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Nearshore Placement Webinar: Nearshore Placement Research & Development

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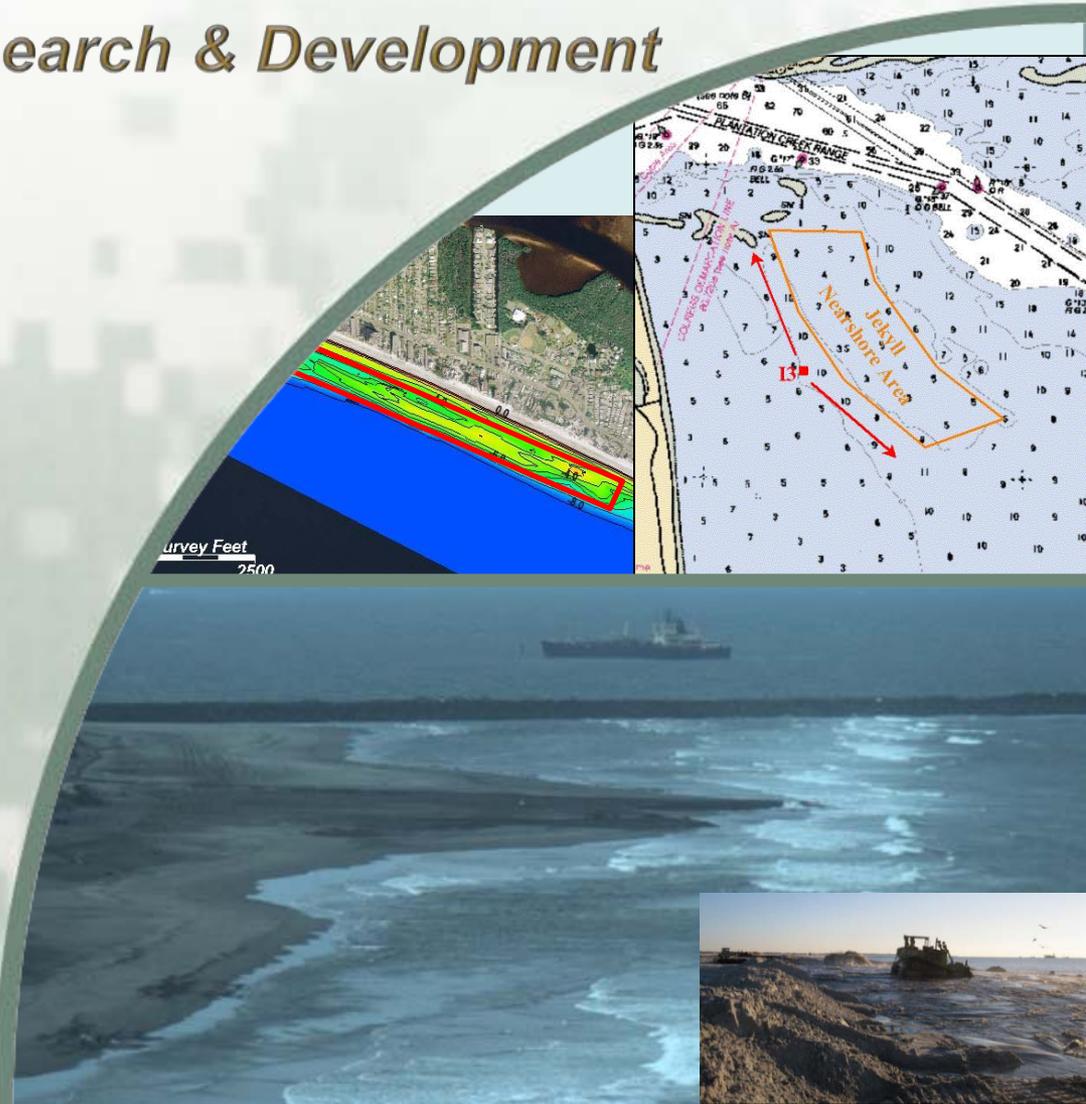
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*Regional Sediment Management (RSM),
Dredging Operations Research (DOER), &
Coastal Inlets Research Programs (CIRP),
Nearshore Berms R&D*



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Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE 29 NOV 2012		2. REPORT TYPE		3. DATES COVERED 00-00-2012 to 00-00-2012	
4. TITLE AND SUBTITLE Nearshore Placement Webinar: Nearshore Placement Research & Development				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, 3909 Halls Ferry Road, Vicksburg, MS, 39180				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Agenda

Overview

All times Eastern

1:30 PM – 1:40 PM	Opening Business/Introductions
1:40 PM – 2:10 PM	Risk and Regulatory/Permitting
2:10 PM – 2:40 PM	Measurement Capabilities
2:40 PM – 2:50 PM	<i>Break</i>
2:50 PM – 3:20PM	Modeling Techniques
3:20 PM – 3:45 PM	Recent Studies
3:45 PM – 4:00 PM	Discussion & Closing





Goal of this Webinar Series

- **Initiate a Nearshore Placement Community within USACE**
- **Facilitate discussion on a focused topic**
- **Interface for District to District, and District to ERDC**
- **Provide a starting point for successive webinars on other related topics**
 - **“Strategic Placement → Nearshore Placement → Nearshore Berms” = One example of Dredged Material Management**
- **Follow-up topics could include:**
 - **Permitting issues and strategies to move forward**
 - **Further discussion of the available measurement and modeling tools**
 - **Long-term viability of nearshore placement sites**



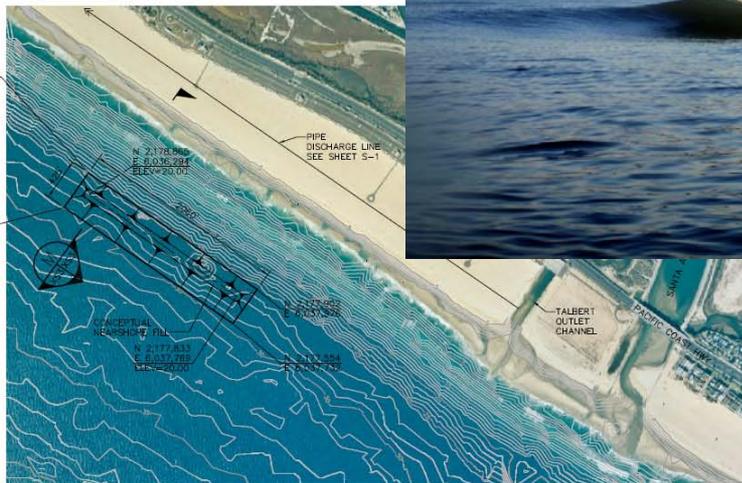


Nearshore Berms Examples

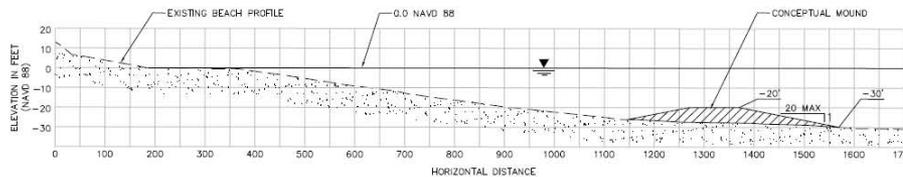
Small Dispersive Placements



Shark River Inlet (NAN)



HUNTINGTON BEACH NEARSHORE CONCEPTUAL FILL PLAN VIEW
1"=500'



Huntington Beach (SANDAG)



Positive Recreational Feature

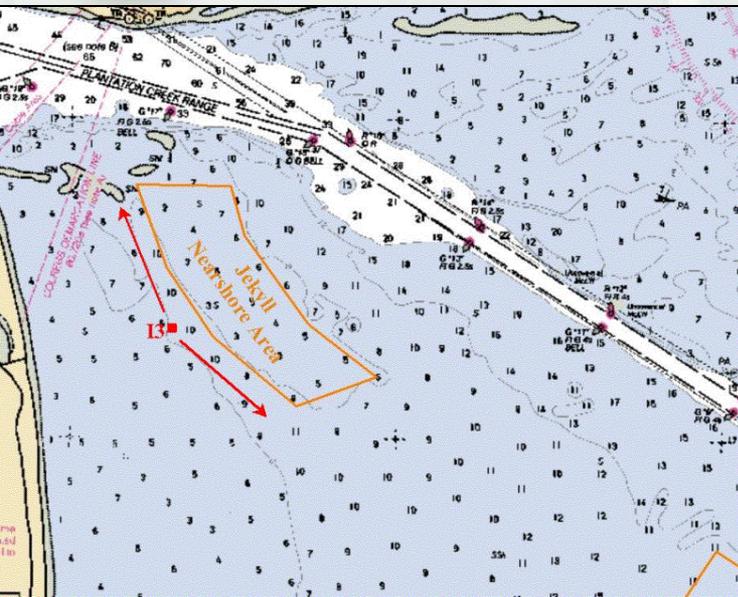


Assateague Island, MD (NAB)



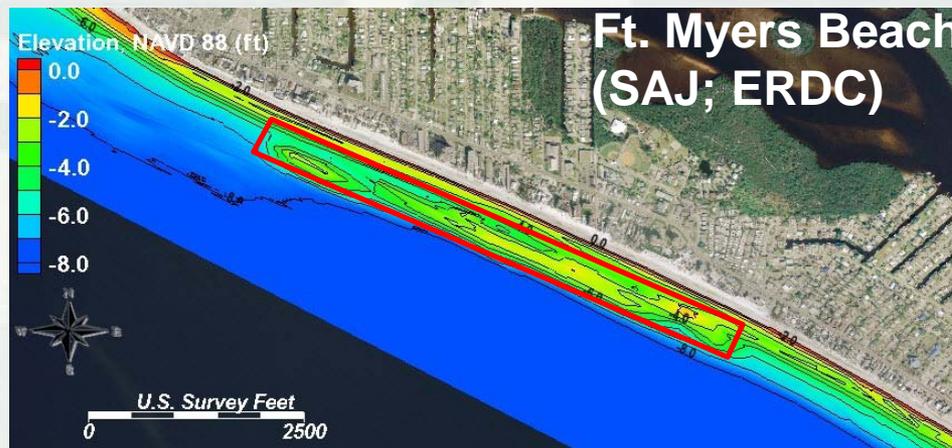


Nearshore Berms Examples

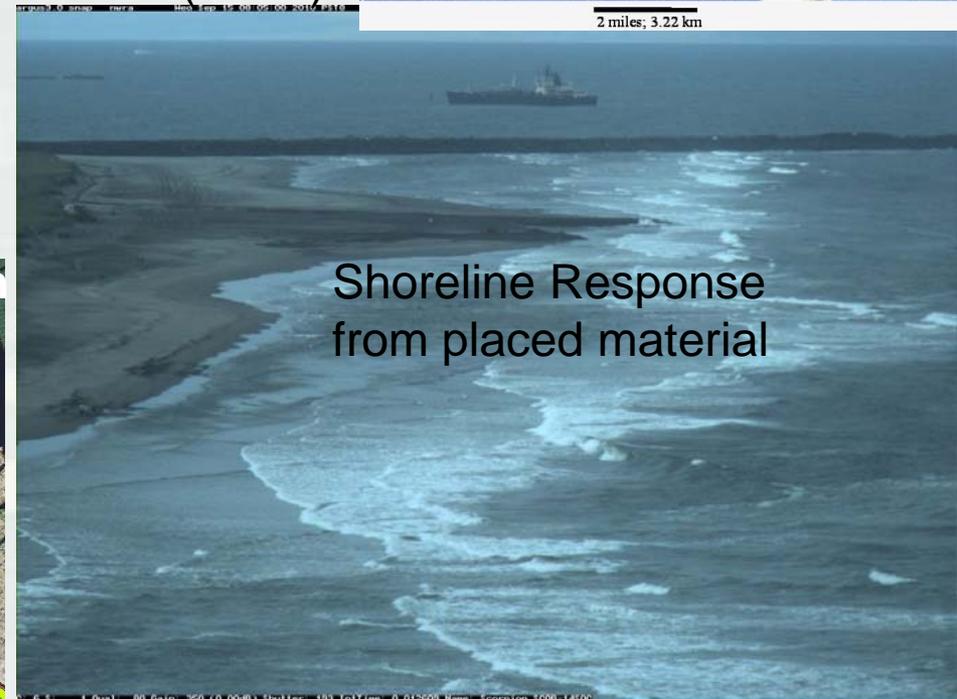


Brunswick
(SAS;
DOER)

Benson Beach
Beneficial Use
Placement
(NWP)



Ft. Myers Beach
(SAJ; ERDC)



Shoreline Response
from placed material



Risk and Regulatory/Permitting Discussion



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Strategic Placement in the Nearshore Risk, Regulatory, and Permitting

John L. Childs, P.E. Research Engineer

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29 November 2012



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Risk, Regulatory, and Permitting

- Risk
 - ▶ Site Model to determine:
 - *Potential Impacts to Water Column*
 - *Potential Impacts to Benthos*
 - *Potential Impacts by Benthic Bioaccumulation*
 - ▶ *Engineering and Operational Controls*
- Regulatory
- Permitting
- Depth of Closure
- Beneficial Use





Technical Guidance for Management of Dredged Material



USEPA and USACE 2004

Evaluating Environmental Effects of DM Management Alternatives (33CFR 336.1)
(A Technical Framework)

USEPA/USACE 1991

**Marine Protection
Research and
Sanctuaries Act**

**Ocean Testing
Manual**

USEPA/USACE 1998

Clean Water Act

**Inland Testing
Manual**

USACE 2003

**Five Risk Pathways
for CDFs**

**Island, Nearshore,
or Upland Testing
Manual**





Technical Guidance for Management of Dredged Material



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Evaluating Environmental Effects of DM Management Alternatives (33CFR 336.1)
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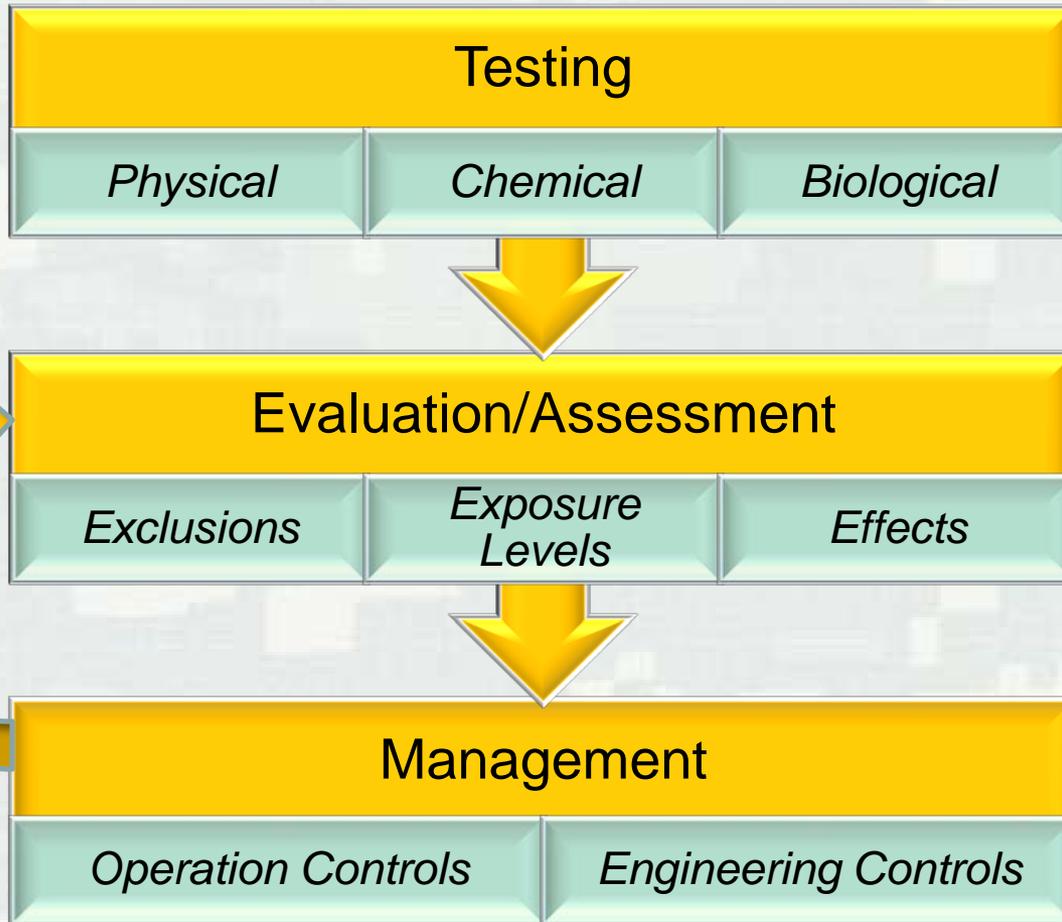
USACE and USEPA
Aquatic Placement of Dredged Material: Testing, Evaluation, Assessment, and Management Manual (TEAMM)

USACE 2003
Five Risk Pathways for CDFs
Island, Nearshore, or Upland Testing Manual





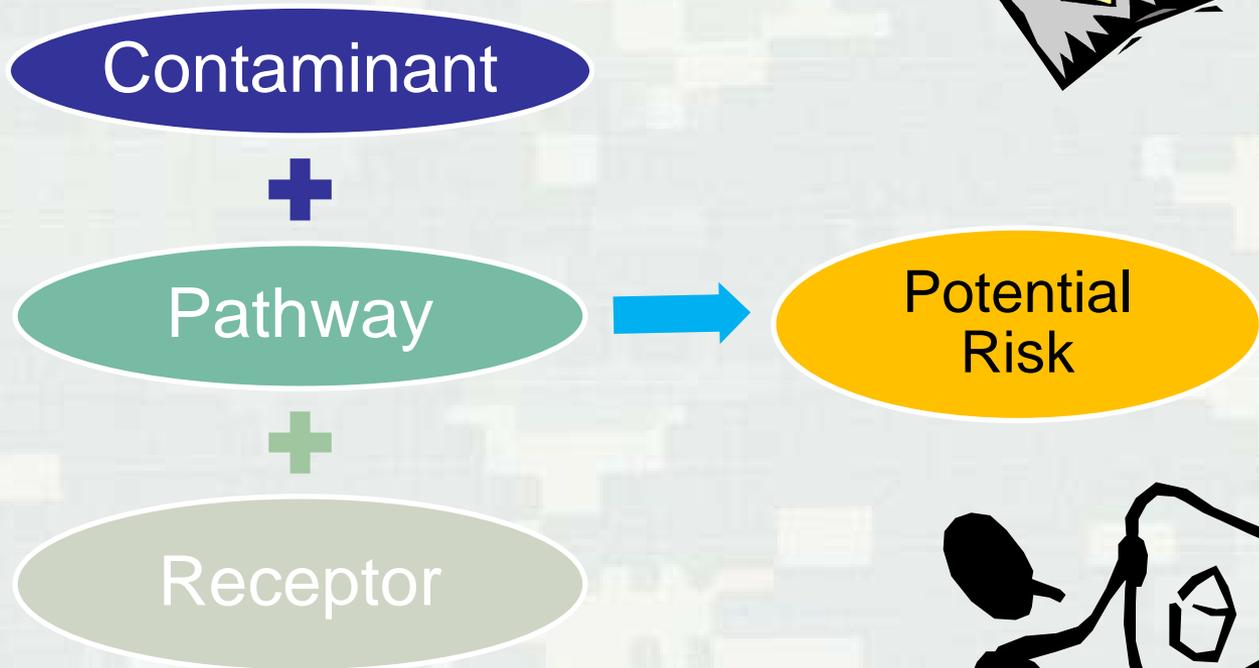
Risk Evaluation with Risk Management





Site Models for Risk Characterization

...can be written description or visual representation that depicts project-specific conditions...



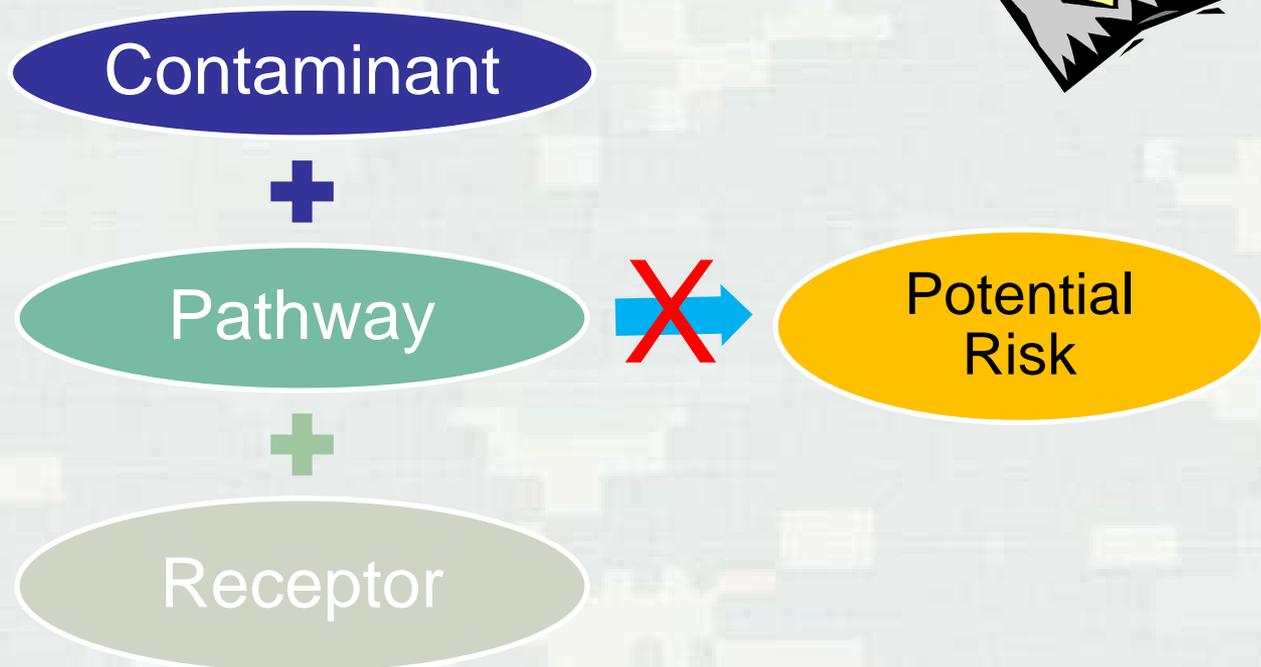
“...are abstractions of reality created to express a general understanding of a more complex process or system,” Fischenich 2006





Site Model for Risk Management

“Risks can be minimized by reducing either their likelihood or their impact” Suedel, et al. 2012



where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, discharged material may be intended to be spread naturally in a very thin layer over a large area 40CFR 230.11(f)





Dredged Material Placement Scenarios for TEAMM

- Scenario 1- Barge or hopper release in open water (ocean and inland)
- Scenario 2- Pipeline placement in open water (ocean and inland)
- Scenario 3- Strategic placement nearshore or onshore for beneficial use (coastal and inland)
- Scenario 4 - Open water placement then capped (Level Bottom Cap or Confined Aquatic Disposal)
- Scenario 5 - Agitation dredging for RSM (hopper overflow or flow-lane placement)

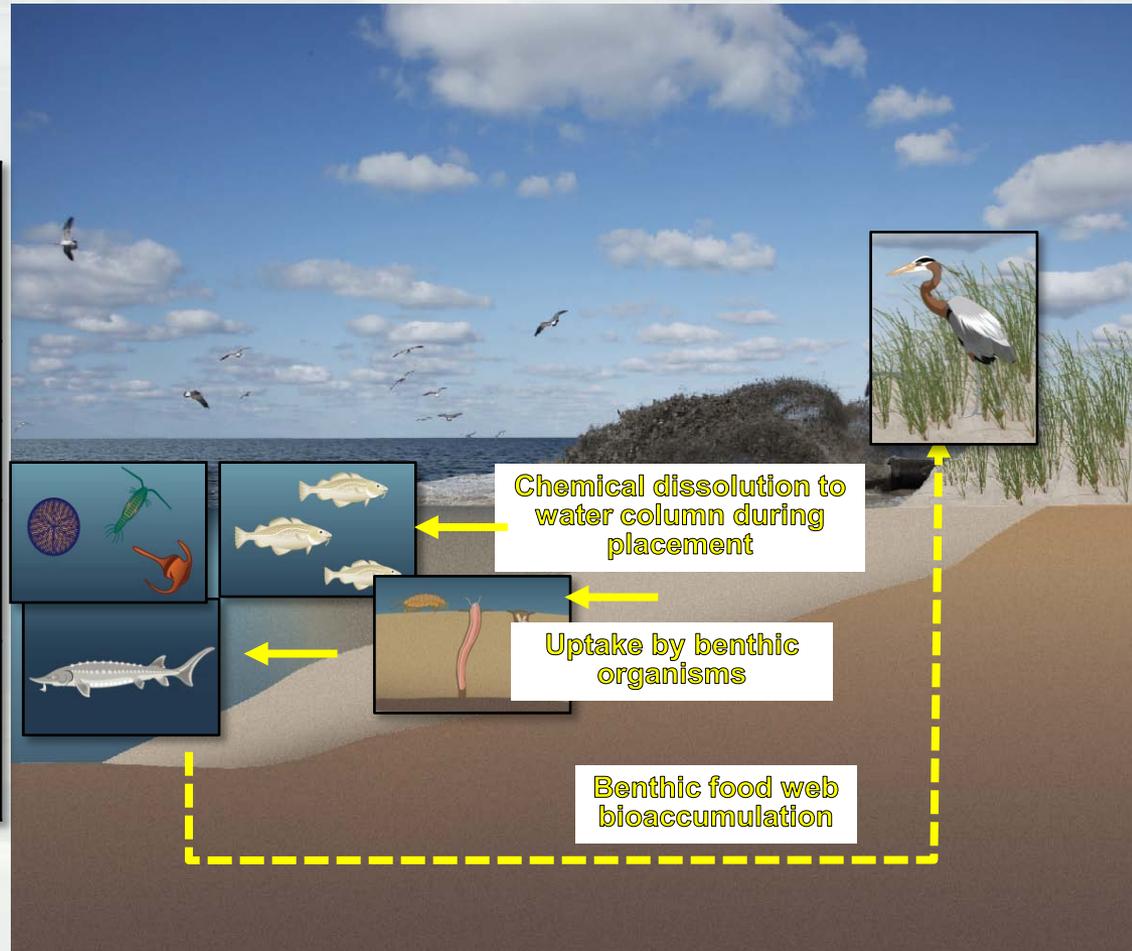




Strategic placement
nearshore or onshore
for beneficial use

TEAMM CSM-Scenario 3

Potential Receptors	Completed Exposure Pathway?
Water column	Yes ?
Benthic Toxicity	Yes ?
Fish and aquatic wildlife	Yes ?
Terrestrial wildlife and humans	Possibly





Management of Water Column Effects

Operational Controls

- Reduce release rate
- Depth of release
- Release under tow
- Increase overflow to reduce water content

Engineering Controls

- Submerged diffuser
- Tremie tube
- Dredge type
- Silt curtain
- Amend sediment or water column





Management of Benthic Toxicity & Bioaccumulation

Operational Controls

- Schedule placement based on conditions
- Sequence placement—cleaner material on top

Engineering Controls

- Amend sediment to reduce desorption
- Lateral confinement
- Capping
- Enhanced MNR





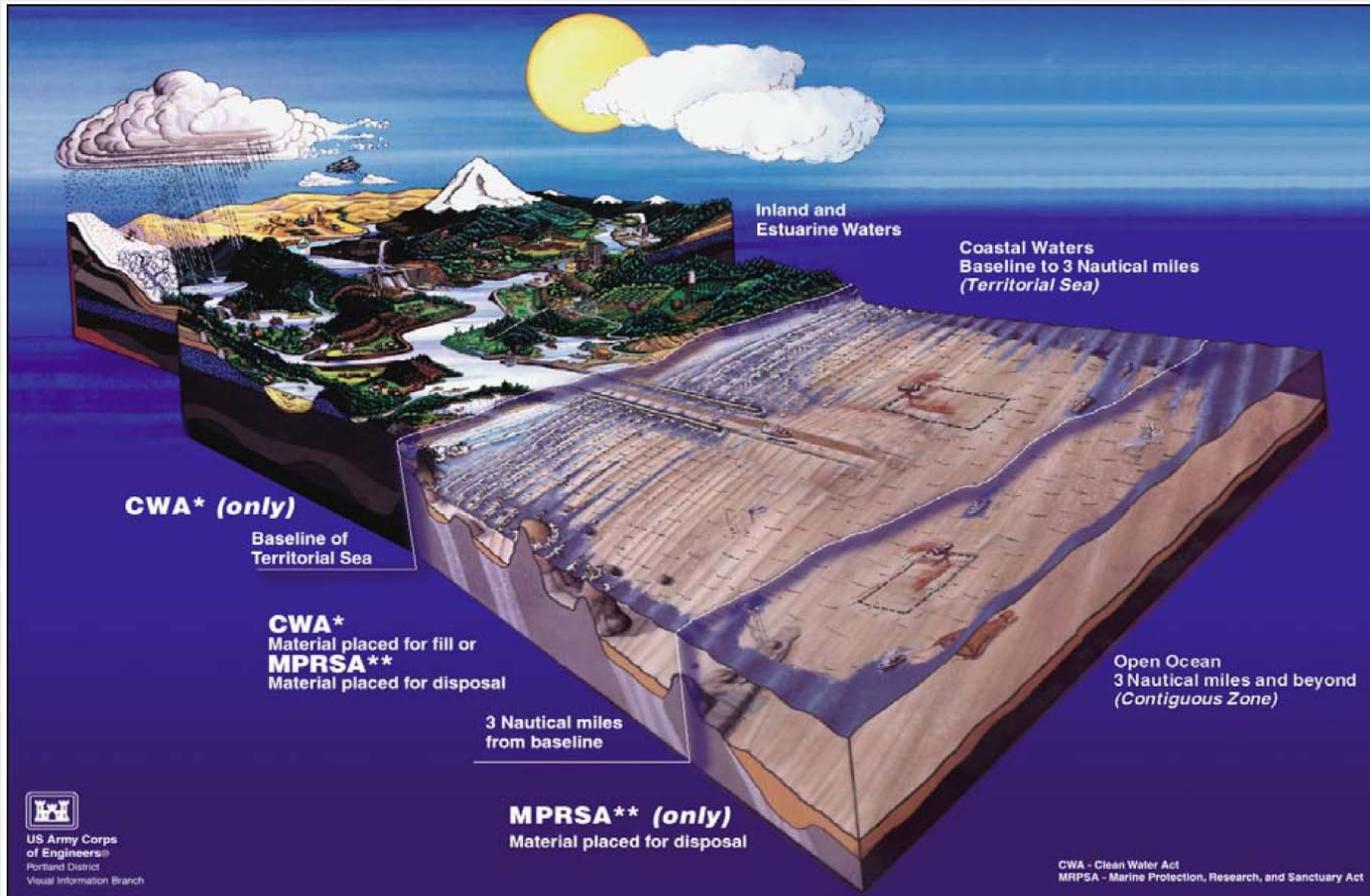
Strategic Placement in the Nearshore Regulations - Permitting

- Rivers and Harbors Act – Sec. 10
- National Environmental Policy Act – Sec. 102
- Fish and Wildlife Coordination Act
- Endangered Species Act
- Coastal Zone Management Act – Sec. 307(c)
- Marine Protection, Research, and Sanctuaries Act (**Ocean Dumping Act**) – **Sec. 103**
- Federal Water Pollution Control Act (**Clean Water Act**) – **Secs. 404 and 401**



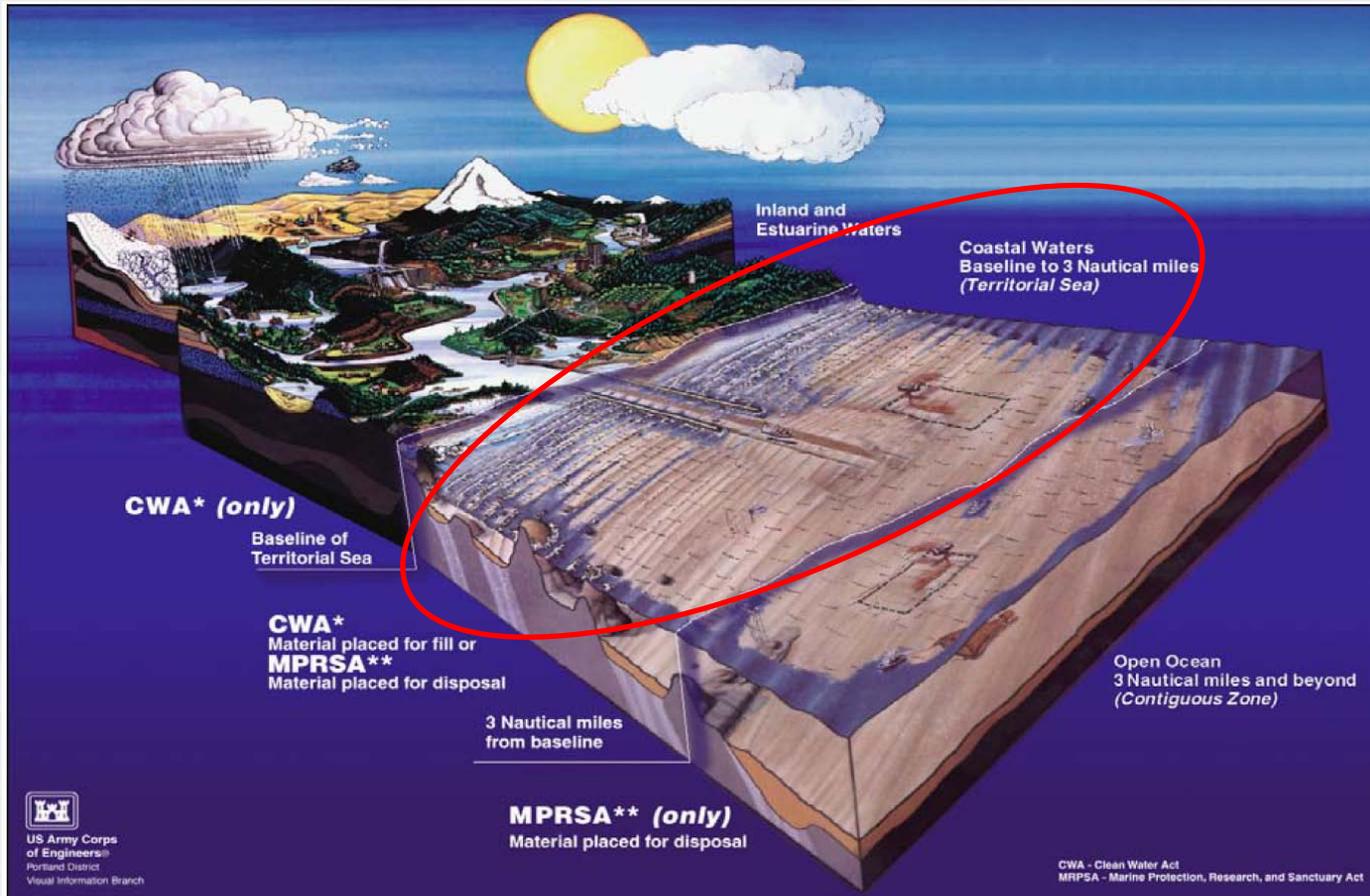


Strategic Placement in the Nearshore Regulations - Permitting





Strategic Placement in the Nearshore Regulations - Permitting





Strategic Placement in the Nearshore

ODA vs. CWA

- 33 CFR Part 336 – Factors to be considered in the evaluation of USACE dredging projects involving the discharge of dredge material into waters of the U.S. and ocean waters.
- (a) The disposal into ocean waters, including the territorial sea, of dredged material ... will be evaluated by the Corps in accordance with the ODA. (**also requires a 401 WQC)
- (b) In those cases **where the District Engineer determines that the discharge of dredged material into the territorial sea would be for the primary purpose of fill**, such as the use of dredged material for beach nourishment, island creation, or the construction of underwater berms, the discharge will be evaluated under Section 404 of the CWA.





Strategic Placement in the Nearshore CWA – Sec. 404

- **Fill material.** (40 CFR Part 232.2)
 - ▶ Material placed in waters of the U.S. **where the material has the effect of:**
 - Replacing any portion of a water of the U.S. with dry land; or
 - **Changing the bottom elevation of any portion of a water of the U.S.**

- **Discharge of fill material.** (40 CFR Part 232.2)
 - ▶ **The addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees...

- **404(b)(1) Guidelines** (40 CFR Part 230)





Strategic Placement in the Nearshore CWA 404 Information Needs

Must prove that what we propose:

- 1) Meets the 404(b)(1) Guidelines on effects
- 2) Is fill (40 CFR)
- 3) Is a discharge of fill material - “the **addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees... (40 CFR)
- 4) The discharge is for the **primary purpose** of fill (33 CFR - Substantiate DE’s assertion)





Strategic Placement in the Nearshore CWA 404 Information Needs

Must prove that what we propose:

- 1) Meets the 404(b)(1) Guidelines for effect assessment
- 2) Is fill (40 CFR)
- 3) Is a discharge of fill material - “the **addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees... (40 CFR)
- 4) The discharge is for the **primary purpose** of fill (33 CFR - Substantiate DE’s assertion)

Information Needs:

- Effect Assessment (40 CFR Part 230)
- Need proof of concept the discharge is for an activity/construction
- Need to show discharged material is “predominantly” fill material (not disposed material)
- Typically interpreted as 50% + 1 grain must serve primary purpose of fill





Strategic Placement in the Nearshore CWA 404 Lines of Evidence

Challenge to Engineers and Scientists:

- ▶ **Keep us away from the ODA!**
 - Site Designation= Cost, Time, Unlikely, Lost Resource, Missed Opportunity = HEADACHE

- ▶ Show that more than half of the material (fill) is expected to serve the construction activity (contribute to purpose).

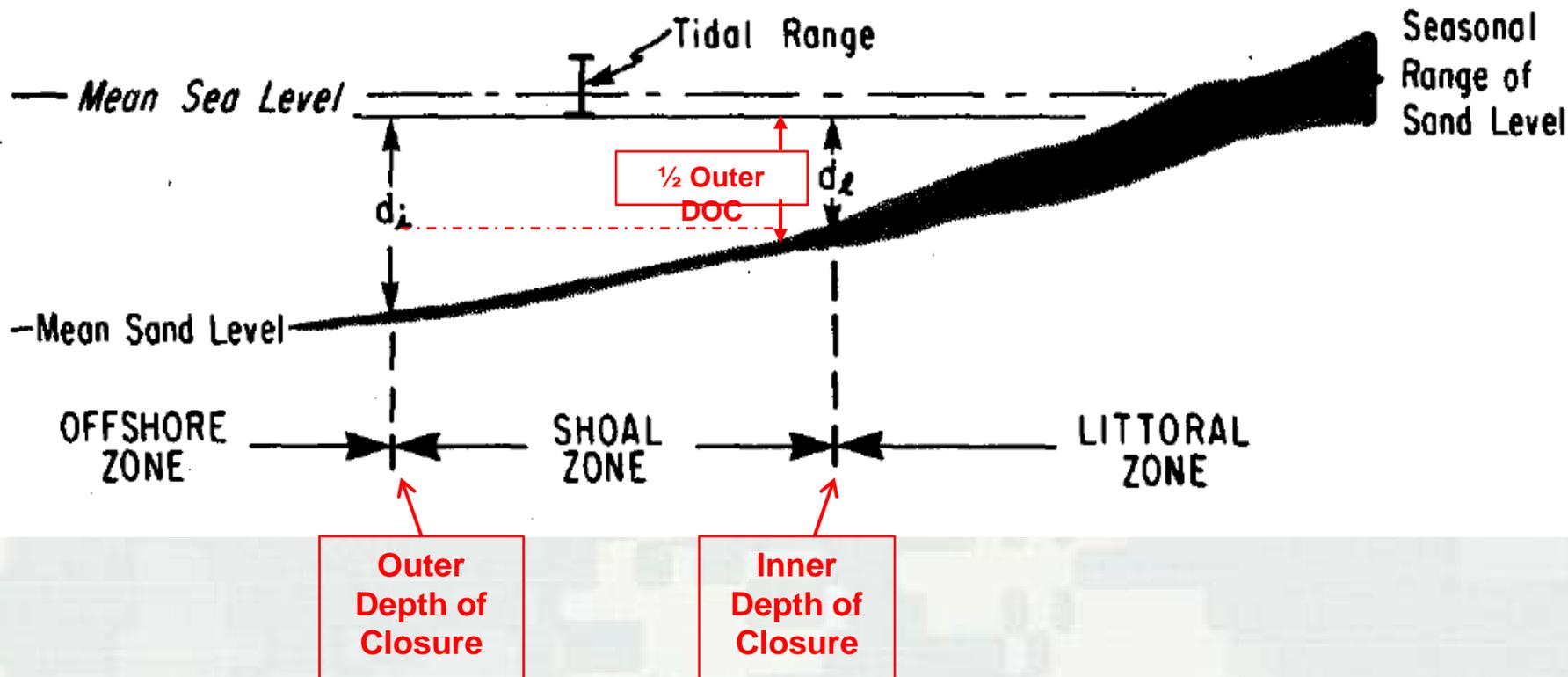
- ▶ Need LINES of EVIDENCE for:
 - ▷ Right Sediment Composition
 - Material Characterization – Aquatic Placement of DM TEAMM
 - ▷ Right Placement/Construction Method & Location
 - Experience – Monitoring of Completed Projects
 - Site Specific Data & Models
 - Other Agreed Upon Criteria





Placement Nearshore to meet CWA 404

Figure (adapted from Hallermeier, 1981)





Dredged Material = SEDIMENT SEDIMENT is a RESOURCE

Corps 1987 EM 1110-2-5026: *Beneficial Use is utilizing dredged material as a resource in a productive way, which provide environmental, economic, and/or social benefits.*

National Dredging Team's Dredged Material Management: Action Agenda for the Next Decade (2003): Much of the sediment dredged each year could be used in a beneficial manner, such as habitat restoration and creation, beach nourishment, and industrial and commercial development; yet much of this dredged material is disposed in open water, confined disposal facilities, and upland disposal facilities; Beneficial use must become a priority at all levels of management and there must be recognition that dredged material is a valuable resource (EPA 2003).





Dredged Material as a Resource: Measurements and Modeling

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Corps sediment management needs

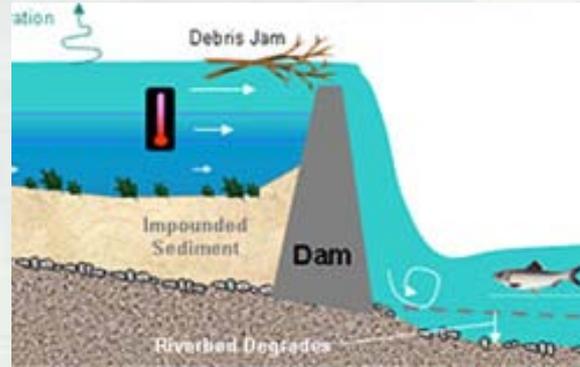
- Corps infrastructure often alters natural movement of sediment
- Changes to transport patterns have both positive and negative impacts
- RSM/EwN Goals
 - ▶ Minimize negative impacts
 - ▶ Maximize benefits
 - ▶ Reduce costs to maintaining infrastructure, safety, and business line missions
 - ▶ Dredged sediment as a resource



Sediment Transport Issues



Maintain Navigation



Effects of Structures



Land Loss/morphology



 Regulation and effects on species/habitat
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Event Sedimentation and Erosion



Dredged sediment as a resource/RSM
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Dredged material as a resource: Nearshore Berms

- Dispersive Berms
 - ▶ Nourish sandy shorelines
 - ▶ Provide mineralogical sediments to wetlands or other habitat
- Stable Berms
 - ▶ Protect habitat, coastline, infrastructure
 - ▶ Create features suitable for colonization
- This presentation: nourish sandy shorelines





Dredged material as a resource: Nearshore Berms

- Objectives:
 - ▶ Permit fines/sand to winnow
 - ▶ Migration of sand to the beach
 - ▶ Transport of fines away from beach
 - ▶ Sustainable DMM solutions
- General Issues:
 - ▶ Fate of sand and fines
 - ▶ Regulatory compliance
 - ▶ Effects on local habitat/resources
 - ▶ Minimize cost while providing most benefit





Nearshore Berms: Sustainable DMM Solutions

- Need to balance multiple objectives
 - ▶ Provide designated benefits (sand, habitat, etc)
 - ▶ Minimize risk of negative impacts (WQ, eg)
 - ▶ Cost effective
 - ▶ Sustainable (can reuse the site effectively in DMM solutions)
- In general, measurements and modeling are required to address:
 - ▶ Regulatory approval
 - ▶ Optimize sand supply - assess alternatives
 - ▶ Support risk assessment





Measurements and Modeling

- The majority of sediments handled by USACE at entrance channels are mixtures of sand, silt, and clay
- Measurements and modeling permit us to develop multiple LOEs to effectively manage mixed sediment
- Development efforts:
 - ▶ Improve measurement/monitoring methods
 - ▶ Improve mixed sediment transport algorithms
 - ▶ Improve site-specific parameterization methods





How are measurement used?

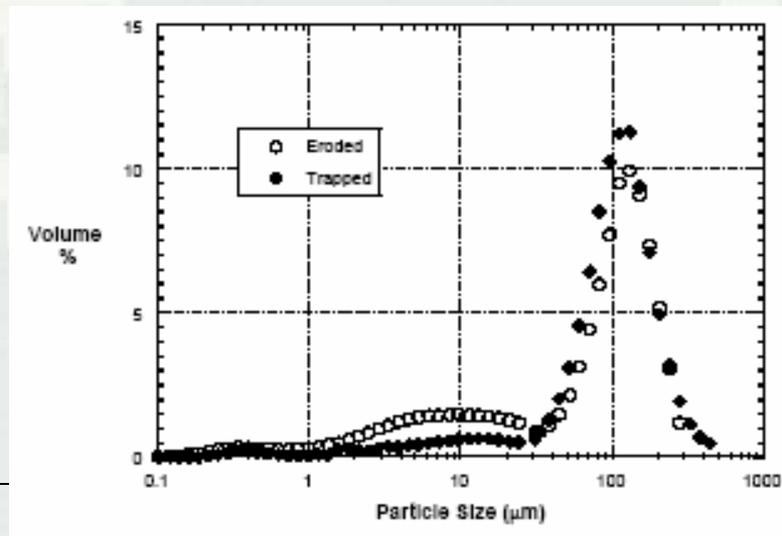
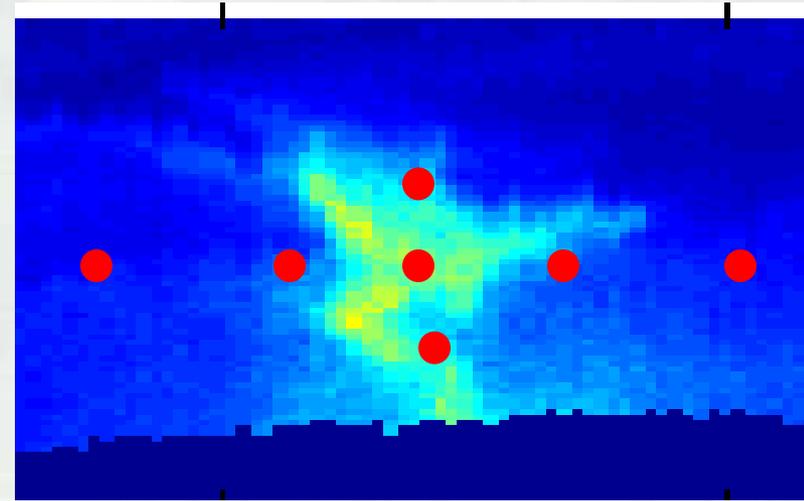
- Understand how sand, silt, and clay transport in a system (CSM)
 - ▶ Range from particle- to system-scale
 - ▶ Determine dominant transport processes/events
 - ▶ Data are used in models to represent transport processes
- Parameterize, calibrate, validate model(s)
- Monitoring data used to assess regulatory compliance, refine CSM
- Validated models used to assess alternatives, evaluate risk





What do we measure/monitor?

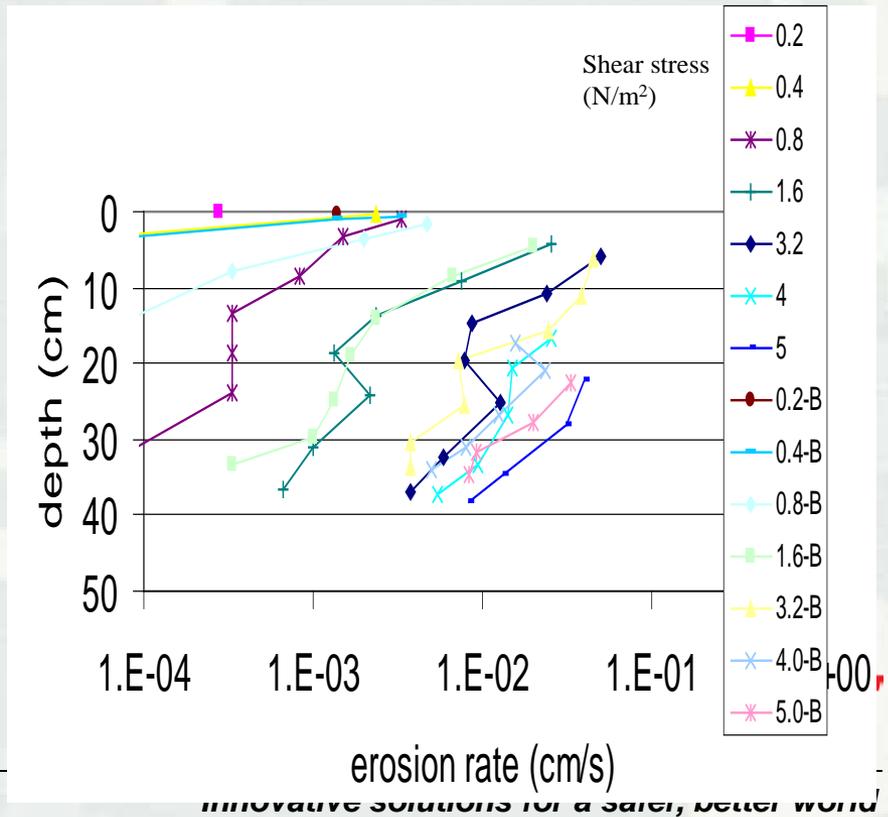
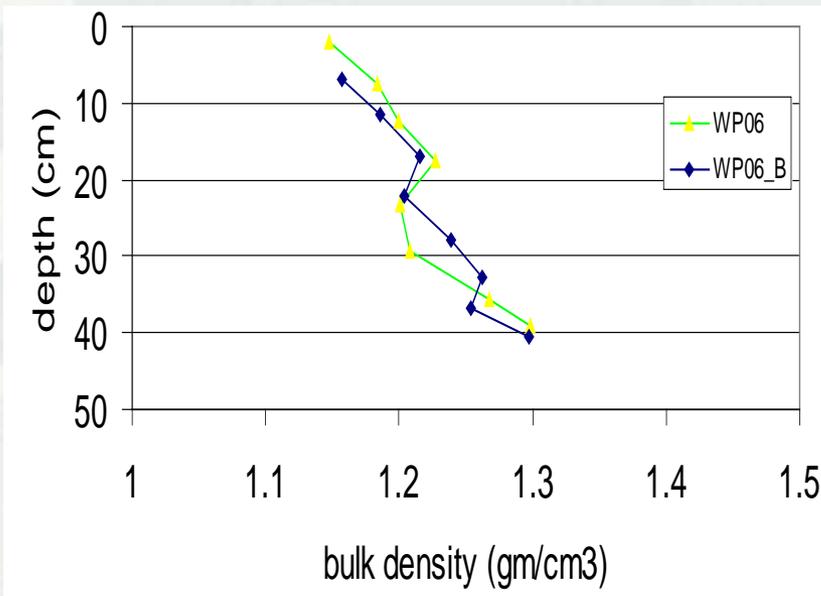
- Full suite of hydrodynamic conditions (tide, currents, waves, salinity,...)
- Process measurements
 - ▶ Erosion potential
 - ▶ Sediment settling (deposition/sedimentation)
 - ▶ Bed consolidation
- Sediment bed composition
- Water column concentration



Morphologic evolution

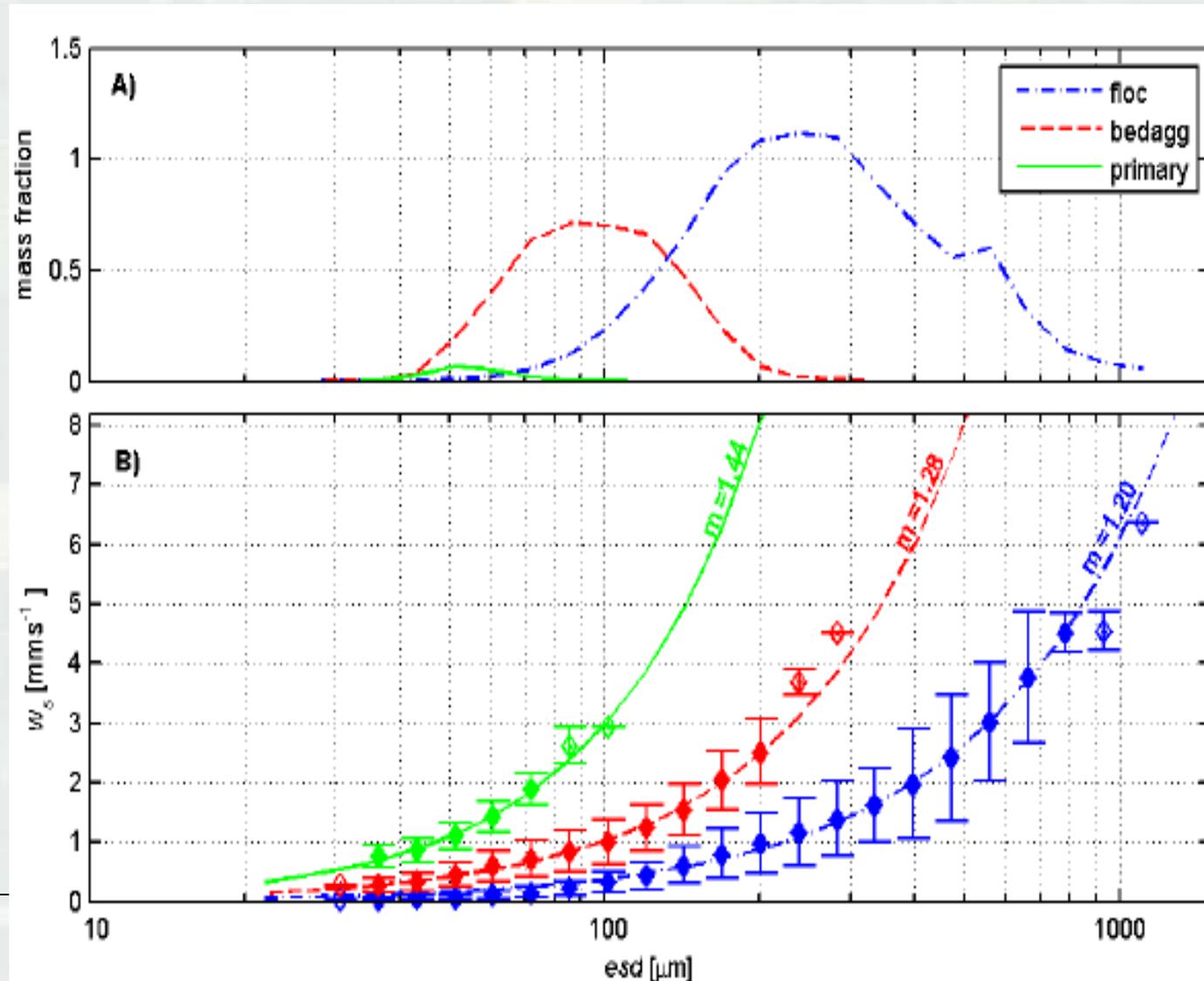
Erosion with depth

- Why make these measurements?
 - Erosion of mixed sediment mounds is a function of density, other factors
 - Must understand under what conditions surface- and sub-layers will move
 - Used to parameterize and calibrate models



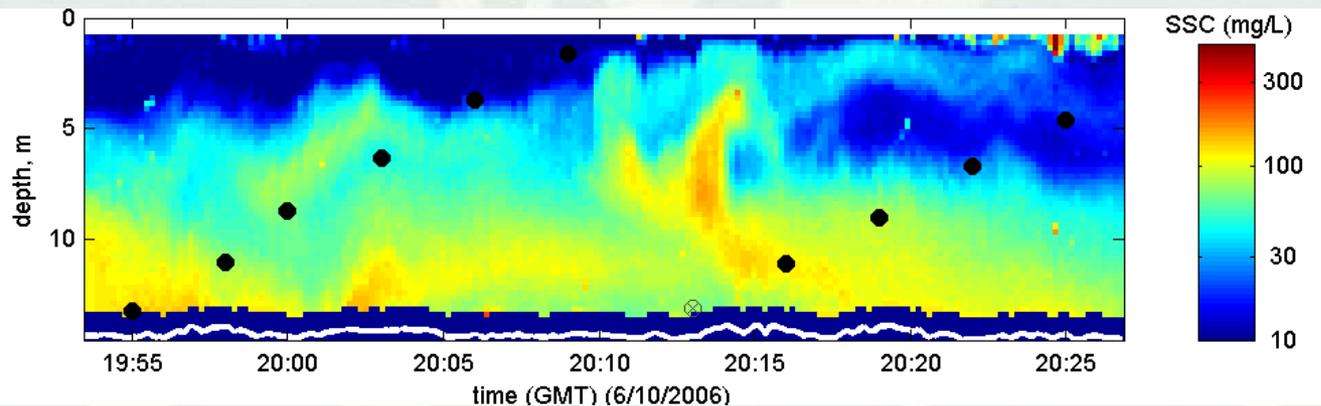
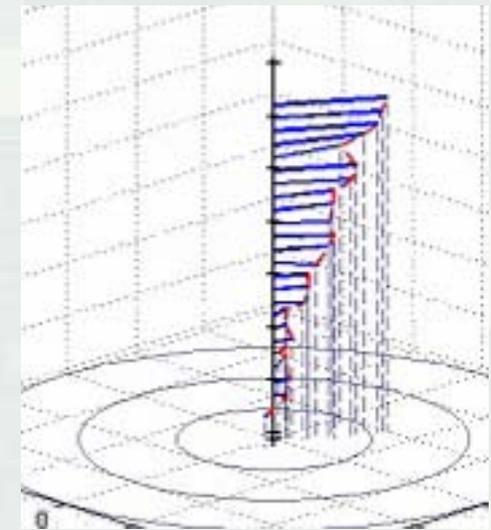
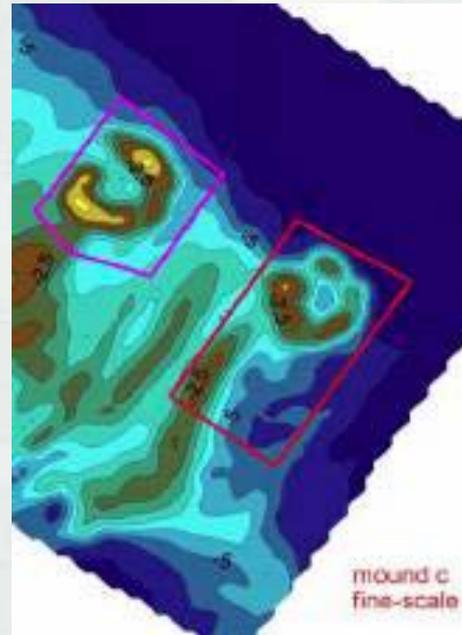
Concentration, Aggregate States and Settling

- Why make these measurements?
 - Aggregate state influences plume decay, transport distance, and fate of FGS
 - Required for model parameterization, calibration and validation
 - Note: aggregate state can change FGS settling by orders of magnitude



Monitor Dredging Process

- Direct verification of regulatory compliance (TSS)
- Support development and parameterization of models for dredging process
- Develop input for long-term fate models (initial mound bathymetry and composition)



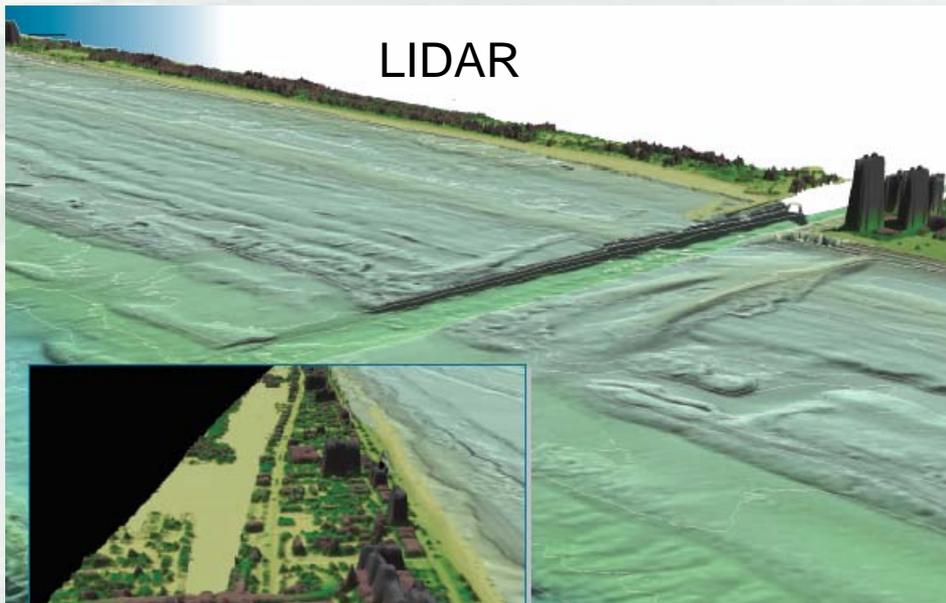
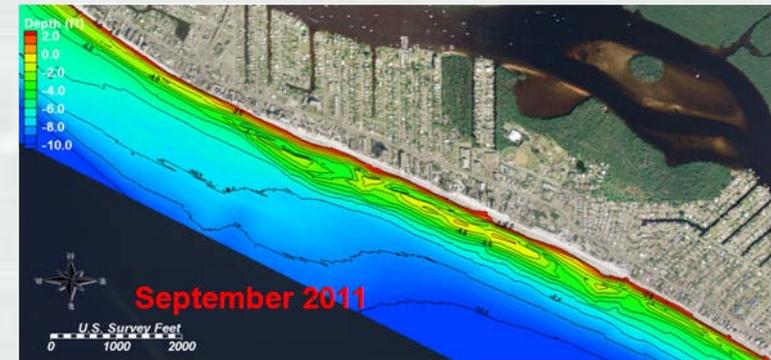
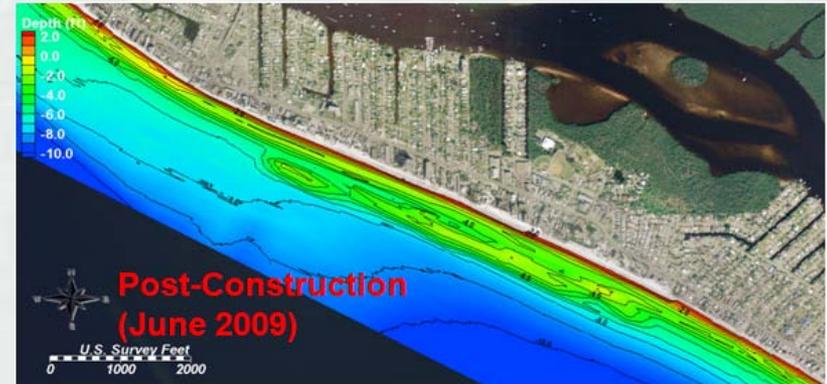
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Field Measurements Post-Placement

- Repeated surveys – berm/beach morphologic evolution (multibeam, LIDAR, side-scan, beach profile,...)
- GSD of the berm and surrounding area
- Geochemical (natural) tracers
- Manufactured tracers



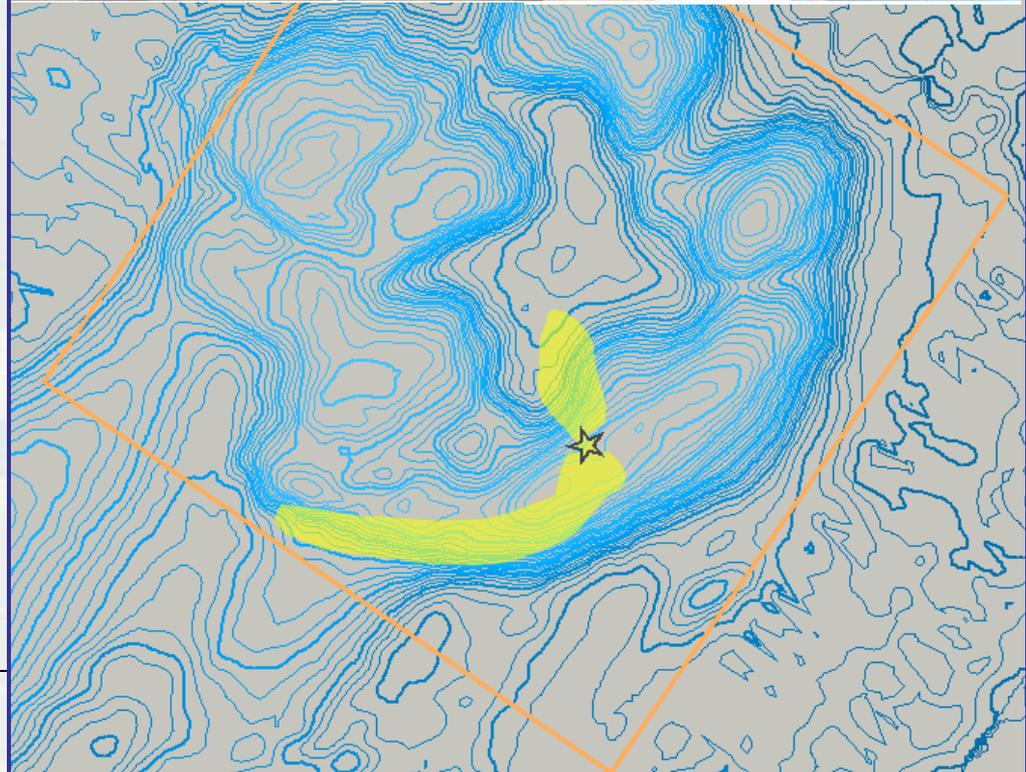
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Field Measurements Post-Placement

- Geochemical (natural) tracers
 - Use for DM BU is currently being assessed at ERDC
 - Generally used to track fine fraction
- Manufactured tracers
 - Seeding (to represent entire mound) is difficult
 - Generally, represents transport for only a specific set of conditions
 - Difficult to prove a negative
 - Qualitative vs. Quantitative





Sediment Transport Models Tools for Nearshore Berm Projects



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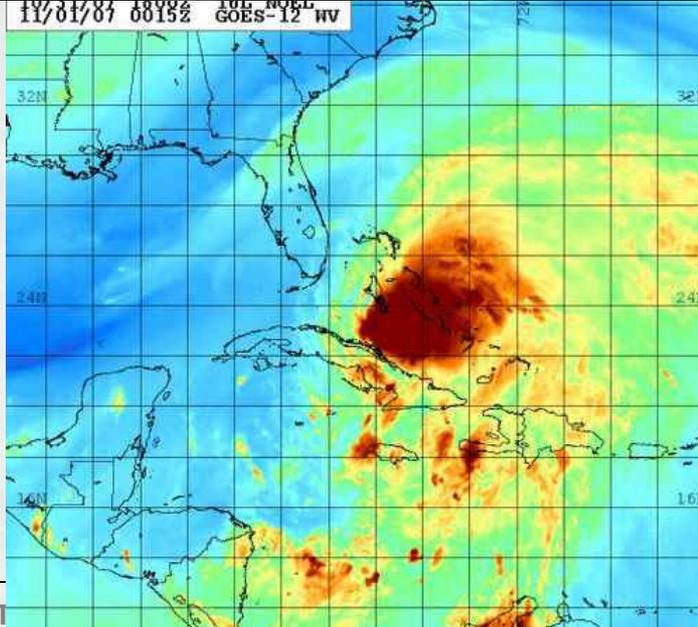


Transport Modeling Basics

- WHY: Models predict how a system will behave under conditions for which we have limited or no data
 - ▶ Planning
 - ▶ Regulatory approval
- Sediment transport models are based on:
 - ▶ Our understanding of physical processes
 - ▶ General understanding of processes at a site (CSM)
 - ▶ Site-Specific sediment process data
 - ▶ Models must be consistent with all site-specific data
- RSM requires models that accurately predict sediment transport through complex, interconnected regions
 - ▶ Pushing the envelope of transport model capabilities
 - ▶ Must be aware of model limitations
 - ▶ Process research/data collection ongoing



The Modeling Process



- CSM: Collect relevant historic, hydrodynamic and sediment data
- Select model(s) that will address relevant issues
- Parameterize, calibrate, & validate model using data
- Predicts sediment fate for conditions without data
 - ▶ Large events
 - ▶ Post-construction
- Model output/data analysis to support project design



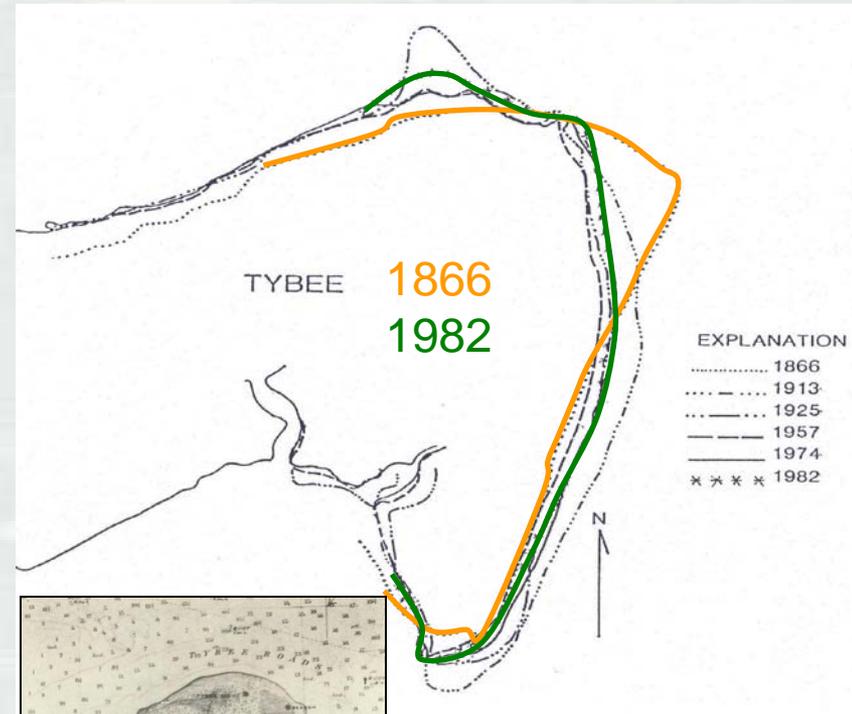
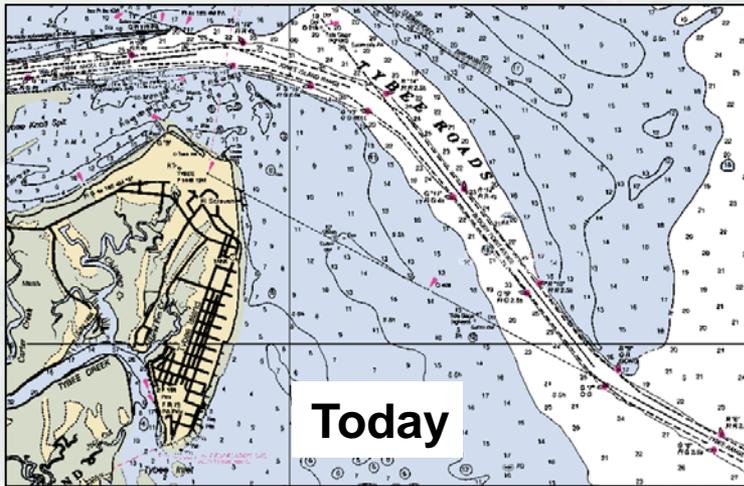


How Models Support Nearshore Berm Management

- Transport in these regions is inherently complex
- Models are used to address
 - ▶ Regulatory compliance
 - ▶ Environmental Resources/Risk Assessment
 - ▶ Transport from placement site to area of interest
 - ▶ Site/lifecycle management \iff sustainable solutions
 - ▶ Design placement to minimize need for LDC or other expensive handling
 - ▶ Assess alternatives to select cost-effective options
- Models are one of multiple tools (line/lines of evidence)



Savannah Entrance Channel



- Federal navigation channel project (jetties and deepened channel)
- Evolving ebb shoal complex and beach erosion problem downdrift of the entrance (on Tybee Island)
- Federal shore protection project constructed to address the erosion
- High sand loss rate on north Tybee, adjacent to the inlet

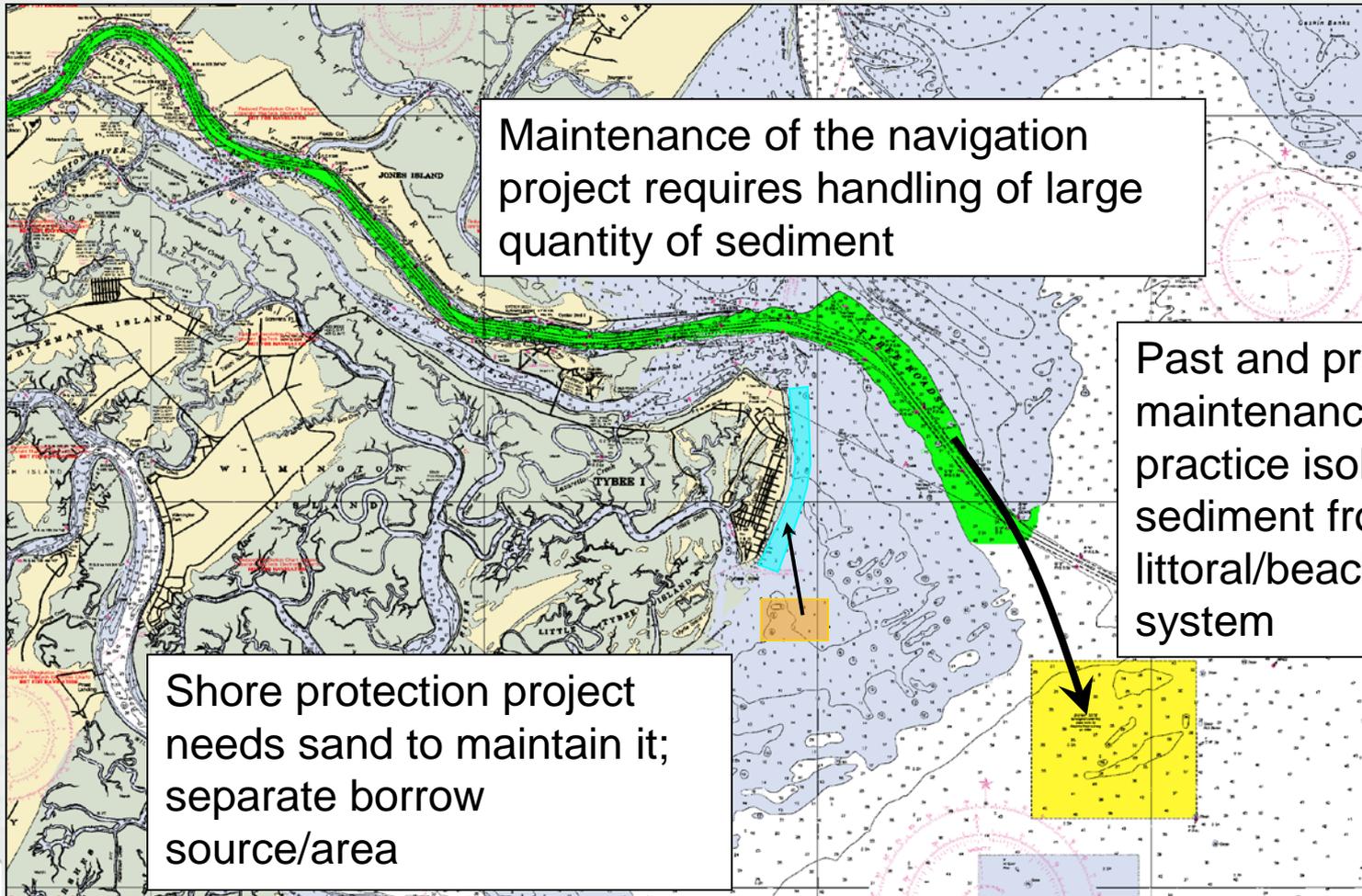


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Project Specific Sediment Management Approach



Maintenance of the navigation project requires handling of large quantity of sediment

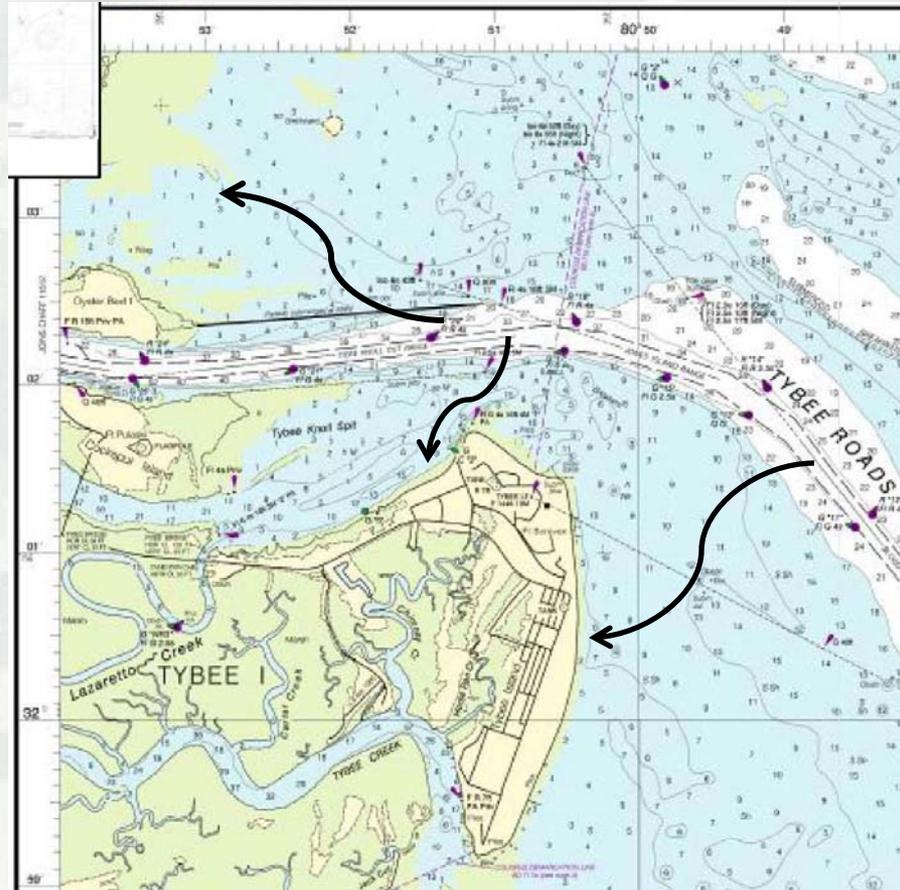
Past and present maintenance practice isolates sediment from the littoral/beach system

Shore protection project needs sand to maintain it; separate borrow source/area





Sustainable RSM Solutions



- Many coastal regions are not receiving sufficient sand or fine sediment
- RSM : Strategic mixed sediment placement in nearshore
 - Flood tide moves sediment into wetland
 - Waves move sand toward shore and fines offshore
 - Lower cost than direct placement
 - Sustainable placement sites
 - Natural sorting of mixed sediments
- Use models to assess alternatives and optimize design

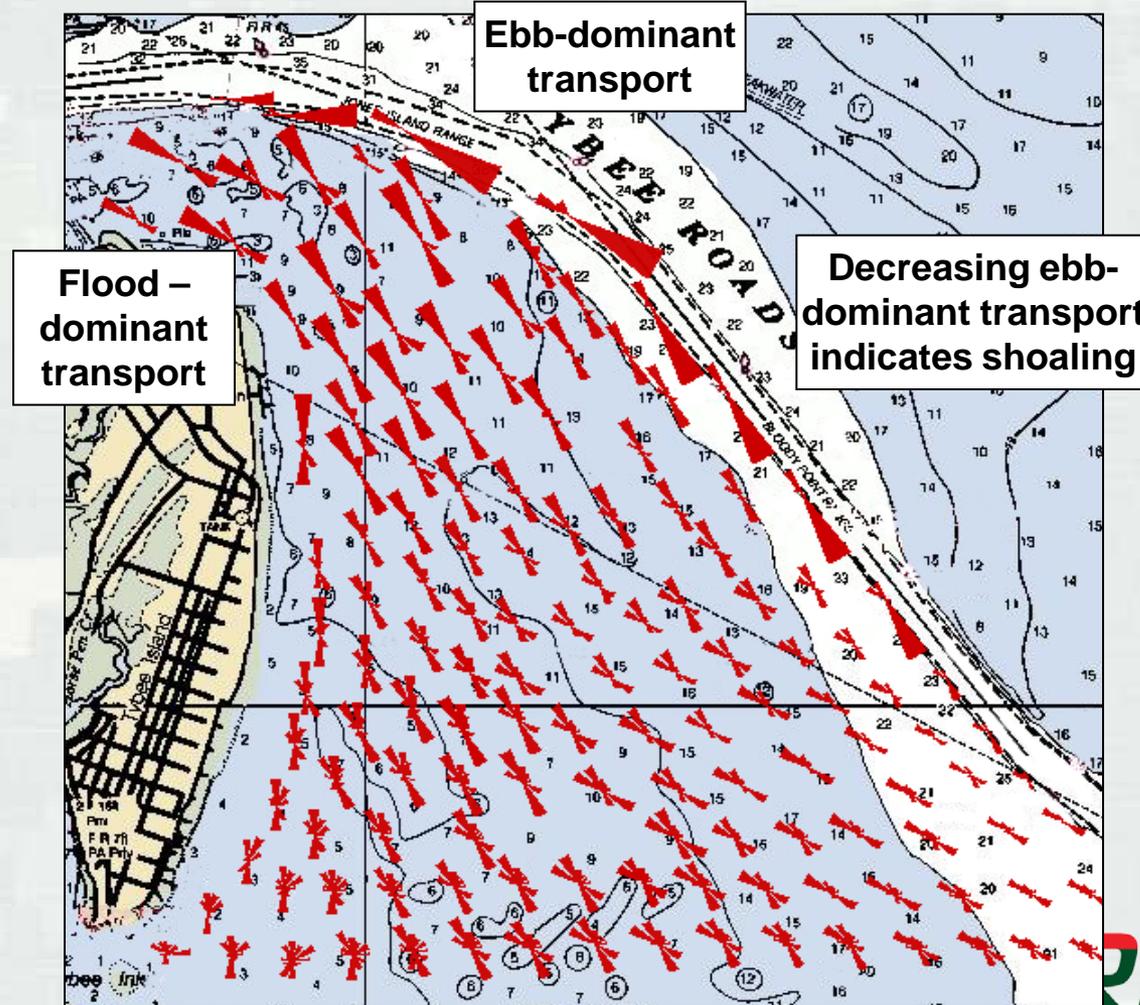


Sediment transport direction and magnitude for existing natural conditions

- Sediment model results shed light on existing inlet sediment transport processes and pathways, and preferred placement locations

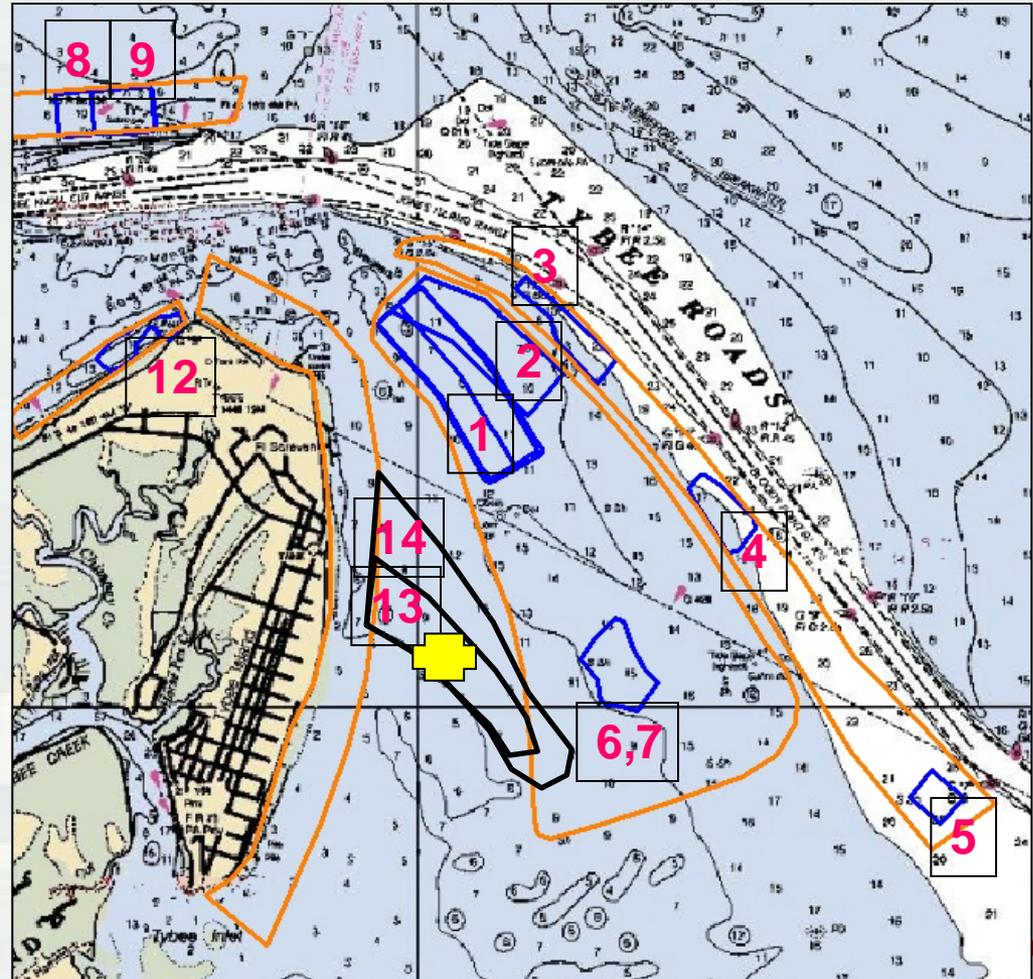
- Results consistent with observed shoaling patterns in the channel and north Tybee

- Results consistent with Brunswick tracer study

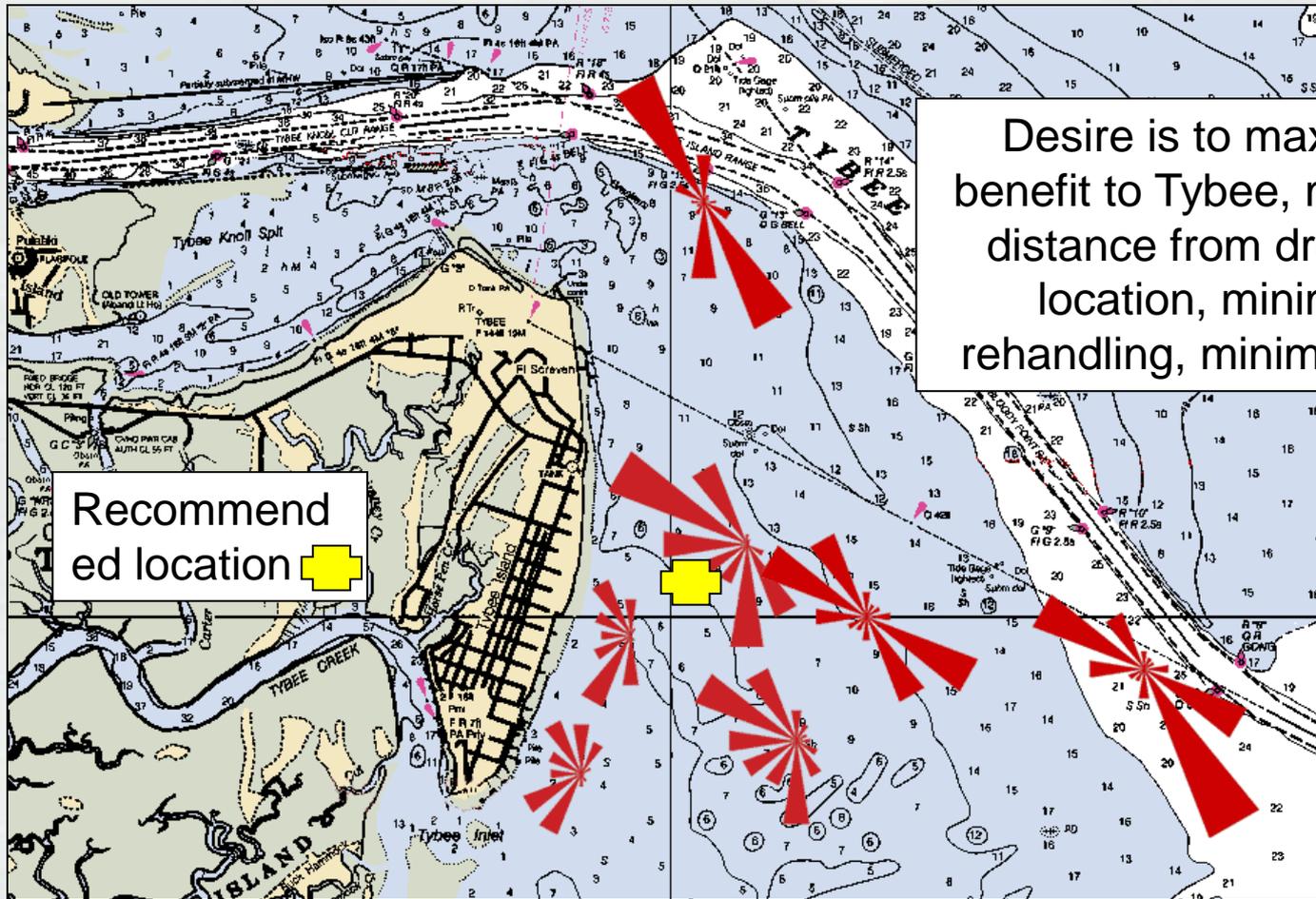


Proposed Berm Locations

- Multiple berm locations modeled
- New alternatives (13,14) added as result of findings
- Nearshore bathymetric relief influences wave transformation
- Changes in transformation influence longshore transport
- Longshore transport affects shoreline change

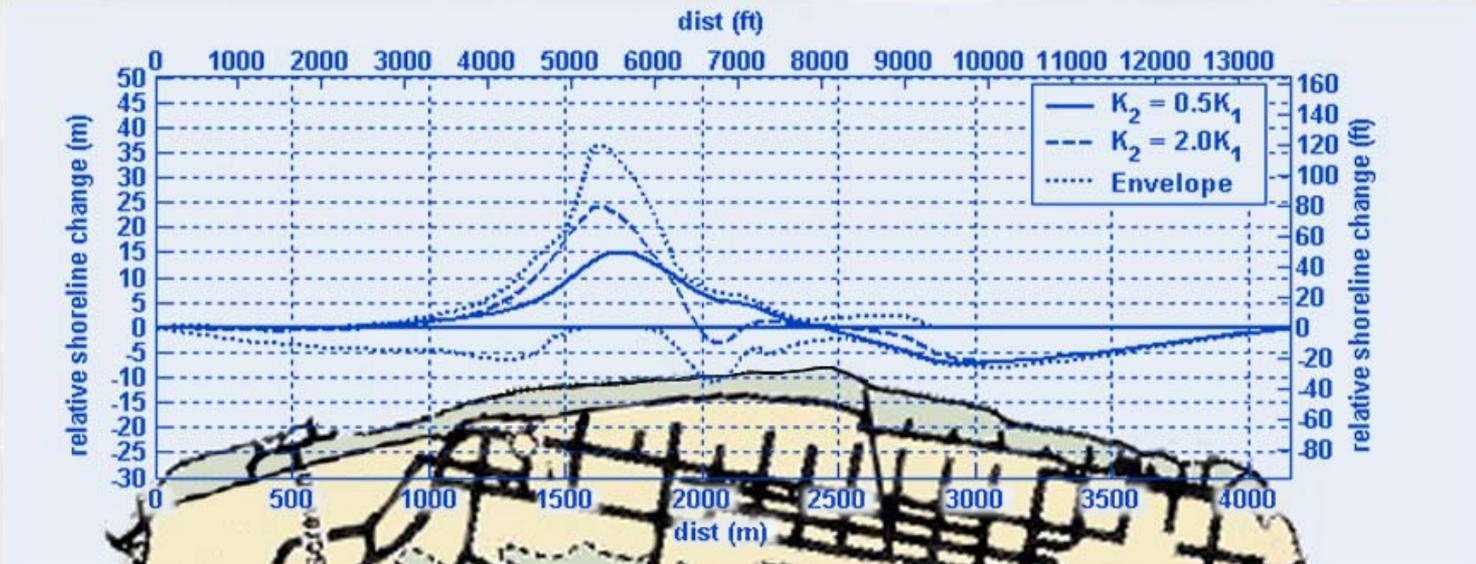


Sediment transport direction and magnitude at proposed berms





Relative Shoreline Change Over 20 years, Berm 13 (GENESIS Model Results)

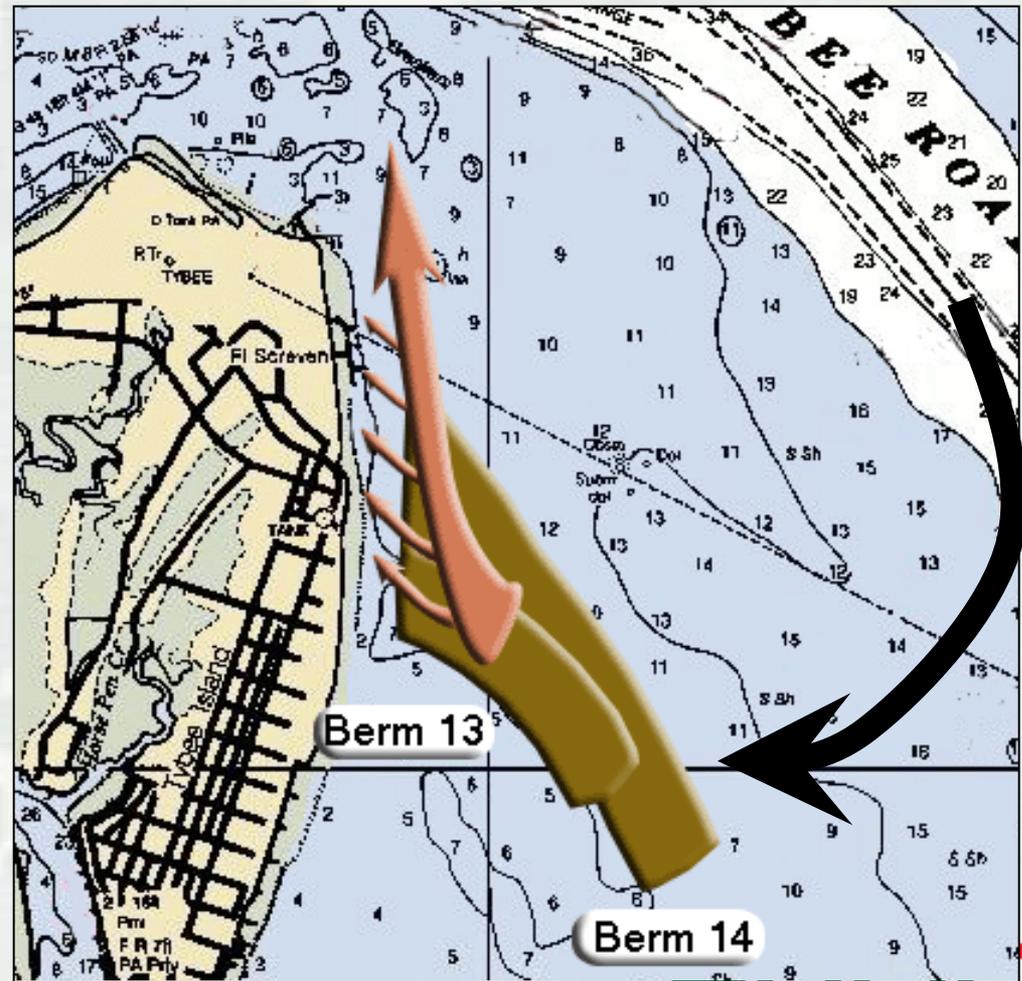


- Negligible negative impacts on the shoreline
- Less than 20-30 ft erosion over 20 years to south Tybee where beaches are healthiest
- Can be offset by future renourishment or occasional modification of nearshore placement practice



Recommendations

- Place mixed sediment from channel into Berm 13/14
- Allow natural winnowing to remove fine content
- Longshore transport patterns will move sediment into north Tybee littoral zone





Summary

- Models provide important lines of evidence when developing CSM based on process understanding
- Multiple models and levels of modeling required
- Models require data for parameterization, calibration, and validation
- RSM often requires that we use models to address conditions for which we have no data
- Model benefit to RSM: evaluate options/improve practice





Examples of Recent Monitoring Projects



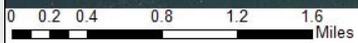
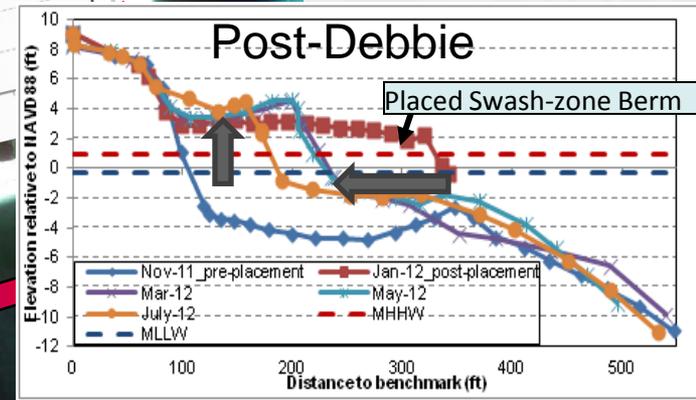
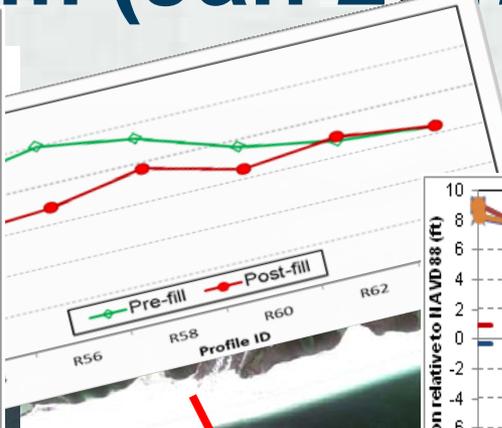
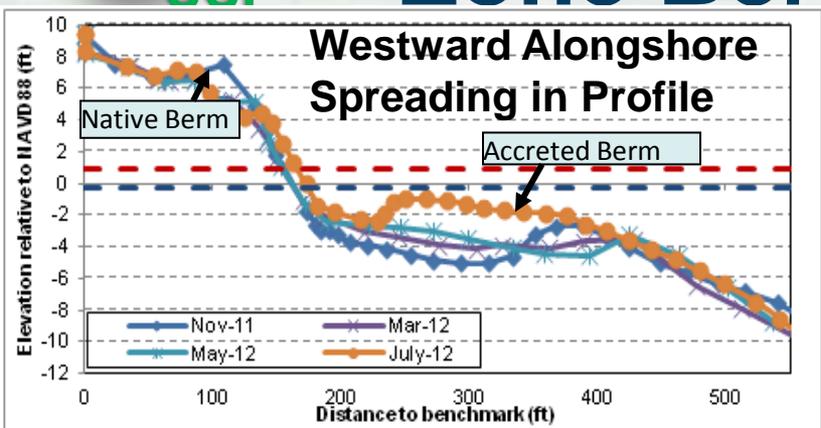
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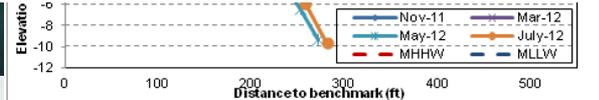
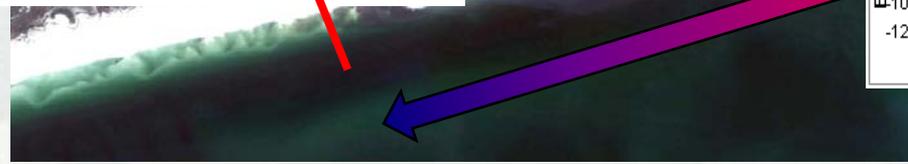
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Perdido Key Swash Zone Berm (Jan 2012)

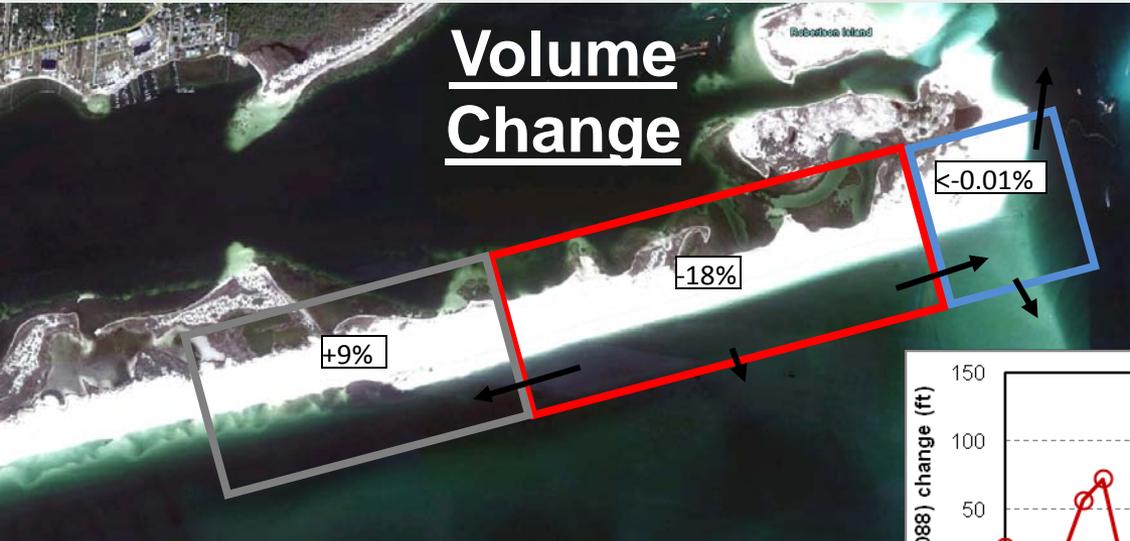


State Plane Florida North, NAD83



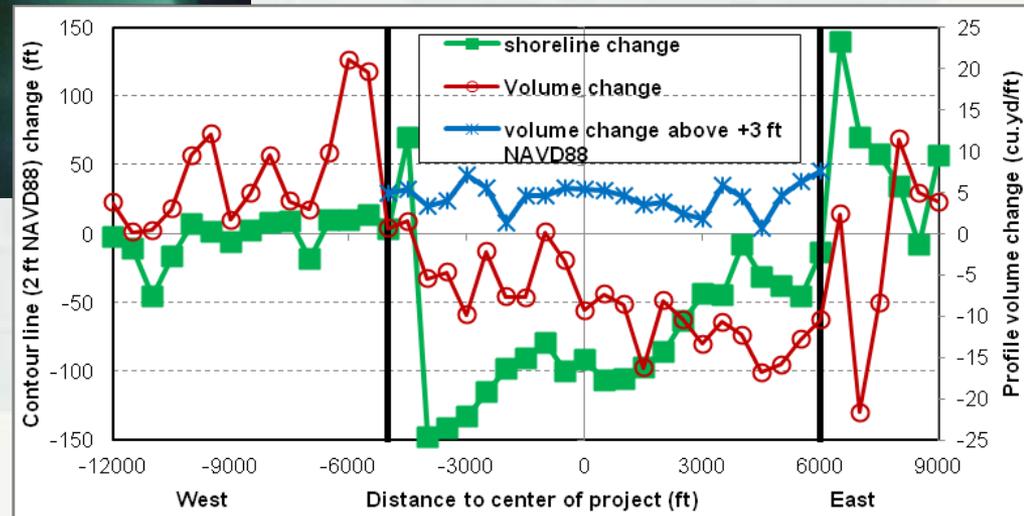
- Sediment grades coarser away from inlet; fill is uniform inlet material
- Following placement, shoreline erodes landward and shoreface accretes
- Rapid Erosion furthest from the inlet; lowest erosion rates near the ebb shoal
- Alongshore spreading through the nearshore profile
- Inlet shoreline changes not substantial; limited bayside changes

Perdido Key Swash Zone Berm (Jan 2012)

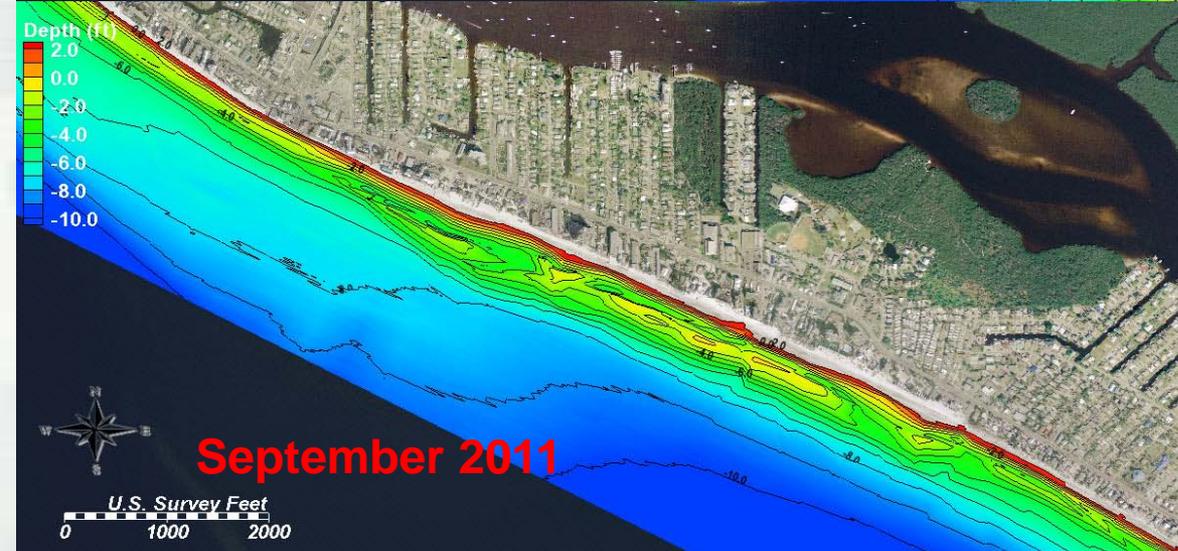
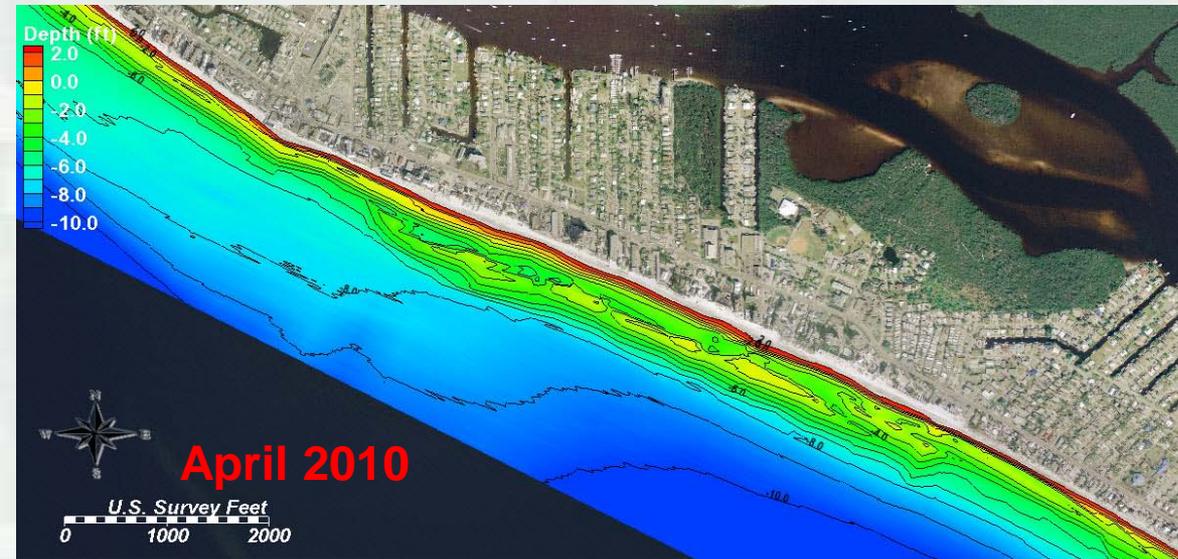


6 Month Volume Calculation

- Accurate means of determining sand retention within the nourished area
- Quantitative method to describe the movement of material



Ft. Myers Nearshore Berm (Jun 2009)



- Fine sediment found in trough and offshore for 1st year; 2nd year none in trough, and coarsening of berm/trough to native grain size as migrating
- Berm migrated 150 ft/yr; characteristic of an asymmetric onshore migrating bar
- Gaps in berm migrated alongshore, but there was little alongshore spreading
- Negligible effects to the shoreline response (low-wave energy)
- Overall, positively viewed nearshore berm



New Smyrna Nearshore Berm

CESAJ

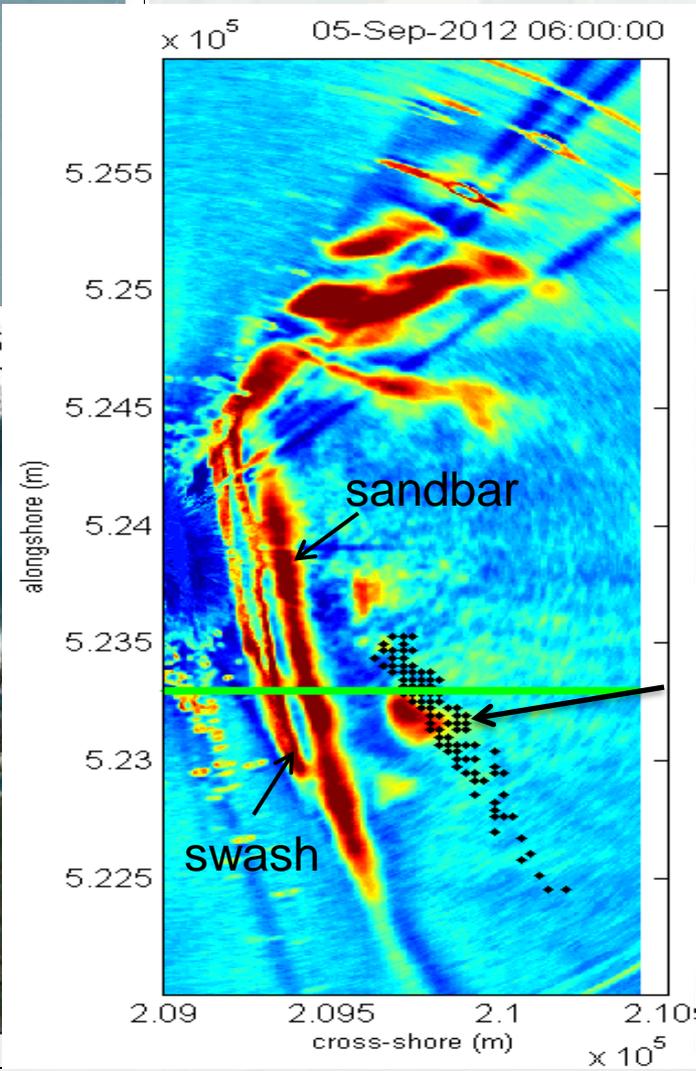


US ARMY CORPS OF ENGINEERS: ENGINEER RESEARCH & DEVELOPMENT CENTER
Field Research Facility

RADAR INLET OBSERVING SYSTEM:



www.offshoreswell.com



Placement locations

WQC PLATES	FILE NAME:	OWN BY:	GENERAL NOTES:
NOT FOR CONSTRUCTION		CMK	
DEPARTMENT OF THE ARMY	STATE: FEBRUARY 2012	BSW BY: GMS/CR	
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS	PROJECT: AS SHOWN	DES BY: SR	
JACKSONVILLE, FLORIDA			



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New Smyrna Nearshore Berm

CESAJ



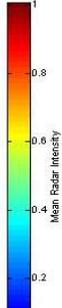
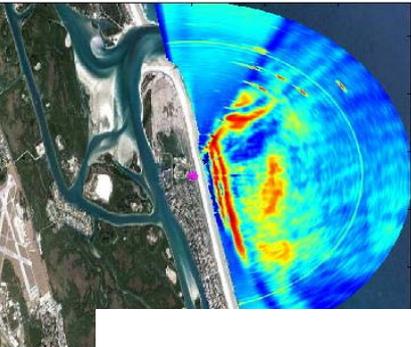
US ARMY CORPS OF ENGINEERS: ENGINEER RESEARCH & DEVELOPMENT CENTER
Field Research Facility

**RADAR INLET
OBSERVING SYSTEM:
Remotely acquired waves,
currents, and bathymetry**

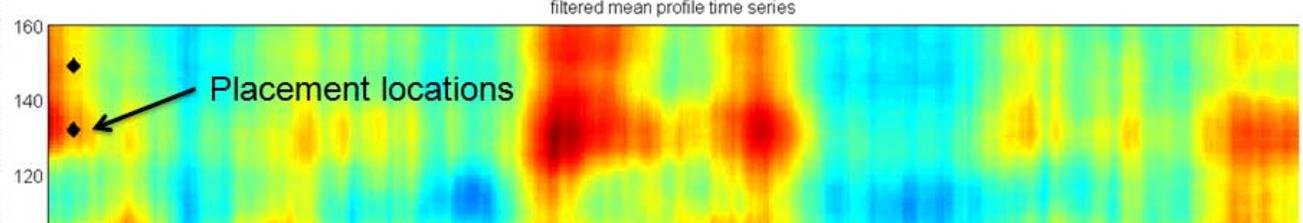


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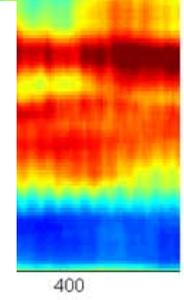
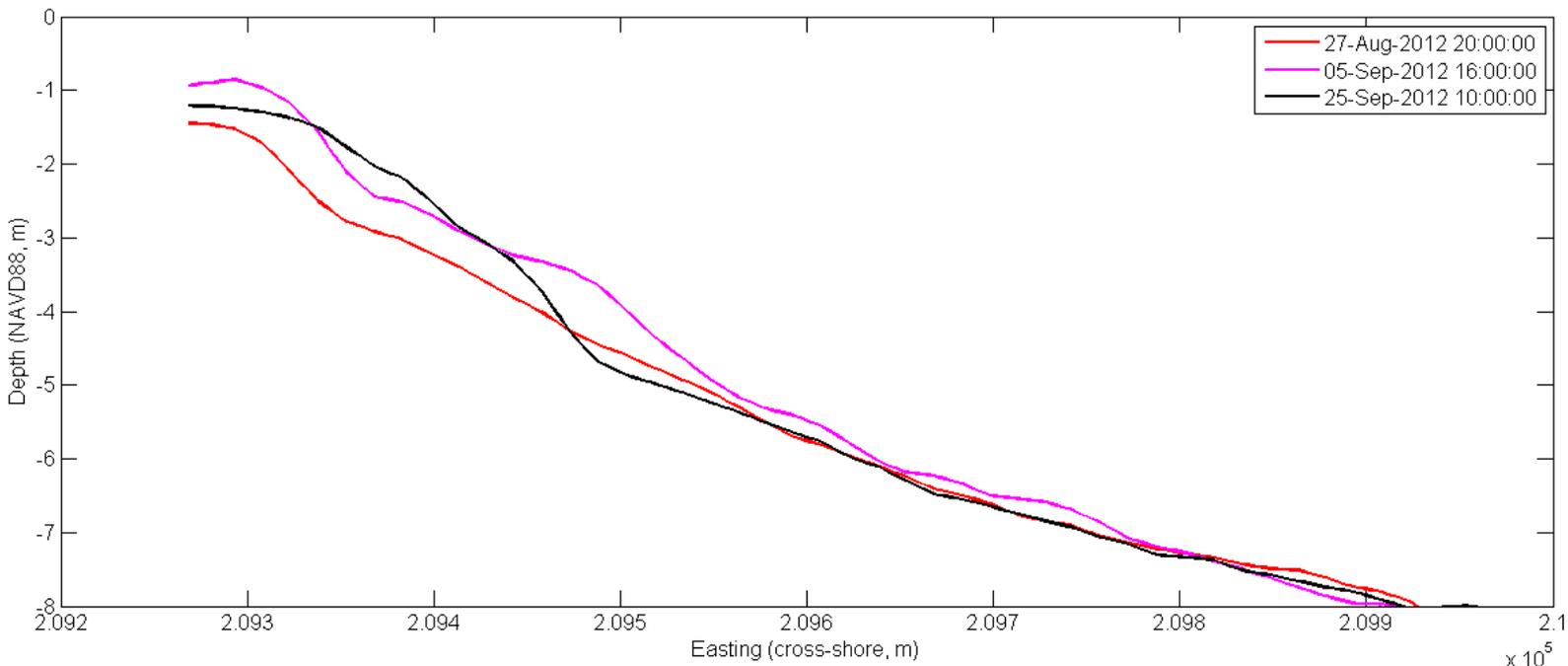
25-Sep-2012 10:00:00



ice (units x5m)



filtered mean profile time series





Discussion



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Potential Discussion Topics Related to Presentation

- ❖ Acquiring permitting for new nearshore placement sites
 - ❖ Guidance on defining active berm placement zones
- ❖ Direct measurements to meet Regulatory Needs
 - ❖ Sand Rule & turbidity issues
 - ❖ Need for pre-placement measurements
- ❖ Modeling
 - ❖ A proxy for measurements to acquire permits
 - ❖ Confidence with inclusion of measurements
 - ❖ Are simple or sophisticated numerical models desired by Districts, Stakeholders, or Regulators?





Potential Discussion Topics Related to Active Nearshore Berms

- ❖ What type of design guidance do District folks want? A Hands and Allison upgrade, or numerical modeling?
- ❖ Influence of type of placement method – hopper or pumped
- ❖ Existing guidance excludes currents (tidal), an important factor for most placements near navigation channels – how to address?
- ❖ How temporal and spatial scales of longshore/cross-shore evolution are defined, monitored, and included in permitting

