Borrow Area Management and Monitoring (BAMM) Program for Coastal Restoration in Louisiana

Syed M. Khalil\textsuperscript{1}, Ed Haywood\textsuperscript{1}, Jeff Andrews\textsuperscript{2}, Beth Forrest\textsuperscript{2}, Carrie Sonders\textsuperscript{2}, & Melany Larenas\textsuperscript{2}

\textsuperscript{1} CPRA and \textsuperscript{2} CB&I

State of the Coast Conference
New Orleans, LA
19\textsuperscript{th} March 2014
Background

1. An important component of Louisiana Sediment Management Plan (LASMP)

2. As borrow areas (inland/nearshore, river and offshore) are not routinely monitored, BAMM is a first attempt to monitor and manage

3. BAMM will help us understand:
   • **Physical characteristics** such as “Infilling Rate”, pit-slope gradient, and sediment transport regime
   • **Water quality** such as potential development of hypoxic conditions in the borrow areas and its relationship to dredge depth
   • **Environmental impacts** such as how borrow area design affects wave heights and energy of the surrounding environment

4. BAMM will also help us by providing a scientific basis to influence the numerous restrictions and/or regulations that govern the use of borrow areas

5. Management of borrow areas help optimize use of sediment for protection and restoration
Land Loss vs. Accommodation

*Land loss (1932 - 2010)*

- Land loss: \(~4877 \text{ km}^2 (~1883 \text{ mi}^2)\)
- Accommodation: \(~2.9 \text{ BCM} (~3.83 \text{ BCY})\)

**Moderate Scenario**

- Land loss (2010 - 2060): \(~1994 \text{ km}^2 (~770 \text{ mi}^2)\)
- Accommodation: \(~1.2 \text{ BCM} (~1.7 \text{ BCY})\)

**Less Optimistic Scenario**

- Land loss (2010 - 2060): \(~4532 \text{ km}^2 (~1750 \text{ mi}^2)\)
- Accommodation: \(~2.7 \text{ BCM} (~3.5 \text{ BCY})\)

* Morton et al., 2010
BAMM Tasks:

1. **Inventory** of existing nearshore, offshore and riverine borrow areas

2. **Physical characteristics**
   - Geophysical and geotechnical data collection and analysis
     - Data collection within select borrow areas
     - Push Core collection to characterize sediment characteristics of select borrow areas

3. **Water quality**
   - Hypoxia Monitoring to identify hypoxic conditions within select dredge areas

4. **Environmental impacts**
   - Model Development
     - Evaluate physical impacts of select borrow areas (Delft3d, Delft3d-FLOW and SWAN)
## BAMM - Summary Table

<table>
<thead>
<tr>
<th>Borrow Area</th>
<th>Location</th>
<th>Survey</th>
<th>Hypoxia</th>
<th>Push Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Marsh Island</td>
<td>Inland</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Lake Mechant</td>
<td>Inland</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>West Lake Boudreaux</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Little Lake</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Goose Point</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Barataria Basin Landbridge BA1</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Barataria Basin Landbridge BA2</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Barataria Basin Landbridge BA3</td>
<td>Inland</td>
<td>✅</td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>New Cut</td>
<td>Offshore</td>
<td></td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>West Belle Pass Sand BA</td>
<td>Offshore</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Belle Pass Marsh BA</td>
<td>Offshore</td>
<td></td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>West Grand Terre (WGT BA-C)</td>
<td>Offshore</td>
<td></td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>Sandy Point</td>
<td>Offshore</td>
<td></td>
<td></td>
<td>✅</td>
</tr>
</tbody>
</table>
East Marsh Island-Post Construction Bathymetry

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-construction max. cut elevation</td>
<td>-24.2 ft NAVD88</td>
</tr>
<tr>
<td>Original seafloor elevation</td>
<td>-10 ft NAVD88</td>
</tr>
<tr>
<td>Maximum cut depth</td>
<td>14.2 ft</td>
</tr>
</tbody>
</table>
East Marsh Island-2013 BAMM Bathymetry

Survey Dates: May 24-25, 2013
Line Miles: 26.9
Survey Spacing: 250 ft
Depth Range: -9 ft to -13 ft
## East Marsh Island-Infilling

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infilling</td>
<td>• Approximately 2,986,000 cubic yards</td>
</tr>
<tr>
<td></td>
<td>• 7.0 ft on average</td>
</tr>
<tr>
<td></td>
<td>• Range: 0-12.7 ft</td>
</tr>
<tr>
<td></td>
<td>• 3.5 feet/year</td>
</tr>
</tbody>
</table>

Coastal Protection and Restoration Authority of Louisiana
East Marsh Island-Hypoxia

Dissolved Oxygen - June-October 2013

East Marsh Island

Sonde Depths:
Control -8.0 ft
BA -13.2 ft

Note: Gaps in data due to inability to retrieve Sonde
Lake Mechant-Post Construction Bathymetry

Post-construction max. cut elevation: -16 ft NAVD88
Original seafloor elevation: -7 ft NAVD88
Maximum cut depth: 9 ft

Notes:
2. Vertical control for post-construction data is unknown. Post-construction data were shifted down 0.5 feet to meet 2013 CB&I data at areas of no expected change.
3. Post-construction elevations were provided by CPRA. Data were collected in August 2009.
Survey Dates: May 25-26, 2013
Line Miles: 31.3
Survey Spacing: 250 ft
Depth Range: -4 ft to -12 ft
## Lake Mechant-Infilling

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infilling</td>
<td>• Approximately 1,222,000 cubic yards</td>
</tr>
<tr>
<td></td>
<td>• 1.3 ft on average</td>
</tr>
<tr>
<td></td>
<td>• Range: 0-7.4 ft</td>
</tr>
<tr>
<td></td>
<td>• 0.3 feet/year</td>
</tr>
</tbody>
</table>
Lake Mechant-Hypoxia

Dissolved Oxygen - June-October 2013
Lake Mechant

Sonde Depths:
- Control -6.0 ft
- BA -11.7 ft

Note: Gaps in data due to inability to retrieve Sonde.
Goose Point-Post Construction Bathymetry

Post-construction max. cut elevation: -23 ft NAVD88
Original seafloor elevation: -14 ft NAVD88
Maximum cut depth: 9 ft

Notes:
1. Coordinates are in feet based on the Louisiana State Plane Coordinate System, South Zone, North American Datum of 1993 (NAD 93).
2. Vertical control for post-construction data is unknown.
3. Post-construction elevations were provided by CPRA. Data were collected in August, 2009.

Legend:
- Push Core
- Sonde
- Sonde Control
- 2009 Post-Construction Bathymetry
- PO-33 Goose Point Borrow Area

Coastal Planning & Engineering, Inc.
A CB&I Company
3411 N. W. BOCA RATON BOULEVARD
BOCA RATON, FL 33431
Tel (954) 392-9189
Fax (954) 392-9199

Figure No. 1

Date: 12/03/09 By OR Comm No: 140568
Goose Point-2013 BAMM Bathymetry

Survey Dates: May 12, 2013
Line Miles: 10
Survey Spacing: 250 ft
Depth Range: -13 ft to -20 ft
Goose Point-Difference Map

**Notes:**
1. Coordinates are in feet based on the Louisiana State Plane Coordinate System, South Zone, North American Datum of 1993 (NAD 93).
2. Elevation difference in feet.
3. Bathymetry were collected by CB&I in May 2013.
4. Post-construction data provided by SPFRA.
5. 2013 elevations were tide corrected and in feet based on the North American Vertical Datum of 1988 (NAVD88).

**Legend:**
- Push Core
- Sondes
- Sondes Control
- Change in Bathymetry
  - > 5
  - 2.5 - 5
  - 1 - 2.5
  - < 1
  - 2.5 - 1
  - < - 2.5

**Title:** Borrow Area Mgt. and Monitoring 2013 Goose Point Difference
Task | Details
--- | ---
Infilling | • Approximately 401,000 cubic yards
| • 1.6 ft on average
| • Range: 0-5.3 ft
| • 0.3 ft/year
## Goose Point-Push Cores

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
</table>
| Push Cores| • Collected July 21, 2013  
• Penetrated 4.6 ft and recovered 3.3 ft of material  
• Three layers of material were identified  
• 0.0-2.8 ft: mostly very dark gray clay (5Y-3/1)  
• 2.9-3.1 ft: dark gray clay (5Y-4/1) with little organics  
• 3.1-3.3 ft: grey clay (5Y-6/1) |
Barataria Basin Landbridge

- Goose Point
- West Lake
- Boudreaux
- West Grand Terre
- Sandy Point
- New Cut
- West Belle Pass
- Lake Mechent
- East Marsh Island
Barataria-Post Construction Bathymetry

Post-construction max. cut elevation: -22.5 ft NAVD88
Original seafloor elevation: -9 ft NAVD88
Maximum cut depth: 13.5 ft

2010
Post-Construction Bathymetry
Survey Dates: May 13-16, 2013
Line Miles: 66.7
Survey Spacing: 250 ft
Depth Range: -4 ft to -13 ft
Barataria-Difference Map

[Detailed map and legend with notes on coordinates and bathymetric changes]
### Barataria Basin Landbridge-Infilling

#### Task Details

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infilling</td>
<td><img src="image_url" alt="Image" /></td>
</tr>
</tbody>
</table>
|         | • Approximately 3,248,000 cubic yards  
         | • 2 ft on average  
         | • Range: 0-13.7 ft  
         | • 0.7 ft/year |
Dissolved Oxygen - June-October 2013
Barataria Land Bridge

Sonde Depths:
Control -5.5 ft
BA -11.6 ft
# Barataria Basin Landbridge-Push Cores

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push Cores</td>
<td>• Collected July 17, 2013</td>
</tr>
<tr>
<td></td>
<td>• Penetrated 5.0 ft and recovered 2.8 ft of material</td>
</tr>
<tr>
<td></td>
<td>• Field vane shear test indicated the material to be very soft clay</td>
</tr>
<tr>
<td></td>
<td>• One layer identified as very soft and very dark grey clay (5Y-3/1)</td>
</tr>
<tr>
<td></td>
<td>with little organics</td>
</tr>
</tbody>
</table>

Coastal Protection and Restoration Authority of Louisiana
Coastal Protection and Restoration Authority of Louisiana

West Belle Pass

- Goose Point
- Barataria Basin
- Little Lake
- West Lake
- Boudreaux
- West Grand Terre
- Sandy Point
- East Marsh Island
- Lake Mechaint
- New Cut
- West Belle Pass
West Belle Pass-Post Construction Bathymetry

<table>
<thead>
<tr>
<th>Post-construction max. cut elevation</th>
<th>-50.9 ft NAVD88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original seafloor elevation</td>
<td>-30 ft NAVD88</td>
</tr>
<tr>
<td>Maximum cut depth</td>
<td>20.9 ft</td>
</tr>
</tbody>
</table>

2012 Post-Construction Bathymetry
West Belle Pass-2013 BAMM Bathymetry

Survey Dates: June 12-13, 2013
Survey Spacing: 250 ft
Depth Range: -32 ft to -44 ft
## West Belle Pass-Infilling

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infilling</td>
<td>• Approximately 104,000 cubic yards</td>
</tr>
<tr>
<td></td>
<td>• 1.4 ft on average</td>
</tr>
<tr>
<td></td>
<td>• Range: 0-12.6 ft</td>
</tr>
<tr>
<td></td>
<td>• 1.4 ft/year</td>
</tr>
</tbody>
</table>
Dissolved Oxygen - June-October 2013
West Belle Pass Marsh

Sonde Depths:
Control -31.2 ft
BA -42.7 ft

Note: Gaps in data due to inability to retrieve Sonde
Sandy Point-Post Construction Bathymetry

<table>
<thead>
<tr>
<th>Post-construction max. cut elevation</th>
<th>-76.7 ft NAVD88</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original seafloor elevation</td>
<td>-35 ft NAVD88</td>
</tr>
<tr>
<td>Maximum cut depth</td>
<td>41.7 ft</td>
</tr>
</tbody>
</table>

2012 Post-Construction Bathymetry

Notes:
2. Vertical control for post-construction data is unknown. Post-construction data were shifted down 1 foot to meet 2013 CPE data at areas of no expected change.
3. Post-construction elevations were provided by CPRA. Data were collected in November, 2012.
Sandy Point-2013 BAMM Bathymetry

Survey Dates: June 11, 2013
Survey Spacing: 250 ft
Depth Range: -38 ft to -71 ft
Coastal Protection and Restoration Authority of Louisiana

Sandy Point - Infilling

Task Details
- Approximately 201,000 cubic yards
- 1.4 ft on average
- Range: 0-12.5 ft
- 1.4 ft/year

Potential Maximum Dredge Elevation
Sandy Point-Hypoxia

Dissolved Oxygen - June-October 2013
Sandy Point

Sonde Depths:
Control - 37.1 ft
BA - 71.2 ft

DO (mg/L)


Coastal Protection and Restoration Authority of Louisiana
Physical Characteristics

1. Infilling rate

<table>
<thead>
<tr>
<th>Location</th>
<th>Years Between Post-Construction Survey and CB&amp;I Survey</th>
<th>Average Infill Thickness (ft)</th>
<th>Infilling Rate (ft/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Marsh Island</td>
<td>2</td>
<td>7</td>
<td>3.5</td>
</tr>
<tr>
<td>Lake Mechant</td>
<td>4</td>
<td>1.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Goose Point</td>
<td>5</td>
<td>1.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Barataria Landbridge</td>
<td>3</td>
<td>2.0</td>
<td>0.7</td>
</tr>
<tr>
<td>West Belle Pass</td>
<td>1</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Sandy Point</td>
<td>1</td>
<td>1.4</td>
<td>1.4</td>
</tr>
</tbody>
</table>
### Physical Characteristics

2. Sediment characteristics from push cores

<table>
<thead>
<tr>
<th>Borrow Area</th>
<th>Penetration (ft)</th>
<th>Recovery (ft)</th>
<th>Sediment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barataria Basin Landbridge (BLPC-13-01)</td>
<td>5.0</td>
<td>2.8</td>
<td>Very soft, dark gray clay (5Y-3/1) with little organic material</td>
</tr>
<tr>
<td>Little Lake (LLPC-13-01)</td>
<td>5.0</td>
<td>2.1</td>
<td>Soft, dark gray clay (5Y-3/1) with little organic material</td>
</tr>
<tr>
<td>West Lake Boudreaux (LBPC-13-01)</td>
<td>5.0</td>
<td>2.7</td>
<td>Very soft, dark gray clay (5Y-3/1) with little organic material</td>
</tr>
<tr>
<td>Goose Point (GPPC-13-01)</td>
<td>4.6</td>
<td>3.3</td>
<td>From 0.0 ft to 2.98 ft the material was mostly a very soft, very dark gray (5Y-3/1) clay with little organics. From 2.9 ft to 3.1 ft, the material was very soft, dark gray clay (5Y-4/1) with little organics. From 3.1 ft to 3.3 ft, material was grey (5Y-6/1) clay.</td>
</tr>
</tbody>
</table>
Preliminary Conclusions
Bottom-Water Dissolved Oxygen across Louisiana Shelf

Annual Shelfwide Cruise: July 21-28, 2013

Bottom-water dissolved oxygen across the Louisiana shelf from July 22-28, 2013

Data source: N.N. Rabalais, Louisiana Universities Marine Consortium, R.E. Turner, Louisiana State University
Funded by: NOAA, Center for Sponsored Coastal Ocean Research
Preliminary Conclusions

Water Quality

1. Red stars represent areas where dredging may have some influence on DO levels. It is important however, to consider the size of these borrow areas relative to surrounding open water.

2. Nearshore/Lakes
   1. Lake Mechant-Where data was available, the change in bathymetry following dredging activities did decrease dissolved oxygen levels in the borrow area, but they only reached hypoxic levels for brief periods of time spread throughout the observation period.
   2. Goose Point-Based on the data collected during the observation period, hypoxia was likely caused by the dredging in the borrow area, but recovery did occur relatively quickly to levels similar to the control area.
   3. East Marsh Island-Insufficient information to conclude that the dredging in East Marsh Island had any effect on the existence, persistence, or degree of hypoxia in the borrow area, although where oxygen levels were decreased nearing hypoxic conditions, they were only measured briefly and recovered quickly to levels similar to the control area.
   4. Barataria Landbridge-The change in bathymetry following dredging activities did not influence the existence, persistence, or degree of hypoxia.

3. Offshore
   1. Sandy Point- dredging did increase hypoxia and anoxia in the borrow area, but the control area also exhibited significant and persistent occurrences of hypoxia. This area is also close to the larger Gulf hypoxic zone.
   2. West Belle Pass – It is difficult to say that the change in bathymetry following dredging activities did or did not influence the existence, persistence, or degree of hypoxia. This area is also close to the larger Gulf hypoxic zone.
Preliminary Conclusions

Environmental impacts - ongoing

Modeling to analyze and evaluate potential adverse impacts to wave climate and hydrodynamics due to dredging of large inland borrow areas.
Preliminary Conclusions

Environmental impacts - ongoing

Lake Pontchartrain
Lake Borgne
Timbalier & Terrebonne Bays
## Summary

<table>
<thead>
<tr>
<th>Location</th>
<th>Max. Cut Depth (ft)</th>
<th>Average Infill Thickness (ft)</th>
<th>Infilling Rate (ft/yr)</th>
<th>Hypoxia attributed to dredging (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Marsh Island</td>
<td>14.2</td>
<td>7</td>
<td>3.5</td>
<td>N</td>
</tr>
<tr>
<td>Lake Mechant</td>
<td>9</td>
<td>1.3</td>
<td>0.3</td>
<td>Y</td>
</tr>
<tr>
<td>Goose Point</td>
<td>9</td>
<td>1.6</td>
<td>0.3</td>
<td>Y</td>
</tr>
<tr>
<td>Barataria Landbridge</td>
<td>13.5</td>
<td>2.0</td>
<td>0.7</td>
<td>N</td>
</tr>
<tr>
<td>West Belle Pass</td>
<td>20.9</td>
<td>1.4</td>
<td>1.4</td>
<td>N</td>
</tr>
<tr>
<td>Sandy Point</td>
<td>41.7</td>
<td>1.4</td>
<td>1.4</td>
<td>Y</td>
</tr>
</tbody>
</table>
Questions ???

Funding for this study was provided by the Coastal Impact Assistance Program (CIAP).