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I-10 Mobile River Bridge and Bayway Project - Storm Surge Impact Analysis Level 3

Addendum 1 – Storm Surge Current Velocity Analysis

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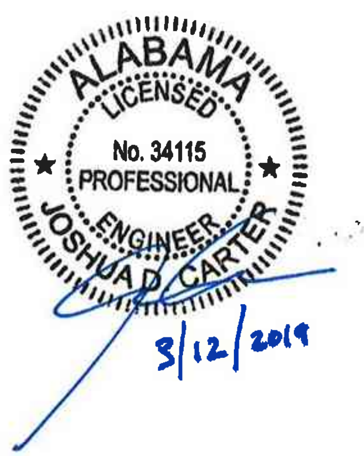

Contents

1 Velocity Analysis

This addendum extends the results of the I-10 Mobile River Bridge and Bayway (MBBB) Project - Storm Surge Impact Analysis Level 3 work conducted by Mott MacDonald (2018). Level 3 analysis provides accurate and robust results associated with environmental conditions and forces from tropical storms and hurricanes on the existing Bayway bridge with the goal of facilitating the design of the bridge to mitigate damage from these forces.

Level 3 method employs a probabilistic framework to encompass the range of possible variations in the storm conditions. This probabilistic framework, called the JPM-OS (Joint Probability Method with Optimal Sampling), provides a method to quantify the statistics of the input storm parameters and output conditions (waves, forces) that provide an accurate level of risk associated with the resulting environmental condition and forces. MBBB Level 3 analysis involves the modeling of a set of 80 synthetic storms using the dynamically coupled wind-surge-wave model. The set of 80 unique storm events are developed based on five different fundamental parameters: storm landfall location, central pressure difference, radius, forward velocity, and storm heading. Each storm is assigned a unique probability based on empirical data derived from the 5 fundamental parameters near Mobile Bay (FEMA, 2013). The model results of the Level 3 analysis were used to compute extremal wave heights and storm surge at the project site.

The work described in this addendum utilizes the same data and statistical methods described in I-10 Mobile River Bridge and Bayway Project - Storm Surge Impact Analysis Level 3 report (Mott MacDonald, 2018) to provide storm-surge generated velocities. The results do not include fluvial velocities generated from rainfall and runoff. Level 3 analysis provides the greatest reduction in uncertainty and accounts for probability in an objective manner.

1.1 Maximum Storm Surge Current Velocities

Following the I-10 Mobile River Bridge and Bayway Project - Storm Surge Impact Analysis Level 3 (Mott MacDonald, 2018) results, the resulting depth averaged velocities were output at each point in the model domain for all 80 synthetic storms. No velocity vertical profiles were evaluated in this study; the results provided are depth averaged current velocities. These velocity data points were then fit to the JPM-OS probability distribution. This allowed developing the current velocity as a function of return period. These velocity data points represent storm-surge generated velocities only; the data points do not include fluvial velocities generated from rainfall and runoff.

JPM-OS Statistical analysis was conducted for several return periods. However, this addendum provides the results associated with the 100-yr event only. Extremal depth average storm surge velocity results were developed for the following scenarios:

- 0 year Sea Level Rise (2017), 100-yr event velocity
- 100 year Sea Level Rise (2117), 100-yr event velocity

In order to determine the maximum storm surge depth average velocity, Mott MacDonald compared the 0-year Sea Level Rise (SLR) (2017) and 100-year SLR (2117) results for the 100-yr event. Differences between the 0 year SLR (2017) and 100 year SLR (2117) results were noted. Figure 1-1 shows a difference map illustrating the change in the 100-yr storm surge current velocity from the 2017 to 2117 conditions.

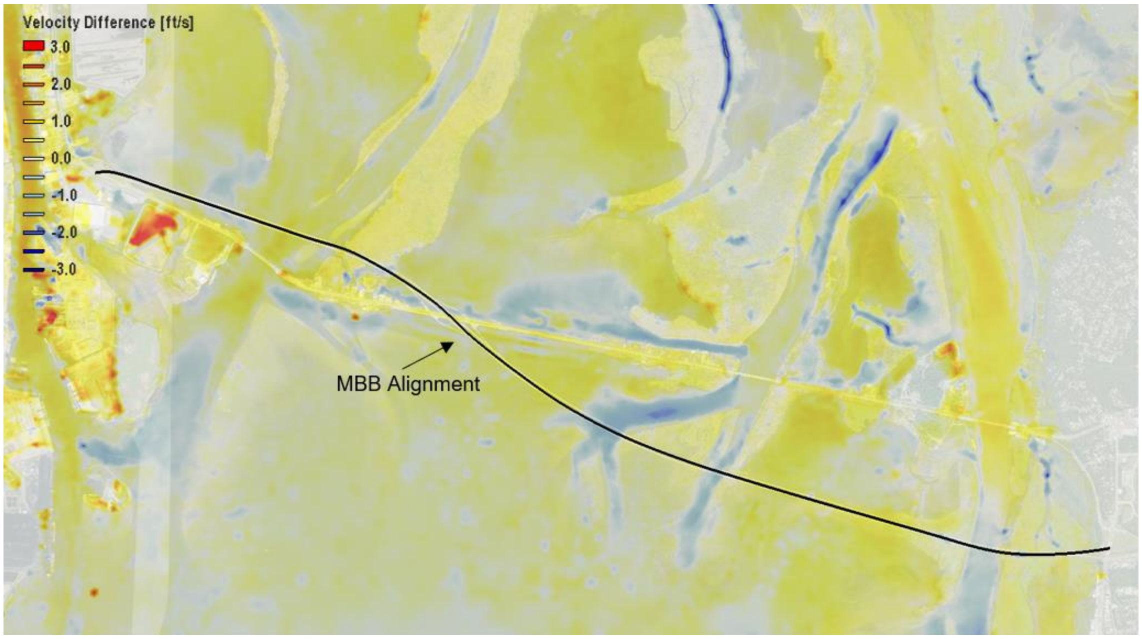

Figure 1-1. Storm surge velocity difference for 100-yr return period case between 0 year SLR (2017) and 100 year SLR (2117) results. Note that the figure shows the 100 year SLR (2117) minus 0 year SLR (2017) results

Two trends are noted along the Mobile River Bridge Alignment. First, in shallower areas of Tensaw, Apalachee, and Blakeley rivers secondary branched channels shown in Figure 1-1, storm surge velocity appears to decrease under future conditions; this is likely attributed to greater depths associated to SLR causing lower velocities. Second, in the main channelized areas of the rivers, storm surge velocities are shown to increase with SLR.

To determine the maximum storm surge velocity at each extraction point along the existing Bayway bridge and the proposed cable stay bridge, the maximum storm surge current velocity between the 0 year (2017) and the 100 year (2117) SLR results was taken. This maximum storm surge velocity is referred to as the composite storm surge velocity and should be used for further design calculations. The composite storm surge velocity results are reported in a Digital Appendix A. Figure 1-2 shows the composite storm surge velocity results for the 100-yr return period event on Mobile Bay Bayway alignment.

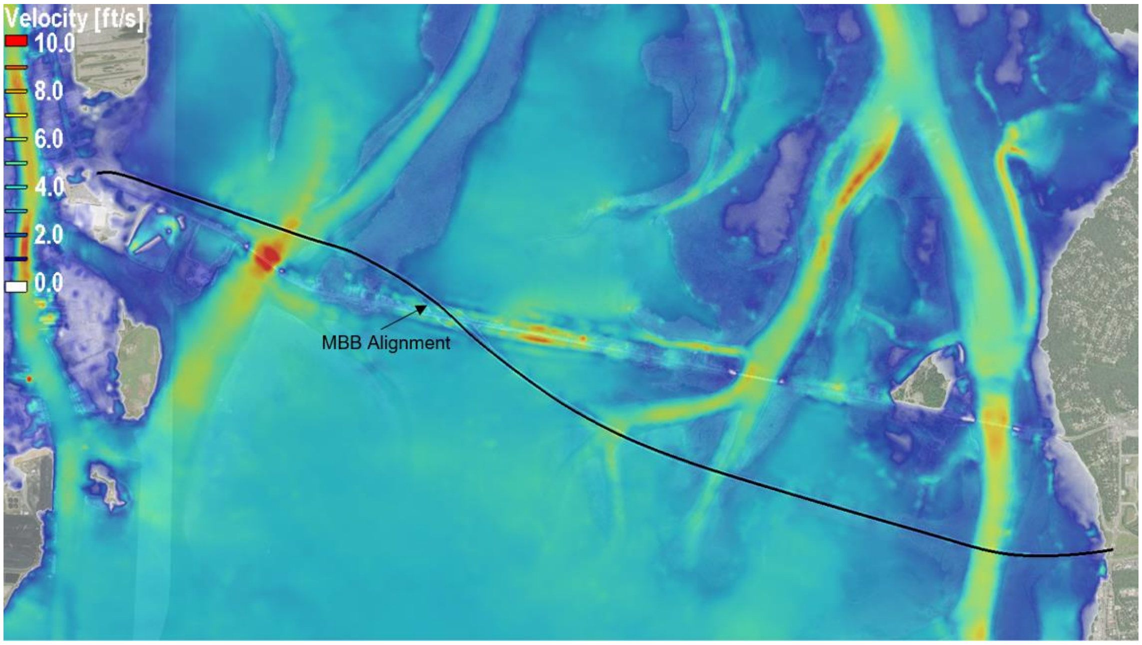

Figure 1-2. 100-year depth averaged composite storm surge velocity results at Mobile Bay Bayway and Mobile River Bridge project site.

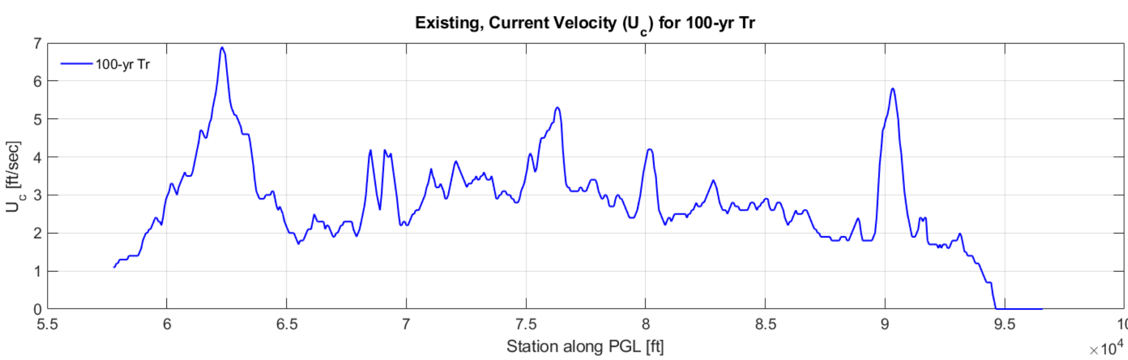

Figure 1-3. 100-year depth averaged composite storm surge velocity results along existing Mobile Bay Bayway

2 References

FEMA. (2013). *Flood Insurance Study: Florida Panhandle and Alabama, Recurrence Interval Analysis of Coastal Storm Surge Levels.* FEMA.

Mott MacDonald. (2018). *I-10 Mobile River Bridge and Bayway Project - Storm Surge Impact Analysis Level 3.* Mobile: Mott MacDonald.

A. Extremal Velocity Results

Digital Appendix A presents the composite storm surge velocity results for the 100-yr event for the following locations

- Mobile Bay Bayway alignment
- Cable Stay Bridge supports