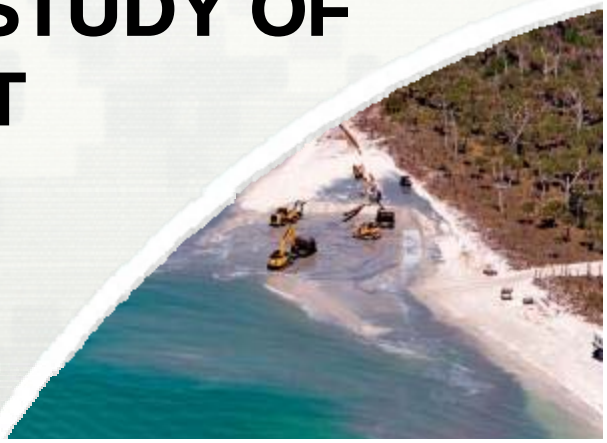
COMPREHENSIVE MONITORING STUDY OF A BENEFICIAL REUSE PROJECT AT EGMONT KEY, FL

Katherine E. Brutsché, Ph.D. (presenter)
Coraggio Maglio, P.E., Jase D. Ousley, P.G., Deborah S. Shafer, Ph.D., Matthew B. Taylor, Cheryl E. Pollock, P.E.
US Army Corps of Engineers (USACE)
Engineer Research and Development Center

Aubree Hershorin, Ph.D. & Millan Mora, P.E.
USACE Jacksonville District

Ping Wang, Ph.D., Zachary J. Tyler
University of South Florida

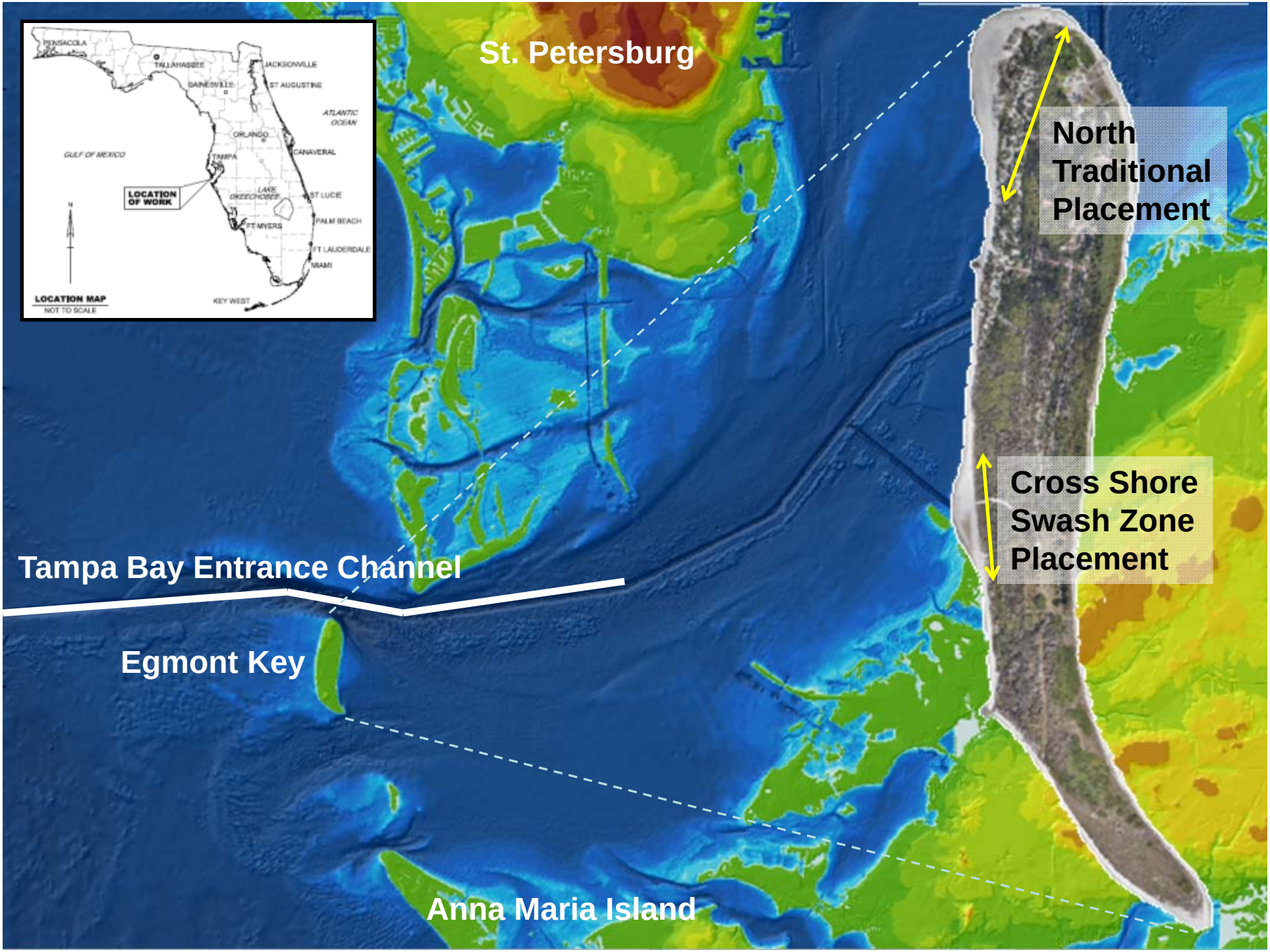


Outline

- Introduction
- Research Objectives
- Project Monitoring
- 2014 Dredging and Placement
- Results
- Summary and Conclusions

Egmont Key

- Virtually uninhabited island located at the mouth of Tampa Bay, Florida
- Cultural and environmental resources
  - Historical structures
  - Bird nesting
  - Turtle nesting
- Highly dynamic island due to its location
- Continually maintained through beach nourishments on north tip of the island


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

Time-series aerial photos

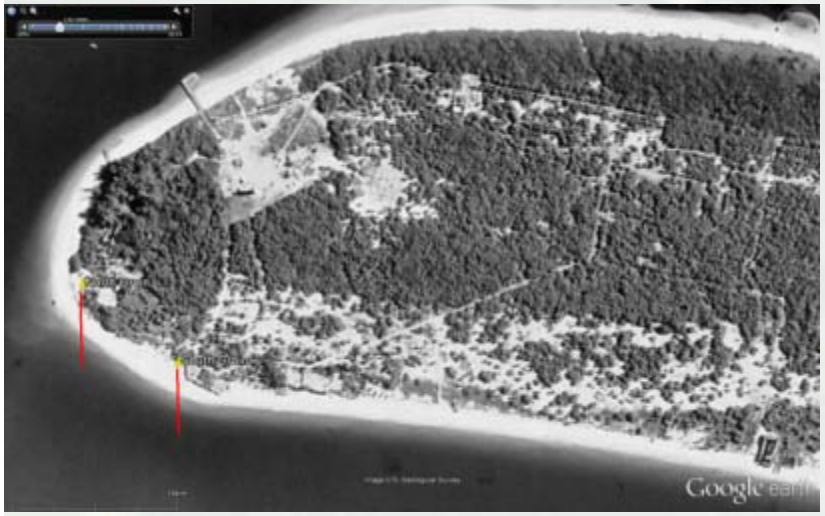
1942

2014 1993 1982

Slides Courtesy of USF

Previous Placements

1999



2002

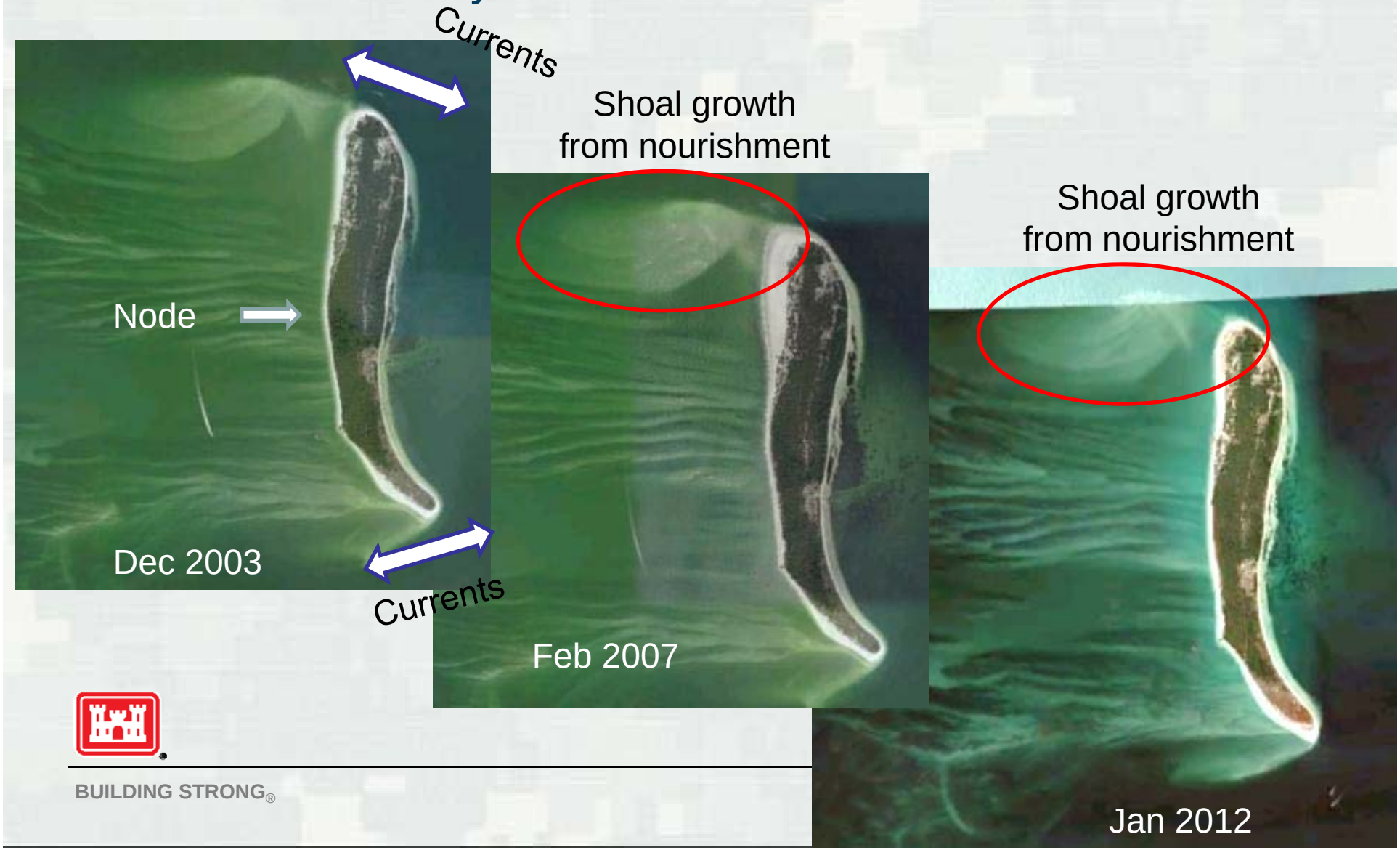
2005

2007

Slides Courtesy of USF

Previous BU – Egmont Key 2001, 2006 & 2011

- Ebb dominated system



Egmont Key

- Dredging commenced November 2014
- Material dredged from Tampa Entrance Channel
- Placement in a traditional beach nourishment and a cross-shore swash zone placement
- In situ fine content approximately 20% passing the #230 sieve
  - Exception to Florida Sand Rule was made for Egmont due to its environmental and cultural resources
- Ideal opportunity to study R&D to address environmental concerns and regulations

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

Research Objectives

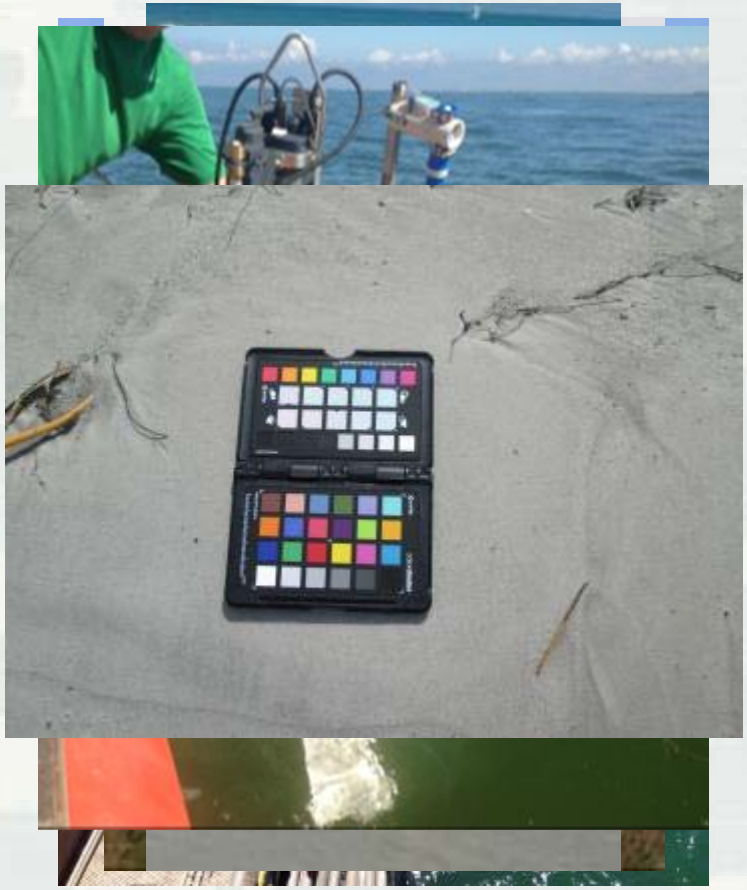
- To track the fine sediment loss through the dredging process and quantify their effects on the placement area.
  - If fine sediments can be more broadly utilized, regulatory standards could be changed which would ultimately save the USACE's limited dredging funds.
- To test several types of relatively inexpensive light and photosynthetically active radiation (PAR) sensors.
  - If lower-cost PARs can be correlated with turbidity measurements, they could be more broadly utilized as an alternative measurement method.
- To compare dredging conditions with ambient conditions.
  - Natural turbidity may be similar to that associated with dredging of fine sediments, lending additional justification to modification of regulatory standards.
- To compare CSSZ and traditional placements

Why worry about fines?

- Compaction and density issues
  - Thought to be an issue for sea turtle nesting
- Light attenuation
  - Dredge plume associated with fine sediments and impacts to biological resources
- Sediment color
  - Impacts to sea turtle male to female ratio, incubation period and reduces hatching success
  - Aesthetic issues
- Overall grain size
  - May not match existing beach

Project Monitoring

- Pre-dredging
  - Vibracores taken in channel
  - Sediment analysis
- During/Post-dredging
  - Cameras
  - Surveying
  - Sediment sampling and analysis
    - Dredge and Placement
  - Compaction testing
  - Light/PAR sensors
  - Munsell color
  - Sea turtle nesting surveys



2014 Dredging and Placement

UAV flight aerial 16 March 2015

Image Courtesy of USACE Jacksonville District

Dredging and Placement Volumes

Traditional (North) Placement Area:		
	Cubic Yards (cy)	% of Total
Dredged in Channel	500,037	100.0%
Pumped to Beach	319,712	63.9%
Surveyed on Beach	222,068	44.4%
Cross Shore Swash Zone Placement Area:		
	Cubic Yards (cy)	% of Total
Dredged in Channel	180,512	100.0%
Pumped to Beach	107,225	59.4%
Surveyed on Beach	68,479	37.9%

Volumes Courtesy of GLDD

Results

- Fines Content and Density
- Morphological Evolution
- Compaction- Cone Penetrometer
- Munsell Color
- Light Attenuation
- Sea Turtle Nesting

Fate of Fines – 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%

Fines Content and Density

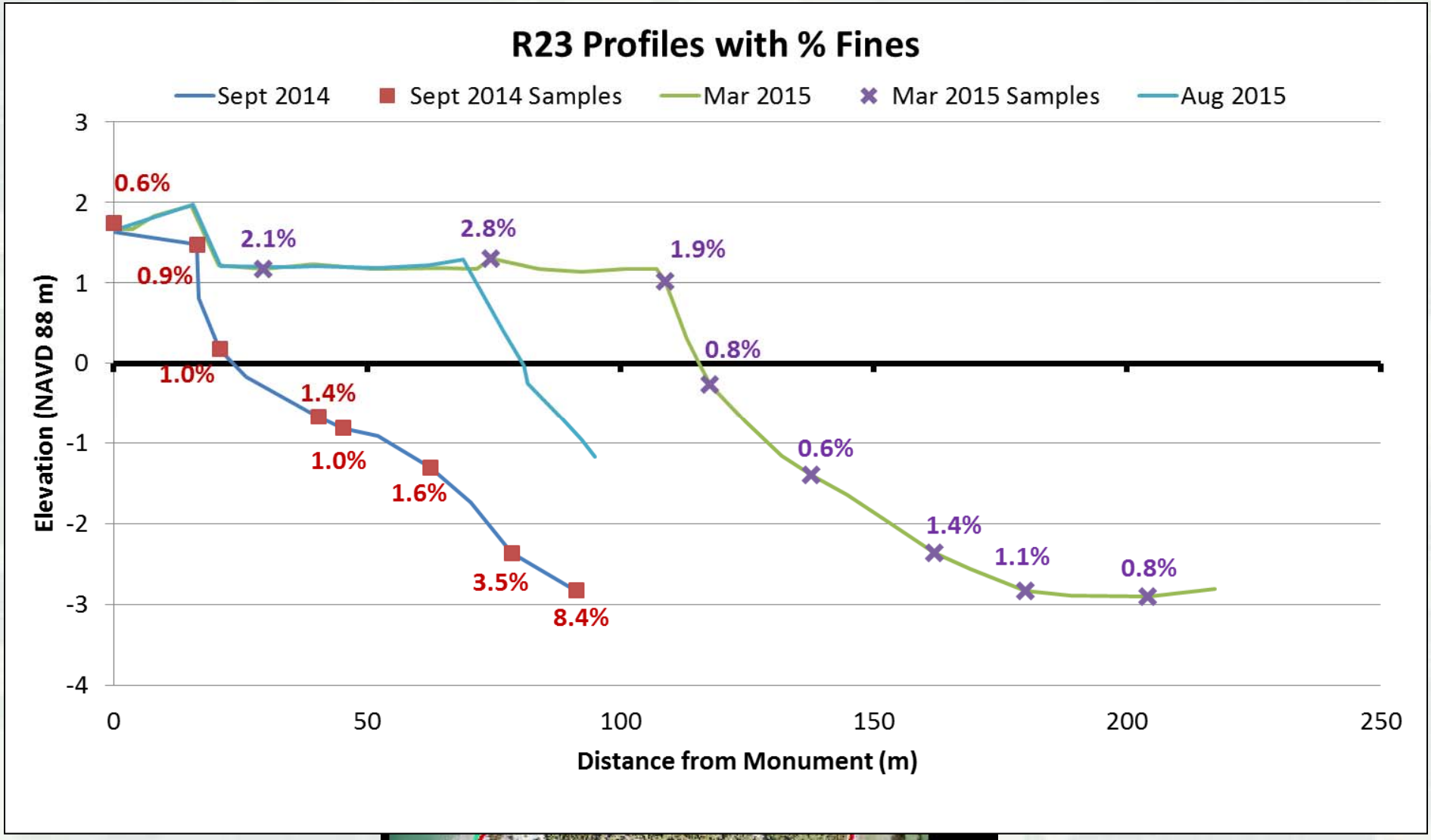
Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Avg. % by wt. passing 230 sieve
In-situ	80	20.7
pre-Beach	6	0.03
post-Dredged	21	0.51
Traditional	14	0.52*
CSSZ	7	0.49 *

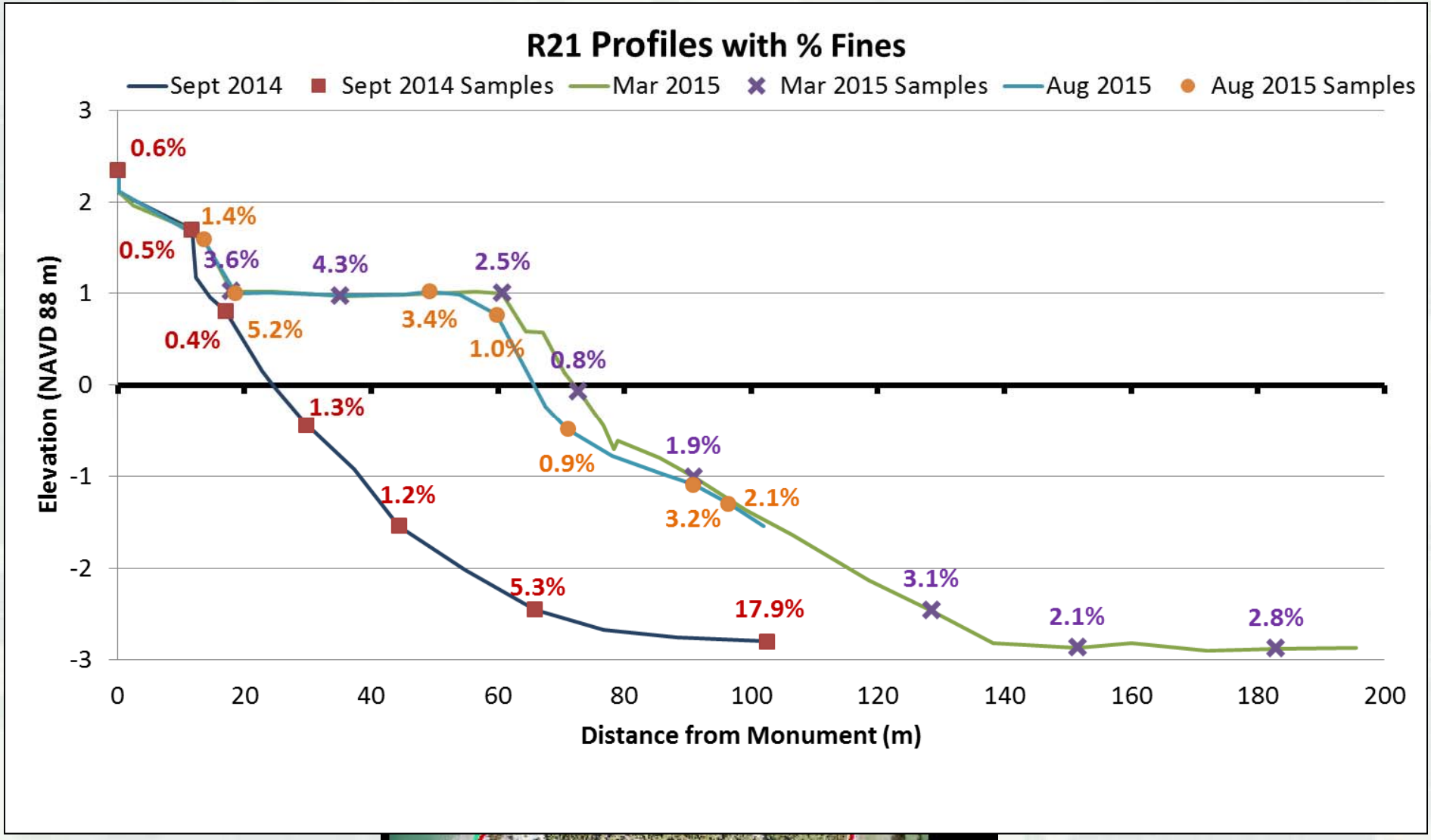
Tampa Harbor MD - Egmont Key 2014			
Density	# of Samples	Value avg. (kg/m3)	% Greater
pre-Beach	7	1405.1	0.0%
post-Dredged	17	1471.6	4.7%
Traditional	11	1476.0	5.0%
CSSZ	6	1463.5	4.2%

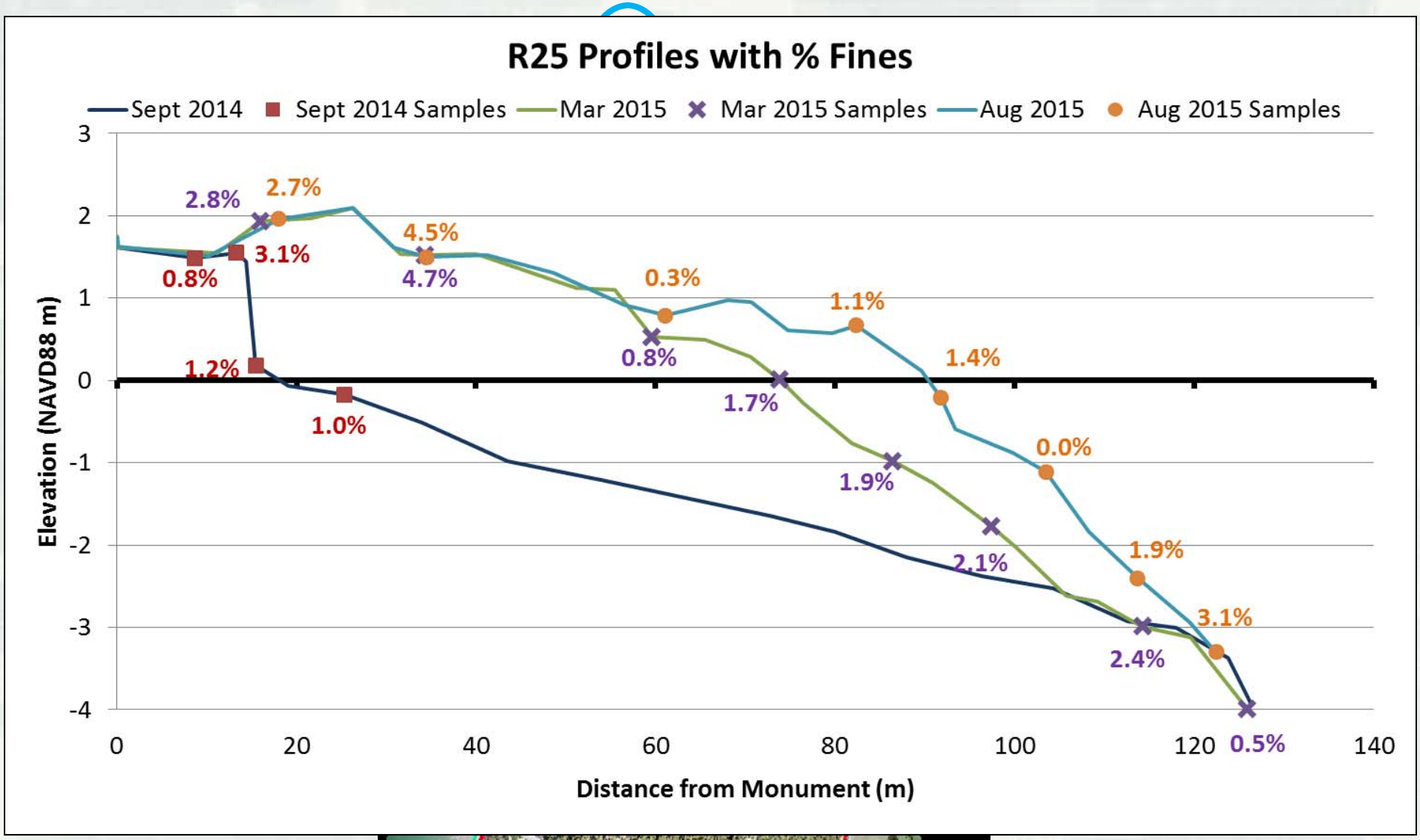
*Sampling occurred within 72 hours of placement completion

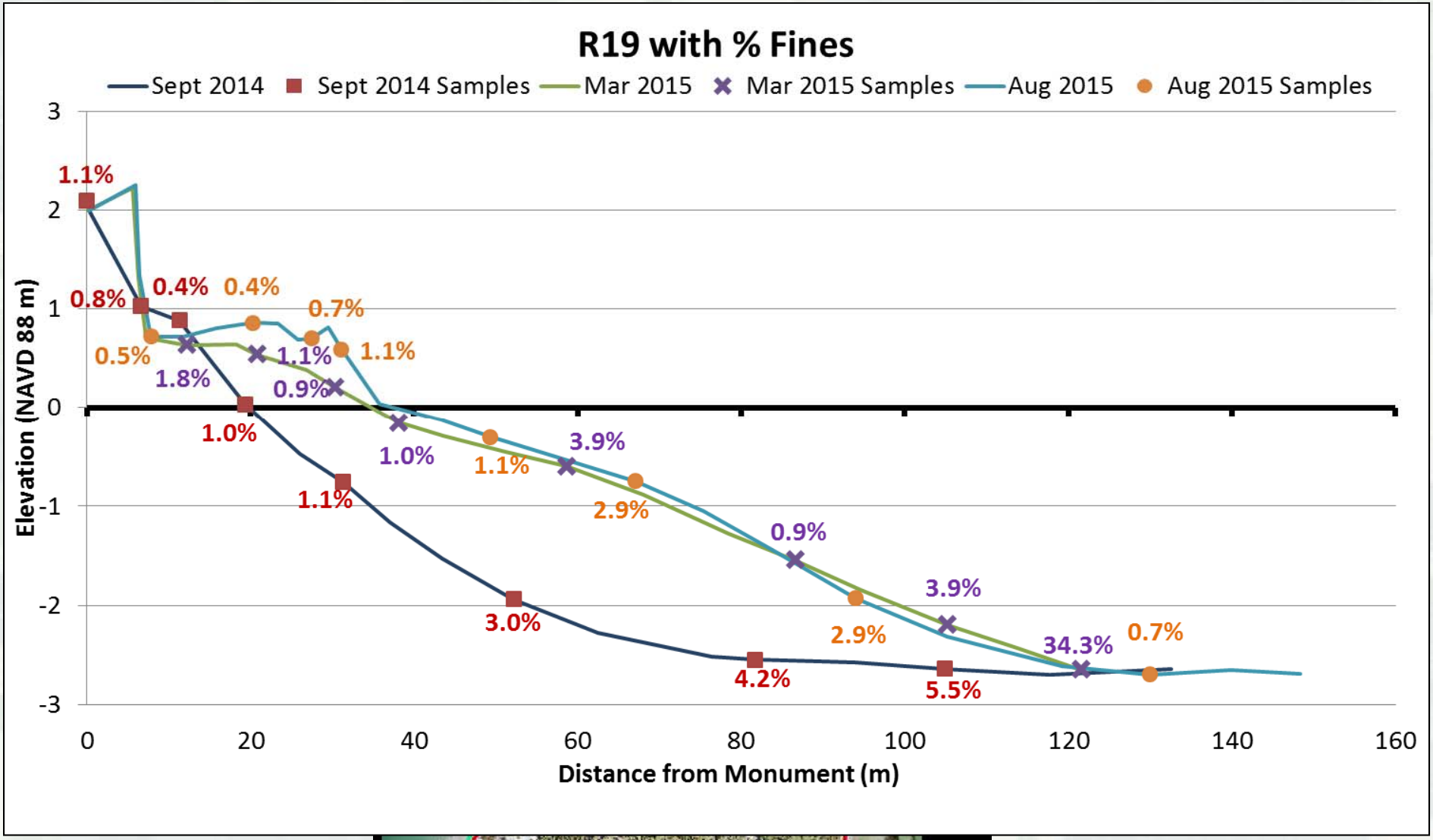
Images Courtesy of GLDD

Traditional Beach Nourishment

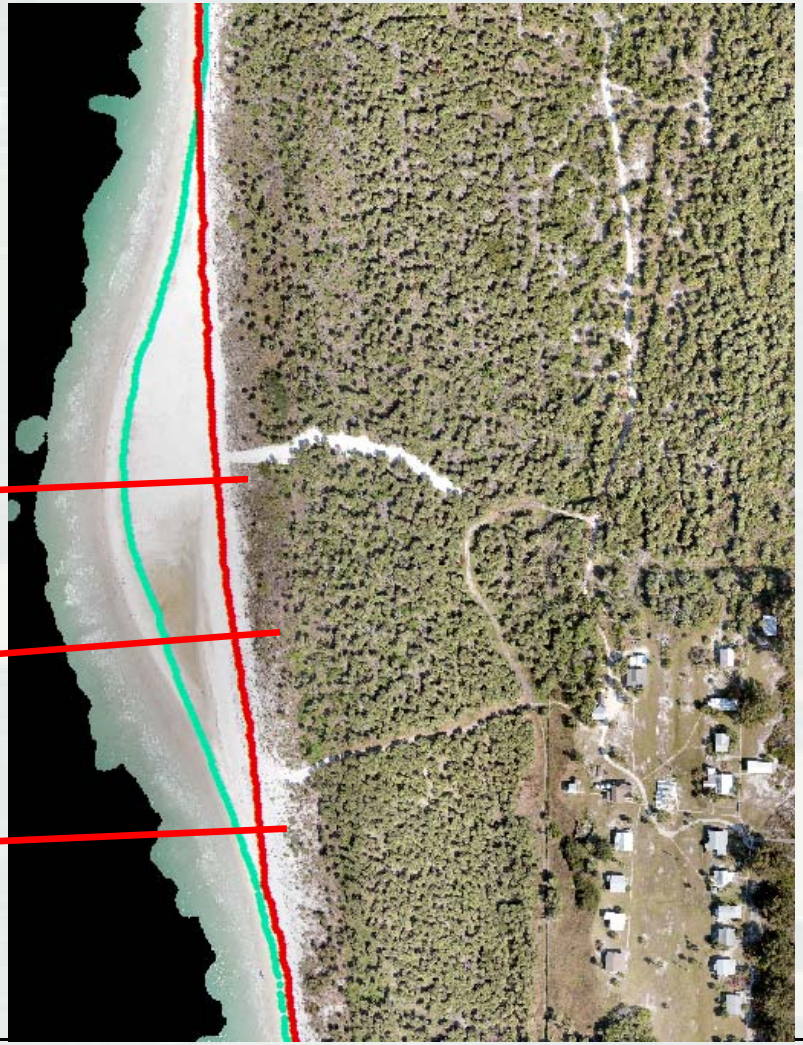

R23 Profiles with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Mar 2015 Samples
Aug 2015
Elevation (NAVD 88 m)
Distance from Monument (m)
3
2
1
0
-1
-2
-3
-4
0
50
100
150
200
250
0.6%
0.9%
1.0%
1.4%
1.0%
1.6%
3.5%
8.4%
2.1%
2.8%
1.9%
0.8%
0.6%
1.4%
1.1%
0.8%

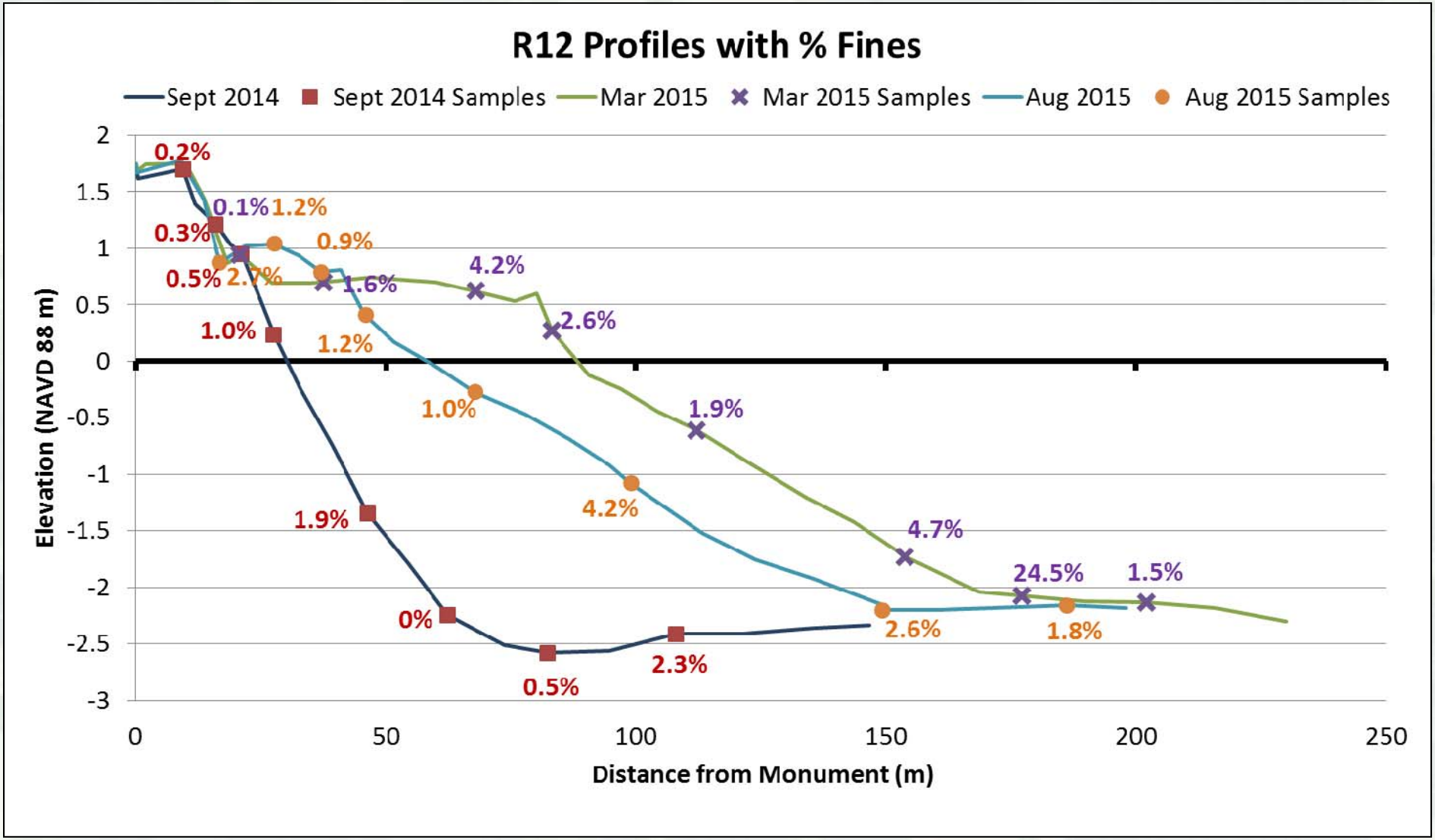

R21 Profiles with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Mar 2015 Samples
Aug 2015
Aug 2015 Samples
Elevation (NAVD 88 m)
Distance from Monument (m)
0.6%
1.4%
0.5%
3.6%
4.3%
2.5%
0.4%
5.2%
3.4%
1.0%
0.8%
1.3%
1.9%
0.9%
1.2%
2.1%
3.2%
5.3%
3.1%
17.9%
2.1%
2.8%


R25 Profiles with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Mar 2015 Samples
Aug 2015
Aug 2015 Samples
Elevation (NAVD88 m)
Distance from Monument (m)
3
2
1
0
-1
-2
-3
-4
0
20
40
60
80
100
120
140
2.8%
2.7%
0.8%
3.1%
4.5%
4.7%
0.3%
0.8%
1.1%
1.4%
1.2%
1.0%
1.7%
1.9%
0.0%
2.1%
1.9%
3.1%
2.4%
0.5%


R19 with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Mar 2015 Samples
Aug 2015
Aug 2015 Samples
Elevation (NAVD 88 m)
Distance from Monument (m)
3
2
1
0
-1
-2
-3
0
20
40
60
80
100
120
140
160
1.1%
0.8%
0.4%
0.4%
0.7%
0.5%
1.8%
1.1%
1.1%
0.9%
1.0%
1.0%
1.1%
3.9%
1.1%
2.9%
0.9%
3.9%
3.0%
2.9%
34.3%
0.7%
4.2%
5.5%

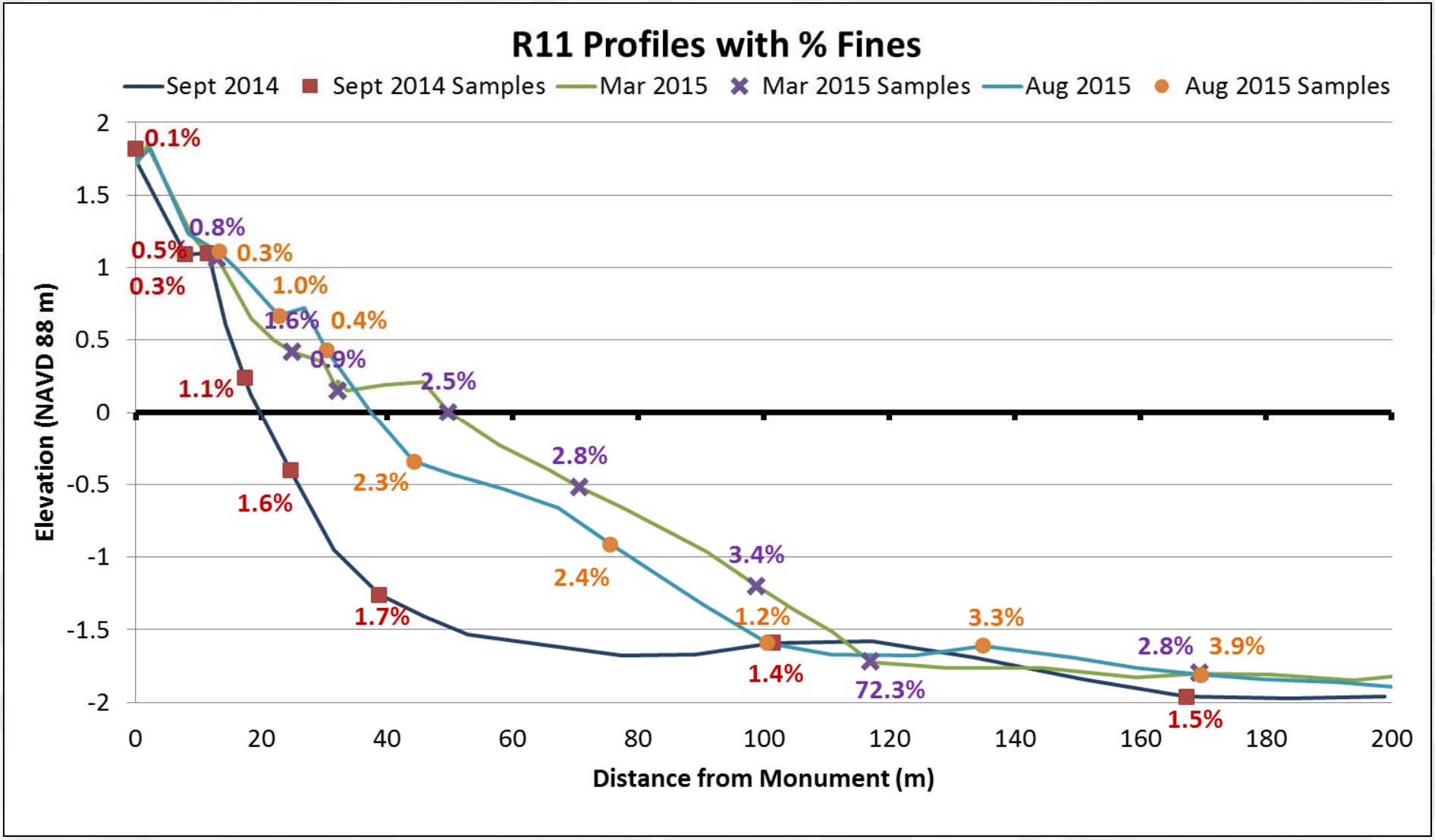
Cross-shore Swash Zone Nourishment





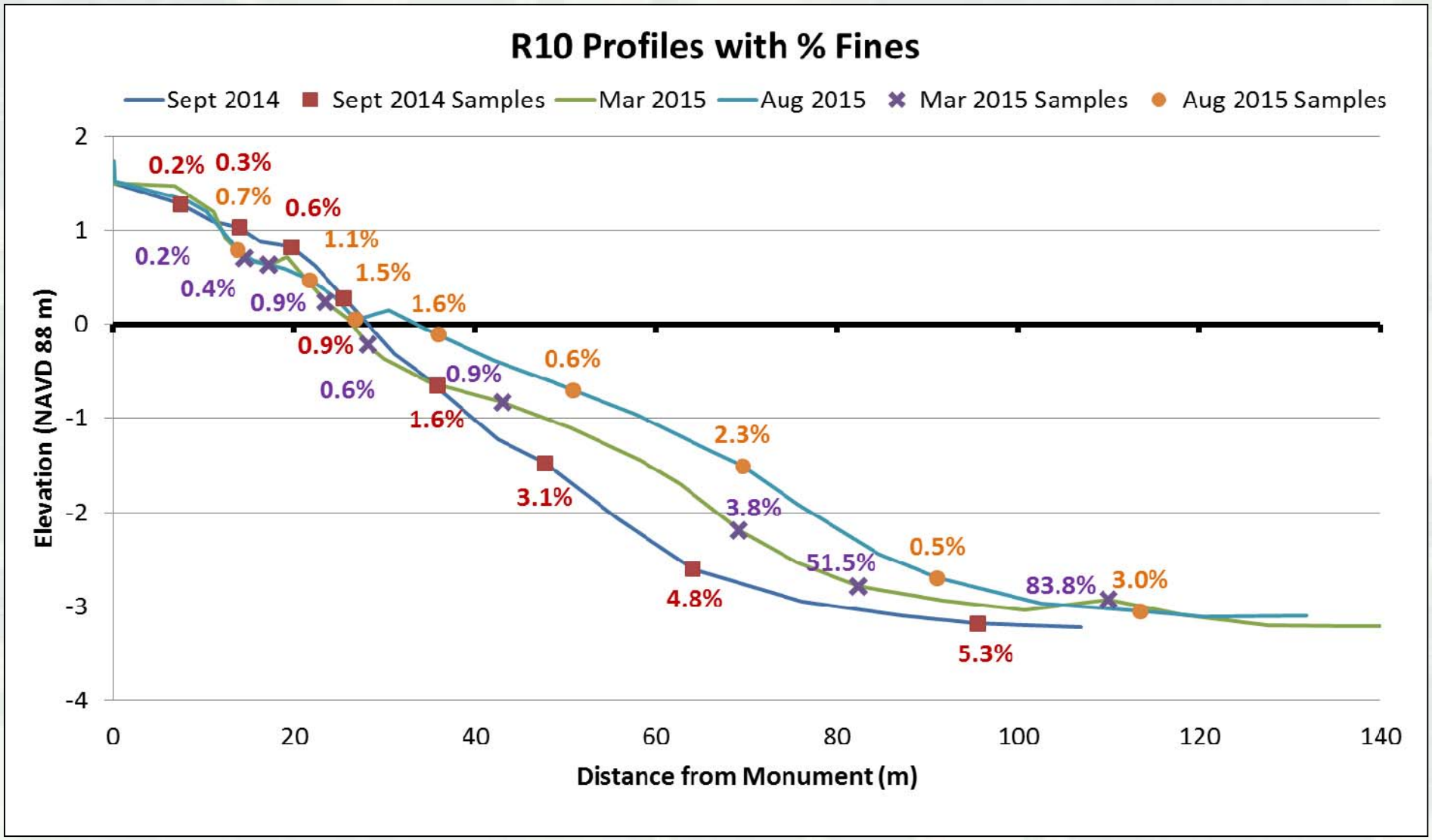
BUILDING STRONG®

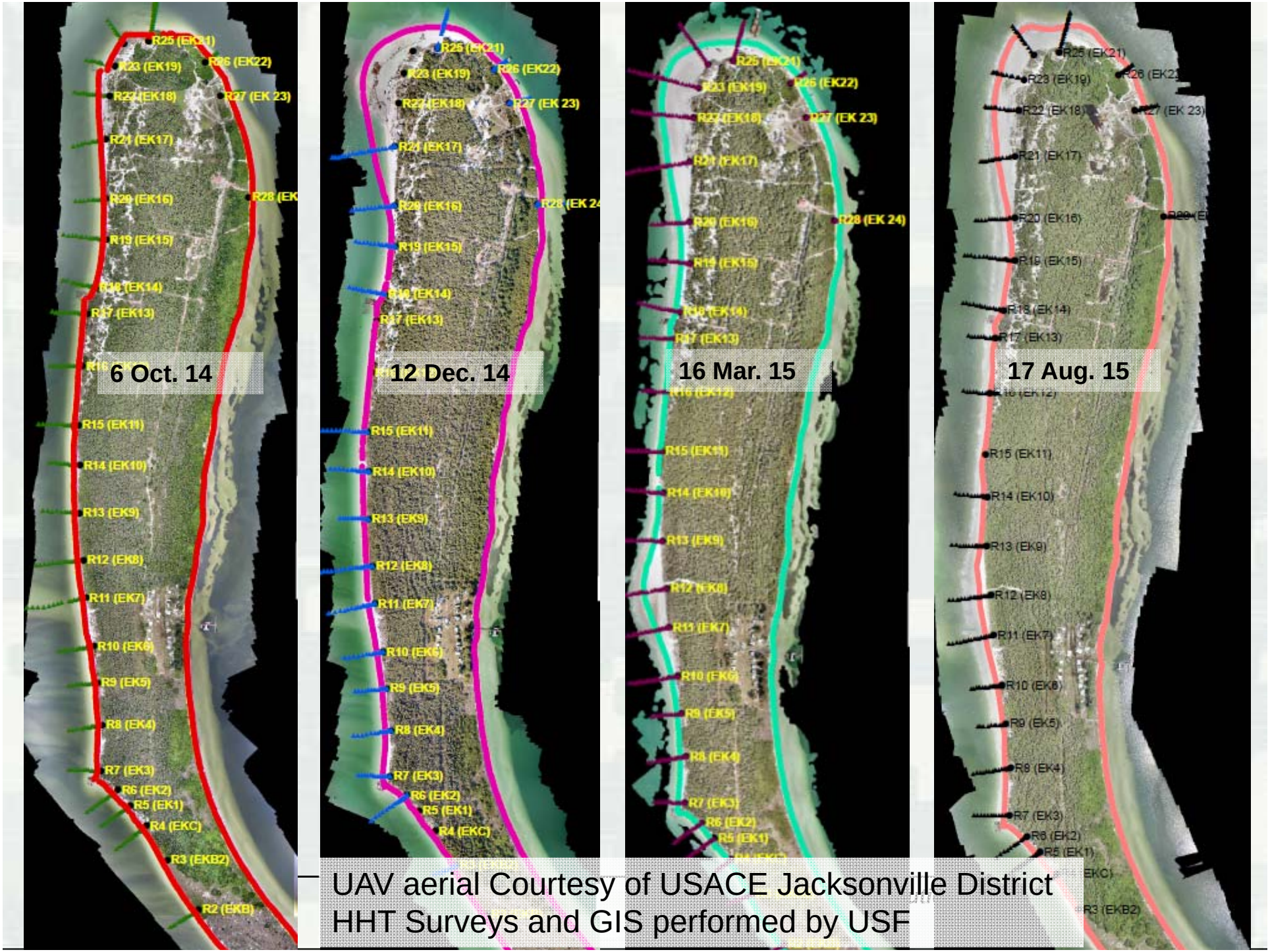
Innovative solutions for a safer, better world



BUILDING STRONG®

Innovative solutions for a safer, better world


R10 Profiles with % Fines
Sept 2014
Sept 2014 Samples
Mar 2015
Aug 2015
Mar 2015 Samples
Aug 2015 Samples
Elevation (NAVD 88 m)
Distance from Monument (m)
2
1
0
-1
-2
-3
-4
0
20
40
60
80
100
120
140
0.2%
0.3%
0.7%
0.6%
1.1%
0.2%
1.5%
0.4%
0.9%
1.6%
0.9%
0.6%
0.9%
0.6%
1.6%
2.3%
3.1%
3.8%
0.5%
51.5%
83.8%
3.0%
4.8%
5.3%



UAV aerial Courtesy of USACE Jacksonville District
HHT Surveys and GIS performed by USF

Cone Penetrometer

Pre-Placement

Depth (in)	0"-6"	6"-12"	12"-18"
Min (psi)	100	100	198
Max (psi)	580	700	617
Avg (psi)	293	406	457
Median (psi)	295	431	515
# samples	19	19	19
Refusals	1	4	5
% Refusal	5%	21%	26%

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%	2	

- Increase in refusals due to shell hash areas

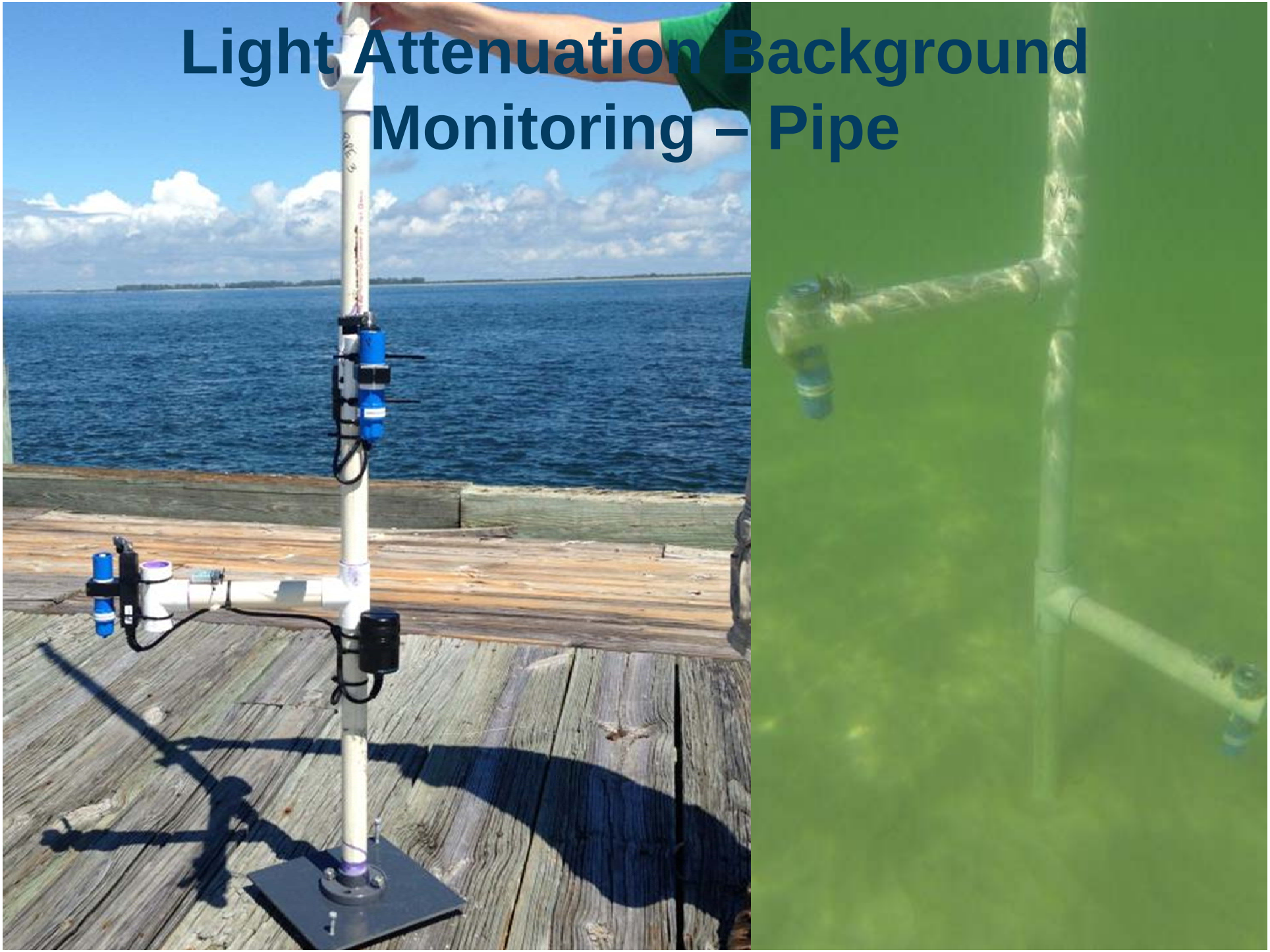
Munsell Color

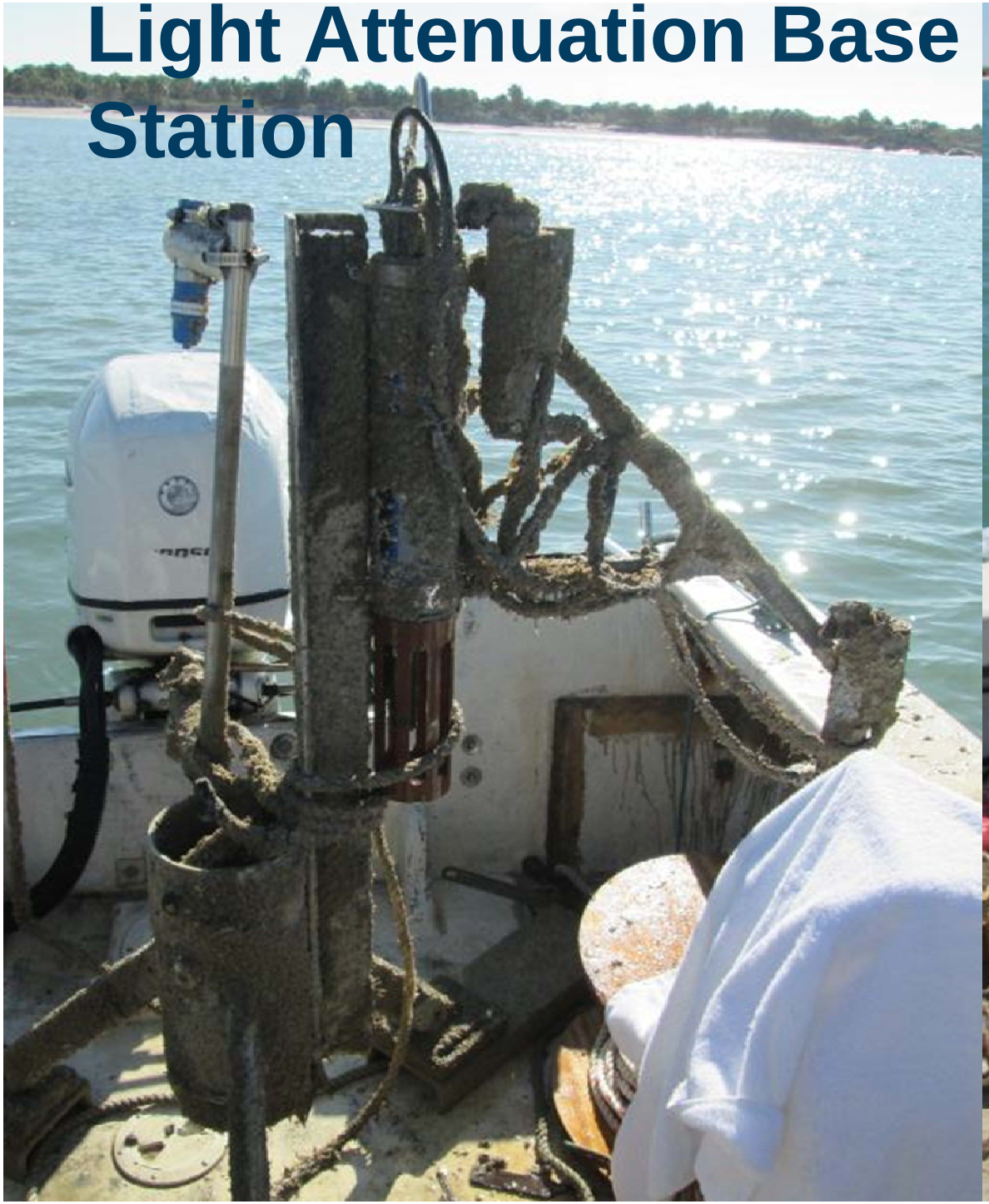
Tampa Harbor MD - Egmont Key 2014		
	# of Samples	Value avg.
In-situ	80	4.36*
pre-Beach	13	5.9
post-Dredged	24	5.3
Traditional	16	5.0
CSSZ	8	5.9

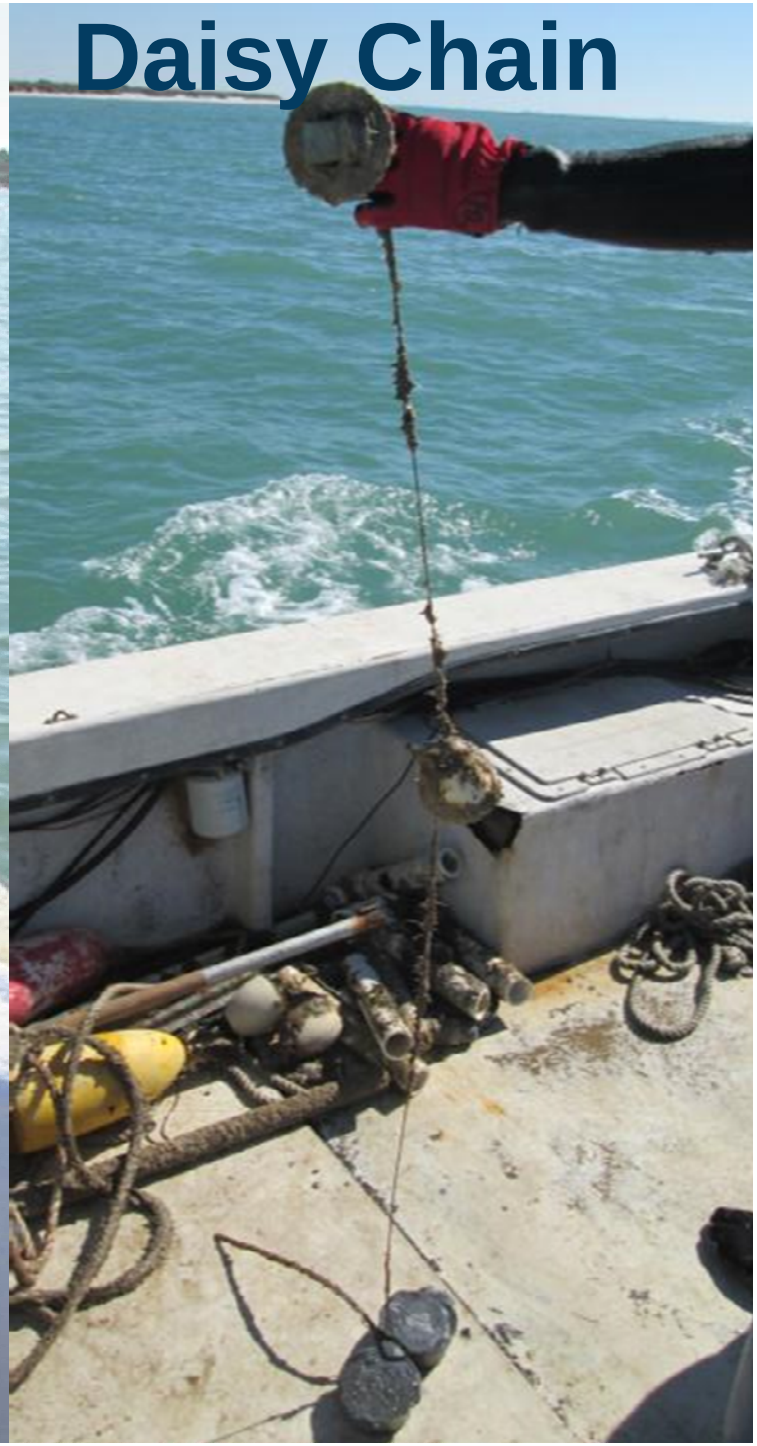
*Munsell color value<5 unacceptable for beach placement in Florida

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 Background Monitoring – Pipe

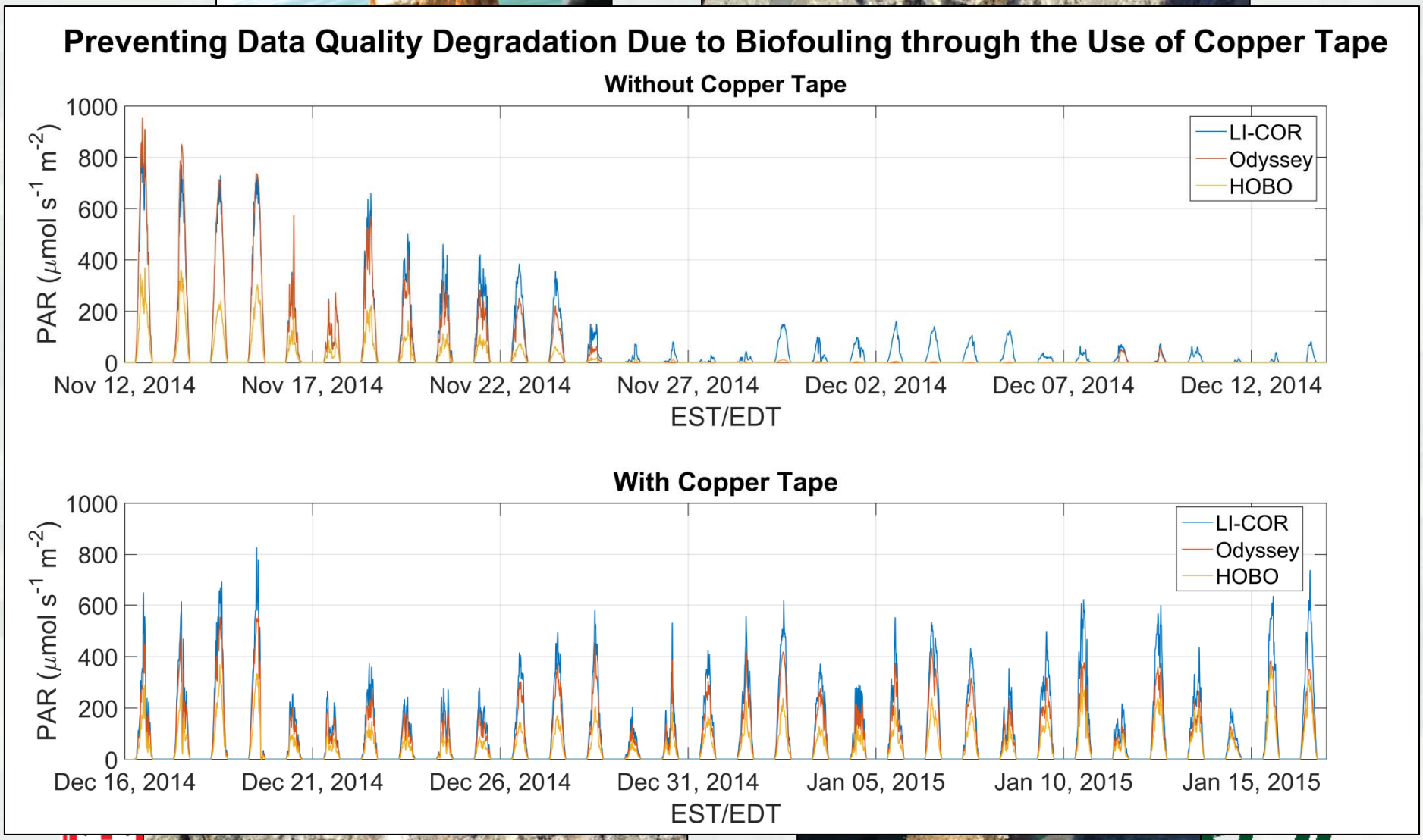



Light Attenuation Base Station


Daisy Chain

Light Attenuation Monitoring – Tire

Instrument Biofouling

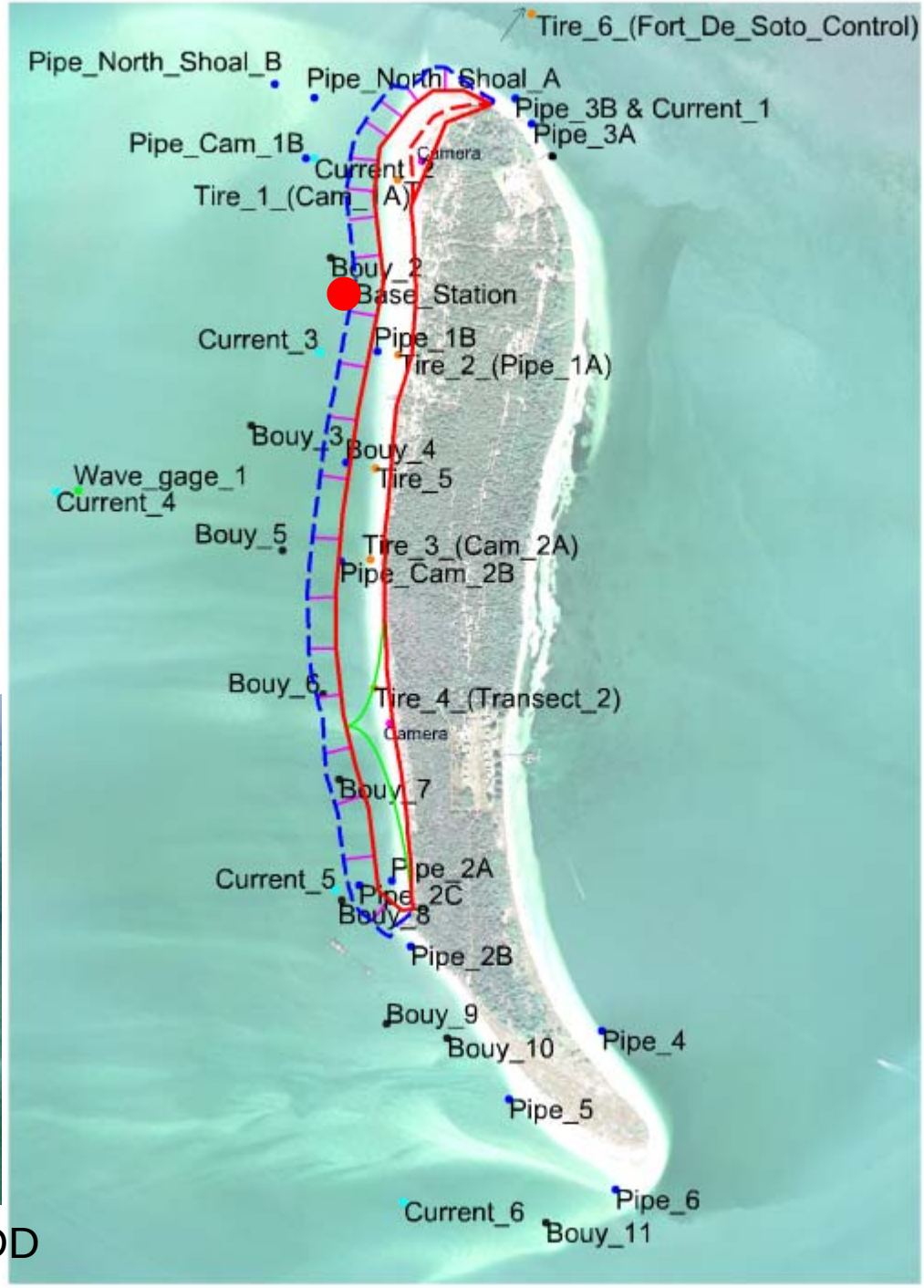


Light Attenuation Long-term Monitoring

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

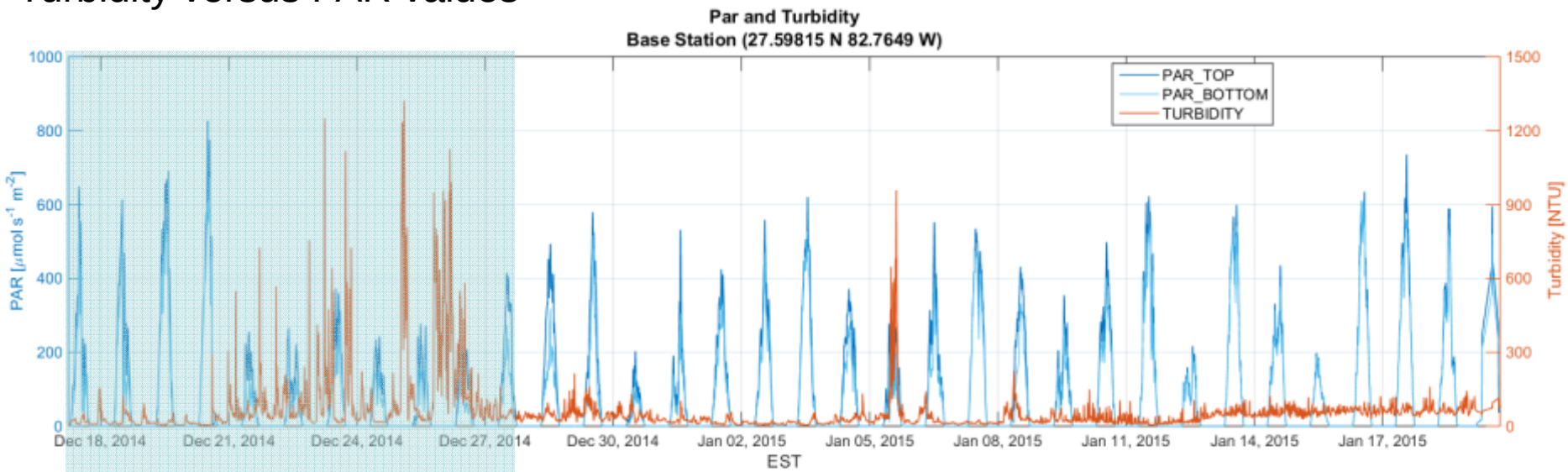
BUILDING STRONG®

Image Courtesy of GLDD



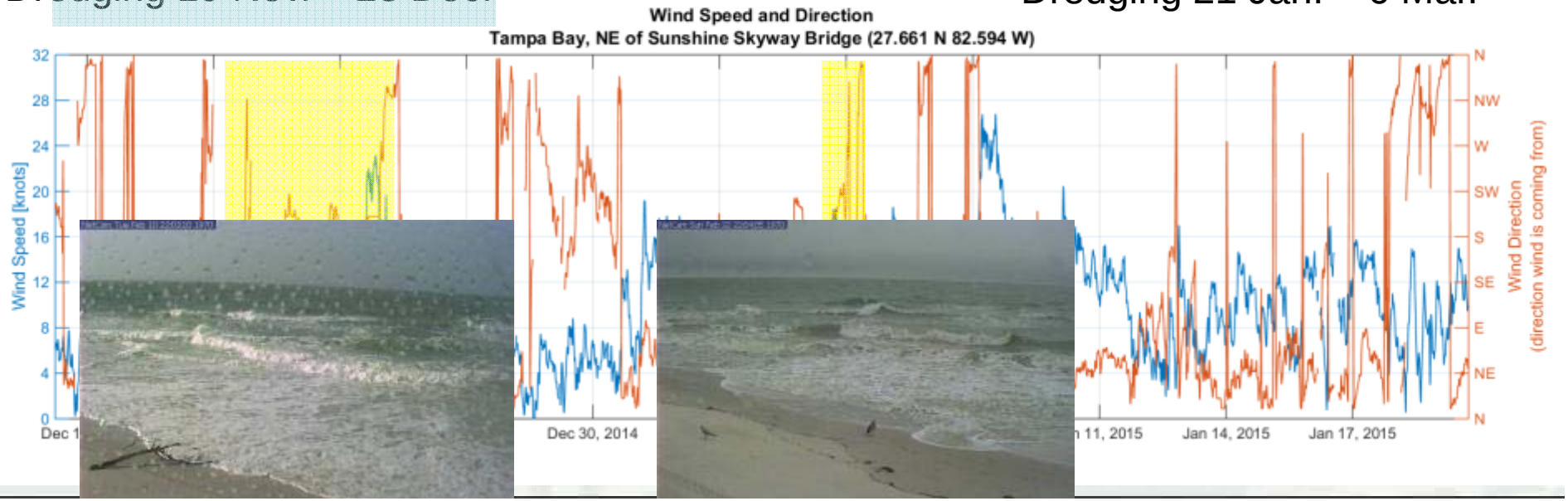
Light Attenuation Long-term Monitoring

Turbidity versus PAR values



Dredging 19 Nov. – 28 Dec.

Dredging 21 Jan. – 6 Mar.



Sea Turtle Nesting 2015

Nesting as of 16 August 2015

Image Courtesy of USACE Jacksonville District

CSSZ vs. Traditional Placement

- **Less linear feet of beach impacted for equivalent volume**
  - CSSZ
- **Reduced environmental Impacts**
  - Cementation
  - Munsell Color
  - Shorebird impacts
- **Material is not visible to public**
- **Lower cost**
  - Construction – less beach equipment
  - Reduced pipeline extensions
  - Maintenance – less escarpment, tilling
- **Purely performance based regulations**
  - More beneficial reuse
  - Lower costs - better bids due to more equipment able to perform work

Image Courtesy of GLDD

Summary and Conclusions

- Grain Size sampling indicates significant “fines” losses through dredging process
- Longshore spreading of both nourishment types occurred
- Most of the sediment gained from longshore spreading appeared in the intertidal to subtidal zones
- Fine material initially located at the toe of the fill no longer appears along profile
- Munsell Color and Compaction similar to pre-conditions
- Turbidity decreases when not pumping
  - Copper tape reduced impacts of biofouling
- Turtle nesting appears lower in traditional nourishment than CSSZ, however overall number of nests may not have been impacted

Acknowledgements

Great Lakes Dredge and Dock – Mr. Manny Vianzon, Ms. Lynn Nietfeld, Ms. Kate Mason, Mr. Michael Tolivar, Mr. Robert Ramsdell III, Mr. Bill Hanson

University of South Florida – Dr. Ping Wang, Mr. Zachary Tyler Mr. Mark Horwitz

U.S. Fish and Wildlife Service – Mr. Peter Plage and Mr. Stan Garner

Florida Department of Environmental Protection – Mr. Tom Watson

Tampa Bay Pilots Association – Ms. Leslie Head

Florida Fish and Wildlife Conservation Commission – Ms. Robbin Trindell

USACE Tampa Field Office – Mr. Andy Cummings, Ms. Tina Underwood, Ms. Erin Duffy

USACE Jacksonville District – Mr. Bryan Merrill, Mr. Mike Hensch, Mr. Vic Wilhelm, Mr. Tom Spencer.

USACE Engineer Research and Development Center – Mr. Coraggio Maglio, Mr Jase Ousley, Mr. Matthew Taylor, Mr. John Bull, Ms. Cheryl Pollock, Dr. Deborah Shafer, Mr. Tommy Kirkland, Dr. Jacob Berkowitz, Mr. Jason Pietroski

U.S. Coast Guard – Mr. Darren Pauly, Mr. Ivan Meneses

Questions?

Contacts:

Katherine Brutsché

Katherine.E.Brutsche@usace.army.mil

Coraggio Maglio

Coraggio.K.Maglio@usace.army.mil