
Joseph “Wes” LeBlanc¹, Angelina Freeman¹, Mandy Green¹, Richard Raynie¹, Mead Allison², Melissa Baustian², Craig Colten², Ehab Meselhe², and Natalie Peyronnin³

¹Coastal Protection and Restoration Authority of Louisiana, ²The Water Institute of the Gulf, ³Environmental Defense Fund
Louisiana is Experiencing a Coastal Crisis

1,880 square miles lost since the 1930s

Currently losing over 16 square miles per year
We Know....

We Could Lose Up to 1,750 Square Miles of Land

Coastal Protection and Restoration Authority of Louisiana
Long History of Planning...

All include diversions
We know that diversions can increase the sustainability of marsh creation projects by supporting increased accretion and delivering nutrients to stimulate vegetation growth.
2012 Master Plan Diversion Considerations

- Considered three maximum discharge capacities: 5,000 cfs, 50,000 cfs, and 250,000 cfs, as well as larger use of the River (i.e., channel realignments).
- Other diversion sizes considered in a few cases where individual projects had already been planned in detail.
Keystone of the 2012 Master Plan: Reconnecting the River
# Diversions in the Master Plan

## Mississippi Sediment Diversions

<table>
<thead>
<tr>
<th>Diversion</th>
<th>Size</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Barataria Sediment Diversion*</td>
<td>Up to 75,000 cfs</td>
<td>Project Specific Planning (E&amp;D)</td>
</tr>
<tr>
<td>Mid-Breton Sediment Diversion*</td>
<td>Up to 35,000 cfs</td>
<td>Basin Level Planning</td>
</tr>
<tr>
<td>Lower Barataria Sediment Diversion</td>
<td>Up to 50,000 cfs</td>
<td>Basin Level Planning</td>
</tr>
<tr>
<td>Lower Breton Sediment Diversion</td>
<td>Up to 50,000 cfs</td>
<td>Basin Level Planning</td>
</tr>
<tr>
<td>Upper Breton Sediment Diversion</td>
<td>Up to 250,000 cfs</td>
<td>Not funded</td>
</tr>
<tr>
<td>Mid Barataria Sediment Diversion</td>
<td>Up to 250,000 cfs</td>
<td>2nd Implementation Period</td>
</tr>
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*Diversion capacities have been refined through the LCA projects Myrtle Grove and White’s Ditch:
- Mid-Barataria Sediment Diversion capacity has increased from 50,000 cfs in the 2012 Coastal Master Plan to 75,000 cfs to increase sediment capture ratios at the project site.
- Mid-Breton Sediment Diversion is considering operation 5,000 cfs and 35,000 cfs.
2012 MASTER PLAN
(Mississippi River Diversion Recommendations)

LOWER BRETON (50,000 cfs)
LOWER BARATARIA (50,000 cfs)
MID BRETON (5,000 cfs)
MID BARATARIA (50,000 cfs)
MID BARATARIA (250,000 cfs)
UPPER BRETON (250,000 cfs)

FEASIBILITY & ENGINEERING MODELING
(Site specific data collection and refined 2012 MP Models, river modeling, and localized Delft3D)

WINTER 2014
CPRA DECISION TO ADVANCE PARTICULAR ALTERNATIVES VIA VERIFICATION OF MASTER PLAN BENEFITS AND COSTS
(Land/Site/Size/Cost/Constructability)

PRELIMINARY DESIGN
(varying levels – LCA feasibility, 10%, 30%)

EXTERNAL TECHNICAL REVIEW
(Review/comparison of cost and design assumptions and constructability determination)

MR HYDRODYNAMIC & DELTA MANAGEMENT
(River and basin side modeling)

BASIN-WIDE INTEGRATED HYDRODYNAMIC, MORPHOLOGICAL & NUTRIENTS MODELING
(Analyze Sequencing and Operation of recommended suite of diversions)

ECOLOGICAL MODELING
(CASM and EwE coupling with Basin-Wide Delft3D and MRHDM AdH)

SOCIOECONOMIC EVALUATION
(Social, economic, and fisheries impacts – past/present/future)

DECEMBER 2016
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DATA SYNTHESIS/VISUALIZATION
(SSPM and Coastal Sustainability Studio)

FALL 2015
CPRA DECISION TO IMPLEMENT
(Advance to full engineering and design)

2017 MASTER PLAN
(Recommendations would be included as part of evaluation)

SWAMP
(Pre/post construction and coast-wide monitoring, adaptive management)

BASIN-WIDE INTEGRATED HYDRODYNAMIC, MORPHOLOGICAL & NUTRIENTS MODELING
(Analyze Sequencing and Operation of recommended suite of diversions)
Mississippi River Sediment Diversions: Process

2012 MASTER PLAN
(Mississippi River Diversion Recommendations)

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(50,000 cfs)

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(50,000 cfs)

MID BRETON
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MID BARATARIA
(50,000 cfs)

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(250,000 cfs)

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(250,000 cfs)

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Feasibility Modeling

Lower Barataria, Lower Breton, Mid Breton, and Mid Barataria

Tools Being Developed:

River Models
• 3D hydrodynamic and sediment transport (*Ehab Meselhe, The Water Institute of the Gulf*)
• Local and regional 3D hydrodynamic and morphological models (*Ehab Meselhe, The Water Institute of the Gulf*)

Basin-side Models
• Site-Specific Delft 3D morphological model using West Bay as an analogue (*Ehab Meselhe, The Water Institute of the Gulf*)

*All models runs will use site specific data (*Mead Allison, The Water Institute and Sam Bentley, LSU*)

What we will evaluate:

- Screening information for site selection:
  - Flow, nutrient and sediment load into the basin
  - Sediment/water ratios
  - Impacts to navigation
  - River morphology
  - Flood stage
  - Long-term assessment (~50 years)
  - Wetland building
  - Future projections of wetland vegetation
  - Guidance for engineering features to stimulate wetland development
  - Impacts to sediment delivery
  - Long term diversion performance
    - RSLR and subsidence
    - Effects on river morphology
Engineering Modeling

Mid Barataria

Tools Currently Being Utilized:

- Multi-Dimensional Models of River, Channel and Outfall
  - Delft 3D, Flow3D, HEC RAS (*Ehab Meselhe-Water Institute of the Gulf and HDR*)
- Ship simulation model (*Waterway Simulation Technology, HDR*)
- Lidar, Bathymetric, and Topographic Surveys (*Fugro Geospatial Services/John Chance Land Surveys*)
- Boring Logs, In situ and Lab Measurements, Geomorphic Assessments (*GeoEngineers and HDR*)
- Material Strengths, Design Loads, Soil Properties (*HDR*)
- Gate Hydraulic Models (*HDR*)

What we will evaluate:

- Site characteristics
- Channel size and location
- Channel dimensions
- Intake and outfall configuration
- Sediment to water ratio
- Sediment transport
- Flow characteristics
- Changes to water surface elevation in Mississippi River and Basin
- Effects on navigating ships
- Guide levees
- Tie-in structures
- Flood gates or back levee structures
- Impacts to rail and road
- Drainage Studies
Preliminary Engineering

Lower Breton, Lower Barataria, and Mid Breton

Lower Breton & Lower Barataria:
- Feasibility level design in progress
- Investigation of optimum siting with relation to costing
- 50,000 cfs structure
- Verification of Master Plan cost assumptions
- Constructability determination

Mid Breton:
- Feasibility level design completed (LCA White Ditch)
- Entered into a Design Agreement
  - Preliminary effort resulted in identification of optimal siting for sediment capture
- 35,000 cfs structure at a total cost of $387.6M
- Feasibility modeling to determine size and operation
Mid Barataria:
• 10+ years of planning
• 30% design and Value Engineering completed
• Preferred site of intake structure identified
• Structure ranging in size from 35,000-75,000 cfs
• Verification of Master Plan cost assumptions
• Determine ability to construct, operate and maintain
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Tool Development

River-Side (LCA – MR Hydro):
- One-Dimensional Model
  - HEC-6T (*Tony Thomas-Mobile Boundary Hydraulics, Ike Mayer and Mike Trawle-BCG*)
- Multi-Dimensional Models
  - AdH-SedLib Multi-D Model (*Gary Brown-USACE/ERDC*)
  - Delft 3D Multi-D Model (*Alex McCorquodale-UNO, Steve Ayres-USACE/MVN, and Ehab Meselhe-Water Institute of the Gulf*)
  - FVCOM Multi-D Model (*Ioannis Georgiou-UNO*)
  - Flow3D Multi-D Model (*Ehab Meselhe-Water Institute of the Gulf*)
- Geomorphic Assessment (*David Biedenharn-Biedenharn Group and Charlie Little-USACE/ERDC*)
- Data Collection (*Mead Allison-Water Institute of the Gulf and Thad Pratt-USACE/ERDC*)
- Data Management (*Christina Hunnicutt and Craig Conzelmann-USGS; Melany Larenas and Beth Forrest-CB&I*)

Basin-Side (LCA – MR Delta Management):
- Hydrodynamic, Sediment Transport, and Morphological Models
  - AdH (*Gary Brown-USACE/ERDC*)
  - Delft 3D (*Ehab Meselhe-Water Institute of the Gulf*) including:
    - Nutrient dynamics, Mophodynamic modules & Soils component
- Ecological Models
  - EwE w/ Trosim (*Kim DeMustert-GMU*)
  - CASM (*Chris Wallen and Shaye Sable-Dynamic Solutions*)
- Small Scale Physical Model (*Cecil Soileau-BCG/Dewberry Joint Venture and Alden Research Laboratory*)

LMR Diversion Planning:
- Social Impact Assessment, including economics (*Stephen Barnes-LSU; Nick Burger- RAND; Craig Colten-Water Institute of the Gulf; Jeff Carney-LSU CSS*)
Basin-Wide Model Development (Delft 3D)

Model Domain of Integrated Hydrodynamic, Morphological, and Nutrient Dynamics

**Outcome Indicators:** Water level, velocity, salinity, water temperature, suspended sediment, sediment deposition, sediment erosion, bed-level changes, aboveground and belowground biomass, wetland vegetation type (7 species), nitrogen, phosphorous, silicate, chlorophyll-\(a\), dissolved oxygen
Basin-Wide Model Development (Delft 3D)

Project-Specific Mid-Barataria

Model Development: Moffatt & Nichol and The Water Institute of the Gulf
Fisheries Modeling/Studies

Following recommended dual model approach (Sable and Rose, 2013)

1. Improved Habitat Suitability Indices (HSIs)
   • Develop polynomial regressions that relate fish and shellfish abundance to key environmental variables

2. Development of a community-level food web model
   • Evaluate how food web dynamics affect species response to change in environmental conditions, and show changes in species biomass over time

Outcome Indicators: Fish and shellfish habitat quality, food web responses over time, changes in species biomass over time, changes in species distribution over time
Habitat Suitability Index (HSI) Models

**IMPROVEMENTS UNDERWAY**
- Oyster
- Largemouth Bass
- Alligator
- Waterfowl (Mottled Duck, Green-Winged Teal, Gadwall)
- Crawfish
- Brown and White Shrimp
- Speckled Trout

**NEW**
- Blue Crab
- Gulf Menhaden
- Bay Anchovy
- Blue Catfish
- Brown Pelican

**NO IMPROVEMENTS PLANNED**
- Other Coastal Wildlife (Roseate Spoonbill, Muskrat and Otter)

Improved HSIs being developed for 2017 Master Plan using existing Louisiana Department of Wildlife and Fisheries field data

Experts engaged include Buddy Clarian, Paul Leberg, Robert Romaine, Hardin Waddle, Meg O’Connell and Shaye Sable
Food Web Models

• EcoPath and EcoSim and EcoSpace (EwE)
  – Longer temporal scales
  – Trophic Simulation Model (TroSim) to capture lower tropic levels / oysters
    • Short temporal scale (daily)
    • Feed into EwE model
  – 2017 Master Plan integration will provide environmental inputs
    • Predict monthly biomass and distribution changes over 1 km² grid over 50 years
  – MRHDMS Study
    • Will have capability to integrate with both Basin-Wide and AdH models
    • Spatially and temporally more refined environmental inputs
    • Predictions over 50 years

• Comprehensive Aquatic Systems Model (CASM)
  – Shorter temporal scales
  – MRHDMS Study
    • Will have capability to integrate with both Basin-Wide and AdH models
    • Predictions over 50 years
SOCIO-ECONOMIC ANALYSIS

[Past - Present - Future]

GOALS: Further analyze the potential effects to communities, fisheries, and the economy from continued land loss and the implementation of sediment diversion projects recommended in the 2012 Coastal Master Plan.

SCALE: Regional

TIMEFRAME:

<table>
<thead>
<tr>
<th>Phase 1</th>
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<tr>
<td>Historic Coastal Atlas</td>
</tr>
<tr>
<td>LSU/RAND Economic Study</td>
</tr>
<tr>
<td>Diversion Feasibility Modeling</td>
</tr>
<tr>
<td>Socio-Economic Analysis</td>
</tr>
</tbody>
</table>

<p>| 2014 |</p>
<table>
<thead>
<tr>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
</tr>
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<p>| 2015 |</p>
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<tr>
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</tbody>
</table>

| 2016 |
|---|---|---|---|
| | | | |
The Historic Coastal Atlas
[past-present]


- Examine past trends (1950-2010) at parish level.

- Examine current trends (1990-2010) at census block level.

Areas Investigated:

- **Storm/flood events** affecting coastal parishes (1950-2010)

- **Long-term shifts** - industry, fisheries, agriculture, housing values, and jobs

- **Population and employment** - past trends including demographic analysis such as race, population density, elderly

- **Recovery factors** - population return, percent of vacant homes, and unemployment rates

- **Fisheries history** - trip tickets, landings, distance traveled to fishing grounds

Scale: Coastal Louisiana
### Economics of Coastal Land Loss

**[future without action]**

- Monitizes the direct, indirect, and induced economic costs of storms and coastal erosion in Louisiana.
- Explores far-reaching fiscal impact on the State of Louisiana, other states, and the nation.
- Sums the value of economic activities and replacement costs of infrastructure that will be affected by coastal land loss or increased storm risk.
- Quantifies impacts in terms of output, employment, and wages.

### Areas Investigated:

#### Homes & Businesses
- Housing stock
- Historic districts
- Private businesses
- Shopping centers

#### Institutions
- Schools
- Hospitals
- Community facilities
- Government & military

#### Fisheries Habitat
- Coastal fishing/harvesting areas
- Offshore fisheries habitat areas

#### Infrastructure
- Transportation
- Water/wastewater/drainage
- Oil & gas (on/off shore, extraction, production, transportation)
- Gasoline prices

#### Ecosystem Services
- Freshwater availability
- Flood control
- Carbon sequestration
- Wildlife habitat
- Clean Water Act credits

#### Recreation
- Recreational fishing
- Tourism/eco-tourism
- National/state parks
- Historic sites

#### Future Growth
- Currently undeveloped land suitable for future homes & businesses

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Scale: Coastal Louisiana, Gulf, & Nation
Coastal Protection and Restoration Authority of Louisiana

**Diversion Modeling**

*future with projects*

- Examines sediment diversion impacts on land building and fisheries.
- Compares a “Future Without Action” to a “Future With Projects” over next 50 years.
- Investigate impacts on land building and maintenance, flood risk, fisheries' abundance and distribution, and other coastal habitats.

**Effects of Sediment Diversion Projects**

- WATER & SALINITY LEVELS
- LAND BUILDING
- HABITATS
- FISHERIES ABUNDANCE & DISTRIBUTION

Scale: Local

LCA
MISSISSIPPI RIVER
HYDRODYNAMIC & DELTA MANAGEMENT STUDY
Mississippi River Sediment Diversions: Process

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Diversion Path Forward

Three Outcomes:

1) Engineering and Design
2) Construction
3) Not Feasible

How do we achieve goals?
Questions?