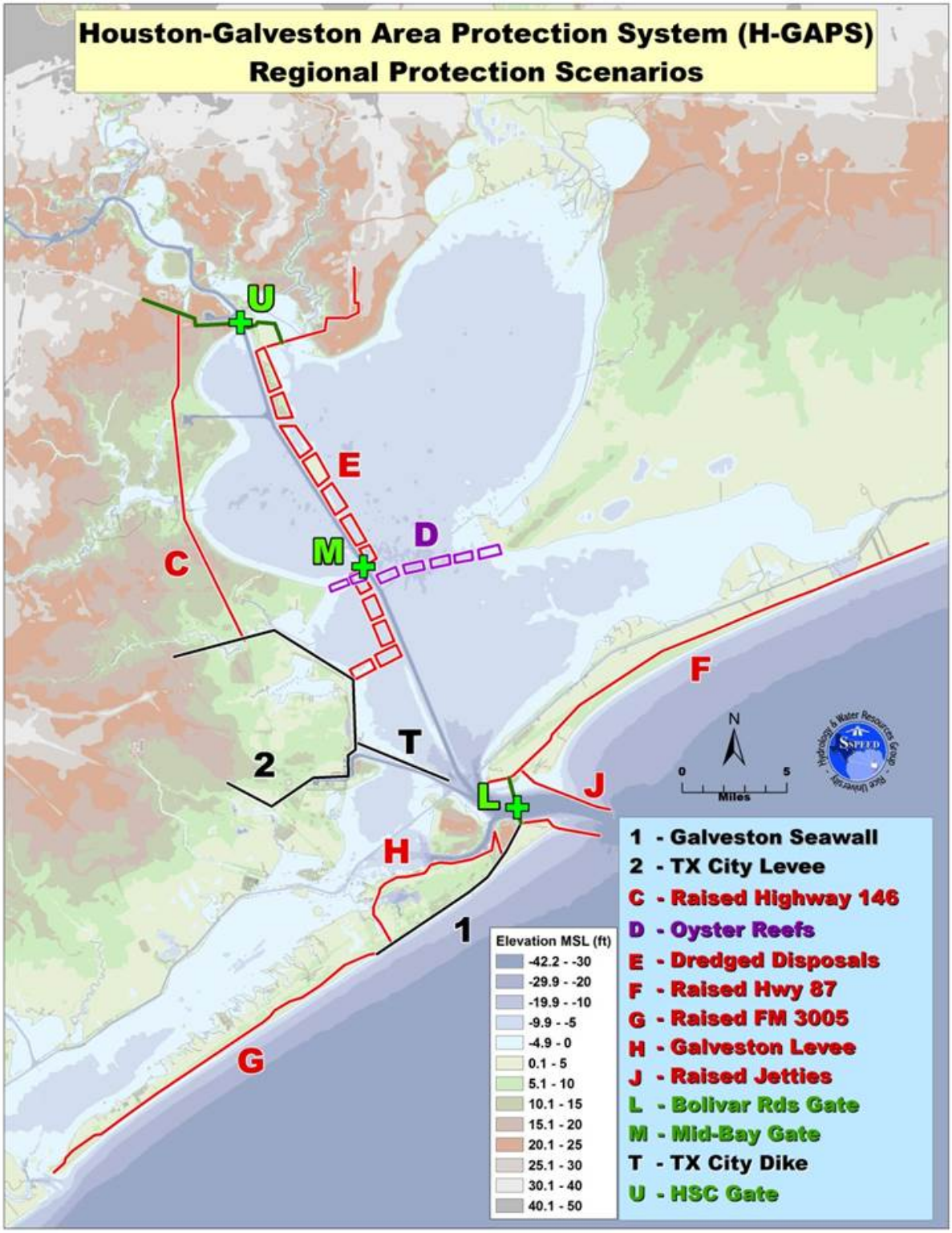
Report analyzes new option for hurricane protection

September 1 2015, by David Ruth



Credit: Rice University's SSPEED Center

Past discussions of hurricane-protection options for the Houston-Galveston region have focused on constructing a floodgate at the mouth of either Galveston Bay or the Houston Ship Channel. In its latest analysis of options that federal, state and local officials might consider, Rice University experts offer a third alternative: a mid-bay gate halfway between the previously discussed sites.

In a new report, Rice's Severe Storm Prediction, Education and Evacuation from Disasters (SSPEED) Center describes how the mid-bay alternative could provide storm-surge protection for the heavily populated communities on the west side of Galveston Bay as well as for the industrial complex along the Houston Ship Channel. The report also details how the mid-bay gate could be part of a comprehensive regional flood-reduction plan if it were combined with components of the "Ike Dike" like new levees, dikes and elevated roadways.

SSPEED's latest analysis is part of an ongoing effort to create the Houston-Galveston Area Protection System, or H-GAPS, a comprehensive and well-documented set of options that policymakers can consider in developing a regional hurricane-protection plan. SSPEED is coordinating its research with ongoing efforts at Texas A&M University at Galveston, the U.S. Army Corps of Engineers and others.

The H-GAPS mid-bay alternative calls for constructing a floodgate across the ship channel near San Leon. The gate, which would be closed to hold back storm surge from an approaching hurricane, would be tied into an extensive network of man-made reefs and island berms—many of which already exist—that would bisect the bay in both north-south and east-west directions.

SSPEED officials say computer simulations have shown that the mid-

bay alternative would significantly reduce storm-surge flooding in both the Houston Ship Channel and in the heavily populated west Galveston Bay communities that are difficult to evacuate.

"The mid-bay gate strategy is designed to reduce storm surge in the ship channel's industrial complex as well as in west bay communities like Clear Lake, Kemah, Bayview and Seabrook," said SSPEED Director Phil Bedient, Rice's Herman Brown Professor of Engineering. "The former represents the most significant economic and environmental threat from a hurricane and the latter represents the most significant threat to human life."

SSPEED first began studying regional hurricane protection in the wake of Hurricane Ike in 2008. The sprawling 600-mile-wide Category 2 storm struck Bolivar Peninsula northeast of Galveston on Sept. 13, 2008, causing $29.5 billion in damages, most of it due to surge flooding. SSPEED's analysis relies on sophisticated simulations developed by researchers at the University of Texas at Austin. The simulations, which run on UT supercomputers, allow SSPEED to recreate historical storms like 2008′s Ike and 1961′s Carla, relocate them anywhere along the coast and observe the storm-surge flooding that would occur, not only at the coast but also within the bay and in the ship channel's industrial complex. The models also allow the researchers to test how well any combination of dikes, levees, seawalls and storm-surge barriers would reduce flooding in any of the storm scenarios.

Of the many scenarios SSPEED has studied, the one that most closely resembles the Federal Emergency Management Agency's (FEMA) benchmark 100-year storm-surge flooding event for Galveston Island is a storm with wind speeds 15 percent stronger than Ike's that makes landfall southwest of Galveston near Freeport. Such a storm would be a Category 3 hurricane, and SSPEED's simulations show the storm's surge would go over the Galveston Seawall, inundate the Houston Ship

Channel with about 25 feet of seawater and flood hundreds of square miles of densely populated suburbs along west Galveston Bay.

"For those who believe this scenario is far-fetched, I would point out that more than 100 Category 3 hurricanes have made landfall on the coastlines of the Gulf of Mexico since 1900," said SSPEED Co-director Jim Blackburn, professor in the practice of civil and environmental engineering at Rice. "If we look closer to home, records show that a storm of this intensity strikes the upper Texas coast roughly every 25 years. It is not a matter of if such a storm will strike, but only when and where."

SSPEED's latest analysis is the first part of a three-year study funded by Houston Endowment to provide recommendations to the state of Texas, the Corps of Engineers and other federal agencies on the best way to protect life, industry and the environment from large, potentially devastating hurricanes.

In addition to the main gate over the ship channel, the mid-bay gate proposal calls for smaller gates that would fill the space between existing dredged containment berms that run from north to south along the upper bay. Some of these already stand 25 feet high and tie into high ground to the north near Cedar Bayou and to the south at the Texas City levee. These existing containment sites are made from the sediment collected from dredging the Houston Ship Channel.

"This scenario utilizes the berms that are being filled with dredged material from the Houston Ship Channel," Blackburn said. "It also presents opportunities for nonstructural improvements, such as creating oyster reefs under the water surface of the berms, marsh areas adjacent to the berms or rookery habitat on the filled islands. This scenario will also include periodic openings for normal boat traffic and environmental flows between the enclosed islands with a gate structure to block the

flow of water through the system during a storm. And this solution is absolutely compatible with the two landscape-scale, nonstructural alternatives—the Texas Coastal Exchange and the Lone Star Coastal National Recreation Area—also conceived by the SSPEED Center."

In addition to the mid-bay gate complex, the H-GAPS mid-bay regional protection plan calls for creating a "coastal spine" by using and possibly raising the height of Galveston's historic seawall, raising Farm-to-Market Road 3005 along west Galveston Island and raising Texas Highway 87 along Bolivar Peninsula. The plan also calls for raising portions of the Texas City levee, and creating a new levee to prevent backside flooding of Galveston from bay floodwaters.

To prepare their report, SSPEED researchers used the latest FEMA flood maps and recently updated insurance industry assessments that call for 19- to 20-foot storm-surge protection for significant portions of the Houston Ship Channel industrial complex.

In addition to developing and evaluating the cost and performance of the mid-bay gate option, Bedient said SSPEED also evaluated options for upper-bay and lower-bay gate options. He said SSPEED and the other study collaborators are also evaluating other concepts.

The upper-bay gate and mid-bay gate strategies would cost about $2.8 billion each, while the lower-bay gate's preliminary cost estimate is around $7.6 billion.

"Our studies over the past eight years have found there is no one-size-fits-all solution to protect the Houston-Galveston region from the next big hurricane," Bedient said. "One thing that is clear from each scenario we have tested is that a floodgate must be built somewhere across the ship channel in order to meaningfully reduce the risk of catastrophic flooding in the industrialized portion of the ship channel.

"The large gate structure is the single most expensive item in any regional protection plan, and the farther south you move the gate, the more expensive it is to build," Bedient said. "The purpose of looking at each location is to determine what the benefits and costs are at each site so that policymakers will have a clear picture of how they can maximize the flood-reducing benefits for each dollar they spend."

More information: The report is available online: rice.app.box.com/s/jvciwu2tpfo … qo9kxibbfckpr4u11cng

Provided by Rice University