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MYRTLE GROVE DELTA BUILDING DIVERSION: NUMERICAL MODELING OF HYDRODYNAMICS AND SEDIMENT TRANSPORT IN LOWER MISSISSIPPI NEAR MYRTLE GROVE RIVER BEND

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The Mississippi River Delta of south Louisiana, USA, is a highly engineered system with extensive levees, flood control structures, and diversions. This region is experiencing a high rate of coastal wetland loss. Solutions to recover or re-direct a portion of the Mississippi River's sediment to benefit Louisiana's coast are currently being considered, and there is great interest to analyze the impact and feasibility of sediment diversions. As such, there is a need to examine the optimum location, size, and design of these land-building diversions. Three-dimensional numerical modeling of hydrodynamics and sediment transport was used to analyze a 6.7 mile reach of the Mississippi River, encompassing the proposed location of a sediment diversion near Myrtle Grove, Louisiana. The model domain extends from RM 56.0 to RM 63.2 above the Head of Passes.

The three-dimensional model used in this study, FLOW3D, solved the full Navier-Stokes equations. FLOW3D is capable of capturing complex geometries found in the Mississippi River, resolving free surface variations, accounting for turbulence, and modeling sediment transport. Re-circulation eddies and secondary circulation patterns were evaluated and are in good agreement with typical conditions (Fig. 1). The model was calibrated and validated against local ADCP velocity measurements and suspended sediment discrete sampling over the water column and across the channel width.

The model was used to assess the performance of various diversion alignments and sizes including: two alignments (Original and Modified Alignment), two intake locations, and three diversion capacities (15,000, 45,000, and 75,000 cfs). The Original Alignment was developed by the US Army Corps of Engineers to divert a maximum of 15,000 cfs when the Mississippi River discharges 1,000,000 cfs. The Modified Alignment was proposed to increase the diversion's ability to capture sediment and improve the sediment-waste ratio. All three diversion capacities and the inclusion of an earthen dike were examined for the Modified Alignment.

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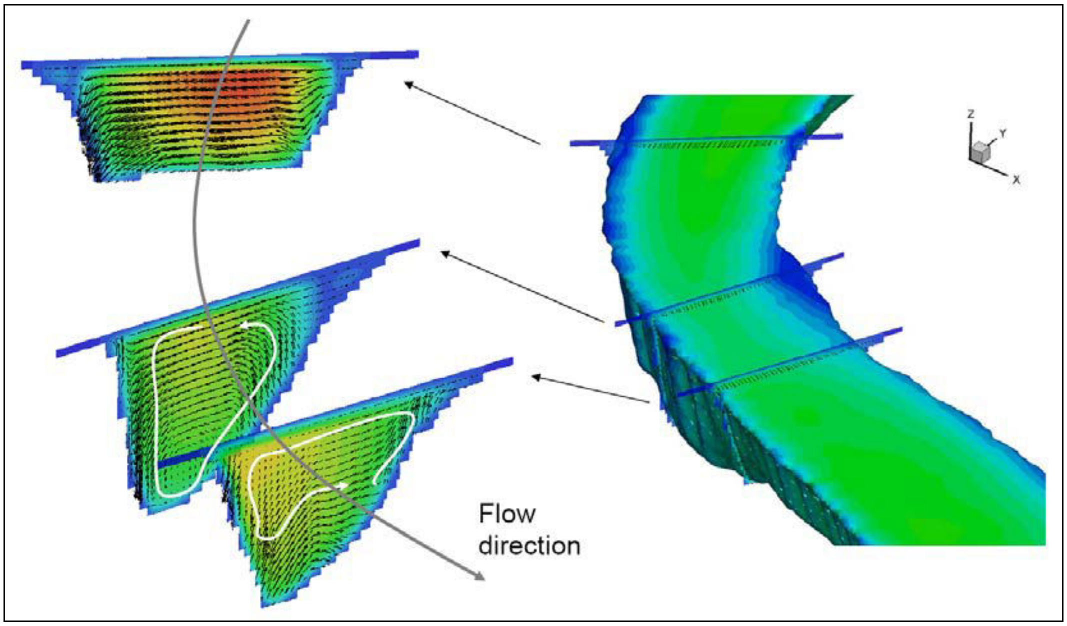

Figure 1 Mississippi River Model Derived Velocity Magnitude (Color) and Direction (Vector) Showing Secondary Circulation at the Meander Bend near Myrtle Grove

The numerical model results showed that the location and size of the intake structure as well as the size and alignment of the diversion channel are critical parameters affecting the sediment-water ratio captured by the diversion. The analysis showed that locating the intake over a lateral sand-bar increases the sediment-water ratio in the diversion. Further, the analysis showed that a larger diversion channel with a favorable alignment orientation in the flow direction of the river results in higher sediment-water ratio. It was observed that the dike component of the Modified Alignment design had an adverse effect on the flow field in the river (large eddy and potential sediment buildup on the downstream side). Thus, the dike was removed and the performance of the diversion was tested without it. The results indicated that the dike does not enhance the performance of the diversion significantly, and it was detrimental for some of the larger sediment size classes. The results from this river model provided water discharge and sediment load to a bay-side morphological model (Delft-3D). The sediment load was provided for each sediment size class separately, and the Delft-3D model was used to quantify the land building potential.