TRADITIONAL BEACH TEMPLATE VS CROSS SHORE SWASH ZONE (CSSZ) PLACEMENT METHODS AT EGMONT KEY, FL

High Silt Content Beneficial Use Placement

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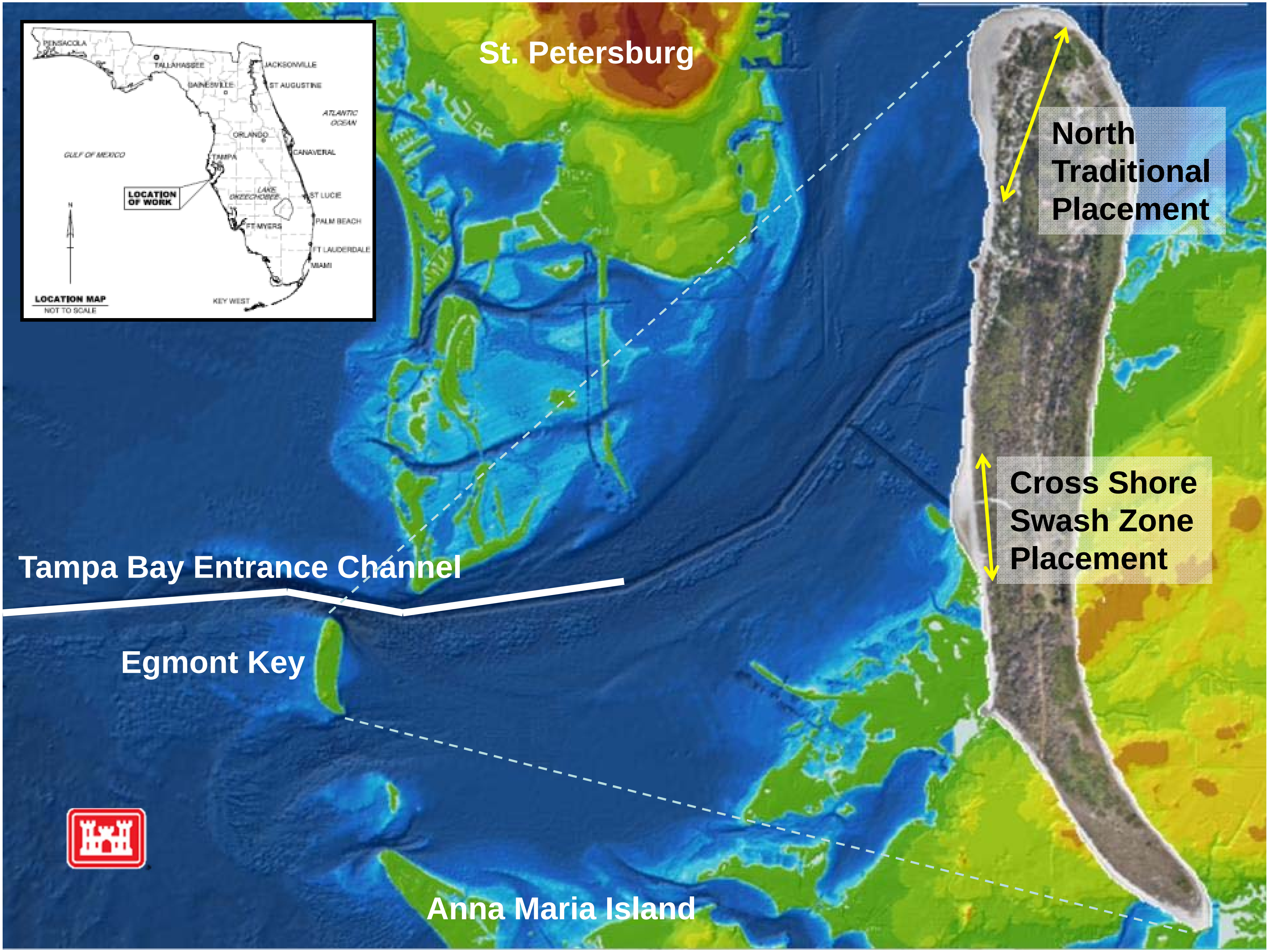
USF UNIVERSITY OF SOUTH FLORIDA

ERDC Engineer Research and Development Center

Outline

- **Background**
  - Ideal opportunity for R&D to address environmental concerns and regulations
  - Egmont Key National Wildlife Refuge – “Sand Rule”
  - Material is approx. 20% “fines” (passing 230 sieve)
  - Definitions and Example Projects
  - Beneficial reuse projects – 2001, 2006, and 2011
  - Time series aerials
- **Dredging and Placement**
  - Volumes
  - Compaction - Cone Penetrometer
  - Mass Balance of “fines”
  - Fines Content, Density, Munsell Color
  - Light Attenuation and Turbidity
  - Sea turtle nesting
- **Conclusions**
  - Traditional vs. Cross Shore Swash Zone Placement
  - Acknowledgments


PENSACOLA
TALLAHASSEE
JACKSONVILLE
GAINESVILLE
ST AUGUSTINE
ATLANTIC OCEAN
ORLANDO
CANAVERAL
GULF OF MEXICO
TAMPA
LOCATION OF WORK
LAKE OKEECHOBEE
ST LUCIE
PALM BEACH
FT MYERS
FT LAUDERDALE
MIAMI
KEY WEST
N
LOCATION MAP
NOT TO SCALE
St. Petersburg
North Traditional Placement
Cross Shore Swash Zone Placement
Tampa Bay Entrance Channel
Egmont Key
Anna Maria Island

Definitions

• **Traditional Placement** – placement of material to “build a beach” using longitudinal dikes to increase settlement. This projects purpose is to create a wide flat dry beach berm.

Definitions

- **Cross Shore Swash Zone Placement** (CSSZ) – placement of dredged material by discharging material directly into the swash zone until a delta builds and then extending outfall shore perpendicular thus building a “point” (salient) feature.

21 Feb 15

29 Apr 15

Images Courtesy of GLDD

Case Examples – Mayport 1972

- Cross Shore Swash Zone Placement (CSSZ)

Clean Water Act (CWA)

Case Examples – Sand groynes Delfland 2009

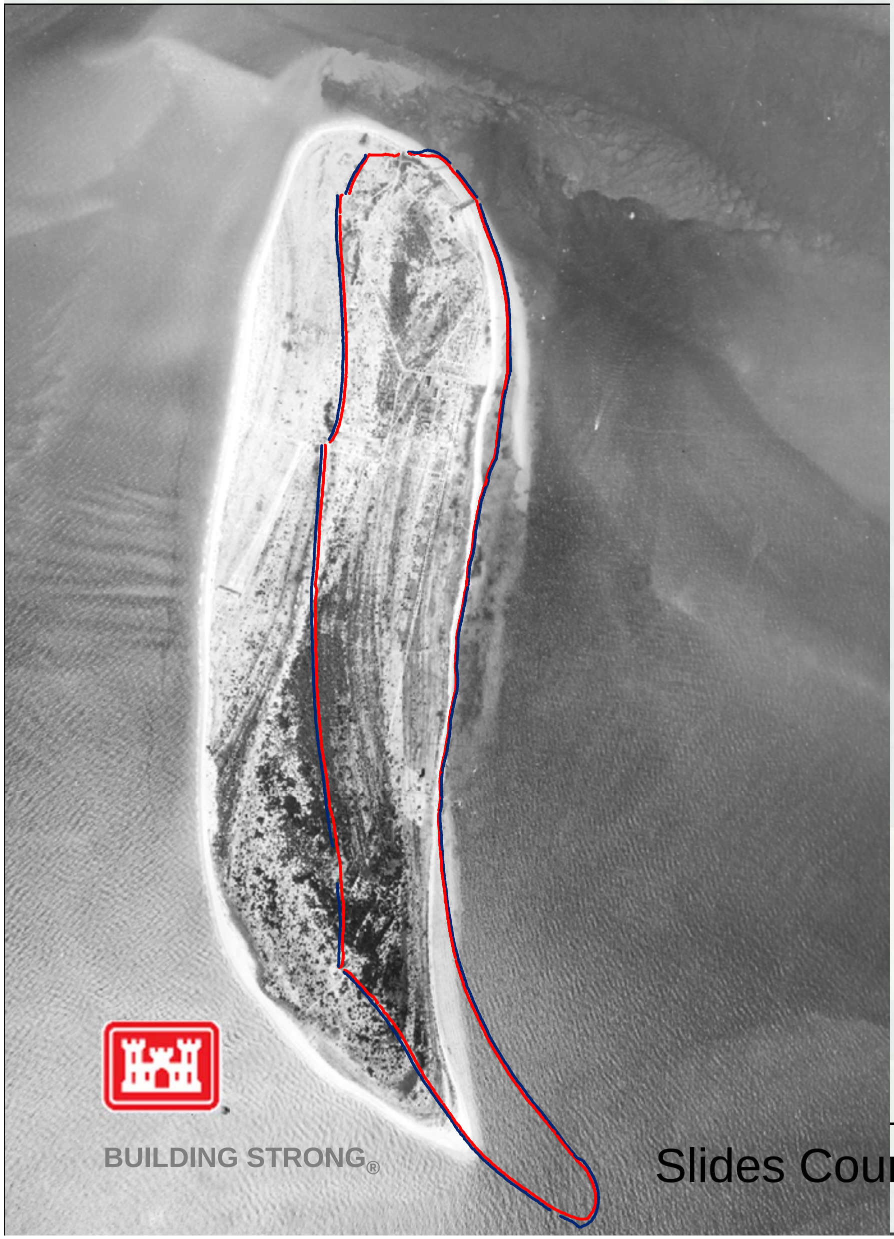
- 3 concentrated nourishments 200k m^3 each
- Uniformly redistributed over a stretch of coast of about 2.5km by the impact of waves and currents
- https://publicwiki.deltares.nl/display/BWN/Building+Block+-+Feeder+beaches+-+Practical+Applications

Case Examples – Delfland Sand Engine 2011

- Concentrated nourishments 28M m^3
- Intertidal ponds were intentional for added habitat
- http://deltaproof.stowa.nl/Publicaties/deltafact/Sand_nourishments.aspx?pId=53#COSTS_AND_BENEFITS

Time-series aerial photos

1942



2014 1993 1984 2004

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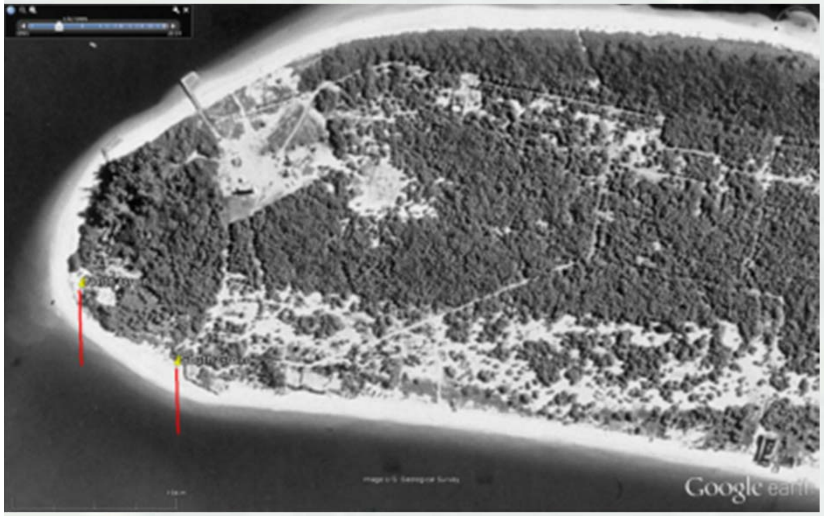
Slides Courtesy of USF

Previous Placement Events

1999



2002

2005

2007

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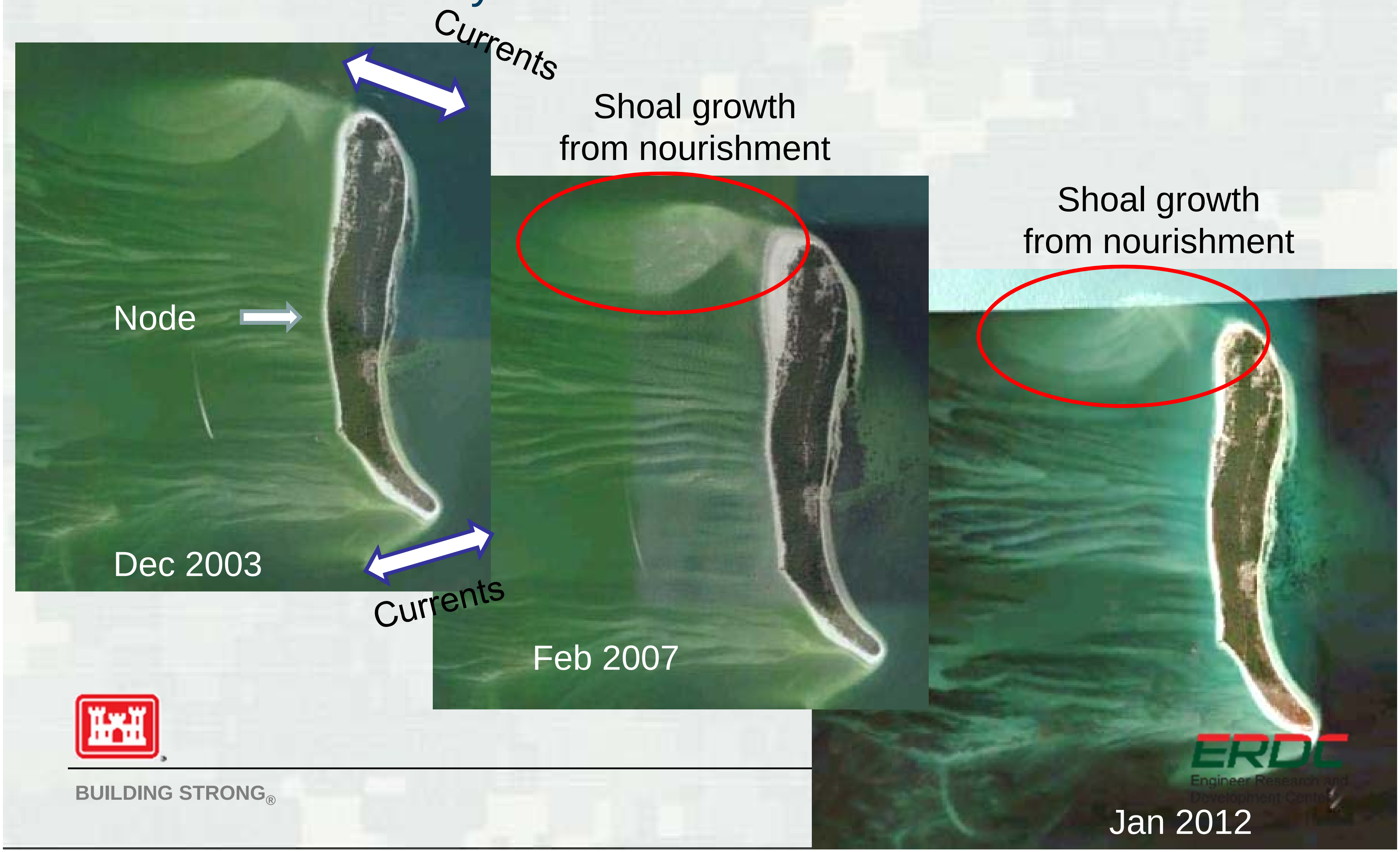
Previous BU – Egmont Key 2001, 2006 & 2011

- Ebb dominated system

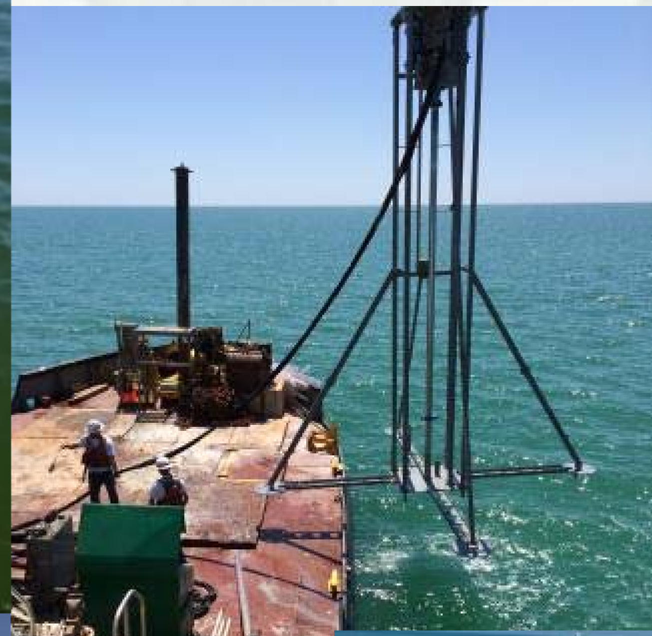


Dredging and Placement

UAV flight aerial 16 March 2015

Image Courtesy of USACE Jacksonville District

Project Monitoring

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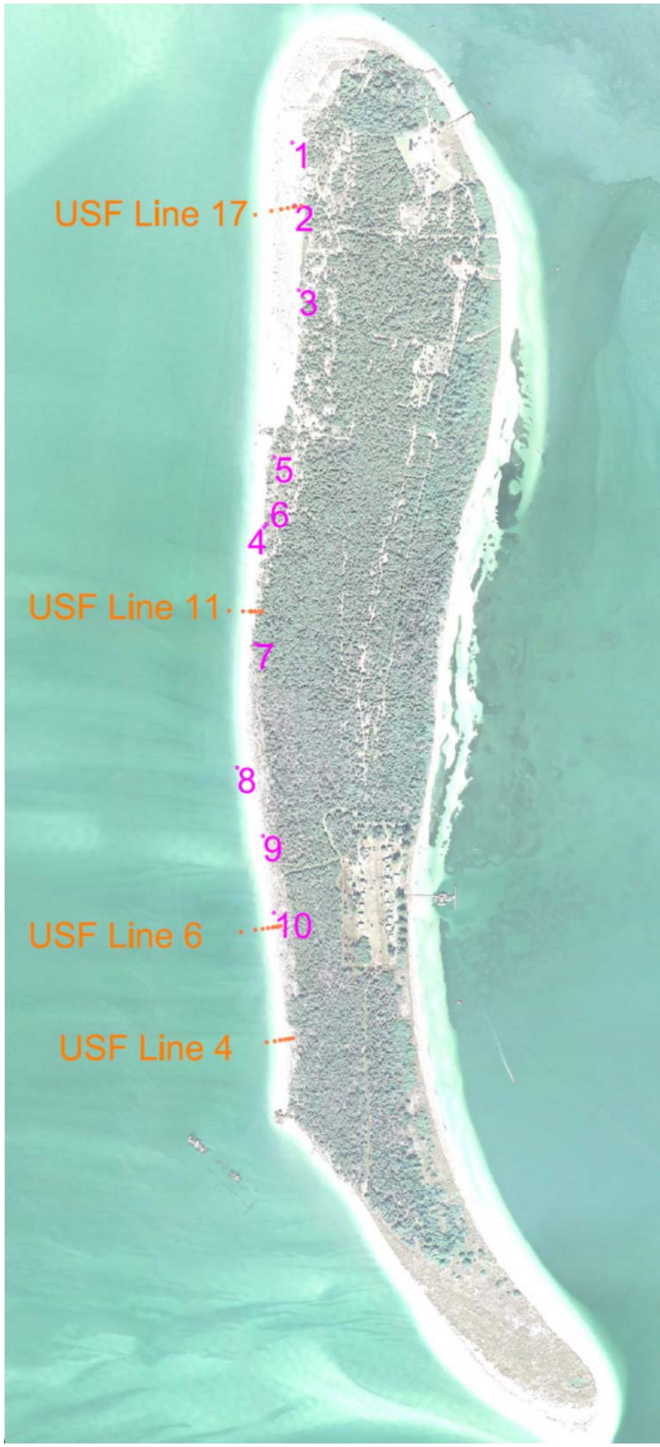
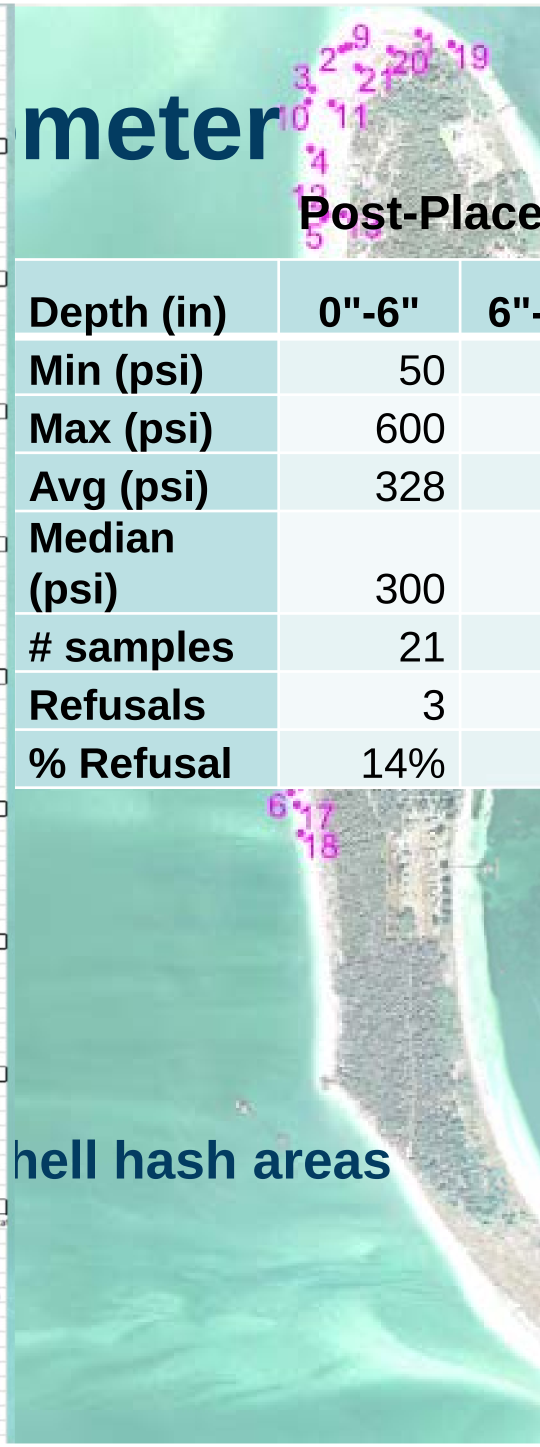
meter



	Pre-Construction Cone Penetrometer		
	USF Line 4	Berm	
	0"-6"	6"-12"	12"-16"
	150	250	500
	250	280	540
	250	230	530
	200	270	500
	170	210	490
	190	250	600
Avg.	202	248	527
	USF Line 4	Foreshore	
	0"-6"	6"-12"	12"-16"
	470	500	430
	350	520	300
	400	450	280
	430	460	250
	380	500	300
	440	430	280
Avg.	412	477	307
	USF Line 6	Berm	
	0"-6"	6"-12"	12"-16"
	350	330	350
	260	200	500
	360	270	360
	390	150	450
	280	140	550
	250	100	450
Avg.	315	198	443
	USF Line 6	Foreshore	
	0"-6"	6"-12"	12"-16"
	170	430	600
	190	400	500
	180	400	550
	150	370	610
	130	350	600
	160	360	450
Avg.	163	385	552
	USF Line 11	Berm	
	0"-6"	6"-12"	12"-16"
	240	150	570
	180	300	580
	190	270	520
	270	160	600
	140	230	500
	200	200	550
Avg.	203	218	553
	USF Line 11	Foreshore	
	0"-6"	6"-12"	12"-16"
	270	310	160
	310	350	210
	350	250	220
	330	260	160
	350	220	250
	340	250	190
Avg.	325	273	198
	USF Line 17	Berm	
	0"-6"	6"-12"	12"-16"
	340	700	500
	280	650	630
	310	640	450
	290	660	560
	300	660	500
	250	670	450
Avg.	295	663	515
	USF Line 17	Foreshore	
	0"-6"	6"-12"	12"-16"
	450	630	650
	450	560	500
	410	650	490
	370	450	460
	340	470	500
	370	500	550
Avg.	398	543	525
	USF Line 17	*Dune	
	0"-6"	6"-12"	12"-16"
	570	570	730
	Refusal	400	600
	560	700	670
	540	Refusal	550
	460	Refusal	700
	200	Refusal	450
Avg.	466	557	617

*Dune is a relic fill, now a soil with higher elevation vegeta

	11/20/2014		
1	0"-6"	6"-12"	12"-16"
2	580	Refusal (shell)	
3	100	200	Refusal (shell)
4	360	590	580
5	450	500	300
	11/21/2014		
6	150	100	400
7	150	350	425
8	200	600	Refusal
9	250	700	Refusal
10	250	200	Refusal
11	300	500	Refusal



Post-Placement

Depth (in)	0"-6"	6"-12"	12"-18"
Min (psi)	50	125	200
Max (psi)	600	700	600
Avg (psi)	328	482	436
Median (psi)	300	500	500
# samples	21	21	21
Refusals	3	6	10
% Refusal	14%	29%	48%

hell hash areas

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Mass Balance – Egmont Key 2014

Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Sample by weight Fines (passing 230 sieve)
In-situ Channel	80	20.7%
Discharge Slurry	27	18.4% *
Swash zone	27	17.5%
Beach samples	22	0.5%

- Assumptions
  - 100% slurry water conveyed to the wash zone
  - Slurry and swash zone sampling a closed system
- Relationships
  - Swash Zone samples carried 13.2% of the Discharge Slurry fines out of the beach template, thus leaving 5.2% on the beach.

*Sampling methods at discharge slurry not ideal

*Only Traditional Placement

Fines Content and Density

Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Avg. % by wt. passing 230 sieve
In-situ	80	20.7
pre-Beach	6	0.03
post-Dredged	21	0.51
Traditional	14	0.52*
CSSZ	7	0.49 *

Tampa Harbor MD - Egmont Key 2014			
Density	# of Samples	Value avg. (kg/m3)	% Greator
pre-Beach	7	1405.1	0.0%
post-Dredged	17	1471.6	4.7%
Traditional	11	1476.0	5.0%
CSSZ	6	1463.5	4.2%

*Sampling occurred within 72 hours of placement completion

Images Courtesy of GLDD

Munsell Color

Tampa Harbor MD - Egmont Key 20		
	# of Samples	Valu avg.
In-situ	80	4.36
pre-Beach	13	5.9
post-Dredged	24	5.3
Traditional	16	5.0
CSSZ	8	5.9

*Munsell color value<5 u

NOTES: Triplicate measurements of hue, value, and chroma were collected from three areas on each moist sand sample using a digital colorimeter (CR-400, Konica Minolta, Osaka, Japan).

Light Attenuation Long-term Monitoring

Egmont Key, FL
Long-term
Deployment Map
14 Nov – 15 Dec

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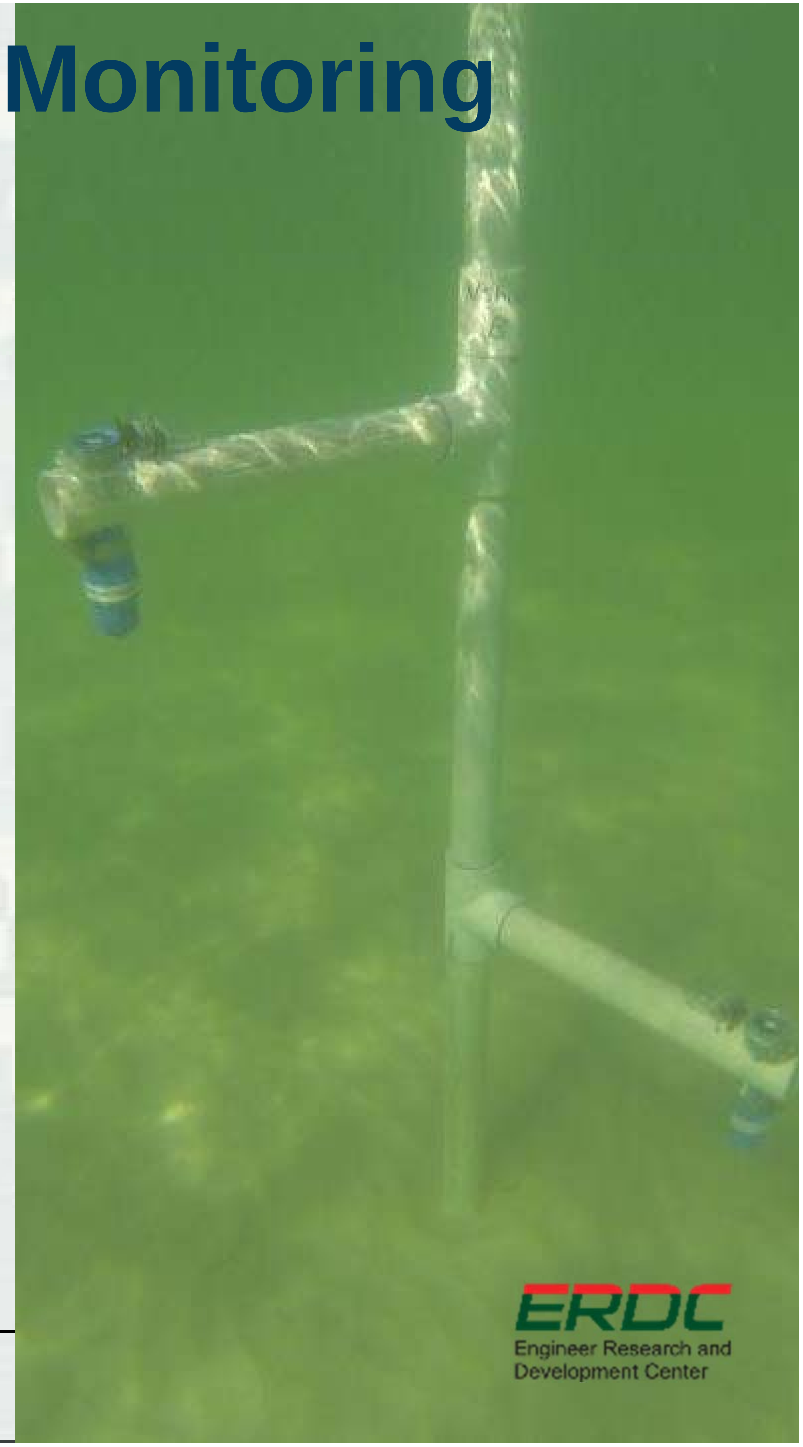
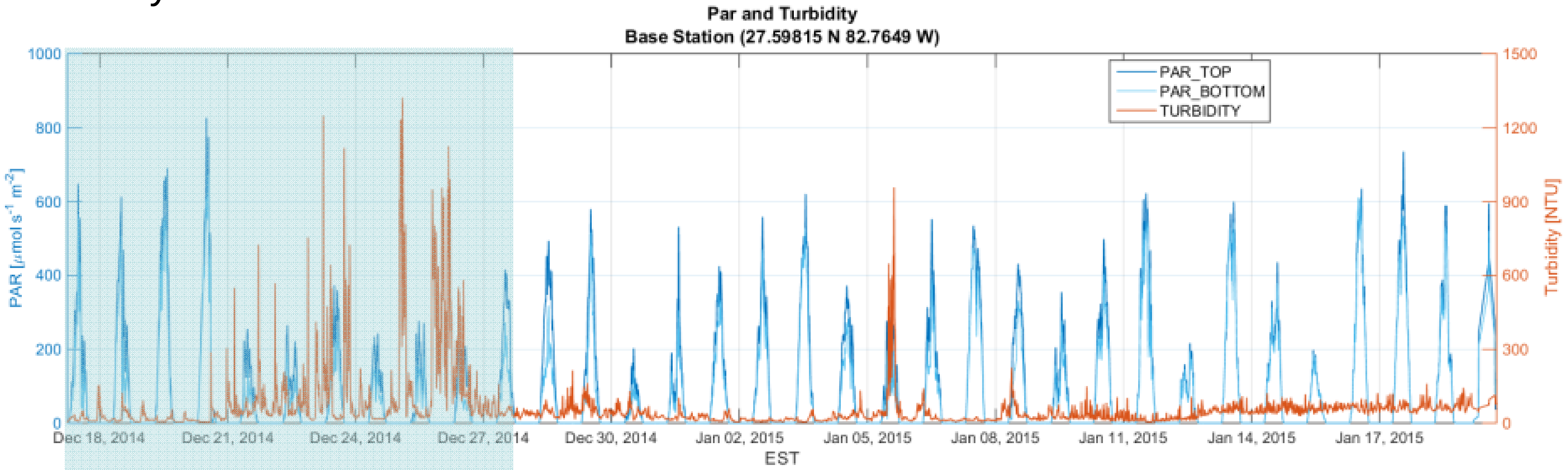
Image Courtesy of GLDD

Light Attenuation Monitoring



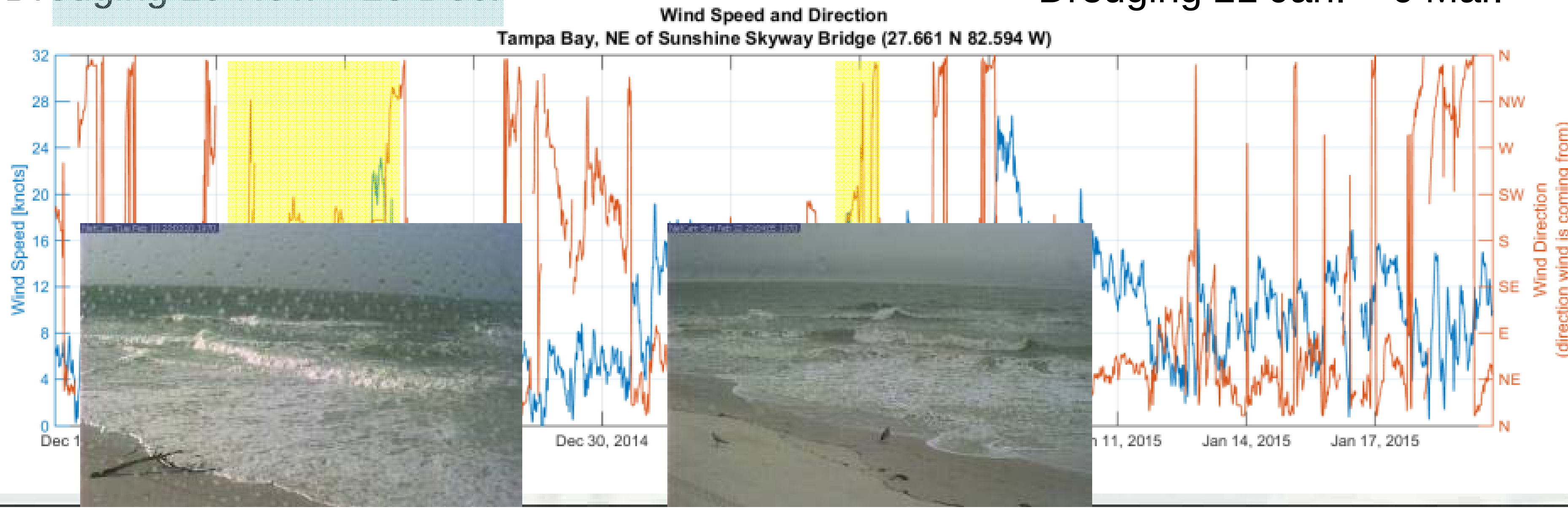
Light Attenuation Long-term Monitoring

Turbidity versus PAR values



Dredging 19 Nov. – 28 Dec.

Dredging 21 Jan. – 6 Mar.



Sea Turtle Nesting 2015

Nesting as of 16 August 2015

CSSZ Drawbacks vs. Traditional Placement

- **Issues**
  - Material is not immediately visible to public
  - Remediation for unacceptable material far more difficult
  - Egmont Key not identical to other projects, low energy, with inlets
  - Each contractor's crew has their preferred operational techniques: longitudinal dike length, equipment, and methodology

- **Risks**
  - If parameters imposed on nearshore placement are more restrictive this placement method could become more expensive than traditional beach placement
  - Project shutdowns for turbidity
    - Instantaneous vs. chronic

CSSZ Benefits vs. Traditional Placement

- **Less linear feet of beach impacted for equivalent volume**
- **Reduced environmental Impacts**
  - Turtle nest relocations
  - Ponding
  - Cementation
  - Munsell Color
  - Shorebird impacts
- **Lower cost**
  - Construction – less beach equipment
  - Reduced pipeline extensions
  - Maintenance – less escarpment, tilling
- **Reduced beach traditional use impacts**
  - Sunbathing and Water sports
- **Another tool in the BU toolbox**
- **Purely performance based regulations**
  - More beneficial reuse
  - Lower costs - better bids due to more equipment able to perform work

Image Courtesy of GLDD

Conclusions

- CSSZ placement operations within intent of
  "Sand Rule" – reasonable assurance
- CSSZ material spread longshore very quickly
- Grain Size sampling indicates significant "fines" losses
  - 2.4% of original (in-situ) "fines" remaining on beach = 0.5% total
  - 98% of "fines" lost
- Munsell Color and Compaction similar to pre-conditions
- Better RSM practice, better environmental practice, and better economic practice
- Engineering with Nature (EwN)

Image Courtesy of GLDD

Acknowledgments

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