

eFlows and Sediment Transport



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EWN and Sediment Transport

■ Problem

- Anthropogenic activity has altered natural sediment transport processes
 - Land use/overland flow
 - Dams/reservoirs
 - Navigation channels/dredging
 - Water extraction
 - Invasive species
- Poor distribution of sediment resources
- Altered/degraded ecosystems

■ EWN Approach

- Align human activities with natural processes (forces) to redistribute sediments
 - BU of dredged sediment
 - Controlled flows (events)

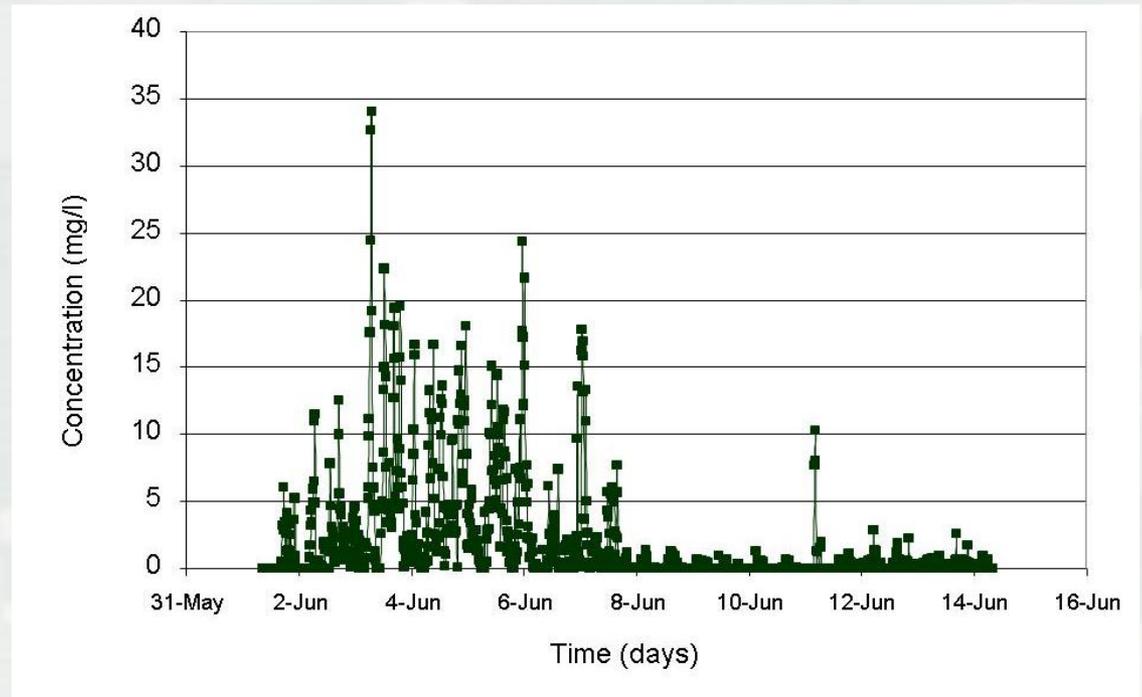


Exposure

- Exposure is a quantification of the level and duration of a stressor affecting the receptor often expressed as a dose

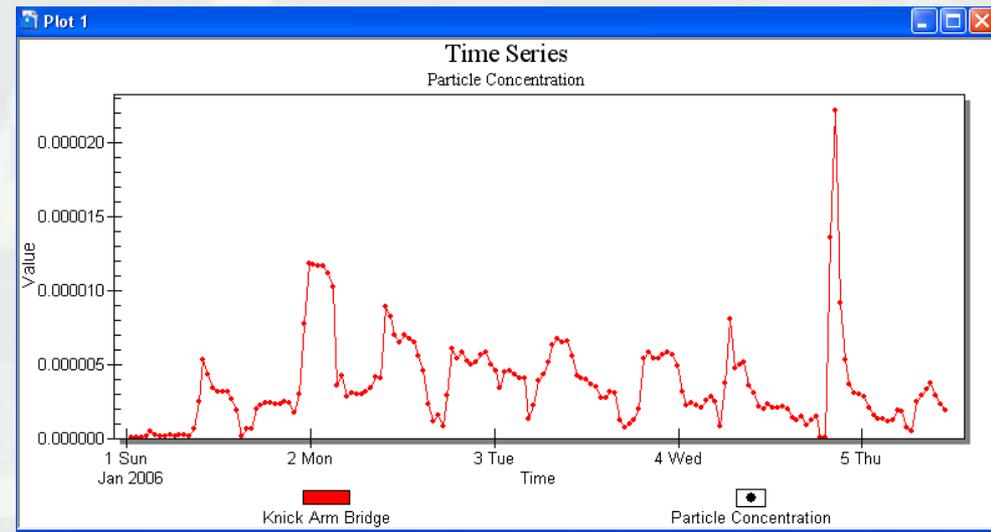
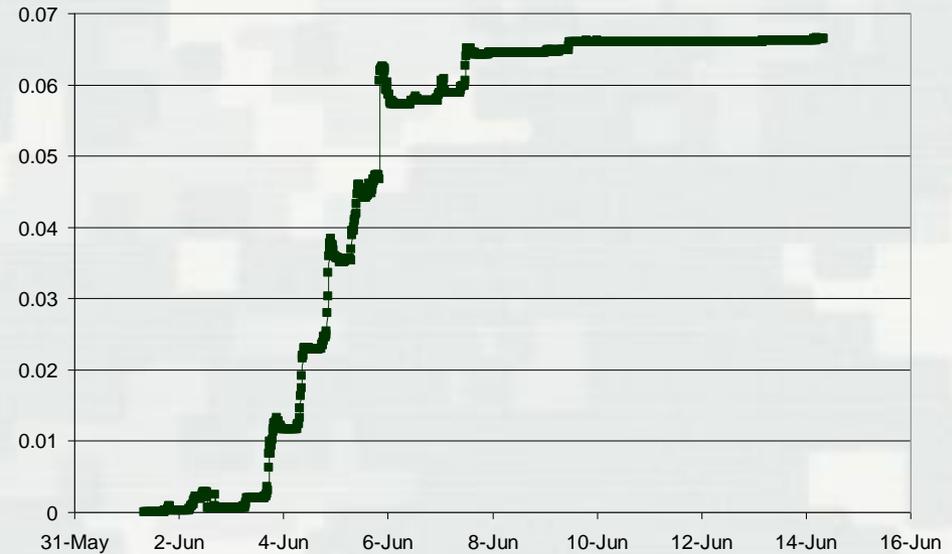
$$D = \int C dt$$

$$D = \sum_{i=1}^n C_i \Delta t$$



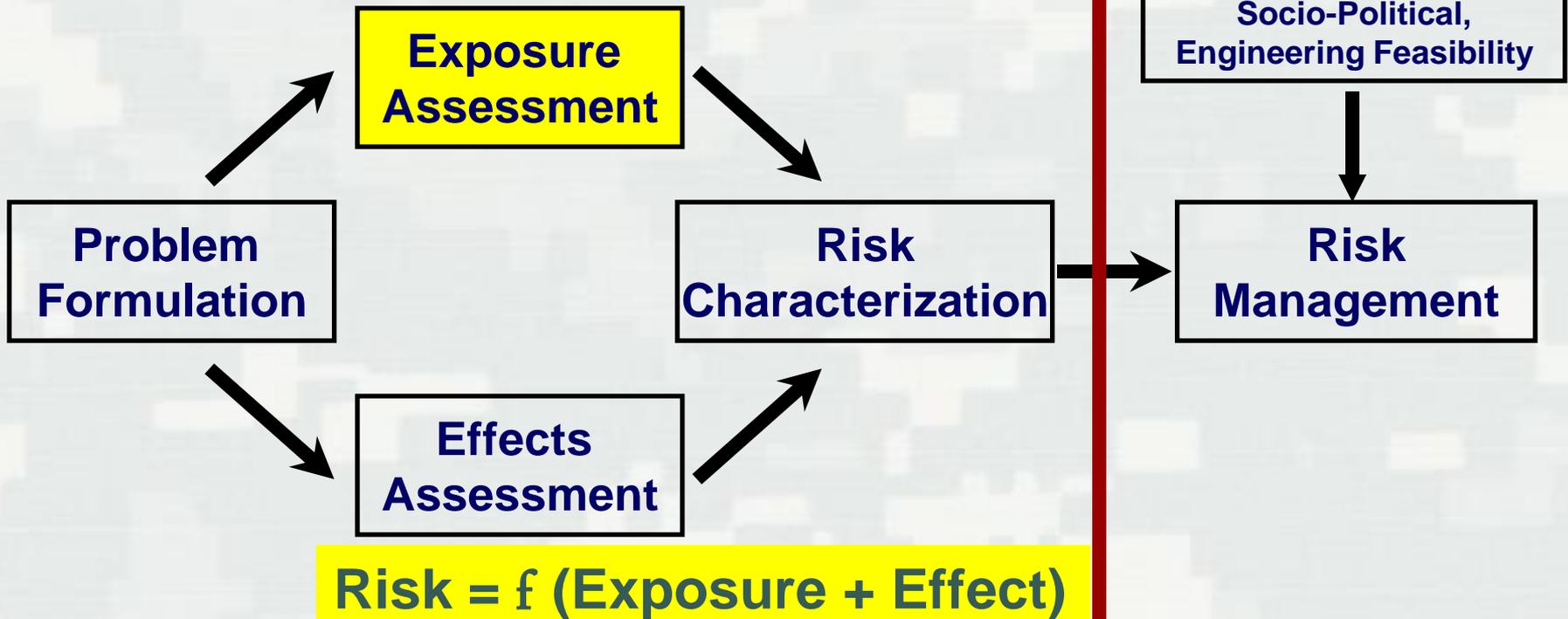
Exposure

- Exposure
 - Most receptors respond to the presence of sediment
 - Too little.....
 - Too much.....
 - Just right.....
 - Unlike contaminants, not all sediment exposure is bad
 - Must maintain the appropriate balance for a healthy ecosystem



RISK FRAMEWORK

RISK ASSESSMENT PARADIGM



Example EWN Solution: Horseshoe Bend

■ Problem

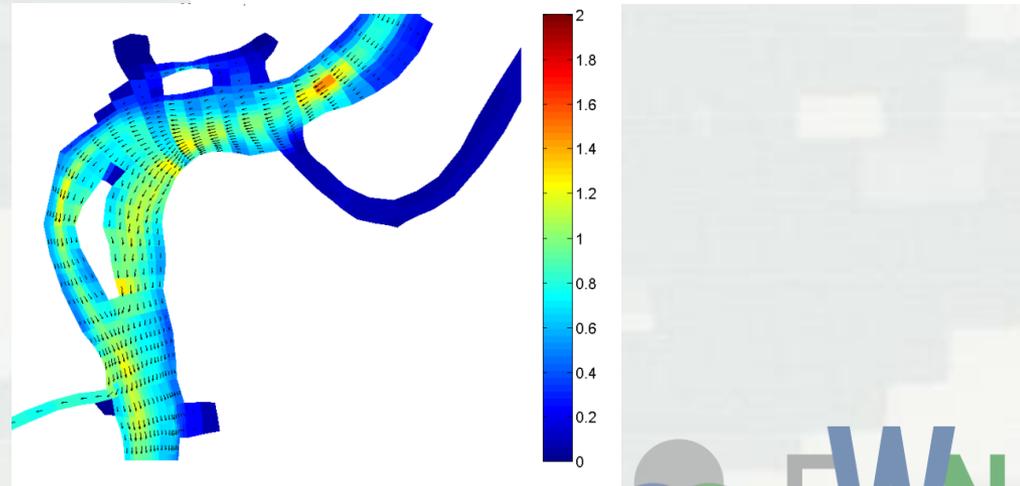
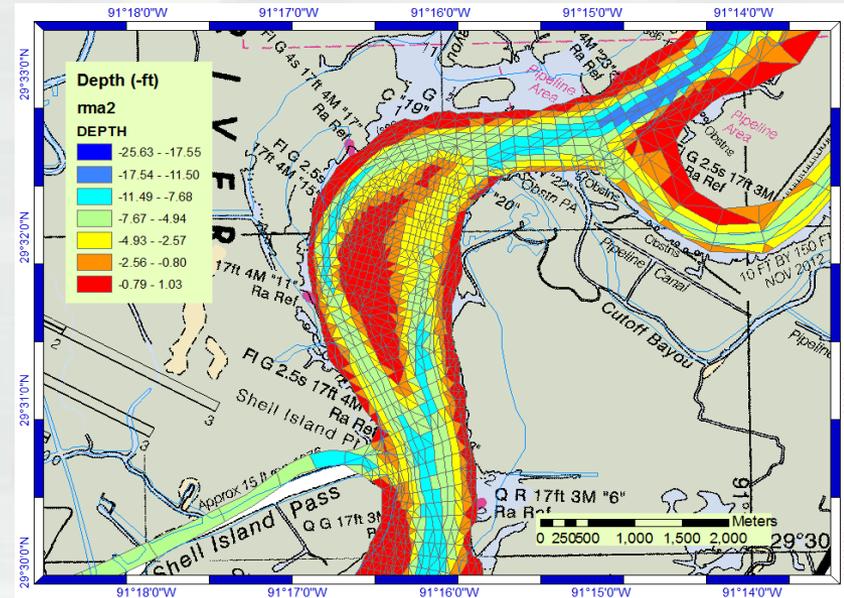
- Infilling of navigation channel
- Limited capacity in existing dredged material disposal sites
- Erosion of channel-adjacent habitat
- Reduced bird habitat

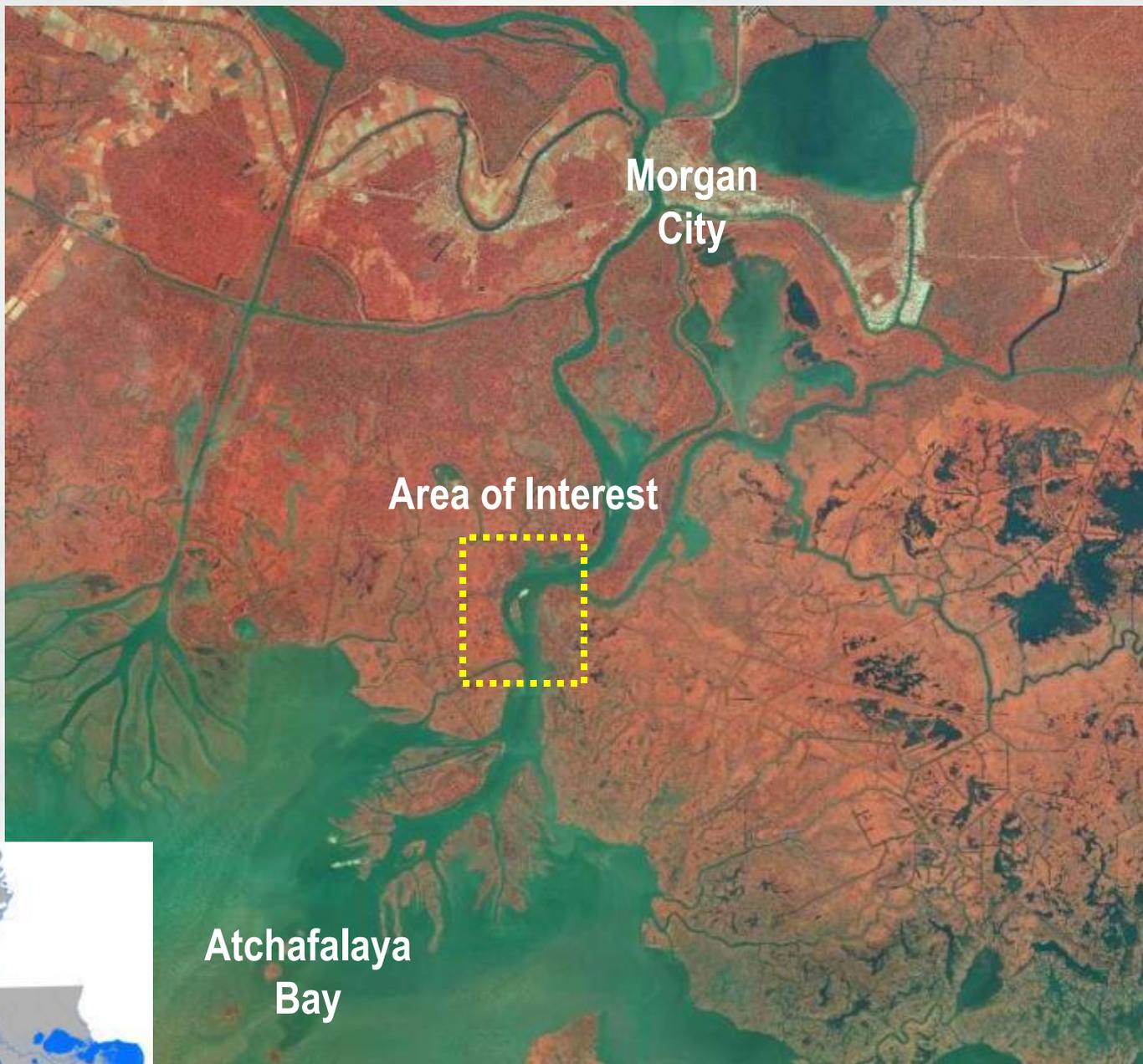
■ EWN Approach

- Place dredged material upstream of island
- Permit natural forces to move sediment toward the island

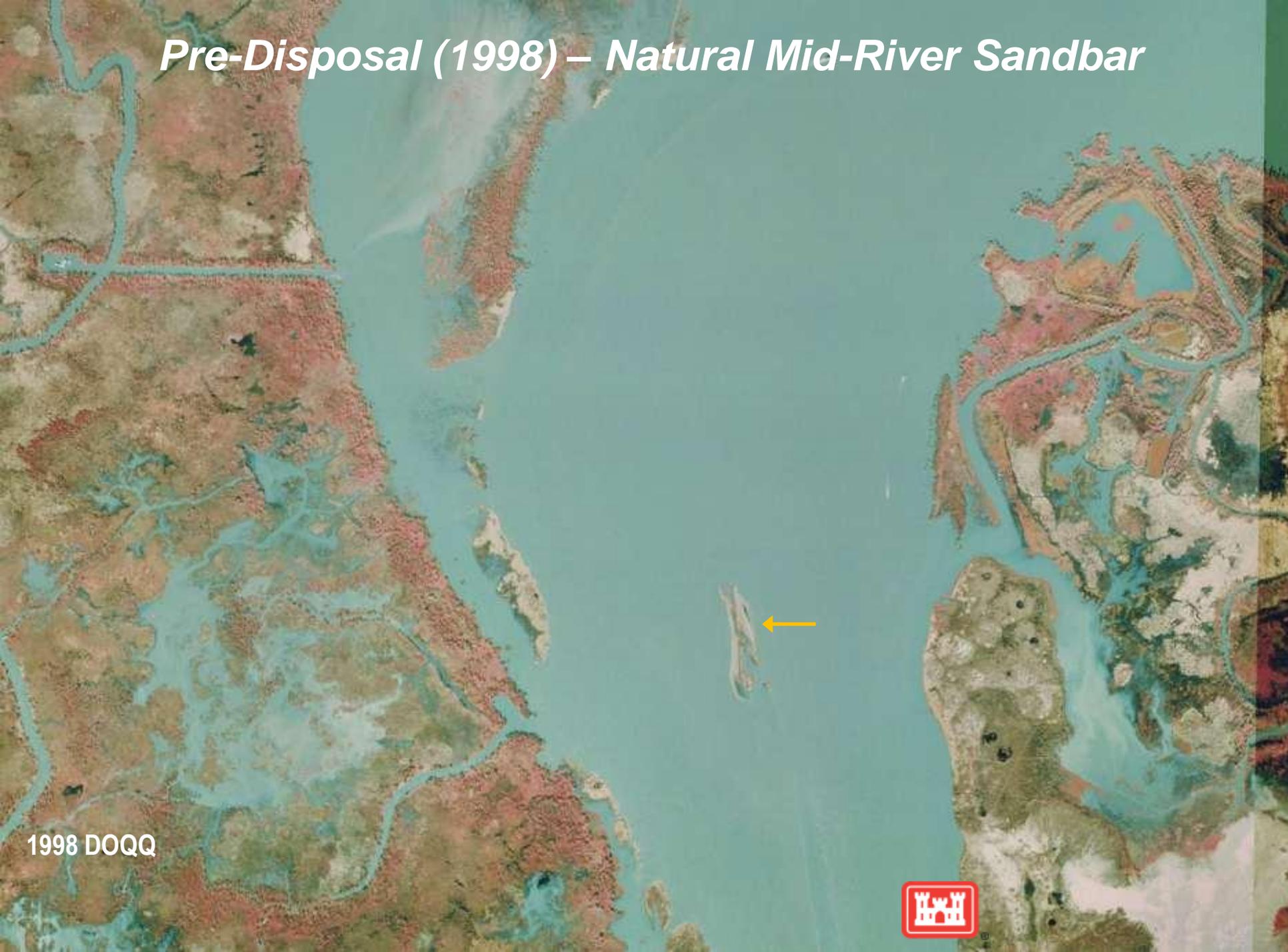
■ Results

- Increased island acreage and habitat
- Less channel shoaling





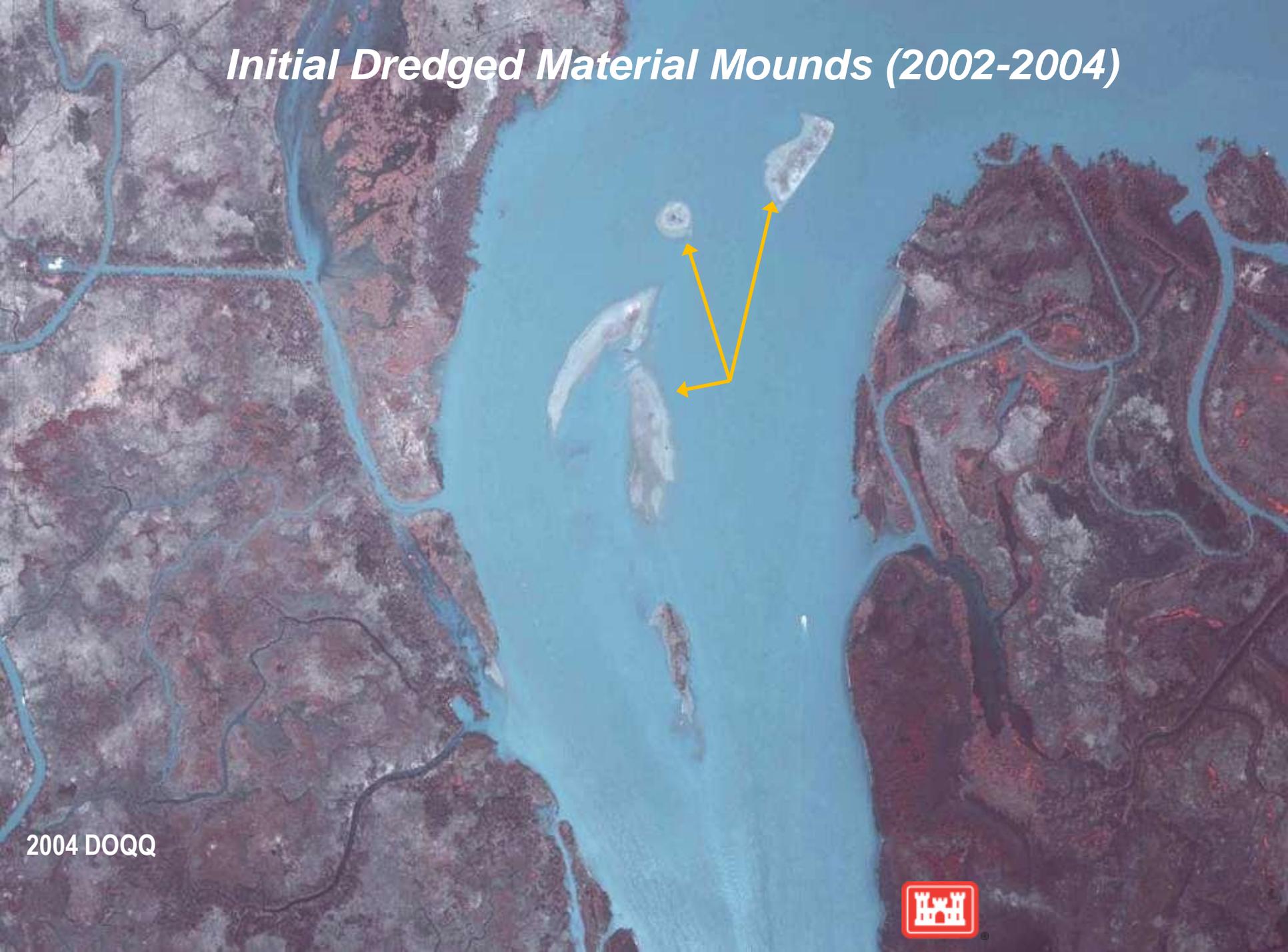
Pre-Disposal (1998) – Natural Mid-River Sandbar



1998 DOQQ



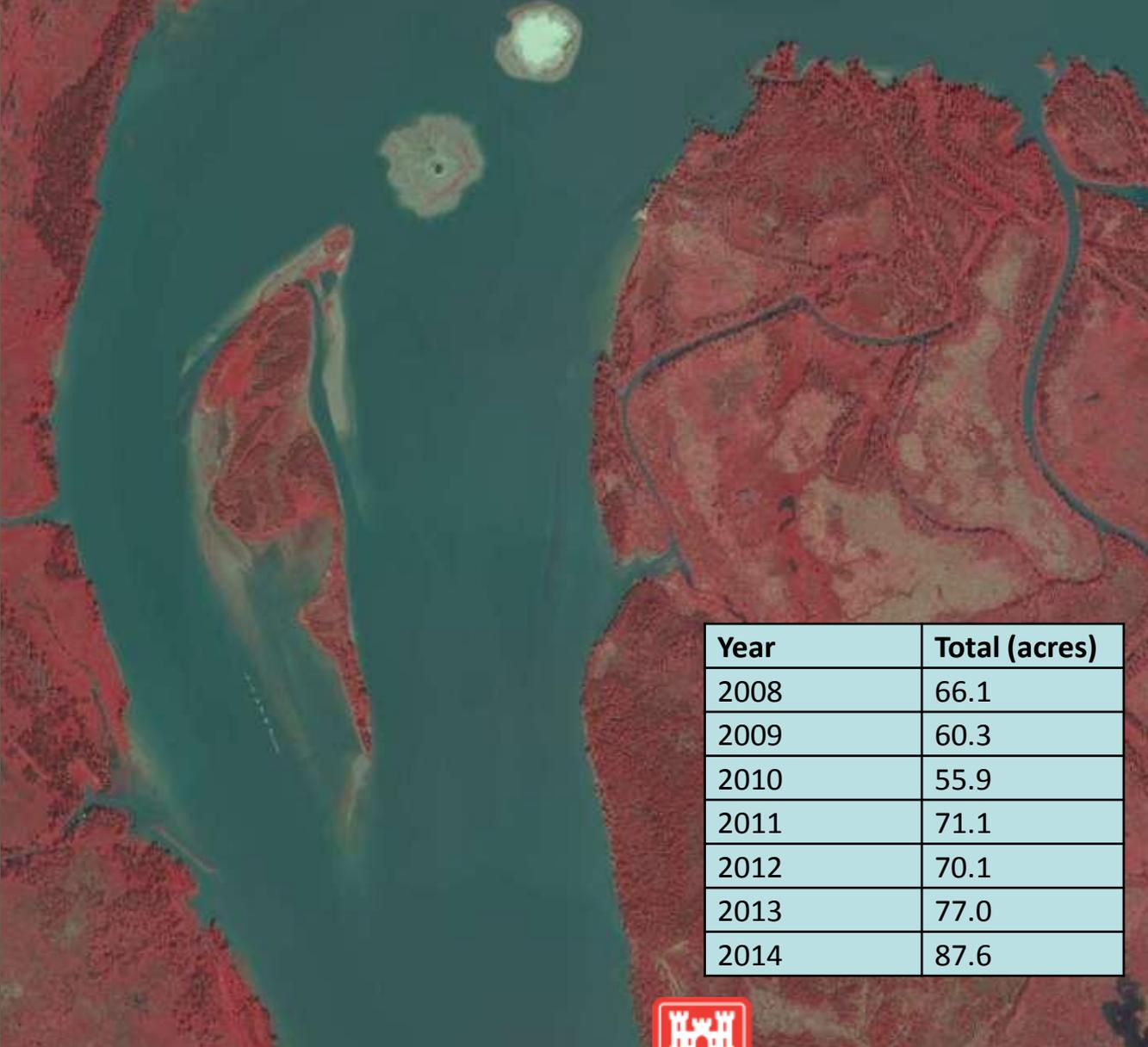
Initial Dredged Material Mounds (2002-2004)



2004 DOQQ



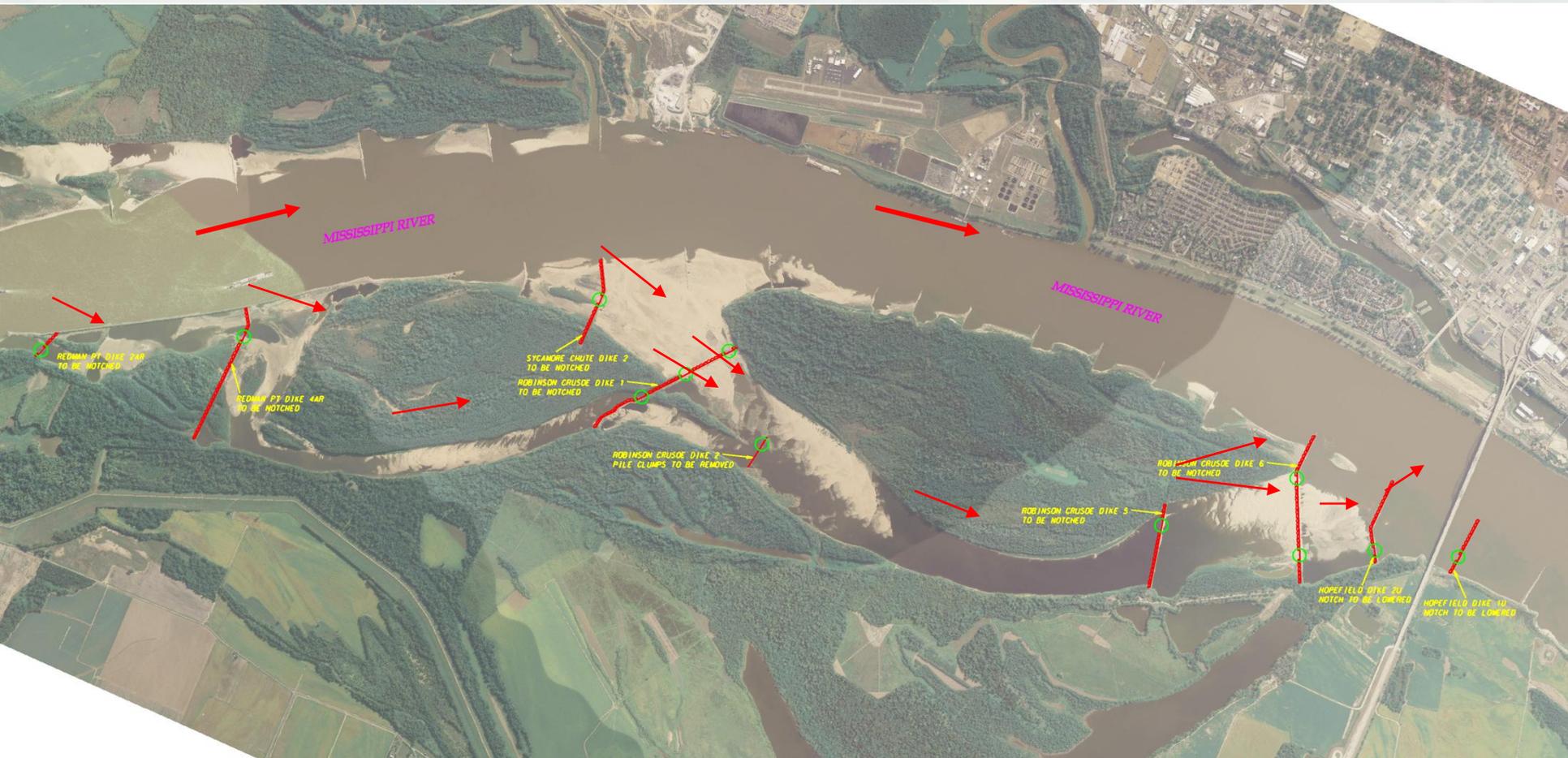
Developed Island with Upriver Feeder Mounds (2010)



Year	Total (acres)
2008	66.1
2009	60.3
2010	55.9
2011	71.1
2012	70.1
2013	77.0
2014	87.6



Example EWN Solutions



Loosahatchie Bar
Aquatic Habitat Rehabilitation

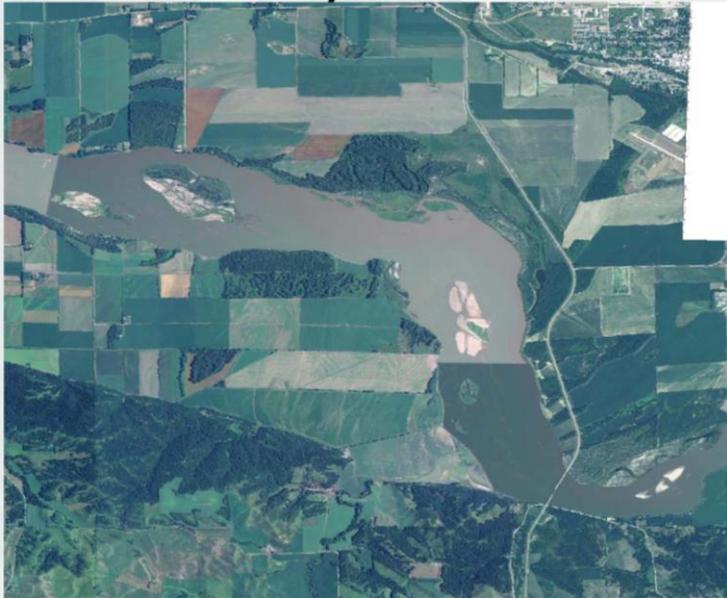


Example EWN Solutions

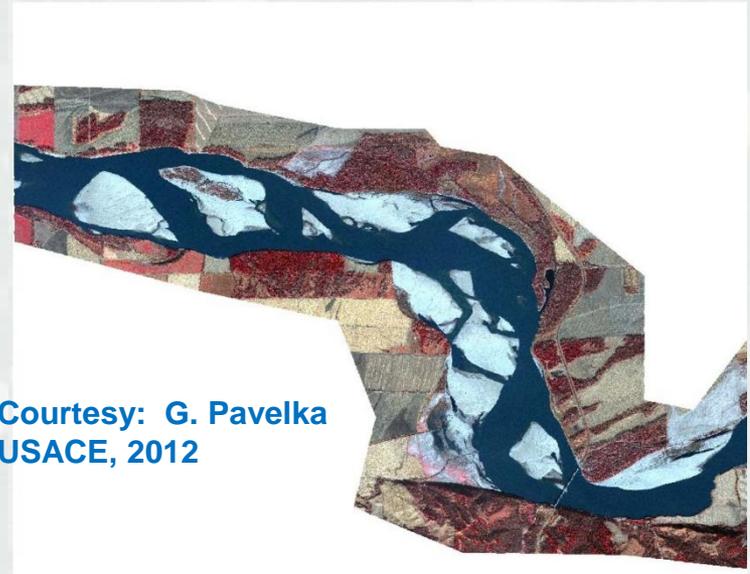
Upper Missouri River Sandbar Habitat

- \$25 Million to construct 650 acres of sandbar
- 16,000 acres created by the flood of 2011

July 2009



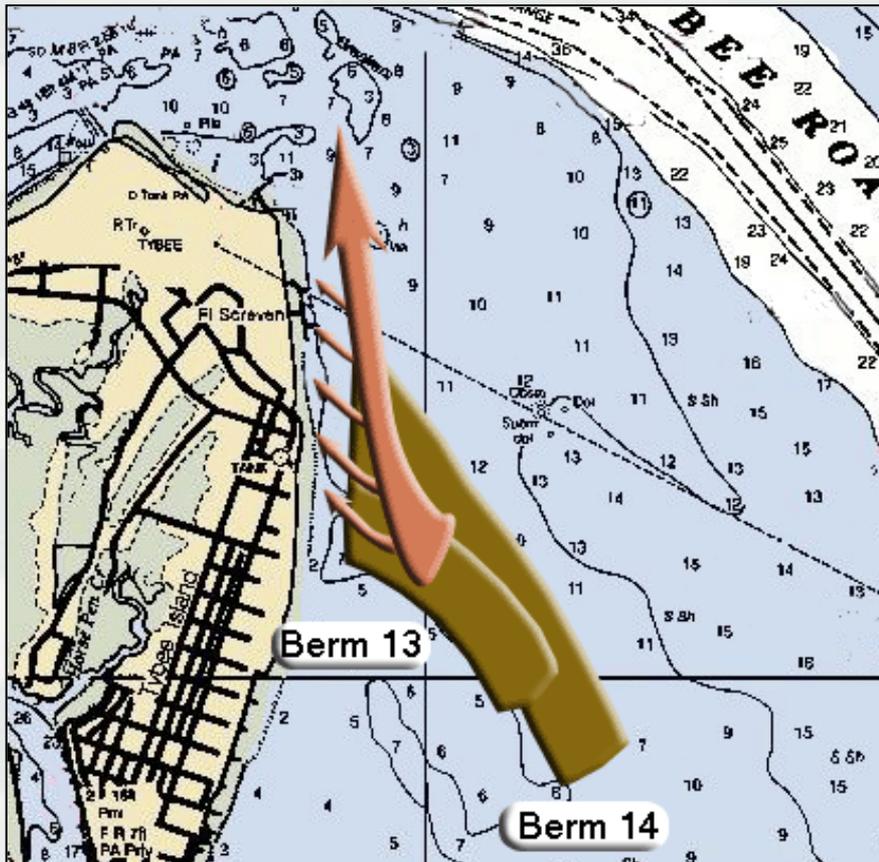
November 2011



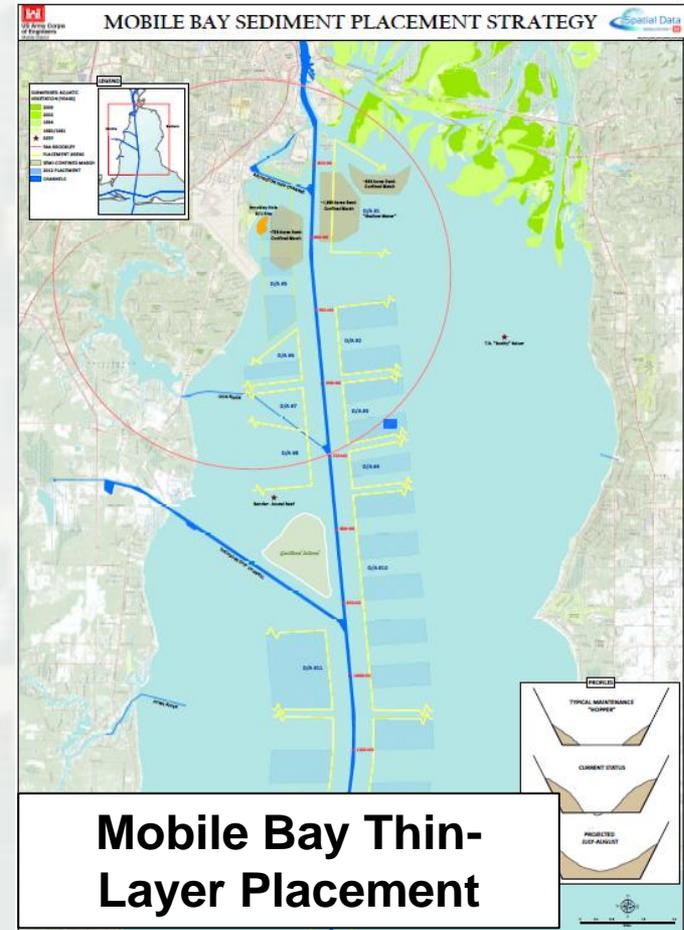
Courtesy: G. Pavelka
USACE, 2012

Example EWN Solutions

Strategic Sediment Placement

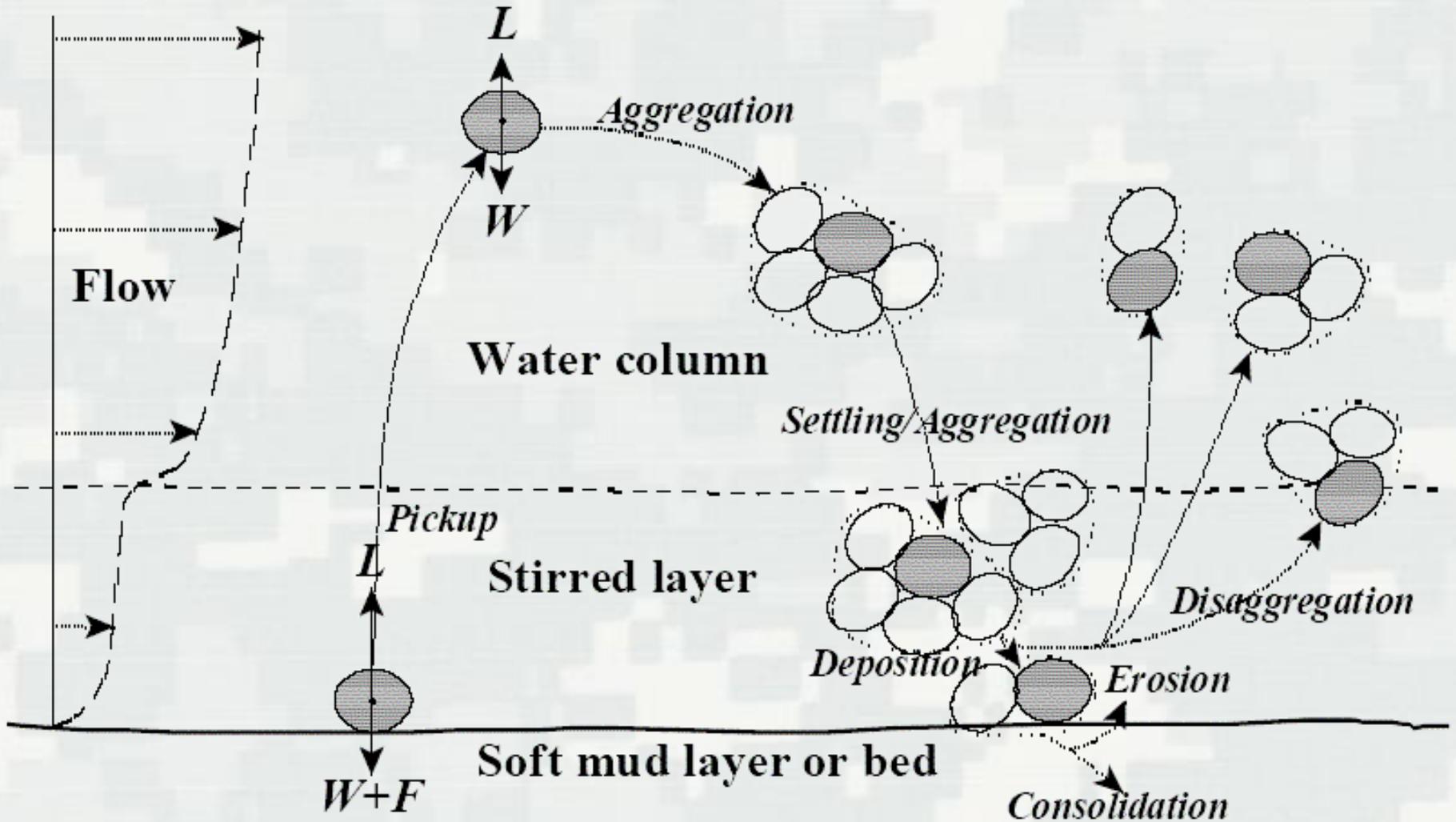


**North Tybee Island
Savannah, Georgia**



Mobile Bay Thin-Layer Placement

Sediment Transport Processes



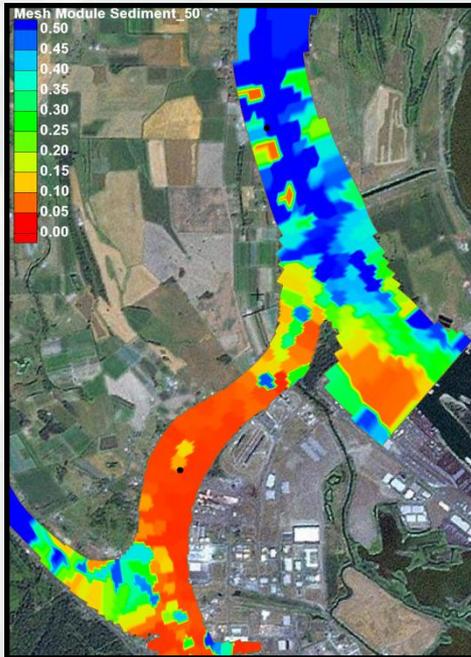
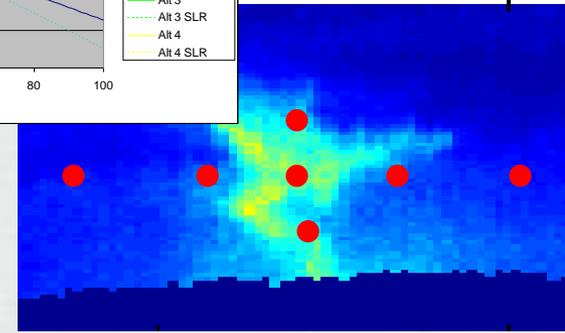
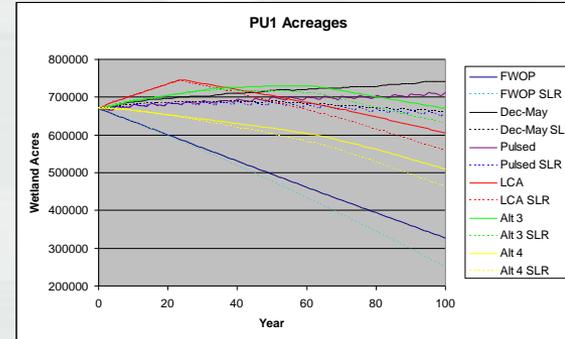
ERDC R&D in Sediment Transport

Process Studies

- ▶ Wave/current erosion
- ▶ Sediment- Fluid Interactions
- ▶ Settling Velocity
- ▶ Sedimentation
- ▶ BBL dynamics

Near-term algorithms and mid-term models

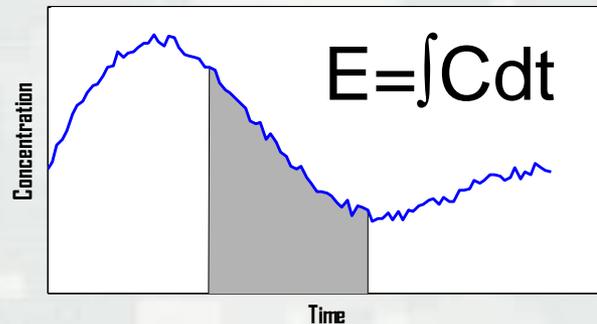
- ▶ PTM
- ▶ LTFATE
- ▶ ADH-SEDLIB
- ▶ STFATE/MPFATE



Far Field and Long-Term Models

- ▶ SAND
- ▶ SBUC
- ▶ Sediment Budgets
- ▶ SMS Tools for exposure

Support Risk, Effects, Habitat, DMMP, Feasibility Studies



Process Research: Physical Processes within Vegetated Environments

■ Problem

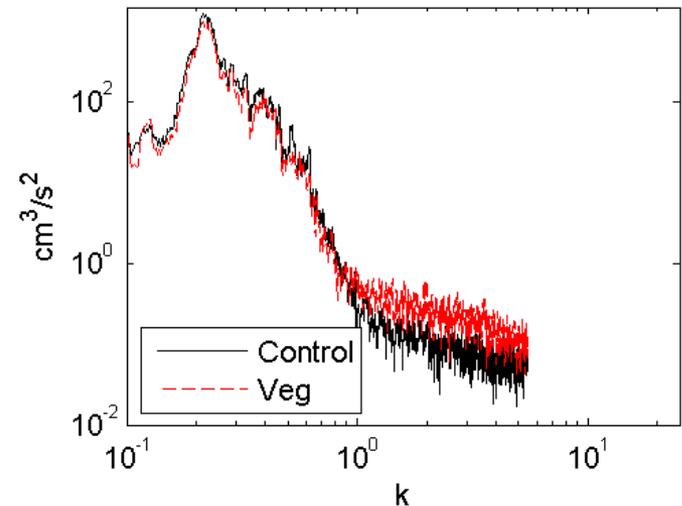
- Poor understanding of mixed sediment transport in vegetated regions with waves and currents
- Unacceptable uncertainty when evaluating wetland sediment transport

■ Approach

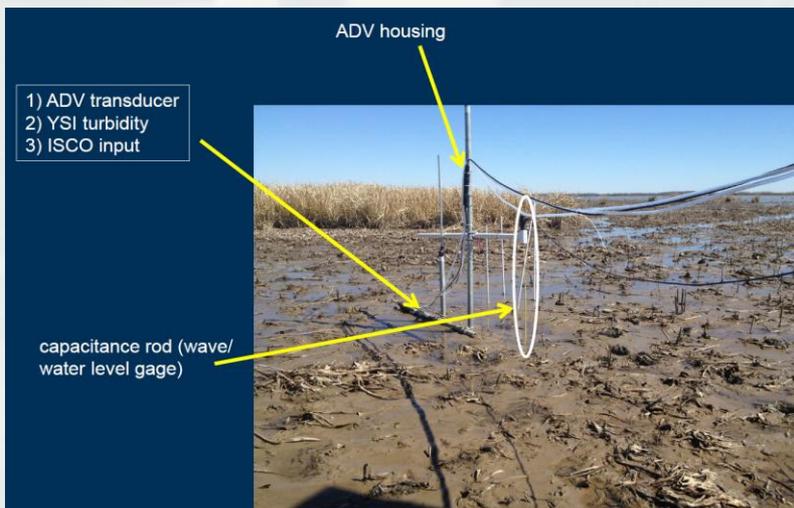
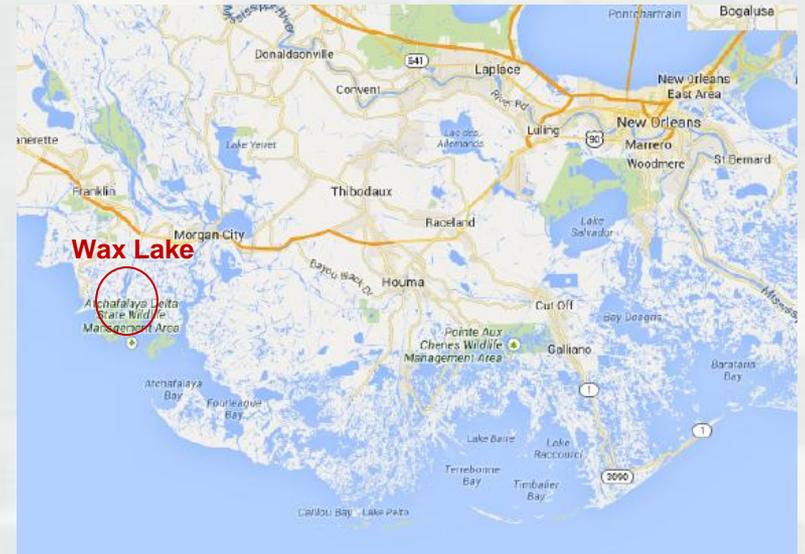
- Laboratory experiments to quantify hydrodynamic and transport processes in vegetation
- Laboratory experiments → 10' flume; Investigated wave energy transformation and limited sediment studies
- Field experiments (ongoing) → Tampa SAV, Hamilton Wetland, Currituck Sound



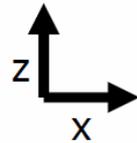
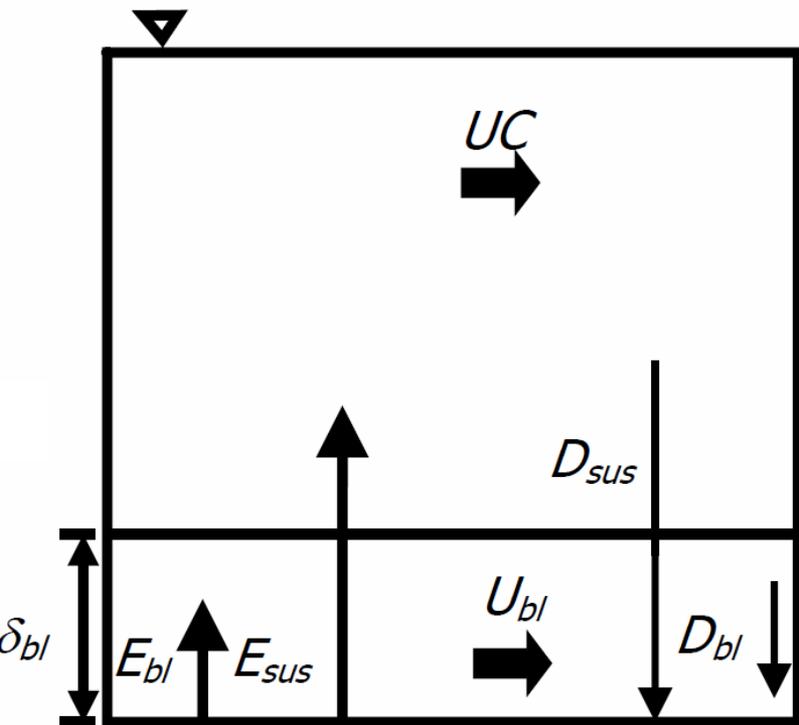
(d)



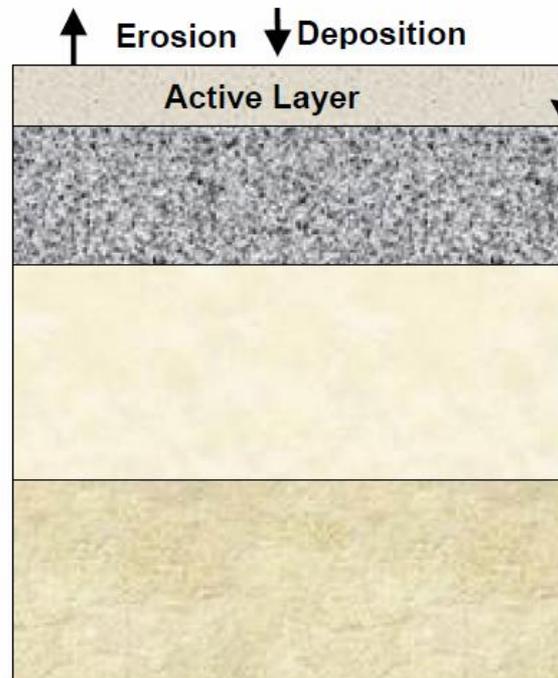
Process Research: Sediment Processes in a Accreting Delta (Wax Lake, LA)



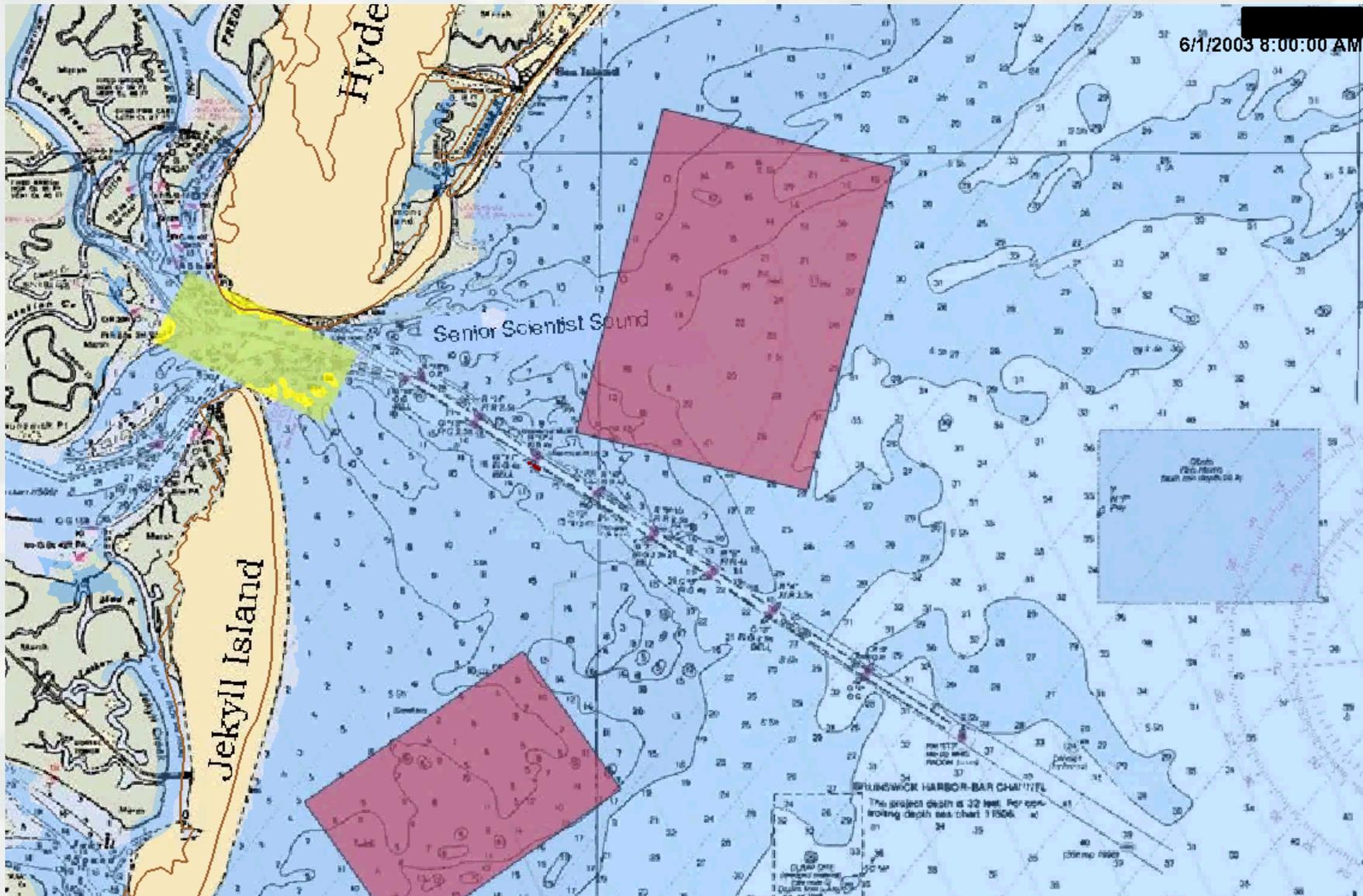
Bottom Boundary Layer Dynamics in LTFATE



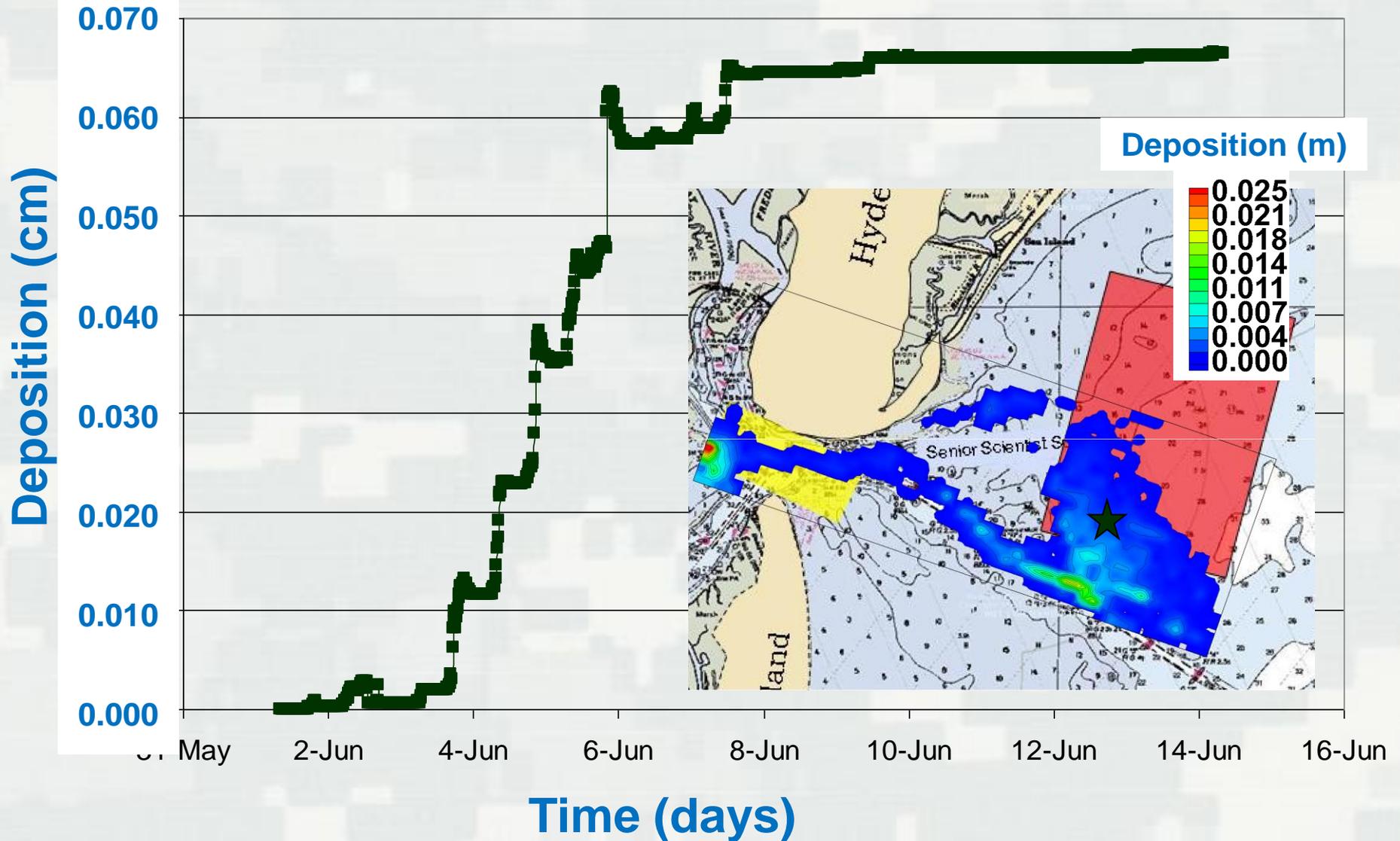
LTFATE models evolving elevation, composition, and consolidation of the entire sediment bed in the domain modeled



The active layer facilitates coarsening through the use of measured quartz erosion rates



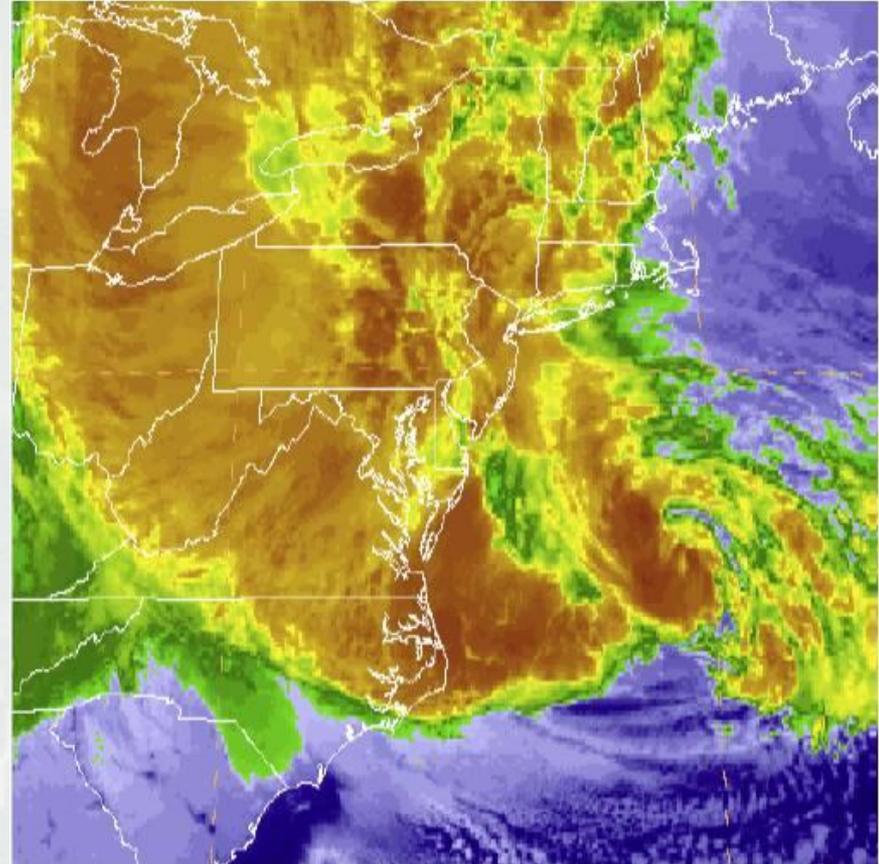
Time Series of Deposition





North Atlantic Coast Comprehensive Study, Natural and Nature-Based Features

- Superstorm Sandy heavily damaged natural and man-made storm barriers
- Broad-scale application of EWN to restoration
- Specific locations being selected for EWN analysis
- Systematic approach to evaluating natural and nature-based features (NNBFs)



2014 EWN Action Demonstration Projects

- Landscape Evolution of the Oil Spill Mitigation Sand Berm in the Chandeleur Islands, Louisiana
- Guidelines for Planning, Design, Placement and Maintenance of Large Wood in Rivers: Restoring Process and Function (Collaboration with BoR)
- The Use and Value of Levee Setbacks in Support of Flood Risk Management, Navigation and Environmental Services (a strategy document)
- Strategic Placement of Sediment for Engineering and Environmental Benefit (an initial guide to opportunities and practices)



EWN Action Demonstration Projects

- Sediment Retention Engineering to Facilitate Wetland Development (San Francisco Bay, CA)
- Realizing a Triple Win in the Desert: Systems-level Engineering With Nature on the Rio Grande (Albuquerque, NM)
- Atchafalaya River Island and Wetlands Creation Through Strategic Sediment Placement (Morgan City, LA)
- Portfolio Framework to Quantify Beneficial Use of Dredged Material (New Orleans and New England)
- Engineering Tern Habitat into the Ashtabula Breakwater (Ashtabula, OH)
- Living Shoreline Creation Through Beneficial Use of Dredged Material (Duluth, MN)
- A Sustainable Design Manual for Engineering With Nature Using Native Plant Communities



2013 EWN Action Demonstration Projects

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