



DEPARTMENT OF THE ARMY  
CHIEF OF ENGINEERS  
2600 ARMY PENTAGON  
WASHINGTON, DC 20310-2600

DAEN

DEC 07 2017

THE SECRETARY OF THE ARMY

SUBJECT: Sabine Pass to Galveston Bay, Texas, Coastal Storm Risk Management and Ecosystem Restoration Study

1. I submit for transmission to Congress my report on Coastal Storm Risk Management (CSRM) and Ecosystem Restoration (ER) within six counties of the upper Texas coast (Orange, Jefferson, Chambers, Harris, Galveston, and Brazoria Counties). It is accompanied by the report of the Galveston District Engineer and the Southwestern Division Engineer. These reports are a partial response to a resolution from the Committee on Environment and Public Works dated June 23, 2004, entitled "Coastal Texas Protection and Restoration Study." The resolution requested that this study be undertaken to "develop a comprehensive plan for severe erosion along coastal Texas for the purposes of shoreline erosion and coastal storm damages, providing for environmental restoration and protection, increasing natural sediment supply to coast, restoring and preserving marshes and wetlands, improving water quality, and other related purposes to the interrelated ecosystem along the coastal Texas area." The project area was hit by a Category 4 hurricane, Hurricane Harvey, on August 25, 2017. At the time of signature of this Report of the Chief of Engineers damage assessments are still underway. Early reports indicate extensive flooding and damages across the project area in addition to the loss of 10 lives in Orange County and four lives in Jefferson County. Preconstruction engineering and design (PED) activities, if funded, would be continued under the authorities provided by the resolution cited above.

2. The reporting officers' recommendation for the upper Texas coastal region encompassing the six counties along 120 miles of coastline include authorization of a plan to reduce the risks of tropical storm surge impacts in Orange, Jefferson and Brazoria Counties through the construction of structural measures and the continuation of the study of the Galveston region (Galveston, Harris, and Chambers Counties) for CSRM. Continuation of the study of ER alternatives assessed in the six counties will be conducted under the comprehensive Coastal Texas Protection and Restoration feasibility study. The recommended plan was developed utilizing a region-wide systems approach to achieve the full range of benefits, although the CSRM plans are separable and able to function individually. The plan includes (i) increasing the level of performance and resiliency of the existing Port Arthur and Vicinity Hurricane Flood Protection (HFPP) project in Jefferson County, Texas (the Port Arthur and Vicinity CSRM Plan); (ii) the construction of a new levee/floodwall system (the Orange 3 CSRM Plan) along the edge of the Sabine and Neches River floodplains from Orange, Texas to the vicinity of Orangefield, Texas that is approximately 26.7-miles; and (iii) increasing the level of performance and resiliency of the existing Freeport and Vicinity HFPP project in Brazoria County, Texas (the Freeport and Vicinity CSRM Plan).

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3. Based on October 2017 price levels, the estimated project first cost of the recommended plan, which includes three separable elements, is \$3,318,772,000. All construction work will be cost shared in accordance with the cost sharing provisions of Section 103 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213). The Federal share of the project first costs of the hurricane and storm damage risk reduction features is estimated to be \$2,157,202,000 (65 percent) and the total non-Federal share is estimated to be \$1,161,570,000 (35 percent). The total cost of non-Federal contribution of lands, easements, rights-of-way, relocations, and dredged or excavated material disposal areas (LERRDs) is estimated to be \$52,451,000. The total annual cost of Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the project is currently estimated to be \$5,585,000 per year. The OMRR&R estimate includes \$41,000 per year for monitoring of the environmental mitigation component after the commencement of OMRR&R. Based on a 2.75 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the three separable elements for the project are estimated to be \$141,799,000 including OMRR&R. Additionally, the non-Federal sponsors would be fully responsible for removing and relocating utilities and discharge pipelines on the project site that are non-compensable, at a total cost estimated to be \$128,320,000. The equivalent average annual benefits for the three separable elements are estimated to be \$452,633,000 with net average annual benefits of \$310,834,000. The recommended plan is the National Economic Development plan.

a. The first element of the recommended plan is the Port Arthur and Vicinity CSRSM Plan.

(1) The Port Arthur and Vicinity CSRSM Plan would raise approximately 5.5 miles of the existing 27.8 miles of earthen levee to elevations ranging from 14.4 to 17.2 feet North American Vertical Datum (NAVD 88), and construct or reconstruct approximately 5.7 miles of floodwall to elevations ranging from about 14.4 to 19.4 feet NAVD 88. A separate 1,830 feet of new earthen levee would be constructed in the Port Neches area northwest of the existing northern terminus. Additionally, 26 vehicle closure structures would be replaced and erosion protections would be added.

(2) The existing Port Arthur HFPP local sponsor, Jefferson Country Drainage District No. 7, will be the non-Federal cost-sharing sponsor for the Port Arthur and Vicinity CSRSM Plan. Based on October 2017 price levels, the estimated project first cost of the recommended plan is \$744,865,000. All construction work will be cost shared in accordance with the cost sharing provisions of Section 103 of WRDA 1986, as amended. The Federal share of the project first costs of the hurricane and storm damage risk reduction features is estimated to be \$484,162,000 (65 percent) and the total non-Federal share is estimated to be \$260,703,000 (35 percent). The non-Federal contribution of LERRDs for the improvements associated with the Port Arthur and Vicinity CSRSM Plan would be about \$8,376,000. The non-Federal sponsor's cost for removing and relocating utilities and discharge pipelines associated with the Port Arthur and Vicinity CSRSM Plan that are non-compensable would be about \$38,544,000. The non-Federal sponsor would be responsible for the OMRR&R of the project after construction. OMRR&R is currently estimated at \$199,000.

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(3) Based on a 2.75 percent discount rate and a 50-year period of analysis, the total average annual costs of the project are estimated to be \$29,757,000, including OMRR&R. The recommended plan would reduce average annual coastal storm damages by about 76 percent and would leave average total equivalent annual residual damages estimated at \$42,604,000. The equivalent average annual benefits for Port Arthur and Vicinity CSR Plan is estimated to be \$139,106,000 with net average annual benefits of \$109,349,000, which results in a BCR of approximately 4.7 to 1. The recommended plan is the National Economic Development plan.

b. The second element of the recommended plan is the Orange 3 CSR Plan.

(1) This element includes 15.6 miles of newly constructed levee ranging from 12.0 to 17.5 feet NAVD 88 in elevation and 10.7 miles of newly constructed floodwalls and gates ranging from 13.5 to 16 feet NAVD 88. Seven pump stations, 56 drainage structures, and 32 closure gates located at road and railway crossings would be constructed to mitigate interior flooding during surge events. Finally, two navigable sector gates with adjacent vertical lift floodgates for normal channel flows would be constructed in Adams and Cow Bayous to reduce surge penetration. Unavoidable direct and indirect environmental impacts to 2,409 acres of forested wetlands and estuarine marsh associated with the Orange 3 CSR Plan would be fully compensated by the implementation of the mitigation plan. Monitoring and adaptive management of the mitigation areas will be conducted until the mitigation measures have been demonstrated to be successful.

(2) Orange County, Texas will be the non-Federal cost-sharing sponsor for the Orange 3 CSR Plan. Based on October 2017 price levels, the estimated first cost of the recommended Orange 3 CSR Plan is \$1,967,826,000. All construction work will be cost shared in accordance with the cost sharing provisions of Section 103 of WRDA 1986, as amended. The Federal share of the first costs of the hurricane and storm damage risk reduction features is estimated to be \$1,279,087,000 (65 percent) and the total non-Federal share is estimated to be \$688,739,000 (35 percent). The non-Federal contribution of LERRDs for the newly constructed levee/floodwall system associated with the Orange 3 CSR Plan would be about \$33,199,000. The non-Federal sponsor's cost for removing and relocating utilities and discharge pipelines associated with the Orange 3 CSR Plan that are non-compensable would be about \$62,387,000. The non-Federal sponsor would be responsible for OMRR&R of the project after construction. OMRR&R is currently estimated at \$4,663,000.

(3) Based on a 2.75 percent discount rate and a 50-year period of analysis, the total average annual costs of the Orange 3 CSR Plan are estimated to be \$87,268,000, including OMRR&R. The recommended plan would reduce average annual coastal storm damages by about 64 percent and would leave average total equivalent annual residual damages estimated at \$60,496,000. The equivalent average annual benefits for Orange 3 CSR Plan is estimated to be \$105,919,000 with net average annual benefits of \$18,651,000, which results in a benefit-cost ratio (BCR) of approximately 1.2 to 1. The recommended plan is the National Economic Development plan.

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c. The third element of the recommended plan is the Freeport and Vicinity CSRM Plan.

(1) The recommended Freeport and Vicinity CSRM Plan would raise approximately 13.1 miles of the existing earthen levee system and construct or reconstruct approximately 5.5 miles of floodwall, improving approximately 43 percent of the existing 43-mile long system. Final elevations would range from 15.8 to 23.8 feet NAVD 88. Navigable sector gates would be installed in the Dow Barge Canal to reduce surge penetration in that area. Ten vehicle closure structures at road and railroad crossings would be replaced and erosion protection would be added. Other project features include raising and reconstructing the Highway 332 crossing, installation of four drainage structures, including one at the head of the Dow Barge Canal, and raising the floodwall at Port Freeport's Berth 5 dock.

(2) The existing Freeport Harbor Flood Protection Project local sponsor, the Velasco Drainage District, will be the non-Federal cost-sharing sponsor for the Freeport and Vicinity CSRM Plan. Based on October 2017 price levels, the estimated project first cost of the recommended plan is \$606,313,000. All construction work will be cost shared. In accordance with the cost sharing provisions of Section 103 of WRDA 1986, as amended, the Federal share of the project first costs of the hurricane and storm damage risk reduction features is estimated to be \$393,953,000 (65 percent) and the total non-Federal share is estimated to be \$207,660,000 (35 percent). The non-Federal contribution of LERRDs for the improvements associated with the Freeport and Vicinity CSRM Plan would be about \$10,876,000. The non-Federal sponsor's cost for removing and relocating utilities and discharge pipelines associated with the Freeport and Vicinity CSRM Plan that are non-compensable would be about \$27,389,000. The non-Federal sponsor would be responsible for the OMRR&R of the project after construction. OMRR&R is currently estimated at \$723,000.

(3) Based on a 2.75 percent discount rate and a 50-year period of analysis, the total average annual costs of the Freeport Harbor CSRM Plan are estimated to be \$24,774,000, including OMRR&R. The recommended plan would reduce average annual coastal storm damages by about 66 percent and would leave average total equivalent annual residual damages estimated at \$107,006,000. The equivalent average annual benefits for Freeport and Vicinity CSRM Plan is estimated to be \$207,608,000 with net average annual benefits of \$182,834,000, which results in a BCR of approximately 8.4 to 1. The recommended plan is the National Economic Development plan.

d. The recommended plan is intended to prevent damages to structures and content and critical infrastructure from coastal storm surge and waves. It should be noted, however, that reducing the risk of loss of life during major storm events can only be achieved by adhering to existing procedures for evacuation of residents and visitors well before expected hurricane landfall, thus removing people from harm's way. This study recommends continuation of the evacuation policy both with and without the project.

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4. In accordance with USACE Sea Level Change (SLC) Guidance, Engineer Regulation (ER) 1100-2-8162, the study evaluated potential impacts in SLC in its plan formulation and engineering of the recommended plan. Three levels of Relative Sea Level Change (RSLC) were considered for both the without-project and with-project conditions. The risk reduction system has been designed to provide a risk reduction against a 1 percent annual chance exceedance probability storm event based on the 2070 intermediate RSLC forecast condition. In recognition of the uncertainty presented by sea level rise, adaptation capacity has been incorporated into the final feasibility-level design to maximize the systems' overall usefulness over the life of the project. The adaptability will allow for limited overtopping of wave and minor still water overtopping that would then be mitigated for using interior drainage features or height increases to the floodwall if required. The equivalent average annual benefits are estimated to range from nearly \$55,000,000 to \$164,000,000 under the low SLC scenario, \$104,000,000 to \$203,000,000 under the intermediate SLC scenario, and to nearly \$157,000,000 to \$291,000,000 under the high SLC scenario. Corresponding annual net benefits for the recommended plan range from approximately \$16,000,000 to \$178,000,000 with BCRs ranging from 1.2 to 8.2. The recommended plan also shows high project performance with a 99 percent conditional non-exceedance probability over a 50-year period under all SLC scenarios.

5. The goals and objectives included in the Campaign Plan of the USACE have been fully integrated into the Sabine Pass to Galveston Bay study process. The recommended plan was developed in coordination and consultation with various Federal, state, and local agencies using a systematic and regional approach to formulating solutions and evaluating the benefits and impacts that would result. The feasibility study evaluated shoreline erosion and coastal storm damage problems as well as opportunities for environmental restoration and protection. Risk and uncertainty were addressed during the study by sensitivity analysis that evaluated the potential impacts of sea level change and economic assumptions as well as cost uncertainties.

6. In accordance with the USACE Engineer Circular (EC) 1165-2-214 on review of decision documents, all technical, engineering and scientific work underwent an open, dynamic and rigorous review process to ensure technical quality. This included District Quality Control review, Agency Technical Review, Major Subordinate Command review, Independent External Peer Review, Public Review, and a USACE Headquarters policy and legal review. All comments from the above referenced reviews have been addressed and incorporated into the final documents. Overall, the reviews resulted in improvements to the technical quality of the report.

7. Washington-level review indicates that the project recommended by the reporting officers is technically sound, environmentally and socially acceptable, and economically justified. The plan complies with all essential elements of the 1983 U.S. Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Land Related Resources Implementation Studies* and complies with other administrative and legislative policies and guidelines. Also the views of interested parties, including Federal, state and local agencies have been considered.

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8. Federal implementation of the project would be subject to the non-Federal sponsors agreeing in a binding written agreement to comply with applicable Federal laws and policies, and to perform the following non-Federal obligations, including, but not limited, to the following:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, and 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits, as further specified below:

(1) Enter into an agreement that provides, prior to construction, 35 percent of design costs;

(2) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction or the operation and maintenance of the project, all in compliance with applicable provisions of the Uniform Relocation and Assistance and Real Property Acquisition Policies Act of 1970, as amended (42 U.S.C. 4601-4655) and the regulations contained in 49 C.F.R. Part 24;

(3) Provide, during construction, any additional amounts as are necessary to make the total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction, and 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portion of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific, directions prescribed by the Federal Government;

c. Inform affected interests, at least annually, of the extent of protection afforded by the project; participate in and comply with applicable Federal floodplain management and flood insurance programs; comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12); and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

d. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsors own or control for access to the project for

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the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

f. Hold and save the United States free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsors with prior specific written direction, in which case the non-Federal sponsors shall perform such investigations in accordance with such written direction;

h. Assume, as between the Federal Government and the non-Federal sponsors, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project; and

i. Agree, as between the Federal Government and the non-Federal sponsors, that the non-Federal sponsors shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

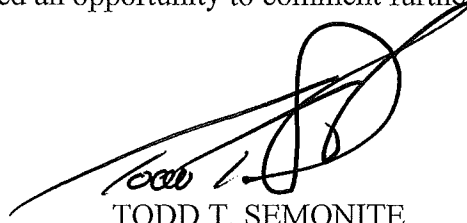
9. I concur in the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that the plan to reduce the risks of tropical storm surge impacts in Orange, Jefferson and Brazoria Counties, Texas be authorized in accordance with the reporting officers' recommended plan at an estimated project first cost of \$3,318,772,000, with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and state laws and policies, including Section 103 of WRDA 1986, as amended.

10. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch.

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Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, the state, interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

A handwritten signature in black ink, appearing to read "TODD T. SEMONITE", written over a horizontal line.

TODD T. SEMONITE  
Lieutenant General, USA  
Chief of Engineers