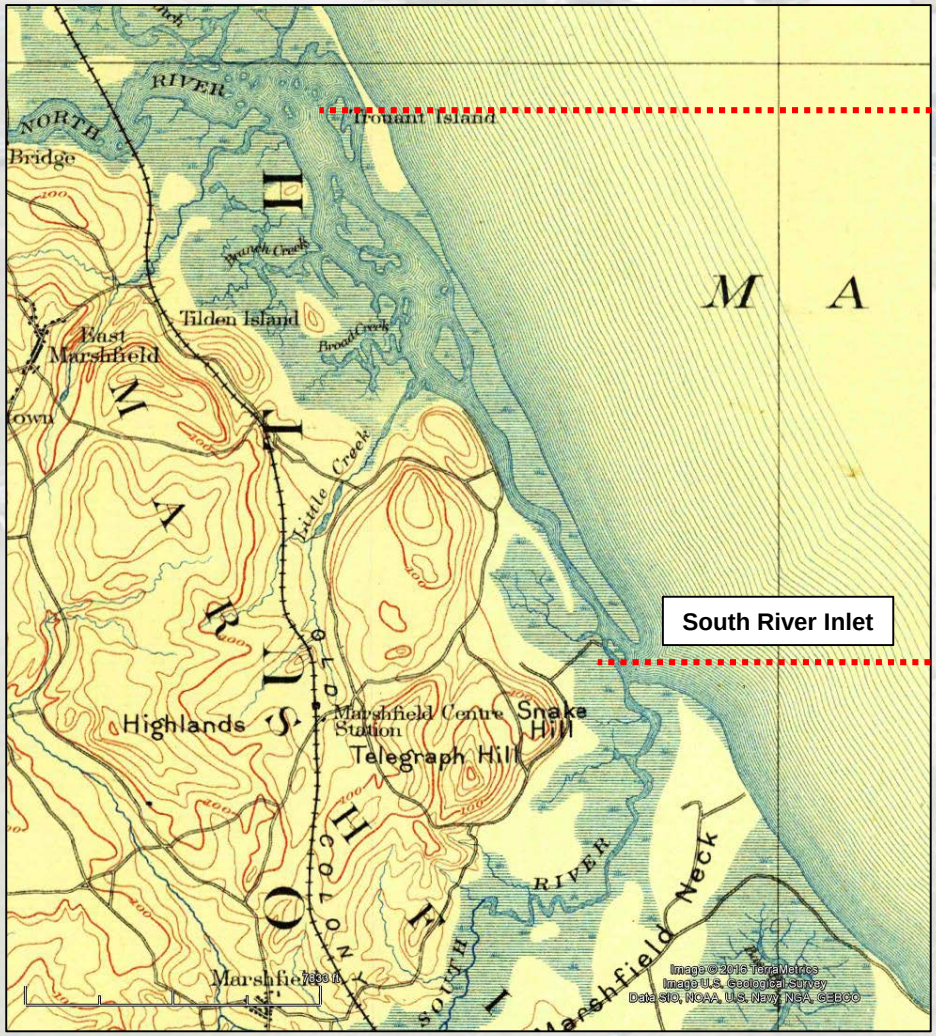
Blizzard of 1978

1991 No-Name Storm

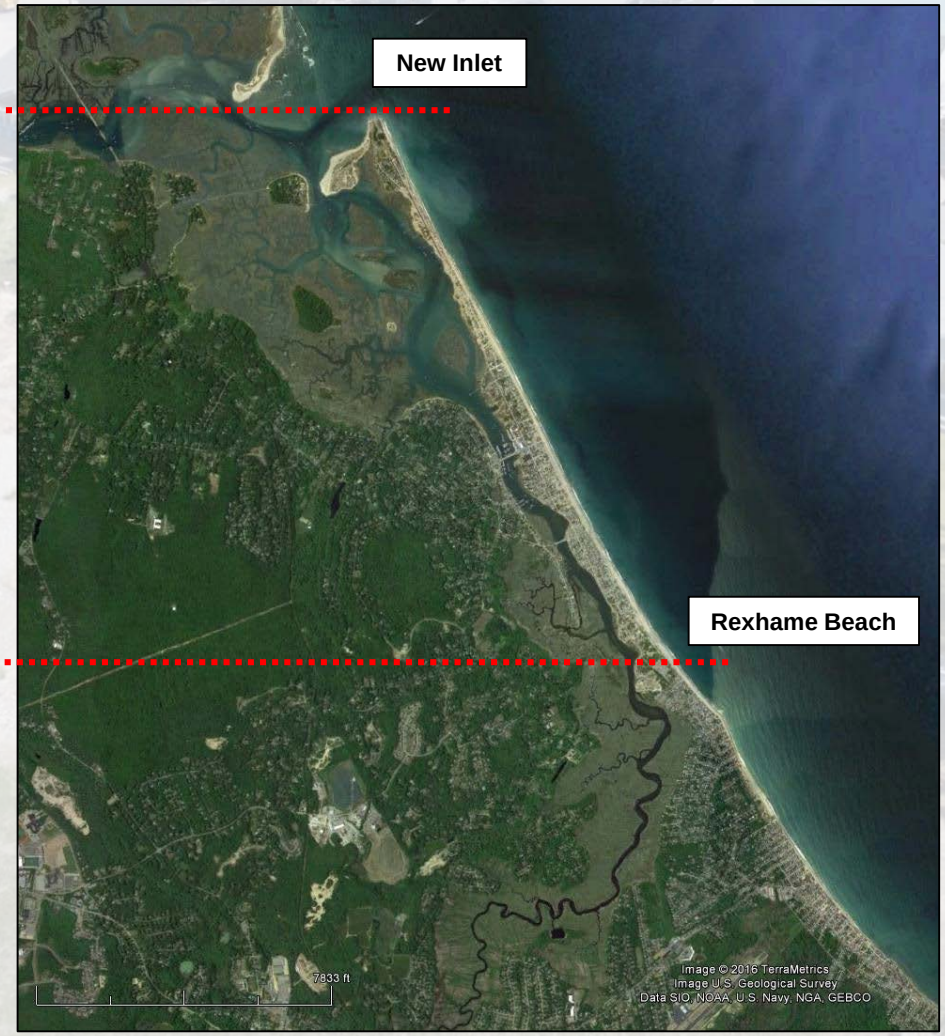
Winter Storm Nemo

Winter Storm Juno

Humarock Beach – Historical Inlet Positions (Breaching)
Portland Gale - 1898



1888

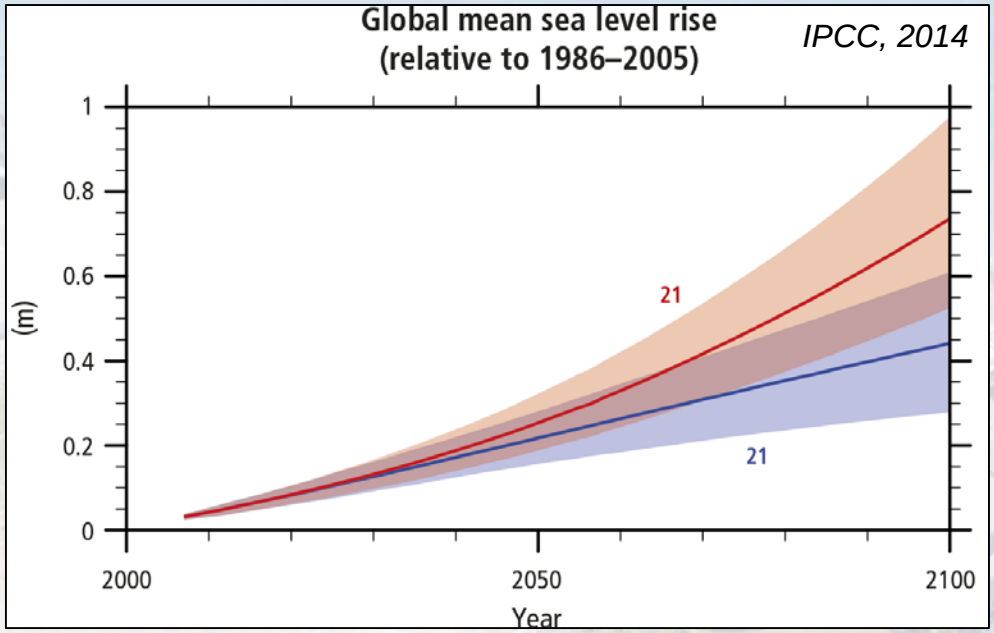


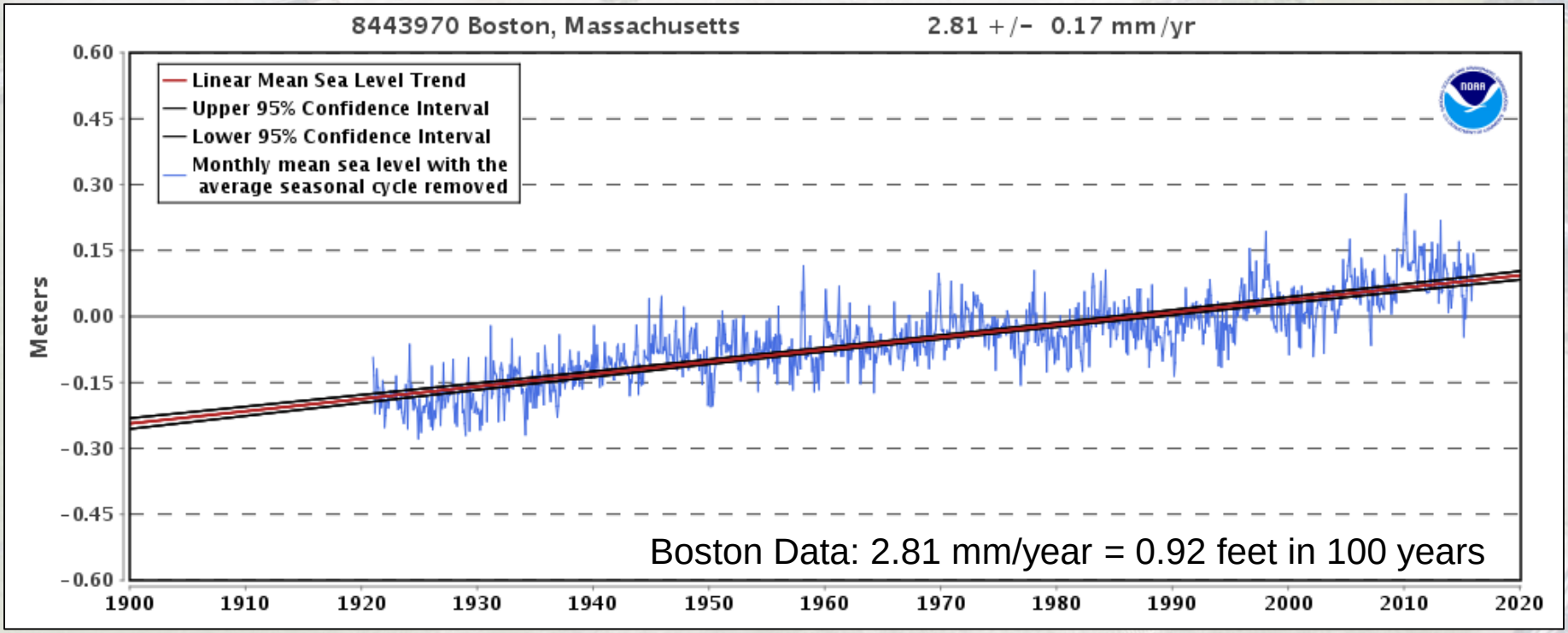
2016

Sea Level Rise

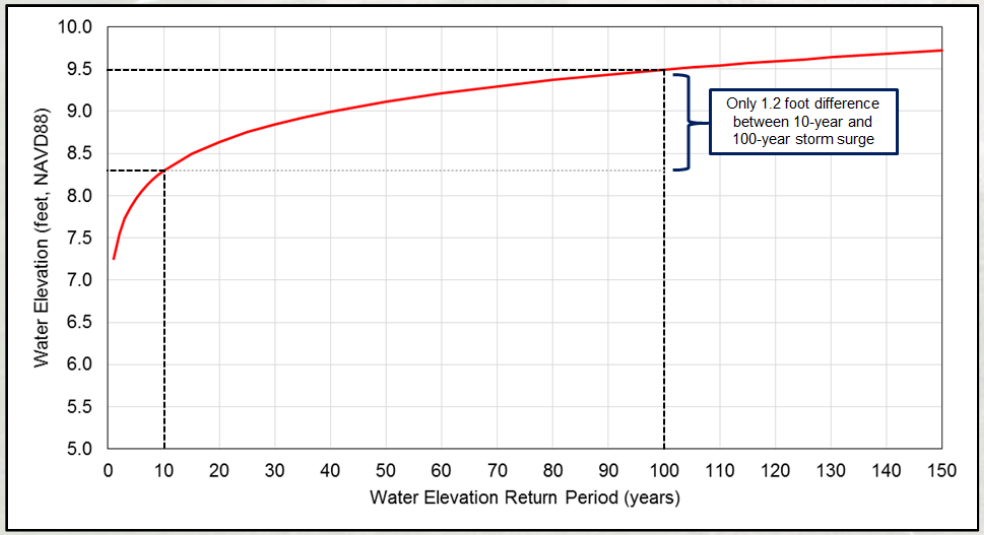
Likely range of global mean sea level rise by 2100:

- Low estimate 0.85 to 1.8 feet
- High estimate 1.5 to 2.7 feet



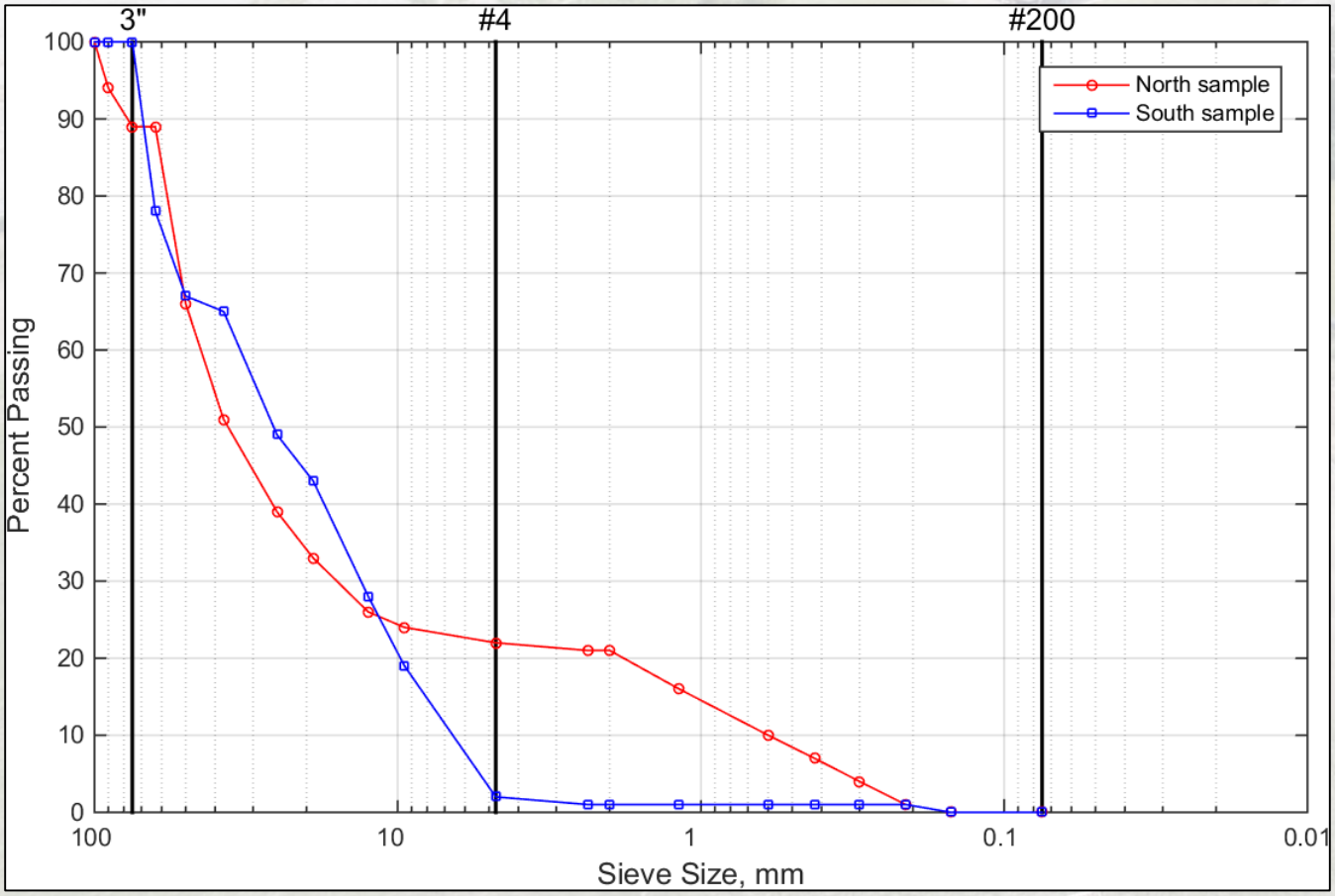


Extreme Water Levels



Sediment Sampling

- Sediment sampling completed by UMass on September 10, 2015 (summer) and March 23, 2016 (winter) along the entire beach
- Additional samples collected by Applied Coastal on February 2, 2017 found mean sediment sizes of 36 mm and 26 mm for North Humarock



Private Coastal Structures

Recommended Shore Protection Approaches

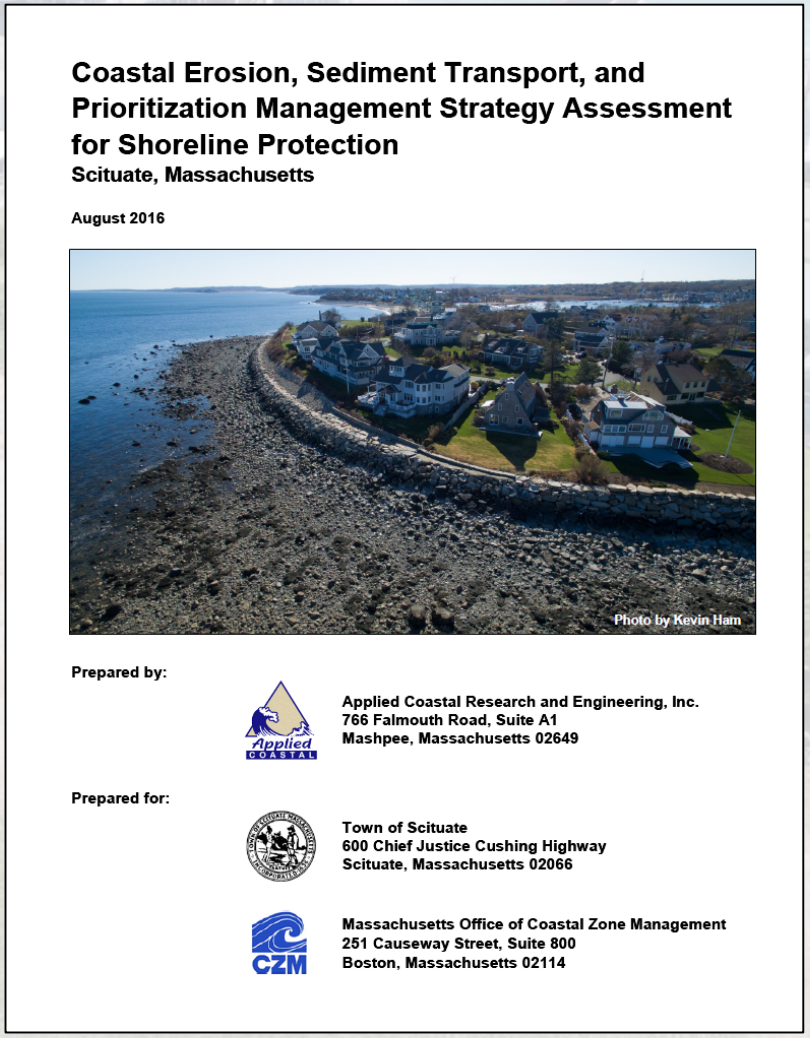
"The recommended shore protection approach for Humarock North is to **elevate Central Avenue, construct dunes along the Humarock North, and nourish the beach along the entire Humarock North and South**."

Dune/Beach Nourishment

- Increase storm protection
- Reduce wave overtopping and overwash
- Reduce the need for post-storm roadway clearing
- Reduce overwash of sediment to the marsh
- Prevent breach between Humarock and Fourth Cliff

Elevating Central Avenue

- Maintain emergency egress during flood events
- Prevent still water flooding from the marsh side
- Prevent breach between Humarock and Fourth Cliff



Coastal Erosion, Sediment Transport, and Prioritization Management Strategy Assessment for Shoreline Protection
Scituate, Massachusetts

August 2016

Prepared by:

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Massachusetts Office of Coastal Zone Management
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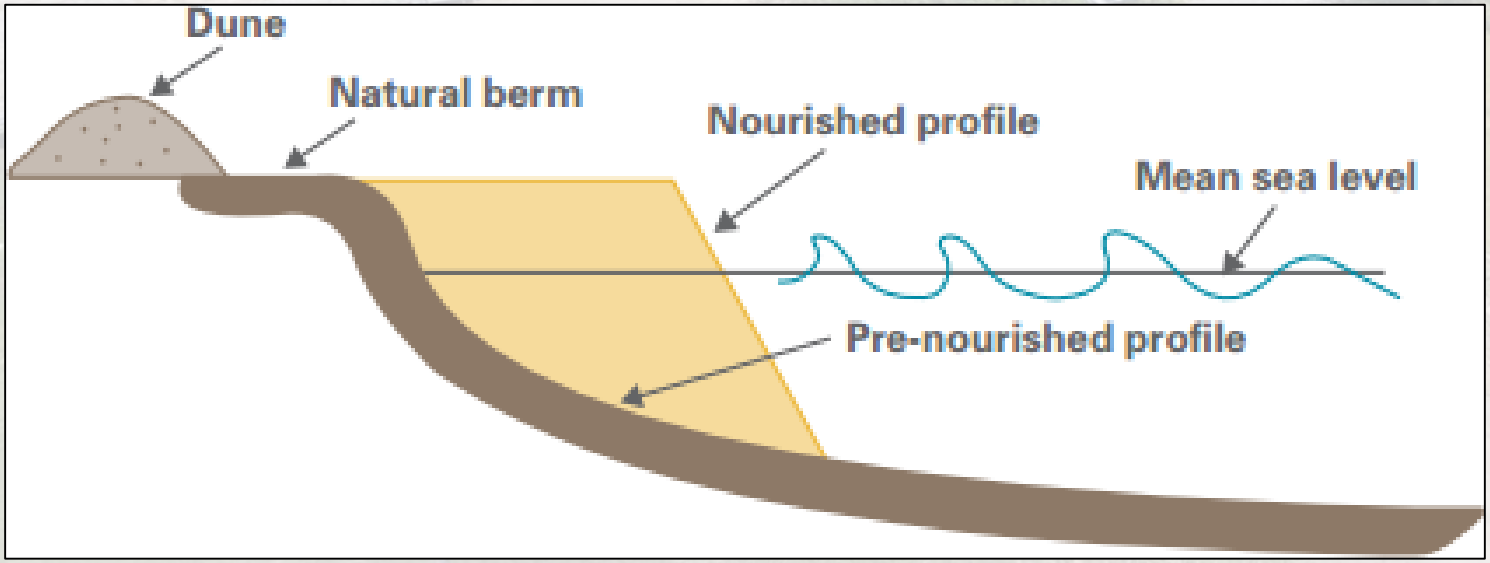
Beach Nourishment

Beach Nourishment

Beach nourishment creates a wider beach to dissipate wave energy, thereby increasing protection to infrastructure and property currently threatened by overtopping and storm damage.



(asbpa.org)

Beach Nourishment

Pros	Cons
• Restoration of the lost aerial and sub-tidal beach • **Nourishment will provide wave dissipation and storm protection** • **Nourishment will re-establish sediment supply to adjacent beaches** • Creation of a recreational resource • Repairs and maintenance funds may be provided by FEMA if nourishment is monitored	• Impacts from covering of inter-tidal and sub-tidal habitats, benthic communities, and nearshore resources areas • **Regular and episodic maintenance and re-nourishment required** • Impacts to the community during construction

Challenges

- Easements required if publicly funded
- Permitting concerns due to large project area footprint
- Significant cost – especially if upland source needed

Beach Nourishment – Winthrop Beach Example

Pre-nourishment

Beach Nourishment – Winthrop Beach Example

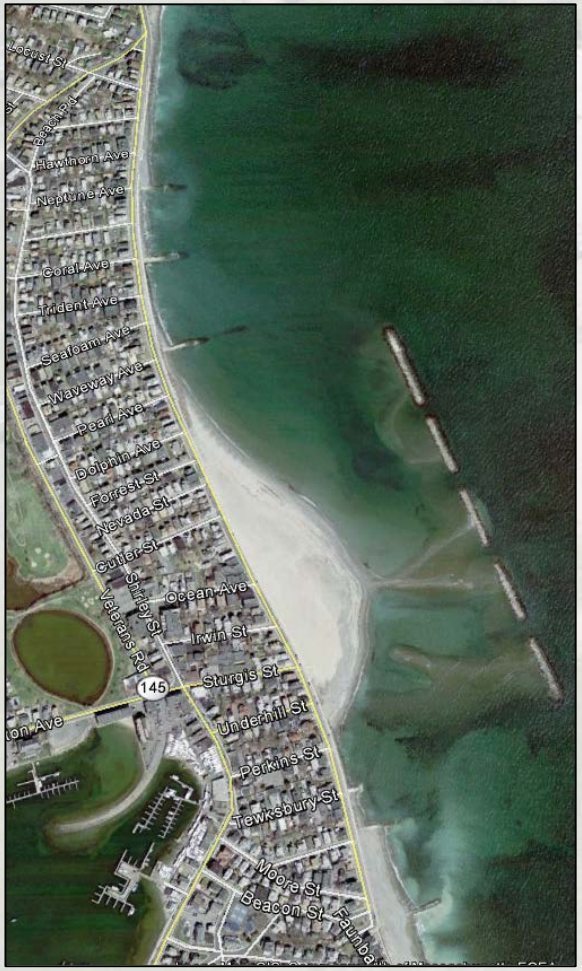
Before Nourishment

During

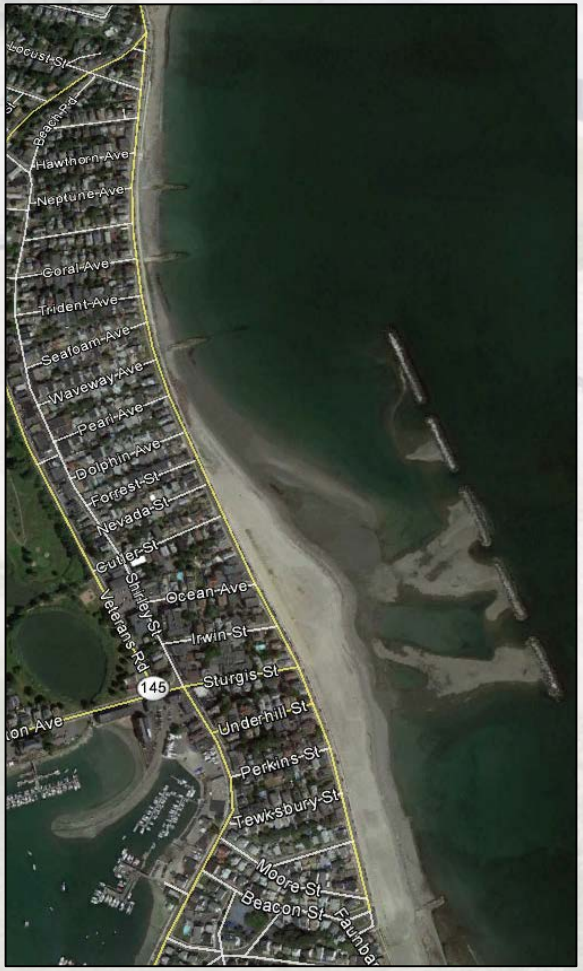
After Nourishment
Photo taken after Winter Storm Juno

Beach Nourishment – Winthrop Beach Example

April 2008

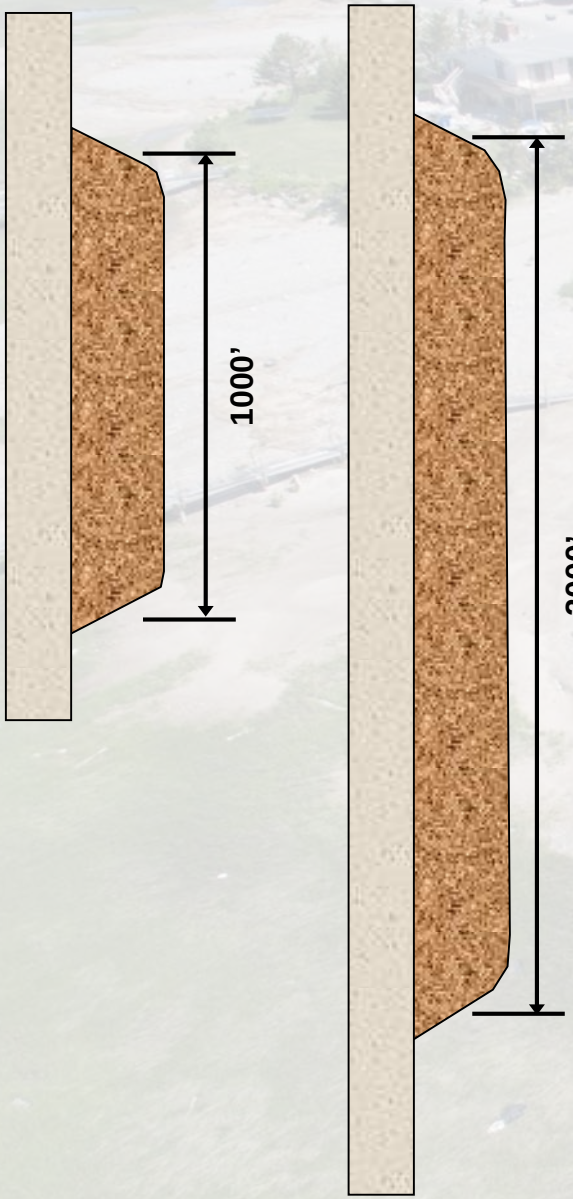


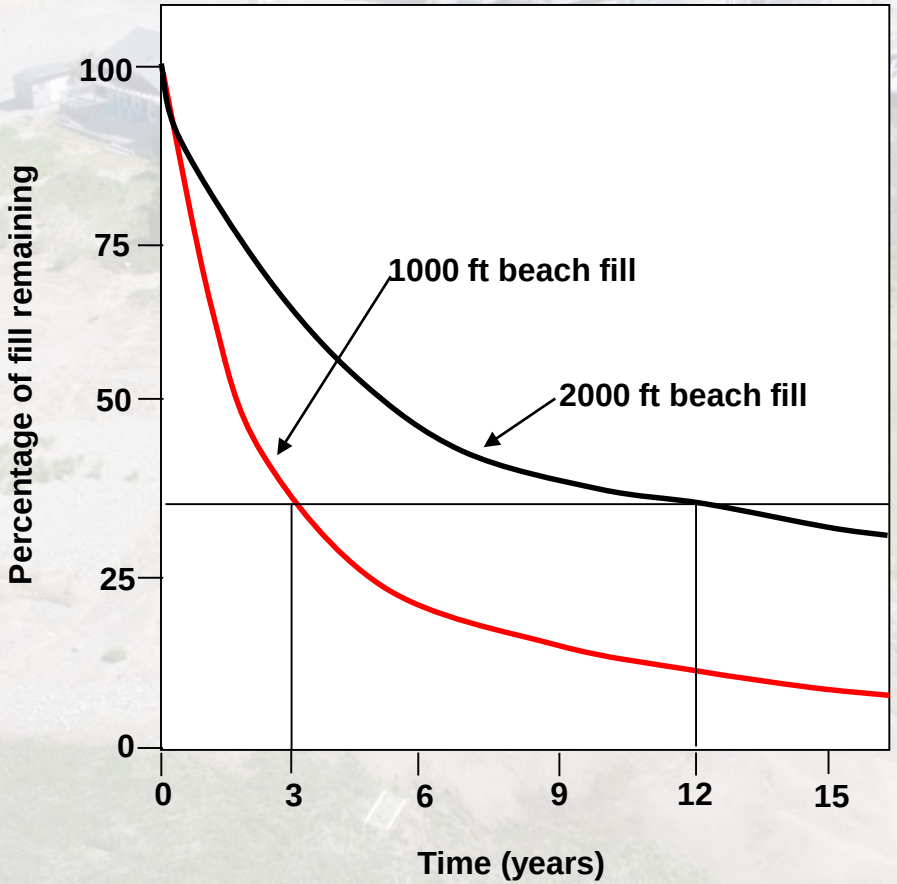
August 2013



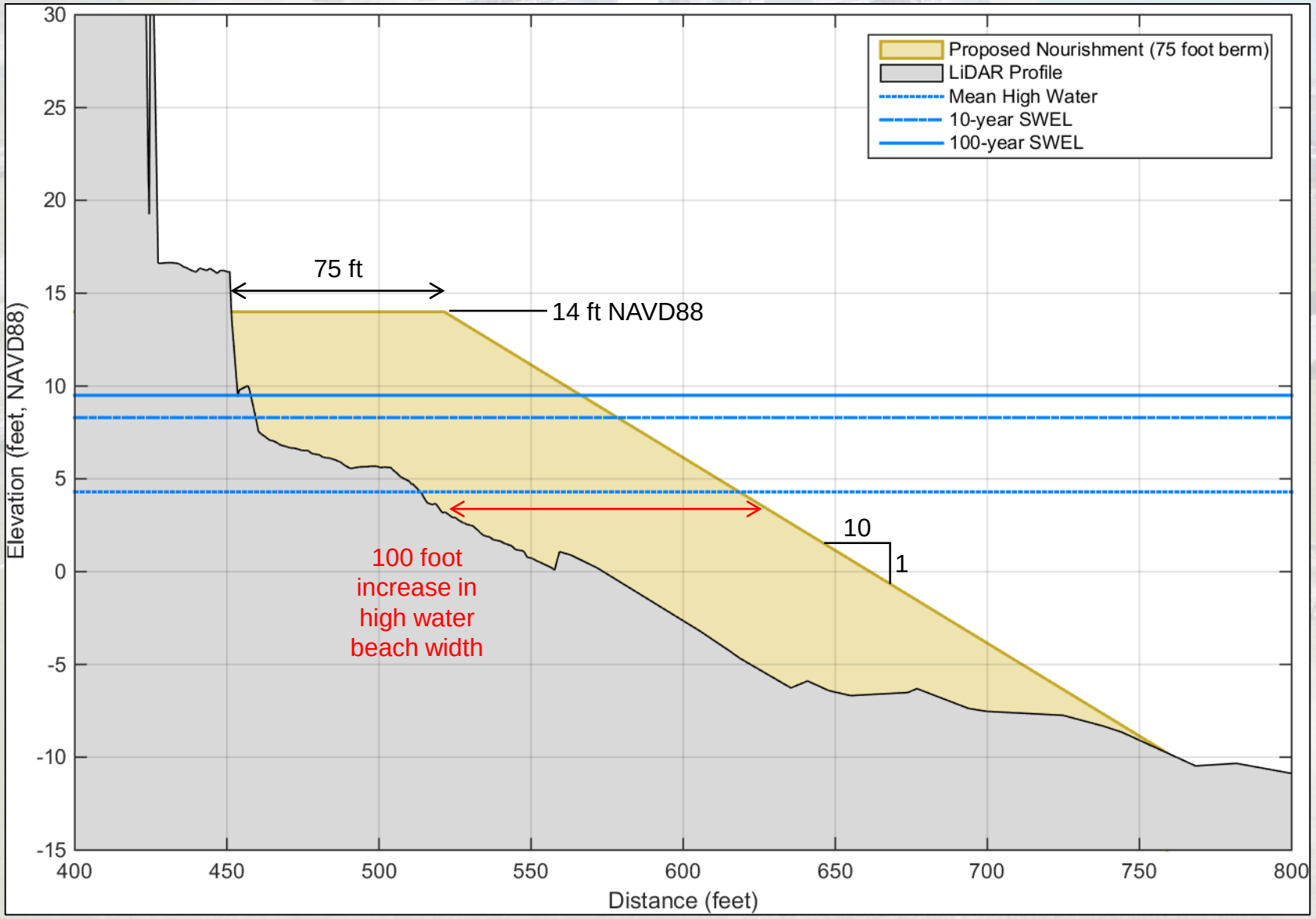
March 2015

Nourishment Design – Influence of Project Length





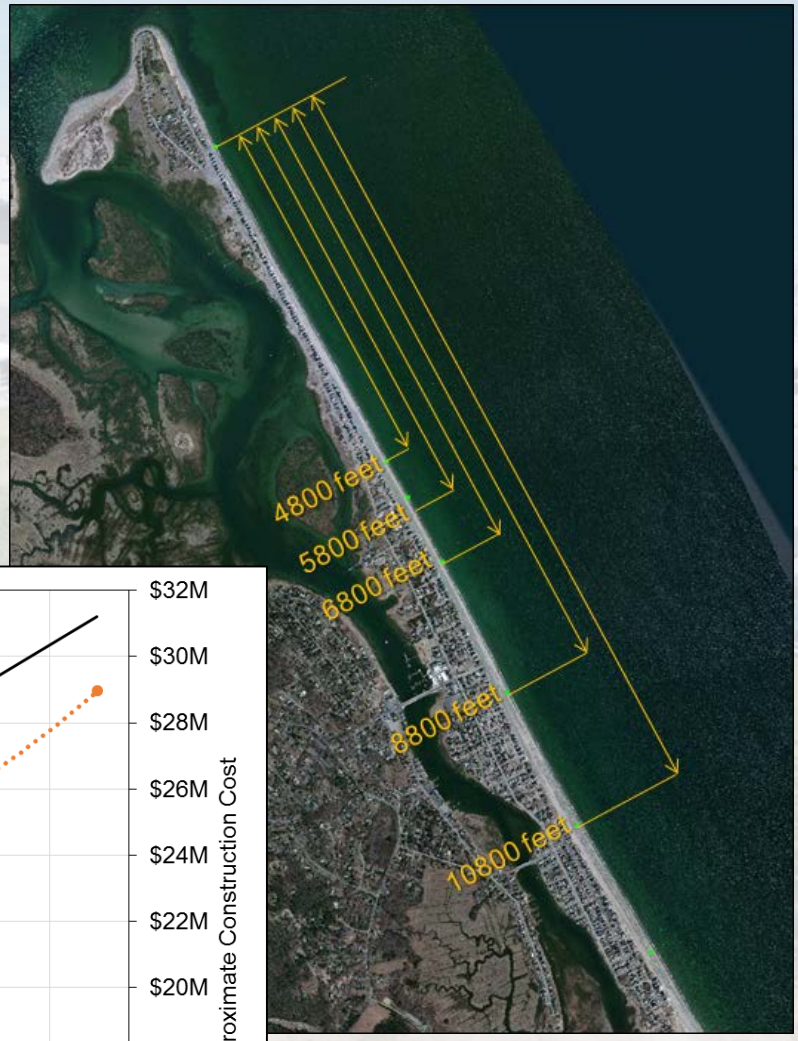
Proposed Beach Nourishment Profile

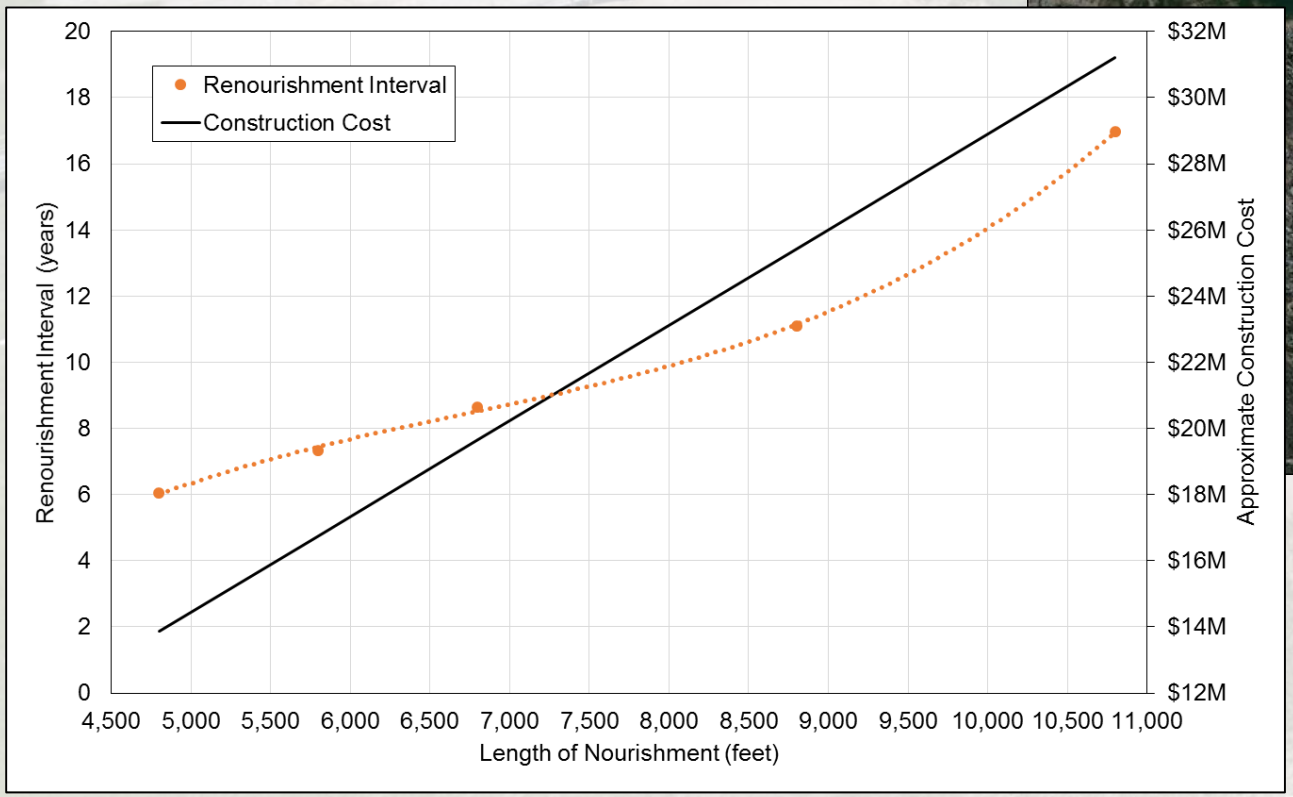


Beach Nourishment Longevity

To nourish along North Humarock:

- Approximately 85 CY per foot of shoreline
- 5,000 feet of shoreline
- 425,000 CY of sediment
- Estimated construction cost: $14.5M
- Renourishment required every ~6 years





Summary: Beach Nourishment

Beach nourishment is recommended if the nourishment length can be extended further south to increase the renourishment interval and area of storm protection.

50-Year Lifecycle Cost Estimate Beach Nourishment along North Humarock (5,000 ft)	
First Cost	$14,450,000
Renourishment Cost	$10,115,000
Renourishment Interval	6 years
Life Cycle	50 years
Inflation Rate	3%
Money Spent over 50 Years	**$209,401,745**

Constructed Dunes

Constructed Dunes

Constructed dunes can provide storm damage protection by reducing flooding and overwash into the marsh. Regular maintenance and re-nourishment is required to maintain sufficient volume.

Pros	Cons
• **Storm damage reduction during smaller storms** • Reduced flooding and overtopping • **Dune nourishment life can be enhanced by adjacent beach nourishment**	• **Regular maintenance and re-nourishment required** • Dune alone may not provide enough protection from larger storms

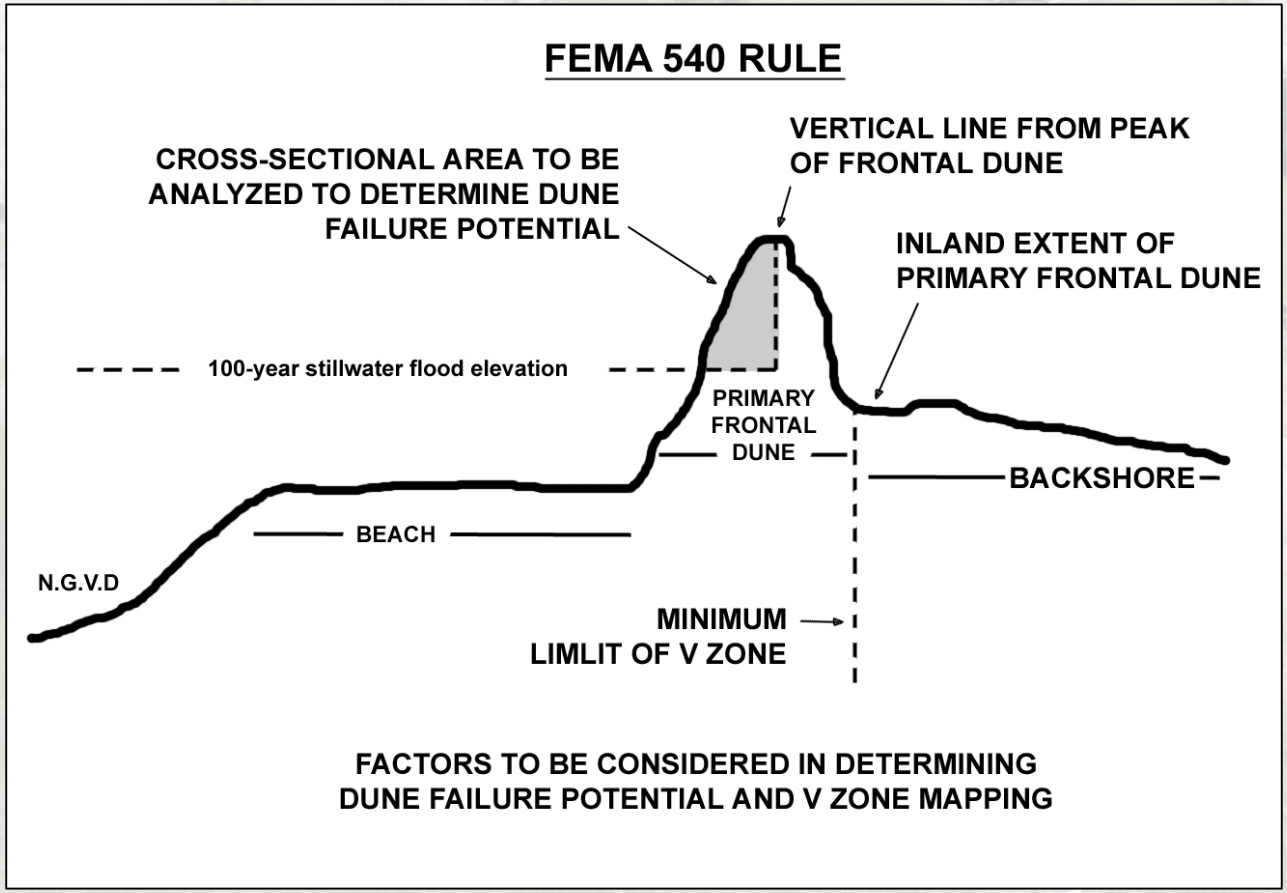
Challenges

- Easements required if publicly funded
- Education of the public required to keep people off dunes

Cobble Dunes at Mann Hill Beach/Egypt Beach

Design of Constructed Dunes

The minimum dune volume required to prevent dune overtopping during a storm is estimated using FEMA's **"540 rule"**. The "540 rule" states that dune volume is sufficient to protect against a 100-year storm when the volume seaward of the dune crest and above the 100-year still water elevation is greater than 540 square feet per linear foot of dune.

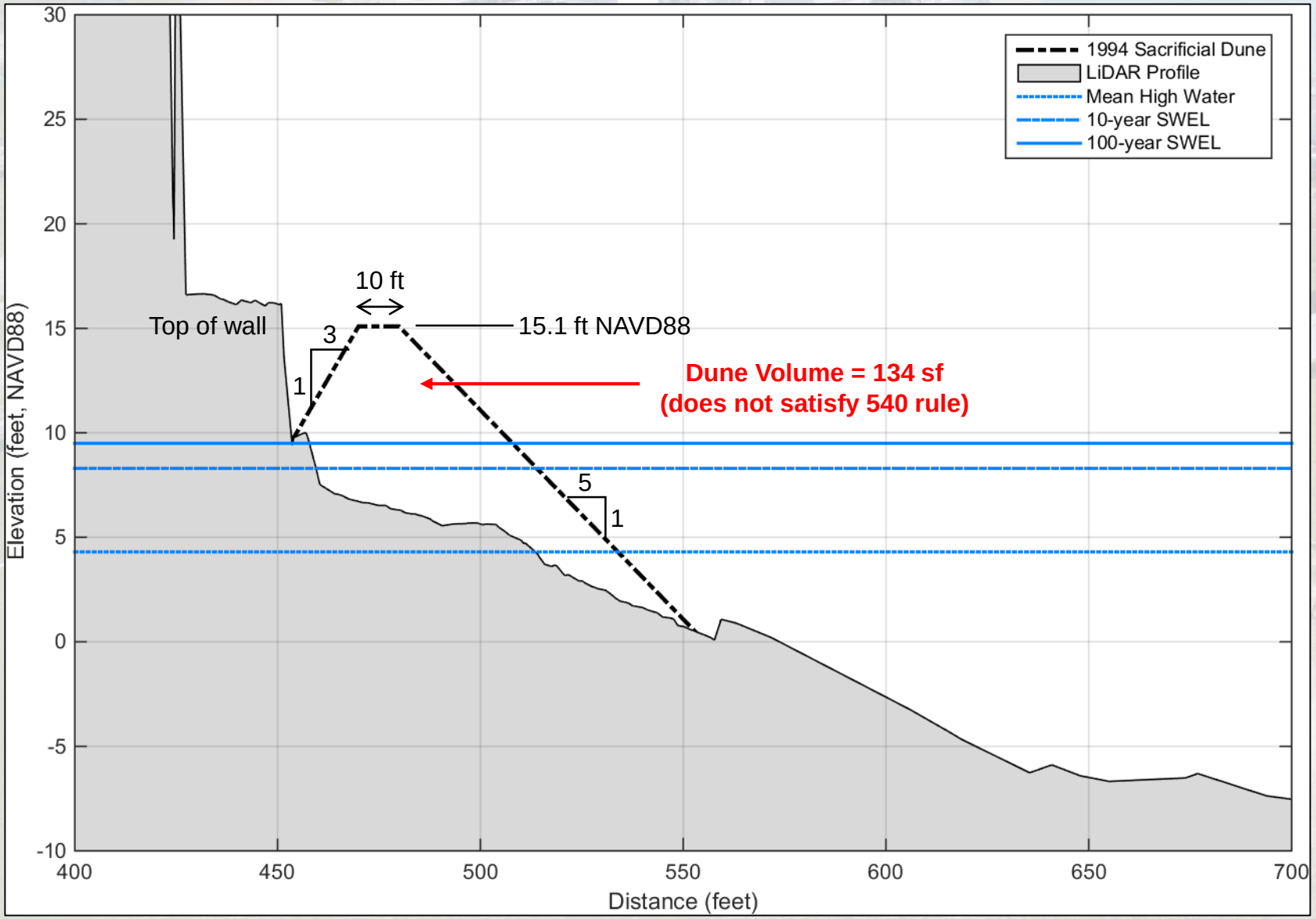


1994 Sacrificial Dune Project

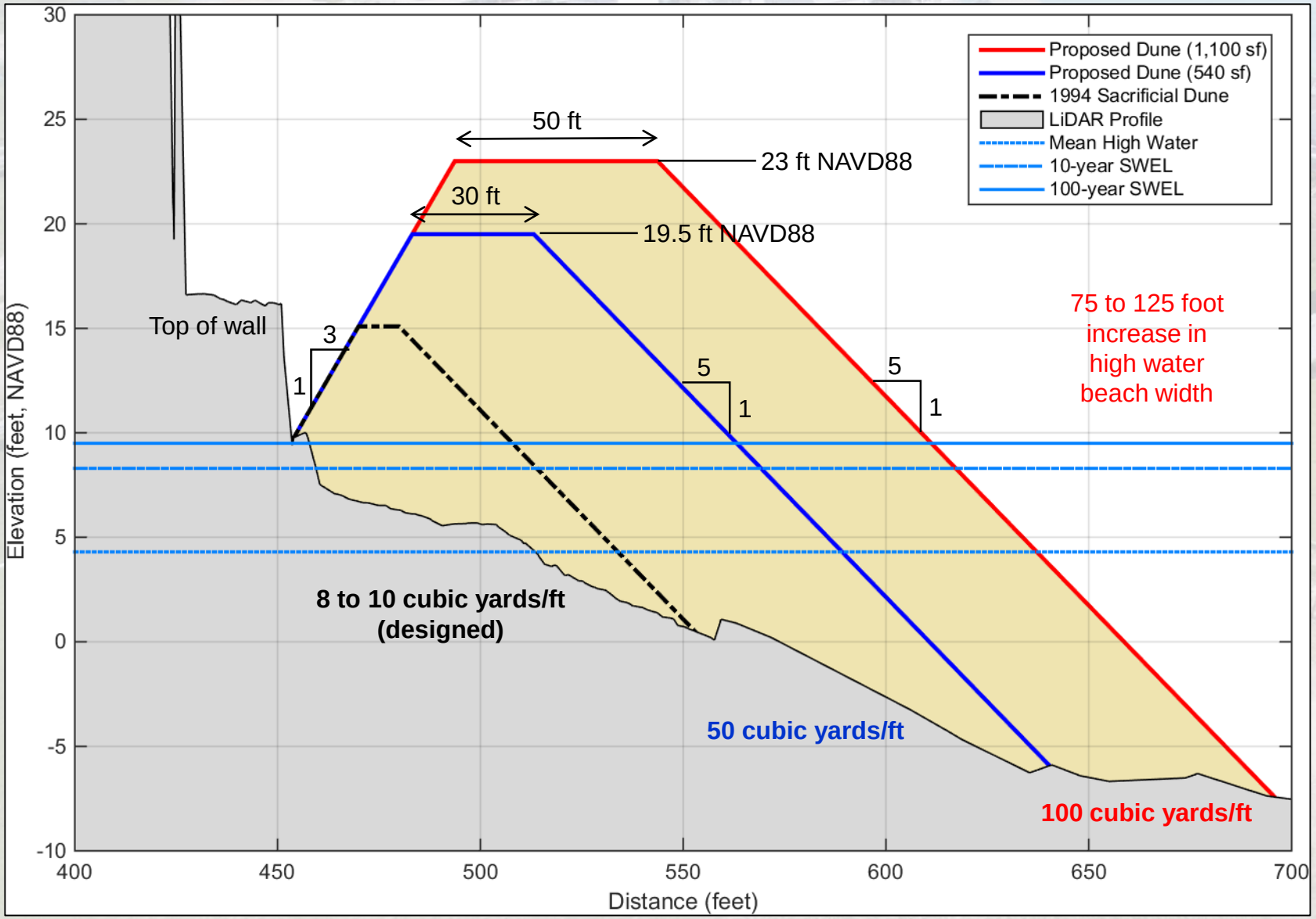
- Designed for a 5-year storm (water levels of approximately 8 feet NAVD88)
- Sand placed from south end of Fourth Cliff to the Marshfield town line
- 49,000 cubic yards of nourishment
- Most of sand lost during Labor Day Storm (September 5, 1994, maximum water level of 5.5 feet NAVD88)

Photos by MCZM, June 23, 1994

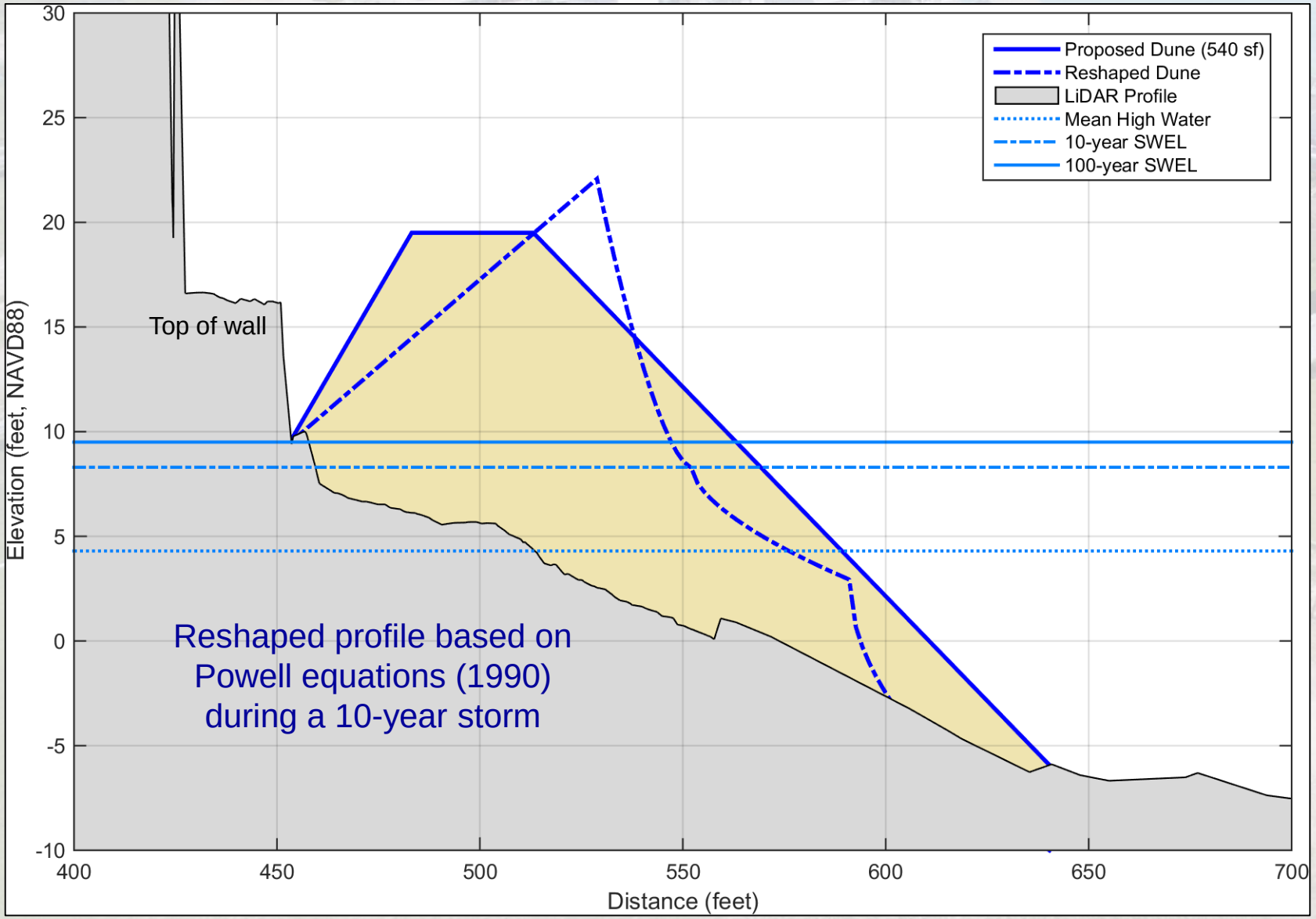
1994 Sacrificial Dune Project



Proposed Constructed Dune Profiles



Proposed Constructed Dune Profile - Reshaped



Summary: Constructed Dunes

Constructed dunes are recommended to reduce wave overtopping and overwash along North Humarock. At a minimum, the volume of the dune will adhere to FEMA's "540 rule". The dune can be redesigned during the project life to account for sea level rise.

50-Year Lifecycle Cost Estimate Constructed Dunes along North Humarock (540 sf)	
First Cost	$8,500,000
Maintenance Cost	$425,000
Maintenance Cost Reoccurrence	2 years
Reconstruction Cost	$4,250,000
Reconstruction Cost Reoccurrence	10 years
Life Cycle	50 years
Inflation Rate	3%
Money Spent over 50 Years	**$69,257,251**

1/3 of the cost for beach nourishment

Elevate Central Avenue

Elevate Central Avenue

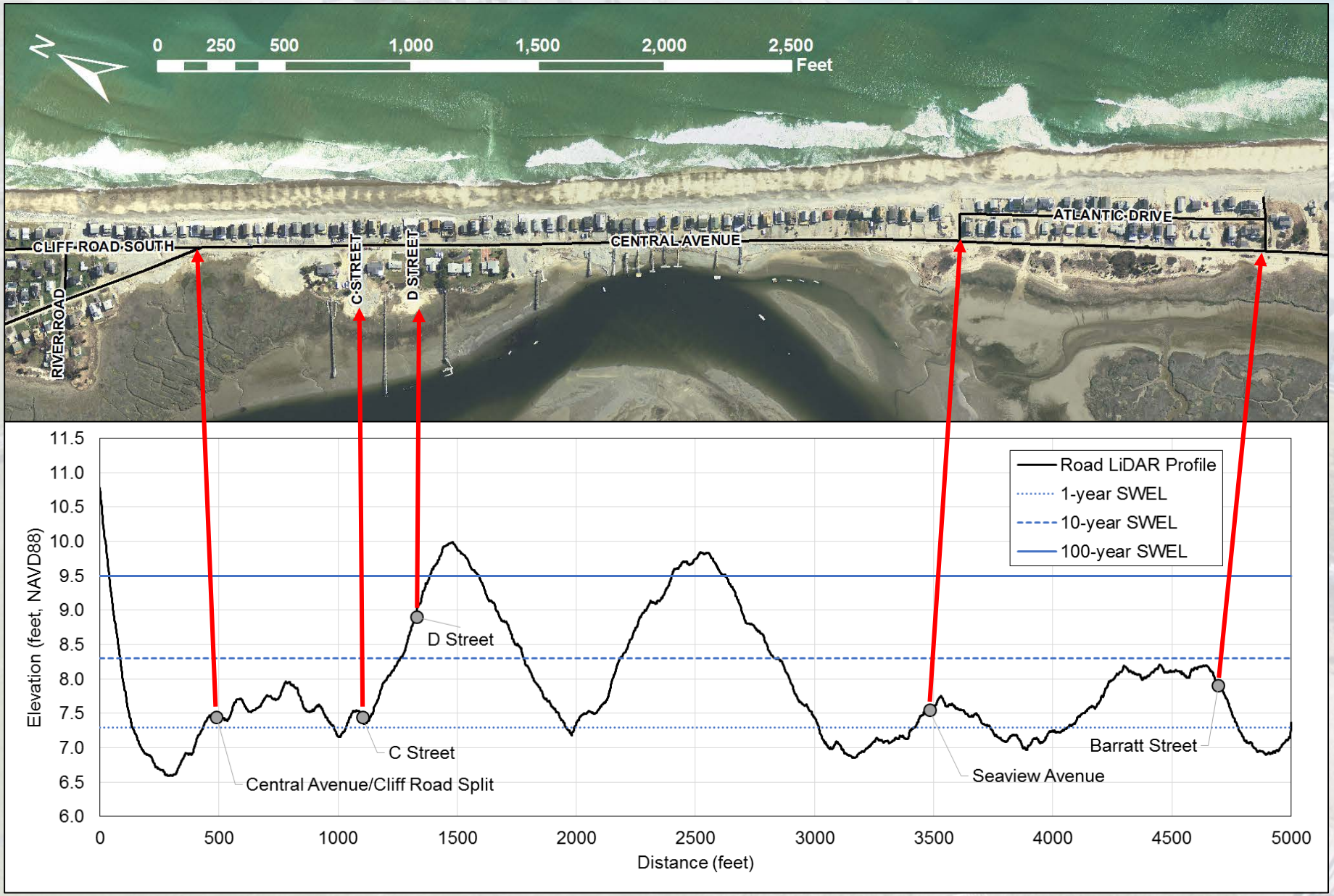
Elevating flood-prone roads can improve emergency egress, reduce overwash and the need for debris clearing, and may also offer improved protection from breaching.

Pros	Cons
• **Improves emergency egress during flood events** • Reduces wave overwash and the need for debris clearing • **May offer improved protection from breaching**	• Utilities must also be raised with the road (water, gas, electric, etc.) • Impacts to the community from construction

Challenges

- Some paved driveways may need to be filled to meet the new road elevation

Existing Elevation of Central Avenue



Issue #1: Existing Paved Driveways

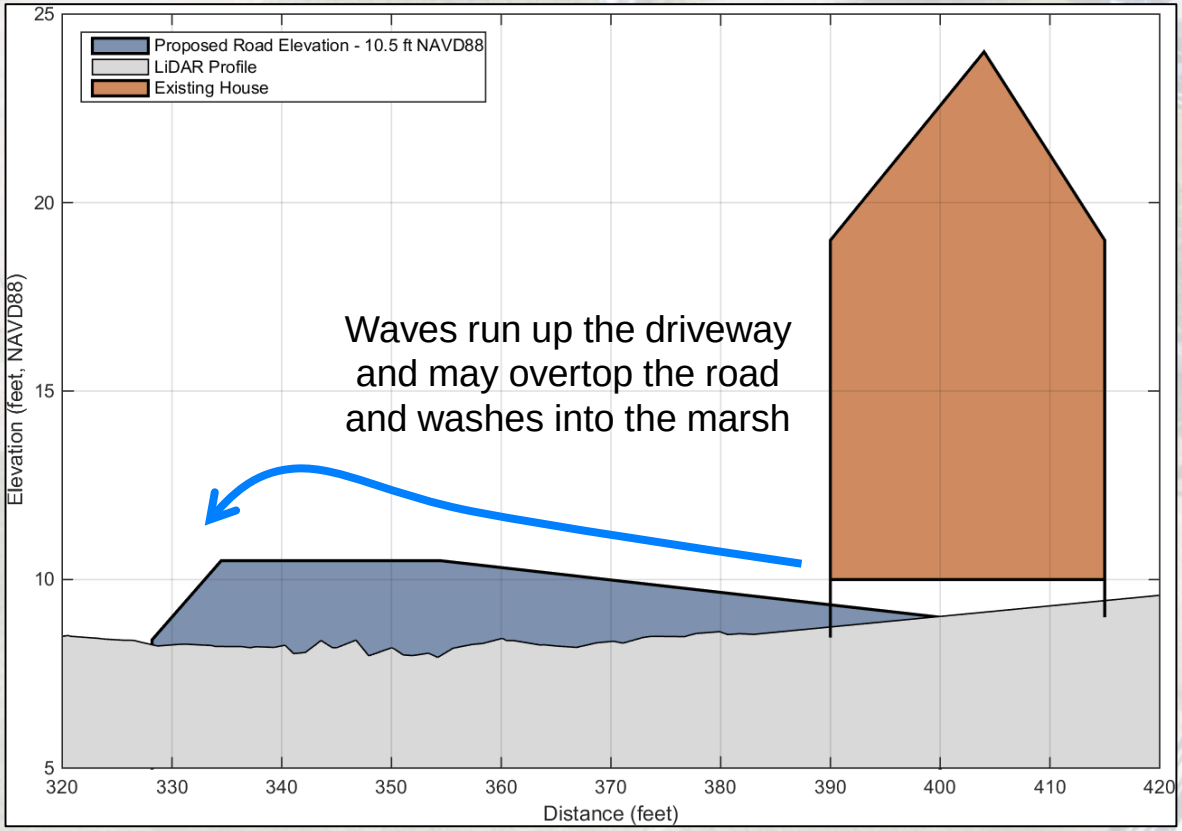
- 32 out of 92 homes have paved/landscaped driveways
- In most cases, the driveways will need to be filled (partially or in entirety) in order to meet the new road elevation

Issue #2: New Driveways Sloping towards Homes

- Ideally, the road and driveway elevation would be the same in order to reduce still water flooding around the houses
- First floor living spaces, garages, non-elevated homes, and paved driveways may require that the driveway slope towards the house

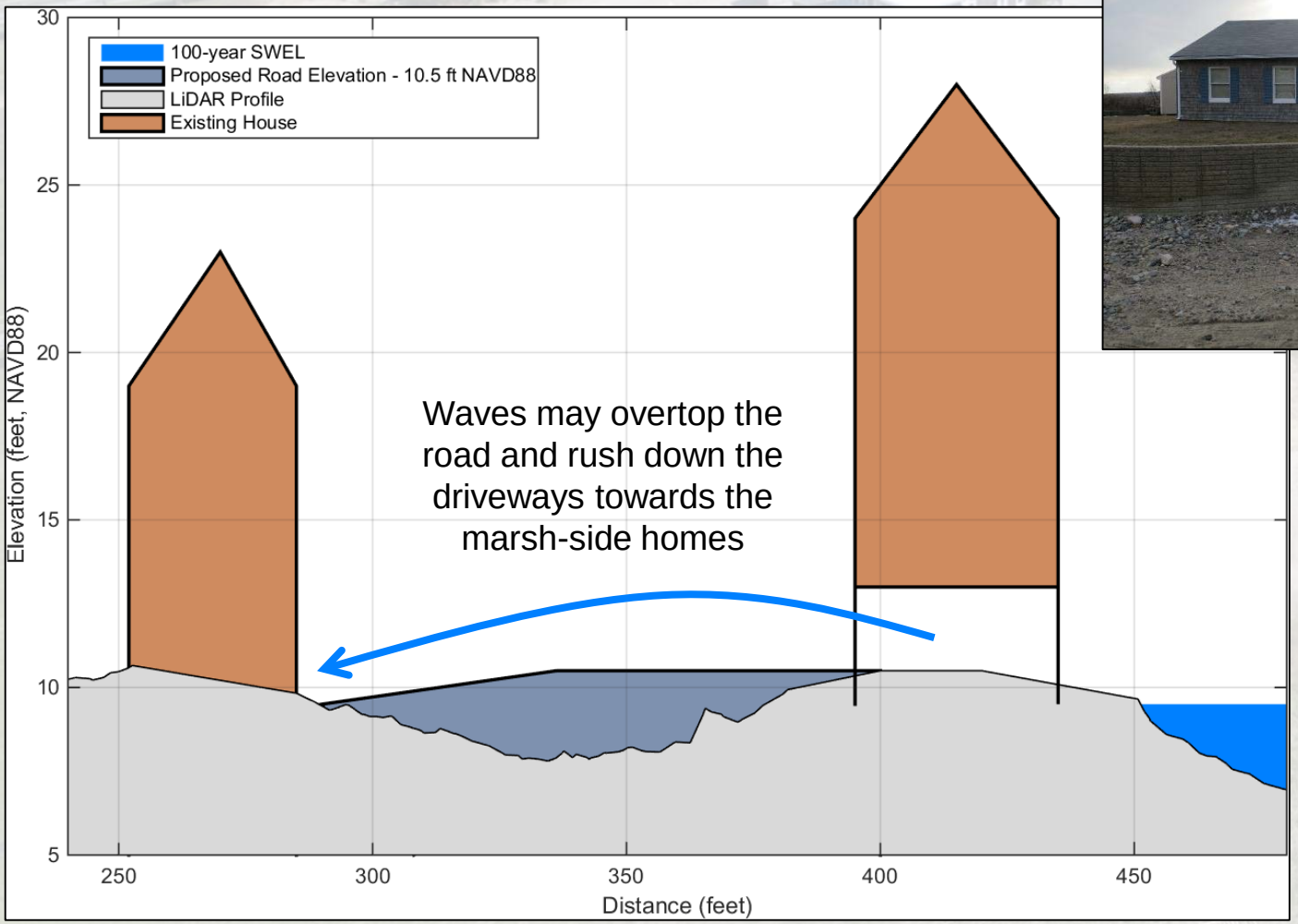
Homes on the ocean side (east side of Central Avenue):

- Generally not an issue unless the new driveway slope is excessively steep (>6%)



Issue #2: New Driveways Sloping towards Homes

Homes on the river side (west side of Central Avenue):



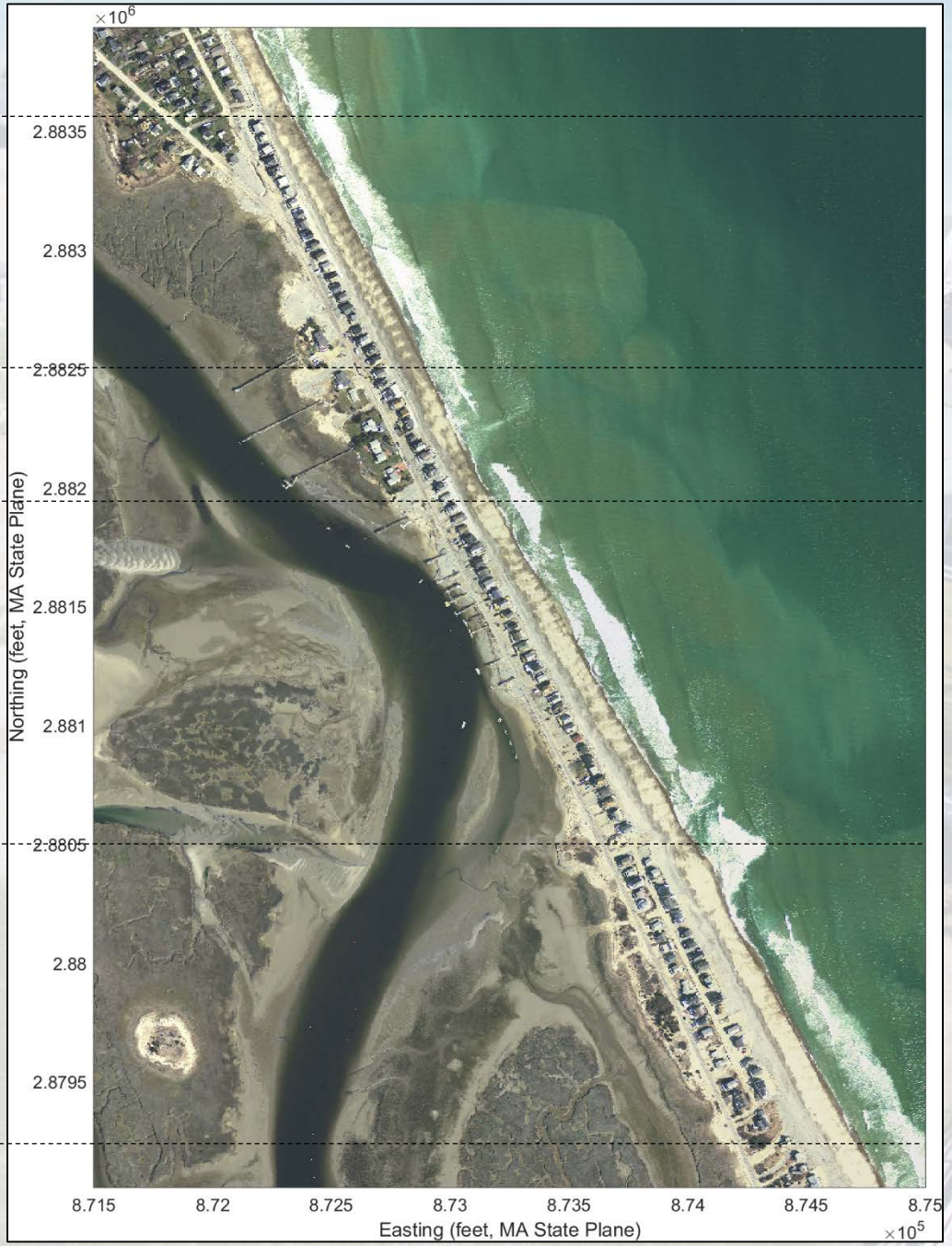
Raise Road Elevation

Mostly elevated homes
10 Cliff Road South to 266 Central Ave

Homes on both sides of the road
265 Central Ave to 238 Central Ave

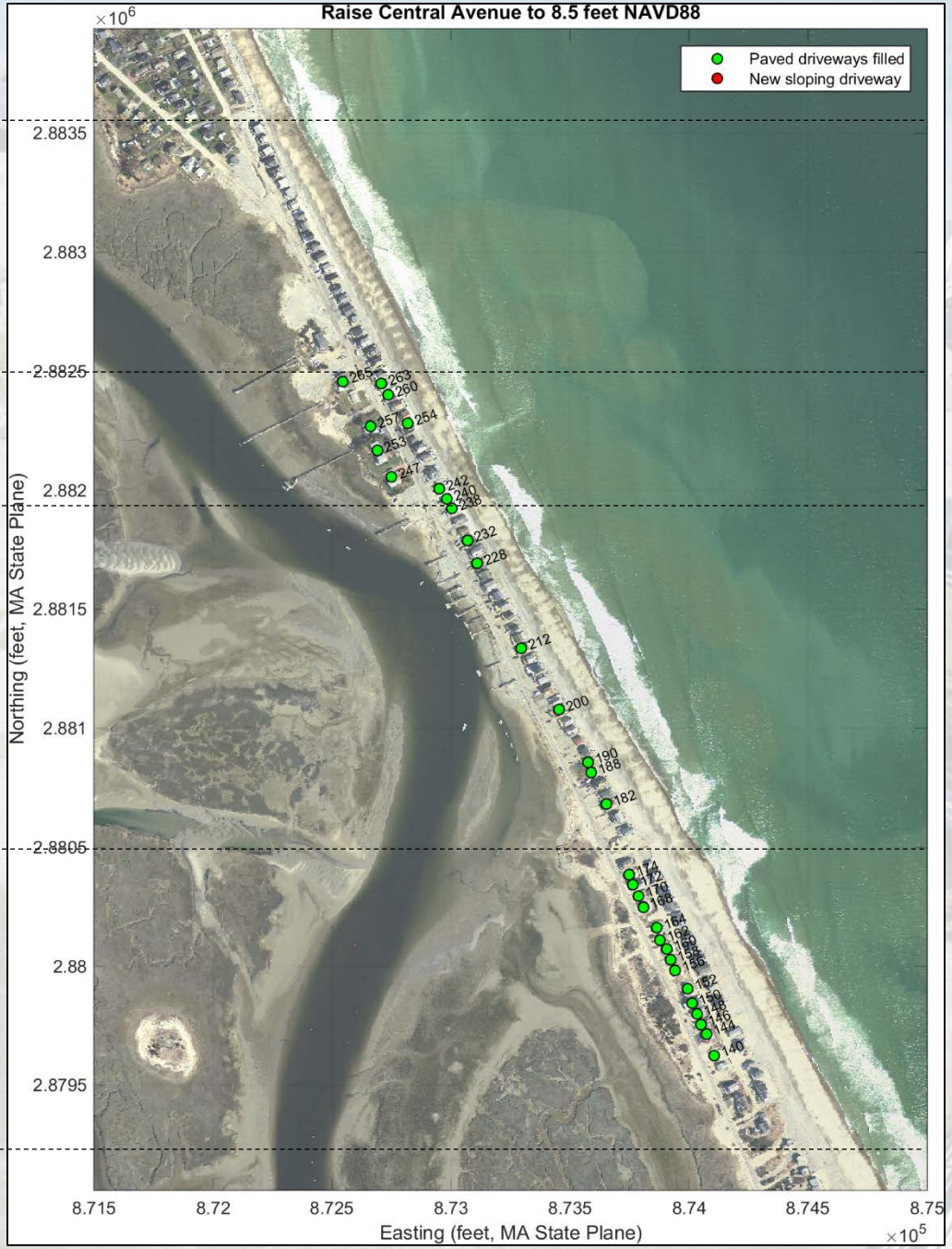
Mix of elevated and non-elevated homes
236 Central Ave to 178 Central Ave

Mix of elevated and non-elevated homes that are set close to road
176 Central Ave to 128 Central Ave



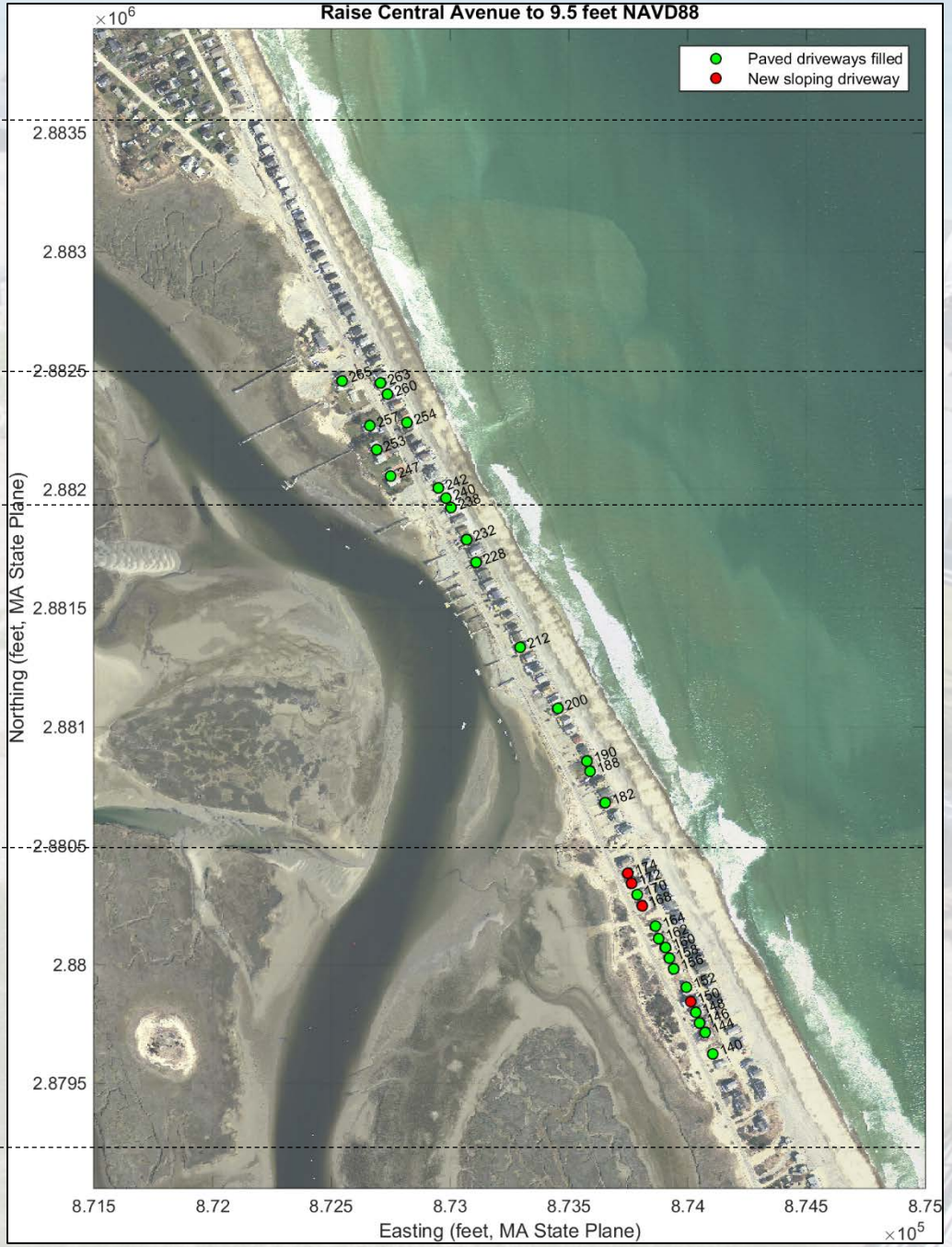
Raise Road to 8.5 feet NAVD88

Homes Affected	
0	No issues
10	Paved driveways filled
7	Paved driveways filled
15	Paved driveways filled



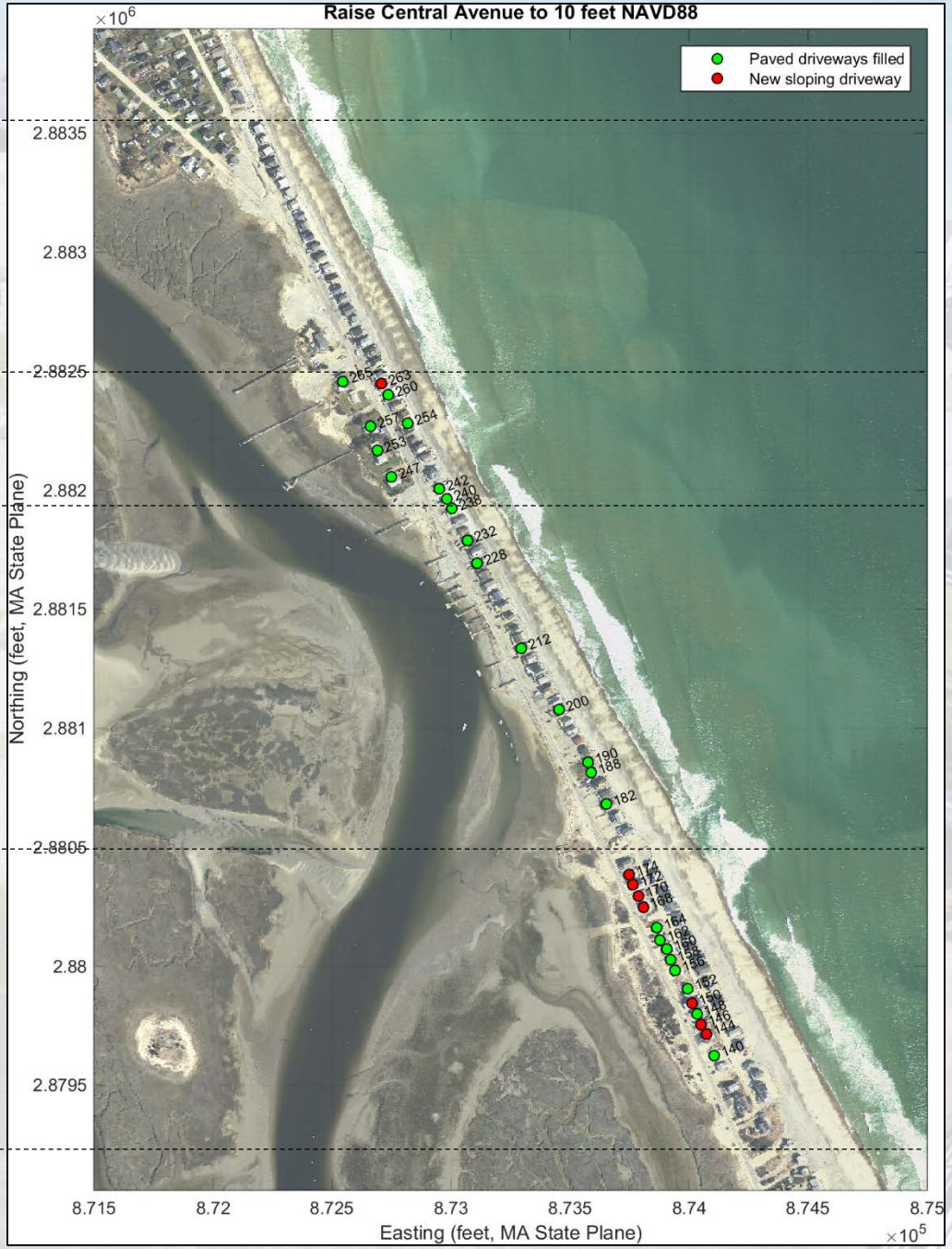
Raise Road to 9.5 feet NAVD88

Homes Affected	
0	No issues
10	Paved driveways filled
7	Paved driveways filled
15	Paved driveways filled Steep sloping driveways



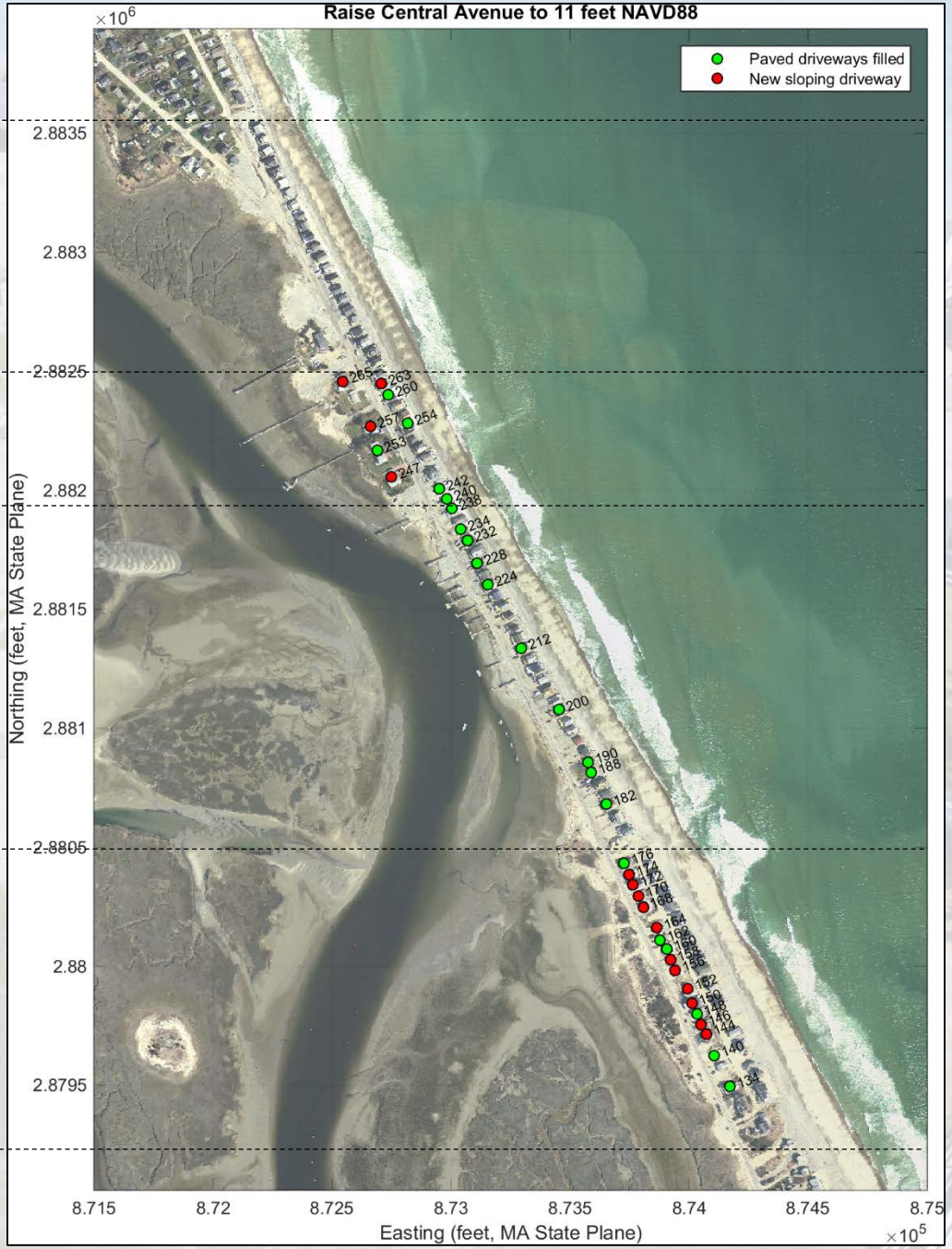
Raise Road to 10 feet NAVD88

Homes Affected	
0	No issues
10	Paved driveways filled Steep sloping driveways
7	Paved driveways filled
15	Paved driveways filled Steep sloping driveways

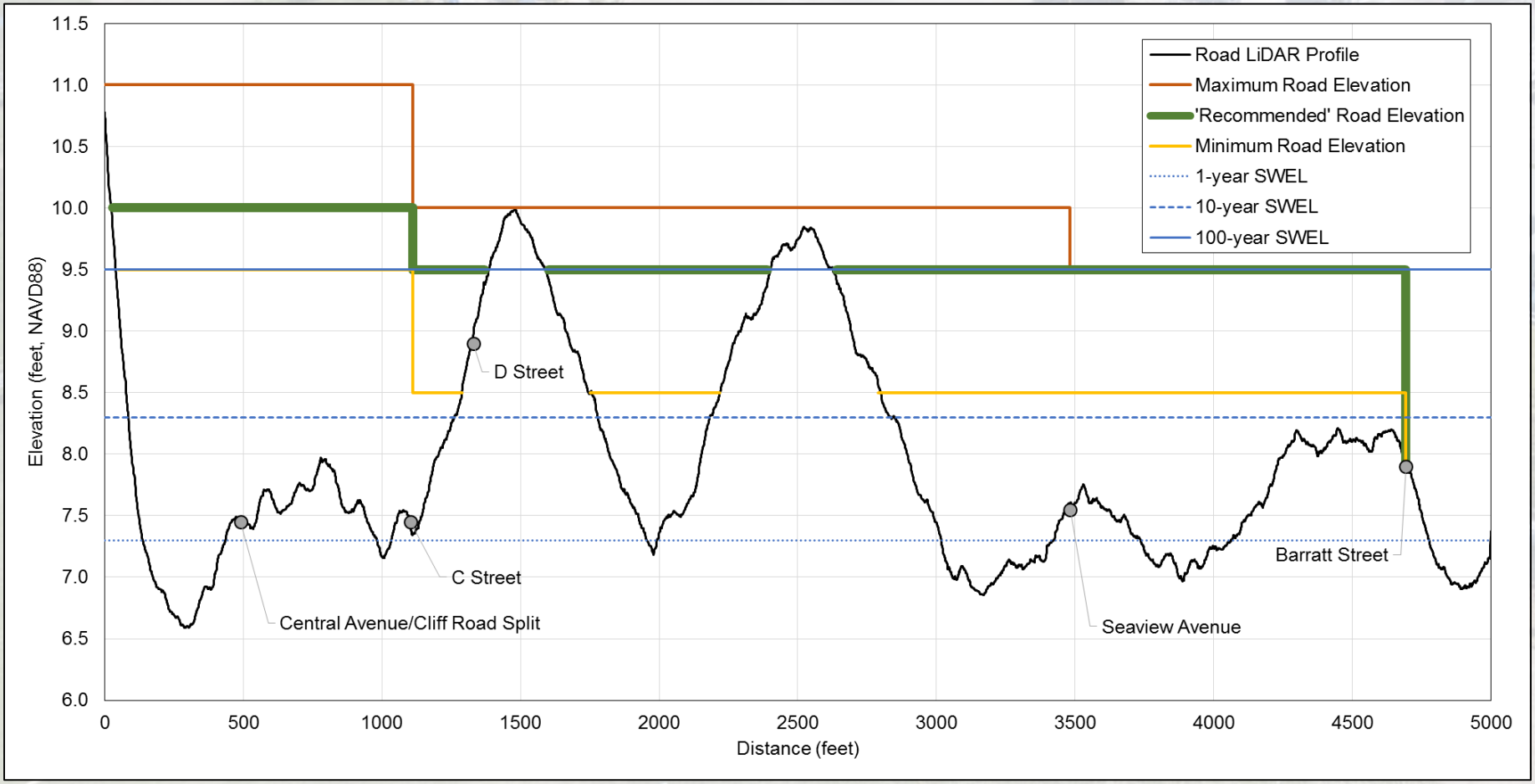


Raise Road to 11 feet NAVD88

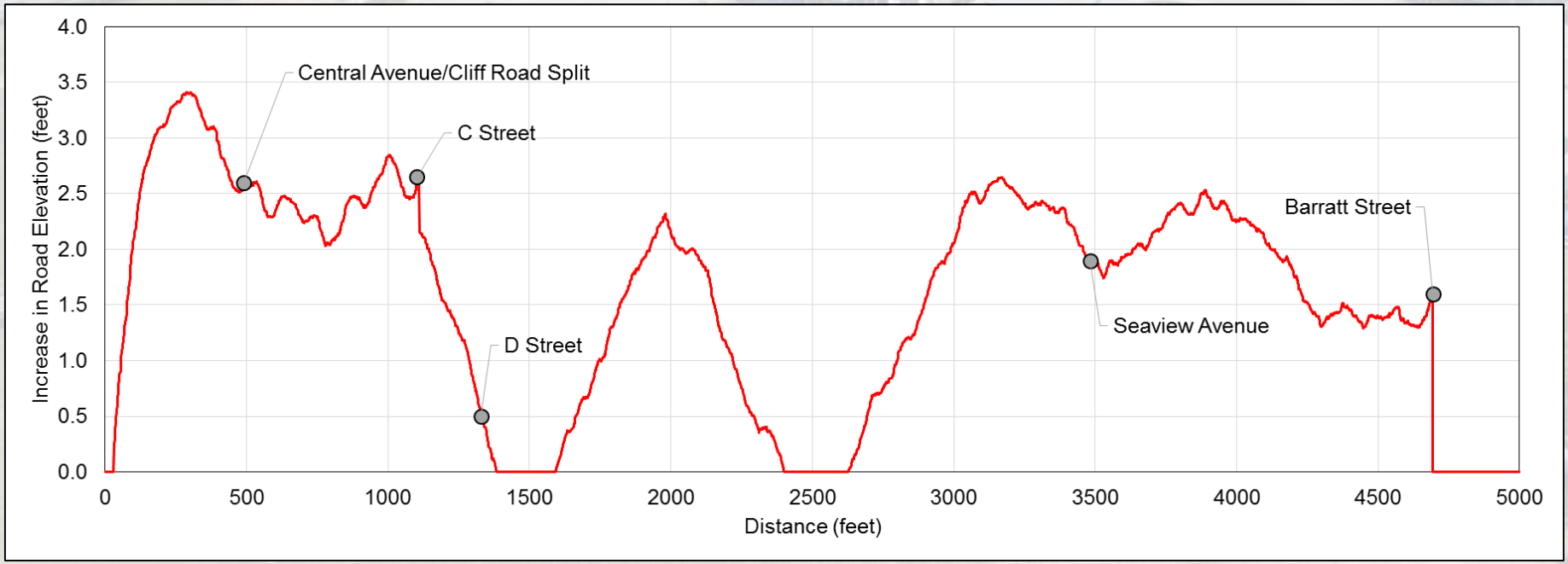
Homes Affected	
0	No issues
10	Paved driveways filled Sloping driveways towards homes
9	Paved driveways filled Steep sloping driveways
17	Paved driveways filled Steep sloping driveways



Proposed Road Elevation



Proposed Road Elevation Increase



Summary: Elevate Central Avenue

Elevating Central Avenue is recommended to maintain emergency egress during still water flooding events. Because portions of the existing road are extremely low, the maximum proposed elevation is recommended to compensate for future sea level rise. At a minimum, the road should be elevated above the existing 10-year still water elevation (8.3 feet NAVD88).

Cost estimate to be determined during conceptual design.

Next Steps

- A **conceptual design** will be developed for constructed dunes and elevating Central Avenue
  - Conceptual level plans will be developed as the basis for preliminary discussions with stakeholders, regulatory agencies, and financial considerations
  - The design will include a more detailed breakdown of project costs
  - **Mid-May 2017**

- **Public presentation** to present the conceptual design efforts
  - An educational pamphlet will be developed to highlight design elements and why they are needed to address long-term sustainability goals for the beach
  - **Early-June 2017**

- **Technical report** that includes a description of the methods, appropriate tables and figures of analysis results, and recommendations for the conceptual design
  - **Mid-June 2017**