Managing Environmental Risks for Riverine Infrastructure Projects

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EWN
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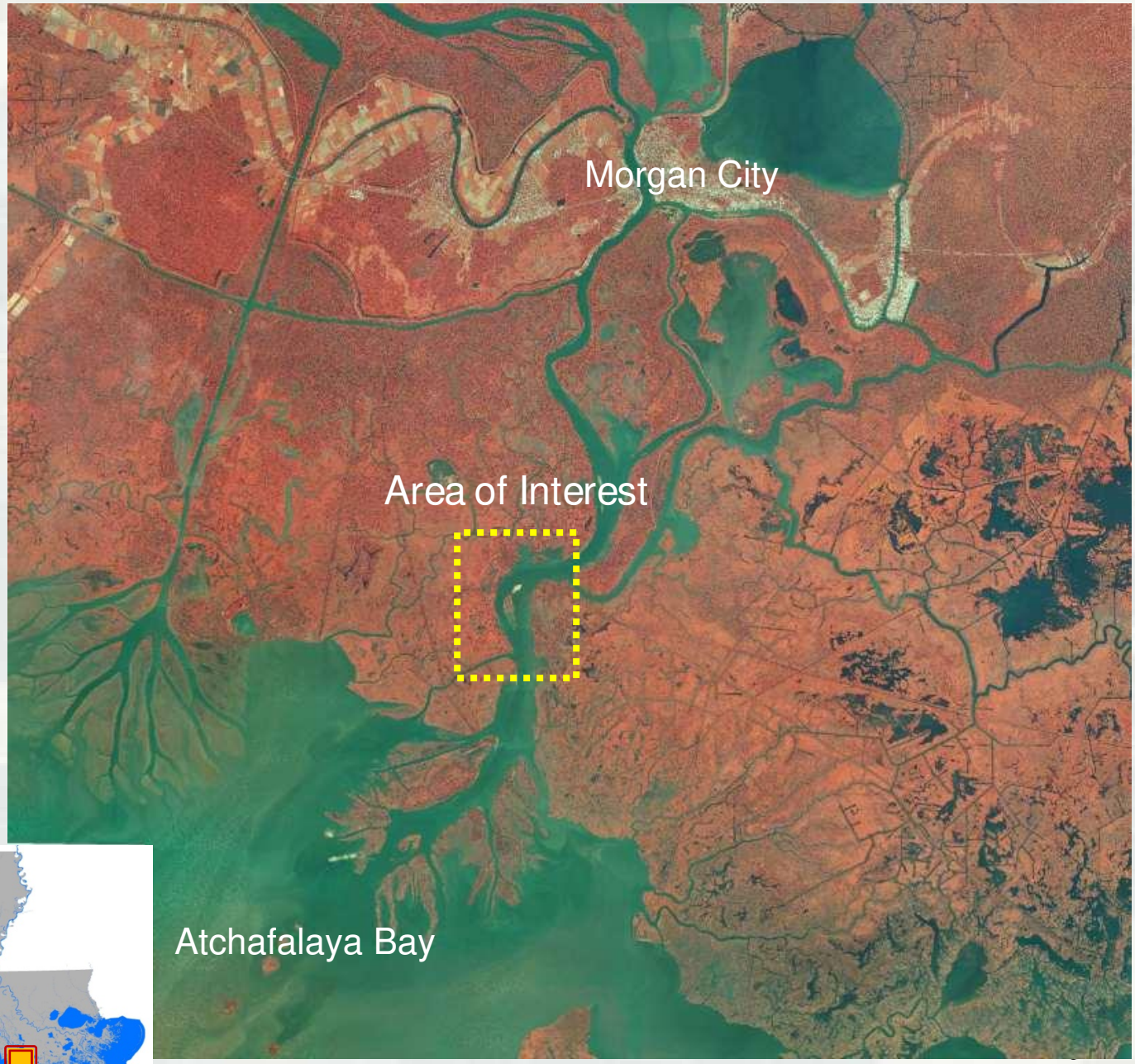
Overview

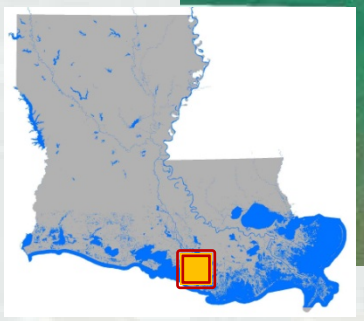
- Strategic placement of dredged material to create riverine habitat

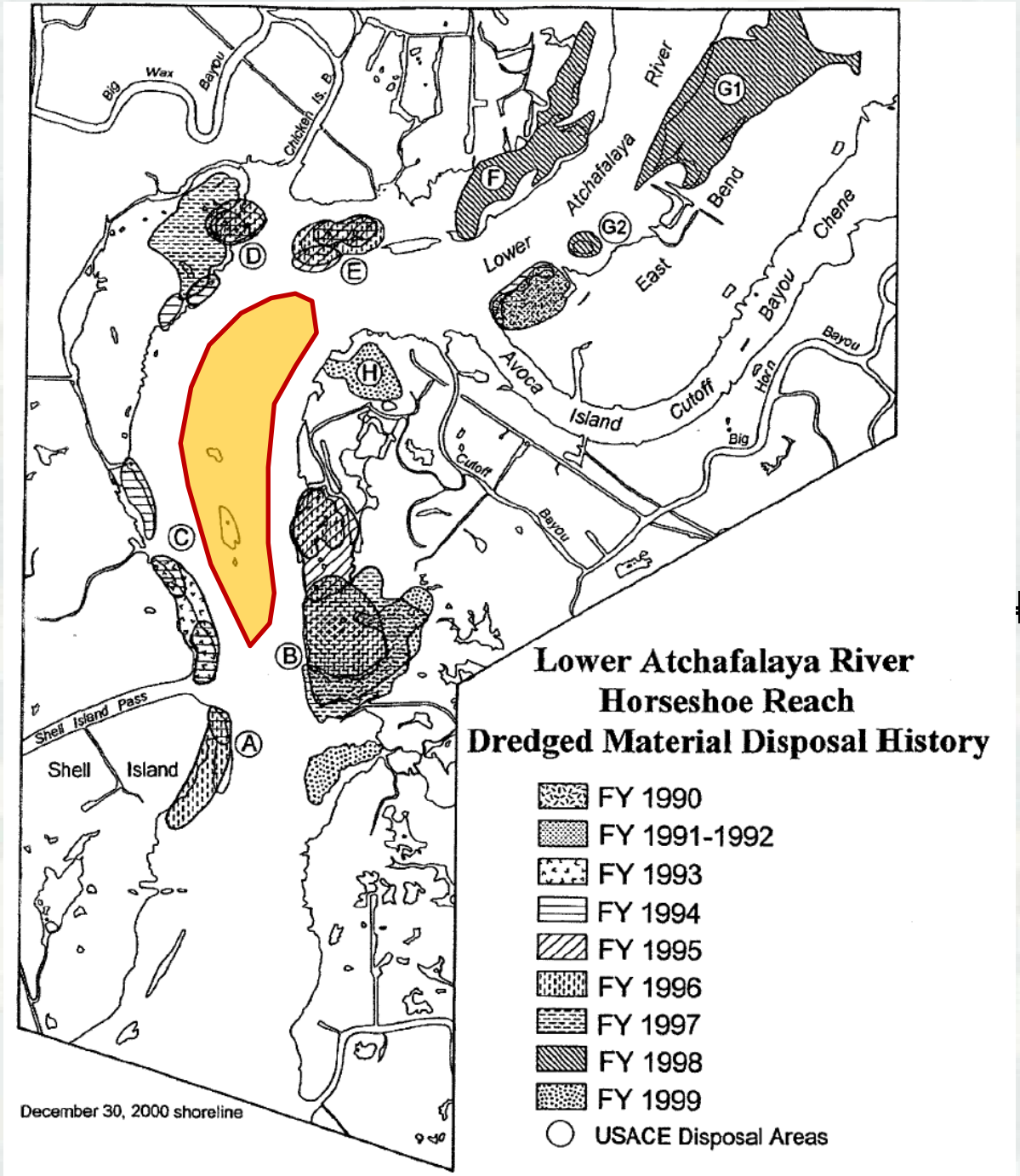
- River training structures

Horseshoe Bend Island

Strategic Placement of Dredged Material







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

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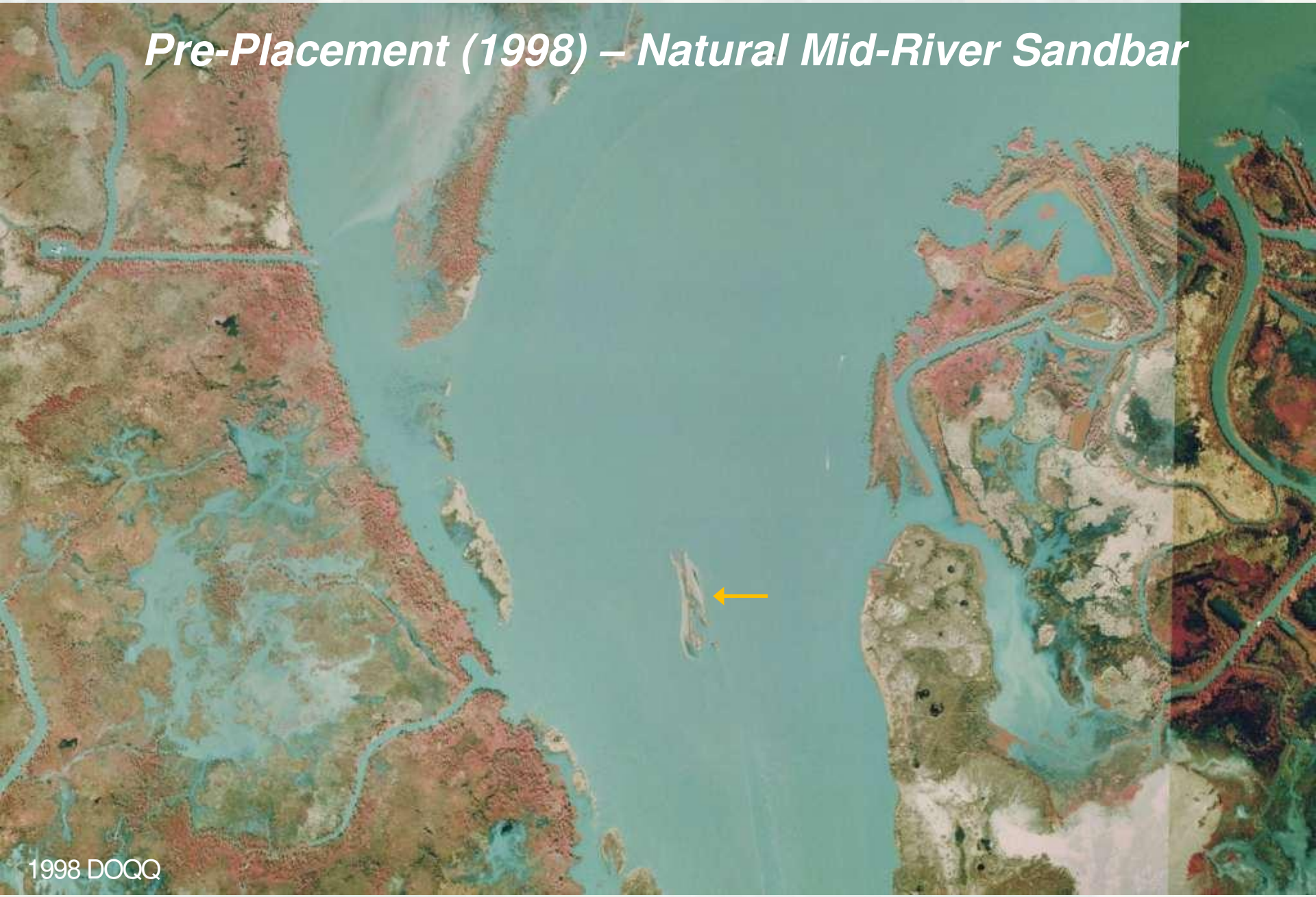
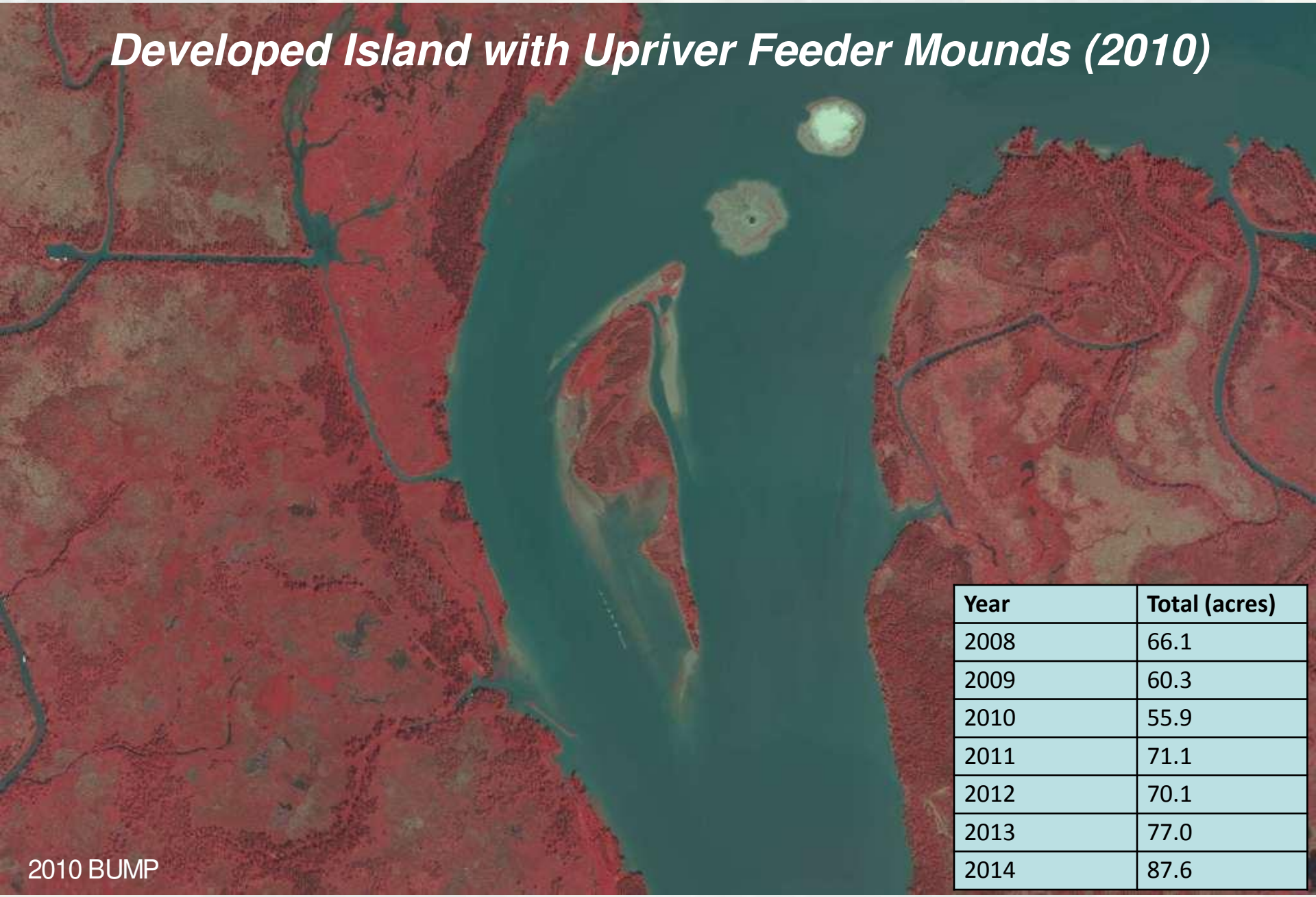
Pre-Placement (1998) – Natural Mid-River Sandbar



1998 DOQQ

Developed Island with Upriver Feeder Mounds (2010)



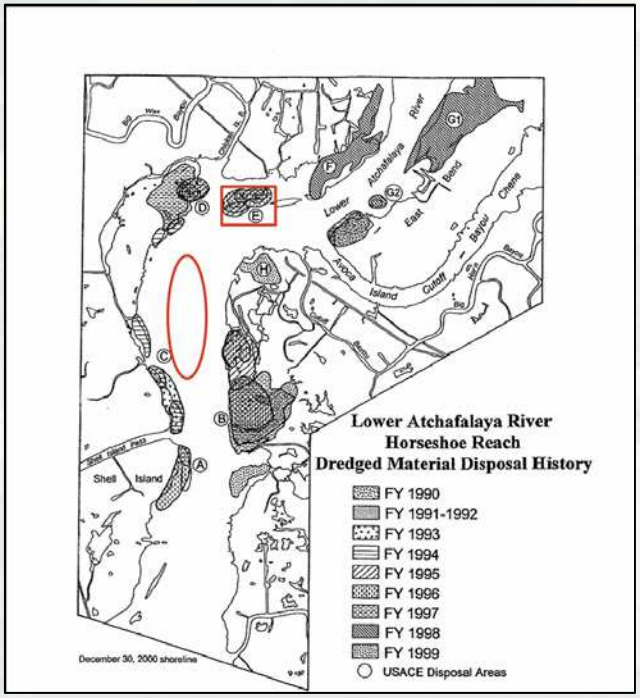
Year	Total (acres)
2008	66.1
2009	60.3
2010	55.9
2011	71.1
2012	70.1
2013	77.0
2014	87.6

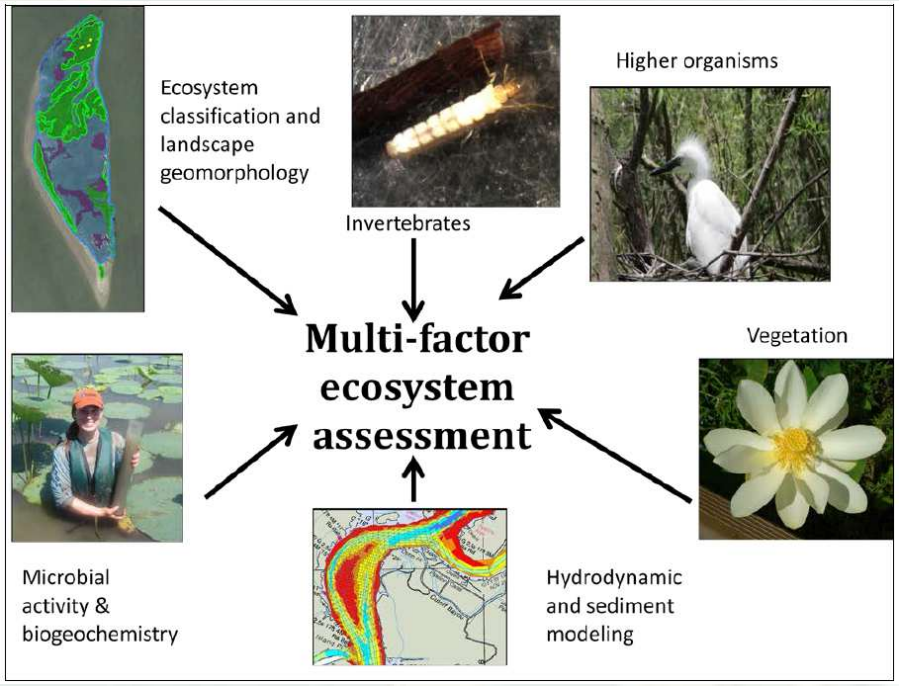
2010 BUMP

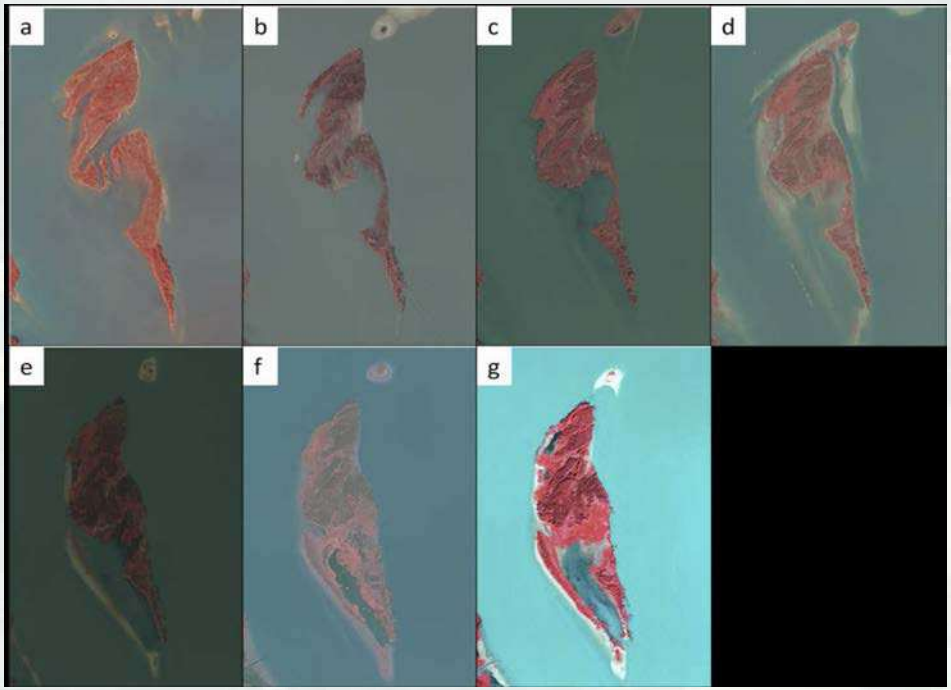
Problem: Limited options for dredged material placement alternatives

Solution: Innovative EWN placement technique created wetland island

Approach: Ecological assessment documented environmental services (ES) benefits







Case Study: ES metrics

Assessment Metrics	Environmental services
Ecosystem mapping	Environmental sustainability/habitat, recreation
Vegetation communities Faunal survey Invertebrate communities	Support for local and migratory species, nesting bird rookeries, and fisheries
Soil characterization Soil nutrient concentrations Soil nutrient retention capacity	Carbon sequestration, water quality improvement
Hydrodynamic and sediment transport modeling	Navigation, energy savings, safety

ES Metrics

Habitat:

- 86 plant species present
- >10 bird species in large nesting colonies
- Support for local fisheries

Water quality:

- Removal of excess nutrients

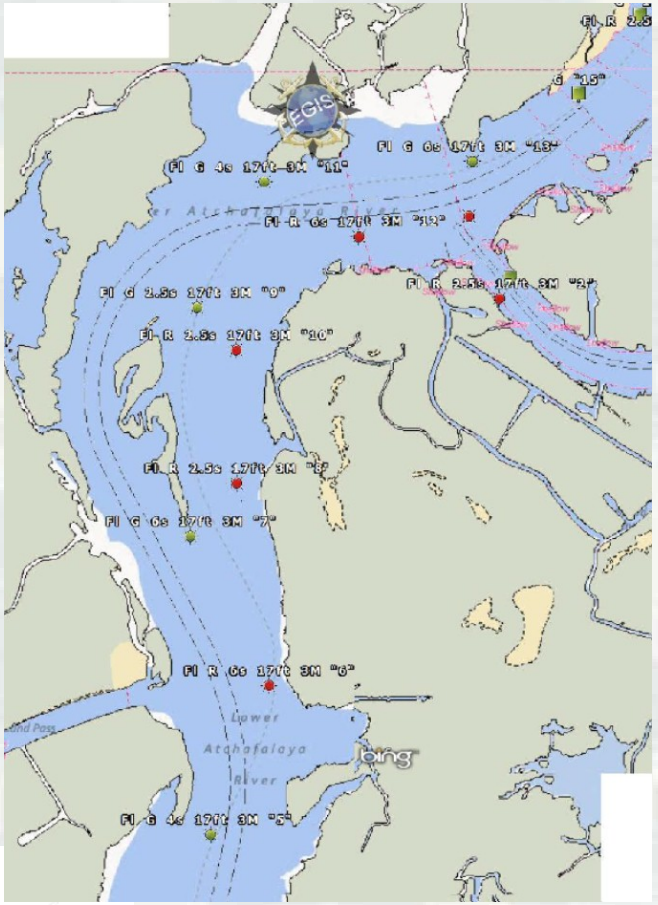
Recreation:

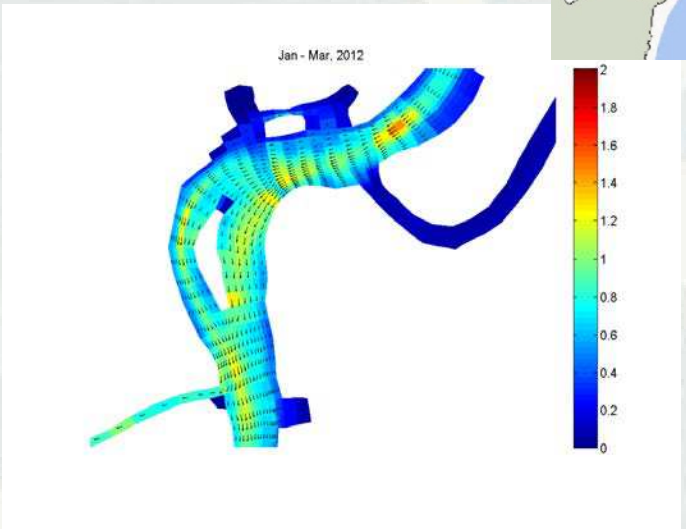
- Fishing, waterfowl hunting, camping

ES metrics

Hydrodynamics and Navigation:

- Increased flow velocity and sediment transport
- Decreased the need for additional dredging
- Allowed for channel realignment, reducing fuel use and travel time, increased safety





Quantifying ES benefits

Environmental Services	Metrics	Benefit
Environmental Sustainability/ Habitat	Four distinct wetland habitats: Aquatic bed 19 ha Forest 10 ha Emergent 4 ha Scrub shrub 1.5 ha	Provides diverse habitat for 86 plant species, >10 bird species, as well as reptiles, mammals, and aquatic invertebrates
Human Safety	Straightening navigation channel pathway	Created island allowed for re-routing of the navigation channel, eliminating a sharp turn while decreasing potential safety risks
Carbon sequestration	336 mega grams carbon accumulated in wetland soil	Long term carbon storage removes CO_2 from atmosphere

Quantifying ES benefits

Environmental Services	Metric	Benefit	Estimated economic value
Water quality improvement	1645 kg excess nitrate-nitrogen removed/yr	Excess nutrient removal by soil denitrification decreases hypoxia in the Gulf of Mexico	$16,450/yr
Climate regulation	186 metric tons CO_2 equivalent reduction/yr	Decreases greenhouse gas emissions	$2,400/yr
Recreation	35 hectares utilized for hunting, fishing, and birdwatching	Increased opportunities for public access	$560/yr
Transportation support	86,000 liters of fuel saved/yr	Cost savings for transportation	$54,000/yr
Navigation	57% reduction in dredging requirements	Decreased channel maintenance dredging costs	$4,300,000/yr

Dredge Fuel Consumption Savings

- Projected maintenance HB: 1.1 MCY annually
- Projected maintenance CC (post construction): 750,000 CY every 3 yr
- Based on 27-30 in cutterhead dredge, removal of 1.1 MCY consumes ~160,000 gal diesel. Assuming same type material settles in CC, removal of 750,000 CY consumes ~109,000 gal fuel
- HB 10 years = 10 maintenance events (=1.6 M gal fuel total) vs. 3 maintenance events for CC (=327,000 gal fuel total/3 events)
- Realized fuel savings over 10 years (by switching) ~1.27 M gal
- CC not dredged since construction in 2014, but some shoaling recently noted along the left-descending bank
- If funding was available it is reasonable to assume CC would have been dredged 3 years after construction

Products and Recognition

Berkowitz, Kim, Beane, Evans, Summers, Suedel, Flanagin, Corbino. 2017. A Multi-Factor Ecosystem Assessment of Wetlands Created Using a Novel Dredged Material Placement Technique in the Atchafalaya River, Louisiana. ERDC/EL TR-17-X.

Berkowitz, Green, VanZomeren, White. 2016. Ecological Engineering. 97: 381–388.

Berkowitz, Beane, Evans, Suedel, Corbino. 2015. Ecological survey of a dredged material supported wetland in the Atchafalaya River, Louisiana. Wetland Science and Practice. 32(1).

Suedel, B., Berkowitz, J., Kim, S., Beane, N., Summers, E., Evans, D, and Corbino, J. 2015. Terra Et Aqua. 140:26-31.

Berkowitz, Beane, Evans, Suedel, Corbino. 2014. Use of strategic placement of dredged sediments to support Horseshoe Island in the Atchafalaya River, Louisiana: A preliminary ecological survey. ERDC TN-EWN-14-4.

2015 Western Dredging Association Gold Environmental Excellence Award

2017 Western Dredging Association Adaptation to Climate Change Award

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Horseshoe Bend Summary

- Multi-factor approach improved assessment
- Engineering with Nature approaches produce equivalent outcomes to natural wetlands
- ES valuation results highlights the full environmental and climate change benefits
- Documenting ES benefits promotes use of innovative solutions
- Allowing the island to “self-form” is key to creating comparatively improved wetland habitat relative to the two reference areas

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River Training Structures

Blunt Nosed Chevrons at Miss. River Mile 266
USACE St. Louis District, Applied River Engineering Center

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Problem

- Navigation channel alignment and sedimentation can be problematic to maintaining inland waterways
- River training structures (i.e., dikes) used to modify the hydraulic flow and sediment response to improve and/or restore the river for human and environmental benefit
- Dikes installed perpendicular to the bank line to help alleviate such issues
- Dikes created self maintaining navigation channels, but sedimentation occurred behind them, decreasing habitat diversity

A WwN Solution

Blunt Nosed Chevrons

- Reduce a continuous need to dredge
- Alleviate dangerous navigation conditions through several bridge crossings
- Support local facilities with shoaling problems
- Increase habitat diversity and support species restoration

Blunt Nose Chevron

Center section of chevron at lower elevation (e.g., notched)

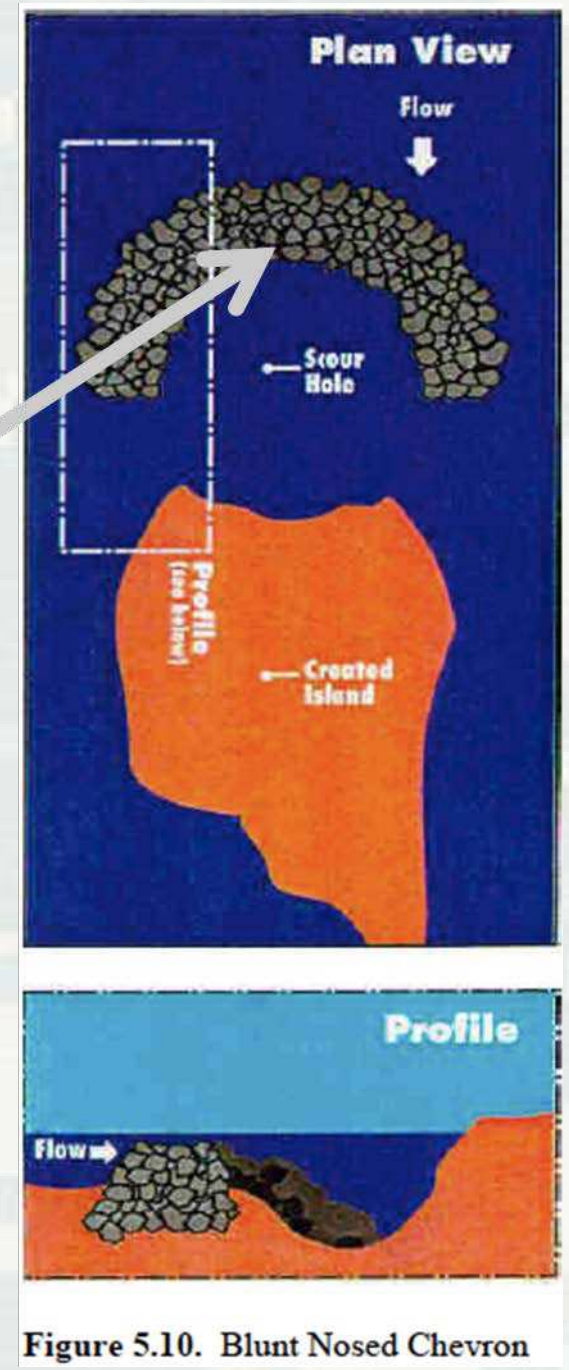


Figure 5.10. Blunt Nosed Chevron

Constructed Chevron Examples

Aerial view (looking upstream) of three chevrons at St. Louis Harbor. Note sand bar island, a habitat used by many wildlife species, created downstream from the middle and nearest chevron structures.

Aerial view of chevrons at Bolters Bar. Note sand bar islands created downstream from the chevron structures.

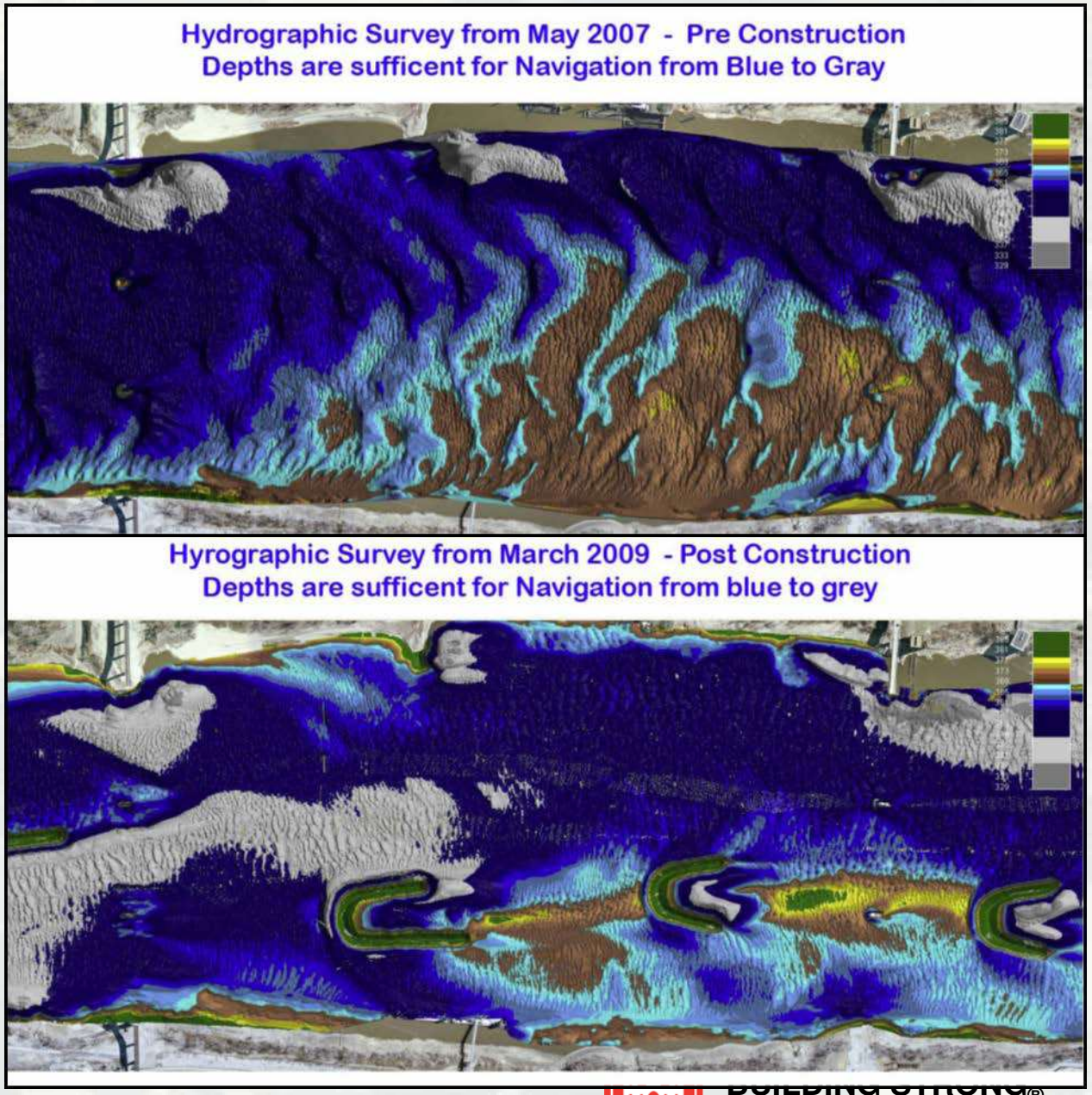
Aerial view of chevrons at Gilbert. Note sand bar islands created downstream from the chevron structures.

1998 DOQQ

(All photos courtesy of USACE St. Louis District).

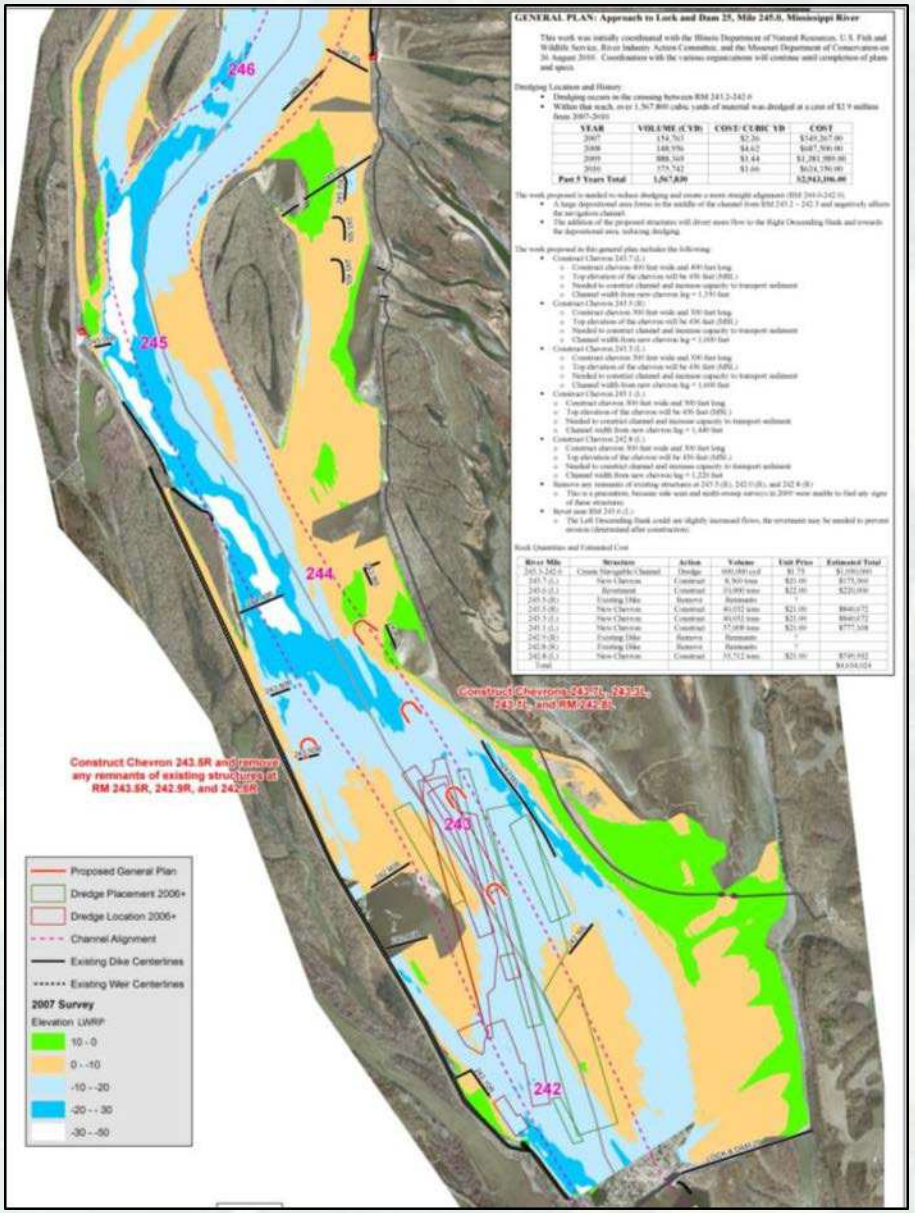
Blunt Nosed Chevrons at St. Louis Harbor

- Hydrographic Survey images from May 2007 before chevron construction and March 2009 after chevron construction
- By splitting the flow, deposition problems were greatly reduced in main channel and along bankline
- Due to the enhanced diversity of the river bed and increased habitat types created, number of species retrieved post-construction more than doubled pre-construction



Miss. River Lock & Dam 25 Approach

- Five LD 25 Approach Structures
  - Four Chevrons on LDB
  - One Chevron on RDB
- Constructed in FY13 for $3.2M
- Reduced repetitive dredging location
- Provided better alignment to the entrance of the lock chamber



Chevron Benefits Summary

- Navigation: Improved channel
  - Decrease side channel conveyance
  - Increase main channel conveyance
- Economic: Reduced dredging requirements – lowered dredging costs
- Environmental: Created diverse riverine habitat
  - Invertebrates and fish
- Reduced navigation risk
  - Increased navigation safety

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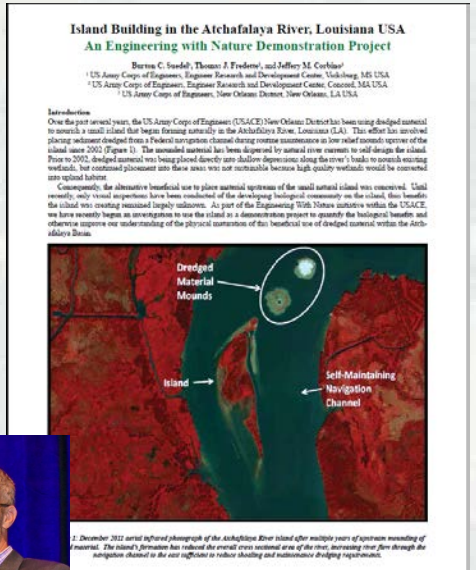
Take Away Points

- Effective waterways management practices are being implemented as part of maintenance dredging and navigation projects, consistent with WwN principles
- Communication essential to promote these good practices
- Lessons learned so innovative approaches can be more broadly applied
- Utilize nature's energy



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