Restoration of the Gulf Coast: Geological and Engineering Issues

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NATIONAL WILDLIFE FEDERATION
Audubon
LAKE PONTCHARTRAIN BASIN FOUNDATION
SAVE OUR COAST SAVE OUR LAKE
EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work
Coalition to Restore Coastal Louisiana

Current Management Strategy is Seen as Unresponsive and Destructive…

Draw Lessons from the Past and Look Ahead

- Continued Wetland Loss and Expansion of Marsh Channels Increases Cost and Decreases Feasibility of 100 Year+ Hurricane Protection
  – MRGO Case Study

- Mississippi River Mouth is Retreating from ‘Bird’s Foot’ Shelf Edge Position
  – West Bay Diversion Case Study

Mississippi River Gulf Outlet

- 76-mile long channel completed by the USACE in 1968
- Shortcut between the Gulf of Mexico and New Orleans

Impact of MRGO

•20,000 acres of wetland were converted to open water during its construction

•An additional 7,600 acres were damaged due to salt water intrusion

•Overall negatively impacted 618,000 acres of habitat

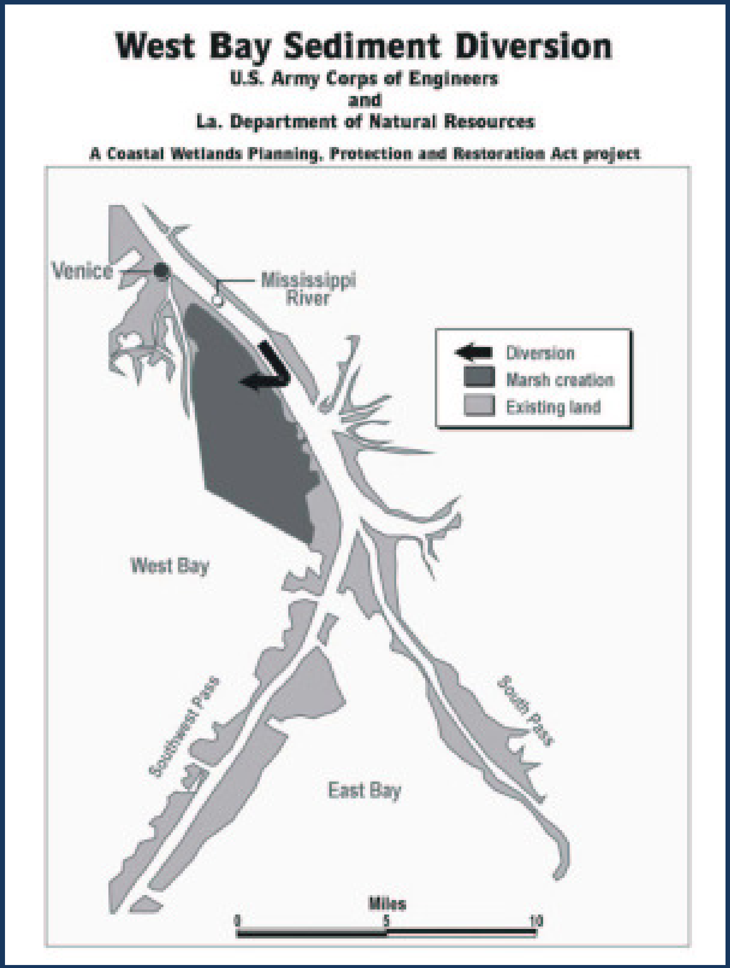
•2009 report suggested extensive flooding in St. Bernard Parish and the Lower Ninth Ward during Hurricane Katrina could be attributed to MRGO

•Channel is now closed to navigation, but the planning to fix the damage to the ecosystem has just begun

Bayou Bienvenue Wetland Triangle,
Lower Ninth Ward (Cypress Swamp)

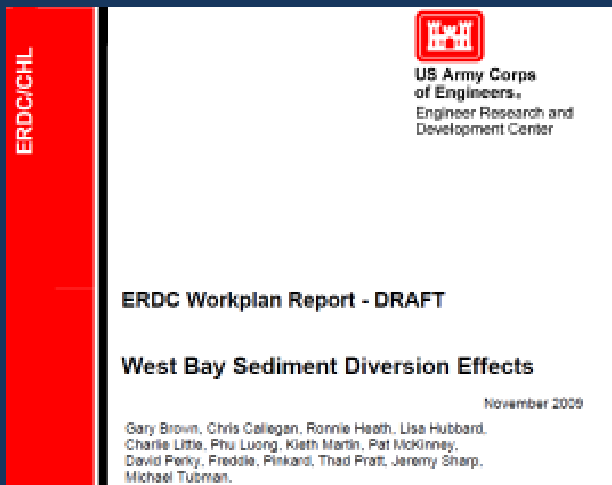
Bayou Bienvenue Wetland Triangle,
Lower Ninth Ward (Open Saltwater)

West Bay Diversion



- Construction was completed in 2003
- Purpose was to restore and maintain 9,831 acres of fresh and intermediate marsh

Questions About the West Bay Diversion



ERDC/CHL

US Army Corps of Engineers.
Engineer Research and Development Center

ERDC Workplan Report - DRAFT

West Bay Sediment Diversion Effects

November 2009

Gary Brown, Chris Callegan, Ronnie Heath, Lisa Hubbard, Charlie Little, Phu Luong, Kieth Martin, Pat McKinney, David Perky, Freddie. Pinkard, Thad Pratt, Jeremy Sharp, Michael Tubman.

Aerial and Bathymetric Spatial Change Analysis
of the West Bay Sediment Diversion Receiving Area, Louisiana
for U.S. Army Engineer District, New Orleans (MVN)
Report

by
John A. Barras, William C. Padgett,
and C. Brett Sanders

1) To what degree can the shoaling in the Pilottown anchorage be attributed to the diversion

2) Is the shoaling in the anchorage a result of longer term sediment transport-morphology changes?

3) How much sediment passes through the diversion ?

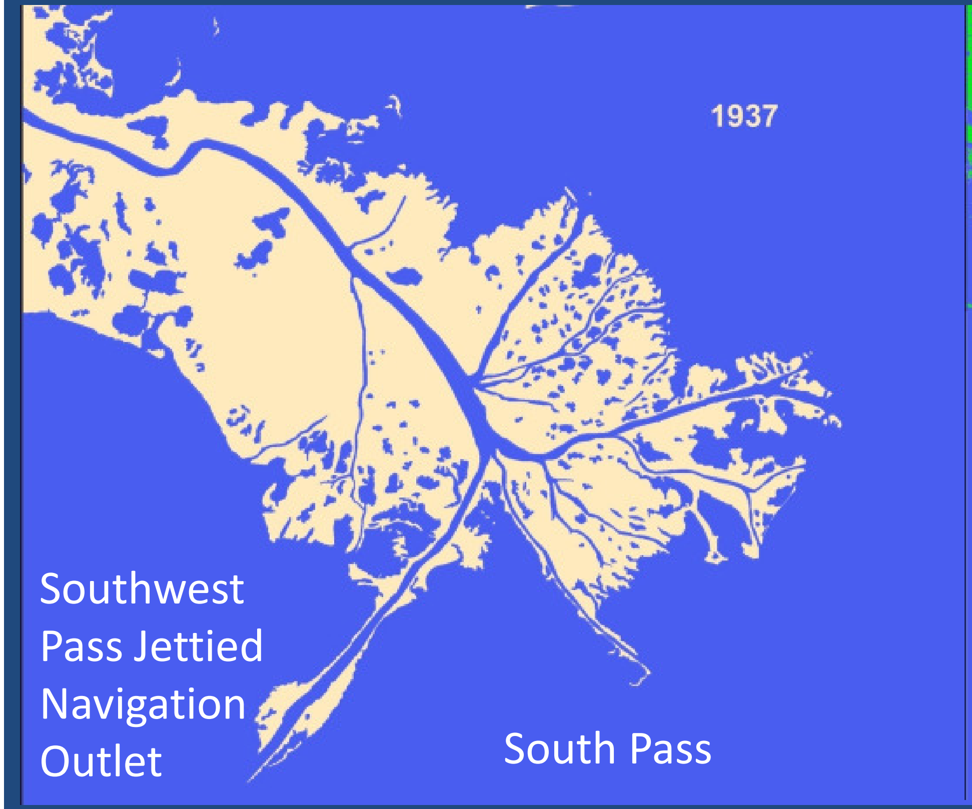
4) How much sediment is retained in West Bay?

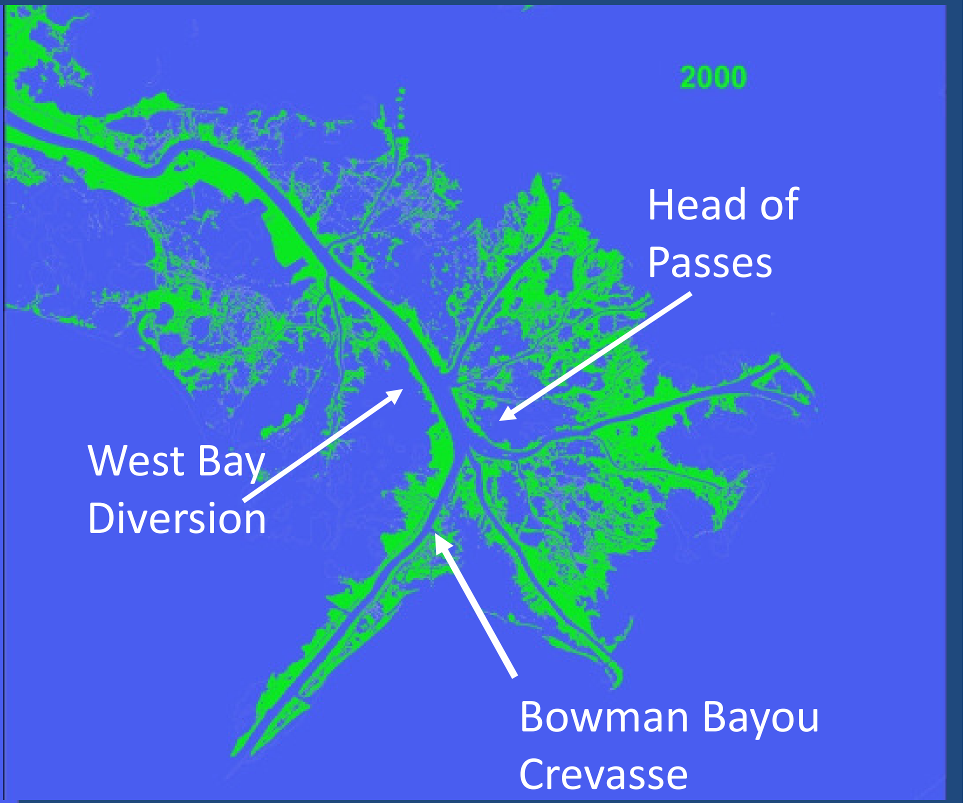
5) What are the ecological benefits of the West Bay project?

To Answer These Questions

- Compilation of data from Tarbert Landing and down: 1962 – Present
- Comparison of 50 years of river surveys
- Bathymetric base map of River near the diversion
- Current speeds and directions near the diversion
- Suspended sediment concentrations and suspended sediment types
- Characterization of bottom sediment types in the river near the diversion
- Preliminary 1D, 2D, and 3D Model Results

Mouth of the Mississippi





Science Driven Engineering:

Myrtle Grove Pulsed Sediment Diversion

STATE OF LOUISIANA

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LAKE PONTCHARTRAIN BASIN FOUNDATION SAVE OUR COAST SAVE OUR LAKE

EDF ENVIRONMENTAL DEFENSE FUND Finding the ways that work

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Location Map

Barataria Bay

WRDA Authorization

•WRDA 2007 – Sec 7006 Construction
Medium Diversion (2,500 to 15,000 cfs) with Dedicated Dredging
$278 million (Oct 2004) with potential increase up to $417 million

Goal of Modifications

•Examine the capability of a modified, larger Myrtle Grove Diversion to maximize the capture of sediment from the Mississippi River and related potential for land building

•Assess the potential impacts, both positive and negative, of the modified diversion on the Mississippi River and in Barataria Basin

Assessing Modifications

- Examine a Range of Possible Diversion Flows
- Determine Optimal Location of Channel
  - Sediment Availability and Capture
  - Downstream Effects on River
- Design and Alignment of the Structure
- Impacts in the Basin
  - Changes in Salinity, Water Level and Velocity
- Potential for Land-Building

Myrtle Grove Field Data Program

Dr. Mead Allison
University of Texas at Austin

Field data collection in support of numerical modeling to calibrate and validate a potential Westbank diversion near Myrtle Grove, LA

Sampling Cruise Data Collection

Data gathered to examine comprehensive fluid, flow, and suspended sediment conditions at range of discharges

Methods:

High-resolution Bathymetry (multibeam)
Water Discharge (ADCP)
Bottom Stress Field (ADCP)
Suspended Load (ADCP, optical and isokinetic samples)
Bedload transport (repeat multibeam bathymetry)
Suspended Grain Size (isokinetic and LISST)
Bed material Grain Size (Shipek grab)

Ongoing Data Collection

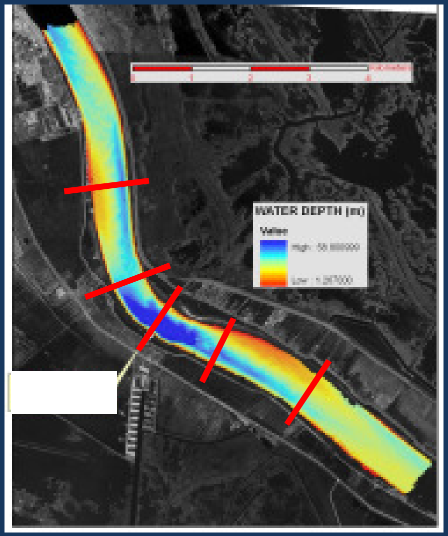
- YSI sonde multi-sensors installed at:
  - RM 72.8 Belle Chasse (A)
  - RM 63.2 Conoco Phillips dock (B)
  - RM 24.2 at Empire (C)

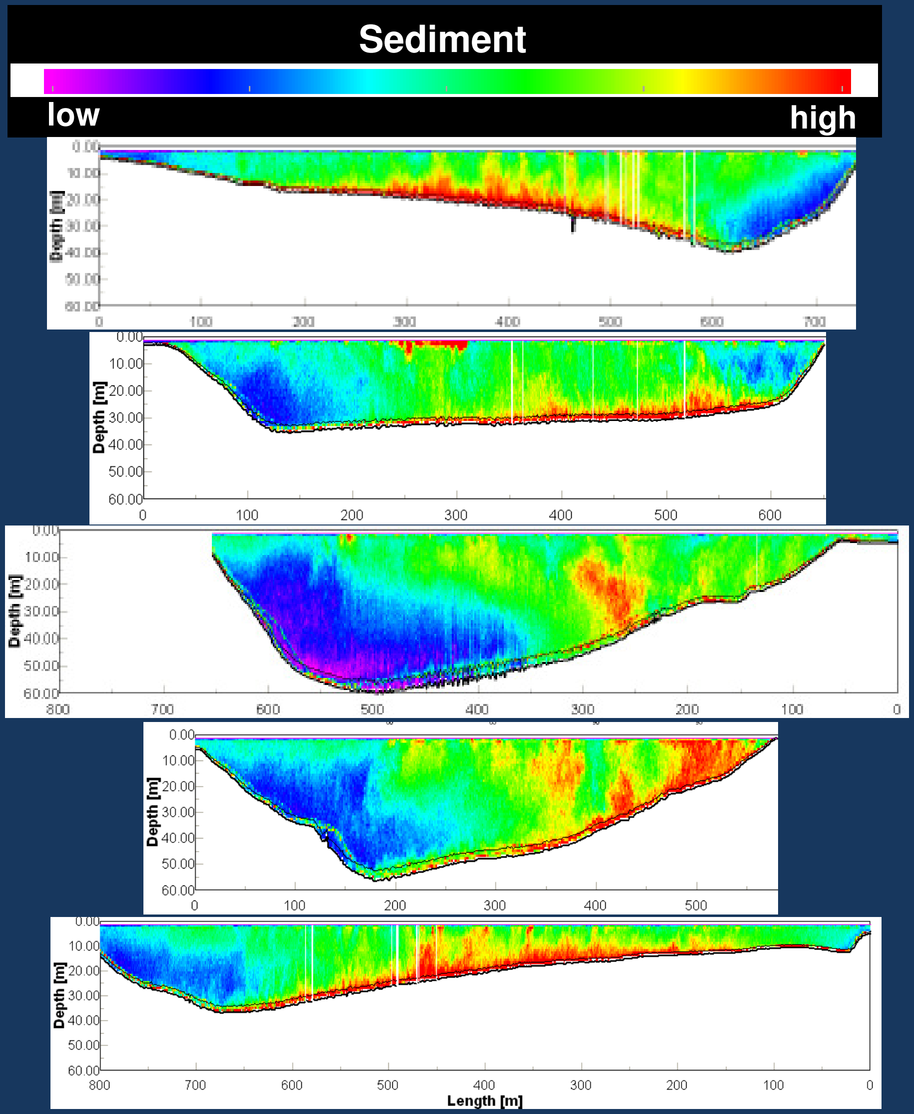
Measuring:

Stage elevation, Temperature, Turbidity

River Stage at Tarbert Landing and Alliance

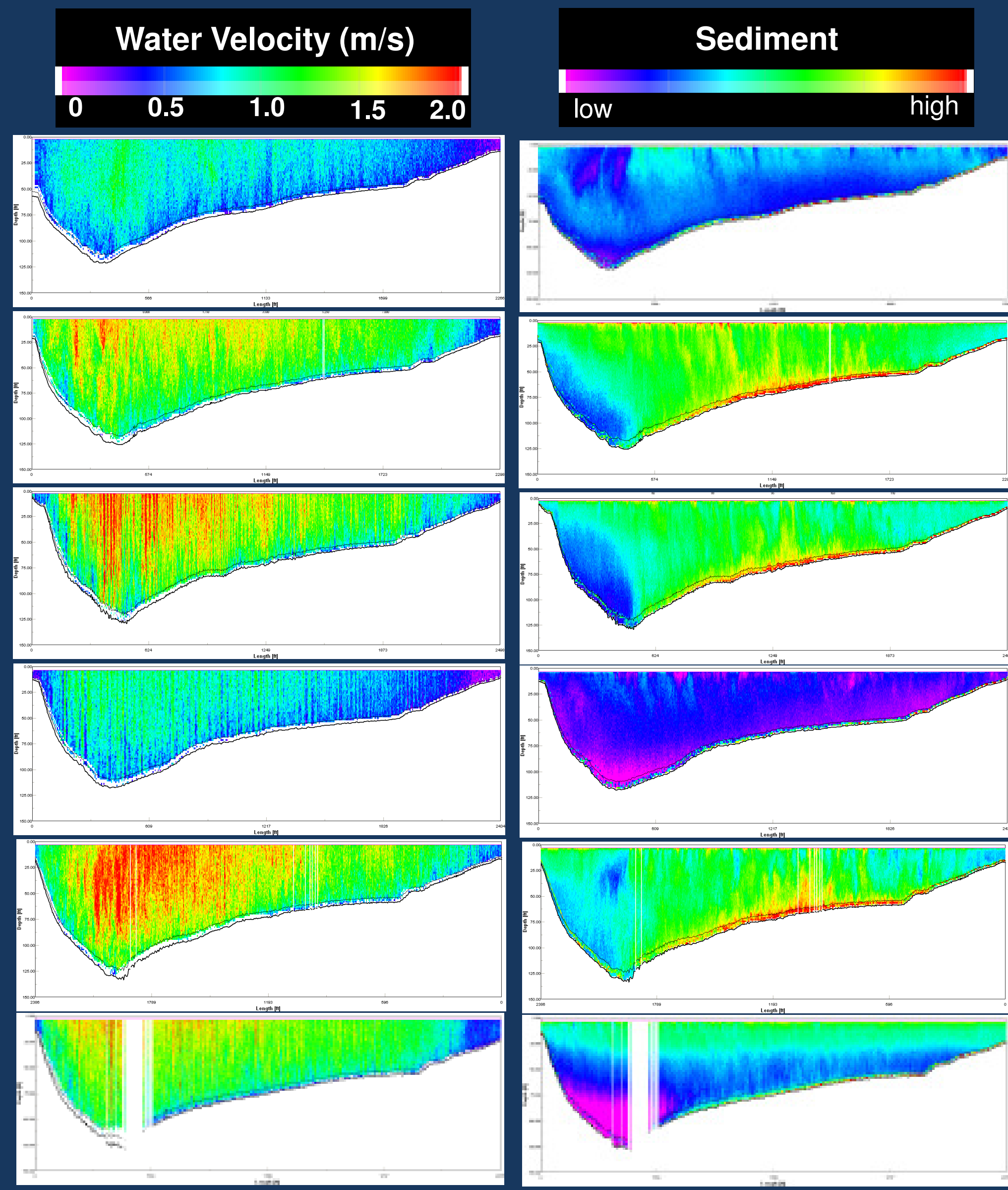
Sediment Distribution in the Water Column





- •April-2009 Data
- •Discharge ~ 700,000 cfs

Water Velocity / Sediment / River Discharge



October-2008
~400,000 cfs

April-2009
~700,000 cfs

May-2009
~760,000 cfs

September-2009
~380,000 cfs

April-2010
~875,000 cfs

May-2010
~660,000 cfs

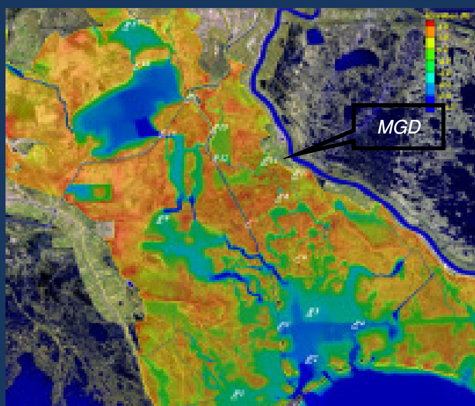
Screening Level Modeling

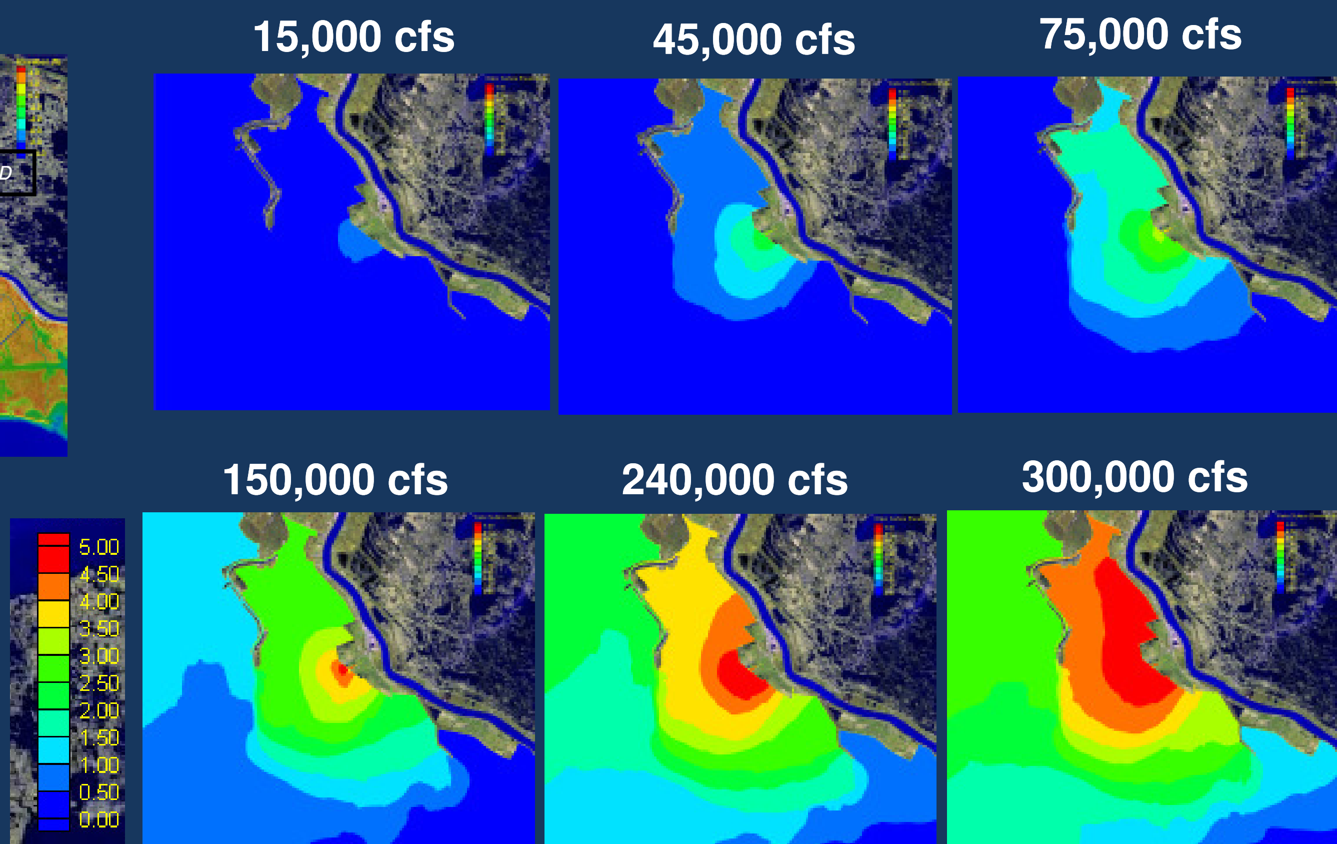
- Used an Existing RMA2 Model Of Barataria Basin
- Baseline: Nominal Discharge From Myrtle Grove and No Wind or Precipitation For Comparisons
- Six Potential Diversion Magnitudes

15,000 cfs **45,000 cfs**
75,000 cfs **150,000 cfs**
240,000 cfs **300,000 cfs**

- Model Runs Performed For the January 2003 Through July 2003 Timeframe
- Extracted Results For:
  - **Monthly Average, Maximum And Minimum Water Surface Elevations**
  - **Monthly Average And Maximum Velocity Magnitudes**

Maximum Water Surface Elevation in April

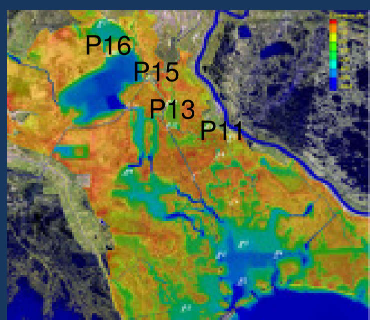


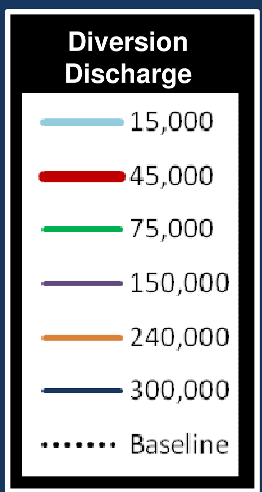


- Water surface elevations are in NAVD88

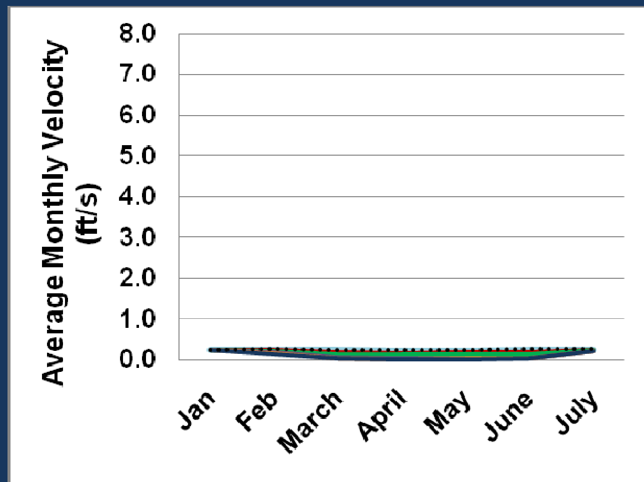
When the diversion flow is 45,000 cfs the model predicts surface elevation near Lafitte would be ~ 1.0 ft.

Average Monthly Water Velocity (ft/s) North of Diversion

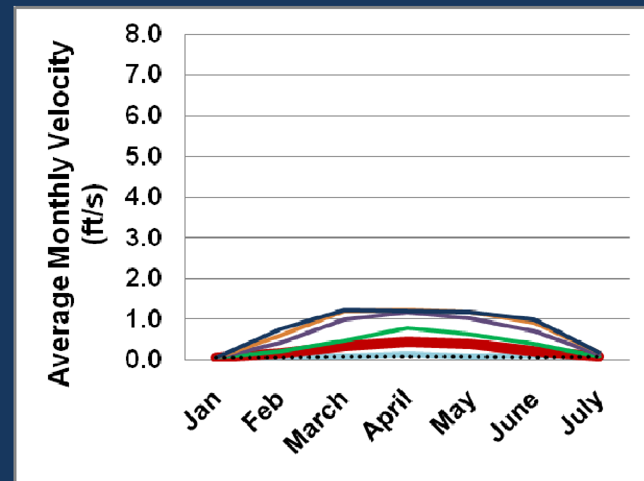




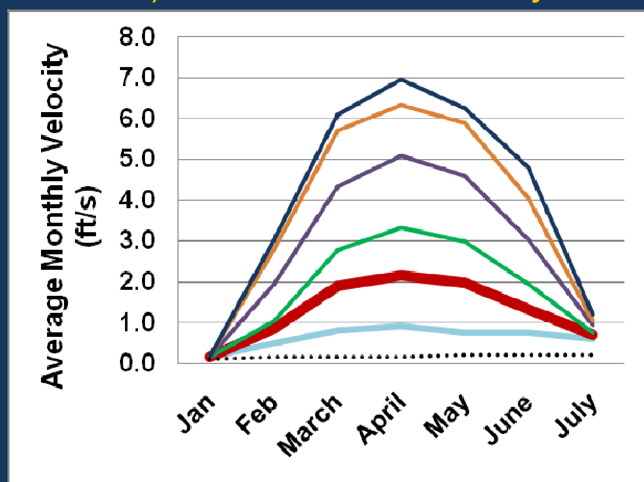
P16) North of Lake Salvador



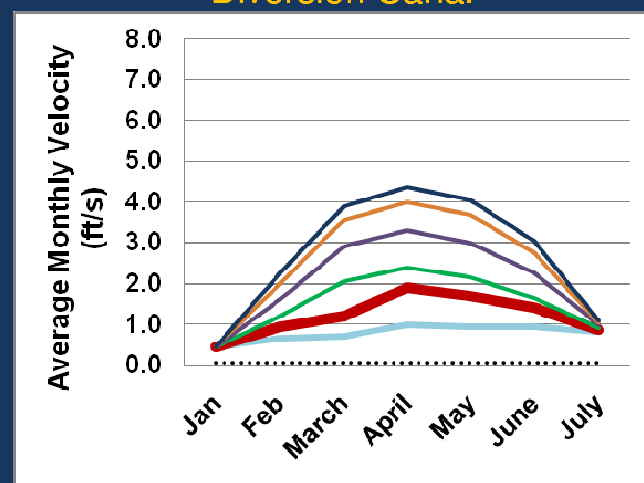
P15) GIWW



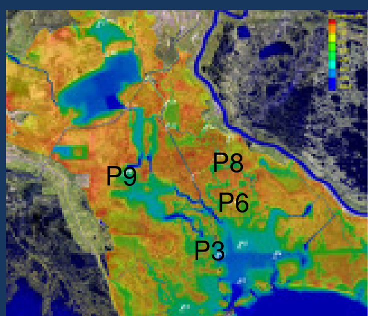
P13) Lafitte – Goose Bayou

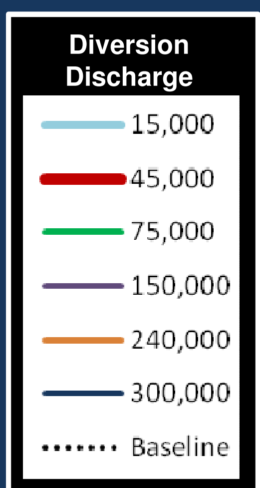


P11) Bayou Dupont – South of Diversion Canal

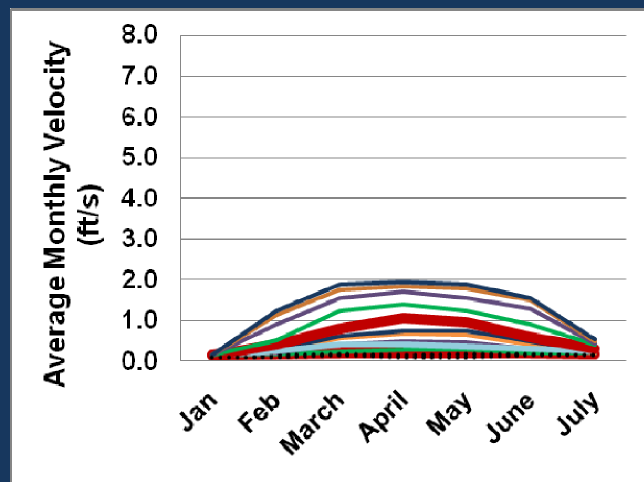


Average Monthly Water Velocity (ft/s) South of Diversion

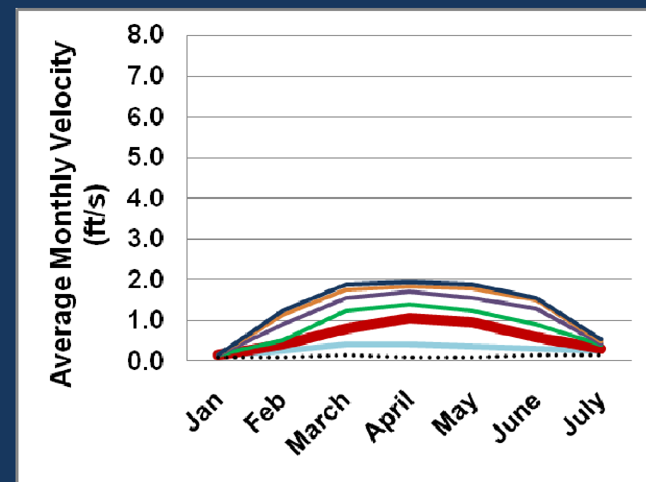




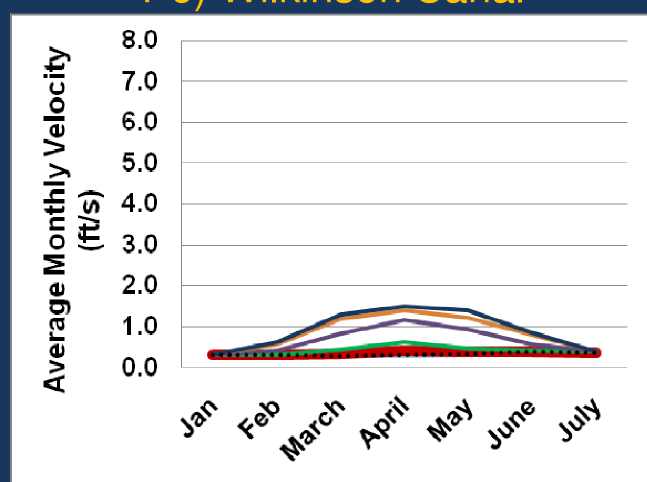
P9) Little Lake



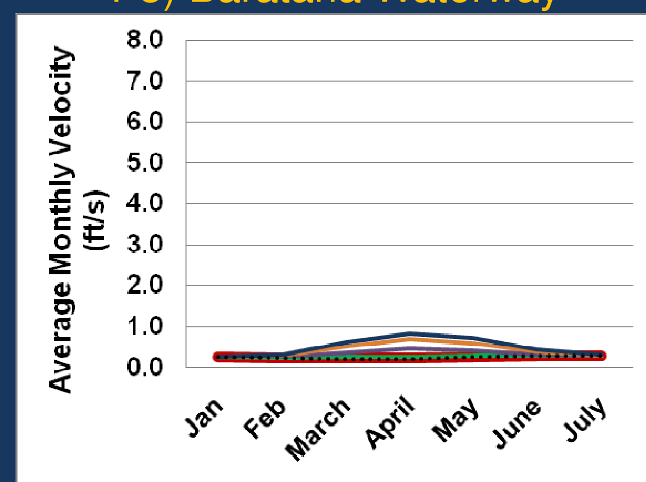
P8) Bayou Dupont – North of Round Lake



P6) Wilkinson Canal

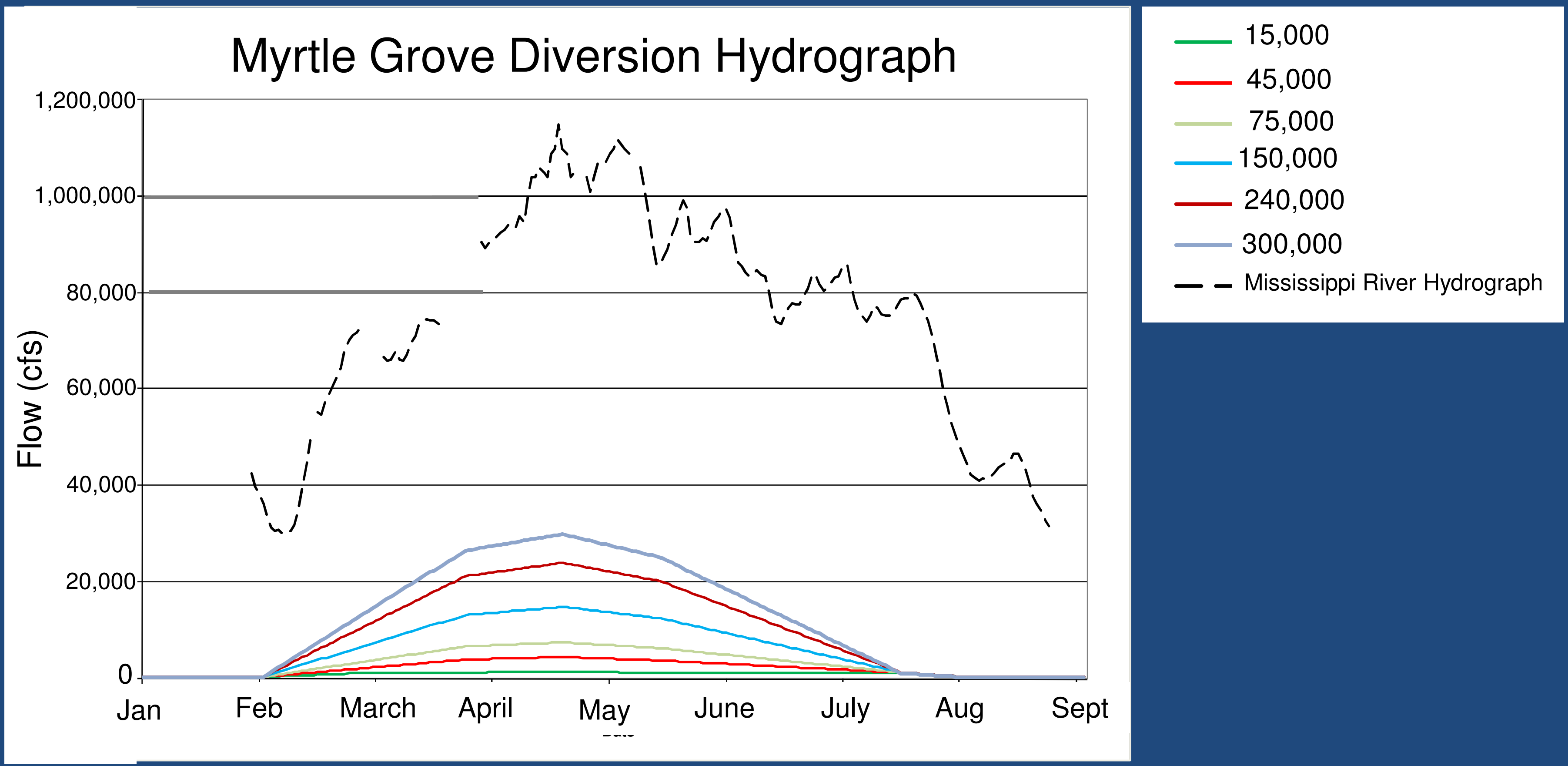


P3) Barataria Waterway



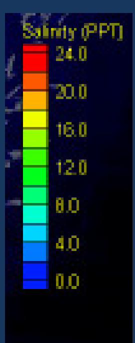
Hydrodynamic Modeling:
Potential Salinity Changes in the Basin

Diversion Hydrograph

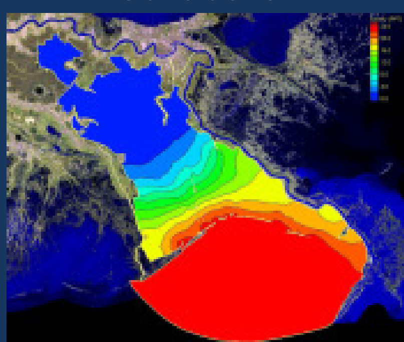


Mean Monthly Salinity in April with Variable Davis Pond Discharge and R1 Myrtle Grove Discharge

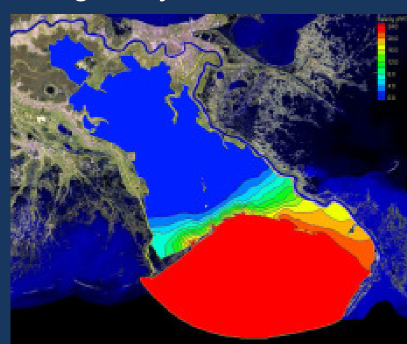
	Davis Pond Diversion (cfs)			Myrtle Grove Diversion (cfs)
	High	**Medium**	**Low**	**R1**
April	10,560	7,920	5,280	39,546



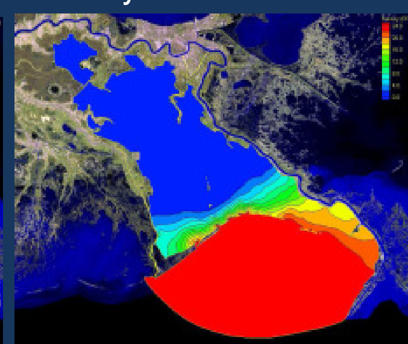
April-2003 Mean Salinity “Existing Conditions”



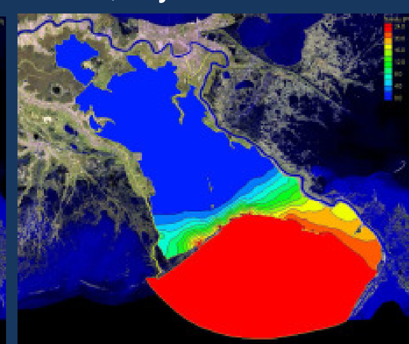
April-2003 Mean Salinity Davis Pond High, Myrtle Grove R1



April-2003 Mean Salinity Davis Pond Medium, Myrtle Grove R1

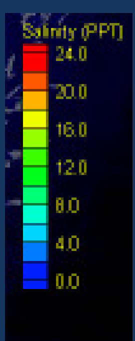


April-2003 Mean Salinity Davis Pond Low, Myrtle Grove R1

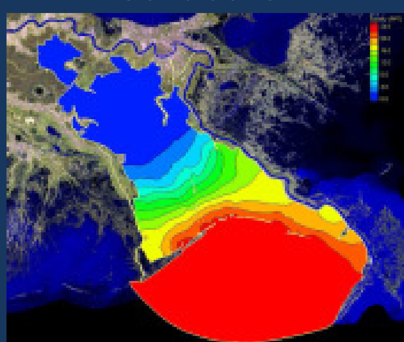


Mean Monthly Salinity in April with Variable Davis Pond Discharge and Medium Myrtle Grove Discharge

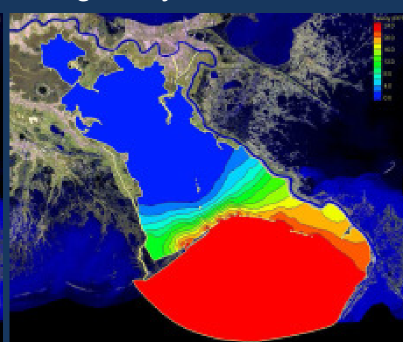
	Davis Pond Diversion (cfs)			Myrtle Grove Diversion (cfs)
	High	**Medium**	**Low**	**Medium**
April	10,560	7,920	5,280	7,500



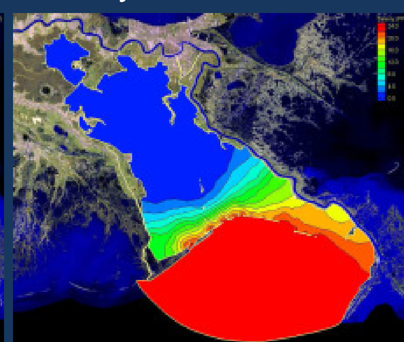
April-2003 Mean Salinity “Existing Conditions”



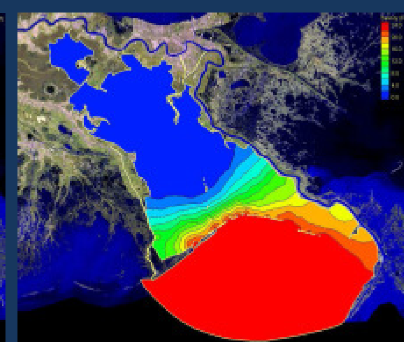
April-2003 Mean Salinity Davis Pond High, Myrtle Grove R1



April-2003 Mean Salinity Davis Pond Medium, Myrtle Grove R1



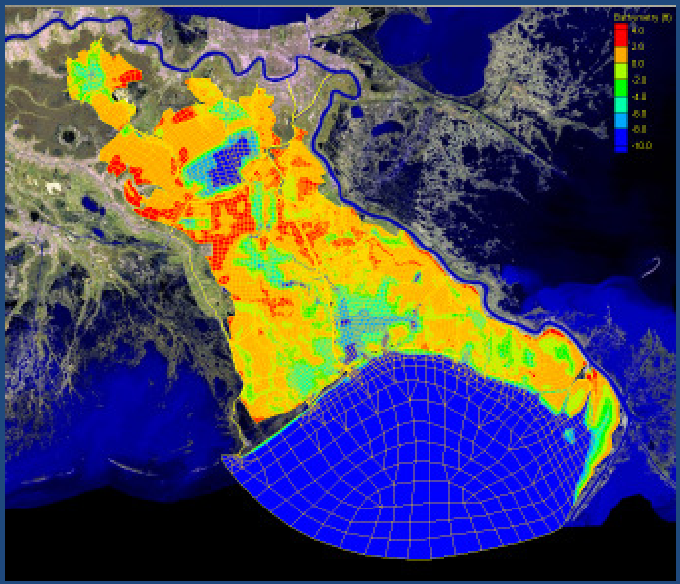
April-2003 Mean Salinity Davis Pond Low, Myrtle Grove R1



Assessing the Potential for Land Building

DELFT3D Model

Model Grid



- Industry standard model
- Includes 3 sediment sizes:
  - fine sand, very fine sand and silt
- Scenarios run to date:
  - 15,000 cfs USACE alignment with sediment consolidation
  - 45,000 cfs Modified alignment with sediment consolidation

Model Input Parameters

Diversion and Sediment Parameters for the USACE Alignment

Month	Discharge Flow (cfs)	Sediment Load (metric tons/day)		
		32 µm	63 µm	96 µm
“April”	11,400	2,789	103	279

Diversion and Sediment Parameters for the Modified Alignment

Month	Discharge Flow (cfs)	Sediment Load (metric tons/day)		
		32 µm	63 µm	96 µm
“April”	33,735	15,306	663	2867

Land Building Potential – 10 years

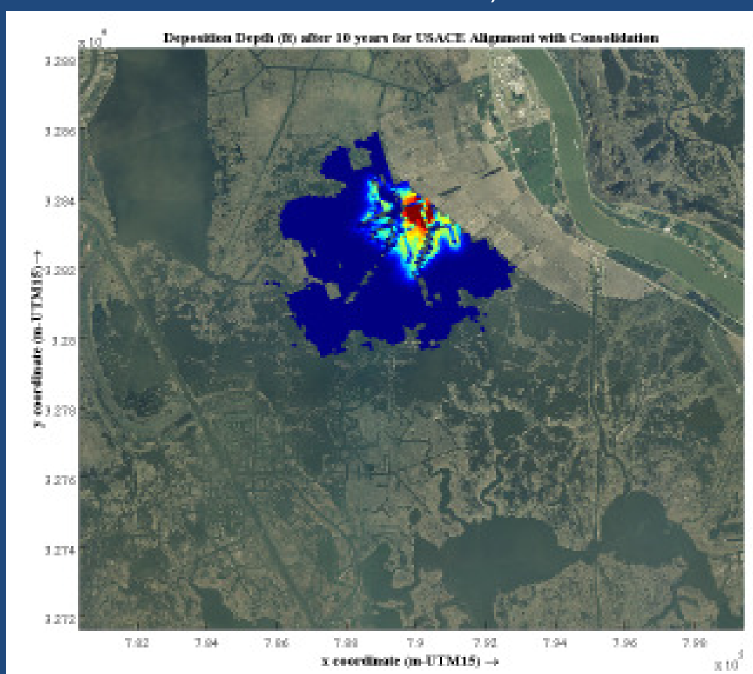
USACE Alignment (15,000 cfs)

	Sediment Volume (yd^3)
TOTAL	**3,400,537**

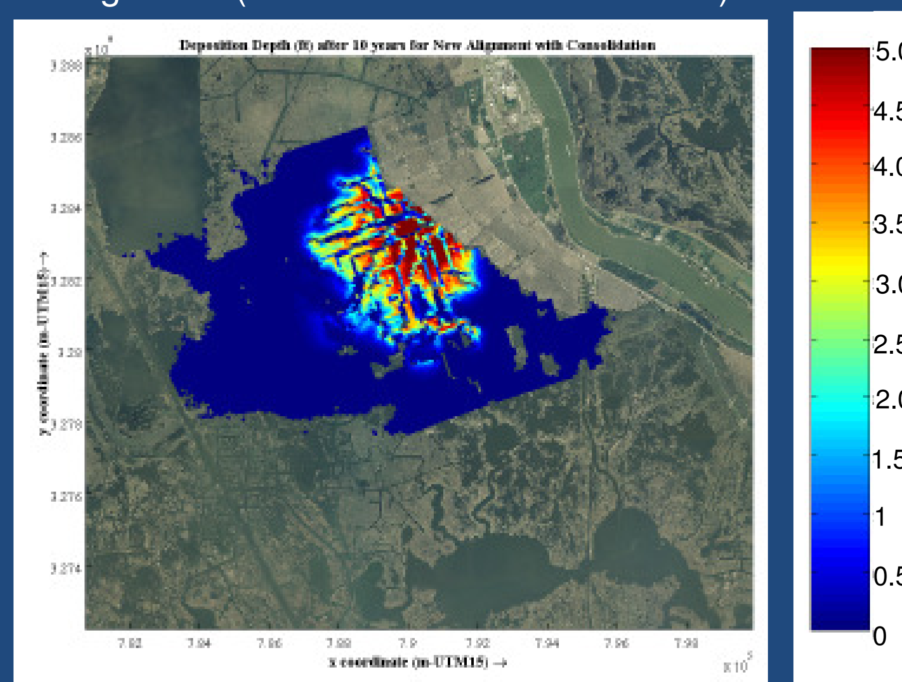
Modified Alignment (45,000 cfs)

	Sediment Volume (yd^3)
TOTAL	**13,828,856**

Deposition Depth (ft) After 10 years for USACE Alignment (with Sediment Consolidation)



Deposition Depth (ft) After 10 years for New Alignment (with Sediment Consolidation)



Land Building Potential – 25 years

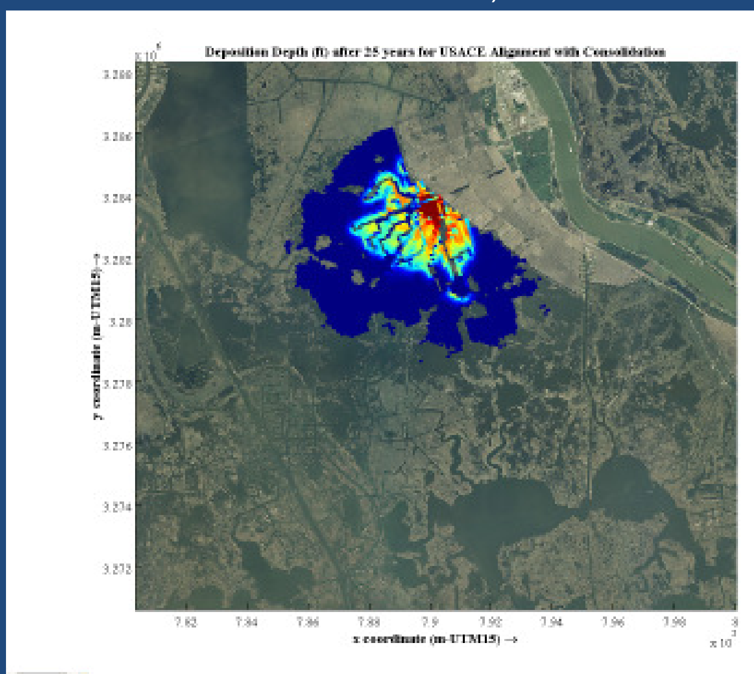
USACE Alignment (15,000 cfs)

	Sediment Volume (yd^3)
TOTAL	**7,857,352**

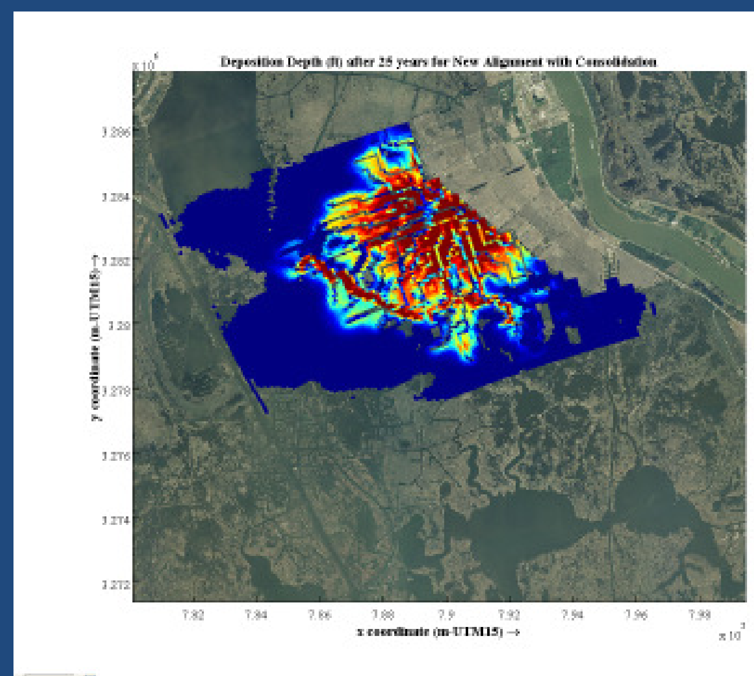
Modified Alignment (45,000 cfs)

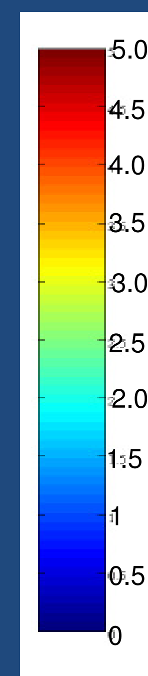
	Deposition Volume (yd^3)
TOTAL	**32,010,488**

Deposition Depth (ft) After 25 years for USACE Alignment (with Sediment Consolidation)



Deposition Depth (ft) After 25 years for New Alignment (with Sediment Consolidation)





Using good science as a foundation for future coastal restoration projects on the Gulf Coast put us in a better position to understand the effects of those project and allow us to avoid the problems experienced past