



U.S. DOT Gulf Coast Study, Phase 2

Engineering Case Study 2: Bridge Over Navigable Waterway Exposure to Sea Level Rise

This is one of 11 engineering case studies conducted under the Gulf Coast 2, Phase 2 Project. This case study focused on the vulnerability of the Cochrane-Africatown USA Bridge over a navigable waterway exposed to sea level rise.

Description of the Site and Facility

The Cochrane-Africatown Bridge, a two cable-stayed segmental concrete box girder bridge, carries Alternate US 90 over the Mobile River. It is the first bridge crossing the Mobile River that ships must pass under when traveling north from the Mobile Bay up the Mobile River, and several important port facilities are located north of this bridge. Therefore, this case study considered whether sea level rise could reduce the navigation clearance under the bridge to the extent that the bridge would serve as an impediment to ship traffic.

The case study looked at the bridge segment between bents¹ 16 and 17 of the 32 bents that support the bridge (see Figure 2). The U.S. Coast Guard bridge permit requires that a minimum vertical clearance of 140 feet (42.7 meters) be maintained between the bottom of the span and the mean high tide elevation.

Climate Stressors and Scenarios Evaluated and Impacts on the Facility

This case study focused on sea level rise, since that is the primary climate change effect that could inhibit navigational clearance. The impacts of three potential

sea level rise values, based on projected climate changes and local vertical land movement, were considered:

- 0.9 foot (30 centimeters) of relative sea level rise by 2050
- 2.3 feet (75 centimeters) of relative sea level rise by 2100
- 6.4 feet (200 centimeters) of relative sea level rise by 2100

These scenarios of sea level rise were previously evaluated for Mobile (taking into account land subsidence and uplift). For areas outside of Mobile, the U.S. Army Corps of Engineers (USACE) sea level rise guidance and associated on-line Sea-Level Change Curve Calculator may be used to develop projections of sea level rise with consideration of vertical land movement. This case study compared the values of projected relative sea level rise values at the Cochrane Bridge as calculated from the Sea-Level Change Curve Calculator with the projected relative sea level rise values calculated previously in this study, as well as estimates from NOAA. This comparison demonstrated the variation in projections among the three sources of information. The values generated in the Gulf Coast study fall within the boundaries of the USACE and NOAA estimates.

¹ Bents, also known as piers, are the vertical columns supporting each bridge span along with the horizontal member, called a cap, which holds them together.

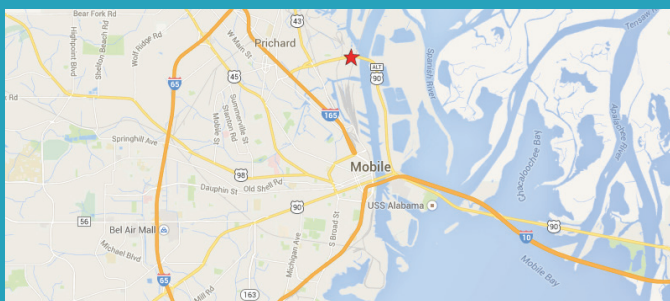


Figure 1: Location of the Cochrane-Africatown USA Bridge within the Mobile Metropolitan Area^{92F}



Figure 2: Plan and Elevation Views of the Cochrane-Africatown USA Bridge Showing the Section of Analysis

The study determined that navigational clearance would not be affected by the lesser two sea level rise scenarios. However, under the scenario of 6.4 feet (200 centimeters), the required minimum navigational clearance would not be maintained.

Identification and Evaluation of Adaptation Options

Since the required navigational clearance would not be met under one of the sea level rise scenarios, some form of adaptation would need to be taken at some point. The following adaptation options were identified:

- Do not make physical changes to the bridge, but restrict marine traffic so that larger ships would not be allowed to travel north of the Cochrane Bridge.
- Raise the bridge superstructure to ensure the minimum clearance is maintained.
- Replace the bridge with a tunnel so that clearance height becomes a non-issue.
- Retrofit or replace the fixed span with moveable bridge center span, so that it can be moved when larger ships need to pass.

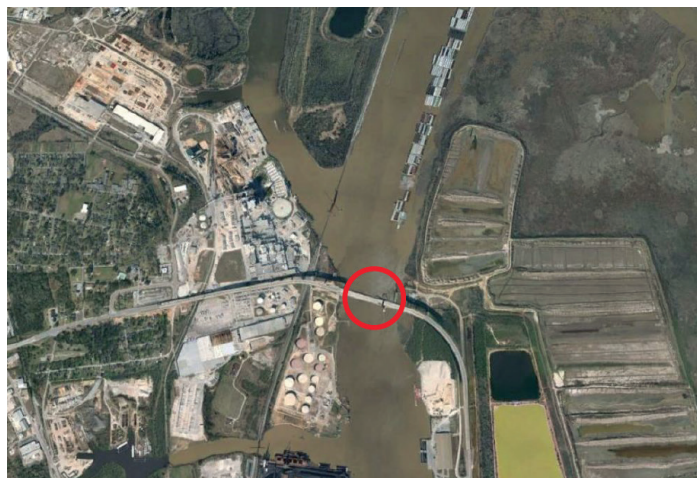


Figure 3: Aerial view of Cochrane-Africatown USA Bridge and Surrounding Area

The cost effectiveness of these adaptation options was not evaluated, but there are some important considerations associated with each option. First, since clearance issues are not projected to occur in the near-term, it is not necessary to take immediate action. However, different adaptation options may require different

levels of advanced planning. For example, a decision to restrict the size of ships that pass under the bridge could have important implications regarding where certain ports need to be situated, as well as the associated transportation network that serves them. Decisions to replace or retrofit the superstructure could potentially be made when the bridge is due for major repair or renovation.

Other considerations that relate to the broader use of the river, and the infrastructure around it, include:

- System-wide navigational changes: Locating or relocating existing or proposed port facilities south of the bridge would reduce the need for the high navigational height requirement.
- Long-term shifts in demand: Vehicular traffic volumes on the bridge may evolve over time through shifts in population, land uses, or loss of service on other major roadways. If sea level rise negatively affects adjoining land use, the need for the bridge within the larger transportation network may be diminished.
- Local perception: Adjacent neighborhoods may respond negatively to plans for a higher bridge.

Potential Course of Action

The key recommendation from this analysis is to monitor trends in actual sea levels over time in the Mobile region and compare them to the projected sea level rise scenarios before making a decision on how to proceed. Immediate action is not needed because navigational clearance is unlikely to be affected in the near future.

Lessons Learned

Bridges over navigable channels should be investigated for clearance reductions due to sea level rise in order to determine if any remedial action needs to be implemented. However, when sea level rise is projected to impede navigation only in the long term, the most important near-term action may be to simply monitor sea level rise so that an appropriate course of action can be selected as better information on sea level rise and future land use becomes available.

Adaptation is best handled in a coordinated manner amongst all bridges along a shipping channel. For example, adapting one bridge may be pointless if other bridges along the channel are low and will impede access. Meanwhile, decisions to restrict vessel size or change the bridge could have important consequences for the surrounding community and ports.

When expected sea level rise will not affect a bridge within its design life, it may be that an eventual full replacement of the bridge with a design that accounts for anticipated sea level changes will be a more cost-effective solution than retrofitting the existing structure now.

For More Information

Resources:

Gulf Coast Study:

[Engineering Assessments of Climate Change Impacts and Adaptation Measures](#)

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