Before the Coastal Texas Study Team can design risk management features for the next major coastal storm, they must first anticipate what storms the Texas coast may face in the future. Computerized storm models incorporate historical storm data and other statistics to inform how a simulated storm will impact an area. These storm models allow engineers to simulate storms of varying size, strength, speed, landfall location, and path. Engineers use these computerized models to predict storm surge impacts to coastal areas, identify design criteria, and test effectiveness of proposed coastal protection features.

There are many variables that can affect how much storm surge will produce in a given location. For the Coastal Texas Study, one variable is set in stone: the location being evaluated, which is the entire Texas coast. However, the same storm can have different impacts on the same location by changing its variables such as path or intensity as it makes landfall. For this reason, storm models test many different storms with varying parameters or variables that occur under various conditions. This is known as a model “ensemble.”

A set of 660 storms with different variables were modeled by the study team as shown below.

Study Approach

The Coastal Texas Protection and Restoration Feasibility Study, also known as the Coastal Texas Study, has been developed to identify coastal storm risk management and ecosystem restoration measures. These measures are evaluated based on long-term benefits, costs, feasibility and resiliency.

A “multiple lines of defense” strategy is utilized in the formulation of the measures and alternatives in the Coastal Texas Study. Employing four primary goals – prepare, adapt, withstand, and recover – coastal communities could consider a system of comprehensive, resilient and sustainable coastal storm risk management and ecosystem restoration solutions. The system could include a combination of measures (structural, natural and nature-based features, and nonstructural) to form resilient, redundant, robust and adaptable strategies that promote life and safety based on local site conditions and societal values. To achieve a multiple lines of defense strategy, the Coastal Texas Study evaluates the following coastal problems:

- Economic damage from coastal storm surge
- Bay shoreline erosion
- Gulf shoreline erosion

More information is available online at: coastalstudy.texas.gov
The Study Team used the Coastal Storm Modeling System (CSTORM)—a comprehensive system of highly skilled and highly resolved models used to simulate coastal storm waves and water levels, as well as a comprehensive methodology of how those models are applied in order to accurately provide inputs for assessing risk to coastal communities. CSTORM was used to evaluate a set of 660 simulated storms as part of the Coastal Texas Study to evaluate risks as thoroughly as possible. This set represents a discrete population of past and possible future storms developed based on ongoing storm-climatology from the historical record. A total of 82 master storm paths were created, and four key storm variables were considered: storm heading, storm intensity, radius to maximum winds, and forward speed of the storm. The modeled storms ranged in intensity from very weak tropical storms to catastrophic category 5 hurricanes. The radius to maximum winds ranged from approximately 5 miles for very small storms to 66 miles for very large storms. The forwardal speeds of the storms varied from 4 miles per hour (mph) to 27 mph.

The results of these models helped define the parameters the Study Team would consider when developing features to reduce risk along Texas coast from future storm surge.

It is important to note that any proposed storm surge protection system will not provide complete risk reduction to the Texas coast from every storm. Even though the study team simulated scenarios ranged from tropical storms to above 1,000- year hurricanes, there could be few extreme cases that may occur in future which are beyond the limits of statistics. These extreme storms will likely challenge the proposed surge protection system and may have residual risks. The proposed storm surge barriers at Bolivar Roads are designed to provide coastal defense from extreme events while other system such as the soft, nature based beach and dune system, are designed to overtop during extreme events, while still maintaining the overall system benefits.

### Sea Level Rise Considerations

Storm surge heights are measured relative to seal level. In general, a 10-foot storm surge will not directly impact land that is 15 feet above sea level. However, sea level rise means an increasing amount of land is under threat from surge and flooding. Along the Texas coast, the variability of sea level rise is mainly due to global sea level rise due to ocean warming and ground settlement due to the compaction of soft ocean sediment. For example, measurements from Pier 21 in Galveston Bay shows that the sea level is rising at a rate about two times higher than other coasts. This high rate should not be considered due to local sea level rise, but due to ground settlement and sediment movement at different rates across different bay systems. This and other factors such as the CORE sea level rise guidance were considered by the Study Team when designing storm surge barrier system to reduce risks along the Texas coast.

### Storm Surge Variables and Example Models

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