ICCE2018

Wrightsville Beach Coastal Storm Damage Reduction (CSDR) – Refined Coastal Modeling

Wrightsville Beach, NC

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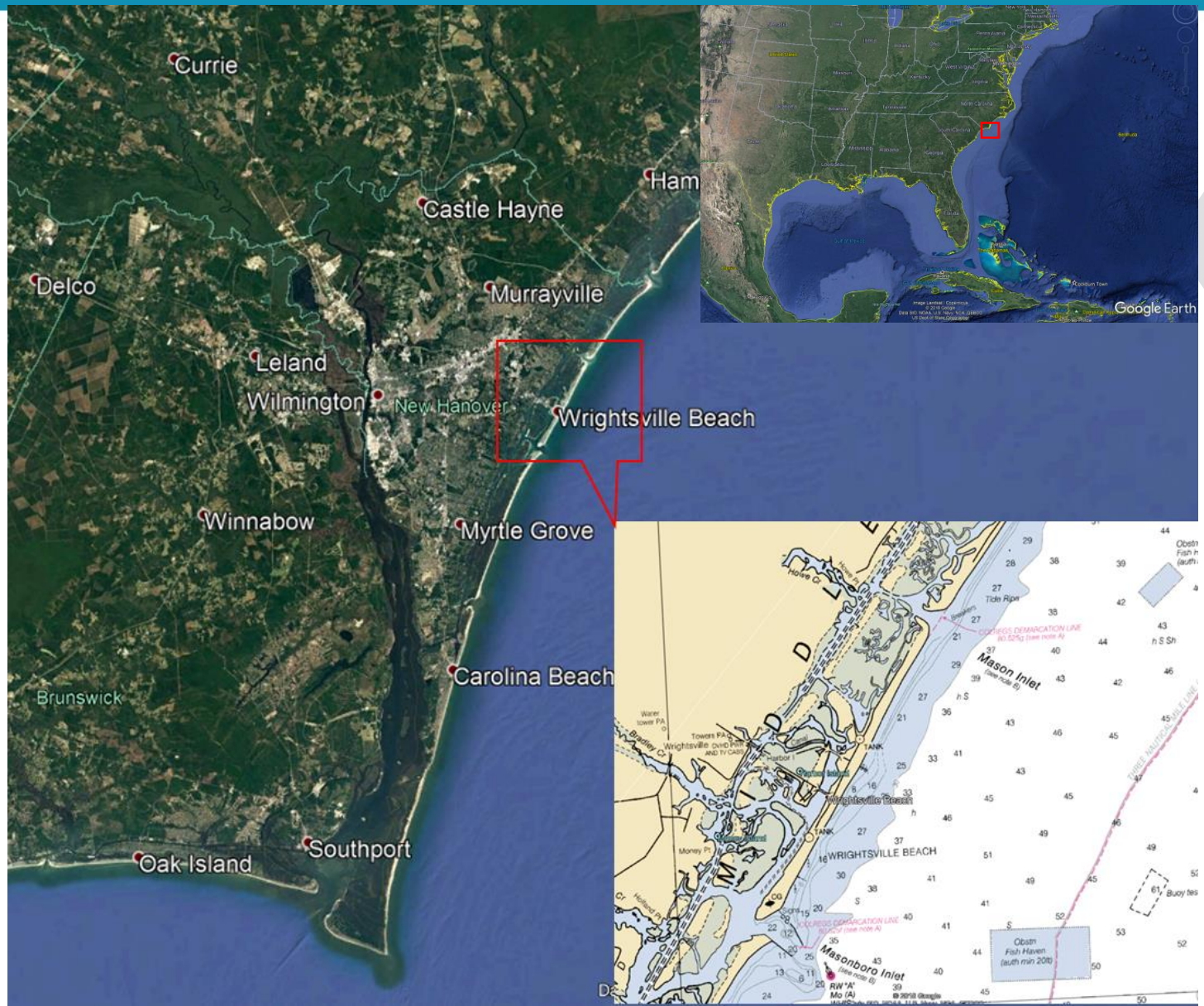
Topics

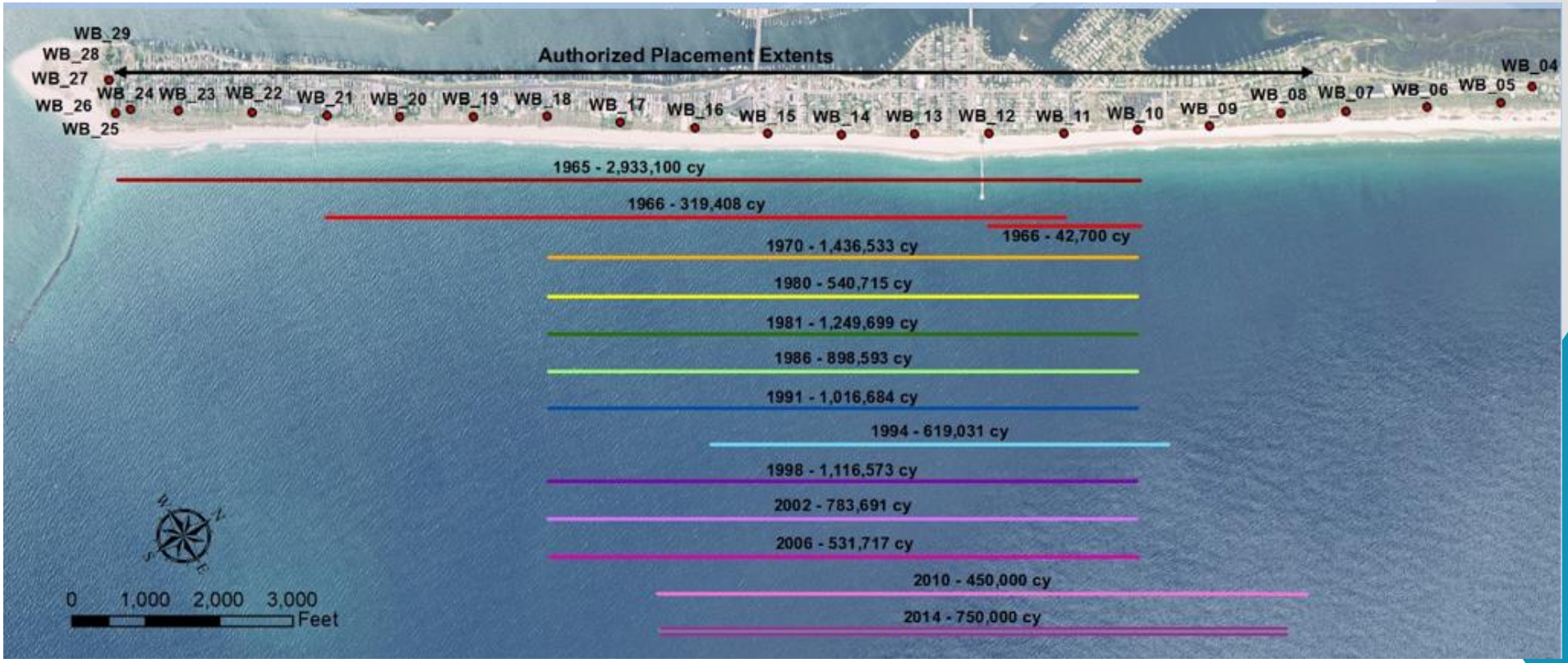
- Introduction
- Model Calibrations
- Alternative Analyses
- Summary and Conclusions

Introduction



Wrightsville Beach CSDR Project History

- **Historical CSDR Material Placement Limits**



Purpose

- Evaluate potential local management strategies for WB CSDR project in case federal participation falters
  - Provides best available estimate on design options & project performance for a locally constructed project
  - Assesses storm level of protection benefits & maintenance frequency
  - Incorporates annual shoreline monitoring data to help evaluate the performance of previous CSDR maintenance events
- Use state-of-art coastal engineering tools to estimate project performance and storm level of protection benefits
  - Delft3d – focuses on sediment transport & morphologic changes influenced by long-term coastal processes
  - GenCade – evaluates shoreline recession & longshore transport based on multi-year wave patterns
  - SBEACH – estimates cross-shore storm induced erosion expected in extreme weather events

MODEL CALIBRATIONS

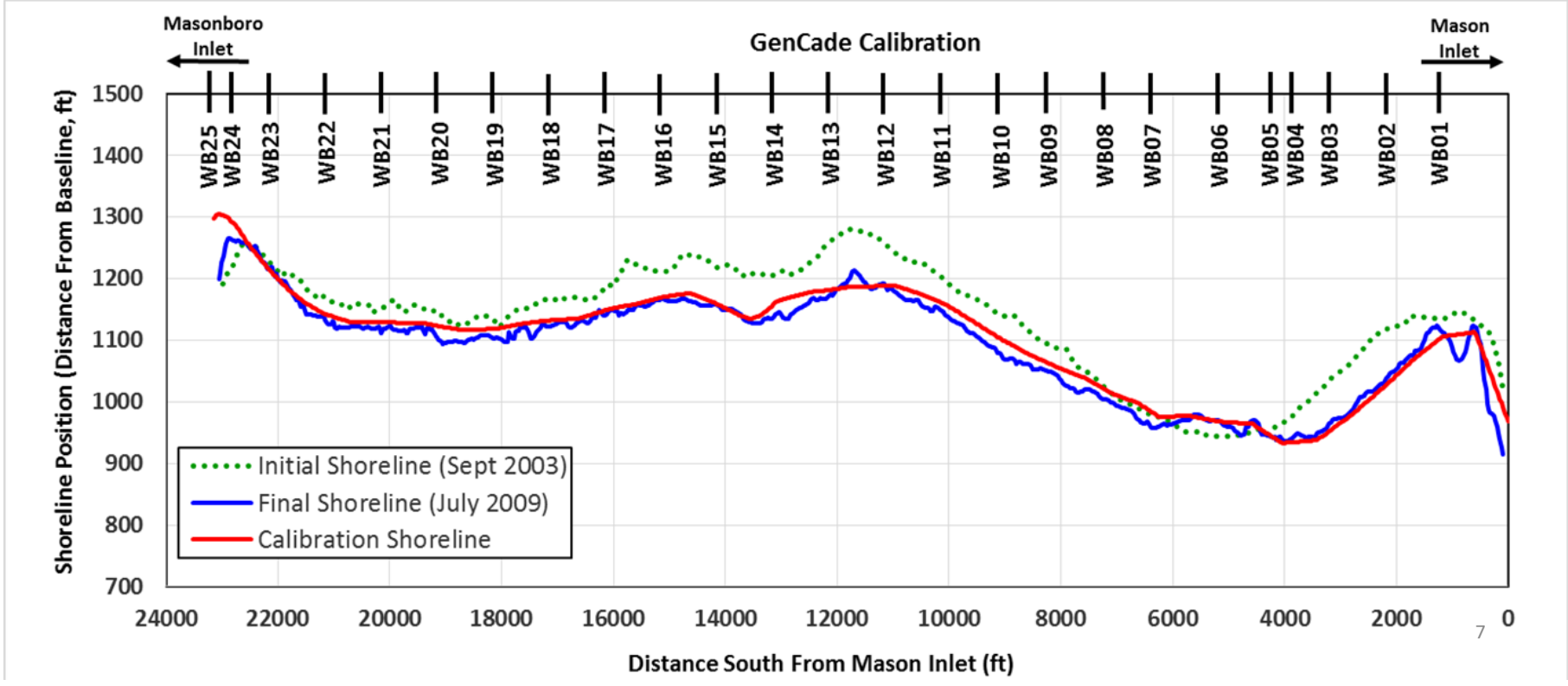
Shoreline Change – GenCade

Volume Change – Delft3D

Storm Protection – SBEACH

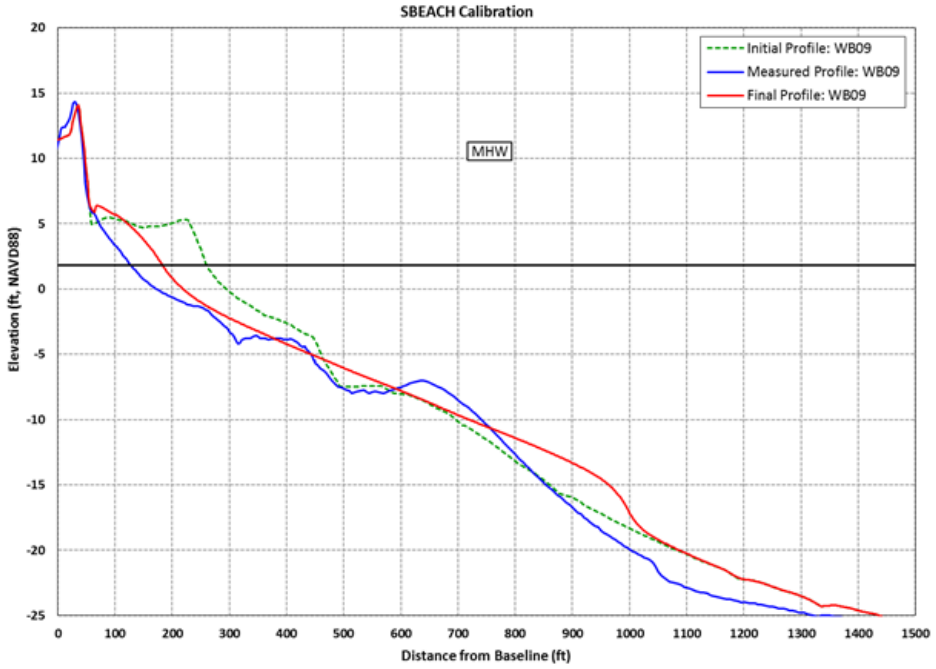
Model Calibration - GenCade

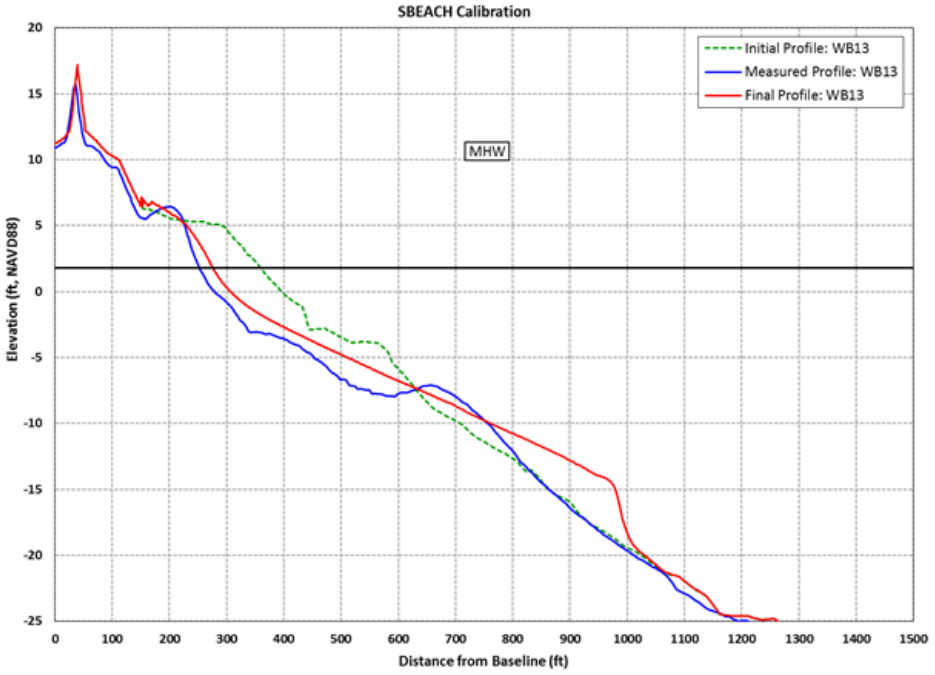
- GenCade calibration
  - Shoreline changes observed from NCDCM Digitized wet/dry shorelines from September 2003 to July 2009
  - Including 2006 Nourishment project between WB10 and WB18
  - Nearshore waves obtained from a Delft3D wave model using WIS 1980-2014 hindcast data along its offshore boundary



Model Calibration – SBEACH

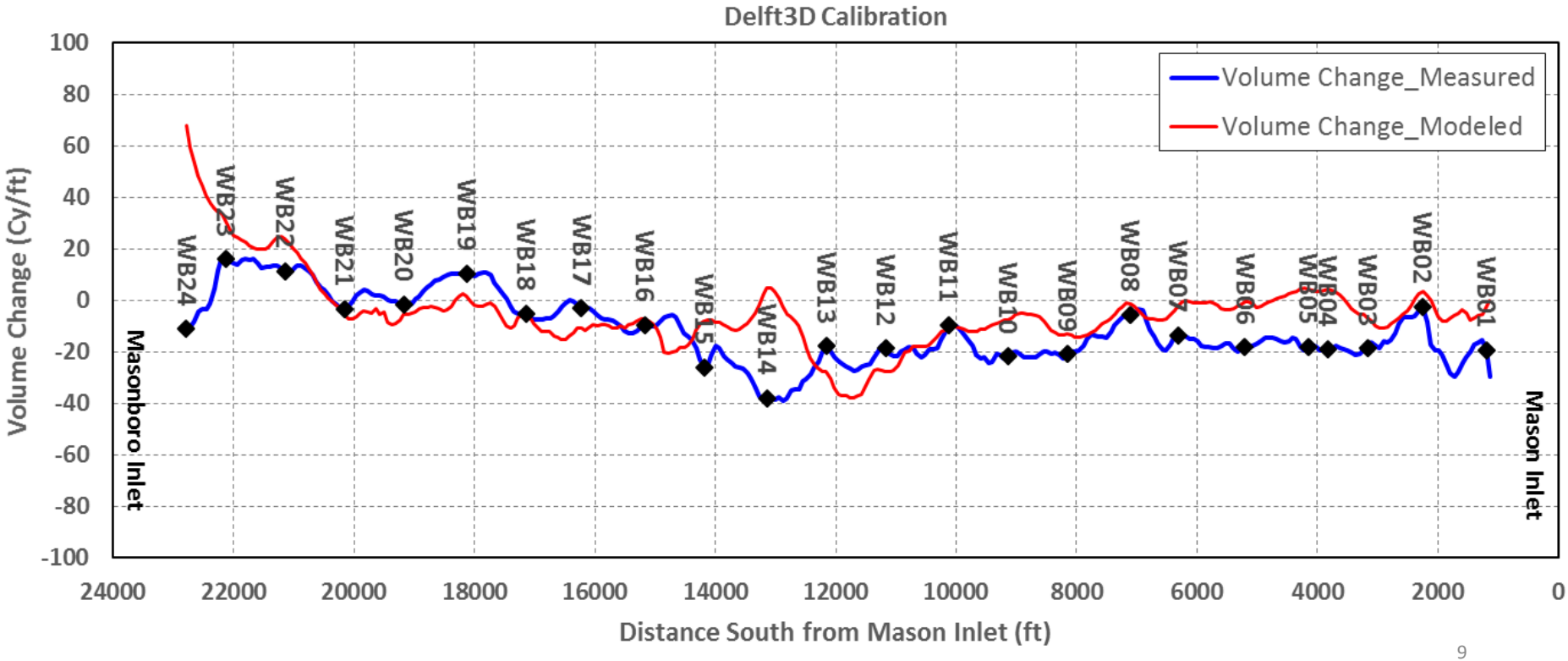
- SBEACH calibration
  - Based on profile response from a synthetic storm based on combined attributes of Hurricane Arthur (July 2014) & Tropical Storm Ana (May 2015).
  - May 2014 and May 2015 profile surveys as the pre- and post-storm conditions respectively
  - Nearshore waves obtained from a Delft3D wave model using measured waves at NDBC station 41110 along its offshore boundary





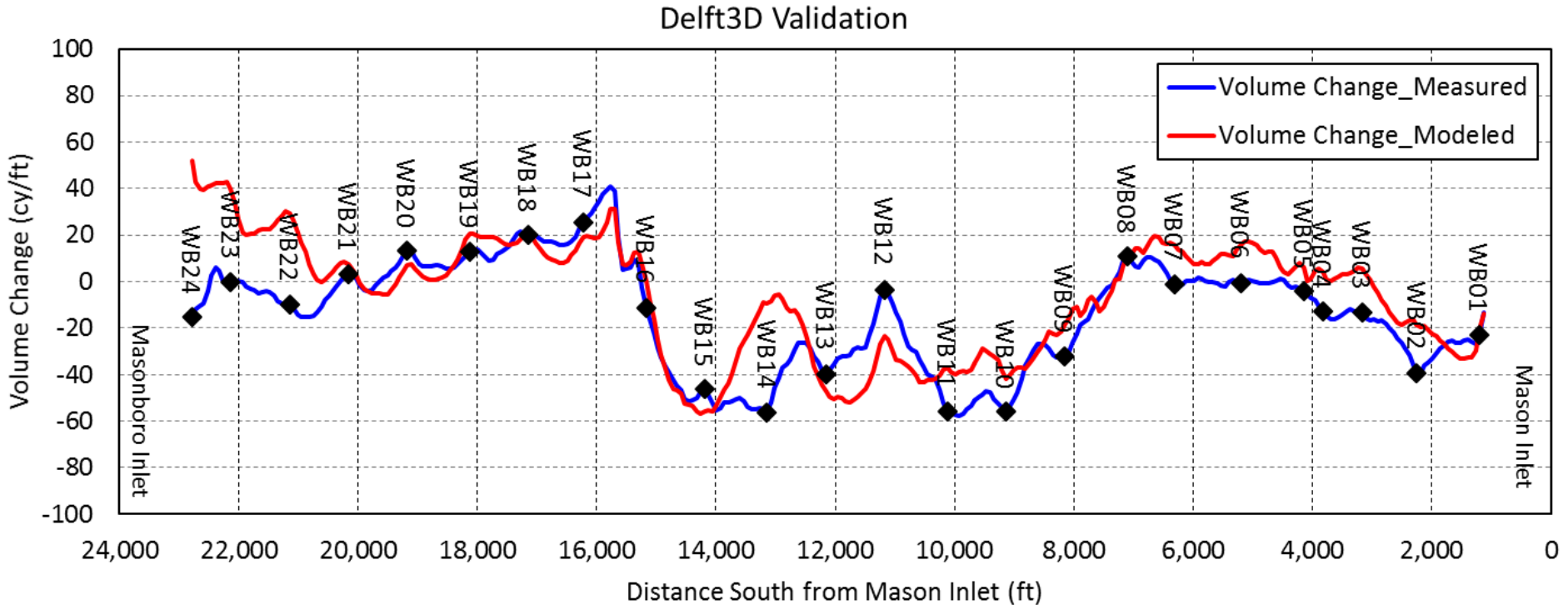
Model Calibration – DELFT3D

- Delft3D calibration
  - Tide and annual average wave conditions schematized to reduce model simulation CPU time significantly
  - Calibration based on measured volumetric changes between May 2015 and March 2016 profile surveys.



Model Calibration – DELFT3D

- **Delft3D Validation**
  - **Same schematized tide and waves as calibration**
  - **Based on measured volumetric changes between post-nourishment June 2014 and May 2015 profile surveys.**



ALTERNATIVE ANALYSIS

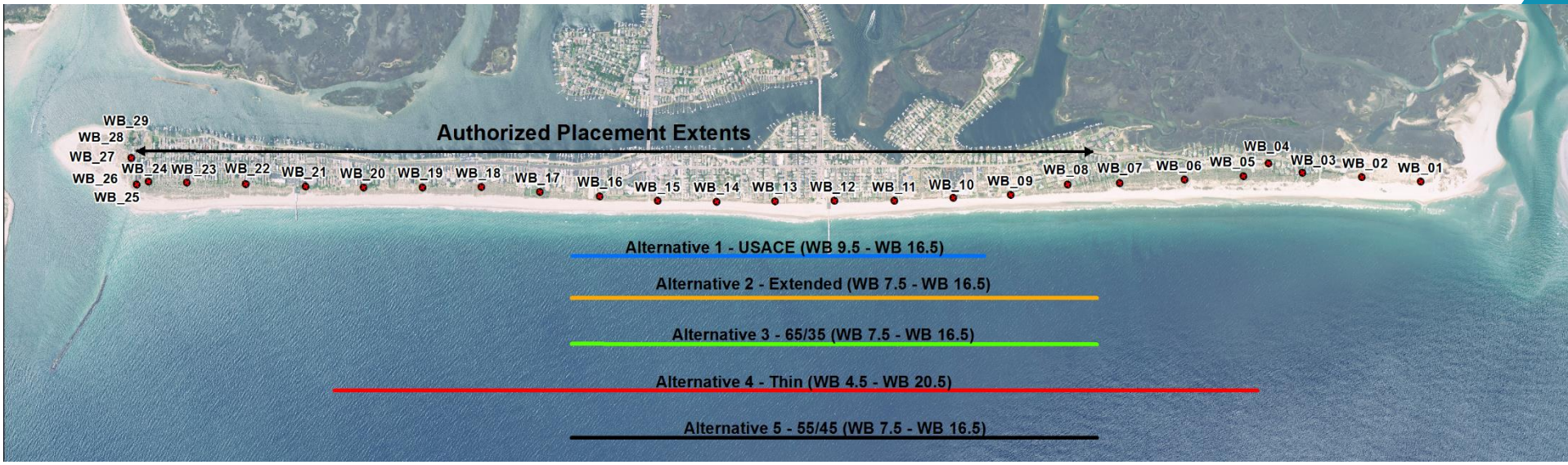
Shoreline Change Analysis – GenCade

Volume Change Analysis – Delft3D

Storm Protection Analysis – SBEACH

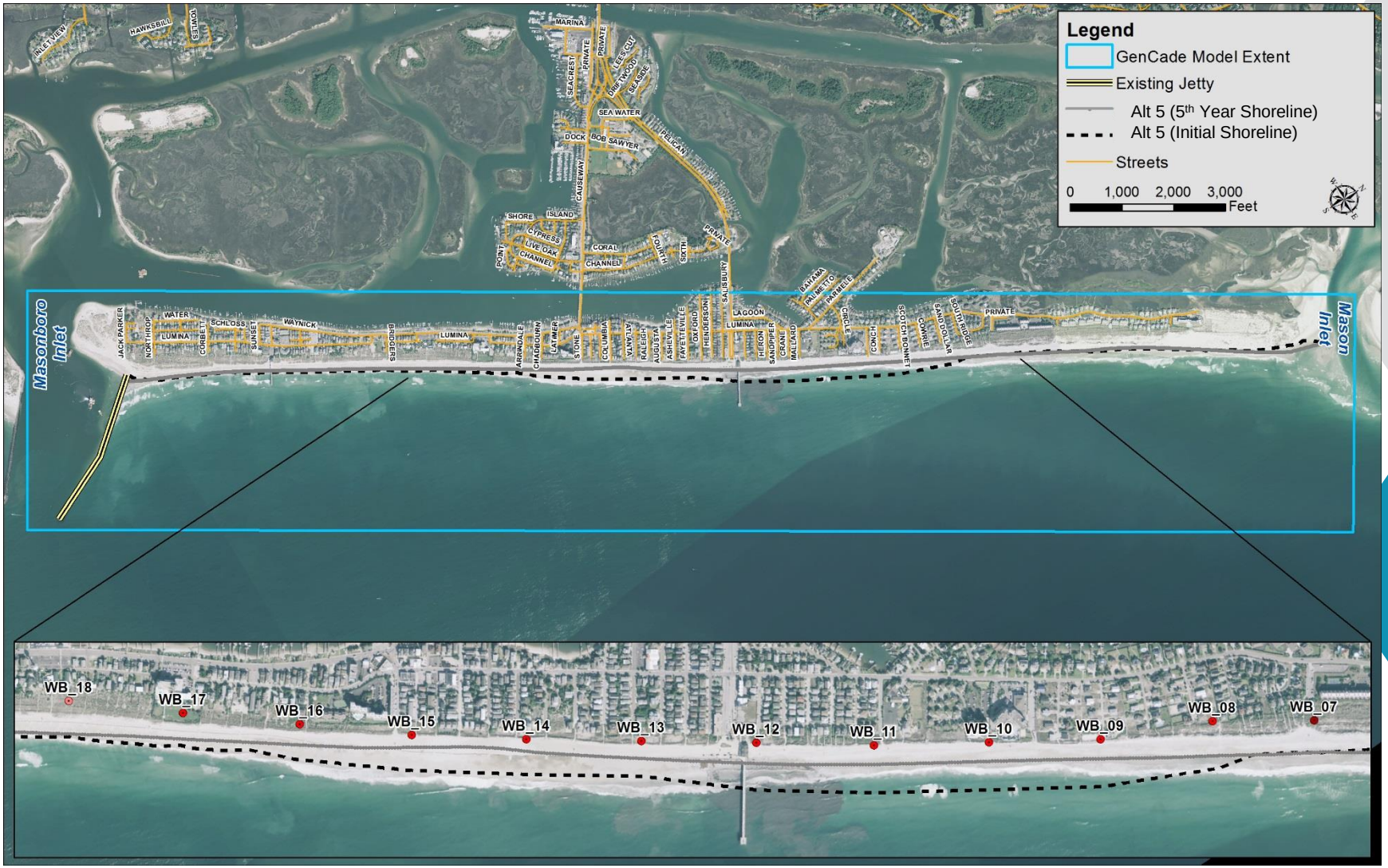
Design Alternatives

- Assumed Permit Volumes of 500,000 cy (A) & 850,000 cy (B)
  - Alternative 1 – USACE Template (WB 9.5 – WB 16.5)
  - Alternative 2 – Extend Slightly North (WB 7.5 – WB 16.5)
  - Alternative 3 – 65% North of Pier/35% South (WB 7.5 – WB 16.5)
  - Alternative 4 – Thinner Template (WB 4.5 – WB 20.5)
  - Alternative 5 – 55% North of Pier/45% South (WB7.5 – WB 16.5)



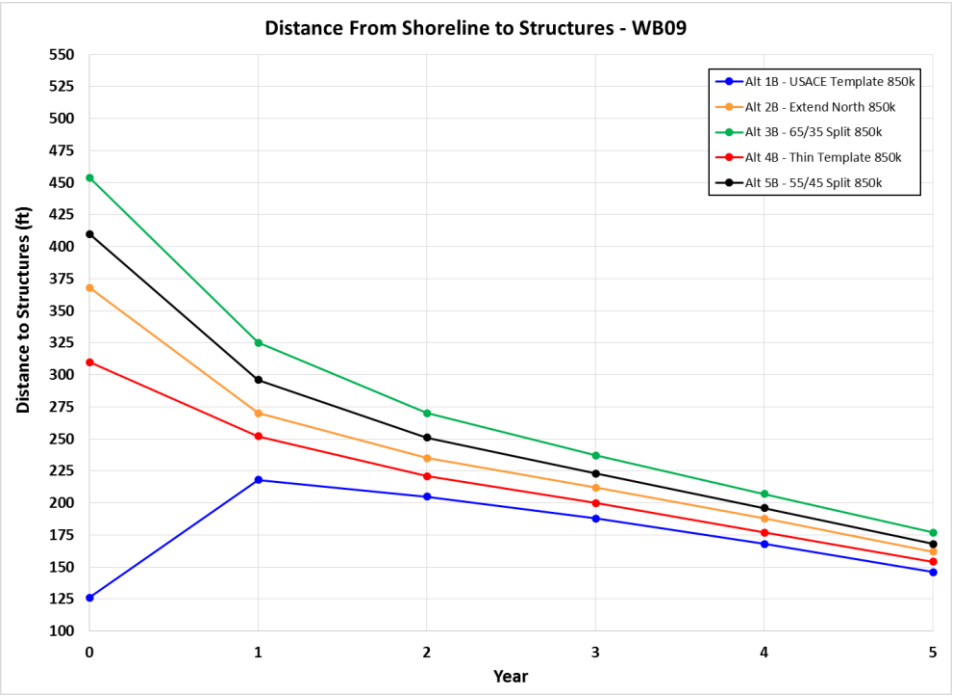
Shoreline Change – GenCade Analysis

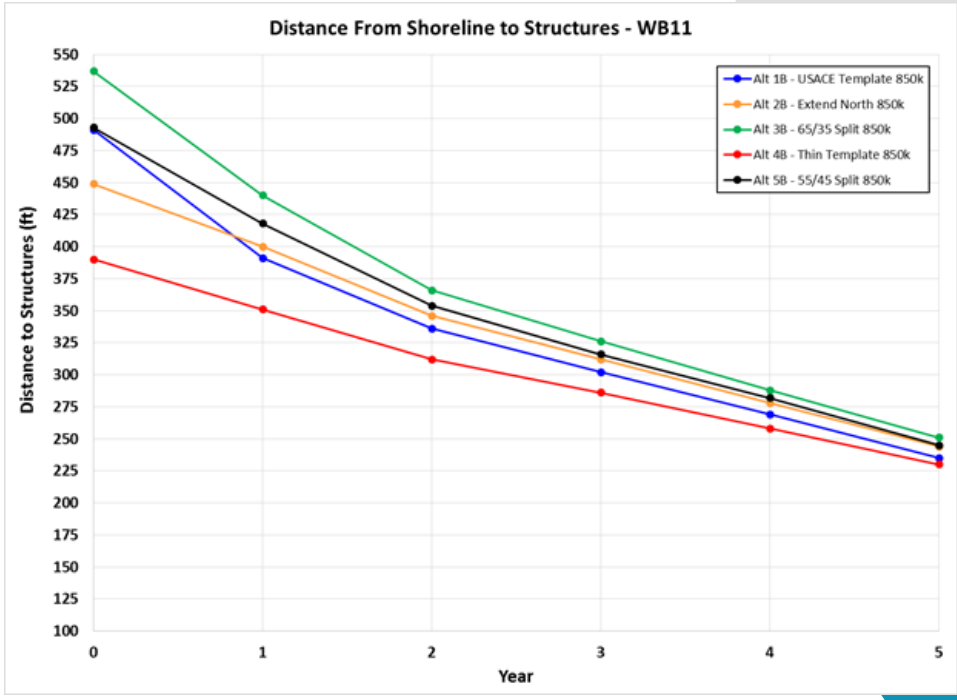
Alternative 5B (5th Year Shoreline Location)



Shoreline Change – GenCade Analysis

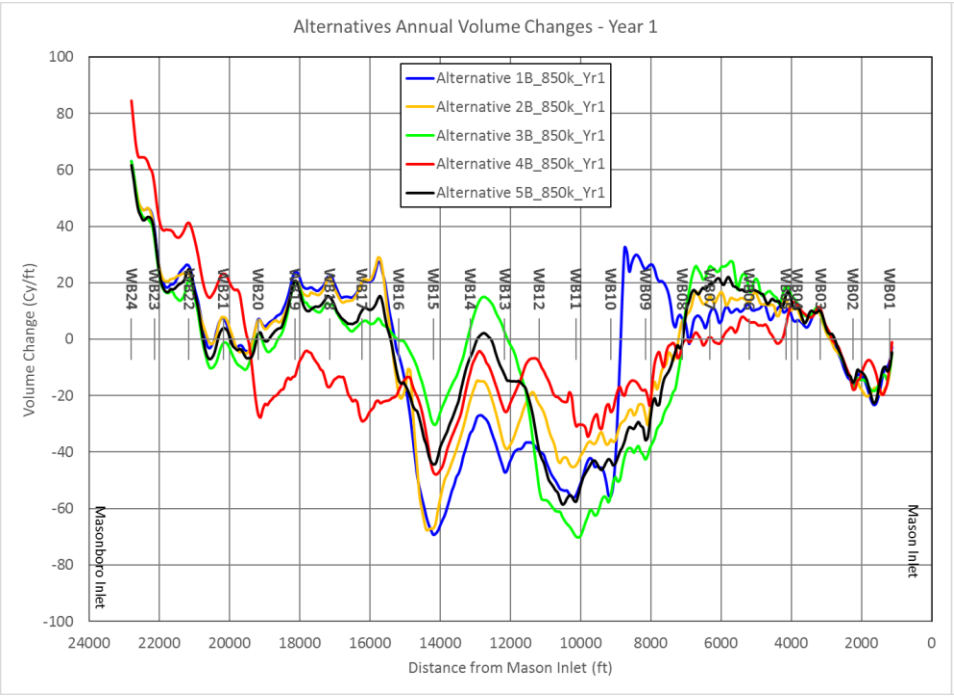
Final Shoreline Positions

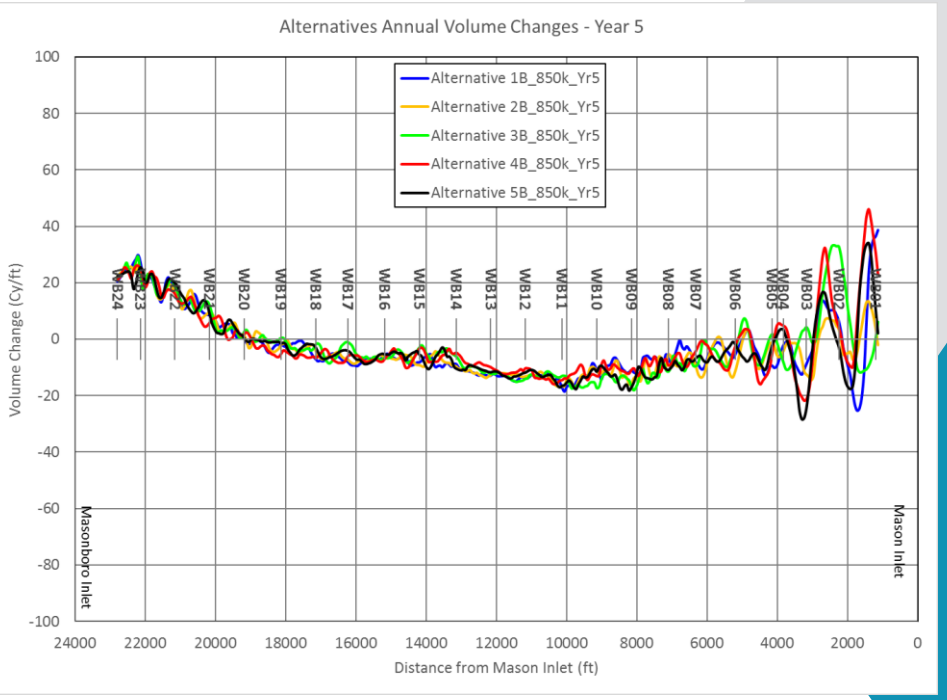




Volume Change – Delft3D Analysis

Volume Changes





Volume Change – Delft3D Analysis

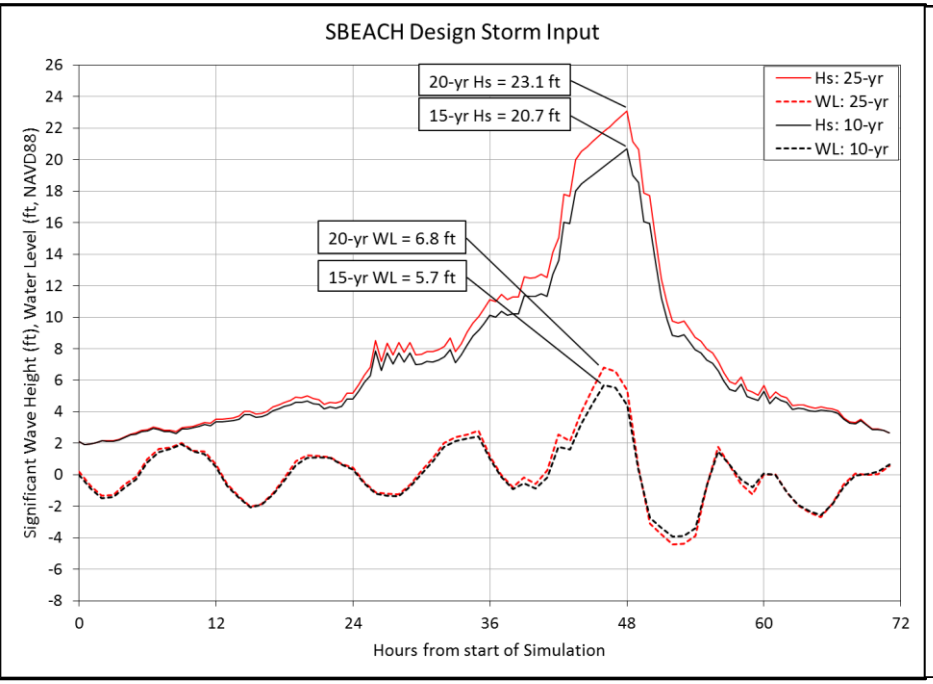
Volume Changes – WB07 to WB17

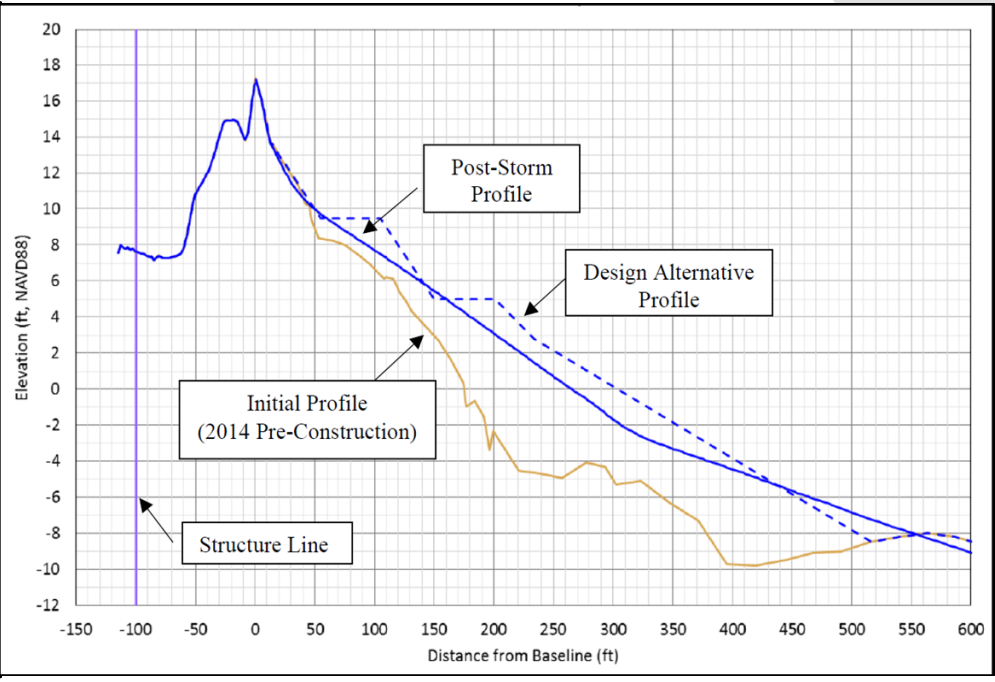
Year Post-Construction	Alt. 1B Volume Loss		Alt. 2B Volume Loss		Alt. 3B Volume Loss		Alt. 4B Volume Loss		Alt. 5B Volume Loss	
	(CY)	(%)	(CY)	(%)	(CY)	(%)	(CY)	(%)	(CY)	(%)
Initial Placement	850,000		850,000		850,000		676,000[1]		850,000	
1	-217,000	26%	-223,000	26%	-208,000	24%	-183,000	27%	-209,000	25%
2	-393,000	46%	-387,000	46%	-374,000	44%	-321,000	47%	-374,000	44%
3	-525,000	62%	-522,000	61%	-508,000	60%	-436,000	64%	-507,000	60%
4	-639,000	75%	-636,000	75%	-625,000	74%	-535,000	79%	-619,000	73%
5	-737,000	87%	-738,000	87%	-728,000	86%	-626,000	93%	-721,000	85%

Cross-Shore Storm Response – SBEACH Analysis

Level of Protection (LOP)

Storm Return Period	2-YR	5-YR	10-YR	15-YR	20-YR	25-YR	50-YR	100-YR
Significant Wave Height (ft)	16.6	19	20.7	21.8	22.5	23.1	24.9	26.7
Peak Period (s)	11.8	12.2	12.5	12.6	12.7	12.8	13.1	13.3
Water Elevation (ft, NAVD88)	4.3	4.6	5.7	6.2	6.6	6.8	8.70	9.9





Cross-Shore Storm Response – SBEACH Analysis

Level of Protection (LOP)

Profile	Return Interval Storm (YR) – 850,000 CY Equilibrated Profile				
	Alt. 1B	Alt. 2B	Alt. 3B	Alt. 4B	Alt. 5B
WB09	5	10	10	10	10
WB11	25	25	25	25	25
WB14	25	25	25	25	25
WB16	25	25	25	25	25
Governing LOP	5	10	10	10	10

Profile	Return Interval Storm (YR)
	Alt. 5 (850,000 CY 5-YR Equilibrated Profile)
WB09	10
WB11	25
WB14	25
WB16	10
Governing LOP	10

Overall Modeling Summary/Conclusions

- Model results indicate that Alt 3 (65%/35%) and Alt 5 (55%/45%) are preferable options for increasing project benefits
- Alt 5 is the Preferred Alternative for increasing storm benefits along northern Wrightsville Beach while still maintaining the highest LOP south of Johnnie Mercer's Pier
- Modeling suggest ±15% of placed material volume should remain in project area through 5th year post construction; however, a change in the maintenance interval is not recommended

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THANK YOU!

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