Hatch Mott MacDonald

Evaluation of Surf Zone Conditions

For the City of Cape May

Hatch Mott MacDonald

Date

15 December 2015

Evaluation of Surf Zone Conditions

- Outline of presentation:
  - Introduction and Background
  - Wave Assessment
  - Grain Size Evaluation
  - Beach Slope Evaluation
  - Alternatives
    - Numerical Model Results
  - Recommendations

- *Note: The information in this presentation is strictly engineering based, with no implied or actual health/medical recommendations.*

Cape May, Looking South

Source: USACE

Gurney Avenue, Cape May

Source: USACE

Philadelphia Avenue, Cape May

Source: USACE

Baltimore Avenue, Cape May

Source: USACE

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Cape May's Beaches

- USCG Station
  - Cape May Inlet Jetty
  - Buffalo Ave./Yeaton Road

- Cape May
  - Cape May Beach Club
  - Third Avenue groin

Change in Beach Fill Templates

- **OLD Design: Federal Project** (per Phase II GDM, 1983)
- Design Berm Elevation: **8.0 ft NGVD 29**
- Design Berm Slope: **1V:25H**
- Design Berm Width: **25 -130 ft.**
- Nourishment interval: **2 years**

- **CURRENT Design: Federal Project** (per USACE FY 09 Monitoring Report)
- Design Berm Elevation: **6.7 ft NAVD 88**
- Design Berm Slope: **1V:10H**
- Design Beach Width (Design Baseline to MLW (-2.8 ft NAVD 88)): **268 ft.**
- Nourishment interval: **2 years**

Historical Sediment Samples

- Earliest known publically available data for NJ from the McMaster (1954) report

Sediment Results from McMaster (1954)			
Sample Number	**Location**	**Position on Beach**	**Median Grain Size**
127	0.17 miles south of harbour jetty, Sewell Pt. Cape May	Berm crest	0.130 mm
128 (compare to CRC #108)	0.31 miles north of Wilmington Ave., Cape May	20 ft below berm crest on 6° slope (1V:9.5H)	0.357 mm
129 (compare to CRC #107)	0.28 miles north of Madison Ave., Cape May	Beach controlled by seawall. 15 ft from wall on 3° slope (1V:18H)	0.157 mm
130	Perry Street, Cape May	15 ft below berm crest on 6° slope (1V:9.5H)	0.182 mm

Historical Sediment Samples

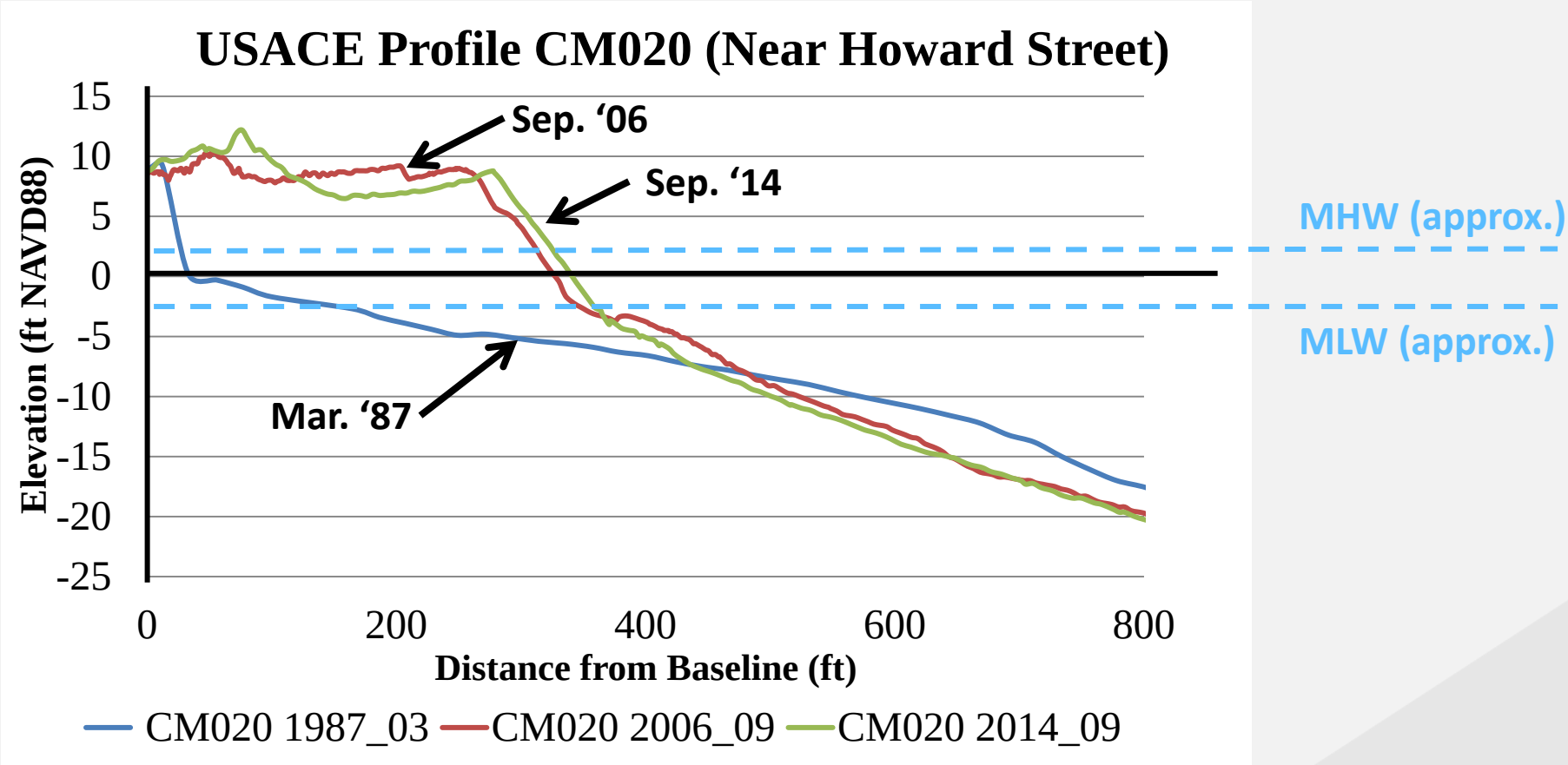
Sediment Results from USACE (1983)			
Sample Number	**Location**	**Position on Beach**	**Median Grain Size**
121	USCG, Sewell Pt. Cape May	Berm High tide Mid tide	0.163 mm 0.139 mm 0.187 mm
122	Baltimore Avenue, Cape May	Mid tide	0.154 mm
123	Municipal Pier, Cape May	High tide Mid tide	0.144 mm 0.132 mm

Recent (Oct. 2015) Sediment Samples

2015 Data Collection by Hatch Mott MacDonald			
Sample Number	**Location**	**Position on Beach**	**Median Grain Size**
108	Cape May Beach Club, Cape May	High tide Mid tide Low tide	0.350 mm 0.450 mm 0.410 mm
107	Baltimore Avenue, Cape May	High tide Mid tide Low tide	0.370 mm 0.470 mm 0.460 mm
206	South Broadway Ave., Cape May	High tide Mid tide Low tide	0.360 mm 0.420 mm 0.430 mm

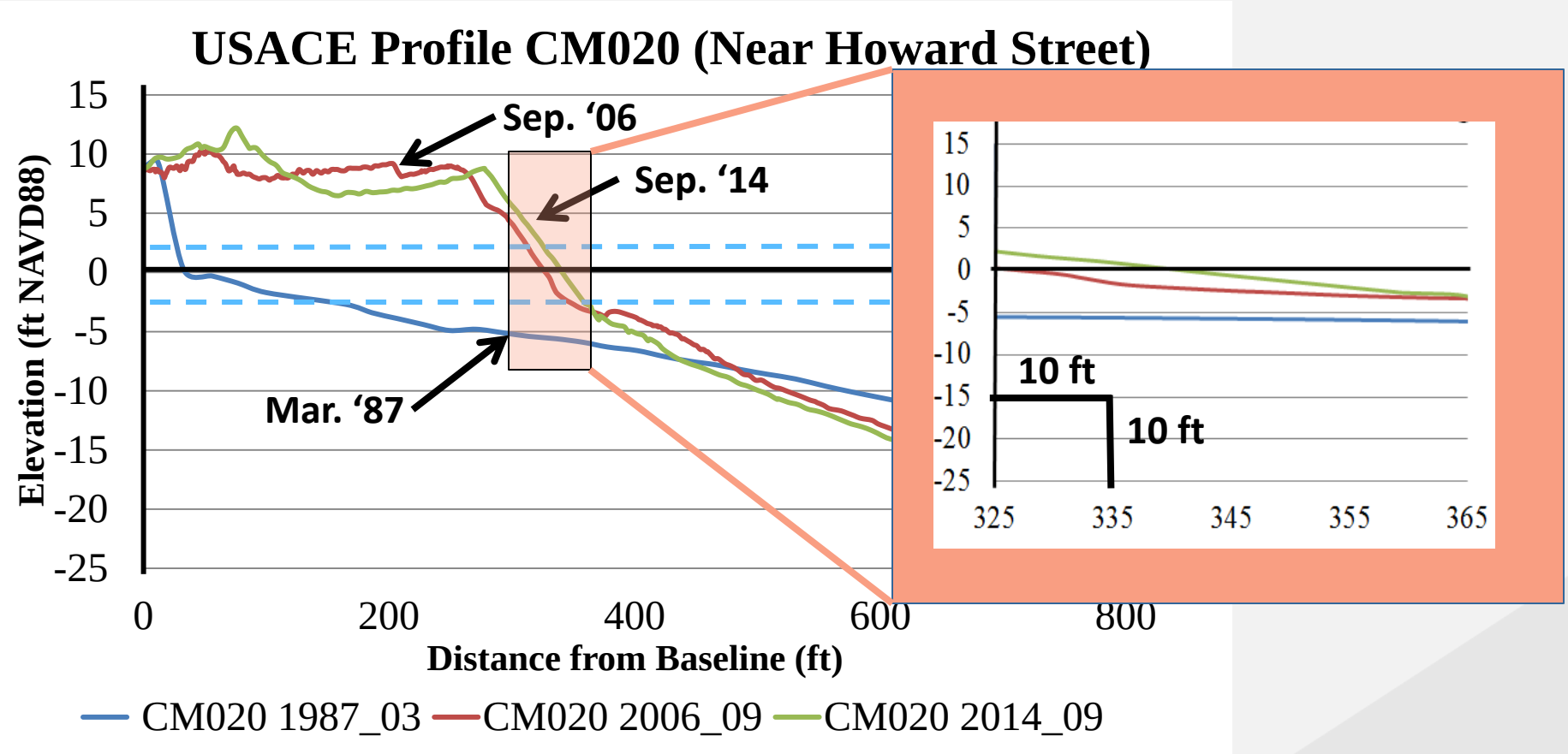
Historical Profile Locations

Howard Street Historical Profiles



- Data from USACE
- Profiles for March 1987 (**blue line**), September 2006 (**red line**), and September 2014 (**green line**)

Howard Street Historical Profiles



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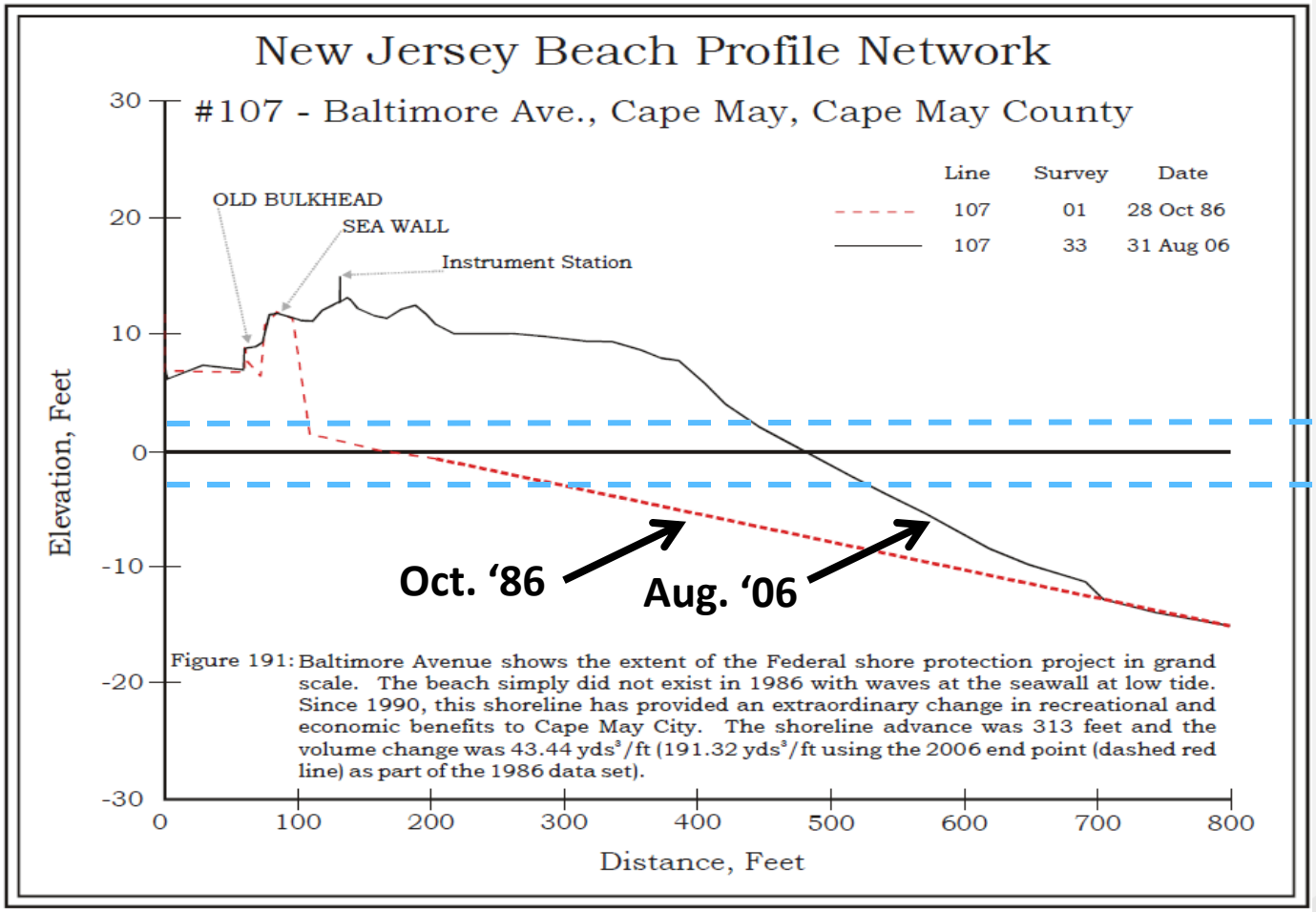
Baltimore Ave. Historical Profiles

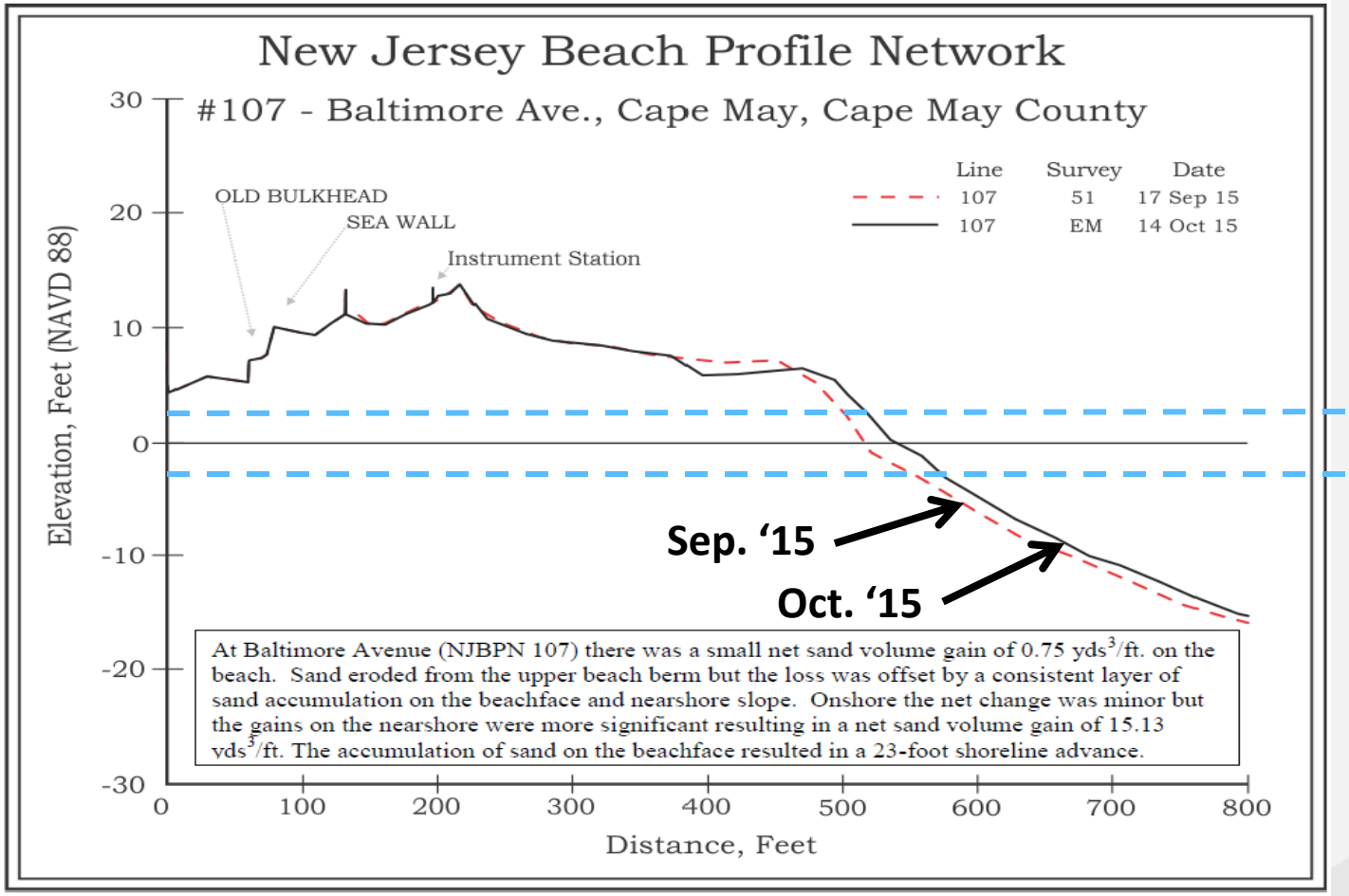


MHW (approx.)

MLW (approx.)

- Data from Stockton University NJ Beach Profile Network database
- Profiles for October 1986 (red dashed line) and August 2006 (black solid line)

Baltimore Ave. Historical Profiles



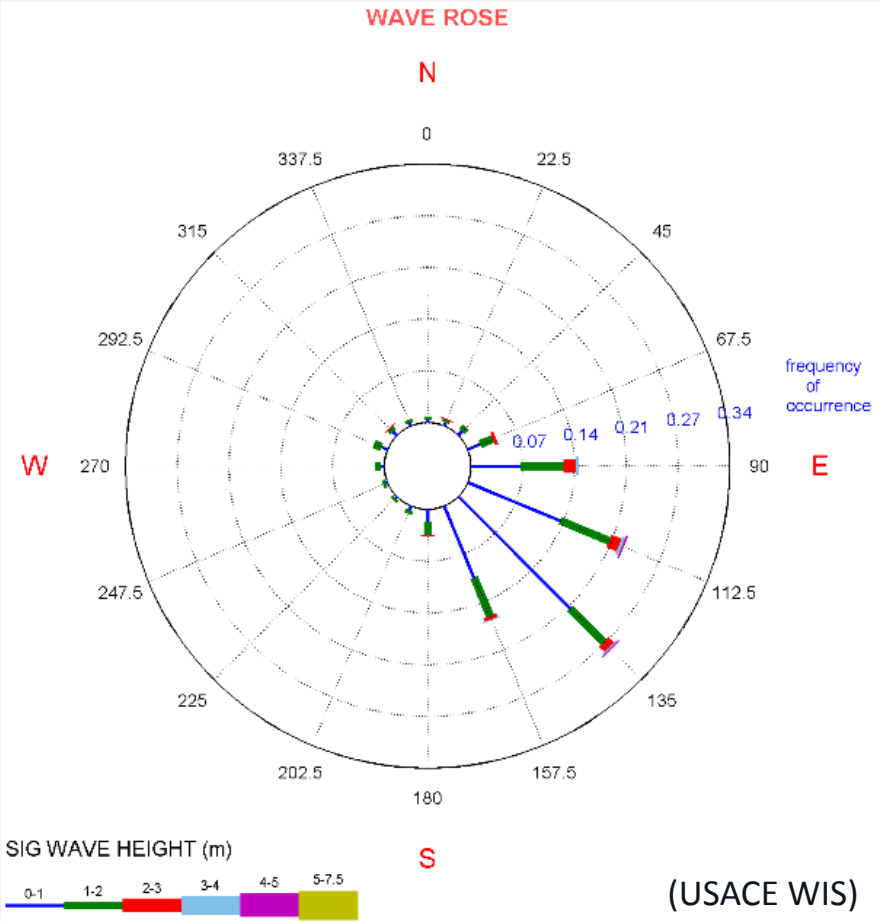
MHW (approx.)

MLW (approx.)

- Data from Stockton University NJ Beach Profile Network database
- Profiles for September 2015 (red dashed line) and October 2015 (black solid line)

Waves

- USACE Wave Information Studies (WIS) Station 63152 Data
- 1980 - 2012



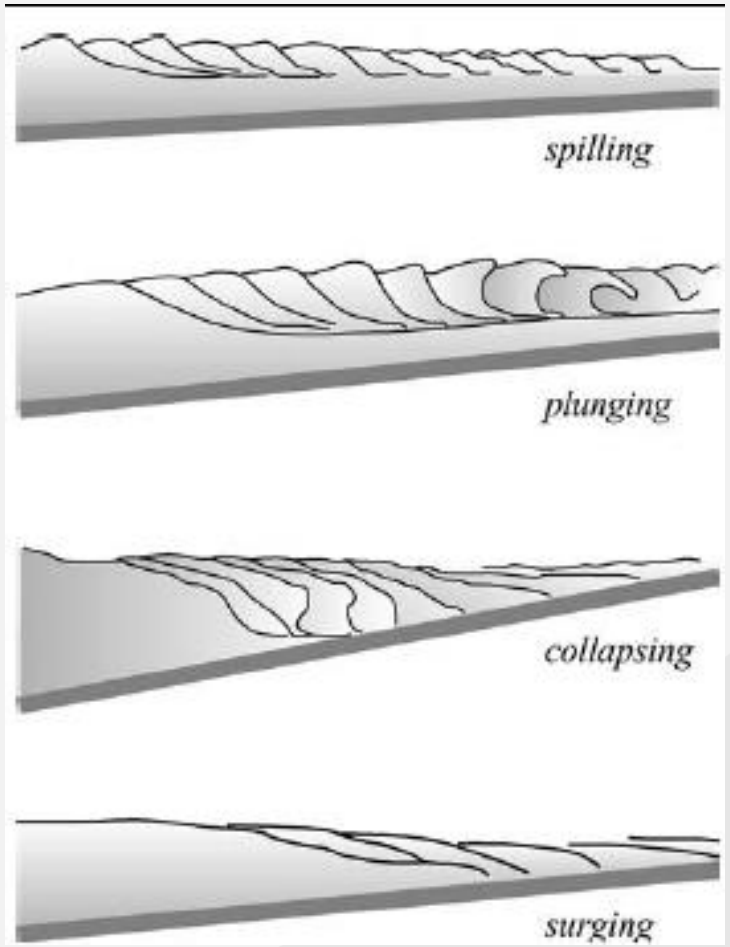
(USACE WIS)

WIS Station No. 63152 Analysis Results for a 2 ft Wave	
Parameter	**Value**
Average Tm for Hmo = 2 ft	6.6 seconds
Average θ for Hmo = 2 ft and Tm = 6.6 ± 0.01 seconds	124º from True North

Howard Street

Wave Breaker Type

- Typical wave beaker types:
  - Spilling
  - Plunging
  - Collapsing
  - Surging



Galvin (1968)

Wave Breaker Type

- Wave breaker type can be determined by the Surf Similarity Parameter/Iribarren number, ξ_0 :

$$\xi_0 = \frac{tan\beta}{\sqrt{\frac{H_0}{L_0}}} \qquad \text{(Battjes, 1974)}$$

Where:

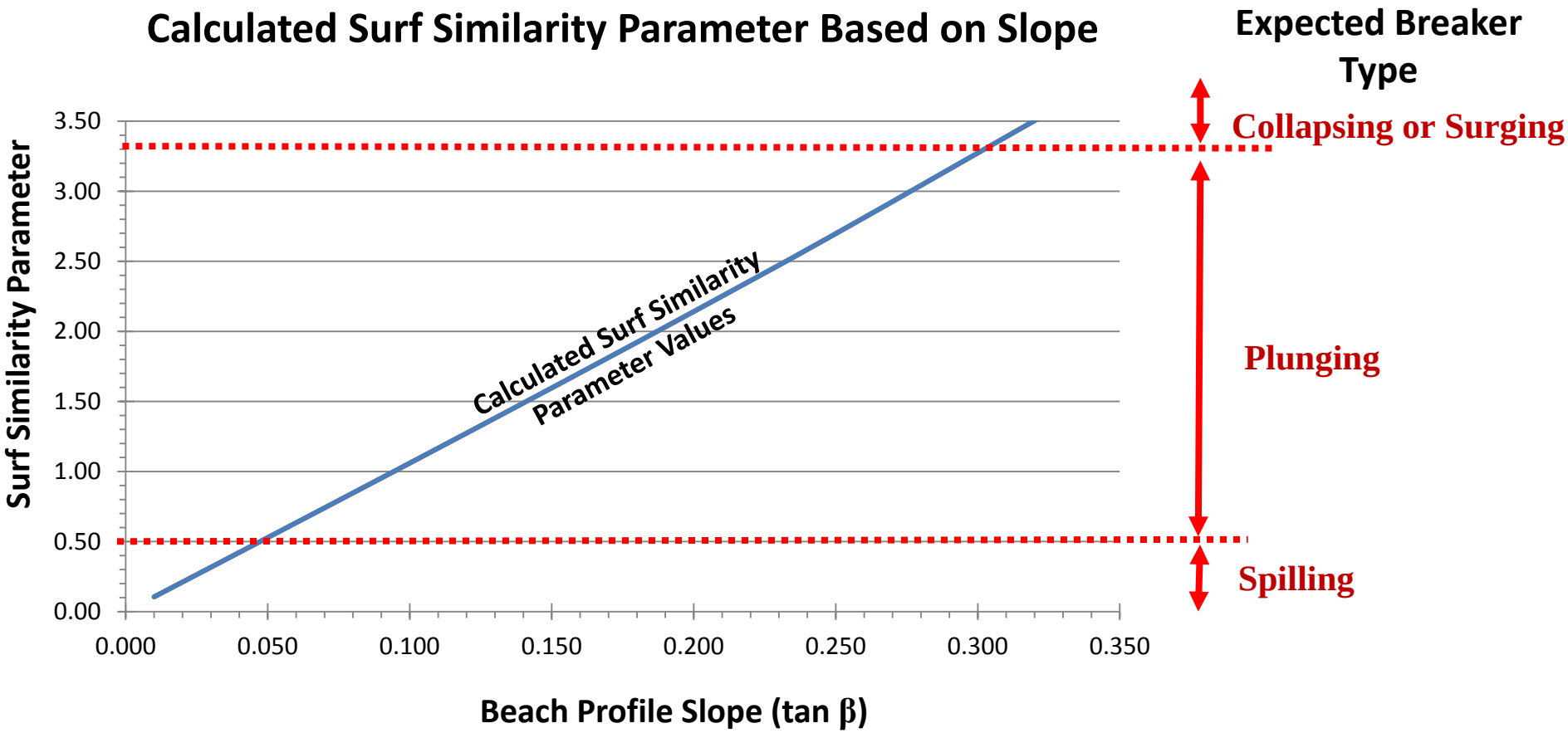
» $tan\beta$ = Slope

» H_0 = Offshore wave height

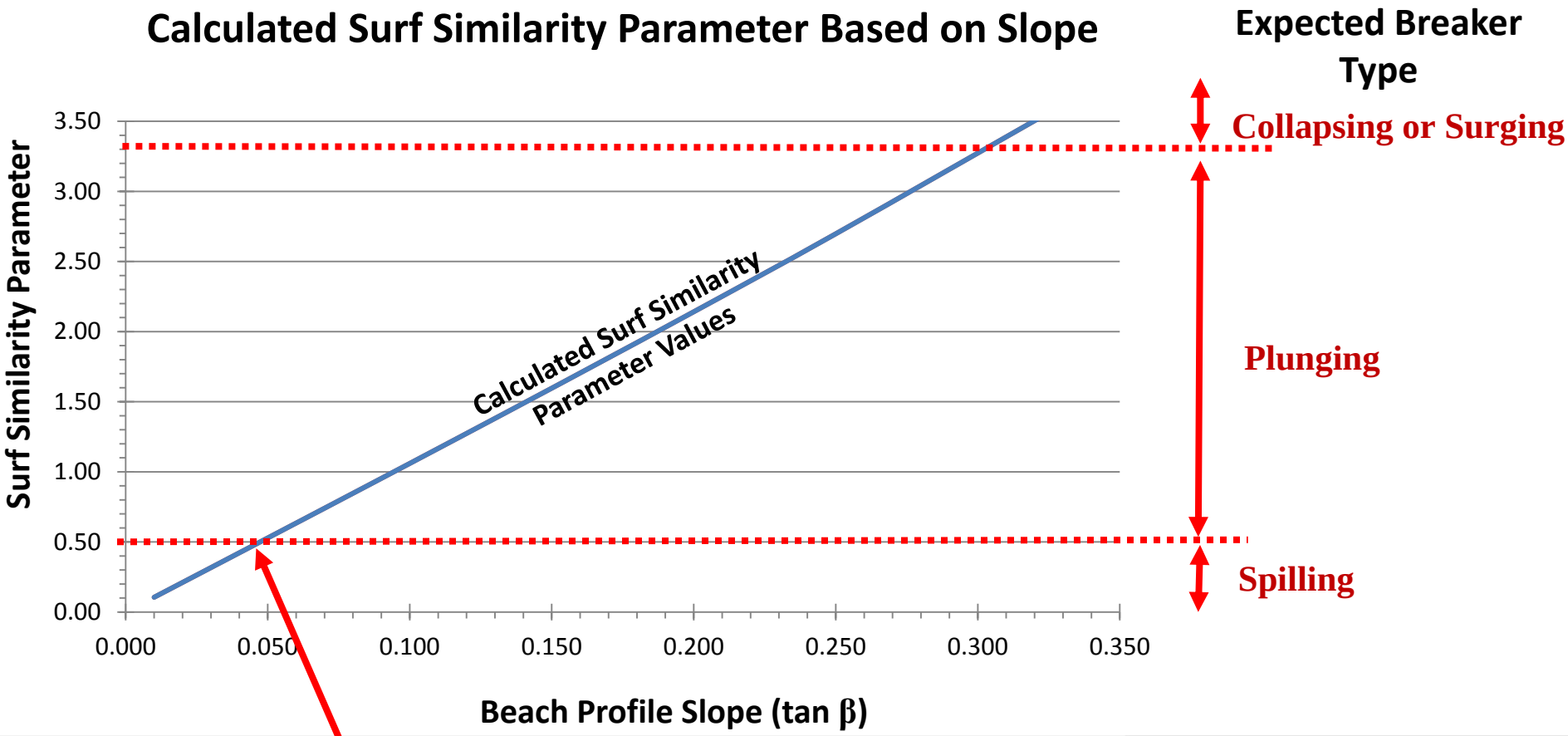
» L_0 = Deep water wavelength

- Wave breaker type range:
  - Collapsing or Surging: $3.3 < \xi_0$
  - Plunging: $0.5 < \xi_0 < 3.3$
  - Spilling: $\xi_0 < 0.5$

Wave Breaker Type



Wave Breaker Type



Change between spilling and plunging breaker type occurs at a 1V:21H slope

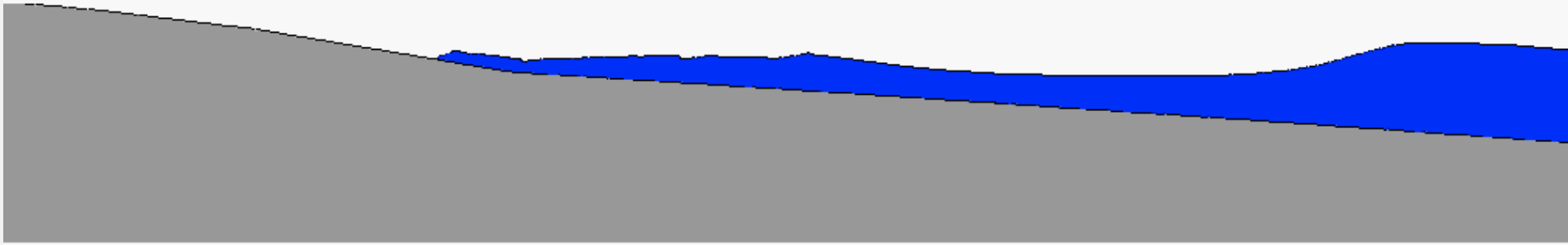
Expected Wave Breaker Types

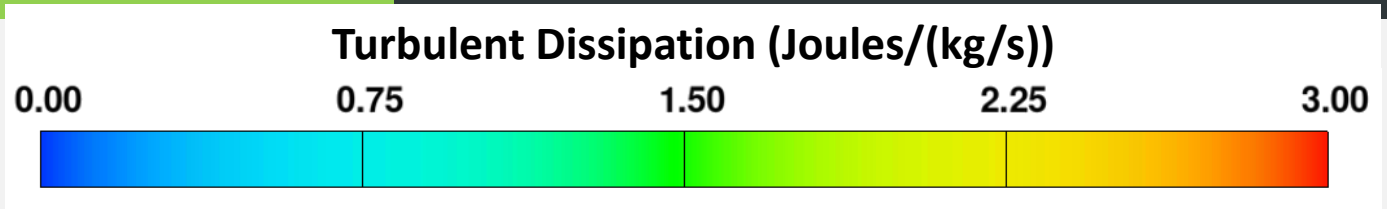
Profile	Slope	Surf Similarity Parameter	Expected Breaker Type
Baltimore Ave. 1986	1V:40.7H	0.26	Spilling
Baltimore Ave. 2015	1V:7.6H	1.40	Plunging
Hypothetical A	1V:10H	1.06	Plunging
Hypothetical B	1V:25H	0.42	Spilling

Wave Model Results

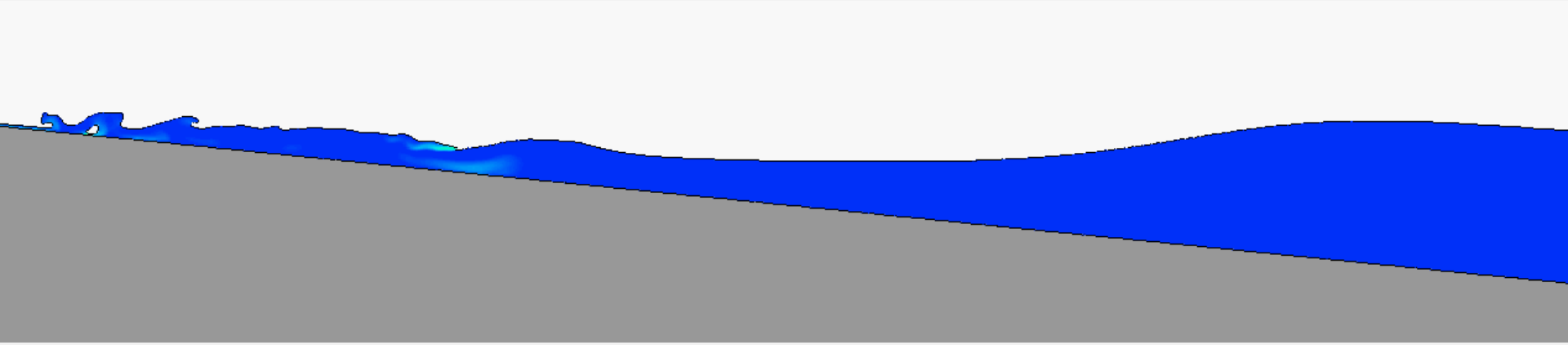
Baltimore Ave. 1986 Profile: 1V:40.7H

Baltimore Ave. 2015 Profile: 1V:7.6H

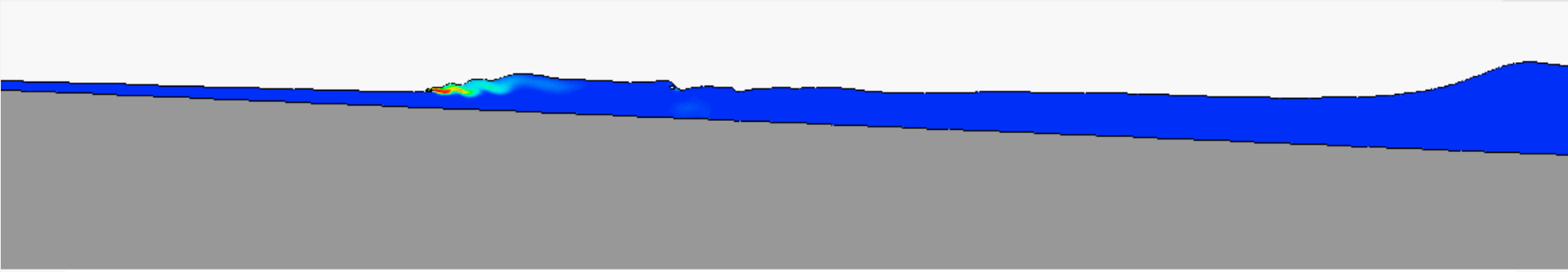




Hypothetical Profile: 1V:10H Slope



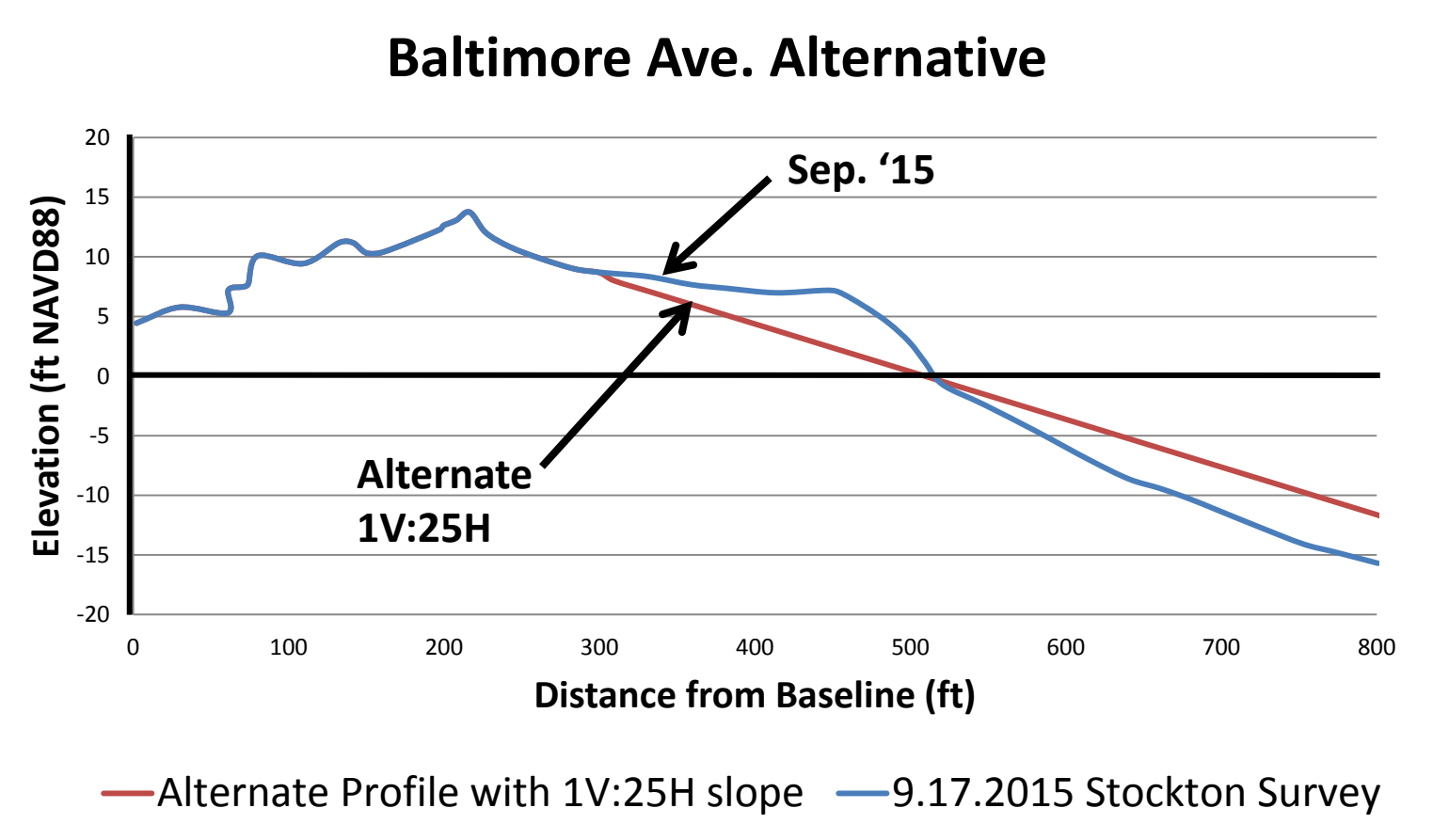
Hypothetical Profile: 1V:25H Slope



- Energy dissipation is more rapid in the plunging wave for 1V:10H than 1V:25H
- Energy dissipation is confined to a smaller region in the plunging wave for 1V:10H than 1V:25H

Alter Beach Slope – Baltimore Avenue

(Initial design investigation)



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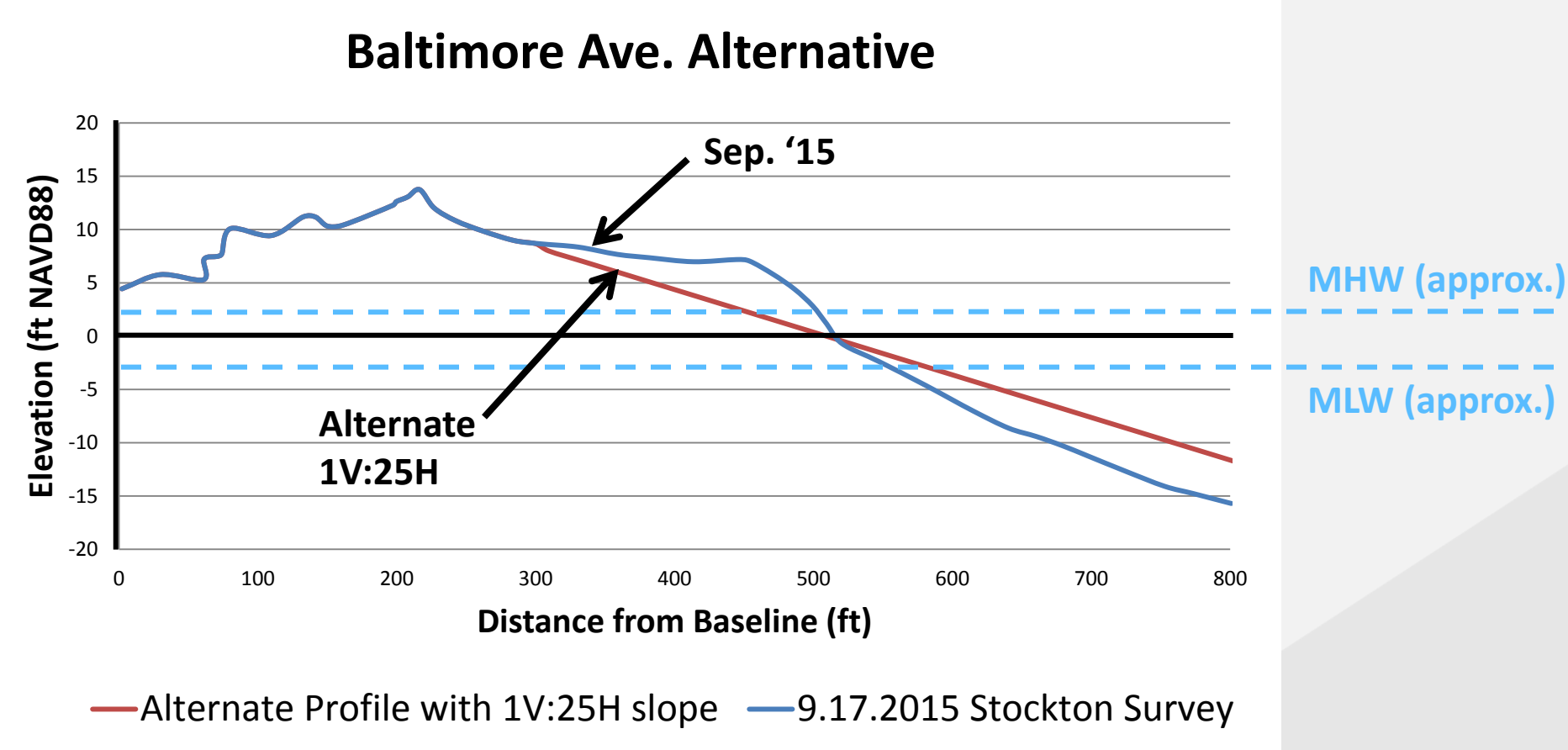

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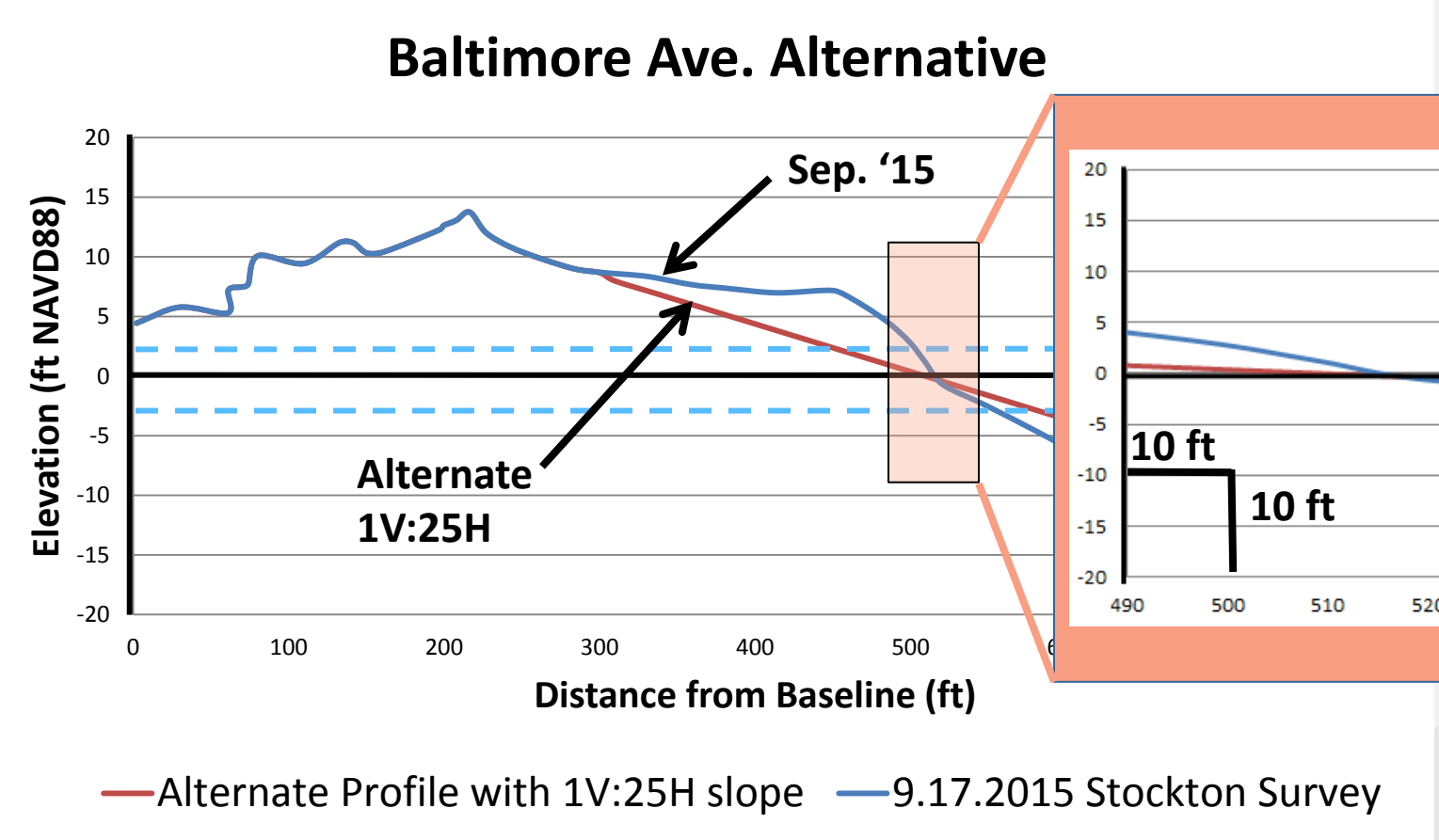
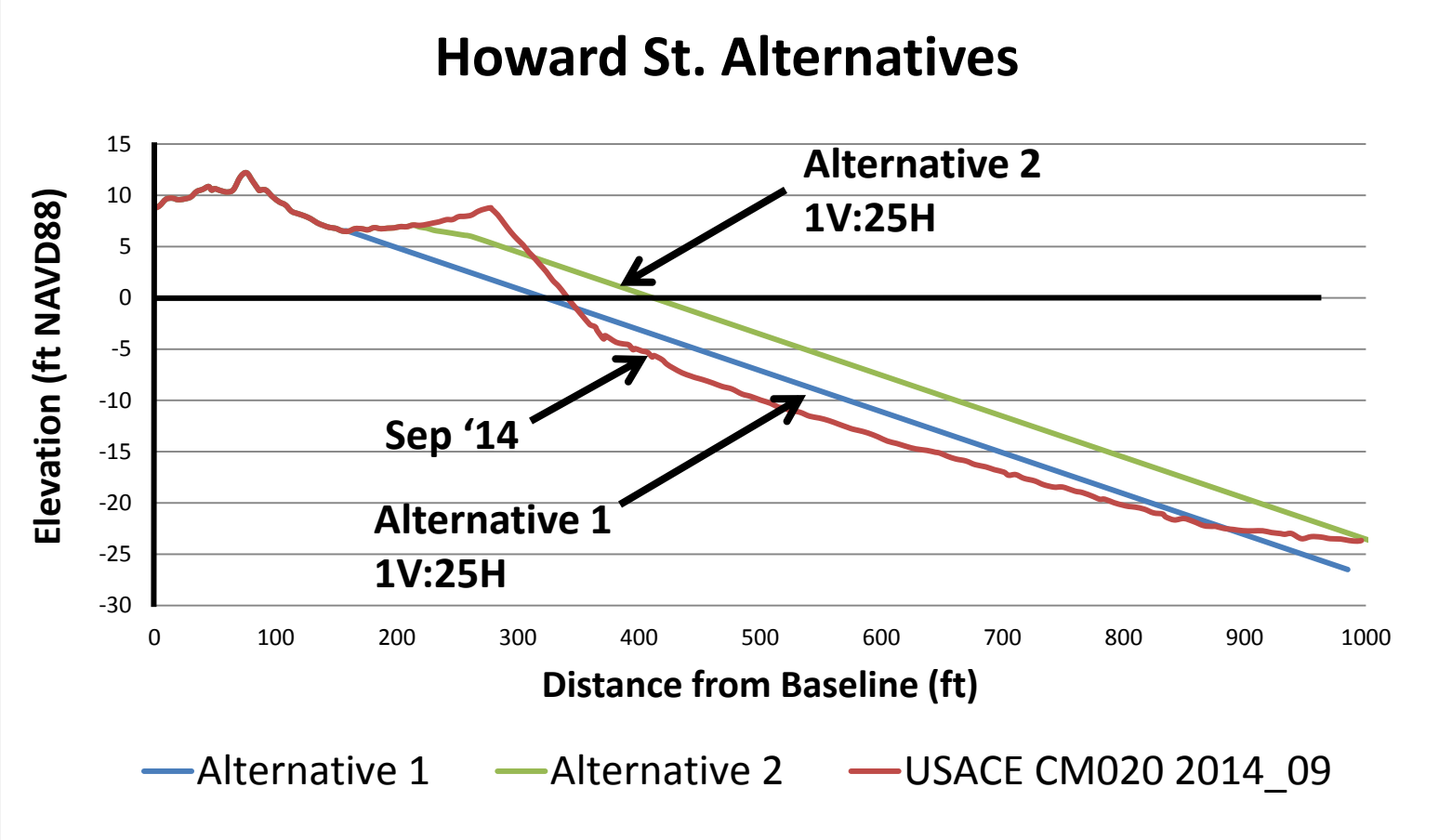


Alter Beach Slope – Howard Street

(Initial design investigation)



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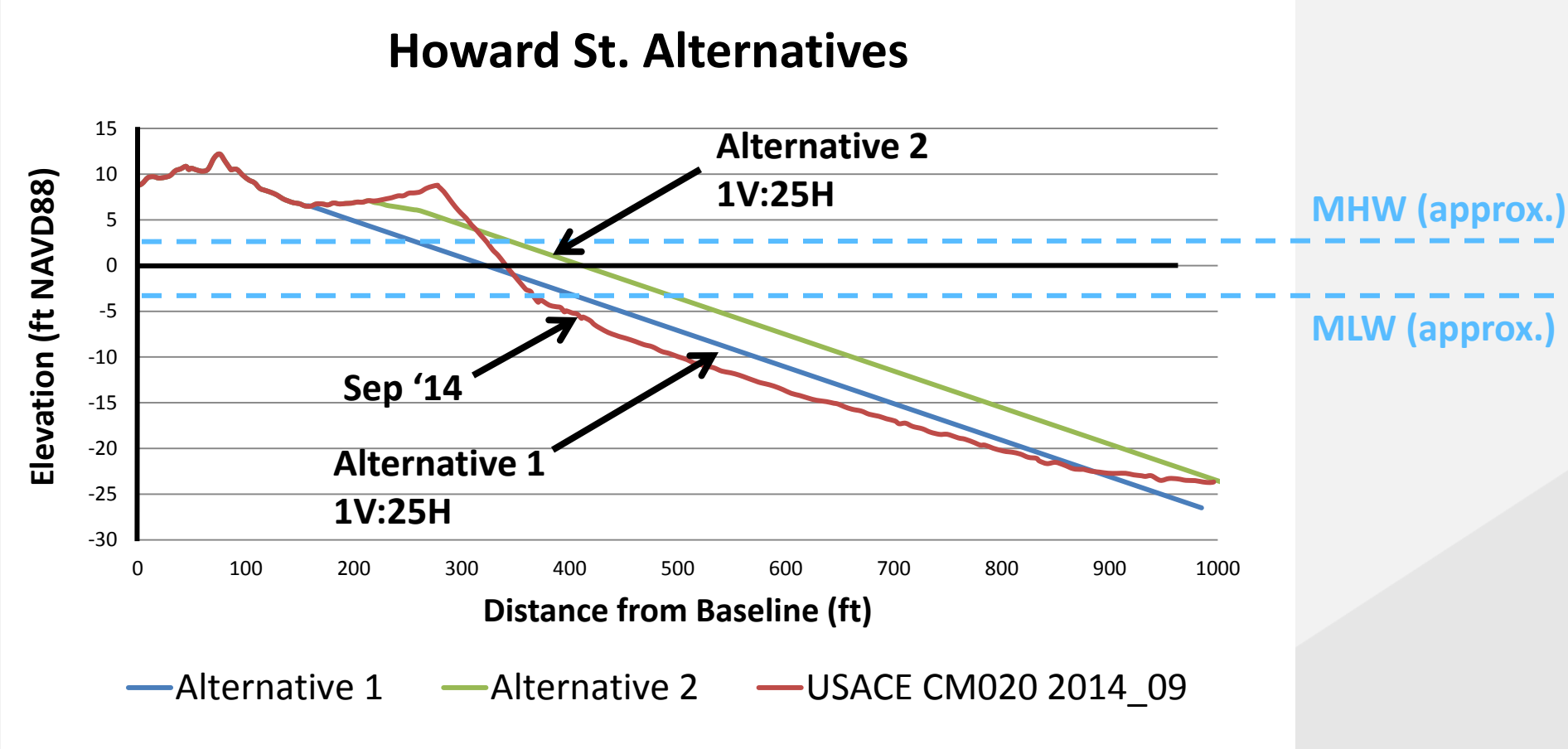

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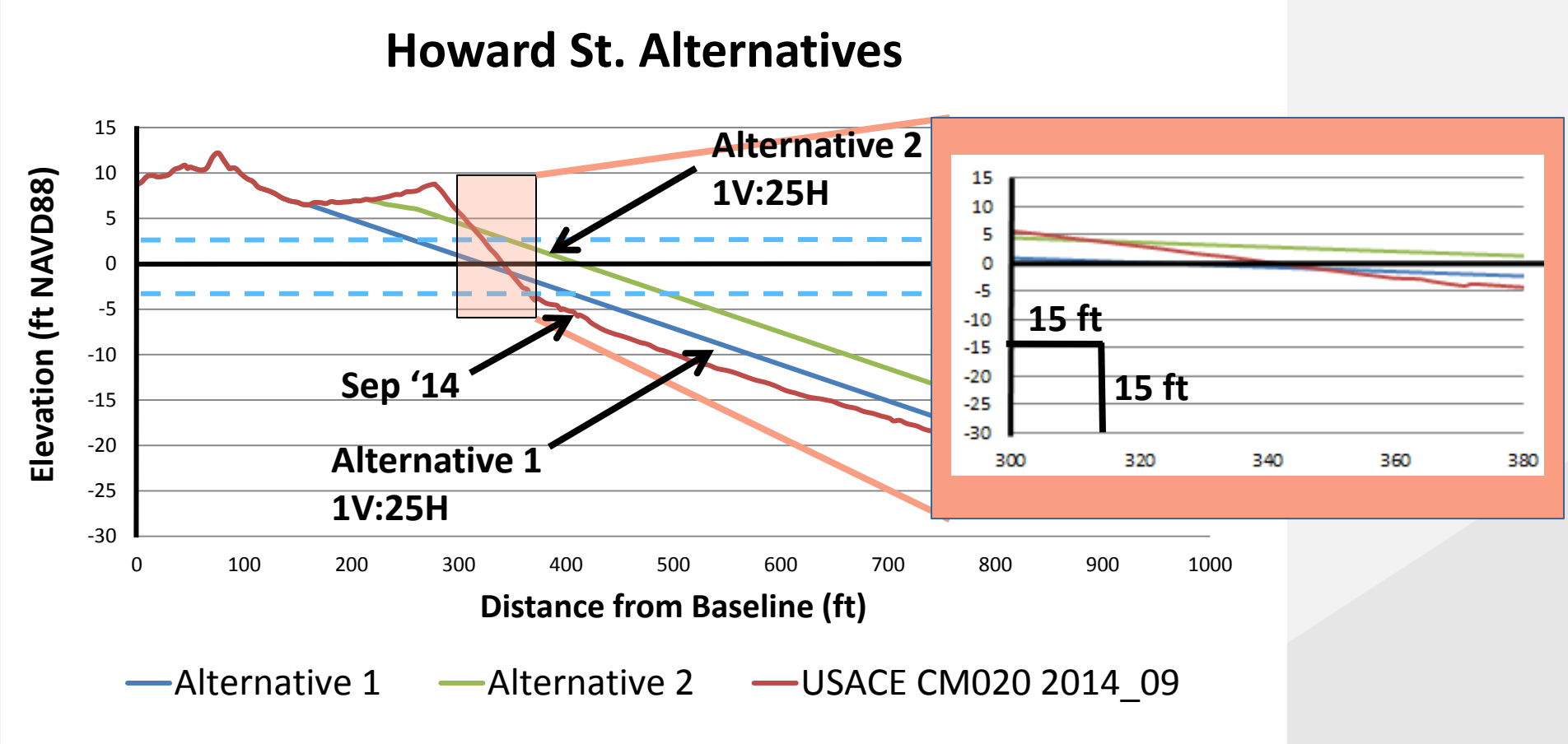


Alter Beach Slope – Initial Quantity Estimates

(Initial design investigation)

- Eastern Section (Yeaton to Philadelphia)
  - Cut 28.5 cy/l.f. from beach face
  - Approximately 154,000 cubic yards
- Western Section (Philadelphia to Third Ave)
  - Alternative 1: Cut 21.0 cy/l.f. from beachface
  - Approximately 168,000 cubic yards
  - Alternative 2: Cut and fill 120 cy/l.f.
  - Approximately 816,000 cy of additional sand needed
  - Extends beyond the end of the groins

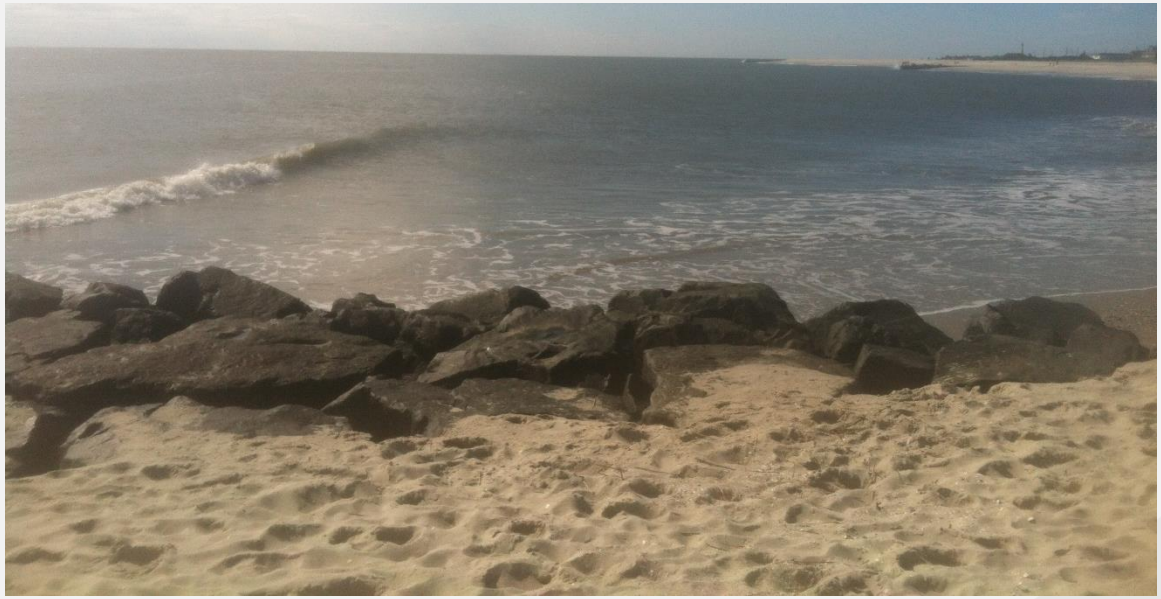
Groins

Location	Inner End El. NAVD	Outer End El. NAVD	Length Feet
Baltimore	7.14	7.14	220
Trenton	7.14	7.14	220
Philadelphia	6.14	4.14	360
Queen	4.14	4.14	572
Gurney	7.14	4.14	425
Jackson	6.84	4.14	650
Grant/Windsor	7.14	4.14	673
Patterson	6.14	4.64	370
Third Ave.	8.14	4.14	786

Groins

(Initial design investigation)

- Grant Avenue Groin is too high and has a large offset to the neighboring beach
  - Reduce elevation to 6.14 ft NAVD 88 and shorten
- Jackson Avenue Groin has a large offset to the neighboring beach
  - Reduce elevation to 6.14 ft NAVD 88 and shorten
- Gurney Avenue Groin is too high, but because it is short, the impact is less
  - No change



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(Initial design investigation)

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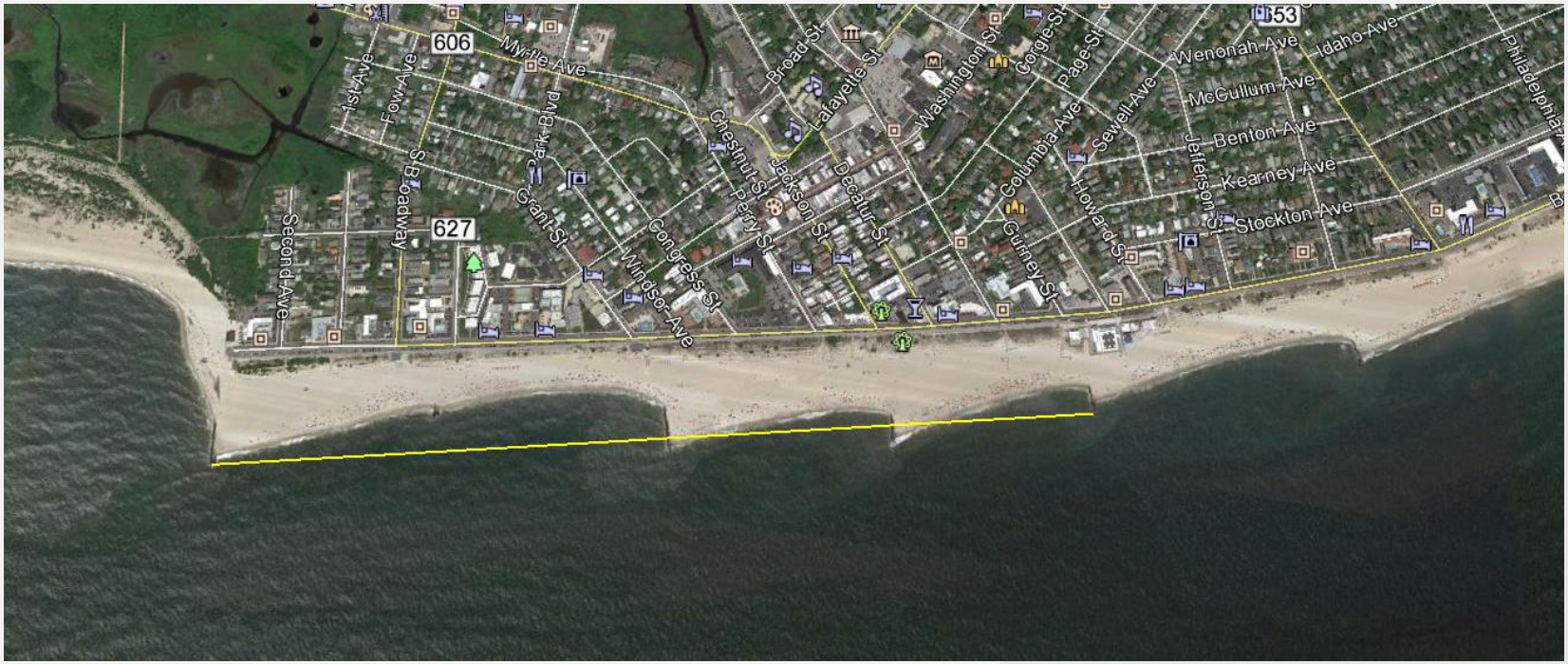


Project Alternatives

- Mechanically alter the foreshore slope
- Alter groins
  - Lower crest height and shorten selected groins
- Decrease the grain size of future corps beachfills
  - Unlikely to have any affect

Federal and State Permits and Authorizations

- **Federal (USACE)**
  - The USACE regulates activities that take place in navigable waters under Section 10 of the Rivers and Harbors Act of 1899. The United States Army Corps of Engineers (USACE) regulates activities that take place in navigable waters under Section 9 and 10 of the Rivers and Harbors Act of 1899 and waters under Section 404 of the Clean Water Act. This Act prohibits the obstruction or alteration of "waters of the US" without a permit from the Corps of Engineers. Proposed beach grading activities that will take place below the high tide line will require authorization by a USACE Individual Permit.
  - The Cape May beach is an USACE engineered beach therefore beach activities that may take place in support of the Surf Zone Study will require authorization to alter a USACE Civil Works Project pursuant to 33 USC 408.

Federal and State Permits and Authorizations

- **State (NJDEP)**
  - Under the NJDEP Coastal Zone Management Rules N.J.A.C. 7:7-2.2, a CAFRA permit shall be required for any development in the CAFRA area located on a beach or dune.
  - Under the NJDEP Coastal Zone Management Rules N.J.A.C. 7:7-2.4, a Waterfront Development permit shall be required for any activities in any tidal waterway up to and including the mean high water line.
  - The City of Cape May currently has a valid Coastal Permit for beach and dune maintenance activities. **Specifically, the bulldozing of sand from the upper beach (berm) to the lower beach (beach face), for the purpose of increasing the berm width or flattening the beach profile, is not considered to be routine maintenance and is not authorized by this permit.**

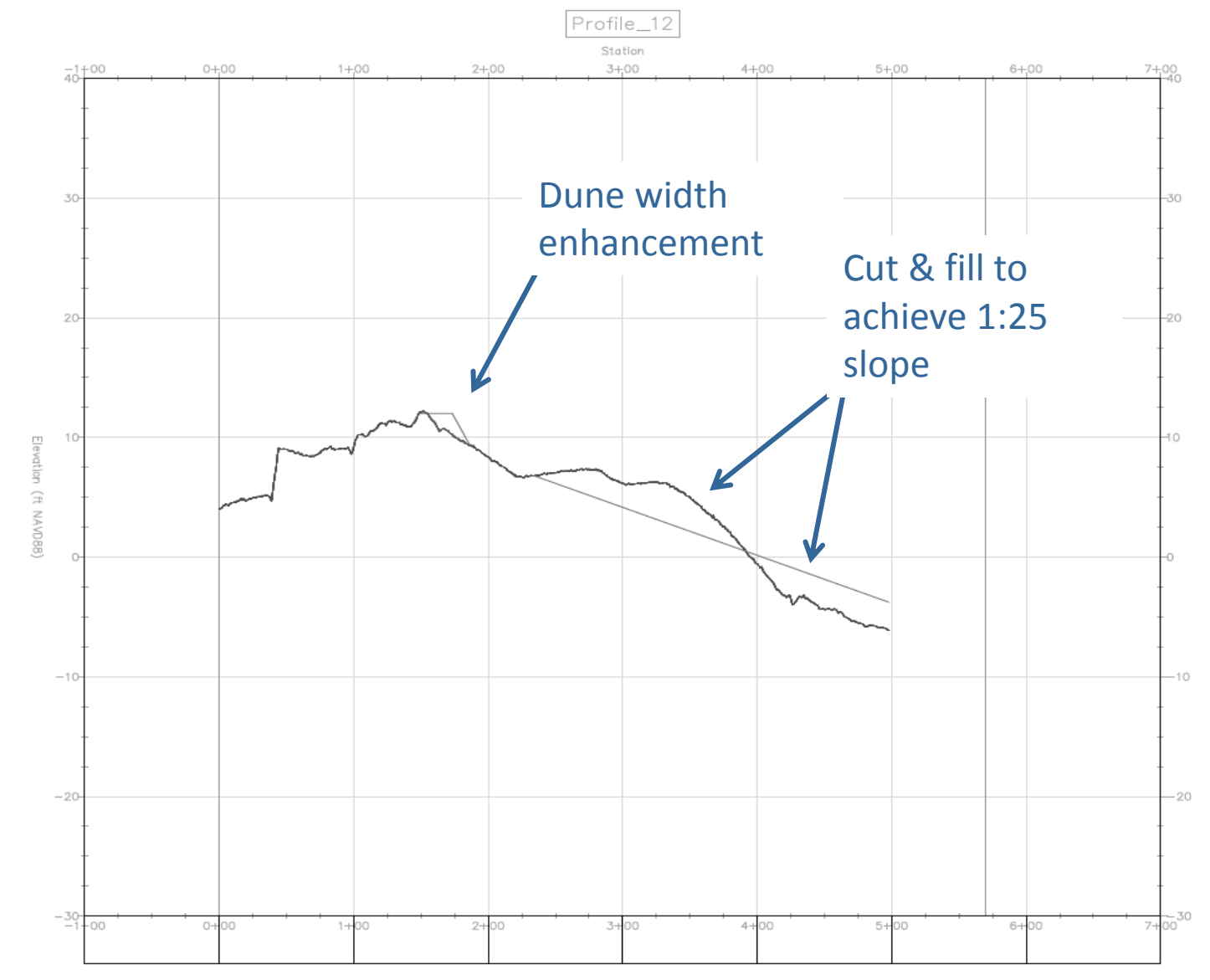
Findings and Recommendations

- City-wide, it is unlikely that the Federal beachfill project has resulted in a steepening of the beach slope in the surf zone
  - There is natural variation and information from 1954 that indicates that approximately 1V:10H in the surf zone may be a natural slope
- Sand grain size has become slightly coarser since the beachfills
  - Altering the grain size currently on the beach is not a realistic option
- Based on previous USACE attempt to alter the slope (2011), changes will not be permanent
  - Therefore, maintaining an unnaturally gentle slope (1V:25H) will likely require maintenance during the course of the summer months
  - Will require permits
  - Alternative 2 (depicted at Howard Street) which requires additional sand is unfeasible from a performance perspective

Findings and Recommendations

- **The Recommended Project is:**
- **Pre-summer only, beach slope adjustment from Queen Street to Grant Street**
  - Sand will be mechanically moved to downdrift sides of groins, into the surf zone, and into dunes where beneficial to provide a uniform 1V:25H slope to MLW.
  - Any excess sand is to be trucked to Wilmington Ave
- **Primary project purpose is to alter the wave breaking from plunging to spilling**
- **Secondary project purpose is to provide increased resiliency to dunes in the areas flooded by Sandy**
- **Recommended for further study:**
  - Altering groins may result in locally gentler slopes (updrift side) and less impact to shoreline, however this option is very expensive and may result in less beach width between Queen Street and Broadway.

Recommended Plan



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Recommended Plan Cost Estimate

Project	Construction Cost	Engineering Cost	Monitoring Cost	Total Cost
Base Project: Queen Street to Grant Street	$700,000	$100,000	$50,000	$850,000
Expanded Project: 375' West of Grant Street and East of Queen Street	$900,000	$105,000	$55,000	$1,060,000

Thank You

For more information, please contact:

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