HISTORICAL ANALYSIS

Of the Change in Percent Fines During Beach Nourishment

Dr. Jennifer Coor, PG
U.S. Army Corps of Engineers
Jacksonville District

Jase D. Ousley, PG
U.S. Army Corps of Engineers
Headquarters – Dredging Program

February 6, 2020

US Army Corps of Engineers ®

RSM RCX

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

PRESENTATION OUTLINE

- Background
- Objectives
- Data Collection and Analysis
  - ▶ Case Study: Egmont Key, FL
- Ongoing Work
  - ▶ Case Study: Ship Island, MS
- Environmental Considerations
- Potential Applications
- Conclusions

BACKGROUND

- Regulators apply conservative assumption of 0% fines loss
  - Concern for fines related to: compaction, cementation, turtle nesting, turbidity, and sensitive resources
- Originated with the SAND Study (ERDC/CHL TR-14-10)
- FDEP "Sand Rule" sets criteria for beach quality sediment
  - 62B-41.007(2)(j)(k), FAC

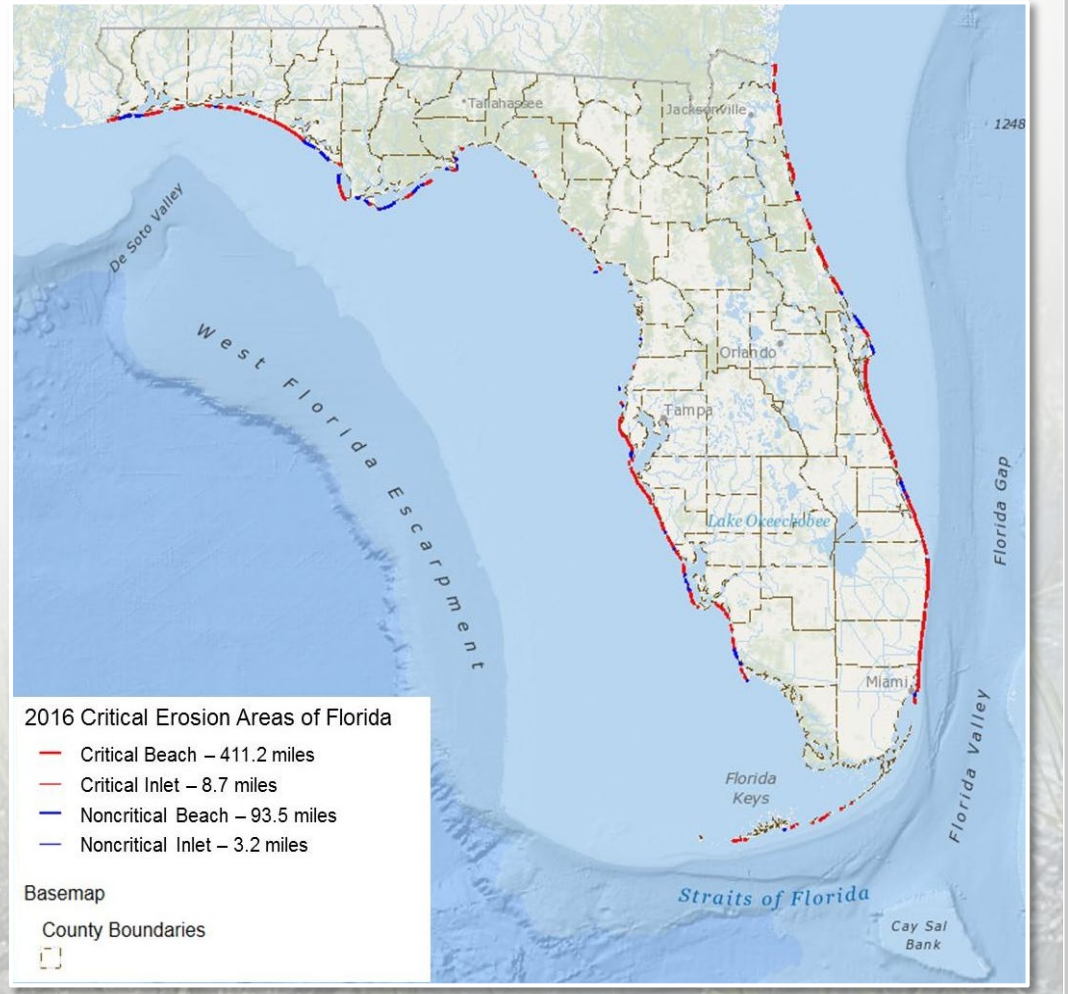
Table 6. Compatibility data for projects showing the borrow source and post-fill composite statistics.

Project/Year	Fill Volume	Sediment source	Source composite stats			Post-fill beach composite stats		
			Mean mm	Sorting phi	% passing #230	Mean mm	Sorting phi	% passing #230
Duval SPP, 2005	710,000 cy	Duval B/A "Area A"	0.25	1.15	3.4	0.25	0.85	0.70
Tampa Harbor O&M, Egmont Key, 2005	1.3 mcy	Egmont Channel and Mullet Key Cut	0.35	1.58	25	0.27	1.21	2.5
Ft. Pierce SPP, 2007	517,000 cy	Capron Shoal	0.43	0.97	1.6	0.60	1.34	0.10
IWW O&M, St. Augustine Inlet, 2008	122,648 cy	IWW, St. Augustine Inlet	0.28	1.94	2.57	0.28	0.84	0.41
Lee Co. SPP, Captiva Island, 2008	98,270 cy	Borrow Site VI	0.40	1.04	0.87	0.51	1.34	0.53
IWW, Matanzas Inlet, 2009	288,647 cy	IWW, Matanzas Inlet	0.16	0.64	3.15	0.24	0.42	0.29
John's Pass O&M, 2010	250,000 cy	John's Pass Entrance Channel, Shoal east of channel	0.24, 0.16	0.73, 0.56	0.86, 1.69	0.22	1.07	0.21
Treasure Is./Long Key SPP, 2010	160,000 cy	Blind Pass Entrance Channel	0.24	1.59	1.71	0.18	0.89	0.21
Duval SPP, 2011	689,015 cy	Duval B/A "A + A2"	0.17-0.26	-	1.70	0.25	0.87	1.18
IWW O&M, Bakers Haulover Inlet, 2011	33,000 cy	IWW, Bakers Haulover Inlet	0.26	1.30	6.48	0.67	0.72	0.20
Sand Key SPP, 2012	1.2 mcy	Borrow Area L	0.18	0.96	3.04	0.28	1.37	0.58

SPP: Shore Protection Project, O&M: Operation and Maintenance, IWW: Intracoastal Waterway, cy: cubic yards, mcy: million cubic yards

STUDY OBJECTIVES

- Quantify historic change in fines during beach nourishment
  - ► Existing data indicates a loss in “fines” due to hydraulic dredging of greater than 50% from in-situ sources to post-construction fill
- Understanding change in fines can have regional sediment management (RSM) opportunities
  - ► Benefit the Navigation program by retaining more sand in the system, closer placement, reserving ODMDS and DMMA capacity
  - ► Benefit SPP by increasing the amount of sand available for beach construction
- Partner with the State and other agencies
  - ► Provide reasonable assurance to regulators that material is beach quality

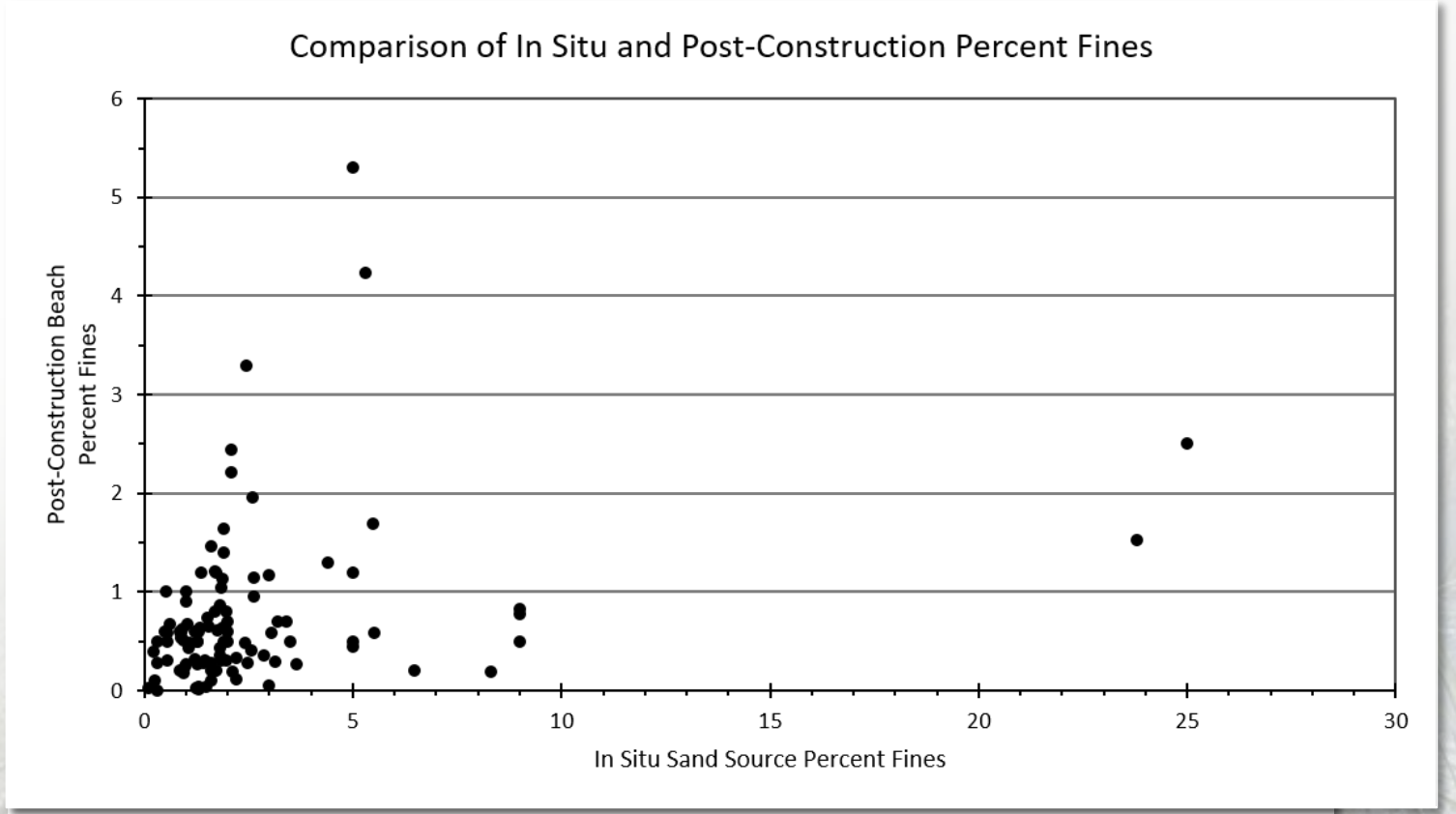


DATA COLLECTION

- Historic project data from FDEP and USACE project files (through 2015)
- 103 construction events in Florida analyzed
  - 44 project locations
  - In situ sand source
  - Post-construction beach
- Focus on hydraulic dredges
  - Data spans high and low in-situ fines contents
  - 33 hopper, 29 cutter suction, 15 combo, and 26 hydraulic

DATA ANALYSIS & PRELIMINARY CONCLUSIONS

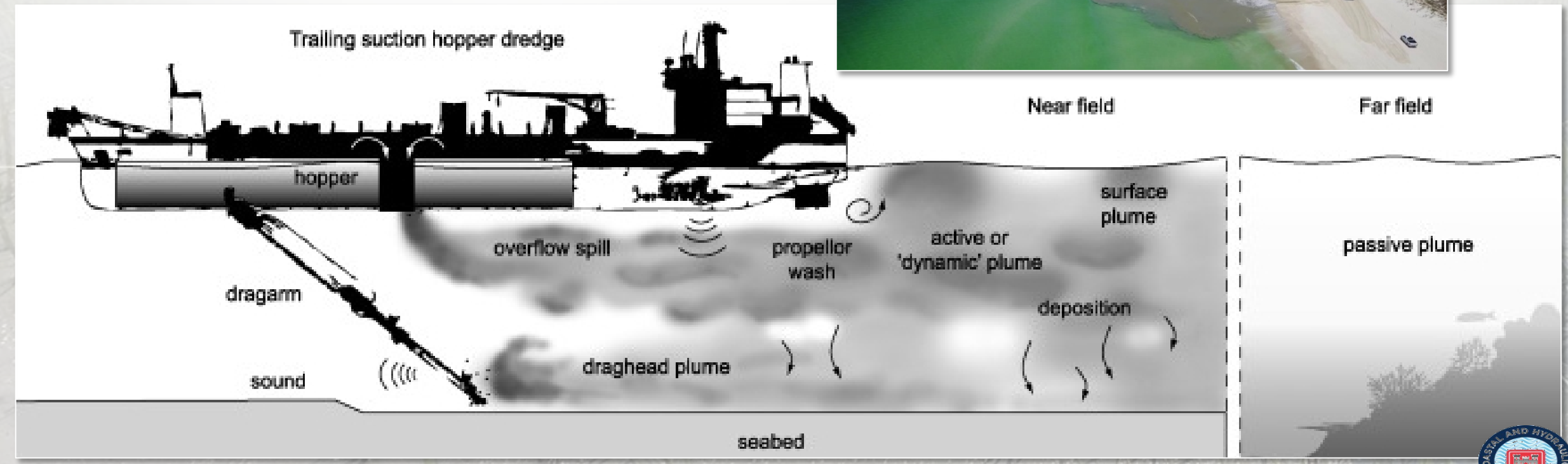
- n=103
- Mean loss: 57%
- Median loss: 70%
- 90% of projects showed loss of fines
  - ► 69% of projects show greater than 50% loss of fines
- 10% of projects showed increase in fines



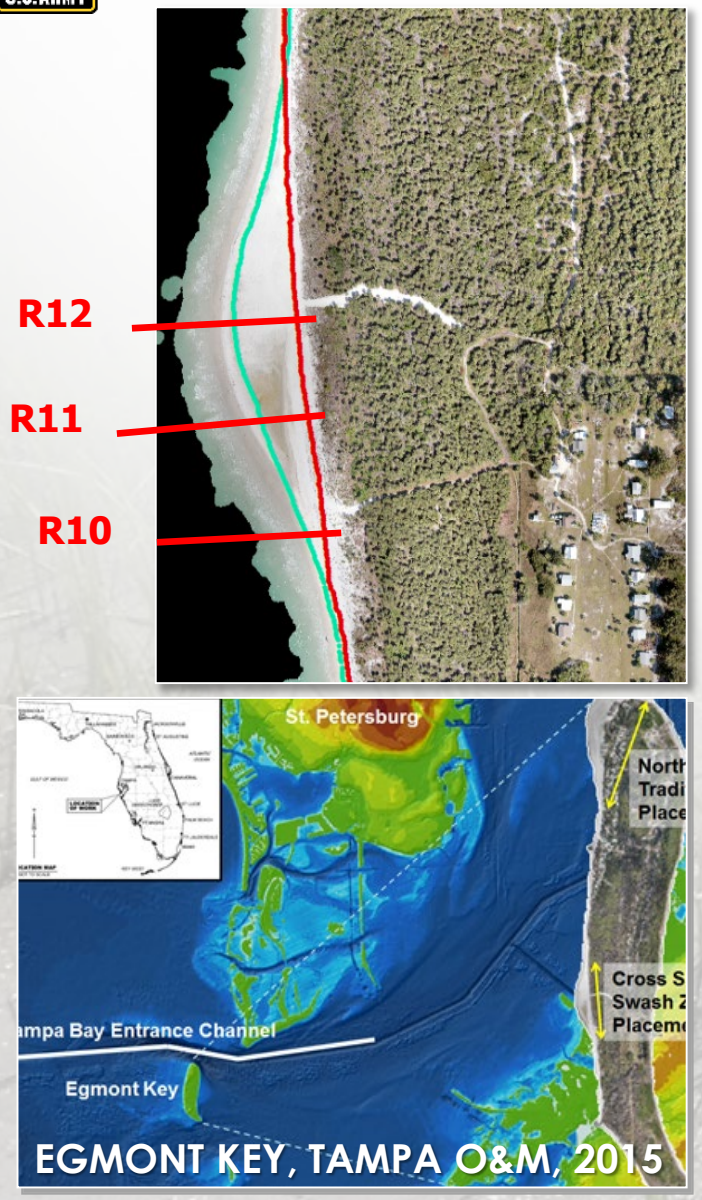
Percent Fines Lost

WHERE ARE FINES "LOST" DURING DREDGING?

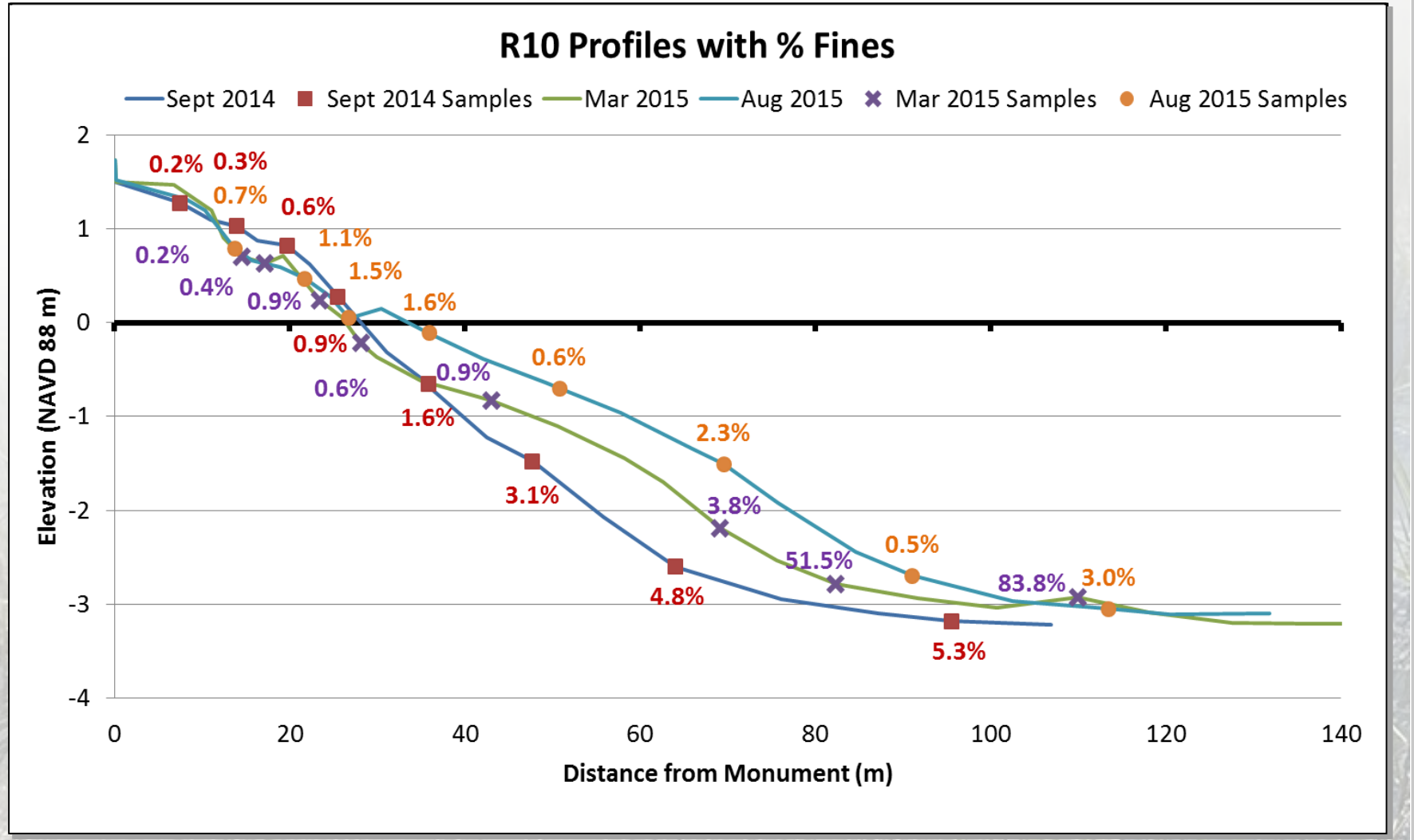
- Dredge Head
- Hopper Overflow
- Beach Construction



PROJECT EXAMPLE OF FINES LOSS



23.8% fines in-situ 1.5% post-fill berm



BOEM-USACE INTERAGENCY AGREEMENT

Ongoing work with BOEM to address separation and fate of fines:

- Sorting through components of dredging process
- Plume dynamics and transport

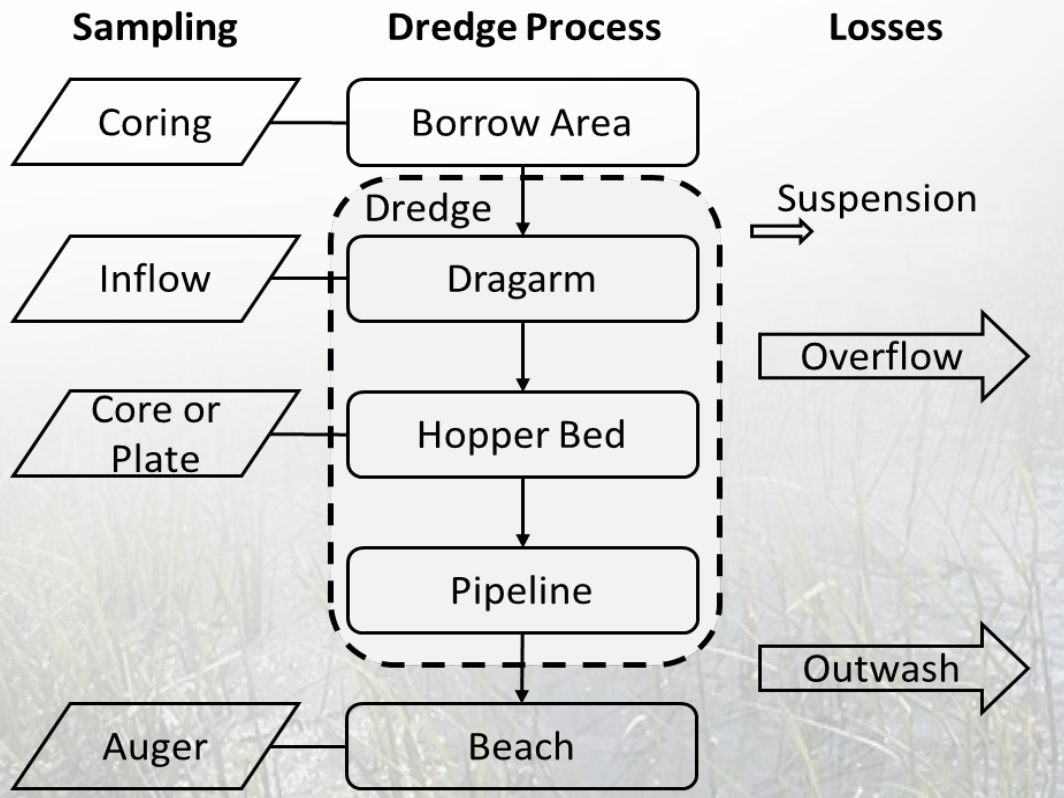
WHY INITIATE THE STUDY:

1. Beach quality sand is a limited resource that is instrumental in supporting local and state economies, reduces risks from to coastal flooding and storms, and supports coastal resiliency and ecosystem restoration.
2. Opportunity to identify additional quality sand could support all items listed above for decades, reduce costs to sponsors and taxpayers, and inform environmental risks.

US Army Corps of Engineers ® Jacksonville District
US Army Corps of Engineers Mobile District
RSM RCX
BOEM Bureau of Ocean Energy Management
ERDC

PHASE 1

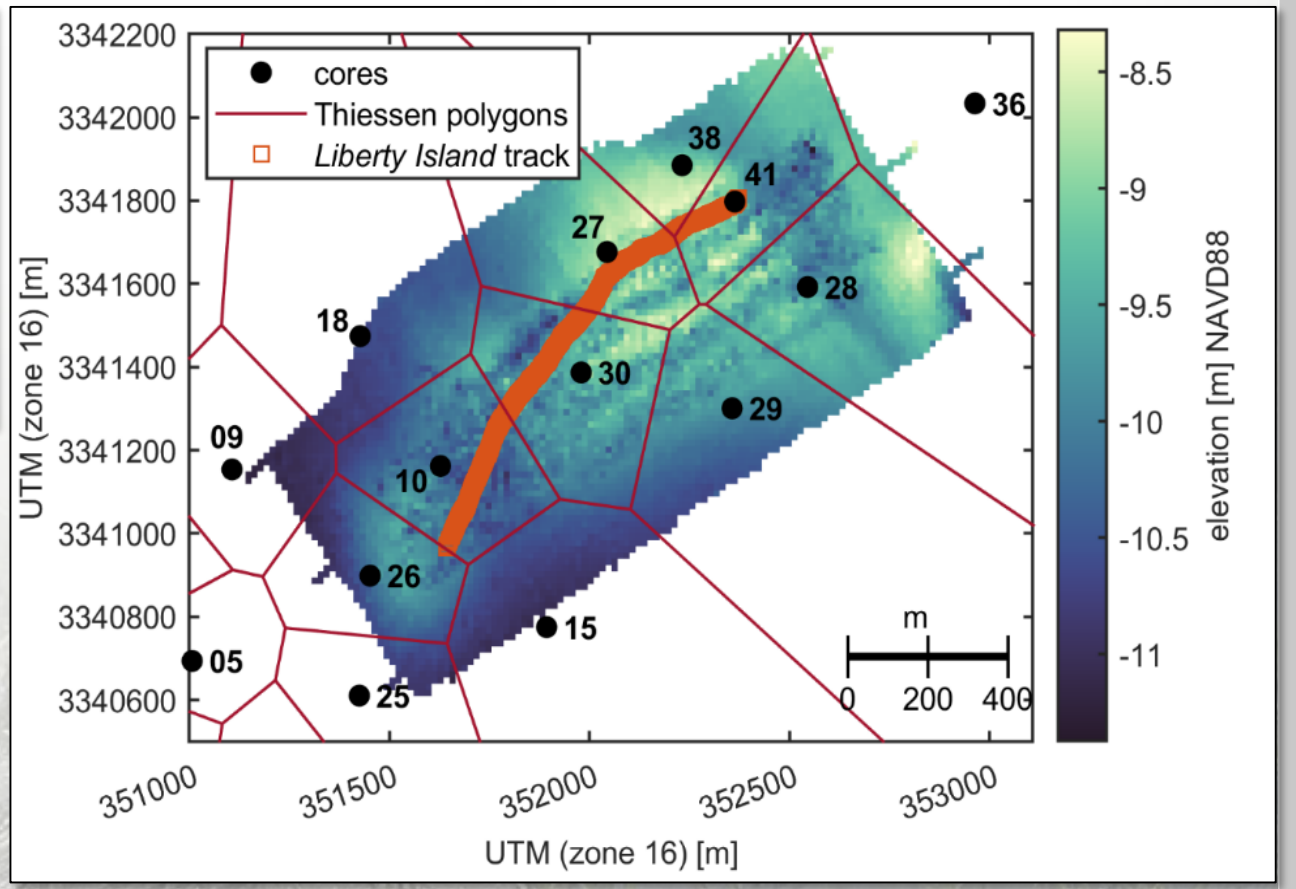
- 2 Year Study Initiated in October 2017
- Objective:
  - Quantify changes in sediment characteristics (i.e., grain size, sorting) and the degree, timing, and variability of sediment sorting during dredging and placement operations to determine the extent of potential sediment coarsening to better inform sediment compatibility analyses and subsequent management of sediment resources.
- Process:
  - Literature review, conceptual model
  - Proof of concept, develop field sampling plan
  - Field sampling
  - Laboratory analyses
  - Analyze data, write up reports



CASE STUDY

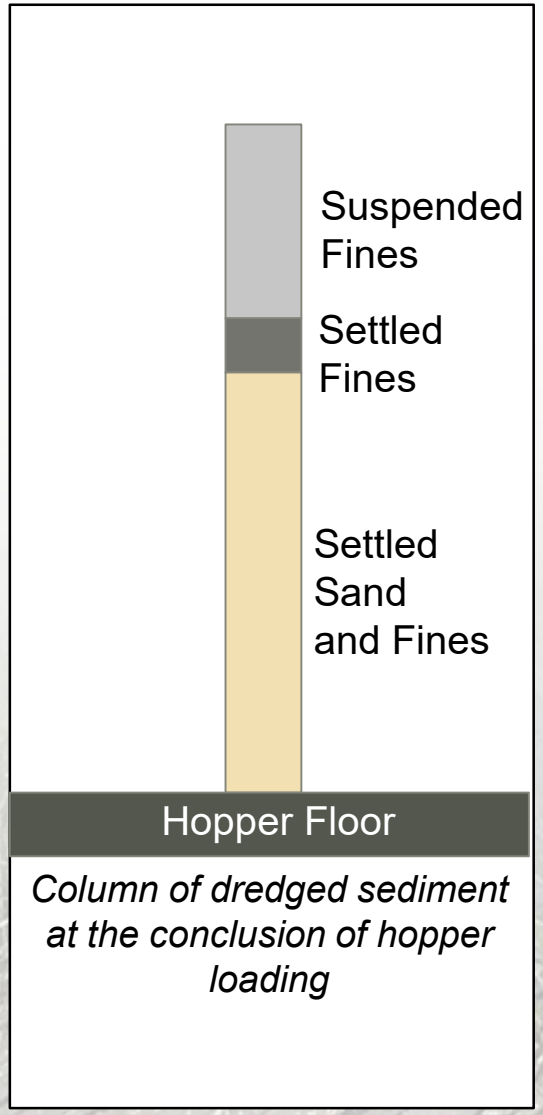
- **Project Site:** MSCIP Ship Island Restoration

- **Borrow Area:**
  - Horn Island Pass
  - Extensive geotechnical investigation (20' cores spaced 150 – 600 m)
  - Average cut depth 4'
  - Average fines 4.4% (range: 1.2 – 12.7%)
  - Correlated dredge arm location to polygon representing cores

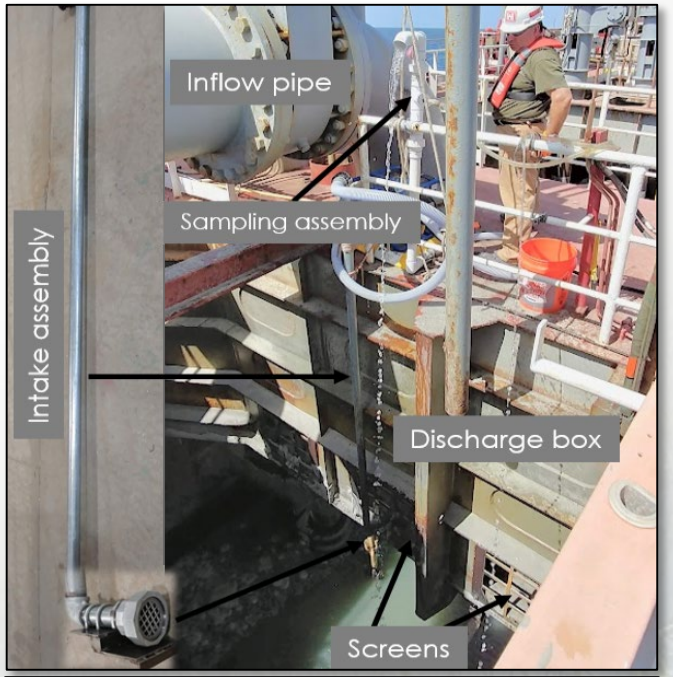


SAMPLING AND METHODS

- Dredge Sampling:
  - Inflow sampling
  - Hopper sampling
  - Three distinct layers in hopper
  - Samples will be acquired from each layer and the mass of each sediment constituent per unit area for each layer will be determined
- Beach Sampling:
  - Hand auger
  - Immediately following pump-out to thickness of pumpout
  - Samples collected prior to grading
- Lab Analyses:
  - Samples processed at ERDC
  - Sediment size distribution and fraction fine sediment by sieving and laser diffraction

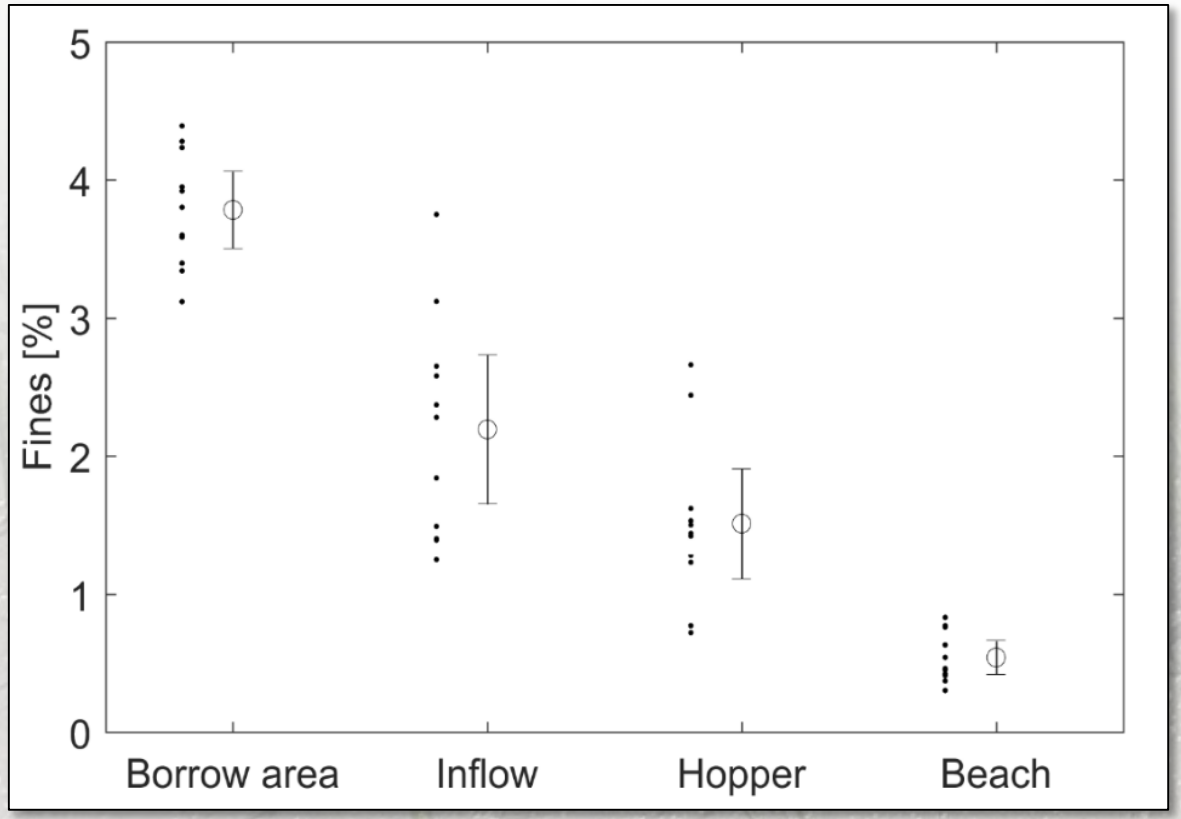


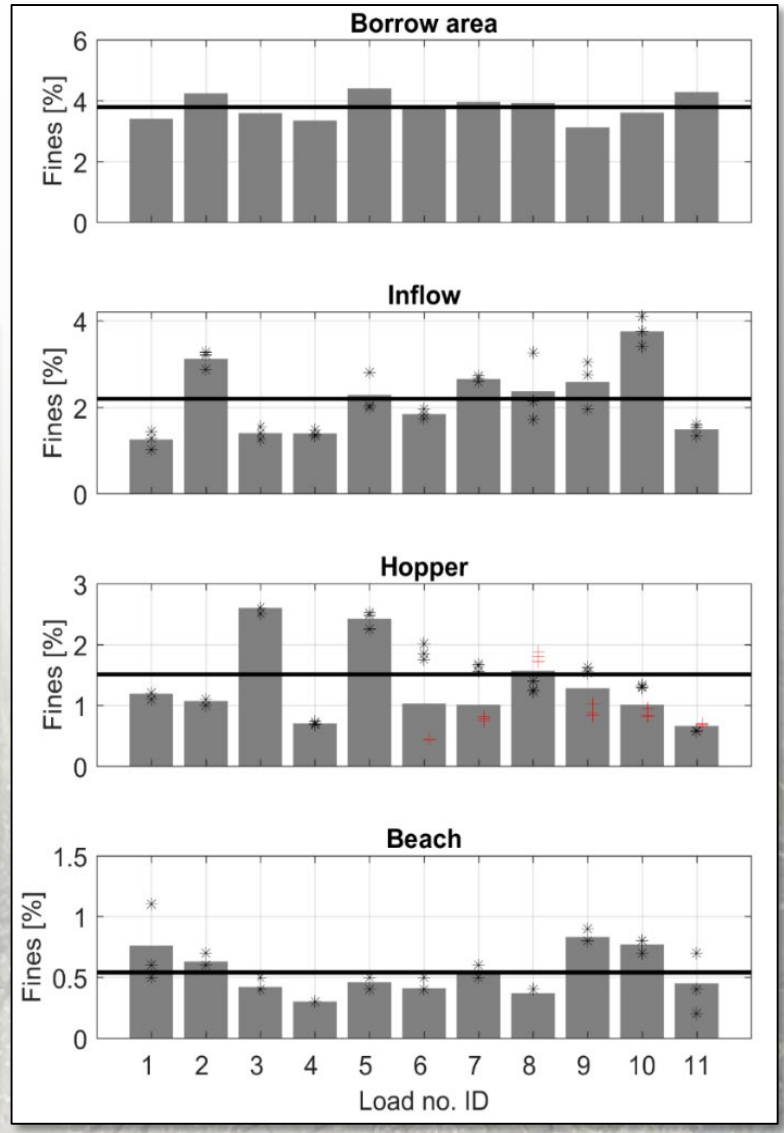
Column of dredged sediment at the conclusion of hopper loading



RESULTS

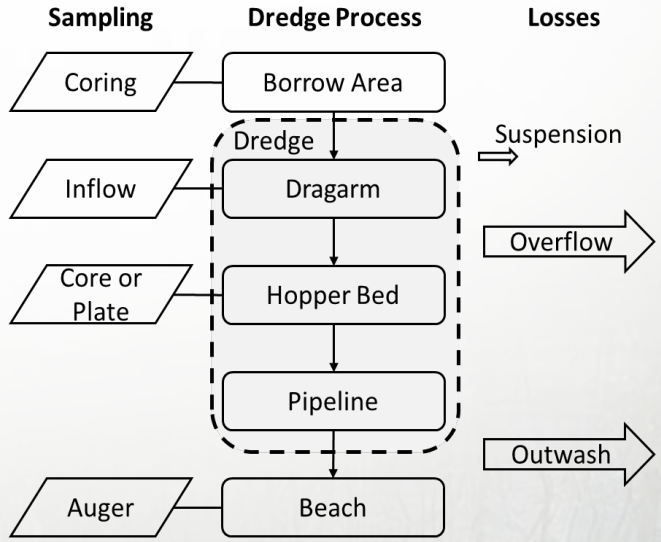
- 11 hopper loads (20 June – 1 July 2018)
- Total Fines Lost: 87%
- Loss at Borrow Area: 61%
  (3.8% at borrow area to 1.5% in hopper)
- Loss at Beach: 26% (0.5% at beach)

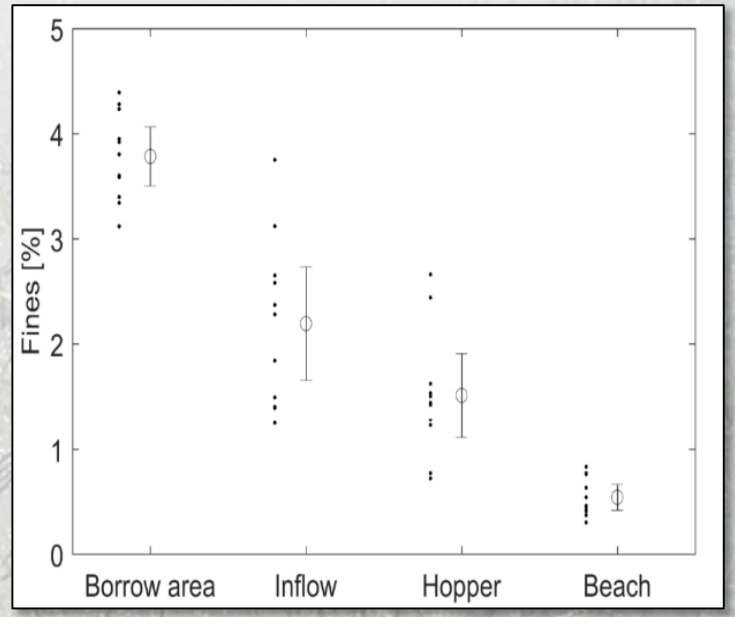




PHASE 1 CONCLUSIONS

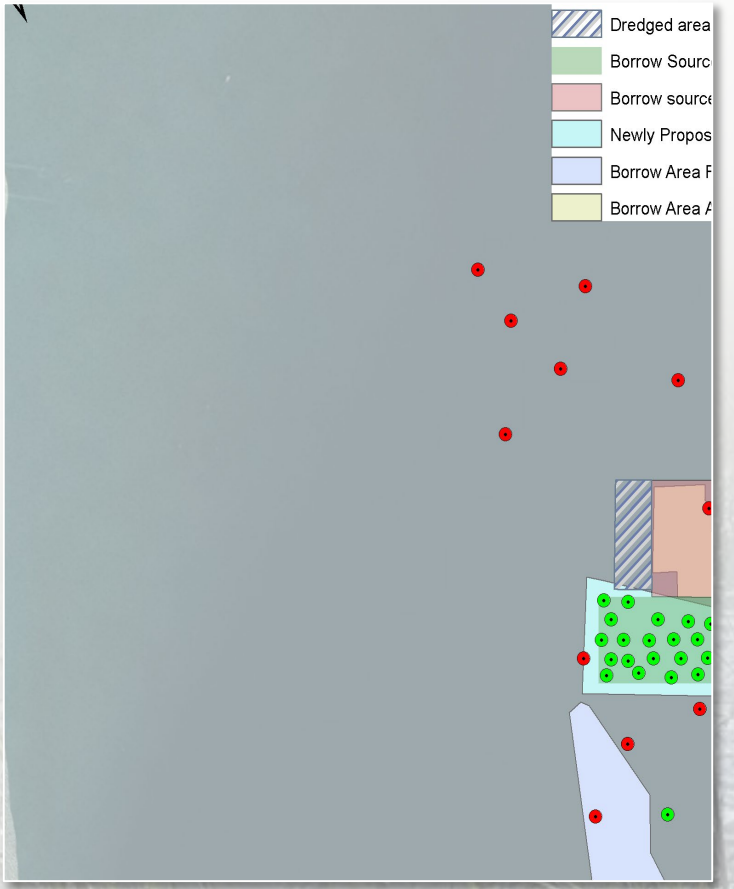
- Study demonstrates separation/loss of fines can be scientifically quantified at loss points during dredging process
- Supports Coor and Ousley (2019) of 75+% loss of fines for projects with 1 – 25% fines content at borrow area
- Additional studies needed to assess:
  - Relationship between fines content and % loss: Is it linear at % fine content ≥ 10%
  - Immediate and longer term fate of fines at borrow area and placement area





PHASE 2 CONCLUSIONS

- 2 year study initiated in August 2019
- GOAL: Use borrow source with ≥ 5% fines and incorporate dredging and sorting processes in beach nourishment compatibility requirements
- So What: Identified 8 M CY sand (5-10% fines) in previous Duval County investigation
- Focus:
  (1) Separation AND fate of fines: offshore and nearshore
  (2) Expansion of sediment sampling, exploring modeling options
  (3) Work with FDEP to develop project design/methods and criteria to define success



US Army Corps of Engineers ®
Jacksonville District

RSM RCX

BOEM
Bureau of Ocean Energy Management

ERDC

Florida Department of Environmental Protection

ENVIRONMENTAL CONSIDERATIONS

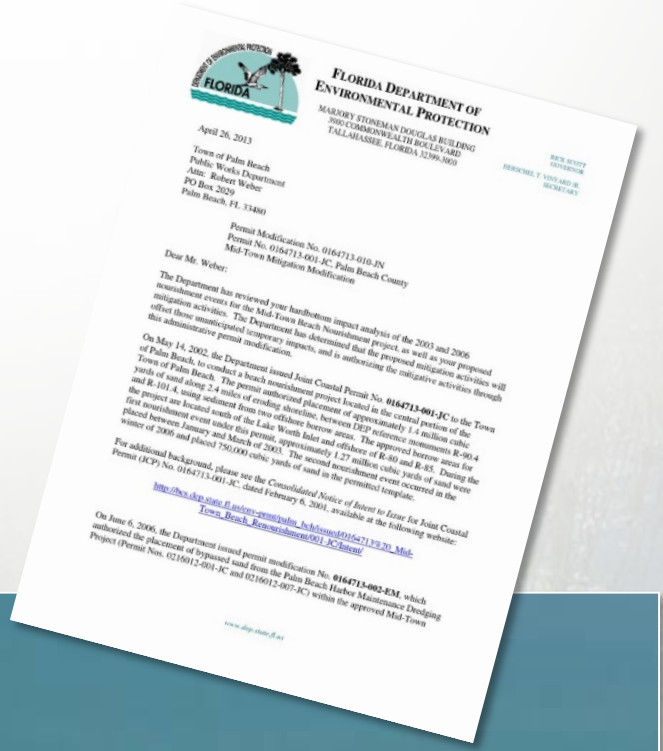
When applying the results of these studies, beach nourishment activities at the sand source:

- Must not exceed turbidity requirements during construction
- Must consider sensitive nearshore and offshore resources
- Must comply with all WQC permit conditions

ENVIRONMENTAL CONSIDERATIONS

When applying the results of these studies, beach nourishment activities at the beach:

- Must not exceed turbidity requirements during construction
- Must meet all WQC permit criteria for sediment quality
- Maintain engineering and biological functions of a beach
- Must comply with all WQC permit conditions



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

MARJORY STONEMAN DOUGLAS BUILDING
3900 COMMONWEALTH BOULEVARD
TALLAHASSEE, FLORIDA 32399-3000

April 26, 2013

Town of Palm Beach
Public Works Department
Attn: Robert Weber
PO Box 2029
Palm Beach, FL 33480

Permit Modification No. 0164713-010-JN
Permit No. 0164713-001-JC, Palm Beach County
Mid-Town Mitigation Modification

Dear Mr. Weber:

The Department has reviewed your hardbottom impact analysis of the 2003 and 2006 nourishment events for the Mid-Town Beach Nourishment project, as well as your proposed mitigation activities. The Department has determined that the proposed mitigation activities will offset these unanticipated temporary impacts, and is authorizing the mitigative activities through this administrative permit modification.

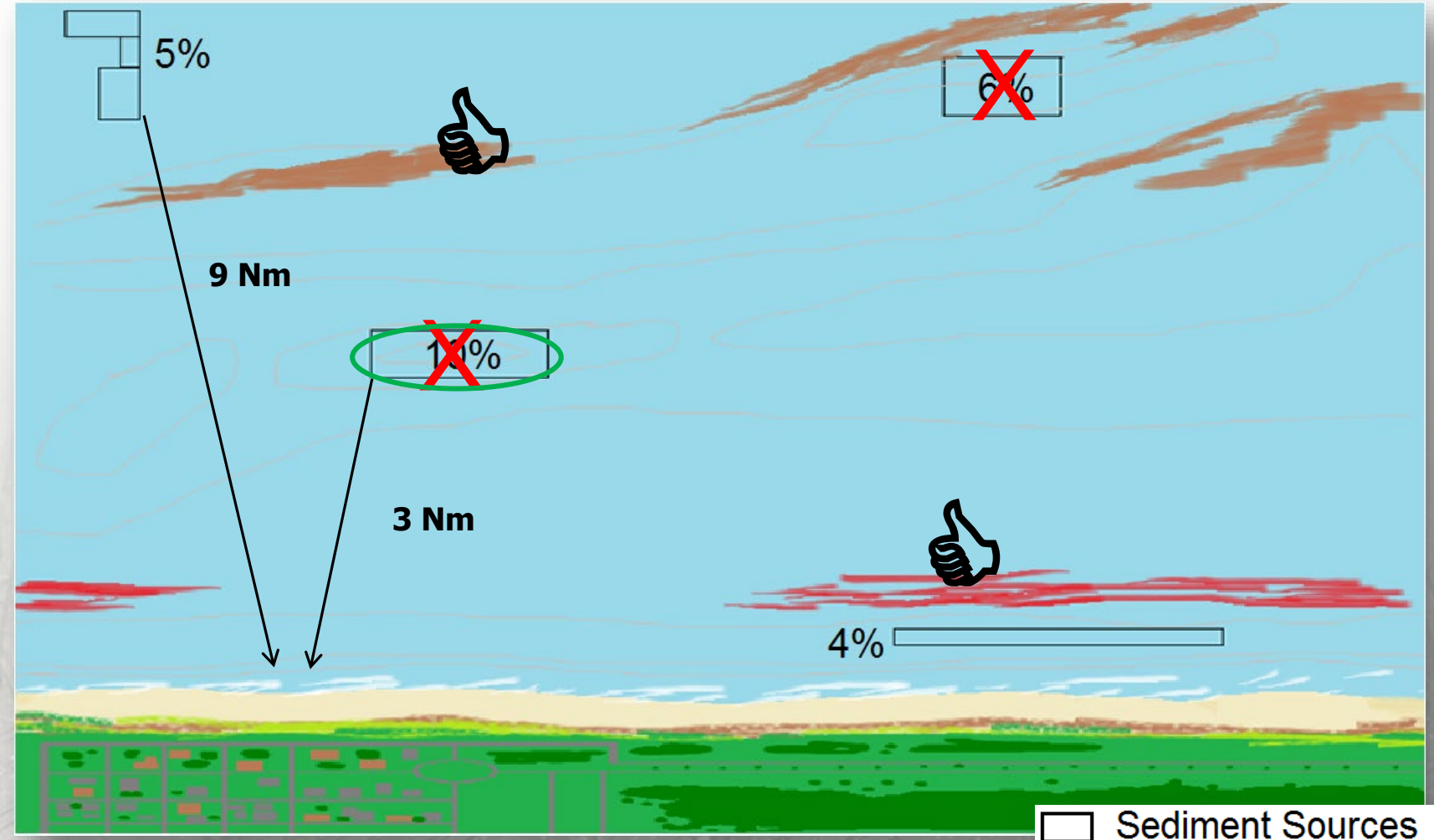
On May 14, 2002, the Department issued Joint Coastal Permit No. **0164713-001-JC** to the Town of Palm Beach, to conduct a beach nourishment project located in the central portion of the Town of Palm Beach. The permit authorized placement of approximately 1.4 million cubic yards of sand along 2.4 miles of eroding shoreline, between DEP reference monuments R-90.4 and R-101.4, using sediment from two offshore borrow areas. The approved borrow areas for the project are located south of the Lake Worth Inlet and offshore of R-80 and R-85. During the first nourishment event under this permit, approximately 1.27 million cubic yards of sand were placed between January and March of 2003. The second nourishment event occurred in the winter of 2006 and placed 750,000 cubic yards of sand in the permitted template.

For additional background, please see the *Consolidated Notice of Intent to Issue* for Joint Coastal Permit (JCP) No. 0164713-001-JC, dated February 8, 2001, available at the following website:
http://bcs.dep.state.fl.us/coy-permit/palm_bch/issued/0164713/970_Mid-Town_Beach_Renourishment/001_JC/Intent/

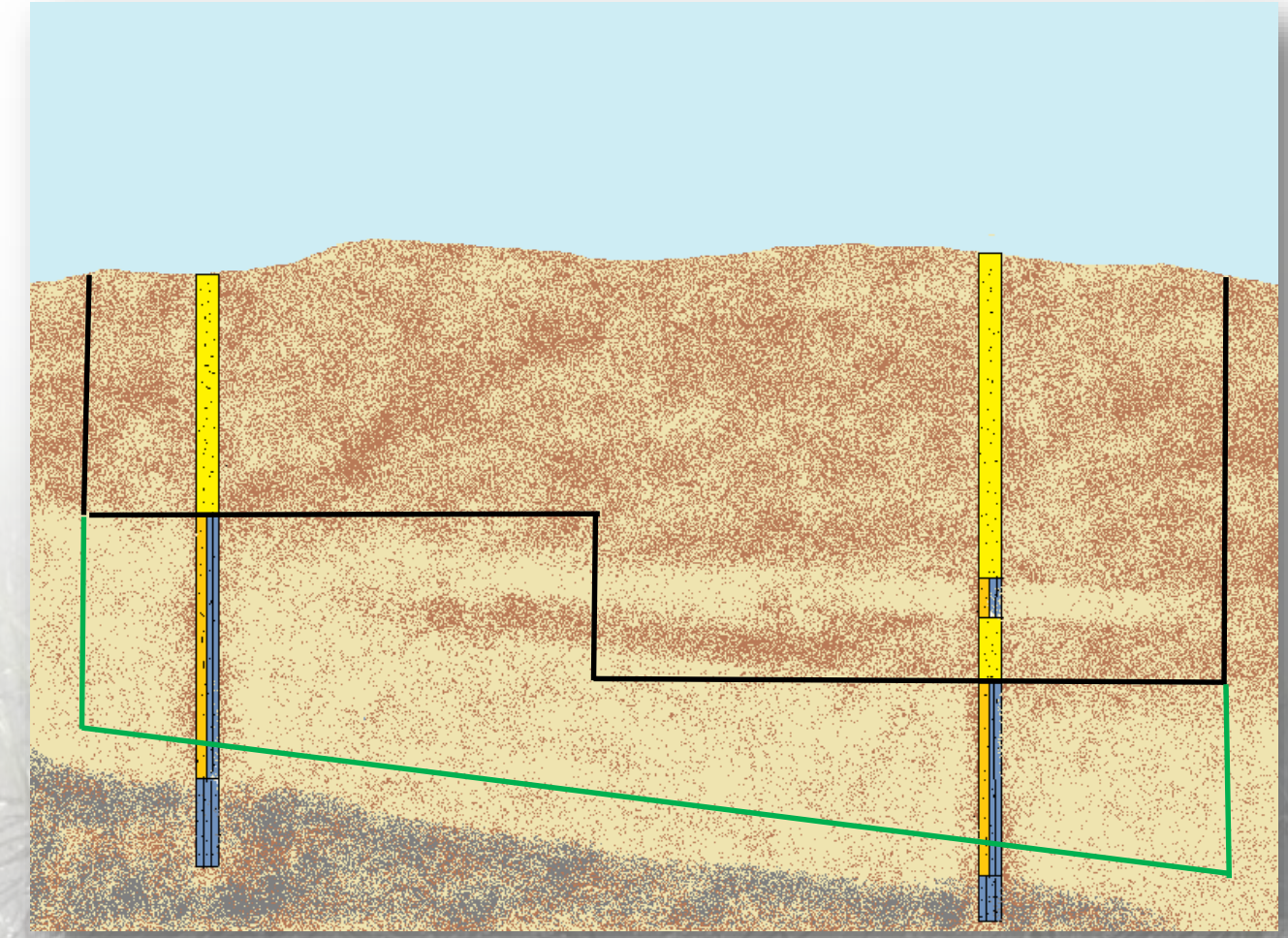
On June 6, 2006, the Department issued permit modification No. **0164713-002-EM**, which authorized the placement of bypassed sand from the Palm Beach Harbor Maintenance Dredging Project (Permit Nos. 0216012-001-JC and 0216012-007-JC) within the approved Mid-Town

www.dep.state.fl.us

SPATIAL IMPACT

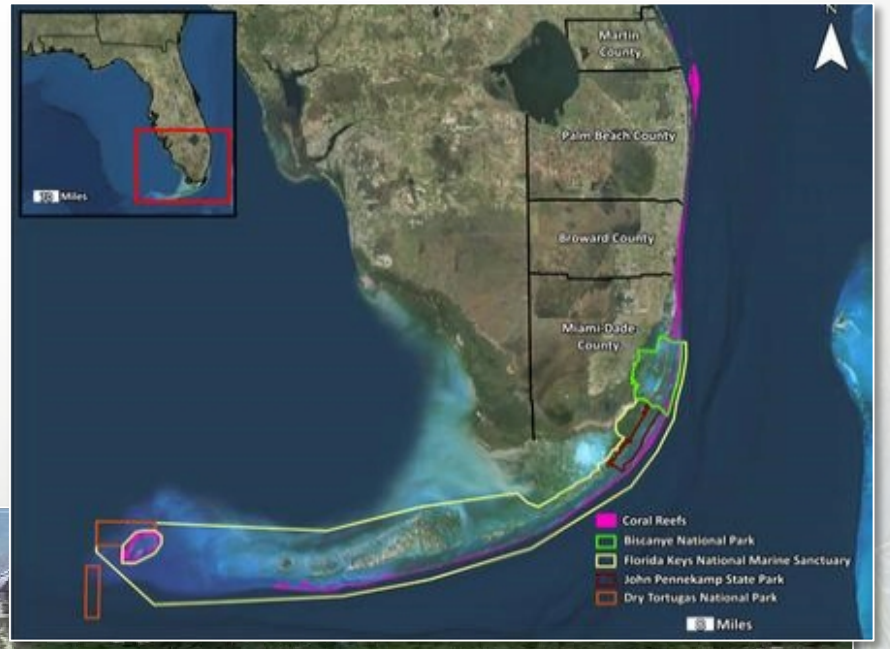


VERTICAL IMPACT FOR SAND SOURCES



POTENTIAL IMPACTS OF UTILIZING SAND SOURCES WITH MORE THAN 5% "FINES"

- Benefit areas with limited sand resources
- Consider and protect areas with sensitive nearshore resources
- Benefit project areas with marginal cost/benefit ratios
- Benefit projects with limited ODMDS/DMMA capacity
- Provide more opportunities for beneficial use of dredged material to combat coastal hazards



CONCLUSIONS

- Hydraulic dredging and placement remove fine sediments from the berm and the loss of fines can be predicted
- Findings indicate losses:
  - 69% of projects lose < 50% fines
  - 90% of projects lose fines
- Assume 50% loss of fines as conservative estimate
  - Reasonable assurance provided from 2 studies
  - More sand sources can be utilized
- Better RSM practice (beneficial use opportunities), better environmental practice, and better economic practice
  - Protection of sensitive resources
  - Cost savings for beach nourishment projects


THANK YOU!