Mid-Breton Sediment Diversion (MBrSD) Assessment – Final Report

Project Personnel

Jerry D. Wiggert, PhD
Professor & Associate Director, School of Ocean Science and Engineering
The University of Southern Mississippi

Brandy N. Armstrong
Research Scientist, School of Ocean Science and Engineering
The University of Southern Mississippi

Mustafa Kemal Cambazoglu, PhD
Assistant Professor, School of Ocean Science and Engineering
The University of Southern Mississippi

K. K. Sandeep, PhD
Research Associate, School of Ocean Science and Engineering
The University of Southern Mississippi

Acknowledgements

The authors express their appreciation for the feedback and suggestions from the internal review group at The University of Southern Mississippi (Drs. Kim de Mutsert, Read Hendon, Kelly Lucas and Scott Milroy). We also appreciate the efforts of the Mississippi-Alabama Sea Grant Consortium in arranging for three anonymous external reviews, whose critical assessment served to significantly improve this report. The overall guidance of Dr. Paul Mickle and assistance of the staff at the Northern Gulf Institute, in report formatting and logistics, facilitation of the peer-review process, and review of this final report is gratefully recognized. The authors also acknowledge HPC at The University of Southern Mississippi supported by the National Science Foundation under the Major Research Instrumentation (MRI) program via Grant # ACI 1626217. This research and reporting effort was supported by MDMR Tidelands Grant # FY20-M648-32 and GOMESA Grant # 3000030947.

Full Report Citation:

Wiggert, J. D., B. N. Armstrong, M. K. Cambazoglu, and K. K. Sandeep (2022), Mid-Breton Sediment Diversion (MBrSD) Assessment - Final Report, 96 pp, The University of Southern Mississippi, DOI pending approval for public release.

Executive Summary

The Mississippi Department of Marine Resources (MDMR) tasked ocean scientists and engineers at the University of Southern Mississippi (USM) with developing an assessment of potential environmental impacts to Mississippi jurisdictional waters and resources from the Mid-Breton Sediment Diversion (MBrSD), proposed by the Louisiana Coastal Protection and Restoration Authority (CPRA). The MDMR requested this assessment to guide its response to this proposed action.

Louisiana has the highest rate of wetlands loss in the country. The MBrSD seeks to build new wetlands by reconnecting the linkage that would allow deltaic sediment to be deposited into the Breton Sound Basin (in the Western Mississippi Bight) using an engineered diversion designed to deliver up to 75,000 cubic feet per second (cfs) of sediment-laden Mississippi River freshwater.

Concern about the proposed MBrSD stems from impacts to Mississippi waters and resources – particularly decreased salinity and oyster mortality – experienced from previous freshwater diversions, such as when the Bonnet Carré Spillway (BCS) opened twice in 2019 (to reduce flooding in downstream Louisiana communities) and in 2011.

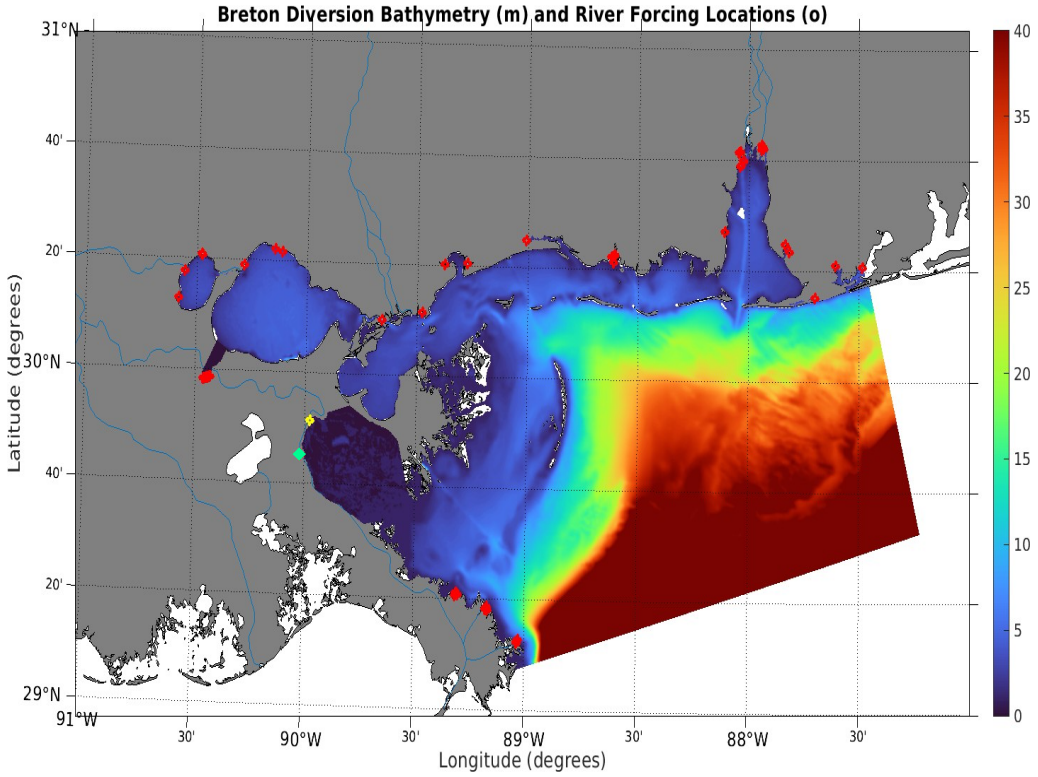

Figure E1. The USM ocean modeling system applied to assess potential impacts from the Mid-Breton Sound Diversion accounts for coastal water depth (bathymetry) in meters (see color legend) and freshwater inflows from surrounding rivers and the Bonnet Carré Spillway (red diamonds). Data from the USGS gauge station at Belle Chasse (yellow diamond) is the basis for inputs of MS River water at the Mid-Breton Sediment Diversion (green diamond) and along the Birdfoot Delta (red diamonds).

The USM team applied their detailed physical modeling system, driven by realistic atmospheric conditions and river inflows (Figure E1), to address the question that MDMR asked: *How would this inflow of freshwater into the Western Mississippi Bight affect the well-being of the aquatic ecosystems of the Western and Central Mississippi Sound?*

The USM team's assessment focused on oyster reefs in the Mississippi Sound because they are key ecological health indicators and economic drivers for the State of Mississippi and their survival is jeopardized during extended periods of very low bottom salinity conditions. The USM ocean modeling system provides bottom salinity distributions at high temporal (hourly) and spatial (400m) resolution, making it well-suited to reveal how the introduction of the proposed MBrSD will impact these critical oyster reef communities.

The MDMR requested that the ocean modeling experiments include three scenarios:

1) A climatological MBrSD discharge scenario based on the 11-year average Mississippi River hydrograph, to assess the impact of this diversion under typical conditions. This climatological scenario serves as a representative state for the Mississippi Sound and Bight.

2) A scenario, based on 2019 conditions, that incorporated both the impact of that year's double opening of the Bonnet Carré Spillway (BCS) and a variable MBrSD discharge based on the 2019 Mississippi River hydrograph, to assess the relative and combined impacts of the BCS and MBrSD.

3) A continuous maximum design flow of the MBrSD discharge (75,000 cfs; flowing 24/7 for 9 months), to assess the impact on Mississippi coastal waters of the MBrSD operating at full capacity in concert with the 2019 spring freshet.

To isolate the influence of the MBrSD within these three diversion scenarios, numerical model experiments were performed with and without the MBrSD included, revealing the net influence of the MBrSD.

To characterize whether bottom salinity conditions provide a healthy environment for oysters, maps were generated depicting the difference in total (cumulative) number of days of low bottom salinity (S<5 ppt, the critical ecological threshold for oyster health and survival) from January to September for each scenario when the MBrSD is active (Figure E2):

- For scenario 1, the model projects a significant increase in cumulative days of S<5 within the Western and Central Mississippi Sound when the MBrSD is active. A notable increase in cumulative days is also indicated in eastern Mobile Bay.
- For scenarios 2 and 3, the model reveals mixed results of minor increases and decreases throughout the Mississippi Sound, indicating that the MBrSD did not further degrade the already low bottom salinity conditions in place during this extremely atypical year.

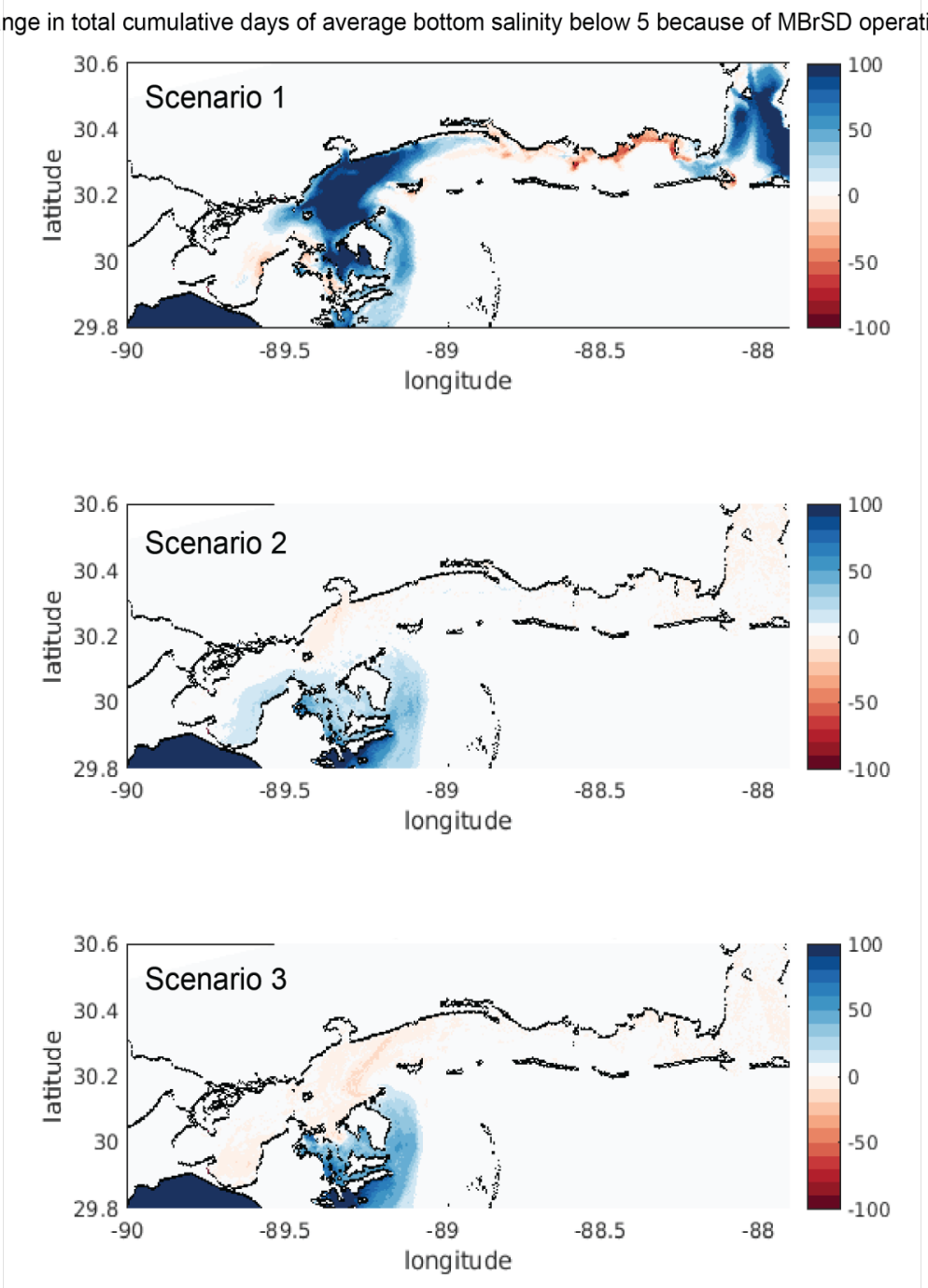

Figure E2. Maps of the difference in total cumulative days (over January – September) where average bottom salinity is below 5 ppt, with and without active Mid-Breton Sound Diversion (MBrSD) for the three scenarios described above. When the MBrSD is active, the positive values (blue, fresher water) indicate there are more cumulative days when salinity is below 5 ppt, and the negative values (red, saltier water) indicate there are less cumulative days when salinity is below 5 ppt.

In summary, overall key findings (from Scenario 1) include:

- During elevated freshwater influx of the spring freshet, combined with the dominant prevailing wind direction, additional freshwater flowing into Western Mississippi Sound from an activated MBrSD is projected to shift bottom salinities below the critical ecological threshold for oyster health and survival over the January – June timeframe.
- The Western and Central Mississippi Sound regions are projected to experience a significant increase in the number of cumulative days when salinity levels are below the critical ecological threshold for oyster health and survival. A notable increase in cumulative days of low salinity levels is also indicated in eastern Mobile Bay.

Based on these overall findings, the following recommendations are offered with the assumption that the MBrSD will be a gated / controllable structure:

- To avoid causing salinity conditions to be pushed beyond a tipping point that adversely and possibly permanently affect the ecosystem services provided by key species residing in Mississippi jurisdictional waters, exercise caution if a full opening of the MBrSD is being considered during high river discharge, especially during BCS openings.
- Conduct short-term near real-time forecast modeling, currently in development, to assess risks based on relevant weather and riverine conditions as the timing and flow level of a freshwater diversion are key factors that affect impacts on Mississippi jurisdictional waters. Surface wind plays a key role in influencing whether freshwater becomes trapped in the nearshore or is flushed out to the shelf and broader Northern Gulf of Mexico region.