

Salinity Impacts of Conceptual Designs of the Lake Borgne Surge Barrier of the Lake Borgne Surge Barrier on the Gulf Intracoastal Waterway

Conceptual Design Alternatives

The conceptual design alternatives were developed in two phases. In the first phase, four surge barrier systems (A thru D) were simulated using the numerical model. The results of the design simulations was compared back to the existing condition/base simulation. Based upon the results of that testing, two of the four systems were selected for year-long simulation testing in Phase 2. In Phase 2, the base condition was altered to include a closure of the MRGO at La Loutre Ridge. This closure was a result of the deauthorization of the MRGO. The alternatives tested in Phase 2 are:

System A

- 150 foot by 16 foot (sill) one way sail thru structure on the GIWW located just east of the Michoud Canal (A3)
- 56 foot by 8 foot (sill) structure on Bayou Bienvenue (A2)
- MRGO closed just South of Bayou Bienvenue (A1)

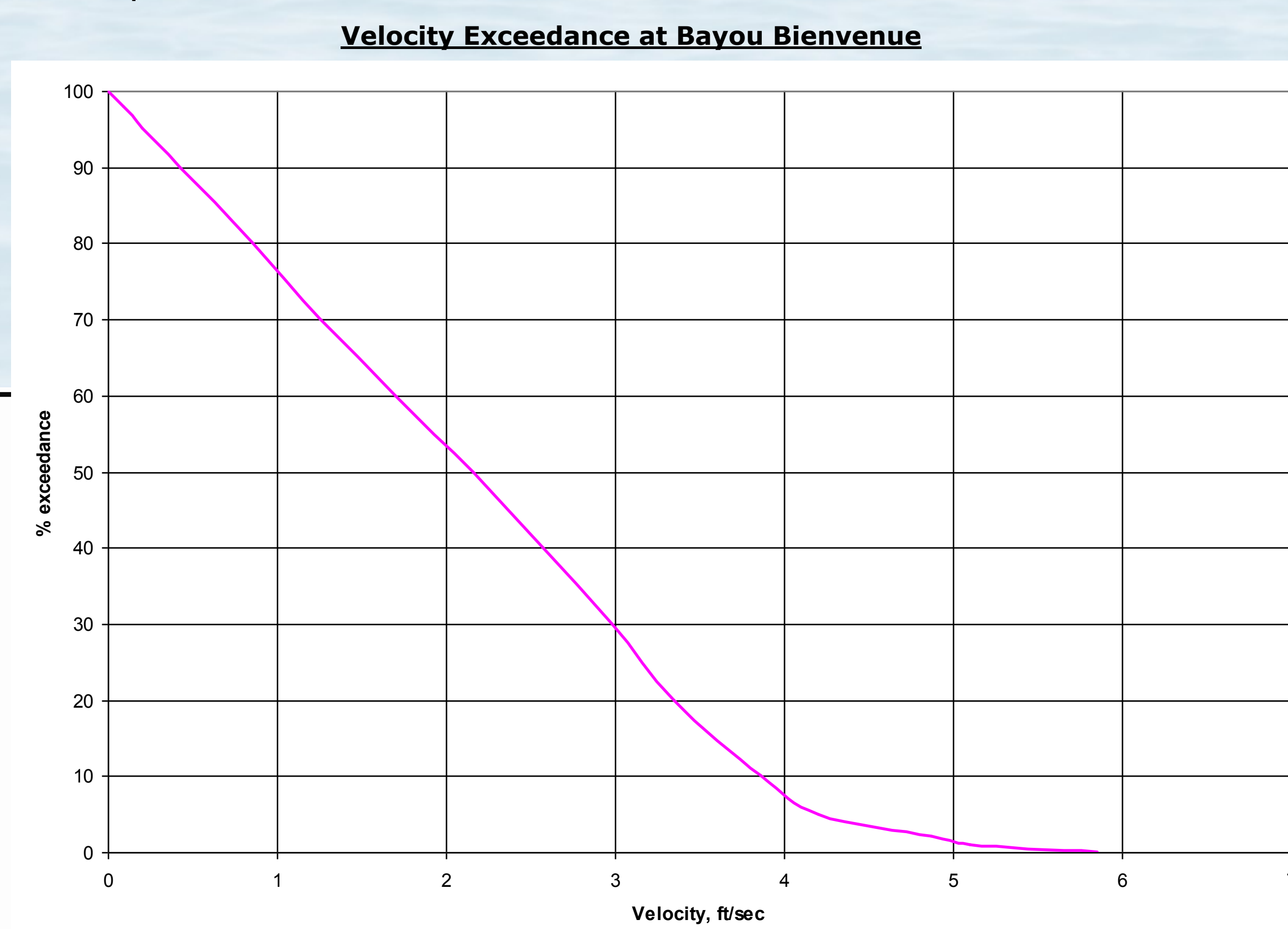
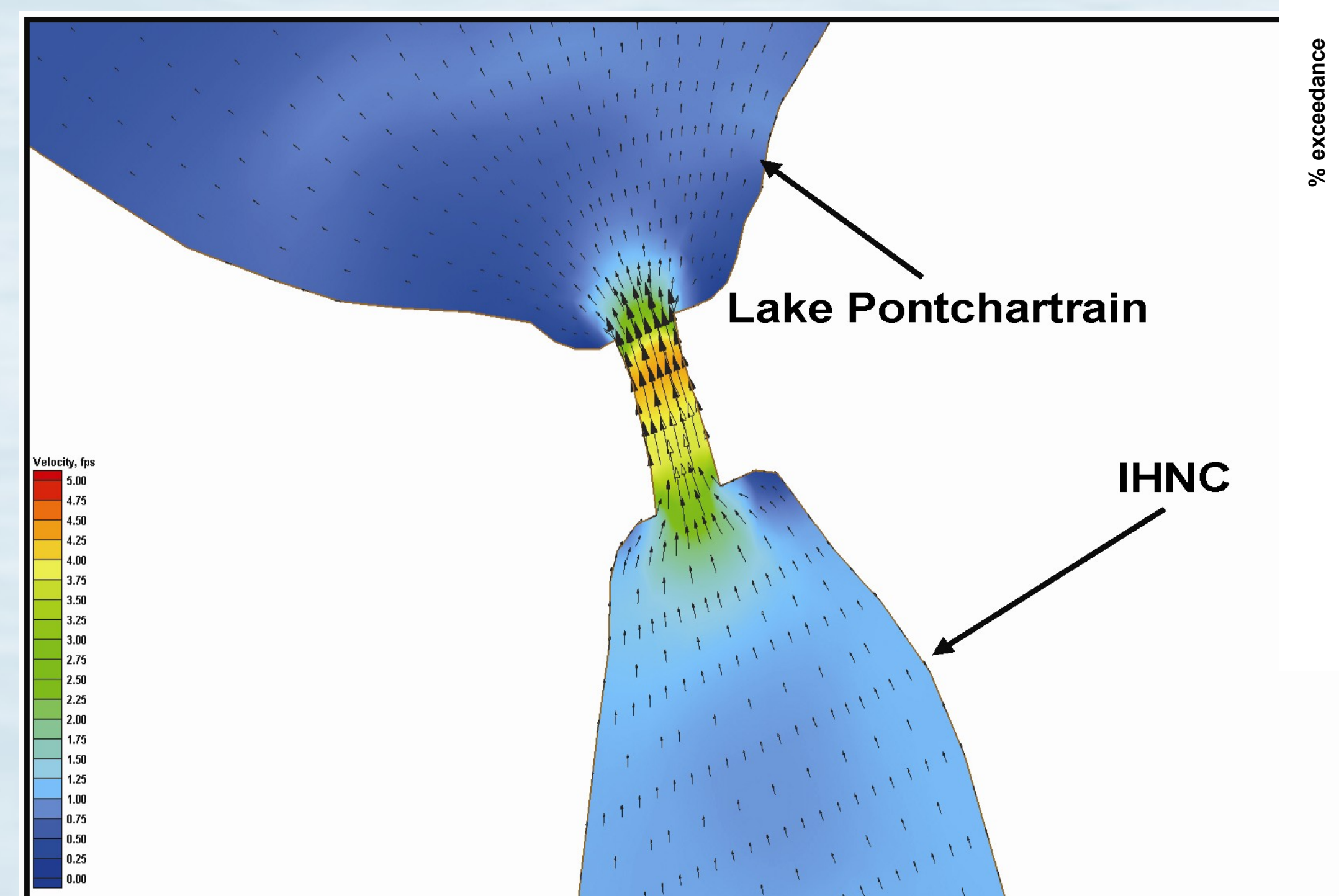
System C

- 350 foot by 40 foot (sill) one way sail thru structure on the GIWW just west of the GIWW/MRGO confluence (C1)

In Phase 2, the individual aspects of each system were tested by adding them incrementally to the base condition with the la Loutre closure. This yielded three simulations for system A and one for System C. An additional simulation was added to each system (A4 and C2) by constricting the IHNC at its entrance to Lake Pontchartrain (Seabrook). The constriction at Seabrook was used to simulate a proposed gate structure at Seabrook. The model simulations were run with a 3 month spin-up period to allow the salinity values to reach an equilibrium. The simulations then proceeded for a full year.

Velocity Results

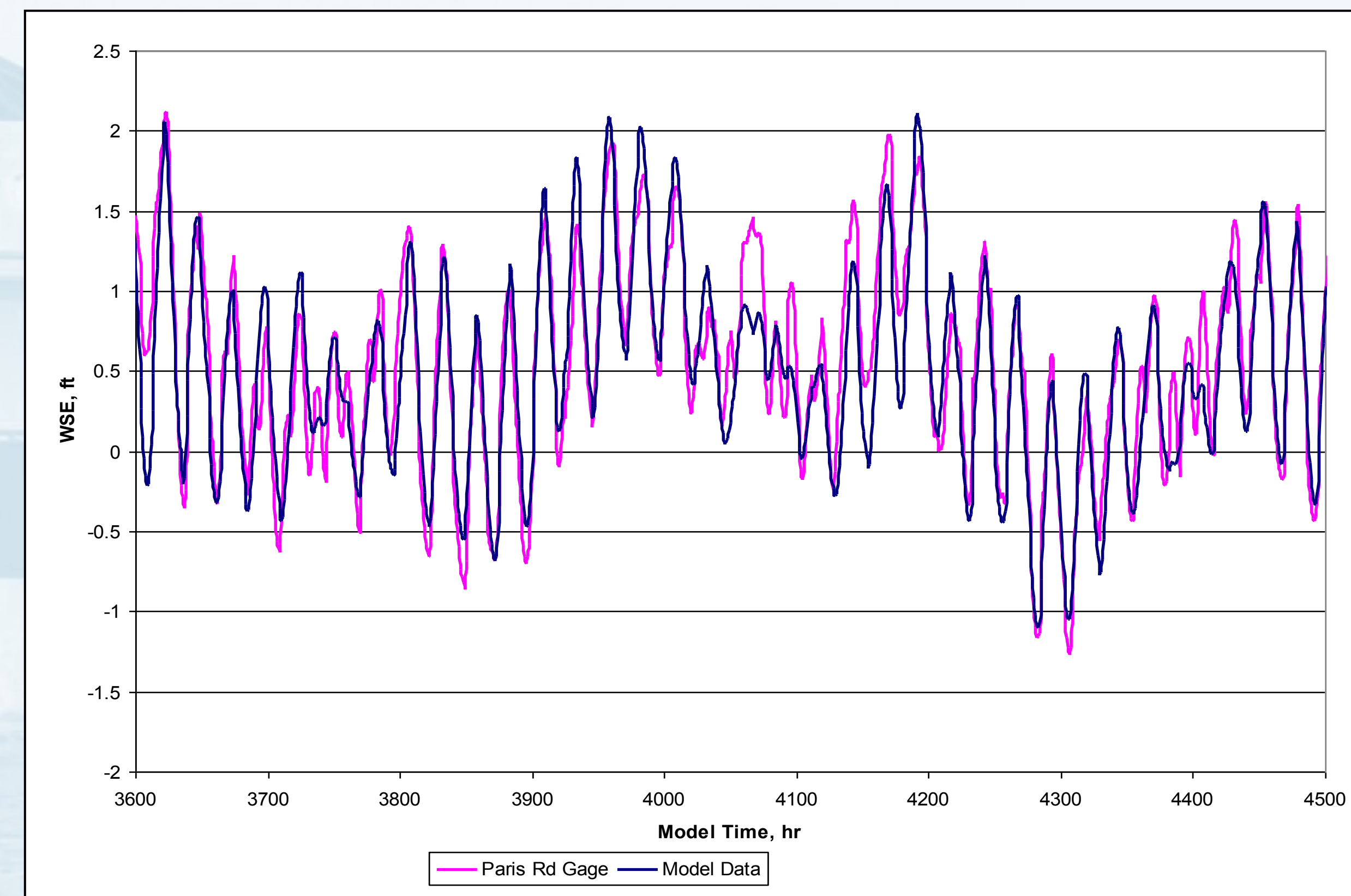
As the base conditions for Phase 1 and Phase 2 differed, a comparison of the two conditions was necessary to assess the impact of closing MRGO at la Loutre Ridge. The closure of MRGO resulted in 20-25% decreases in velocity in the GIWW, the MRGO and most of the IHNC. A 50% decrease was observed in IHNC at Seabrook. The impacts of the various designs were seen in velocity increases in the vicinity of the proposed structures. These increases rapidly diminish as distance from the structure increases. However, Systems A3 and A4 produced a maximum velocity in the Bayou Bienvenue structure of ~5.9 ft/sec. This velocity was of particular concern to environmental stakeholders as velocities over 2.6 ft/sec adversely affect fish movement. However, this proved to be a low frequency event. And upon further analysis this velocity was found to coincide with a high wind event.



Background

Conceptual designs of the Lake Borgne Surge Barrier were developed for the purpose of protecting the city of New Orleans under the guidance of the United States Army Corps of Engineers (USACE) Hurricane Protection Office (HPO). A numerical model study was undertaken in determining the impact of these designs on salinity and current velocities in the Lake Pontchartrain Area. The hydrodynamic/salinity transport modeling was performed using a 3D finite element modeling code. The model simulated flow and salinity characteristics at seven points in the water column in the study area which included the Mississippi River-Gulf Outlet (MRGO), the Gulf Intracoastal Waterway (GIWW), the Inner Harbor Navigation Canal (IHNC), and Lakes Pontchartrain and Borgne. The MRGO is a 66-mile-long deepwater channel that extends northwest from deep water in the Gulf of Mexico to New Orleans, LA. The MRGO merges with the GIWW and continues five miles further to the West where it joins the Inner Harbor Navigation Canal (IHNC). The IHNC proceeds approximately three more miles north from its intersection with the GIWW to connect with Lake Pontchartrain at Seabrook. The section of the GIWW that is of interest for this project extends southwest approximately 20 miles from its connection with Lake Borgne to its confluence with the MRGO.

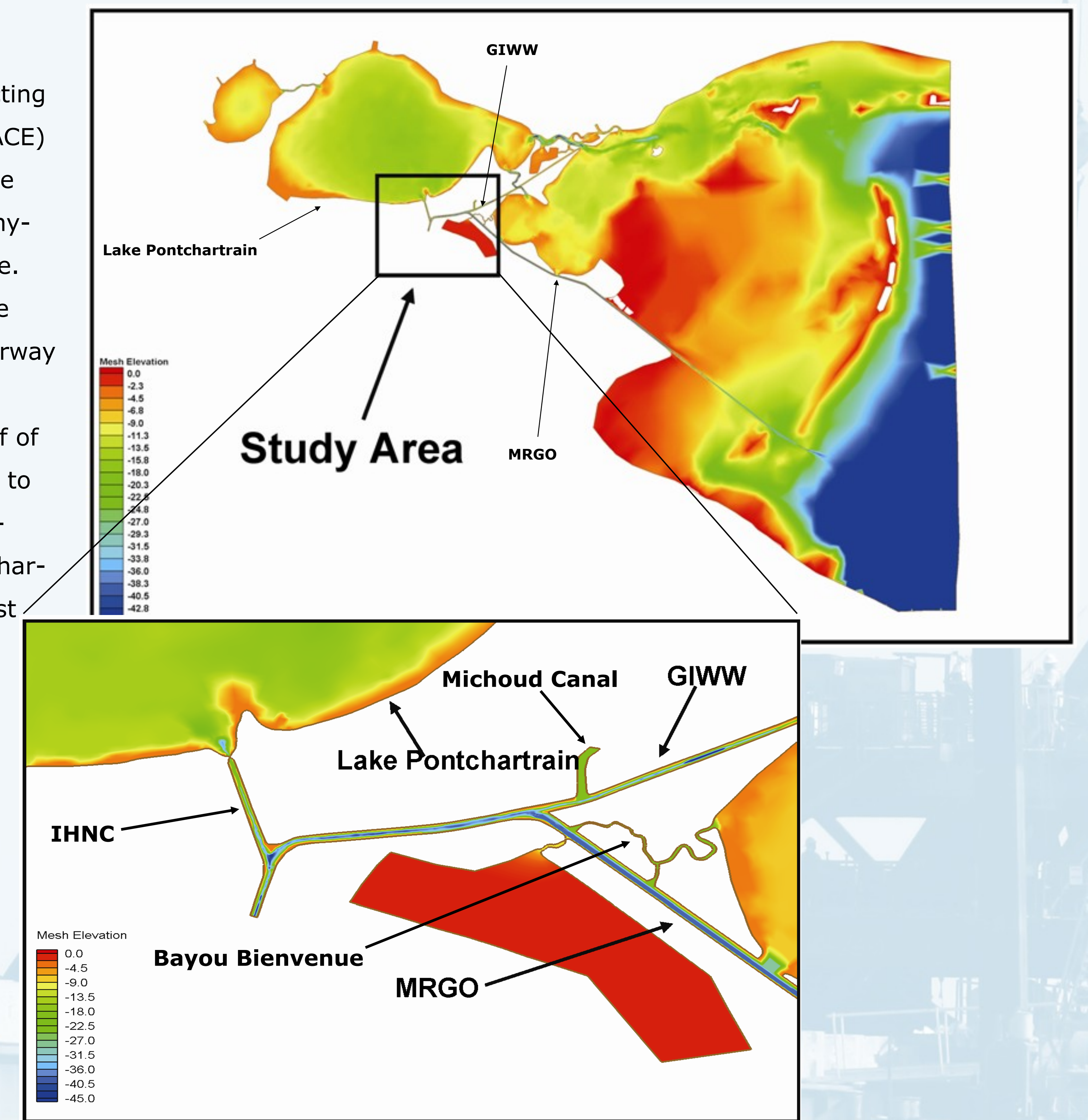
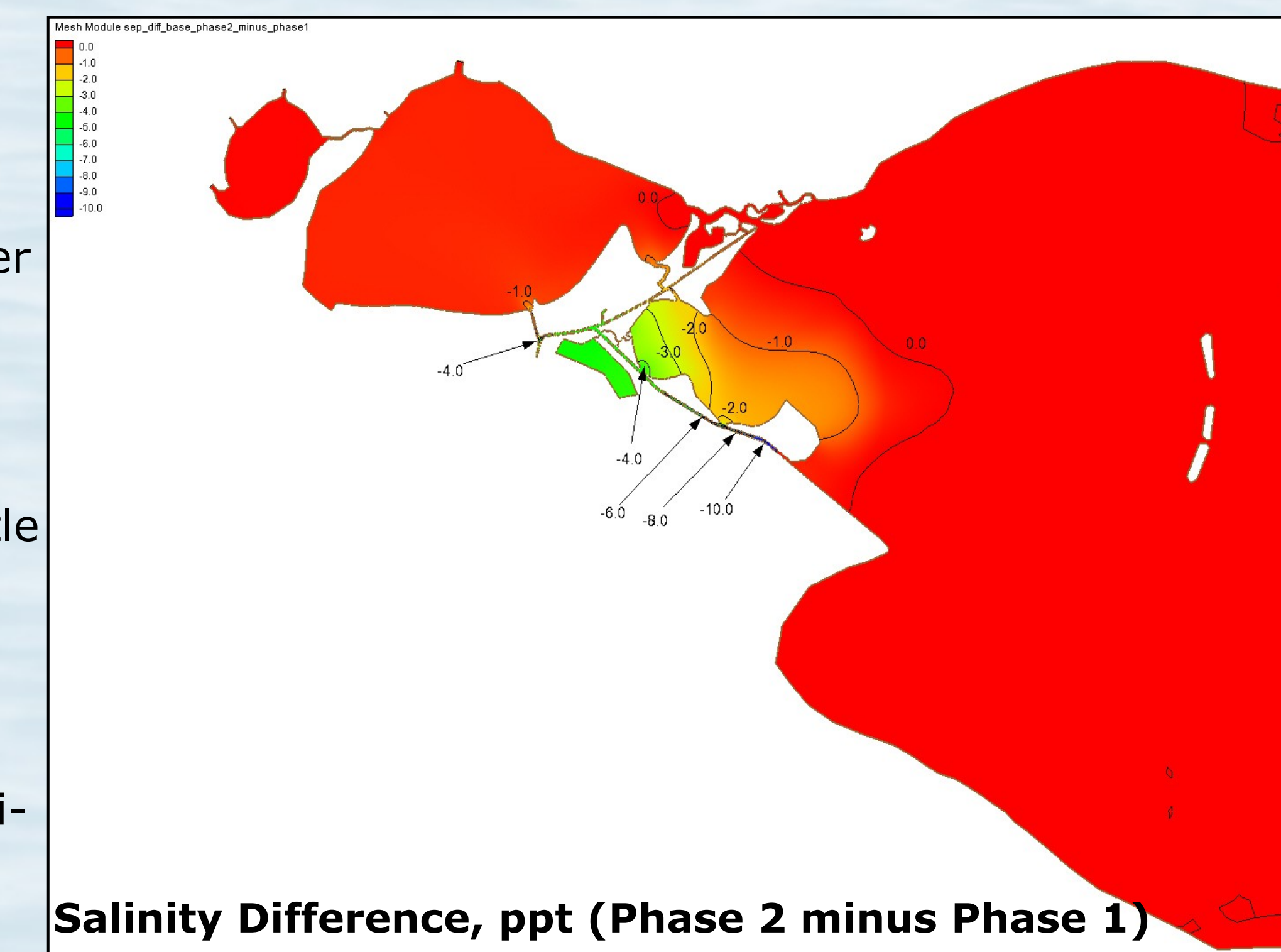
Boundary Conditions and Model Validation



Boundary conditions for river inflow, tidal forcings, and wind conditions were Developed from 2006 data. This year was chosen to ensure that changes to the system, resulting from the passage of Hurricane Katrina were taken into account. The model was verified to water surface elevation data at the Paris Rd gage, the Lake Pontchartrain at West End gages, and several other gages in the system. Also, a comparison of average monthly discharge measurements through the IHNC for the March 2006 timeframe showed reasonable agreement.

Salinity Results

Base to plan comparisons weremade between monthly average salinity values for March 2006 and September 2006. All salinity values used in the analysis were from the bottom layer of the water column. All of the designs in the Phase 2 salinity modeling produced salinity decreases in the MRGO and GIWW on the order of 0.1-2.0 ppt with the with largest decreases occurring during the dryer month of September 2006. Lakes Borgne and Pontchartrain showed little to no change in salinity when the designs were implemented. A comparison of the Phase 1 and Phase 2 base conditions demonstrated that the la Loutre Ridge closure of the MRGO actually produced the largest decreases in salinity.



Conclusions

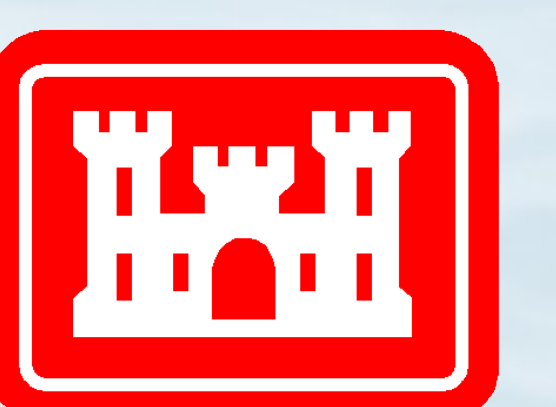
The surface velocities in the MRGO and GIWW did increase in the immediate vicinity of the sail thru structures. However, the surface velocities decreased back to pre-project levels at distances from the structure of approximately twice the width of the structure. Velocities in the structures themselves were significantly higher than the base condition for Systems A3, A4, C1, and C2. In the Bayou Bienvenue structure, the maximum velocity exceeded the 2.6 ft/sec threshold for fish movement, but analyses showed this event to be a low frequency event which would most likely occur under spring tidal conditions that are exacerbated by passage of weather fronts. Phase 2 designs showed small changes in bottom salinity values over the base condition. The largest decrease in bottom salinity was due to the implementation of the MRGO closure at la Loutre Ridge for the Phase 2 base condition. Most areas experienced a 2-4 ppt drop in bottom salinity with the region just north of the closure showing an ~10 ppt decrease. Lake Pontchartrain showed little to no difference between Phase 1 and Phase 2 base condition.

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