National Conference on
Beach Preservation Technology
February 5, 2020

Manasota Key Beach Project Design and Modeling Sarasota and Charlotte Counties, FL

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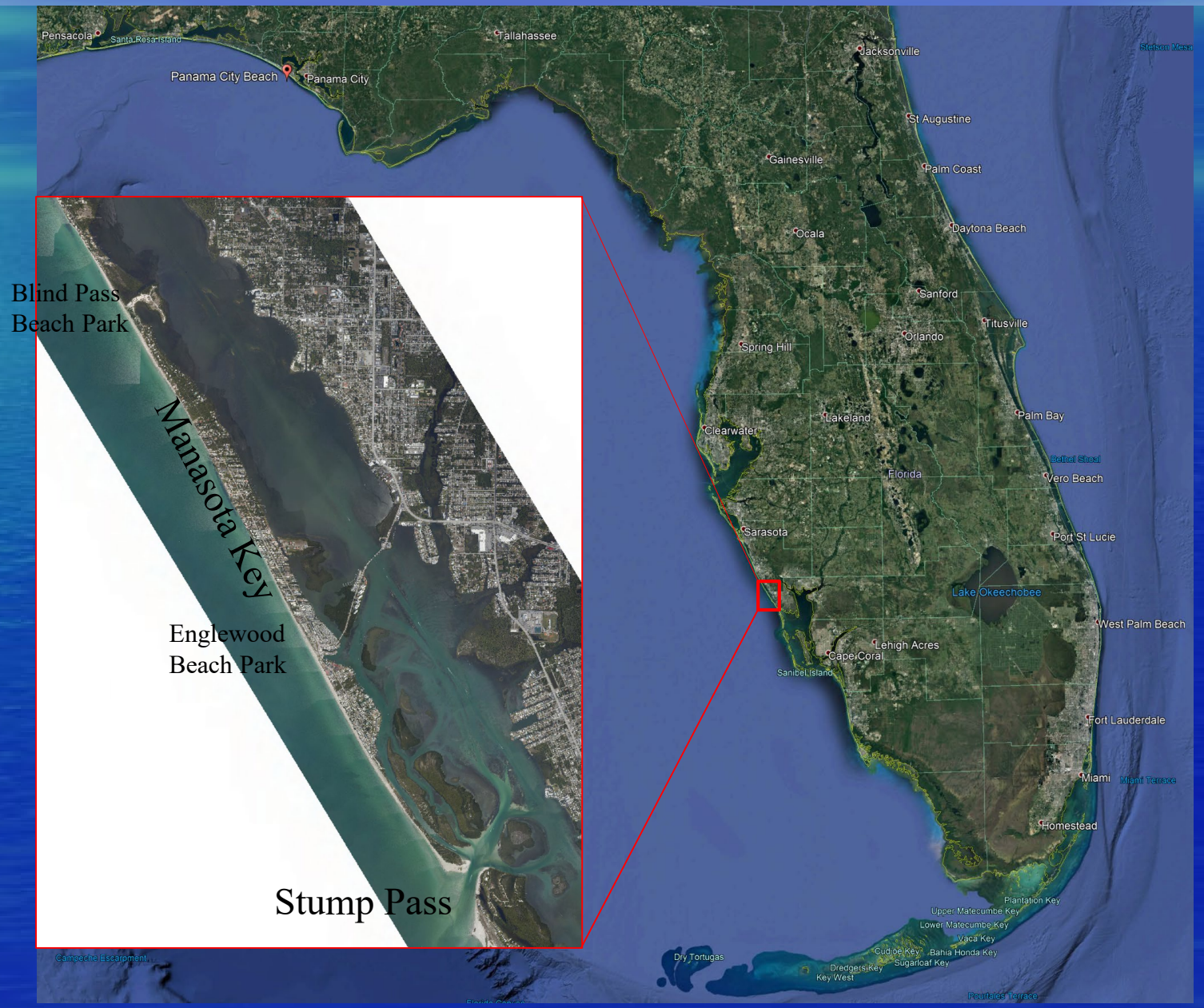
COASTAL ENGINEERING CONSULTANTS INC

Location Map



Outline

- History
- Project Objectives
- Modeling
- Design
- Schedule
- Quantities & Cost

History

- 2003

  1980 Channel Alignment Restored at Stump Pass

- 2006 & 2011

  Maintenance Dredging and Beach Renourishment (Post-Storm Recovery Projects)

- 2017

  Maintenance Dredging, Beach Renourishment and Construction of Terminal Groin at South End of Manasota Key

Objectives

- Restore and maintain critically eroding beaches
- Provide storm damage reduction
- Provide protection to failing armoring structures
- Provide environmental protection for threatened and endangered species
- Avoid, minimize, or mitigate unavoidable impacts to nearshore hardbottom from beach restoration
- Provide and sustain design beach fill template between renourishment cycles
- Align restoration and nourishment cycles with County's existing beach and inlet management program

Design
Components

Design Template to provide storm damage reduction benefits from a 25-year return interval storm event

Advanced Nourishment to offset the background erosion during the nourishment cycle

Equilibrium Profile Adjustment to offset the equilibration in profile slope

Modeling: 25-Year Storm

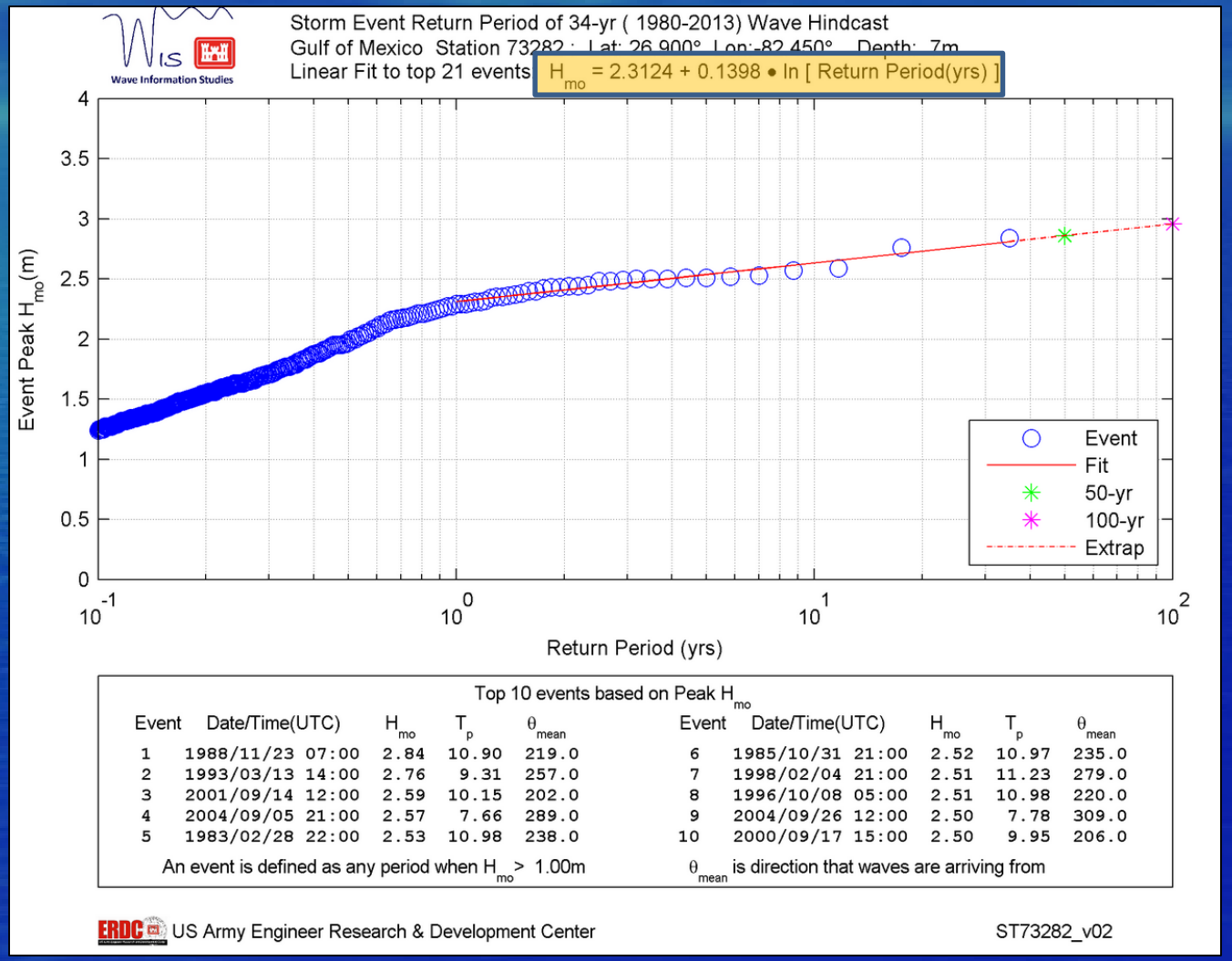
SBEACH Model Parameters

Parameters	Unit	Recommended Values
Transport rate coefficient, K	m^4 /N	0.5 e-006
Overwash transport parameter		0.002
Coefficient for slope dependent term	m^2/s	0.005
Transport rate decay coeff. multiplier	m^{-1}	0.5
Landward surf zone depth	ft	1.0
Effective grain size (mean D_{50})	mm	0.35
Maximum slope prior to avalanching	degree	15

Based on Wang and Manausa (2013): SBEACH High-Frequency Storm Erosion Model Study for Sarasota County

Modeling: 25-Year Storm

Analysis of Storm Events



Top 10 events based on Peak H_{mo}

Event	Date/Time(UTC)	H_{mo}	T_p	θ_{mean}	Event	Date/Time(UTC)	H_{mo}	T_p	θ_{mean}
1	1988/11/23 07:00	2.84	10.90	219.0	6	1985/10/31 21:00	2.52	10.97	235.0
2	1993/03/13 14:00	2.76	9.31	257.0	7	1998/02/04 21:00	2.51	11.23	279.0
3	2001/09/14 12:00	2.59	10.15	202.0	8	1996/10/08 05:00	2.51	10.98	220.0
4	2004/09/05 21:00	2.57	7.66	289.0	9	2004/09/26 12:00	2.50	7.78	309.0
5	1983/02/28 22:00	2.53	10.98	238.0	10	2000/09/17 15:00	2.50	9.95	206.0

An event is defined as any period when H_{mo} > 1.00m

θ_{mean} is direction that waves are arriving from

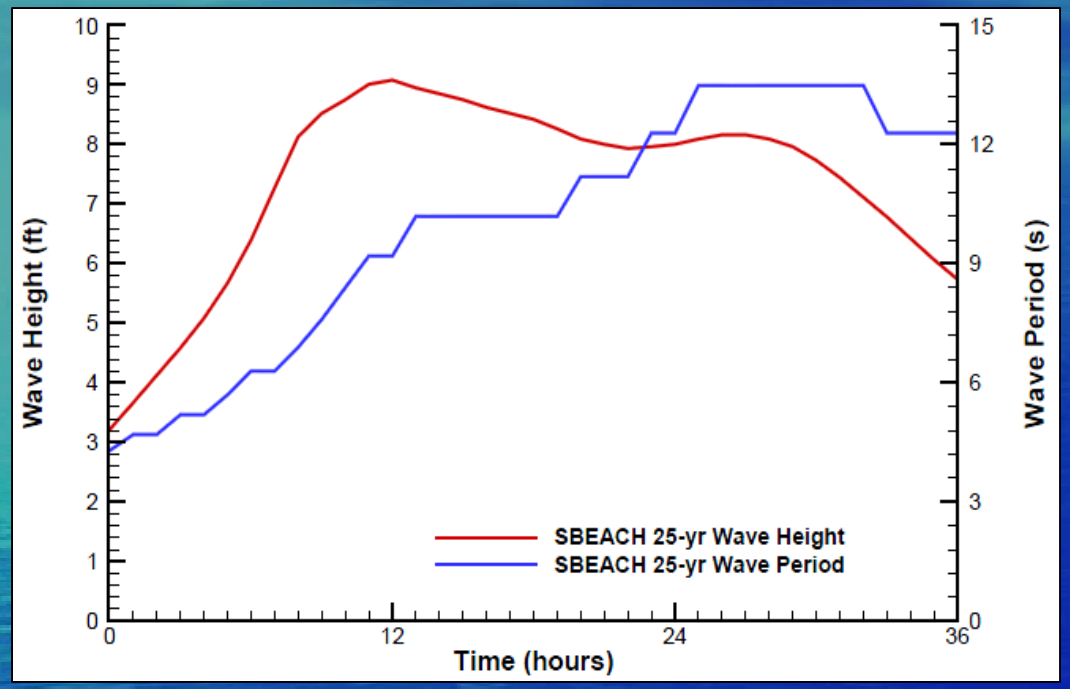
ERDC US Army Engineer Research & Development Center

ST73282_v02

Based on Wave Information Studies (WIS) Database 25-year Storm Wave height is 9.1 feet

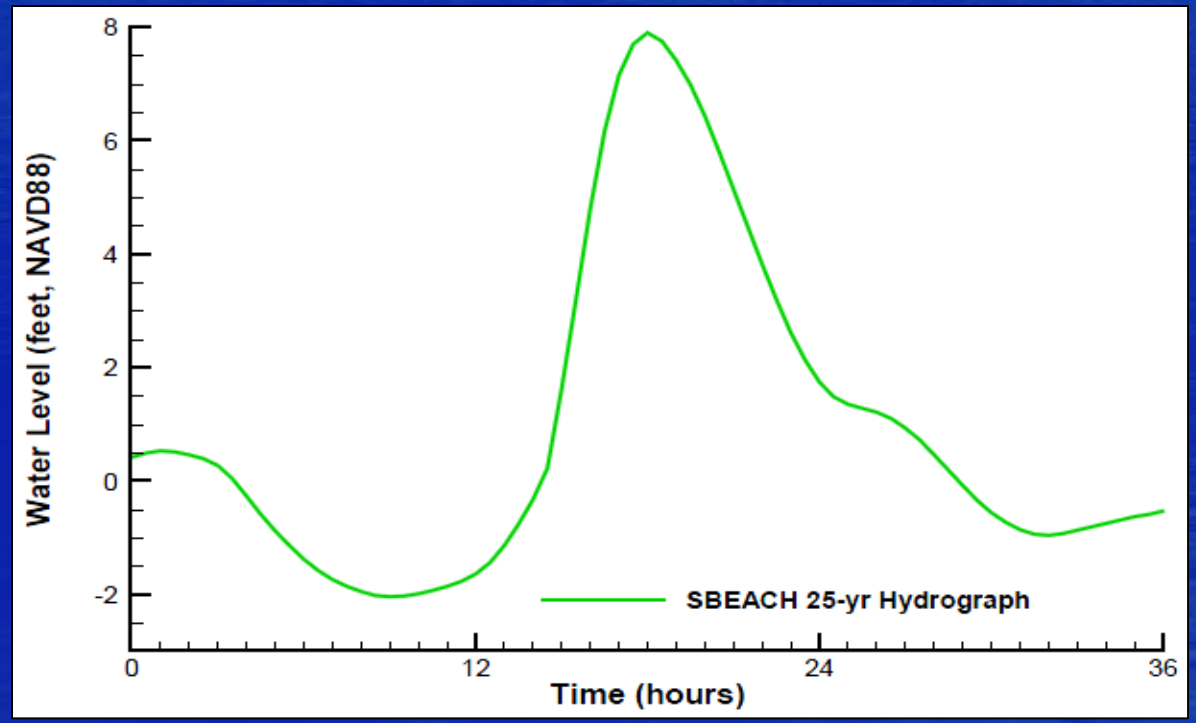
Modeling: 25-Year Storm

SBEACH Wave and Hydrograph Input



Station WIS-282 data series was analyzed to locate a storm event spanning over a 36-hour interval with a close match to the 9.1-foot high wave.

According to Wang (2012), the 25-year peak storm elevation for northern Charlotte County is 7.9 feet NAVD88



MODELING

Beach Fill Design Parameters

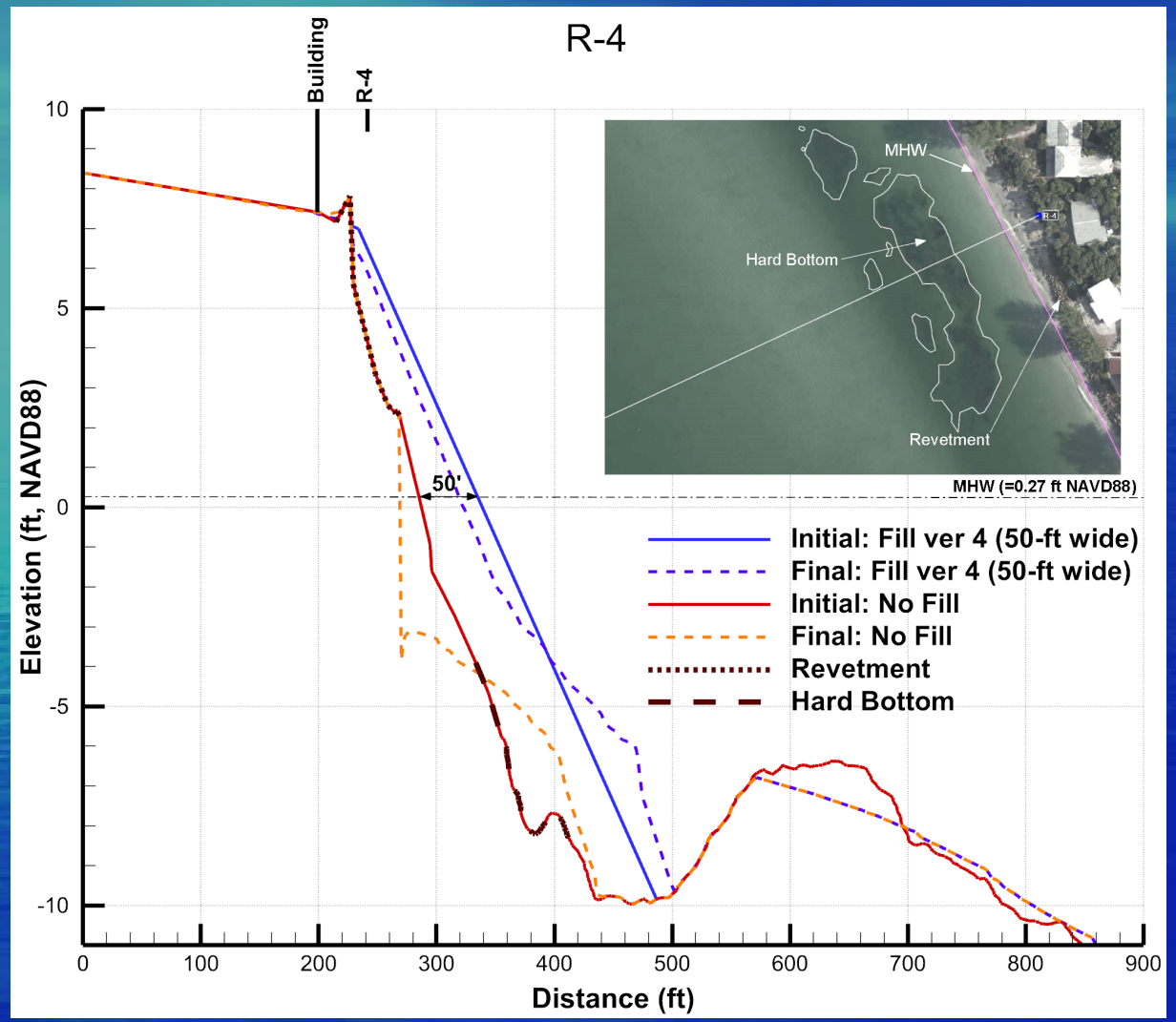
Beach Fill Design ID	Berm Height (feet, NAVD88)	Berm Width (feet)
1	4.75	25*
2	4.75	25‡
3	4.75	50‡
4	7.0	50‡
5	4.75	75‡
6	7.0	75‡
7	4.75	15‡

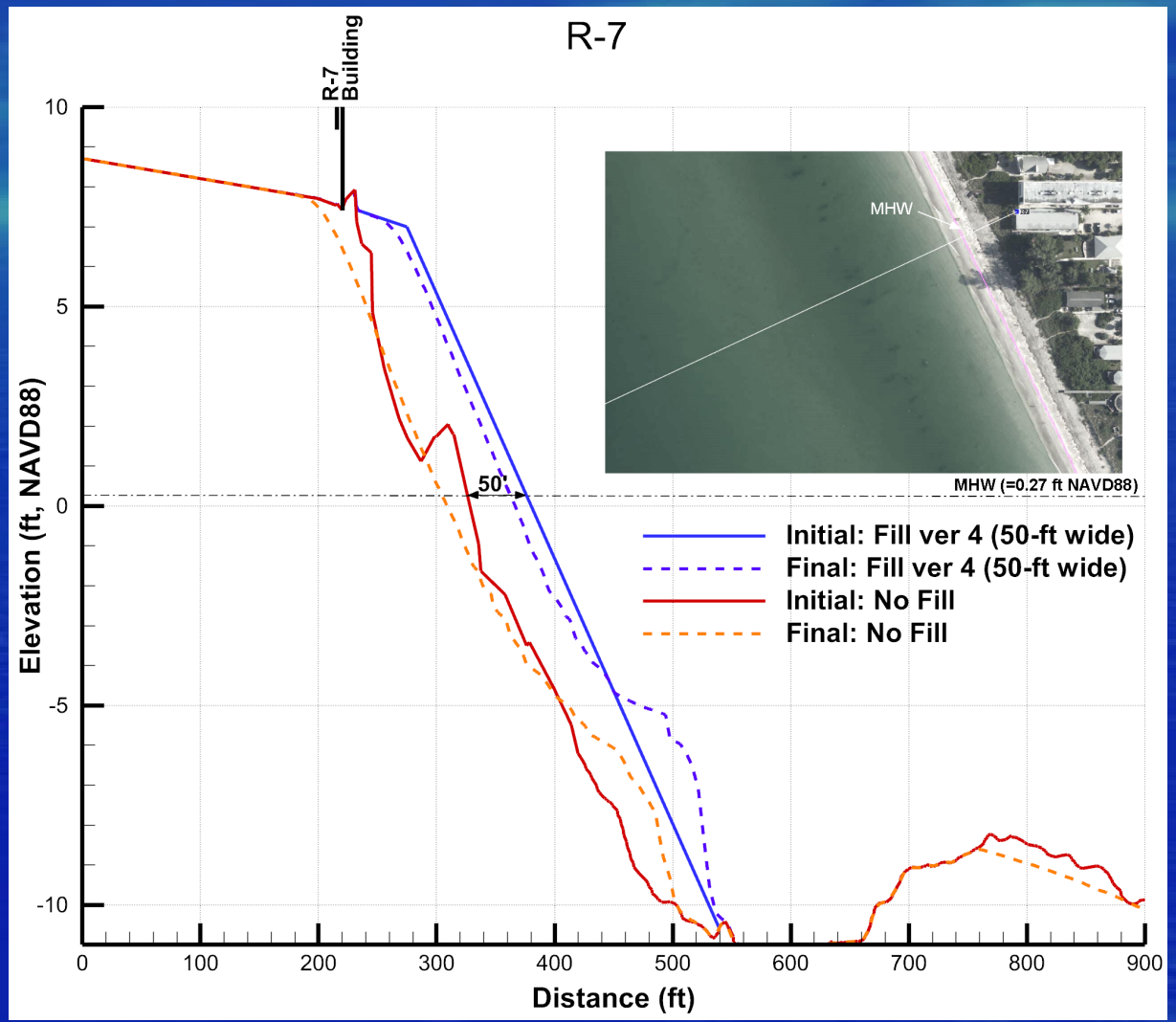
* measured at 4.75 feet NAVD88

‡ measured at MHW (= 0.3 feet NAVD88)

Beach berm slope, 1V:100H; shoreface slope, 1V:15H, were held constant

Modeling: 25-Year Storm





Design Berm Height +7 feet NAVD88

Design Berm Width at MHW 50 feet

Design

Advanced Nourishment

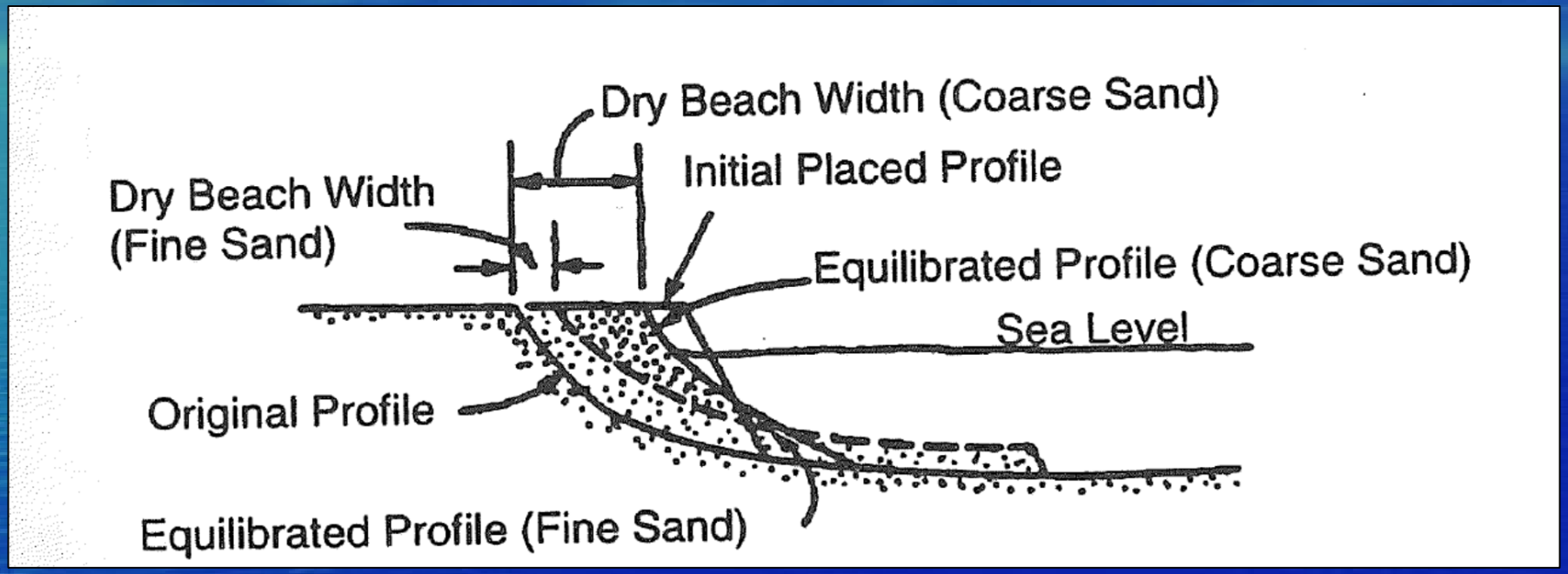
R-Mon	Position 2005 (FT)	Position 2016 (FT)	Change 2005-2016 (FT)	Change Rate (FT/YR) 2005-2016
R-1	93.4	61.3	-32.2	-2.9
R-2	101.4	86.9	-14.5	-1.3
R-3	76.3	72.4	-4.0	-0.4
R-4	66.6	43.5	-23.1	-2.1
R-5	88.2	69.4	-18.8	-1.7
R-6	190.3	157.4	-32.9	-3.0
R-7	119.3	110.8	-8.5	-0.8
R-8	157.0	163.7	6.8	0.6
R-9	163.1	183.3	20.2	1.8
R-10	203.1	217.7	14.6	1.3
R-11	93.5	134.1	40.7	3.7
R-12	193.7	236.5	42.8	3.9
R-13	122.2	152.5	30.3	2.8
R-14	75.9	77.8	1.9	0.2
R-15	195.8	229.3	33.5	3.0

Erosion Rate of 1.7 feet per year

14 feet over 8-year cycle

Design

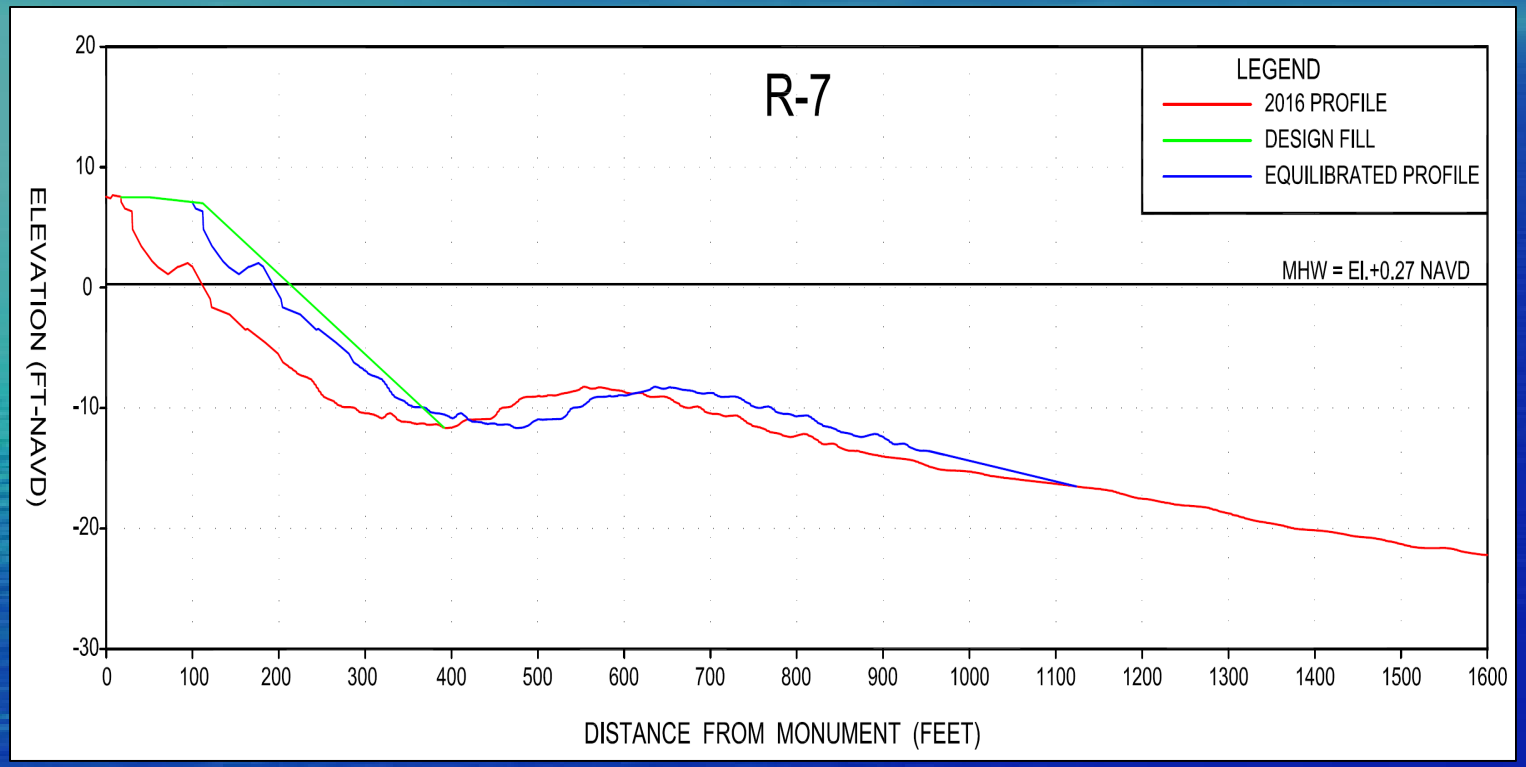
Equilibrium Profile Adjustment



source: R.G. Dean, Beach Nourishment Theory and Practice

DESIGN

EQUILIBRIUM PROFILE ADJUSTMENT



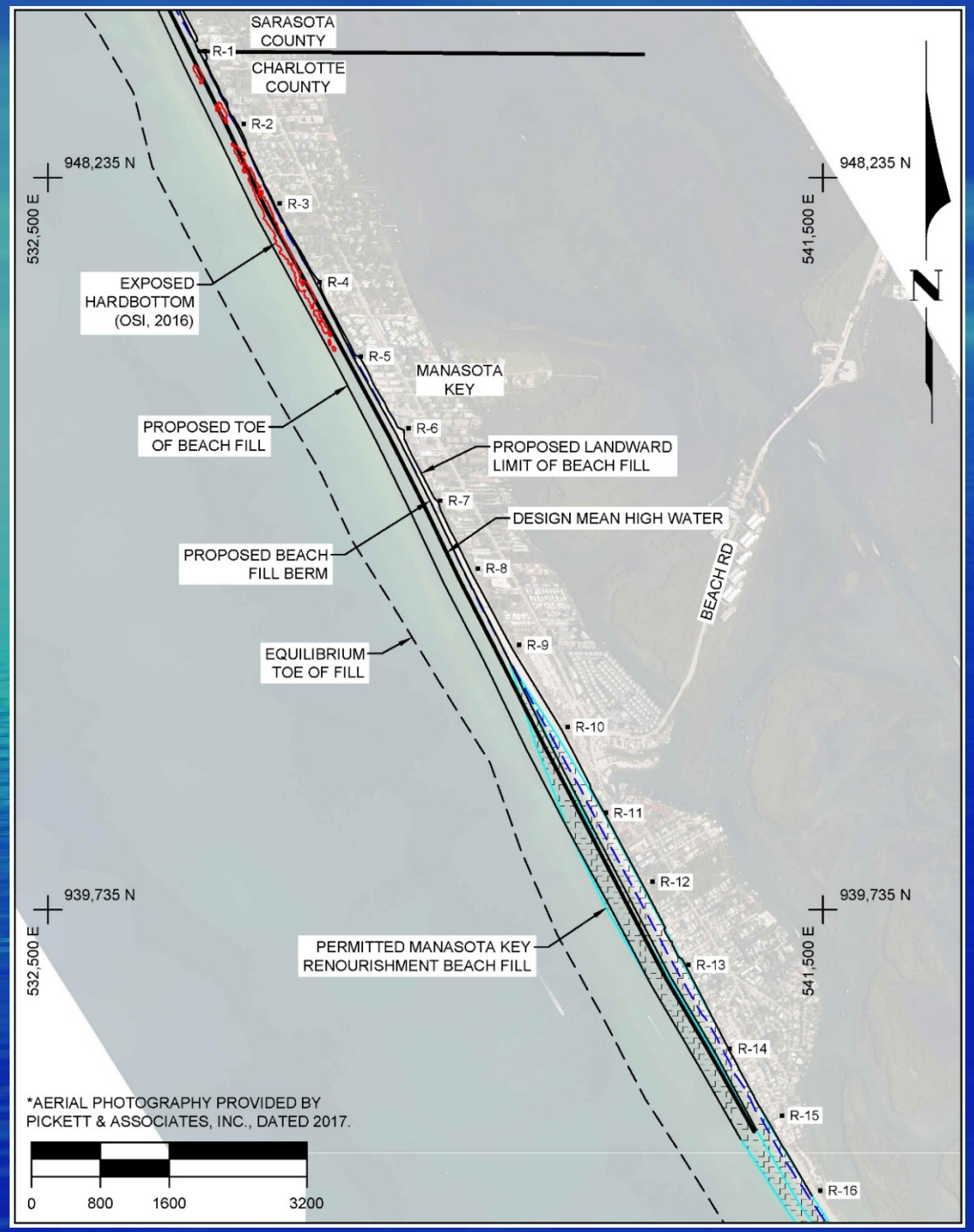
Existing profile was shifted seaward to "create" the post-equilibrium profile.

Fill template was placed to match post-equilibrium profile position at MHW.

Fill was adjusted seaward until losses and gains between adjusted fill template and equilibrium profile were approximately equal in magnitude

Based on the volume balancing, the distance from nourished profile to adjusted profile measured at MHW equaled 20 feet

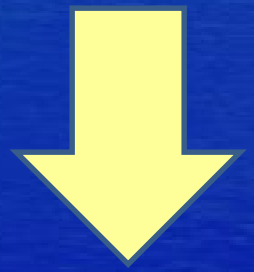
DESIGN



Berm Height +7 feet NAVD88

Berm Width at MHW 84 feet
- 50 feet design
- 14 feet advanced
- 20 feet eq. adjustment

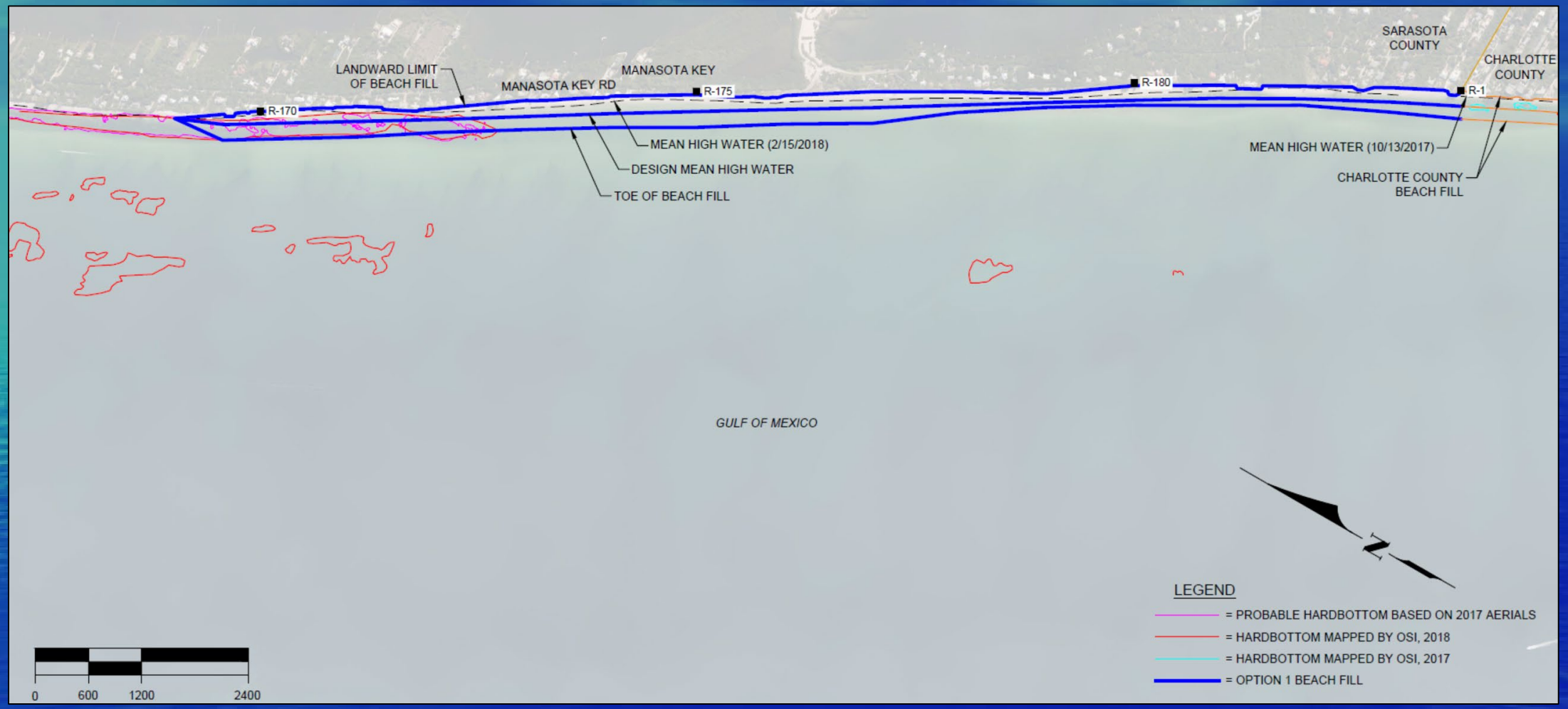
Charlotte County and Sarasota County Enter Interlocal Agreement



Project Extension Into Sarasota County

Beach Fill Extension

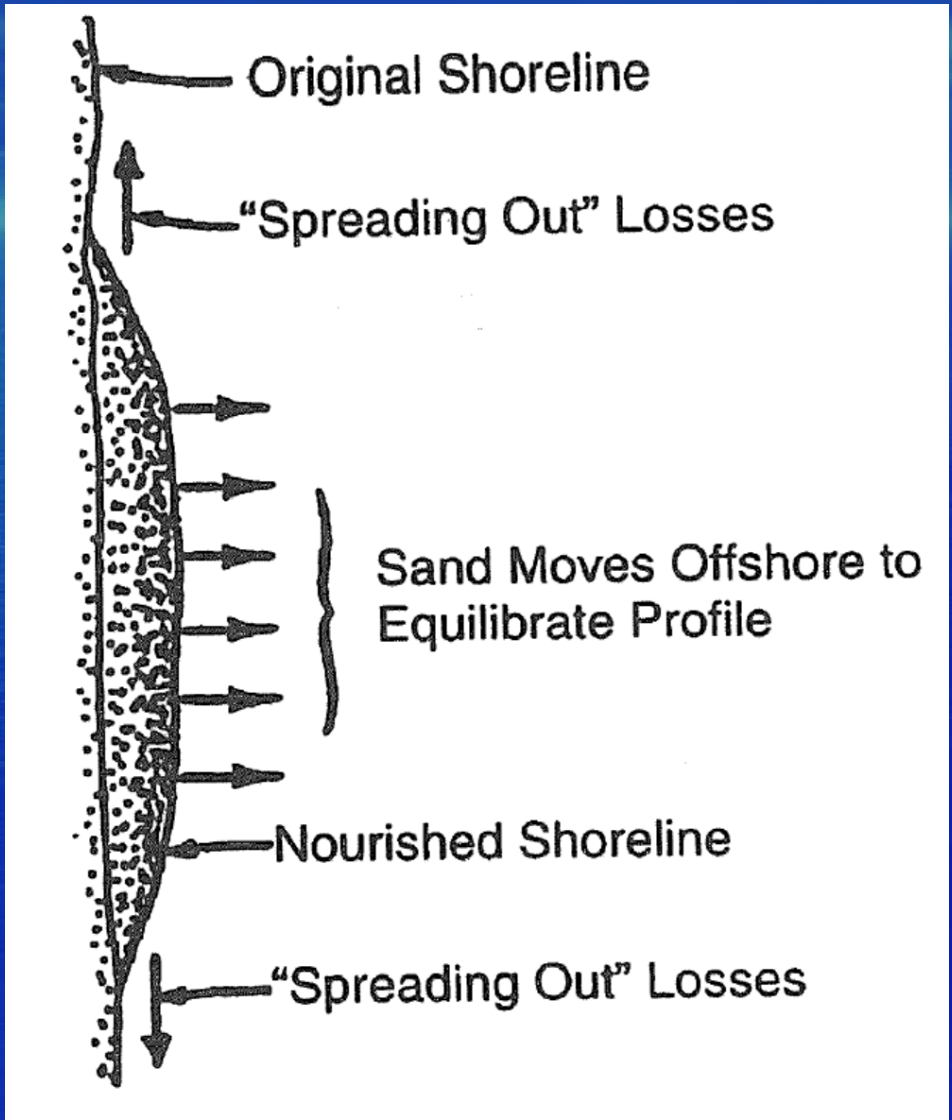
Hardbottom Impacts



To Mitigate Hardbottom Impacts, Create 21-Acre Artificial Reef for $20 Mil.

Change Design to Avoid Hardbottom Impacts

Modeling: Beach Fill Spreading



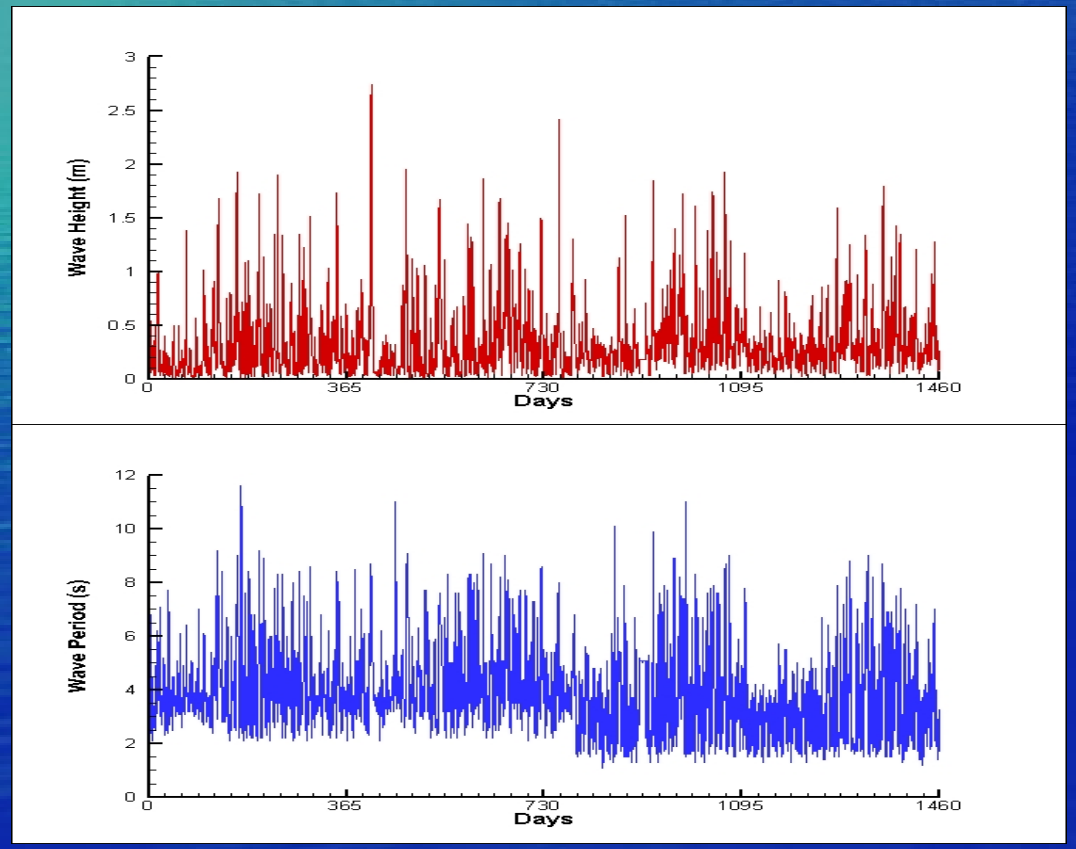
source: R.G. Dean, Beach Nourishment Theory and Practice

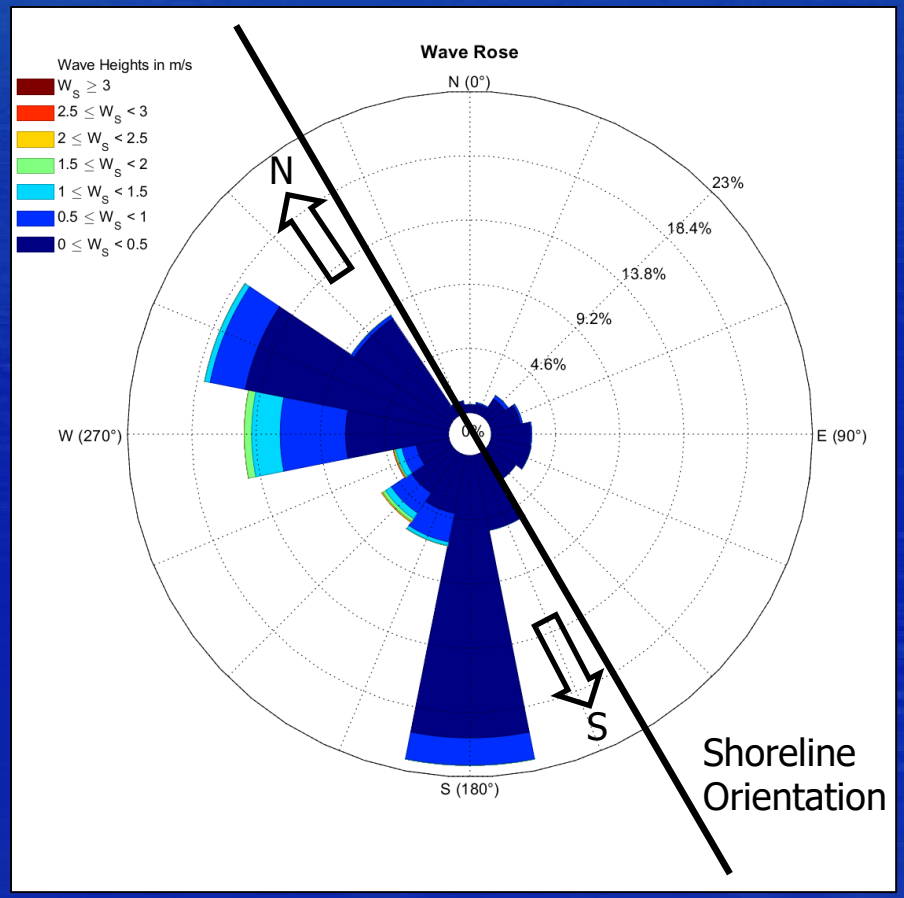
Modeling: Beach Fill Spreading

GENCADE Model Input

The NOAA Wavewatch III regional model wave data were used as forcing.

The data covered the period from July 2012 to August 2015 at 3-hour intervals approximately 6 miles offshore of the Project Area.





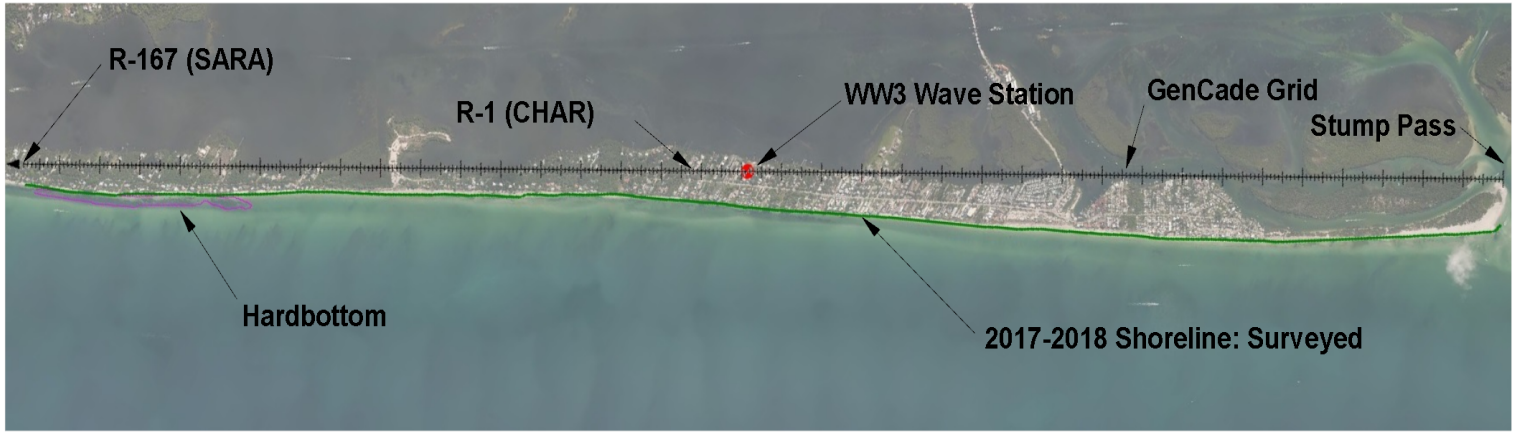
Modeling: Beach Fill Spreading

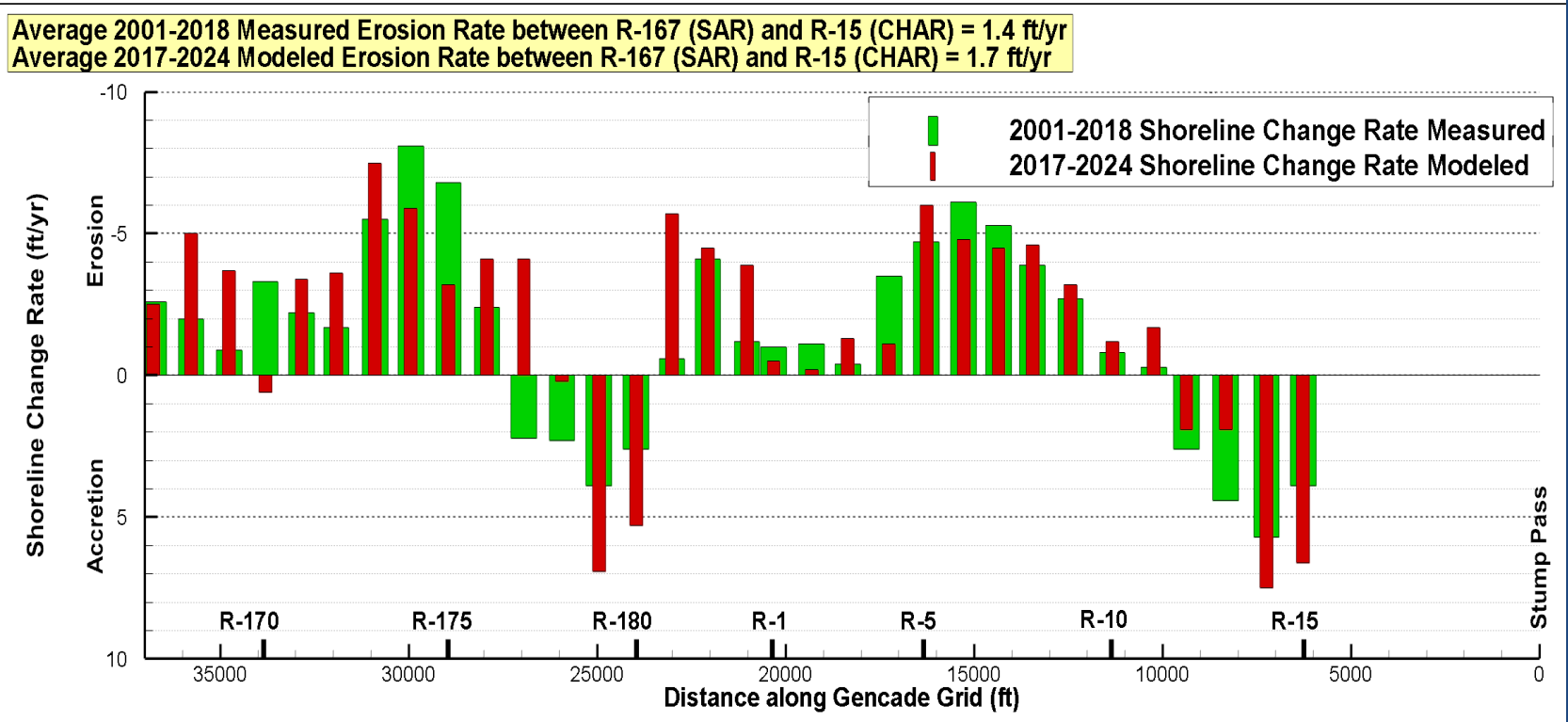
GENCADE Model Parameters

Time Step (hr)	Grain Size (mm)	Berm Height (ft)	Closure Depth (ft)	K1 Transport Coefficient	K2 Transport Coefficient	Bypassing Included?
0.5	0.35	2.0	13.1	1	0.5	Yes

Modeling: Beach Fill Spreading

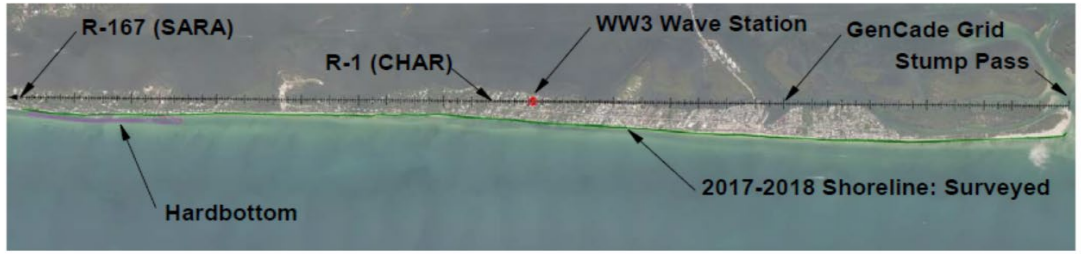
GENCADE Model Calibration

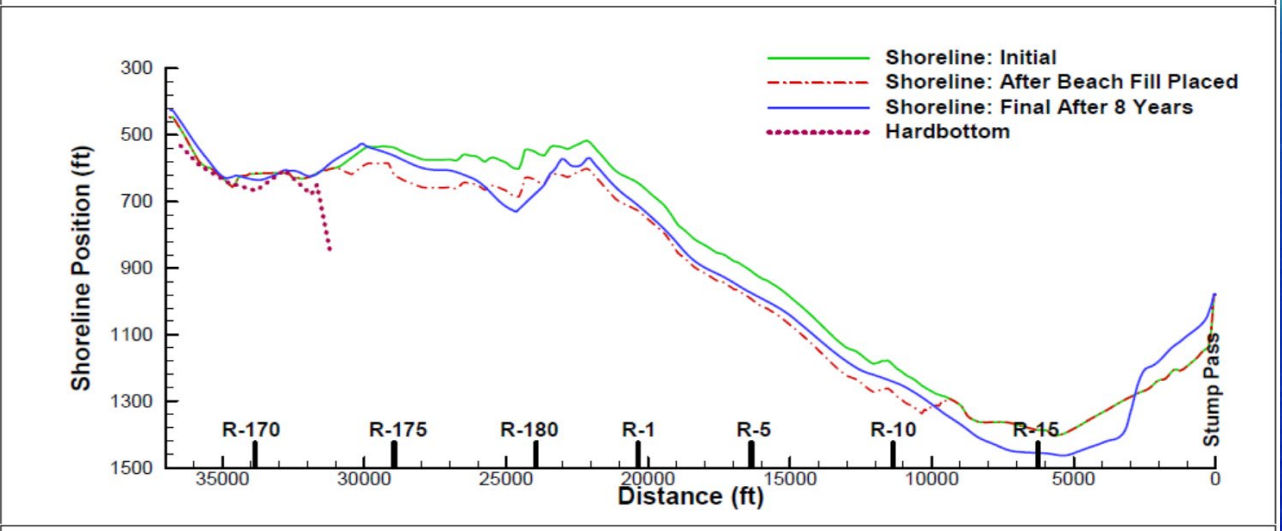


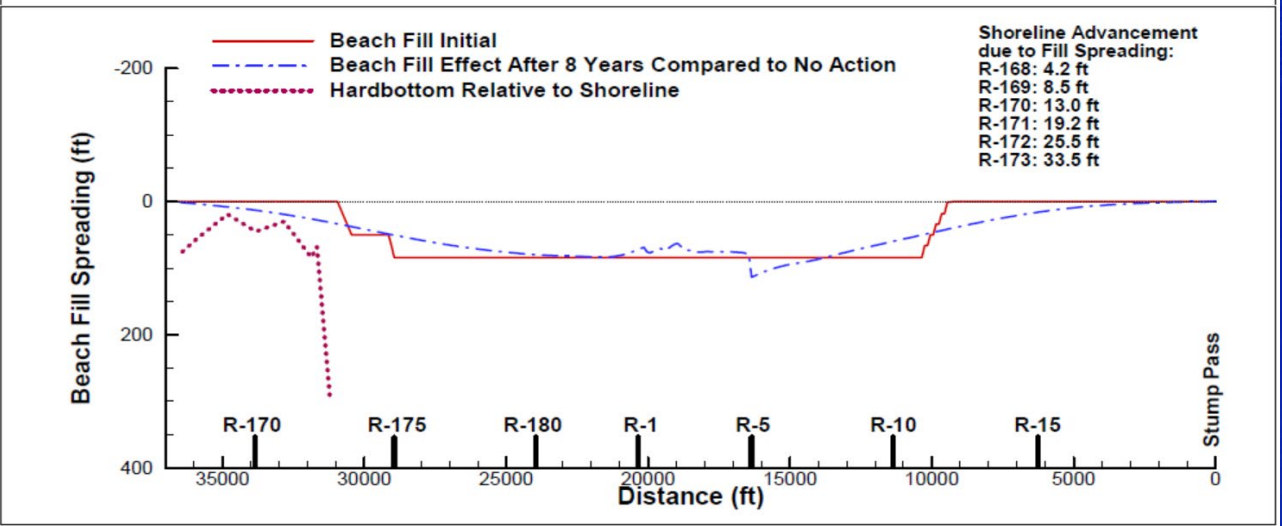


8-year Simulation 2017-2024

Compared Modeled Shoreline Change Rates to Measured based on 2001 and 2018 Surveys







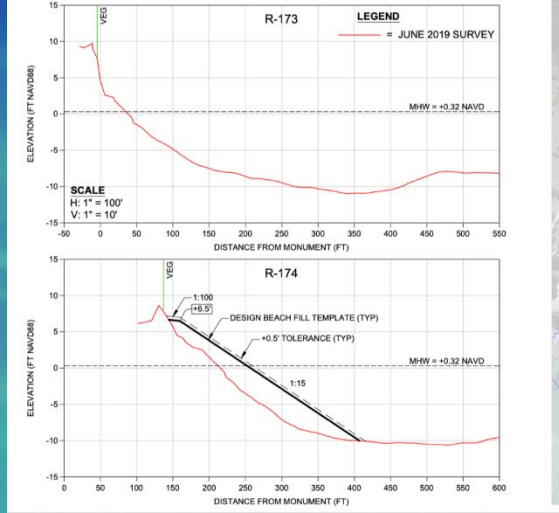
Modeling: Beach Fill Spreading

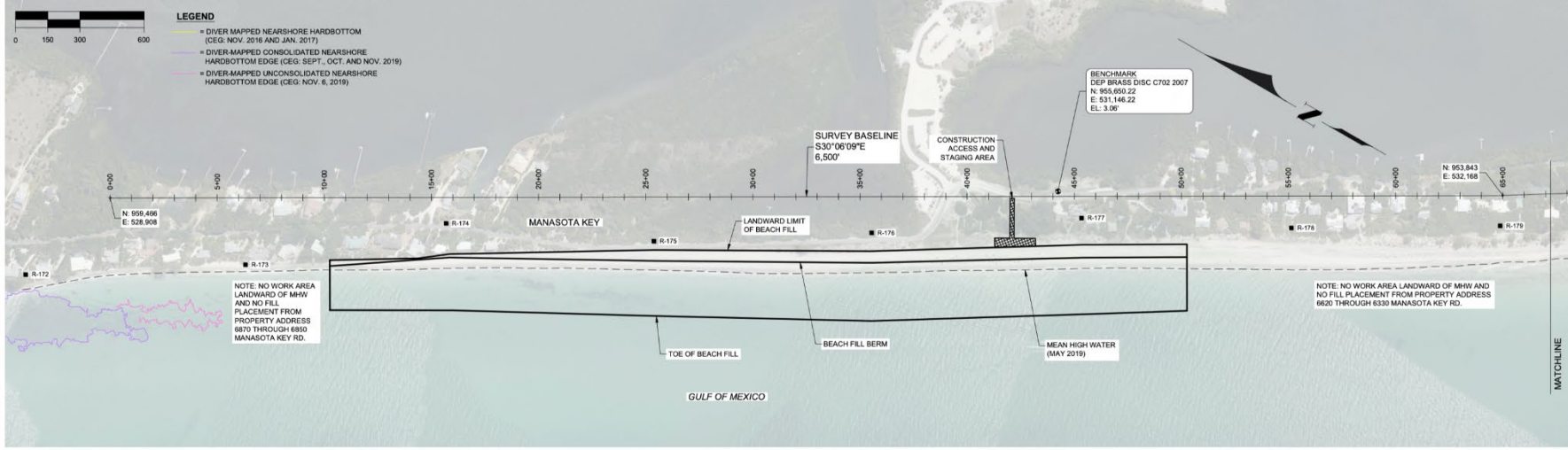
GENCADE Model

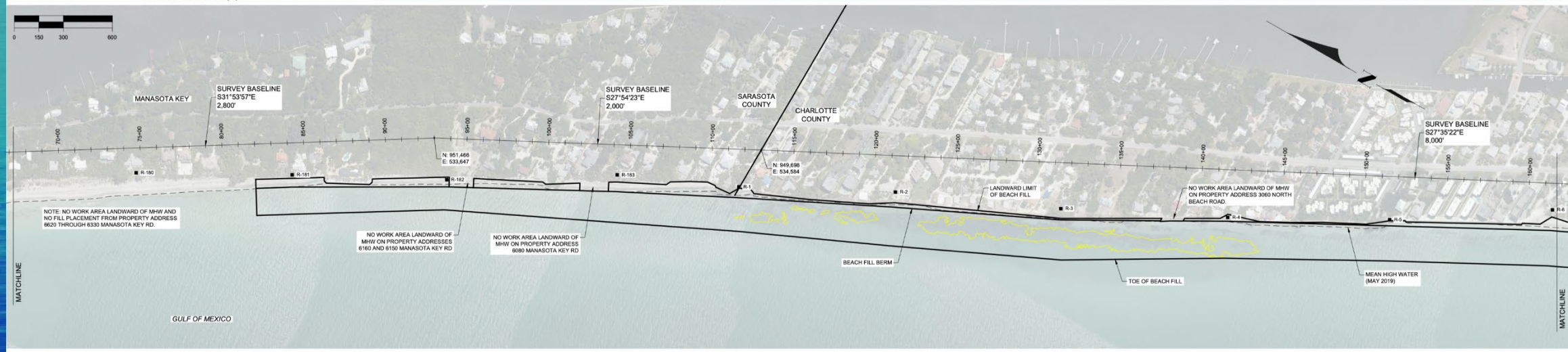
8-year Simulation 2017-2024

Fill from R-173+450 in Sarasota County to R-11 in Charlotte County

FINAL DESIGN







Quantities and Cost

Length: 4.6 Miles on Manasota Key

Volume: 937,000 CY on Manasota Key

Density: 55 CY/FT

Cost: Beach Fill $30.4 Mil. (Manasota Key & Knight Island – addl. 313,000 CY)
Artificial Mitigation Reef $6.8 Mil.

SCHEDULE

February 16 ~ 20, 2020

Hopper Dredges to Arrive and
Start Pumping Sand

Acknowledgements

- Charlotte County BCC & Staff
- Sarasota County BCC & Staff
- Residents
- Advisory Committees
- State and Federal Agencies
- Shorebird and Sea Turtle Monitors