Hydrodynamic and Sediment Transport Modeling for Horseshoe Bend Island Creation in the Lower Atchafalaya River, Louisiana

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WEDA 2015 Dredging Summit & Expo
Houston, Texas

US Army Corps of Engineers
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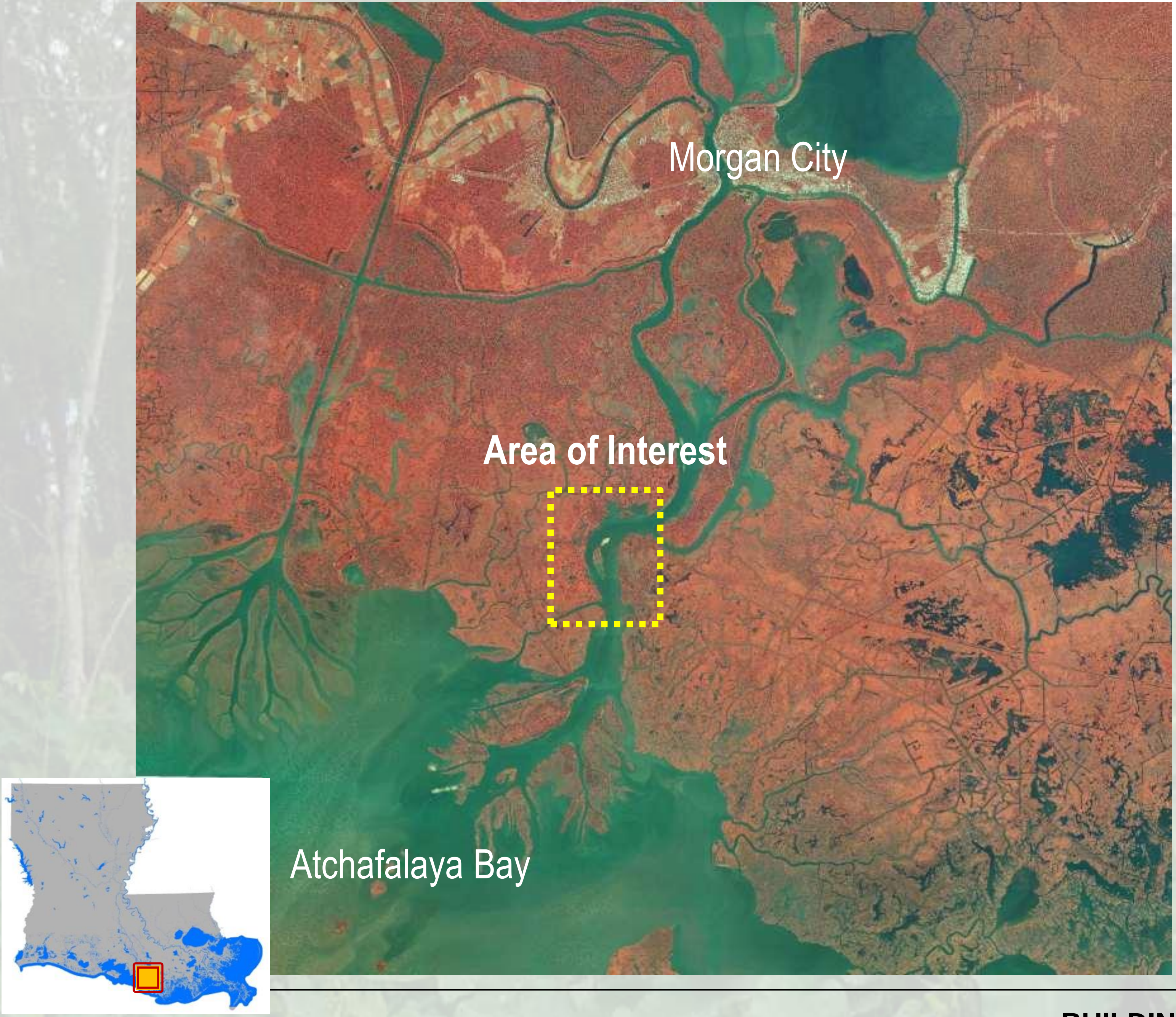
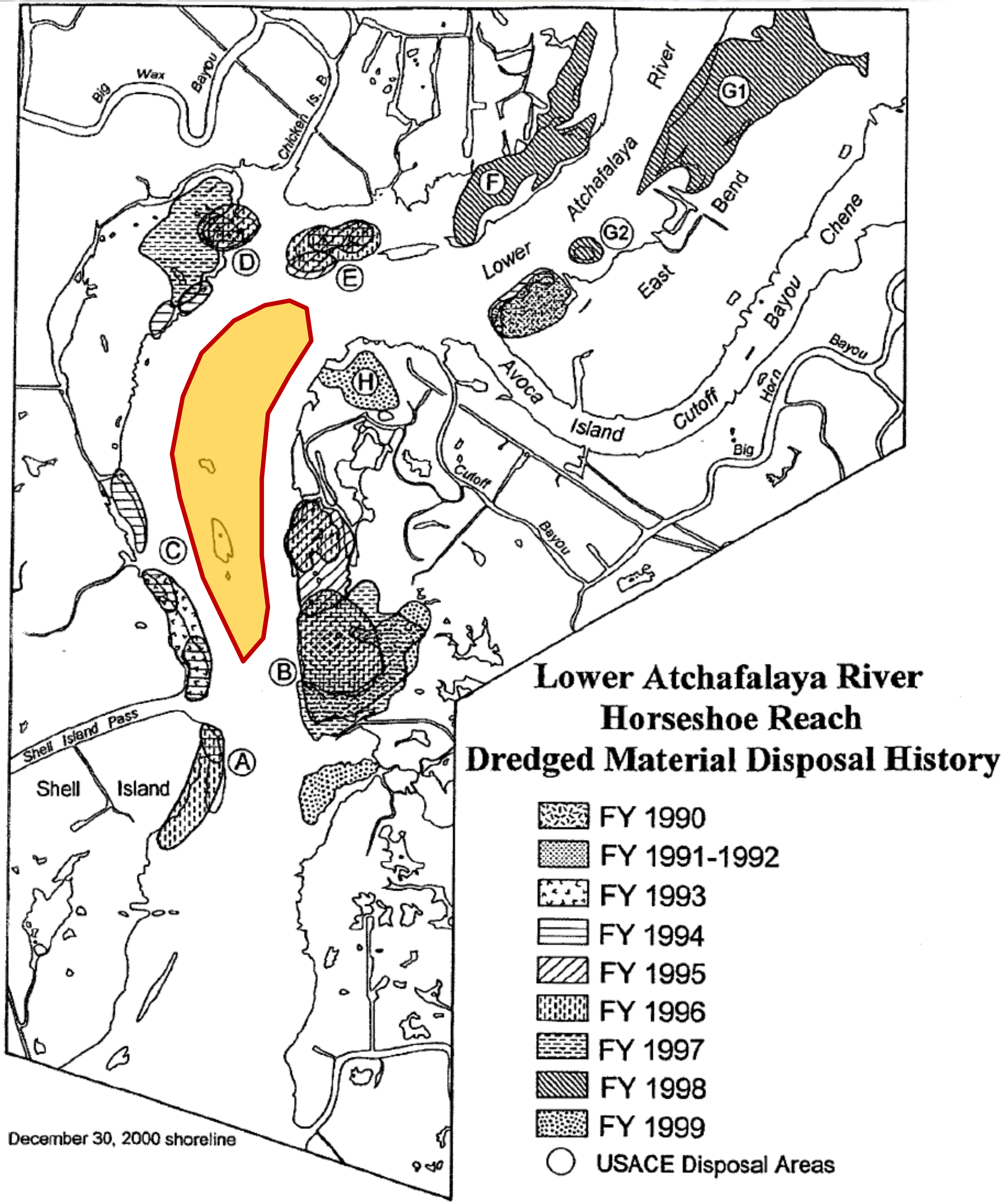

Morgan City
Area of Interest
Atchafalaya Bay



Problem

Capacity of Bankline Disposal Areas Exhausted

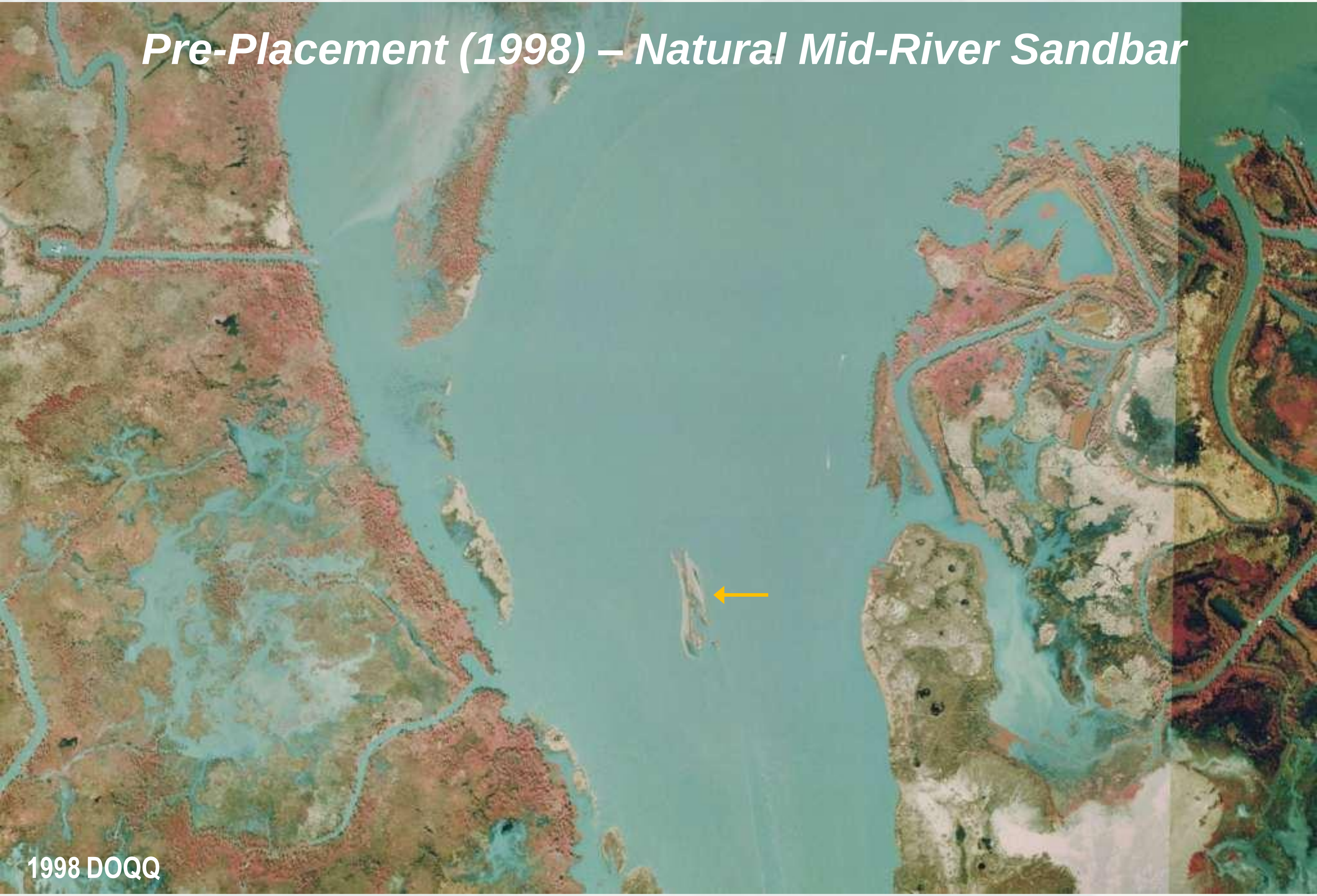
Alternatives

~~Conversion of Wetland Disposal Areas into Upland~~

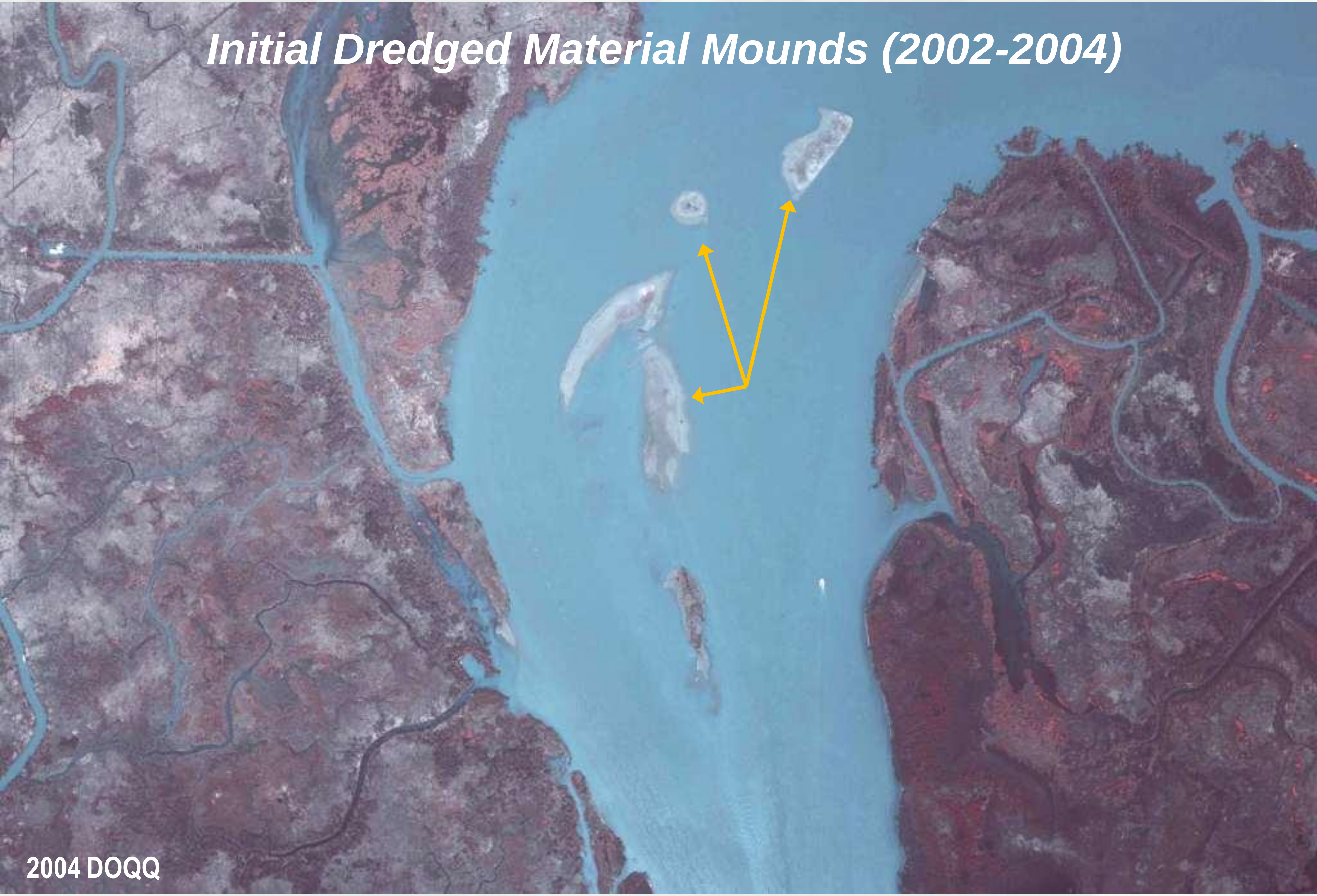
~~Open Water Disposal in Atchafalaya Bay~~

Mid-River Mounding of Dredged Material

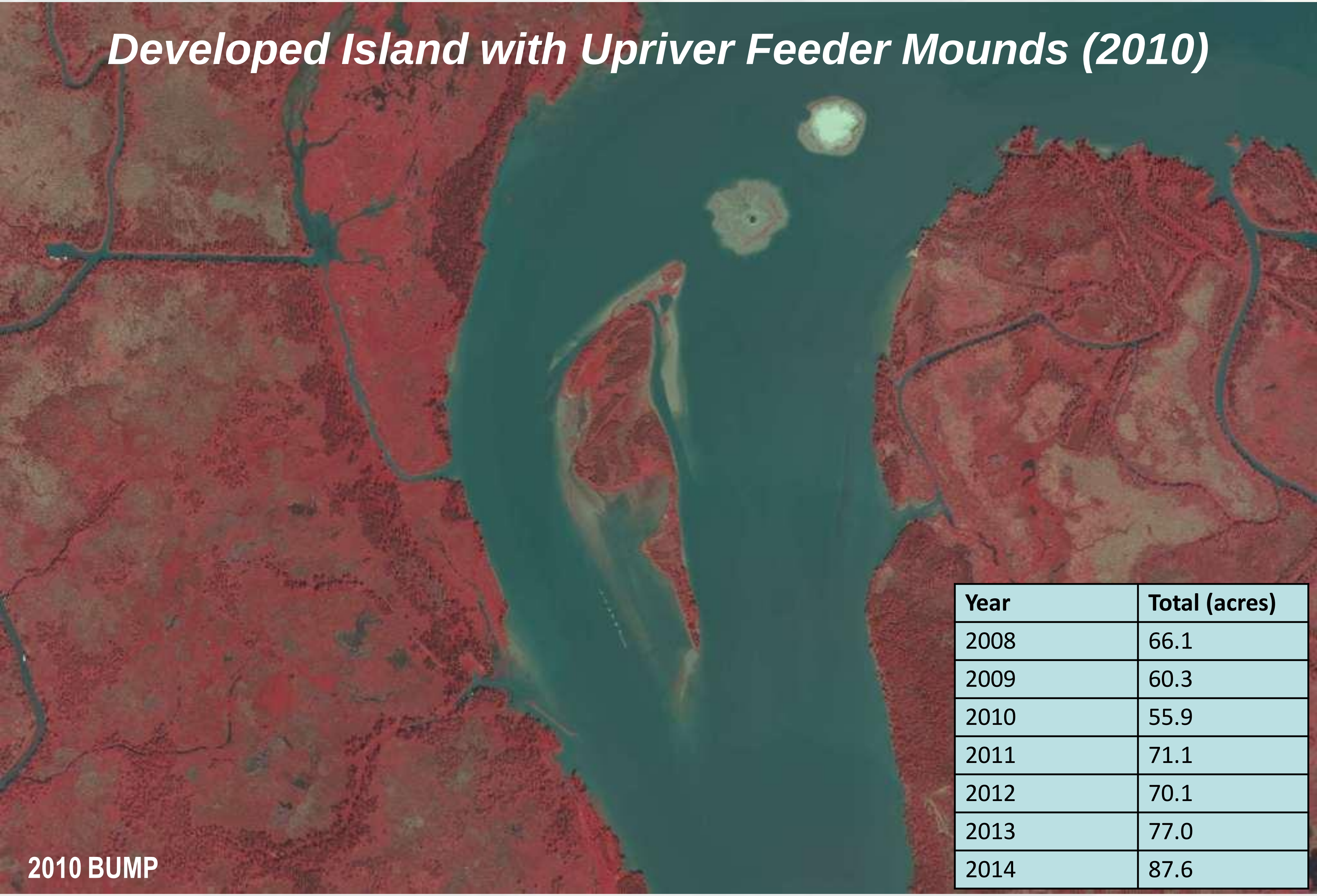
Pre-Placement (1998) – Natural Mid-River Sandbar



Initial Dredged Material Mounds (2002-2004)



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

USACE EWN Case Study

- Riverine island creation
- Multi-factor assessment
  1. Habitat classification
  2. Vegetation
  3. Invertebrates
  4. Avian community
  5. Water quality improvement
- Navigation benefits
- Hydrology and sediment transport

USACE EWN Case Study

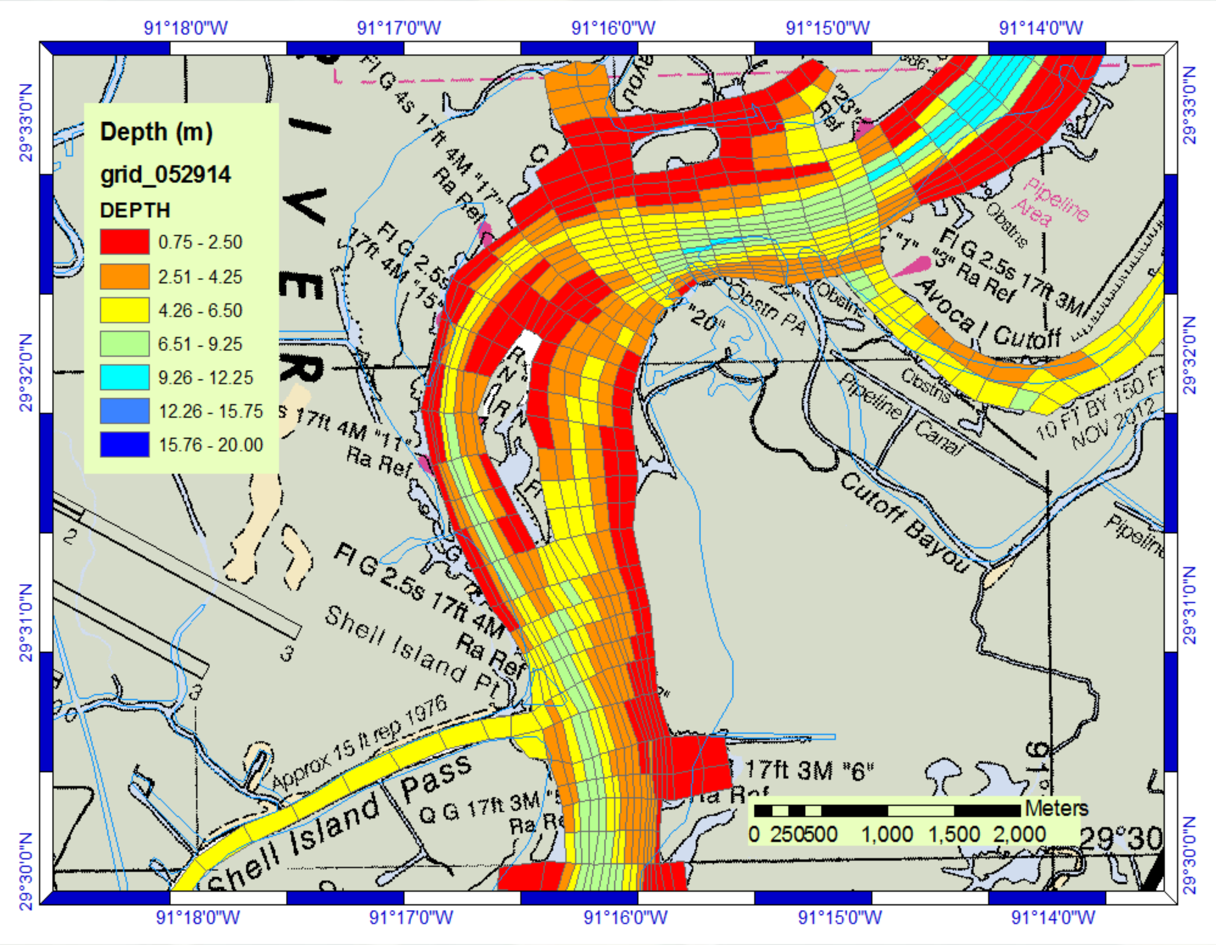
- Hydrology and sediment transport
  - To assess the formation of the island
  - Gain understanding about how the island footprint is growing and to serve as input into models determining the transport of sediments from dredged material seed mounds to the island

  - Identify processes associated with hydrodynamics and sediment transport of the island’s creation and growth

Computational Grid

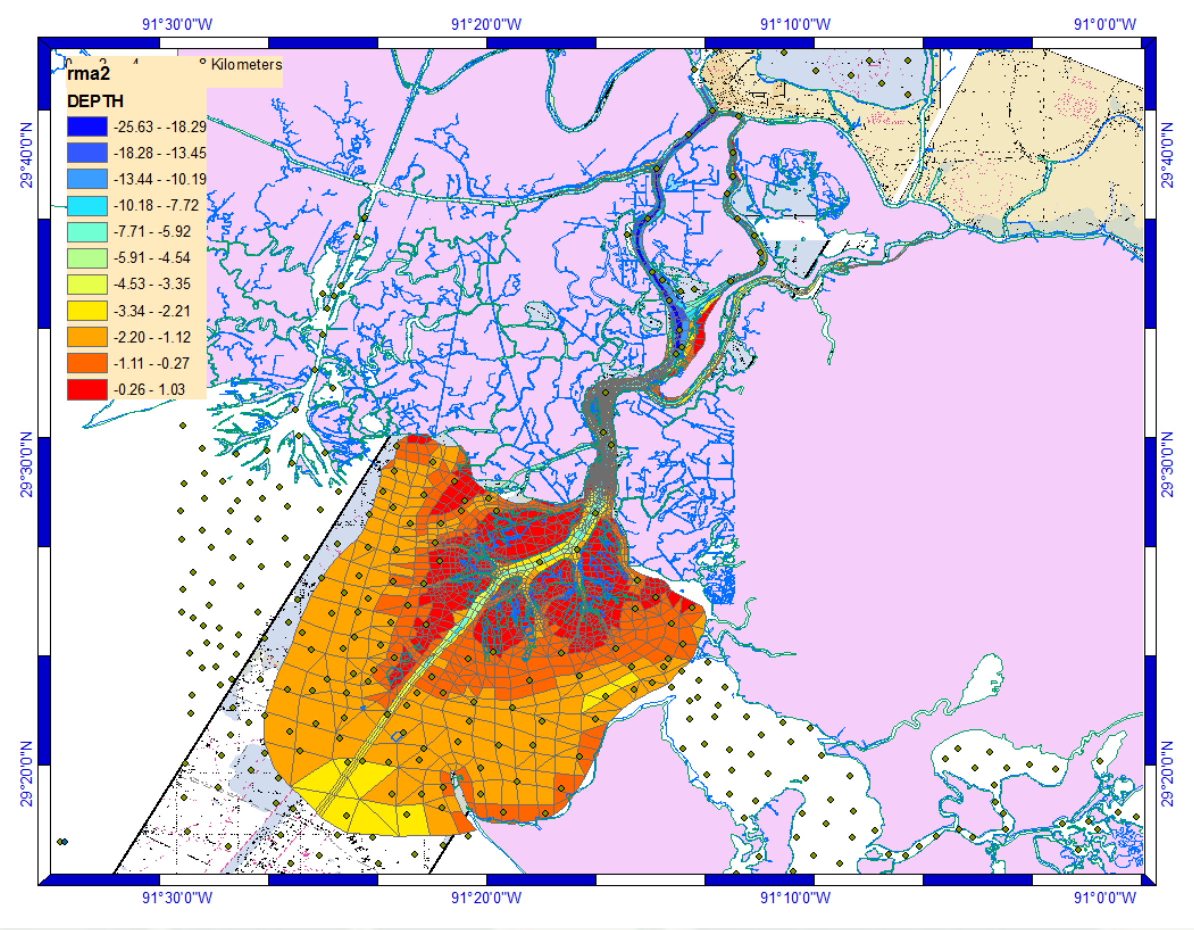
- Curvilinear Hydrodynamic Model in three-Dimensions (CH3D) at Horseshoe Bend island vicinity (meters)

- The number of vertical layers was set to five (5) so that the vertical resolution for 6 m channel at Horseshoe Bend was about 1.2 m



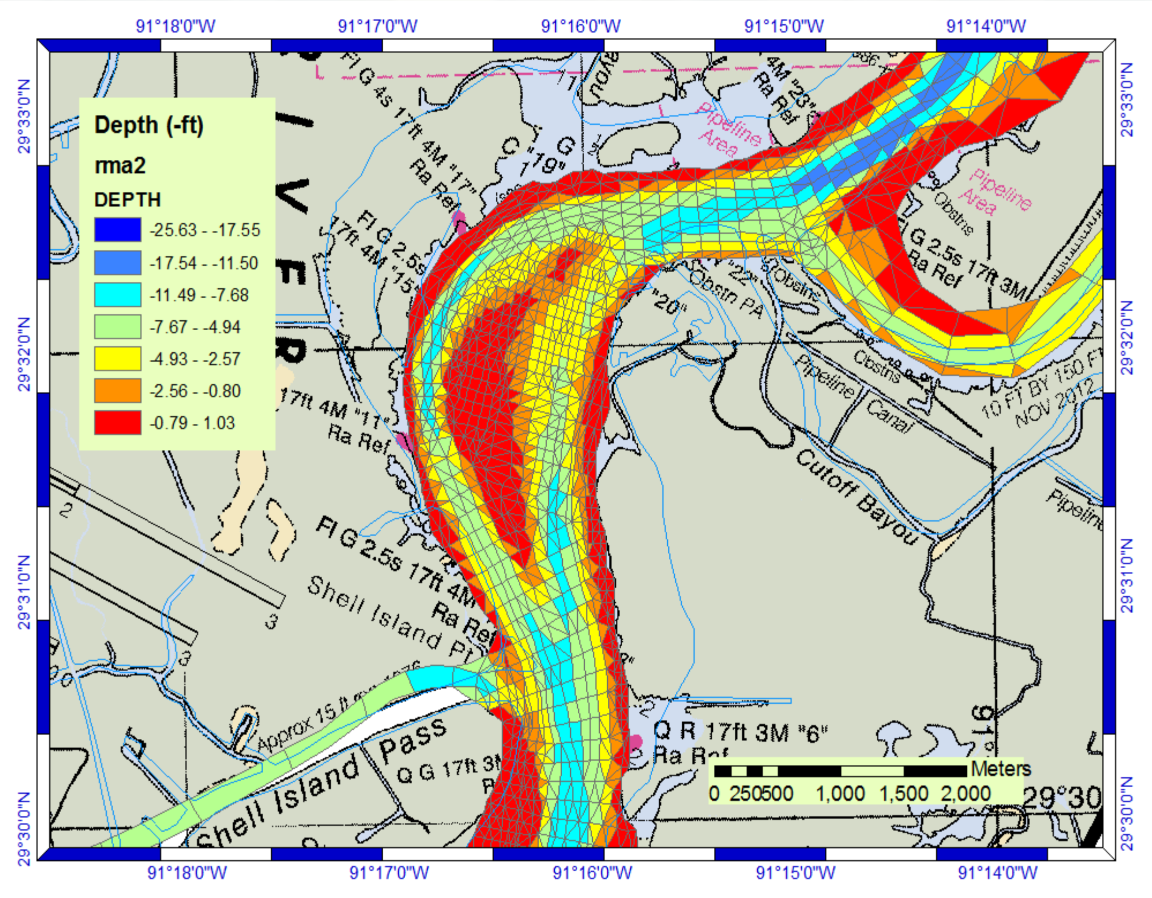
Computational Grid

- RMA-2 grid with bathymetry data (feet) developed to simulate 3 flow conditions:
- Changes in velocities analyzed to determine potential impacts of relocating channel
- Sediment transport simulated to study erosion and deposition
- Utilizes grid and bathymetry data for defining the boundary conditions



Computational Grid

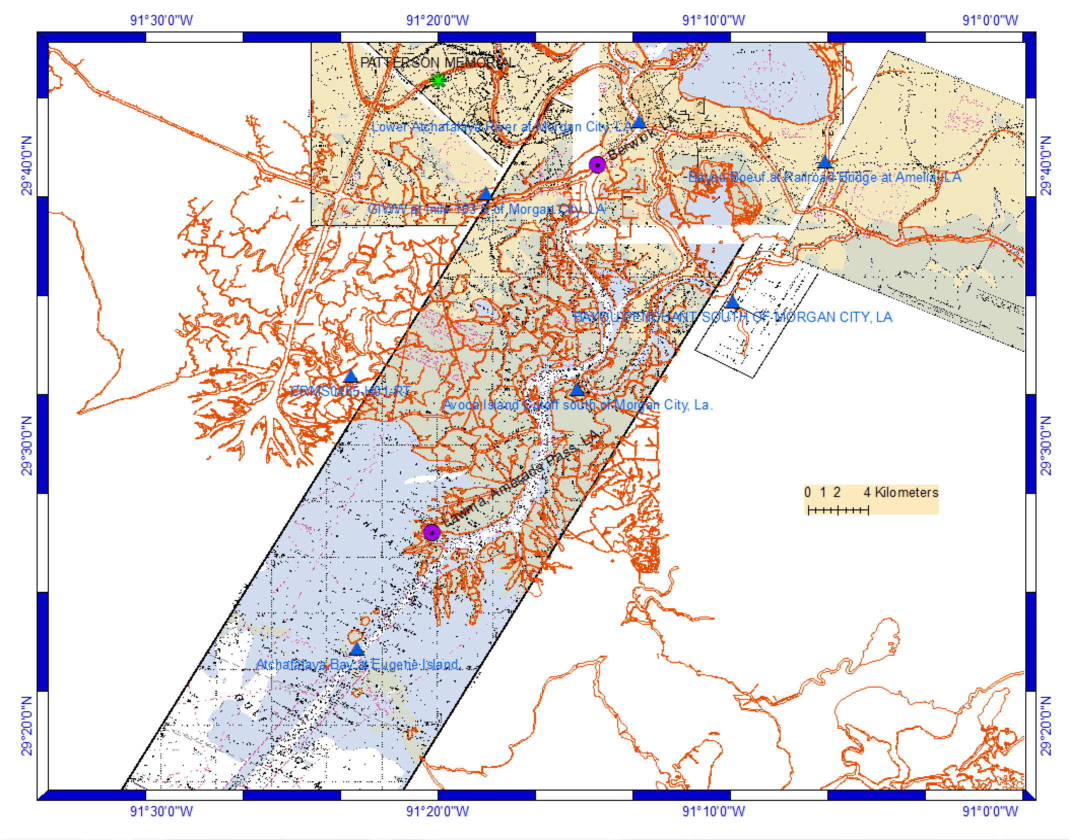
- RMA-2 grid overlaid at Horseshoe Bend
- Highest grid resolution:
  50 m (near the island)
- High channel resolution: about 50 - 100 m
- Low resolution: about 1,800 m applied near the open boundary grid
- Total number of nodes: 12,314



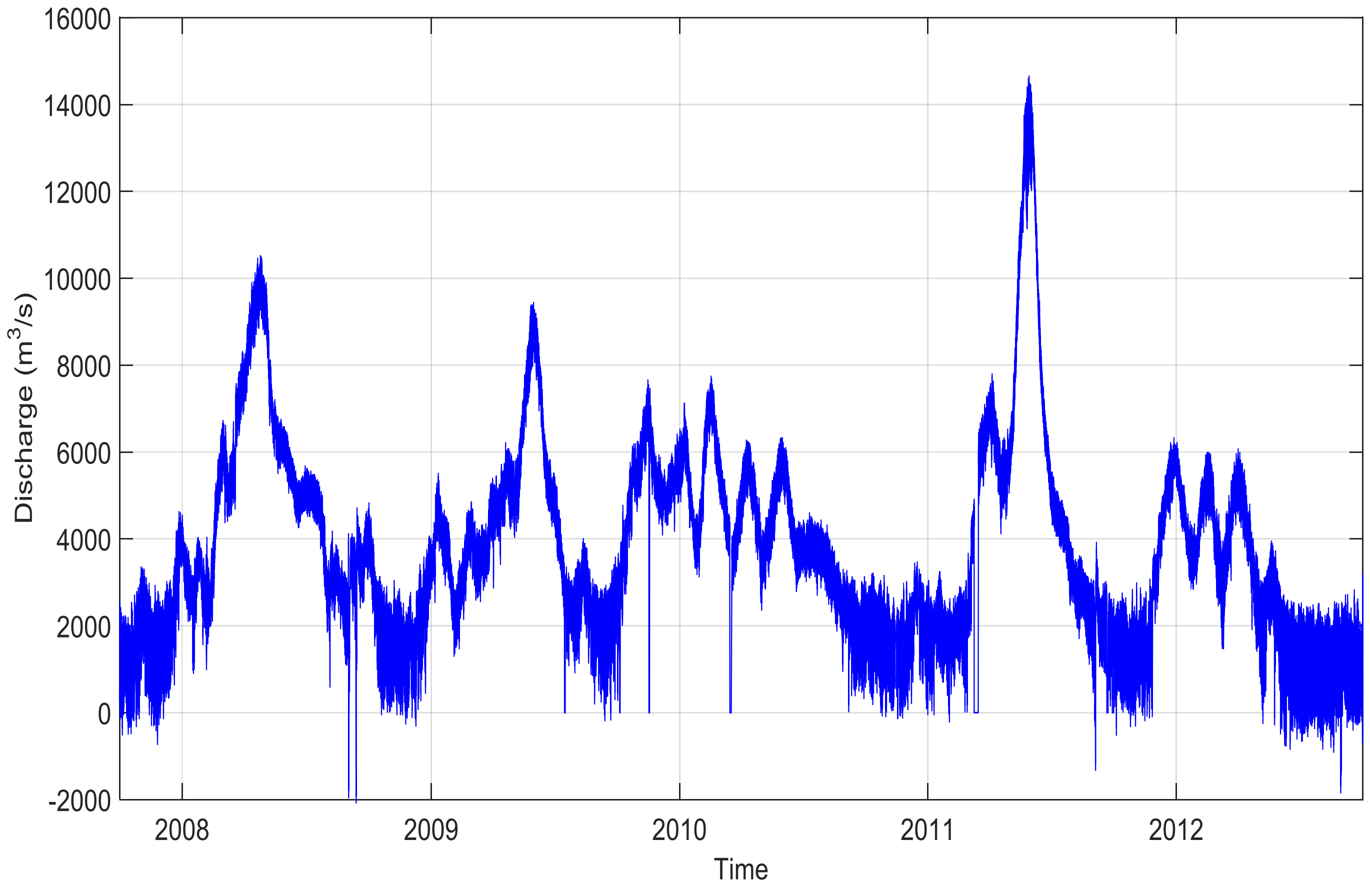
Boundary Conditions and Forcings

Gage locations for Lower Atchafalaya River:

- Triangles (blue) represent USGS gage locations
- Circles (purple) are for NOAA tide gage locations
- Asterisk (green) denotes a meteorological station

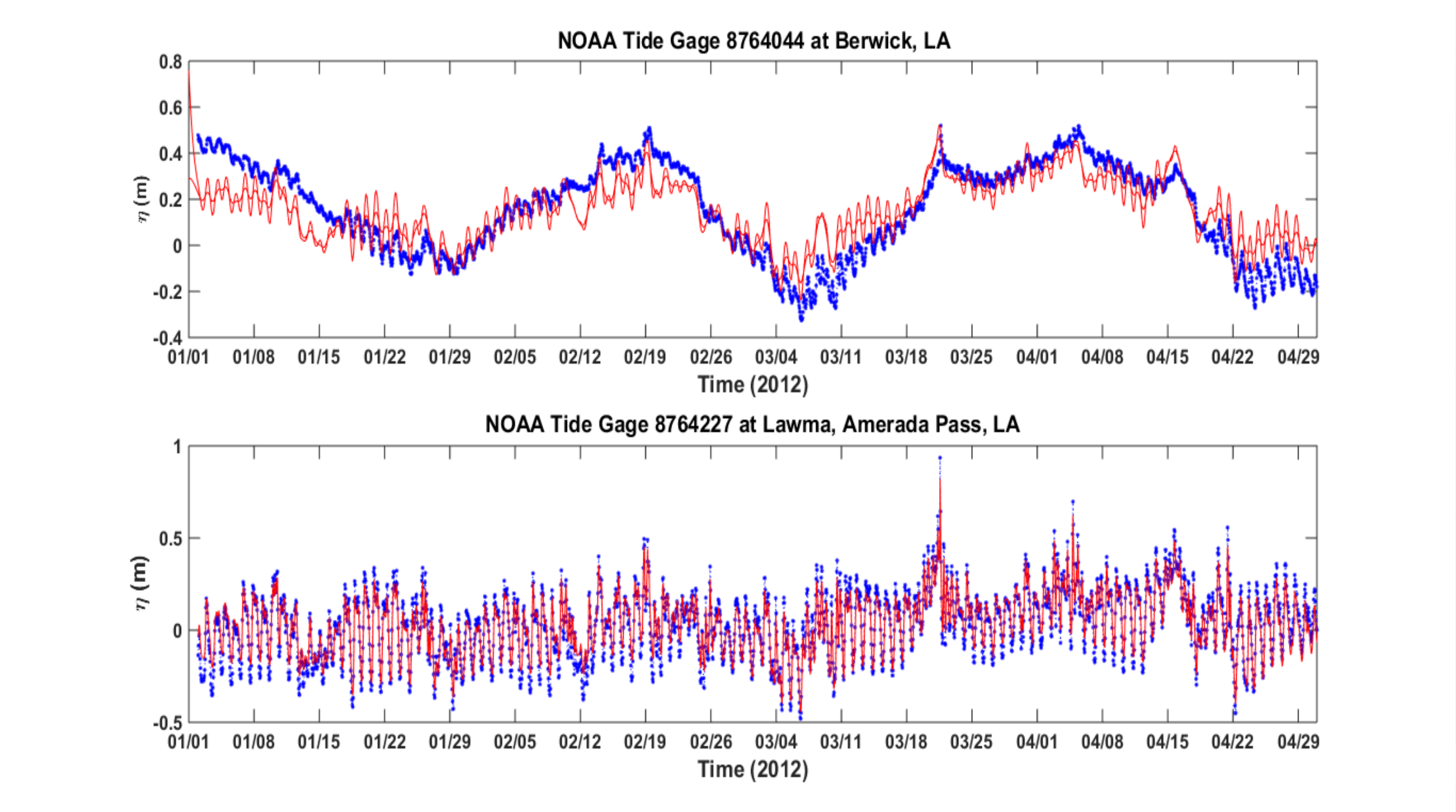


Boundary Condition and Forcings



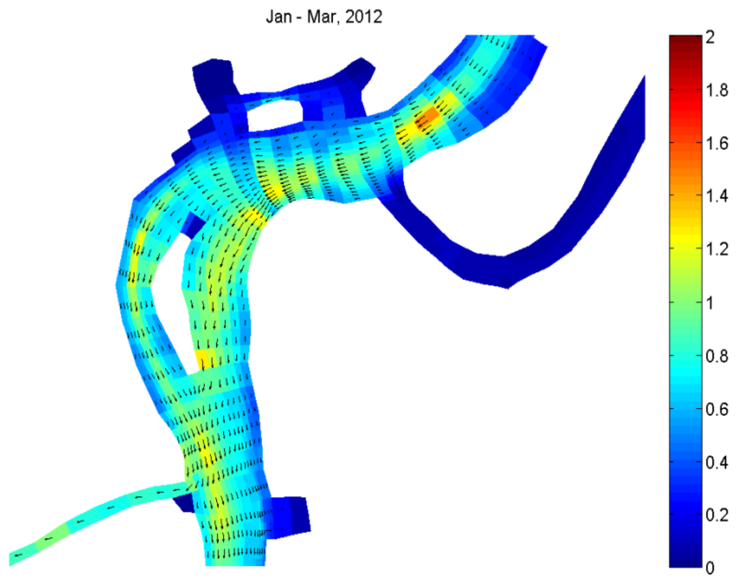
Hydrology Record 2007- 2013

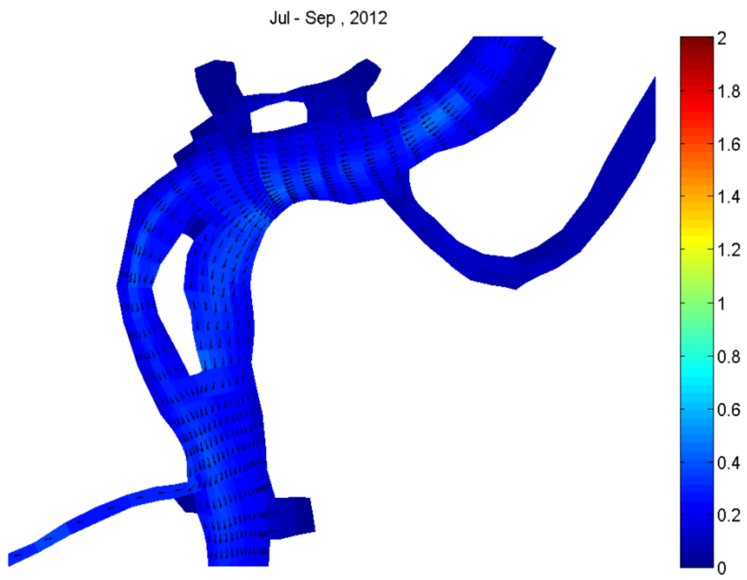
Model Calibration Results – Water Levels



Predicted (red lines) and observed (blue dots) hourly water levels for the first four months of 2012 at Berwick, LA NOAA gage Lawma, LA NOAA gage.

Sediment Transport Assessment Suspended Load Transport

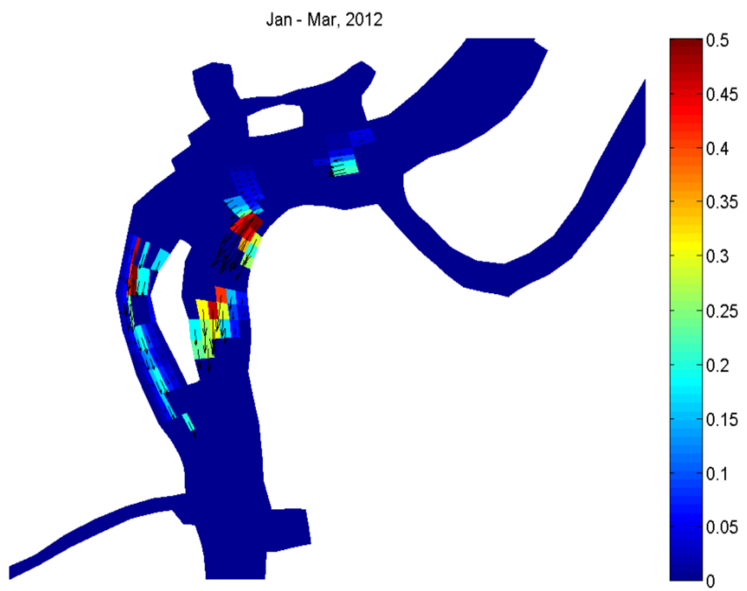




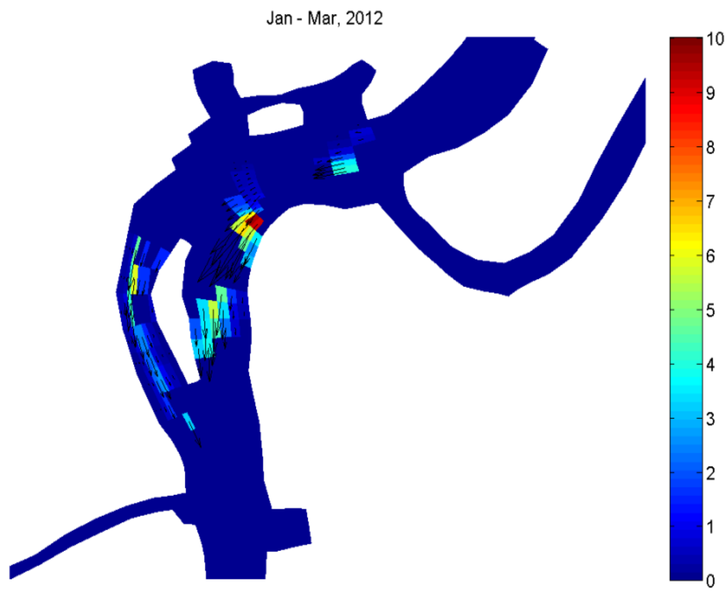
Mean bottom current during the relatively wet season from January through March, 2012 (max: 1.44 m/s)

Mean bottom currents during the relatively dry season from July through September, 2012 (max: 0.47 m/s)

Sediment Transport Assessment
Bedload Transport



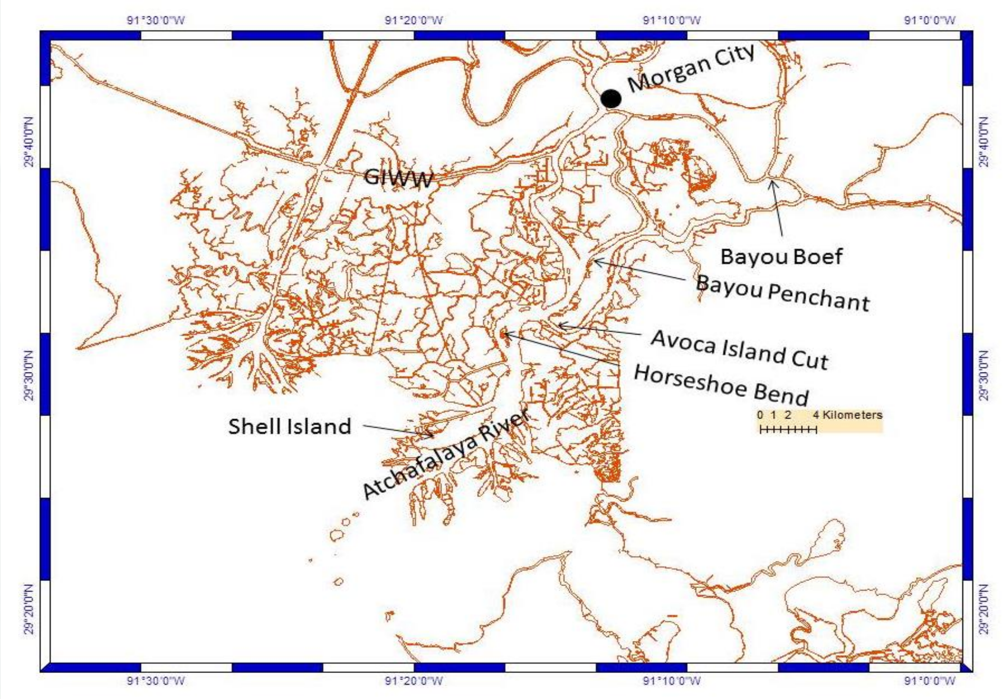
Mean bedload transport rate from January through March, 2012 (max: 0.71 $m^3/m/s$)



Mean suspended sediment transport rate from January through March, 2012 (max: 10 $m^3/m/s$)

Summary

- A 3-D hydrodynamic model was applied to the Lower Atchafalaya River to assess formation of Horseshoe Bend Island to gain a more complete understanding of the island's growth
- Simulation during 2012 showed the hydrodynamic model behavior is strongly related to hydrological forcings



Summary

- Dynamic response of sediment transport during the wet season extending from January to March
  - Along the eastern shore of Horseshoe Bend Island, possible deposition toward the northern shore and erosion from the southern shore was indicated
  - To a lesser degree, the western shore of the island showed erosion along the northern shore and deposition along the southern shore
- Model results serve as valuable information so that this innovative and strategic use of dredged sediment can be applied in other island building projects