

LAROSE TO GOLDEN MEADOW, LOUISIANA HURRICANE PROTECTION PROJECT

LEON THERIOT LOCK EVALUATION REPORT

INTRODUCTION

This study addresses the feasibility of modifying the Larose to Golden Meadow hurricane protection project to mitigate for delays to navigation that are being caused by closures of the Leon Theriot Floodgate (formerly called the Golden Meadow Floodgate). The Leon Theriot Floodgate is a feature of the Larose to Golden Meadow, Louisiana, Hurricane Protection Project, located in Bayou Lafourche just south of Golden Meadow, Louisiana. The purpose of the floodgate is to provide for navigation on Bayou Lafourche and prevent tidal flooding of residential and commercial property in the area between Larose and Golden Meadow. The floodgate is closed when high stages in Bayou Lafourche threaten to overtop the banks of the bayou, which would cause extensive flooding within the project area. The floodgate is being closed more frequently and for longer durations than originally projected in the studies leading to the authorization of the hurricane protection project. The increase in the closure time can be attributed to the combined effects of more active storm seasons in southeast Louisiana and the effects of sea level rise and ground subsidence. The adverse impacts to navigation resulting from closures of the Leon Theriot Floodgate have increased significantly as a result of changing conditions. The growth of Port Fourchon, located at the mouth of Bayou Lafourche, has led to a dramatic increase in the number of oil and gas supply vessels moving along Bayou Lafourche between the Gulf Intracoastal Waterway and the port. The deauthorization of the Bayou Lafourche and Lafourche-Jump Waterway project also eliminated an alternate route for vessels that was intended to provide relief during periods when the floodgate is closed. Converting the existing Leon Theriot Floodgate into a lock would mitigate for the adverse impacts of these closures.

Authority. This study is being conducted under the authority of Section 325 of Public Law 106-53 (Water Resources Development Act of 1999), which states:

“The project for hurricane protection Larose to Golden Meadow, Louisiana, authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1077), is modified to authorize the Secretary to convert the Golden Meadow floodgate into a navigation lock if the Secretary determines that the conversion is technically feasible, environmentally acceptable, and economically justified.”

Section 204 of Public Law 89-298 (Flood Control Act of 1965), authorized the project “Grand Isle, Louisiana, and Vicinity” to provide protection in accordance with the recommendations of the Chief of Engineers published in House Document No. 184, Eighty-ninth Congress, 1st Session. The report of the Chief of Engineers submitted for transmittal to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers. The Chief of Engineers in his report concurred in the recommendations of the Board of Engineers for Rivers and Harbors, which are as follows:

“... accordingly, the Board recommends authorization for construction of improvements for the prevention of hurricane tidal damages and loss of life in the area between Larose and Golden Meadow, Louisiana, consisting of:

A loop levee approximately 36 miles in length along both banks of Bayou Lafourche;

Enlargement of about 3 miles of the existing levee at Golden Meadow;

Floodgates for navigation in Bayou Lafourche at the upper and lower bayou crossings;

Approximately 8 miles of low interior levees to regulate intercepted drainage; and

Seven drainage structures;

all generally in accordance with the plans of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost of \$7,857,000, consisting of \$6,323,000 for construction and \$1,534,000 for lands, rights-of-way, and relocations...”)

Purpose. The purpose of this evaluation report is to show that the conversion of the existing Leon Theriot Floodgate into a lock is technically feasible, environmentally acceptable and economically justified. The report documents changed local conditions that make the conversion necessary. The changed local conditions include a) the floodgate being closed more frequently and for longer durations than originally planned from more active storm seasons in southeast Louisiana, sea level rise, and ground subsidence; b) the de-authorization of an auxiliary channel that was never constructed but was identified in the Chief of Engineers report as a key alternate route (by-pass) when the floodgate would be closed (de-authorized under Section 1001(a) of Public Law 99-662 (WRDA 1986), on 1 January 1990); and c) dramatic increases in use of the waterway by local navigation interests. Further, this evaluation report documents, for approval by the Secretary of the Army, the necessity for and justification of the lock.

Description of the Original Authorized Project. The Larose to Golden Meadow, Louisiana, Hurricane Protection Project provides for approximately 43 miles of levees and floodwalls enclosing areas along each side of Bayou Lafourche, and two navigable floodgates in Bayou Lafourche where the line of protection crosses the bayou. The major components of the project, as authorized, are described below and shown on Plate 1.

a. A loop levee extends approximately 21 miles on the west bank of Bayou Lafourche, and includes about 3 miles of existing levee at Golden Meadow, and about 22 miles on the east bank of Bayou Lafourche. The net grade of the levee is 13.0 feet National Geodetic Vertical Datum (NGVD) at Golden Meadow and 8.5 feet NGVD at Larose.

b. Floodwalls are provided where the construction of a levee is not possible because of the congested nature of improvements and limited available rights-of-way and at transitions from levees to floodgates or roadgates. The types of floodwalls are inverted T-type and single I-wall, as dictated by their function and structural requirements.

c. Navigation along Bayou Lafourche is maintained by constructing floodgates at Larose and Golden Meadow. Each floodgate has a width of 56 feet. The sill elevations of the floodgates are -10.78 feet NGVD at Larose and -13.78 feet NGVD at Golden Meadow.

d. Land access into the protected area at Larose is provided by Louisiana Highways 1 and 308 without modification, since the finished grades of both roadways are above the predicted flood level. Access at Golden Meadow is provided by raising Louisiana Highway 1 to an elevation of 5 feet NGVD through a 40-foot gap in the levee. A steel roller gate will be provided to close this gap during hurricanes. South of the floodgate at Golden Meadow, Louisiana, Highway 1 will be subject to inundation when stages in Bayou Lafourche exceed 3 feet.

e. A landside levee borrow pit and drainage canal and a system of eight drainage structures were included in the authorized project to provide gravity drainage to the area within the levee system. Construction of the levees and floodwalls interrupt the natural drainage, which is away from the banks of Bayou Lafourche to the lower-lying marshes on either side of the waterway.

f. Construction of the protection system requires the relocation of 14 overhead powerlines, 96 known oil and gas pipelines, local roadway relocations (ramps over the levees), a permanent emergency road by-pass at Louisiana Highway 1 south of Golden Meadow, and a temporary road location at each of 2 road gates west of Golden Meadow.

Local Cooperation for the Original Authorized Project. The Lafourche Parish Police Jury executed the original project-assurances on 8 February 1967. A minor amendment to the estimated costs of Lands, Easements, and Rights-of-Way occurred on 14 June 1967. However, since that time, the South Lafourche Levee District (formerly the South Louisiana Tidal Water Control Levee District) was created and supersedes the Lafourche Parish Police Jury as the local cooperating agency for the project. The South Lafourche Levee District furnished the Agreement for Local Cooperation and Acts of Assurances covering all requirements of local cooperation on 13 November 1972, which was accepted on behalf of the United States on 10 July 1973. The Agreement for Local Cooperation and Acts of Assurances include the additional items of local cooperation required by Public Laws 91-611 and 91-646. By letter dated 4 November 1983, the South Lafourche Levee district furnished certified copies of the adopted resolutions to include both Clovelly Farms and Louisiana Land & Exploration Company into the authorized project and to comply with provisions of local cooperation contained in the original Acts of Assurances for the project.

Funding Since Authorization. Federal funds totaling \$77,886,000 have been expended on the Larose to Golden Meadow project from Fiscal Year 1967 through Fiscal Year 2003. A complete

history of funding for the Larose to Golden Meadow hurricane protection project is presented in Appendix G.

Modifications to the Original Authorized Project. The Larose to Golden Meadow project was authorized in 1965 and construction funds were first appropriated in 1972. In the 37 years since authorization, two major project modifications have been approved, as described below:

- a. The original authorized project, as described in House Document 184, 89th Congress, 1st Session, provided for the levee to terminate at Golden Meadow. The Lafourche Parish Police Jury, by resolution dated 10 June 1967, requested the levee be extended approximately 2 miles below the south corporate limit of Golden Meadow. The proposed extension enclosed an additional 1,800 acres within the protected area, including the largest single manufacturing facility in the project area. It was anticipated that the proposed extension would contribute significantly to the economic and social well-being of residents living in the area. The average annual benefits attributable to the extension of the levee were estimated at \$205,400. The total first costs were estimated at \$1,951,900, which equates to an annual cost of \$77,900. The resulting incremental benefit/cost ratio for the extension below Golden Meadow was estimated at 2.6 to 1. The extension was considered to be within the discretionary authority of the Chief of Engineers and included in Design Memorandum No. 1, General Design, dated May 1972, and approved 5 March 1973.
- b. In February 1984, Design Memorandum No. 1, General Design – Supplement No. 1, was submitted requesting a revised levee alignment at Clovelly Farms and Louisiana Land and Exploration Company. Both areas are located on the east side of Bayou Lafourche between Larose and Golden Meadow. Clovelly Farms is located just southeast of Larose and Louisiana Land and Exploration Company is located just northeast of Golden Meadow. At the time Supplement No. 1 was submitted, both areas were protected from normal tidal action by existing low-level levees. The interior drainage for both areas was being handled by existing small low-lift pumps. The Clovelly Farms revised alignment enclosed an additional 2,468 acres within the protected area, of which approximately 1,300 acres were being used for growing sugarcane. The revised alignment for the Louisiana Land and Exploration Company enclosed an additional 3,296 acres of previously cleared land, with 2,500 acres of pasture being the predominate land use. The additional cost for the Clovelly Farms alignment was estimated at \$800,000 and the additional cost for the Louisiana Land and Exploration Company alignment was estimated at \$1,200,000. The benefit/cost ratio for the Clovelly Farms revised alignment was 1.9 to 1 and the benefit/cost ratio for the Louisiana Land and Exploration Company revised alignment was 1.8 to 1. The revised alignments were approved on 20 September 1984.

History of the Project. The Grand Isle, Louisiana and Vicinity project was authorized by Section 204 of Public Law 89-298 (Flood Control Act of 1965), and is pursuant to the Chief's Report contained in House Document No. 184 of the Eighty-ninth Congress, 1st Session. Design Memorandum No. 1 – General Design, Grand Isle, Louisiana and Vicinity (Larose to Vicinity of Golden Meadow) presented the essential data, assumptions, criteria, and computations used to develop the detailed design for the levees and the general design for the two floodgates. Design Memorandum No. 1 was submitted on 5 May 1972 and was approved on 5 March 1973. The South Louisiana Tidal Water Control Levee District (subsequently renamed the South Lafourche

Levee District) submitted an executed Agreement for Local Cooperation and Acts of Assurances on 13 November 1972. The Agreement for Local Cooperation was accepted for and on behalf of the United States on 10 July 1973.

Design Memorandum No. 2 - Detail Design of the Larose Floodgate was submitted on 2 September 1977 and was approved on 13 December 1979. Design Memorandum No. 3 – Detail Design of the Golden Meadow Floodgate (subsequently renamed Leon Theriot Floodgate) was submitted on 1 November 1978 and was approved on 18 May 1979. Design Memorandum No. 1 Supplement No. 1, Clovelly Farms and Louisiana Land and Exploration Company was submitted on 10 April 1984 and approved 20 September 1984.

The Final Environmental Impact Statement (EIS) for the Larose to Golden Meadow project was filed with the Council on Environmental Quality on 30 April 1974. The EIS was approved by the Environmental Protection Agency in 1974 contingent upon the preparation of a mitigation plan. The Statement of Findings for the EIS was signed on 9 December 1974. A draft supplemental EIS and draft mitigation report (DMR) covering the revised levee alignments, previously unidentified wetland impacts, and necessary mitigation, was filed with the Environmental Protection Agency (EPA) on 20 July 1984. The final supplemental EIS was filed with EPA on 1 March 1985. The Record of Decision (ROD) for the supplemental EIS was signed on 20 May 1985. The final mitigation report, dated April 1987, recommended the construction of the Pointe Au Chien levee to assist in the management of 4,600 acres of wetlands within the Pointe Au Chien Wildlife Management Area. The final mitigation report for the Larose to Golden Meadow project was approved on 2 January 1987. An Environmental Assessment (EA) covering the revised levee alignment for Section D-North was distributed for review on 3 December 1990, and a Finding of No Significant Impact for the revised alignment was signed on 8 March 1991.

Project funding began in Fiscal Year 1967 with the appropriation of \$200,000 to initiate preconstruction engineering and design. Funds to initiate construction were first appropriated in Fiscal Year 1972. To date, the first and second lifts on all levee reaches have been completed, and the third and final lift has been completed on most reaches. The Larose floodgate was completed in 1987 and the Golden Meadow Floodgate, now officially known as the Leon Theriot Floodgate, was completed in 1985. The project is approximately 95 percent complete. The first lift on the Pointe Au Chien mitigation levee and the water control structures were completed in 1991. The second lift was completed in 2002 and additional lifts are not anticipated. The elevation of the Pointe Au Chein levee will be monitored to ensure that the mitigation feature continues to function as designed. Federal funds in the amount of \$77, 886,000 have been appropriated through Fiscal Year 2003. Completion of the project is scheduled for Fiscal Year 2007.

Prior Studies and Reports. Previous studies and reports relating to navigation and water resources projects in the study area have been prepared by the U.S. Army Corps of Engineers and state agencies. Several of these are discussed in the following paragraphs.

- The report, Bayou Lafourche, Louisiana published as House Document Number 45, 73rd Congress, resulted in the authorization by Public Law 73-409 (River and Harbor Act of 30

August 1935), of the closure of Bayou Lafourche at its junction with the Mississippi River, without a lock; a 6- x 60-foot channel from Napoleonville to Lockport, Louisiana, and between Larose, Louisiana, and the Gulf of Mexico; the closure of Pass Fourchon; and a jettied channel at Belle Pass. The reach of the 6- x 60-foot channel between Thibodaux and Lockport, Louisiana, was deauthorized under the authority of Section 1001(a) of Public Law 99-662 (Water Resources Development Act of 1986).

- The report, Bayou Lafourche and Lafourche-Jump Waterway, Louisiana published as House Document Number 112, 86th Congress, 1st Session, resulted in the authorization by Public Law 86-645 (River and Harbor Act of 1960) of a 12- by 125-foot auxiliary channel parallel to and west of Bayou Lafourche from the Gulf Intracoastal Waterway to Bayou Lafourche immediately south of Leeville, Louisiana (see Plate 2). From Leeville, the authorization provided for a 12- by 125-foot channel in Bayou Lafourche to the Gulf of Mexico. The authorization also provided for a 9- by 100-foot channel in Bayou Lafourche from the lower limits of Golden Meadow to Leeville, Louisiana; for the extension of jetties at Belle Pass from the 6-foot to the 12-foot contour; and for the Lafourche-Jump Waterway, a 12- by 125-foot channel, from Leeville to Grand Isle via the Southwestern Louisiana Canal and Bayou Rigaud. The portion of the 12- by 125-foot auxiliary channel parallel to and west of Bayou Lafourche and the Lafourche-Jump channel were never constructed and were deauthorized under the authority of Section 1001(a) of Public Law 99-662 (Water Resources Development Act of 1986) on 1 January 1990. The 12- by 125-foot auxiliary channel parallel to and west of Bayou Lafourche would have allowed vessel traffic on Bayou Lafourche to bypass Golden Meadow and the Leon Theriot Floodgate during periods when the floodgate was closed.
- A report entitled Louisiana - Texas Intracoastal Waterway, New Orleans, Louisiana to Corpus Christi, Texas, was published as House Document Number 230, 76th Congress, 1st Session. The project provides for an inland channel, 12 feet deep and 125 feet wide from the mouth of the Rigolettes to the Sabine River and includes eight primary navigation locks and 384 miles of channel. The Harvey Lock, connecting the inland channel to the Mississippi River, was completed in 1935. The main stem of the waterway was completed to the 12-foot project depth in 1948. The Algiers Canal alternate route and the Algiers Lock were completed in 1956. The Gulf Intracoastal Waterway project was modified by the River and Harbor Act of October 1962 to provide for a channel 16 feet deep and 150 feet wide between the Mississippi River and the Atchafalaya River via the Algiers Canal alternate route and a channel 16 feet deep by 200 feet wide between the Atchafalaya River and the Sabine River. This enlargement has been deauthorized. The main stem of the Gulf Intracoastal Waterway extends along the north side of the project levees and crosses Bayou Lafourche immediately north of the Larose Floodgate.
- The report, Port Fourchon, Louisiana, dated August 1994, resulted in the authorization by the Water Resources Development Act of 1996, of a channel with a project depth of 24 feet Mean Lower Low Water (MLLW) over a bottom width of 300 feet in Bayou Lafourche and Belle Pass between Port Fourchon, Mile 3.4, and the Gulf of Mexico, Mile 0.0, and for a channel with a depth of 26 feet MLLW with a bottom width of 300 feet in the Gulf of Mexico. The construction of the project was completed in August 2001.

PROBLEM IDENTIFICATION

Existing Conditions. Bayou Lafourche extends from the Mississippi River at Donaldsonville, Louisiana, to the Gulf of Mexico near Port Fourchon, a distance of about 88 miles. The bayou was a distributary of the Mississippi River until it was closed by an earthen levee in 1904. The alluvial banks of Bayou Lafourche are the highest natural ground in the area, ranging from an elevation of about 30 feet NGVD near the Mississippi River at Donaldsonville to about 2 feet NGVD near the Gulf of Mexico. Alluvial ridges along Bayou Lafourche are over 5 miles wide near the Mississippi River and continually narrow as you move south toward the Gulf of Mexico. The alluvial ridges are almost nonexistent south of Golden Meadow, Louisiana. The Leon Theriot Floodgate is a feature of the Larose to Golden Meadow hurricane protection project, which is located along an 18-mile reach of Bayou Lafourche in southeast Louisiana. The purpose of the floodgate is to provide for navigation on Bayou Lafourche and prevent tidal flooding within the project area. Construction of the floodgate was completed in 1985.

Bayou Lafourche receives only limited inflows as a result of the closure that was constructed at its junction with the Mississippi River. The State of Louisiana constructed a 210-cubic feet per second pumping station at the head of Bayou Lafourche in 1955 to provide freshwater to the bayou from the Mississippi River. Most of the natural drainage in the study area is from the ridges along Bayou Lafourche toward adjacent interbasin areas, except along the upper reaches of the bayou, near Thibodaux, Louisiana. In this area, drainage canals, with gated control structures, have been cut through the ridges to discharge flood flows to the bayou. Aside from the limited inflows coming from drainage canals along the upper reaches, flows in Bayou Lafourche are primarily limited to pumped flows. Openings in the natural banks of Bayou Lafourche occur upstream of the Larose Floodgate, the upstream limit of the Larose to Golden Meadow project, where existing navigation channels intersect the bayou. These navigation channels provide outlets for headwater flows north of the Larose to Golden Meadow project, and stages in Bayou Lafourche associated with headwater discharges upstream of the project, are not affected by closures of the Larose or Leon Theriot Floodgates.

The elevations of the alluvial ridges along Bayou Lafourche in the Larose to Golden Meadow project area range from 7 feet NGVD at Larose to less than 3 feet NGVD at the Leon Theriot Floodgate (about 2 miles south of Golden Meadow). The alluvial ridges were the first areas to be developed between Larose and Golden Meadow. As the population of the area continued to increase, the availability of undeveloped land along the existing ridges became scarce. The lower more vulnerable areas farther away from the bayou soon began to develop. Continued development along Bayou Lafourche led to the construction of small local levees and drainage canals to provide protection against flooding. Several communities including Larose, Cutoff, Galliano, and Golden Meadow are located within the project area. The total population of the project area based on the 2000 Census is estimated at approximately 20,000.

The Larose to Golden Meadow hurricane protection project authorized a 100-year level of protection to both the east and west banks of Bayou Lafourche. Existing local levees were upgraded, new levees were constructed, and floodgates in Bayou Lafourche were constructed at Larose and just south of Golden Meadow. The hurricane protection levees have generally been constructed between 1 to 2 miles away from the banks of Bayou Lafourche, except in the

Clovely Farms area, where the levee extends as far as 3 miles away from the bayou. The levees vary in elevation from around 9.5 feet NGVD at Larose to over 13 feet NGVD at Golden Meadow. When closed, the Larose and Leon Theriot Floodgates complete the line of protection and prevent a tidal flooding from Bayou Lafourche. The floodgates are generally left in the open position to minimize impacts to navigation. The floodgates are closed only when high stages in Bayou Lafourche threaten to flood the communities within the levee system. In order to prevent overtopping of the banks of Bayou Lafourche and flooding in the lower reaches of the project area, the Leon Theriot Floodgate was designed to be closed when the outside stage reaches 3.0 feet NGVD.

Natural ground elevations within the project area slope away from the ridges along the bayou to intercepted drainage canals located along the protected-side toe of the hurricane protection levee. Drainage is provided by a system of intercepted drainage canals and pumping stations, which discharge flows over the levee system. There are six pumping stations with a combined capacity of about 2,700 cubic feet per second. The pumping stations were constructed by the non-Federal sponsor in lieu of the authorized gravity drainage structures. Water levels in the drainage canals along the protected-side toe of the levee are maintained at an elevation of about -5 feet NGVD.

Closures of the Leon Theriot Floodgate result in delays to commercial navigation moving both north and south along Bayou Lafourche. Vessel traffic moving along Bayou Lafourche is delayed by these closures because there is not an alternative inland route that bypasses the Leon Theriot Floodgate. Closures of the floodgate also affect late arriving vessels seeking refuge within the protected area during hurricane events and delays vessels trying to leave the protected area after the storm has passed. With the development and continued growth of Port Fourchon at the mouth of Bayou Lafourche, the increased offshore oil and gas activity, and the commercial fishing industry, the increase in closures is causing a significant impact to navigation and commerce in the area. The delays experienced by commercial fishing vessels while trapped behind the floodgate are not likely to affect their annual catch because the captains will likely decide to make-up for the lost time by fishing extra days later in the season. Although their annual catch may not change, additional operational costs are being incurred by commercial fishing vessels while trapped behind the floodgate.

The first step in determining the impacts of closing the Leon Theriot Floodgate was to determine the size of the fleet operating along Bayou Lafourche and the number of daily passages through the floodgate. The size and composition of the fleet operating on Bayou Lafourche in the Golden Meadow area was initially estimated using bridge tender reports. Bridge opening data for the Golden Meadow Bridge (located closest to the Leon Theriot Floodgate) documented 6,810 openings in 1997 and 8,115 openings in 1998. This equates to around 20 openings per day. Bridge openings were more frequent during late spring and summer because of the higher number of fishing vessels using the waterway. On average, 50 percent of the openings were to pass a fishing boat, 42 percent for a tugboat, 4 percent for oil and gas supply boats, and 3 percent were unclassified. In order to more accurately determine the size and distribution of the fleet, three separate agencies conducted surveys of the commercial fishing vessels docked along Bayou Lafourche between Lockport and the Leon Theriot Floodgate in December 2000. Based on the results of these surveys, the bridge tender records, and interviews

with local interests, the fleet was estimated to consist of approximately 350 commercial fishing vessels, 100 tugboats, and 60 oil and gas supply boats. There are also approximately 75 commercial fishing vessels that dock along Bayou Lafourche between Golden Meadow and Port Fourchon. These vessels do not normally pass through the Leon Theriot Floodgate, but would seek shelter within the protected area in the event of an approaching hurricane.

Prior to the construction of the Larose to Golden Meadow hurricane protection project, the only restrictions to navigation on Bayou Lafourche south the Gulf Intracoastal Waterway were several low-level swing and lift bridges, which cause very short duration delays. Vessel operators seeking refuge during threats of tropical storms were able to pass through the Larose to Golden Meadow area to the upper reaches of the bayou without encountering significant delays. Additionally, after the storm, or storm threat, had passed, they were able to proceed to their original destinations. Since the construction of the hurricane protection project and the potential for closure of the Leon Theriot Floodgate, vessel operators must seek refuge in Bayou Lafourche much earlier to avoid being precluded access to the upper reaches of Bayou Lafourche. Vessels that do not reach safe harbor prior to the closure of the floodgate will be at risk to sustaining damage from storm surge. These vessels will be forced to ride out the storm anchored along the banks of Bayou Lafourche just south of the floodgate. The low-lying banks in this area offer almost no protection against storm surge. Vessels that reach safe harbor are often delayed waiting for stages to subside to a point where the floodgate can be opened without causing additional flooding. Vessel operators also occasionally encounter significant delays from extratropical weather events that cause high stages in Bayou Lafourche necessitating the closure of the Leon Theriot Floodgate. These delays did not exist prior to the construction of the floodgate.

Changed Conditions. The Chief of Engineers report entitled “Grand Isle and Vicinity, Louisiana,” contained in House Document No. 184, was authorized by Section 204 of Public Law 89-298 (Flood Control Act of 1965). This led to the preparation of the Grand Isle, Louisiana and Vicinity, Design Memorandum No. 1, General Design, dated May 1972. The construction of a lock south of Golden Meadow was considered during preparation of the Design Memorandum, but was not evaluated because the Bayou Lafourche and Lafourche-Jump Waterway project (as discussed under Prior Studies and Reports, pages 6 and 7 herein) was to include the construction of an auxiliary channel. The Bayou Lafourche auxiliary channel was to extend from Leeville, Louisiana to the Gulf Intracoastal Waterway near Larose, providing an alternate route for vessel traffic. The auxiliary channel would have allowed vessels to bypass both the Larose and Leon Theriot Floodgates. The Design Memorandum assumed that construction of the Bayou Lafourche auxiliary channel would be complete before construction of the floodgates was initiated. The auxiliary channel was never constructed and was deauthorized on 1 January 1990 under the authority of Section 1001(a) of Public Law 99-662 (Water Resources Development Act of 1986).

The combined effects of more active storm seasons in southeast Louisiana and sea level rise and ground subsidence have resulted in the Leon Theriot Floodgate being closed more frequently and for longer durations than originally planned. The Leon Theriot Floodgate was designed to be closed when stages in Bayou Lafourche reach an elevation of 3.0 feet NGVD. As a result of sea level rise and subsidence, the South Lafourche Levee District is now forced to

close the floodgate at an elevation of around 2.8 feet NGVD. The banks of Bayou Lafourche in the Golden Meadow area begin to be overtopped when the stage exceeds 2.8 feet NGVD. Flooding occurs as the water flows across Louisiana Highway 1 and into the low-lying residential and commercial structures in the area. Stages in excess of 2.8 feet NGVD in Bayou Lafourche at the Leon Theriot Floodgate usually occur several times a year and can be caused by both tropical and extratropical events. The average annual high water at the Leeville gage, located just south of the Leon Theriot Floodgate, based on the period of record, 1956 to 2001, is 3.3 feet NGVD . Records kept by the South Lafourche Levee District concerning the operation of the floodgate were used to determine the number of closures each year between 1985 and 1998 for both tropical and extratropical events. These records show that the floodgate was closed for a total of 1,539 hours over this 14-year period, for an average of 110 hours or 4.6 days per year. In 1985, Hurricane Juan (a minimal category 1 hurricane) forced the floodgate to remain closed for 78 hours. The total number of days of closure each year has increased over the 14-year period. Between 1998 and 2001, the floodgate was closed for an average of 172 hours per year. From 1995 to 1997, the floodgate was closed about 180 hours each year. The worst year of record was 1998 when the floodgate was closed for a total of 617 hours as a result of 6 tropical and 7 extratropical events. The floodgate was closed for 258 hours in 2001 resulting from 2 tropical and 5 extratropical events. In 2002, both Tropical Strom Isidore and Hurricane Lili made landfall along the Louisiana coast within a 10-day period causing the Leon Theriot Floodgate to remain closed for several days. During the past 9 years (1995-2003), the floodgate has been closed an average of 264 hours or 11 days per year, over twice the closure duration used in the economic analysis. A summary of closures of the Leon Theriot Floodgate is presented in Table 1.

The Leon Theriot Floodgate is located approximately 20 miles inland from the Gulf of Mexico. A hurricane impacting the area will push a tremendous amount of water over the low-lying marsh and up the surrounding bayous and waterways. Once the storm has passed, it will take a significant length of time for the water to drain back out of the area and for stages in Bayou Lafourche to drop sufficiently so the floodgate can be safely reopened. The heavy rain that usually accompanies a storm will increase the stages in Bayou Lafourche within the protected area (between the Leon Theriot and Larose Floodgates). Opening the Leon Theriot Floodgate before the stage outside the floodgate has dropped to an elevation of 3 ft NGVD would cause additional flooding within the protected area. Recent storm events have provided a record of the length of time the floodgate remains closed after a storm has passed. During Tropical Storm Bill in June 2003, the floodgate remained closed for approximately 30 hours after the eye of the storm passed north of Golden Meadow. The eye of the Tropical Storm Isidore passed over Lafourche Parish around 2:00 am on Thursday, 26 September 2002, and the floodgate was not reopened until 6:00 pm on Friday, 27 September 2002, a duration of 40 hours. During Hurricane Lili, the eye of the storm passed over Vermilion Parish around 10:00 am on Thursday, 3 October 2002, and the floodgate did not reopen until 7:00 pm on Saturday, 5 October 2002, a duration of 57 hours. The economic analysis assumed the floodgate would remain closed for approximately 26 hours after a storm has passed. This is a conservative assumption based on actual closures during past events.

TABLE 1
LEON THERIOT FLOODGATE CLOSURES (1985-2003)

Year	Tropical Storms		Extratropical Storms		Total Hours Closed
	Number	Hours Closed	Number	Hours Closed	
1985 ¹	1	78	0	0	78
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	1	33	4	134	167
1992	2	35	1	10	45
1993	1	20	0	0	20
1994	2	68	0	0	68
1995	2	185	0	0	185
1996	4	181	0	0	181
1997	3	120	4	62	182
1998	6	487	7	130	617
1999	2	84	4	87	171
2000	1	10	2	78	88
2001	2	73	5	185	258
2002	3	255	6	205	460
2003	2	78	5	163	241

¹ The Leon Theriot Floodgate was completed in 1985.

Port Fourchon, which is Louisiana's only port directly adjacent to the Gulf of Mexico, has grown from a small, insignificant port in the mid-1970's into the hub of offshore support services activity in the Central Gulf of Mexico today. Port Fourchon is a multi-use port equipped to accommodate and service the offshore oil, commercial fishing, Louisiana Offshore Oil Port (LOOP), seafood, shipping, tourist, and recreation industries. In 1996, Congress passed the Deepwater Royalty Relief Act, which allowed for economical drilling in waters deeper than 1,000 feet. The passage of this act, coupled with significant technological advances, led to tremendous growth in the deep offshore industry and Port Fourchon. Today, more than 600 offshore oil platforms are located within a 40-mile radius of Port Fourchon. The number of companies operating out of Port Fourchon has grown from only 2 in 1978 to 124 in 1999 and the number continues to increase. The physical size of the port has grown from about 25 acres in 1980 to nearly 600 acres in 1999, with an additional 700 acres currently under construction. Most of this growth has taken place within the past 10 years. The recent growth of Port Fourchon has led to an increase in vessel traffic well beyond what could have been anticipated at the time the Larose to Golden Meadow project was authorized. Many of the supplies that are essential for the offshore oil industry are transported to Port Fourchon by barge down Bayou Lafourche and delivery of these supplies are being delayed by closures of the Leon Theriot Floodgate.

These changed local conditions have resulted in a significant increase in the number and duration of closures of the Leon Theriot Floodgate and in the adverse impacts to navigation resulting from the closures.

Most Probable Future Conditions. Projected increases in the frequency and duration of closures of the Leon Theriot Floodgate were developed based on the projected effects of sea level rise and ground subsidence. The historical and projected rate of sea level rise in southeast Louisiana is 0.5 feet per century. Apparent ground subsidence is estimated to occur at a rate of 1.3 feet per century within the leveed areas. A combined rate of 0.9 ft was used to account for the effects of sea level rise and ground subsidence in the project area in the next 50 years (0.65 feet ground subsidence and 0.25 feet sea level rise). Continued ground subsidence will cause the Leon Theriot Floodgate to be closed at lower and lower stages over the next 50 years to prevent the flooding of residential and commercial property within the project area. Sea level rise will increase the frequency and duration of stages that require the floodgate to be closed. The cumulative effects of sea level rise and ground subsidence are projected to cause an apparent 0.9 foot rise in water levels in 50 years, which would result in the closure of the Leon Theriot Floodgate for 78 days per year, or 20 percent of the time (see Appendix A for details). A breakdown of the projected closures of the Leon Theriot Floodgate resulting from tropical and extratropical events for the years 2003, 2027, and 2052 are provided in Table 2.

TABLE 2
LEON THERIOT FLOODGATE CLOSURES
PROJECTED OVER 50 YEARS

Year	Duration of Closures (days)		
	Tropical	Extratropical	Total
2003	3.6	1.0	4.6
2027	31.8	9.5	41.3
2052	60.0	18.0	78.0

The size and composition of the fleet operating along Bayou Lafourche in the vicinity of the Leon Theriot Floodgate was projected for the next 50 years. Shrimp boats comprise the majority of the commercial fishing vessels in the study area. Therefore, the growth rate of the shrimping industry was used to estimate the growth rate for the commercial fishing vessels. Declining harvests, overcrowding due to excessive competition and increased operating costs, are factors that could lead to a decrease in the commercial shrimping industry. However, there are a number of efforts to improve the shrimp habitat in southeastern Louisiana, including the Caernarvon and Davis Pond Freshwater Diversion Structures, the Coastal Wetlands Protection and Restoration Act, and the Louisiana Coastal Area study. The purpose of these projects is to slow saltwater intrusion and to help restore coastal Louisiana. As a result of these offsetting

factors, the size of the commercial fishing fleet was held constant throughout the 50-year period of evaluation. The price and the resulting demand for oil and gas affects the amount of exploration and drilling activity occurring in the Gulf of Mexico, which has a direct affect on the number of oil and gas vessels needed for support. Based on several factors, including the projection that petroleum consumption in the United States is expected to increase at an average rate of 1.18 percent through 2030, a growth rate of 1.0 percent was used for the oil and gas supply vessels. Tugs are often used to support the oil and gas industry and the growth in the number of tugs is closely tied to the growth in the number of oil and gas supply vessels. Therefore, a growth rate of 1.0 percent was also used for projecting the number of tugs. This is probably a very conservative estimate given the growth of Port Fourchon during the past 10 years. The adverse impacts associated with closures of the Leon Theriot Floodgate will continue to increase as traffic on Bayou Lafourche increases and the floodgate is closed more often and for longer durations.

Larose Floodgate. The Larose Floodgate, located approximately 18 miles northwest of the Leon Theriot Floodgate, is also a feature of the Larose to Golden Meadow project. The Larose Floodgate was constructed in Bayou Lafourche just south of where the Gulf Intracoastal Waterway intersects Bayou Lafourche. High outside stages can result in the closure of the Larose Floodgate to prevent flooding within the project area. In order for stages in Bayou Lafourche near the Larose Floodgate to increase significantly, a strong southerly wind or tropical disturbance would need to be present for several days. Stages at Larose are not as heavily influenced by tidal fluctuations as stages at Golden Meadow. For the stages at Larose to increase, water from the Gulf of Mexico must be pushed into the wetlands and forced to flow north in the surrounding bayous and waterways. The stage at the Larose Floodgate usually does not increase as much or as quickly as the stage at the Leon Theriot Floodgate in response to extratropical events. As a result, closures of the Larose Floodgate do not occur nearly as often as closures of the Leon Theriot Floodgate. The South Lafourche Levee District generally closes the Larose Floodgate when the stage in Bayou Lafourche at the floodgate is projected to exceed 3.0 feet NGVD. Historical records show that the Larose Floodgate has only been closed in 5 of the 15 years since the floodgate was completed. The stage at Larose has exceeded 3.0 feet NGVD on only 7 different occasions during the 15 year period and the stage has exceeded 3.5 feet NGVD only twice.

In order to minimize the adverse impacts on navigation, the South Lafourche Levee District will usually open the floodgate to allow vessels to pass as long as the outside stage remains below 3.5 feet NGVD. The floodgate is typically opened for a short duration about once every hour to pass the waiting vessels. By opening the floodgate on an hourly basis, the adverse impacts to navigation are minimized. When stages exceed 3.5 feet NGVD, the floodgate remains closed. The majority of the impacts to navigation occur when the floodgates are closed and remain closed for several hours or days at a time. The stage at the Larose Floodgate usually does not exceed 3.5 feet NGVD unless a tropical storm is approaching the area. By the time a tropical storm would cause a stage in excess of 3.5 feet NGVD at the Larose Floodgate, weather conditions would likely have deteriorated to the point where it would no longer be safe for vessels to continue to operate. The vast majority of the adverse impacts to navigation are caused by closings of the Leon Theriot Floodgate, not the Larose Floodgate.

Delays to navigation from closures of the Larose Floodgate were not included in the economic analysis. Only 5 percent of the total delays to navigation occur during non-storm events. Closures that occur during non-storm events are usually for stages below 3.5 feet NGVD and the South Lafourche Levee District is able to open the floodgates approximately every hour to minimize delays to navigation. Due to the location of the Larose Floodgate, it is closed less often and for shorter durations than the Leon Theriot Floodgate. The operation of the Larose Floodgate generally does not affect vessels seeking refuge during a storm event or vessels seeking to exit the protected area after a storm has passed. Closure records maintained by the South Lafourche Levee District for the Larose Floodgate show that the stage has only exceeded 3.5 feet NGVD on one occasion that was not associated with a tropical storm. As long as the South Lafourche Levee District is able to open the floodgate once every hour to accommodate vessel traffic, the delays to navigation as a result of closures of the Larose Floodgate are relatively minor and would not affect the economic analysis of the proposed project modification.

Problems and Needs. Changing conditions have resulted in a significant increase in the delays caused by closures of the Leon Theriot Floodgate and the impacts of these closures. More active storm seasons in southeast Louisiana and sea level rise and ground subsidence have resulted in the Leon Theriot Floodgate being closed more frequently and for longer durations than originally planned. During design of the Leon Theriot Floodgate, it was assumed that the Bayou Lafourche auxiliary channel feature of the Bayou Lafourche and Lafourche-Jump Waterway project would be complete before construction of the floodgate was initiated. The auxiliary channel would have provided an alternate route for vessel traffic when high stages in Bayou Lafourche force the closure of the Leon Theriot Floodgate. The Bayou Lafourche auxiliary channel was never constructed and was deauthorized in 1990. Port Fourchon has also grown from a small port with very little activity to the hub of offshore support services activity in the Central Gulf of Mexico. The recent growth of Port Fourchon has led to an increase in vessel traffic well beyond what could have been anticipated at the time the Larose to Golden Meadow project was authorized.

During the weekend of 5 October 1996, commercial fishing vessels and oil and gas supply boats valued at about \$15 million were locked out of the hurricane protection system south of Golden Meadow. High tides caused by the formation of a low-pressure system forced the South Lafourche Levee District to close the Leon Theriot Floodgate. The low-pressure system later developed into a hurricane that was initially projected to make landfall in southeastern Louisiana. Since the floodgate was already closed due to high tides, all of the vessels south of the floodgate were prevented from seeking shelter behind the floodgate. Luckily the hurricane turned and missed the Louisiana coast. If the hurricane had continued along the initial forecast track and made landfall near Grand Isle, many of the vessels trapped outside of the floodgate would have likely sustained extensive damage.

Projected sea level rise and ground subsidence will continue to result in future increases in the frequency and duration of required closures of the Leon Theriot Floodgate. The South Lafourche Levee District requested the Corps of Engineers evaluate alternative measures to reduce the impacts these closures are having on navigation interests in the area. In response to their request, an economic analysis was conducted to determine the adverse impacts of these

closures. The average annual cost of the floodgate closures, including storm and non-storm closure costs, storm preparation costs, vessel damage costs, closure delay costs, and egress delay costs, was estimated at \$1,479,900 (see Appendix B for details). These adverse impacts (costs to navigation) are being incurred as a result of the construction of the Leon Theriot Floodgate. This evaluation report presents the changed local conditions making the additional work necessary and the results of studies to determine the technical, environmental, and economic feasibility and justification of alternative measures to mitigate for these impacts.

PLAN FORMULATION

Planning Constraints. Legislative and executive authorities have specified the range of impacts to be assessed, and have set forth the planning constraints and criteria that must be applied when evaluating alternative plans. Plans must be developed with due regard to the benefits and costs, both tangible and intangible, as well as associated effects on the ecological, social and economic well-being of the region. Federal participation in developments should also ensure that any plan is complete in itself, efficient and safe (i.e. technically feasible), economically feasible in terms of current prices, environmentally acceptable, and consistent and acceptable in accordance with local, regional, and state plans and policies. As far as practical, plans should be formulated to maximize the beneficial effects and minimize the adverse impacts of the considered improvements.

Planning Objectives. The following planning objectives were established in response to the identified problems, needs, and opportunities:

- a. Modify the Larose to Golden Meadow hurricane protection project to mitigate for adverse impacts to commercial navigation on Bayou Lafourche caused by closings of the Leon Theriot Floodgate.
- b. Contribute to the Nation's economic development by reducing delays to navigation.
- c. Minimize adverse impacts to the natural environment and social well-being.
- d. Maintain existing level of hurricane protection to residents living along Bayou Lafourche between Larose and Golden Meadow.

Plans Considered. Two alternative plans were developed for reducing delays to navigation on Bayou Lafourche caused by closures of the Leon Theriot Floodgate. The alternatives would reduce impacts to navigation by allowing vessels to continue to transit Bayou Lafourche through the Golden Meadow area when stages south of the Leon Theriot Floodgate exceed 3 feet NGVD. A brief description of each alternative is presented below (see Appendix A for more detail).

Plan 1. Bayou Lafourche Bankline Protection. This plan would provide for the establishment of a low-level line of flood protection along the east and west banks of Bayou Lafourche in the lower reach of the Larose to Golden Meadow project area. By increasing the height of the banks along Bayou Lafourche, higher stages could be tolerated before any flooding would occur. The line of protection would include earthen levees, I-walls, and bulkheads. Space restrictions limit the use of levees to only the east bank of Bayou Lafourche near the Leon Theriot Floodgate. I-walls would be used where there is at least 20 feet between the top of the bank and the nearest obstruction. In locations where the existing road is in close proximity to Bayou Lafourche, a bulkhead was the only option. With this plan, the Leon Theriot Floodgate would remain open until significantly higher stages are reached in Bayou Lafourche. A maximum safe operating stage of 5 feet NGVD was used for this alternative. Closures of the Leon Theriot Floodgate for stages above 5 feet NGVD would not adversely impact navigation interests because the weather conditions associated with a storm of this magnitude would likely

cause all navigation interests to suspend operations. In order to account for the effects of settlement, ground subsidence, and wave run-up, a design elevation of 7.5 feet NGVD was used for the design height of the protection. The protection would extend north from the Leon Theriot Floodgate, until the height of the existing banks of Bayou Lafourche reach the design grade, approximately 12 miles on each side of the bayou.

Louisiana Highway 1 (LA 1) runs along the east bank of Bayou Lafourche between Larose and Golden Meadow and Louisiana Highway 308 (LA 308) runs along the west bank. The existing grade of LA 1 and LA 308 in the general vicinity of Golden Meadow averages between 2 and 3 feet NGVD. Raising these roadways to an elevation of 7.5 feet NGVD was also considered for this alternative; however, this alternative would cost significantly more than constructing the levees, I-walls, and bulkheads.

Plan 2. Leon Theriot Lock. This plan provides for converting the existing Leon Theriot Floodgate into a lock. A second gated structure would be constructed in Bayou Lafourche. Earthen levees constructed between the two sets of gates would form a lock chamber with dimensions of 56 feet wide by 400 feet long. Timber guide walls would be constructed on each side of the lock and at the approach to the new floodgate. The new floodgate would be located on the protected side, or north of the existing floodgate, and would not be subject to hurricane surge. The construction of a second floodgate would allow vessel traffic to lock through the structures when stages in Bayou Lafourche would otherwise force the closure of the Leon Theriot Floodgate. The design height of the new structure would be 7.5 feet NGVD, based on an operating stage of 5.0 feet NGVD, a 1-foot allowance for waves inside the chamber, and 1.5 feet for future sea level rise, ground subsidence, and structure settlement.

Two alternative methods for constructing the second floodgate were considered. The existing Leon Theriot Floodgate was constructed in the 1980's using conventional construction techniques. The conventional approach requires constructing a cellular or braced cofferdam, dewatering the site and building the gate bay monolith inside the dewatered cofferdam. A bypass channel is also generally required to avoid closing the waterway to navigation during construction of the floodgate. The Leon Theriot Floodgate provides protection against a hurricane surge moving up Bayou Lafourche for the areas between Larose and Golden Meadow. Due to the amount of vessel traffic in Bayou Lafourche, a temporary bypass channel would be needed if conventional construction techniques were used. In order to construct a bypass channel, a large cut in the existing protection would be required. The gap in the protection would remain until the new floodgate is completed and the temporary bypass channel can be closed. As a result of the high cost of constructing a cofferdam and bypass channel and the problems associated with cutting a gap in the existing line of protection, conventional construction techniques were eliminated from further consideration.

The technology that has made float-in structures practical in the petroleum industry is now being used in the design and construction of locks and floodgates. A reinforced concrete structure is constructed off-site, floated into place, sunk on a prepared foundation, and ballasted in place. Float-in structures can be built at local graving sites, at casting yard facilities, on barge tops, or in a dry dock. This technology is being used in the design and construction of the Harvey Canal Floodgate sector-gate feature of the West Bank Hurricane Protection project and

the Inner Harbor Navigation Canal Lock replacement project, both within the New Orleans District. The advantages of a float-in structure include a significant cost savings by eliminating the construction of a cofferdam and bypass channel. Using a float-in structure also eliminates the need to cut a gap in the existing line of protection. As a result of these benefits, the float-in approach will be used to further evaluate this alternative.

The existing Leon Theriot Floodgate, with a clear opening of 56 feet, creates a restriction to navigation on Bayou Lafourche. Vessels cannot pass each other within several hundred feet of the floodgate and must generally slow down to safely pass through the gate. Although relatively minor, this causes a delay. If the floodgate is converted to a lock, vessels will be required to slow down for a greater distance, thereby increasing the delay. Openings of greater than 56 feet were evaluated for the new floodgate to ensure that a full-range of alternatives were considered. To minimize any additional delays that would be caused by converting the floodgate into a lock, a 110-foot clear opening was evaluated for the new floodgate. The purpose for the wider gate would be to allow vessels to pass through the structure in less time during open pass conditions. Based on the results of our analysis, the 110-foot gate did not significantly reduce the additional delays that would occur. However, the cost to convert the floodgate into a lock significantly increased. A 110-foot gate resulted in a 65 percent increase in the estimated construction cost when compared to a 56-foot gate. The benefits associated with increasing the width of the second floodgate to 110-feet did not offset the additional cost. As a result, the 110-foot gate was eliminated from further consideration.

Alternative chamber lengths were considered to ensure that the optimum lock configuration is selected. The most significant delays to navigation under the with-project conditions will occur just after a tropical storm or hurricane has passed through the area. As a hurricane approaches, most of the commercial fishing vessels, tugs, and oil and gas supply boats operating in the area will seek shelter between the Larose and Leon Theriot Floodgates. After the storm has passed, these same vessels will want to get back out as quickly as possible to resume operations. Passing through the Leon Theriot Lock would be the only means to exit the area until stages in Bayou Lafourche recede to a point where the gates could safely be left in the open position. Waiting to lock through the structures will result in a delay to many of the vessels. The length of delay is dependent on the number of vessels that can be locked through during each cycle. By increasing the length of the chamber, a greater number of vessels could be loaded into the chamber during each cycle, thereby reducing the delay. Consideration was given to lengthening the chamber to either 600 or 800 feet to reduce this delay. A large seafood processing plant is located in a bend in Bayou Lafourche just north of the existing Leon Theriot Floodgate. In order to maintain the minimum channel dimensions required for vessels to safely navigate the area, the bend would need to be straightened if the chamber were lengthened to 600 or 800 feet. Any efforts to straighten the bend would require the relocation of the seafood processing plant at a considerable expense. The benefits associated with lengthening the chamber would be more than offset by having to relocate the seafood processing plant. The maximum length of a tow operating on Bayou Lafourche is 350 feet, which can be safely accommodated with a chamber length of 400 feet. Chamber lengths of greater than 400 feet were not evaluated further.

In addition to considering chamber lengths of greater than 400 feet, chamber lengths of less than 400 feet were also considered. A chamber length of 200 feet would have two major drawbacks. The chamber would be sufficient to pass the commercial fishing boats and oil and gas supply vessels, but tug-boats pushing a barge would have to look for alternate routes during periods where high stages in Bayou Lafourche necessitate the closing of the floodgate. The continued movement of barges along Bayou Lafourche is critical to support the increase in the offshore oil and gas activity and the continued growth of Port Fourchon. Approximately 30 percent of the benefits associated with converting the existing floodgate into a lock are attributable to tugboat traffic on Bayou Lafourche. A shorter chamber length would also significantly lengthen the amount of time required to lock all of the vessels through after a storm has passed further reducing the benefits. Reducing the chamber length to 200 feet does not result in a significant cost savings because the change only reduces the length of the chamber guidewalls and the earthen chamber levees. The majority of the costs for converting the floodgate into a lock are associated with constructing the additional floodgate, which is not dependent on the length of the chamber. The reduction in cost for constructing a lock with a chamber length of 200 feet is not sufficient to offset the reduction in benefits. A chamber length of only 200 feet would also not be implementable because it would not accommodate the barge traffic moving along Bayou Lafourche.

The final option utilizing the float-in technology would provide for the construction of a much smaller stand-alone lock. The entire lock would be constructed offsite and floated-into place in the general vicinity of the old by-pass channel. The lock would be constructed with a clear opening of 40 feet and a useable length of 100 feet. The lock would only be used during periods when high tides necessitate closing the existing Leon Theriot Floodgate. Due to the reduced clear opening and useable chamber length, only the commercial fishing vessels would be able to pass through the lock. The oil and gas supply vessels and the tugboats would have to find alternate routes during periods when the Leon Theriot Floodgate is closed. Although commercial fishing vessels would benefit from the smaller lock, this alternative would not benefit the tugboats and oil and gas supply vessels. The cost savings associated with constructing a smaller stand-alone lock would be more than offset by the loss of all benefits associated with tugs and oil and gas supply vessels. This alternative would not be implementable because it only addresses the problems of the commercial fishing vessels.

Plan Evaluation. An analysis was conducted to determine the ability of each of the alternative plans to continue to provide hurricane protection for the study area, protect natural resources, reduce adverse impacts to commercial navigation on Bayou Lafourche caused by closings of the Leon Theriot Floodgate, and be accepted by the public.

Plan 1. Bayou Lafourche Bankline Protection. Plan 1 would provide for constructing a low-level line of flood protection along the east and west banks of Bayou Lafourche. The existing banks of the bayou are subject to being overtopped in the Golden Meadow area at a stage of between 2.8 and 3.0 feet NGVD. To prevent the banks from being overtopped, the South Lafourche Levee District must close the Leon Theriot Floodgate. Closures of the floodgate cause significant delays to navigation moving both north and south along Bayou Lafourche. Providing a low-level line of protection along the banks of the bayou would allow the floodgate to remain open until significantly higher stages are reached.

Raising the protection along the banks of Bayou Lafourche in the lower reach of the Larose to Golden Meadow project area would essentially eliminate all delays associated with the closure of the Leon Theriot and Larose Floodgates. Potential damages to vessels precluded from refuge in the project area during an impending tropical storm or hurricane would also be eliminated. Under existing conditions, expected average annual costs of \$1,479,900 are associated with navigation delays and vessel damages resulting from closures of the floodgate. Assuming all of these delays would be eliminated by raising the protection along the banks of the bayou, the maximum reduction in annual delay costs for this alternative would be \$1,479,900.

The estimated implementation cost for Plan 1 is \$30,000,000, exclusive of real estate costs and the cost of gate openings for residential and commercial access. Using a discount rate of 5.625 percent and a 50-year period of evaluation, the average annual cost is estimated at \$2,165,000. The resulting benefit to cost ratio is 0.74

In addition to having a benefit to cost ratio of significantly less than 1.0, constructing a small levee along the east bank of Bayou Lafourche below Golden Meadow would adversely impact approximately 25 acres of wetlands. The construction of bulkheads and floodwalls in the more heavily developed areas would also adversely impact access to the bayou. There are numerous locations along Bayou Lafourche where owners are allowed to tie-up their boats. Even with the construction of gate openings, commercial and residential access would be limited. The access gates would be closed when stages in Bayou Lafourche exceed 3 feet NGVD, further impacting navigation interests.

The Bayou Lafourche bankline protection alternative would be very effective in reducing expected delays to navigation and potential damages to vessels caused by tropical storms and hurricanes. However, Plan 1 is not economically justified based on an initial cost estimate that does not include real estate or gates for residential and commercial access. Further consideration of Plan 1 was discontinued when it became obvious that it would not be economically justified.

Plan 2. Leon Theriot Lock. Plan 2 provides for converting the existing Leon Theriot Floodgate into a lock by constructing a second floodgate 400 feet north of the existing floodgate. The second floodgate would be constructed off-site and floated into place. Earthen levees would connect the gate bay monolith to the existing floodgate and the basin to the lock. Timber guide walls would be constructed on each side of the lock and at the approach to the new floodgate. The height of the interior levees and floodwalls are based on the maximum water levels that can be expected to occur during locking operations. Using a maximum operating stage of 5.0 feet NGVD, and adding another 1-foot allowance for waves inside the chamber and 1.5 feet for future sea level rise, ground subsidence, and structure settlement, results in a final design height of 7.5 feet NGVD. The clear opening of the second floodgate will be the same as the existing floodgate, 56 feet. The length of the chamber will be 400 feet to allow for the passage of the largest tow allowed on Bayou Lafourche. Tows moving on Bayou Lafourche are limited to a maximum length of 350 feet. A 400-foot chamber would safely accommodate the largest tow allowed with 25 feet of clearance from each gate.

Converting the Leon Theriot Floodgate into a lock would eliminate approximately 75 percent of the current delays caused by closures of the floodgate. Vessels would be allowed to

lock through the structures when high stages in Bayou Lafourche would have otherwise resulted in the closure of the floodgate. With a lock in-place, late arriving vessels would no longer be denied access into the protected area during an approaching hurricane. If the area were to be impacted by a hurricane, vessels that took refuge within the project area could begin locking through the structures as soon as the high winds subside. High outside stages could remain for several days preventing the floodgates from being left in the open-pass position. Vessels trying to leave the protected area would initially experience minor delays while waiting to be locked through the structures. These delays would be considerably less than if they had to wait for the stages to drop to a point where the existing floodgate could be left in the open-pass position. By constructing the new floodgate off-site, navigation on Bayou Lafourche would only be adversely impacted during two separate two-week closures that would occur during installation of the new gate. With proper planning and notification, the adverse impacts of these delays could be minimized. The average annual cost of the remaining delays with a lock in-place is estimated at \$365,300. The average annual cost of the delays under existing conditions is \$1,479,900. The resulting decrease in average annual delay costs for this alternative is \$1,114,600.

The estimated implementation cost for Plan 2 is \$12,446,000, including all real estate costs. Using a discount rate of 5.625 percent and a 50-year period of evaluation, the average annual cost is estimated at \$814,000. The average annual cost for the operations, maintenance, repair, replacement, and rehabilitation cost is estimated at \$64,900. This increases the total average annual cost to \$878,900. The resulting benefit to cost ratio is 1.27.

The environmental impacts associated with converting the Leon Theriot Floodgate into a lock would be limited to 8.5 acres of water bottoms. The impacts would be temporary to approximately 7.4 acres of the affected water bottoms because they would likely repopulate with benthics and associated aquatics from the surrounding area. Approximately 13,100 cubic yards of material would be removed from the channel for navigation and an additional 20,000 cubic yards of material would be removed from the site of the new floodgate. The excavated material would be placed in the abandoned by-pass channel to create as much shallow water area as possible. The shallow water area will not only create a fishery habitat, but will also provide a habitat suitable for aquatic vegetation.

Summary of Plan Assessment. The cost to provide a low-level line of protection along the banks of Bayou Lafourche in the lower reaches of the project area (Plan 1) results in a benefit to cost ratio of 0.74. Constructing the levees, floodwalls, and bulkheads along Bayou Lafourche would result in significant environmental impacts and would severely restrict access to Bayou Lafourche. Converting the Leon Theriot Floodgate into a lock (Plan 2) by constructing a second floodgate just to the north of the existing floodgate results in a benefit to cost ratio of 1.27. By constructing the structure off-site and floating it into place, the need for a cofferdam and bypass channel is avoided and the construction duration is reduced. With a lock in-place, delays to navigation would be significantly reduced, the environmental impacts would be minimized, and access to Bayou Lafourche would be maintained. Converting the existing Leon Theriot Floodgate into a lock by constructing a second floodgate with a clear opening of 56 feet and a chamber length of 400 feet provides the greatest net benefits, causes the fewest adverse impacts, and is the recommended plan.

RECOMMENDED PLAN

Plan Description. The recommended plan provides for converting the existing Leon Theriot Floodgate into a 56- by 400-foot lock. Features of the plan include:

- a. A new sector-gated structure constructed off-site and floated into position about 400 feet north of the existing Leon Theriot Floodgate;
- b. Earthen levees between the existing floodgate and the new sector-gated structure forming a lock chamber with dimensions of 56 wide by 400 feet long;
- c. Timber guide walls along either side of the lock chamber and a timber approach guidewall on the north side of the new gate structure; and
- d. A minor realignment of the approach channel on the north side of the lock.

Relocations. There are no relocations of submarine pipelines or cables, roads, overhead cables, or other facilities required for the implementation of the recommended plan.

Real Estate Plan. Development along Bayou Lafourche is mostly industrial and commercial. The property frontage on LA 1 and Bayou Lafourche has a highest and best use for commercial purposes associated with the bayou frontage. The wetland property on the east side of Bayou Lafourche has a highest and best use of recreation purposes.

The non-Federal sponsor owns 39.5 acres in fee that were acquired prior to the construction of the existing Leon Theriot Floodgate. A minor channel realignment is required north of the proposed lock for navigation purposes. This will require the acquisition of a channel improvement easement over 0.53 acres of commercial land and 1.24 acres of marsh. The construction of the recommended project will have a direct impact on three to four owners. Minerals are not affected by the easements. There are no oyster leases within the project area or that would be affected by the construction, operation, or maintenance of the proposed project.

Acquisition of private property will be accomplished in accordance with the Uniform Relocation Assistance and Real Property Act of 1970, Public Law 91-646, as amended. All properties impacted by this project are vacant; since there is no displacement of persons and habitable or commercial structures, the provisions of Title II of Public Law 91-646 are not currently applicable. However, should current plans change, and the displacement of persons and habitable or commercial structures be required during the construction of this project, Title II of this Act may become relevant.

Access to the construction site will be by public road, land owned by the non-Federal sponsor, and by Bayou Lafourche. Because Bayou Lafourche is a navigable waterway used for interstate commerce, the navigational servitude will be invoked for the areas of the channel where the new floodgate will be constructed.

The non-Federal sponsor has been responsible for all acquisition needed to construct the original project and for the operation and maintenance. The non-Federal sponsor has the capability to acquire the necessary interests. The non-Federal sponsor also has quick take authority.

Operations and Maintenance Considerations. Normally scheduled repairs on the existing Leon Theriot Floodgate are currently performed every 10-12 years. Repairs required as a result of navigation impacts are not likely to increase with implementation of the recommended plan. Scheduled repairs on the existing floodgate were last performed in 1995. In order to avoid blocking navigation on Bayou Lafourche for a significant length of time, the existing gates were removed in the wet. This necessitated closing Bayou Lafourche to traffic for approximately 4 days, 2 during removal of the gates and 2 during installation of the refurbished gates. Removing the gates in the wet limited the time Bayou Lafourche was closed to traffic, but it also left the project area without complete protection. The only way to close the gap during the two months the floodgates were being refurbished would have been to use the emergency closure needles stored at the site. Under the with project conditions, the necessary repairs/rehabilitation would be performed without dewatering. One set of the floodgates would be removed in the wet, moved to a work site for sandblasting, painting, and any other necessary repairs. Once the repairs were complete, the gates would be transported back to the site and reinstalled. The second set of gates would then be removed (in the wet) and moved to a work site for repairs. This would allow one set of gates to remain operational at all times and to minimize impacts to navigation.

Design Considerations. The width of the new floodgate would be the same as the existing floodgate, which is 56 feet. The chamber length would be 400 feet to allow for the passage of the maximum tow allowed on Bayou Lafourche. Tows moving on Bayou Lafourche are limited to a maximum length of 350 feet. A chamber length of 400 feet would safely accommodate a tow of 350 feet with 25 feet of clearance from each gate. Several alternatives exist for floating the new structure into place. One foot of clearance is acceptable on smaller lock structures so a work barge 55 feet wide, capable of passing through either the Larose or Leon Theriot Floodgates, could be used. Another alternative would involve designing and constructing the monolith as a buoyant concrete barge, which could be floated into position unassisted, thus eliminating the need for a work barge altogether. The old bypass channel used during the construction of the Leon Theriot Floodgate also provides sufficient space to moor a work barge. Once completed and hauled into place, the new floodgate would be anchored in place and supported using 36-inch diameter steel pipe piles driven through sleeves cast into the gate monolith slab.

The location of the existing floodgate precludes the development of a plan with straight approach channels. The recommended plan provides for some minor realignment of the channel north of the lock to ensure adequate channel dimensions are provided. Acceptable channel curvatures and dimensions were determined using EM 1110-2-1611, Layout and Design of Shallow Draft Waterways. A description of the minimum channel dimensions is provided in Appendix A. The approach channels and lock chamber designs will be addressed further to assure that the optimum alignments are developed and that the approaches are reasonably safe.

A model study has been conducted by the Engineer Research and Development Center (ERDC) to optimize the design of the approach channels, lock chamber, and guide walls and the recommendations from this modeling effort are being incorporated into the detailed design report (DDR).

Due to the highly compressible nature of the foundation, the earthen levees connecting the gate bay monolith to the existing floodgate, and the basin to the lock, would be constructed in two lifts. The tie-in levee will require sheeting for seepage cutoff through the sand fill and to provide flood protection above the levee crown. The height of the interior levees and floodwalls are based on the maximum water levels that can be expected to occur during locking operations. Using a maximum operating stage of 5.0 feet NGVD, and adding another 1-foot allowance for waves inside the chamber and 1.5 feet for future sea level rise, ground subsidence, and structure settlement, results in a final design height of 7.5 feet NGVD.

Construction of the recommended plan will take approximately 18 months. There will be two closures of Bayou Lafourche during the construction period, each lasting approximately 2 weeks. The first closure will permit opening the channel for 12 hours of nighttime transit. The second closure will require the channel to be shut down for the entire 2 weeks. With proper planning and coordination with navigation interests in the area, the impacts of these closures can be minimized.

The existing Leon Theriot Floodgate is currently unmanned except when stages increase to the point where the floodgate must be closed to prevent flooding inside the protected area. The new lock structure will also be unmanned except during periods when the lock is being operated. The possibility of a system that allows the lock to be remotely operated has been evaluated in order to reduce the potential for an accident. The Golden Meadow Bridge is located just north of the floodgate and is manned 24 hours a day by a bridge tender. The bridge tender could easily monitor the flow of traffic through the lock using remotely operated cameras. A lighting system could also be used to remotely control the flow of traffic through the area. The cost for remotely operated cameras and a system of lights has been included in the total project cost. Additional alternatives for monitoring traffic and remotely operating the lock will be evaluated during the detailed design phase.

Implementation Costs. The estimated cost to convert the Leon Theriot Floodgate into a lock is based on readily available data maintained by the New Orleans District. The cost estimate reflects current and applicable pricing and addresses specific construction procedures for the various line items in the estimate. The estimated costs were based on an analysis of each line item evaluating quantity, production rate, and time, together with the appropriate equipment, labor, and material costs. In addition, the costs were based on actual in-house knowledge and experience by cost engineers within the New Orleans District who either personally designed or estimated similar projects. The construction site is accessible by land (LA 1 and LA 308) and by water (Bayou Lafourche). The material required for the project could be delivered to the site by either truck or barge. All of the construction work (excavation, dewatering, pilings, concrete placement, rock placement, etc.) is similar to other work performed within the New Orleans District. Contingencies for the cost estimate were based upon similar cost estimates that had a risk analysis performed using the Range Estimating computer program, historical data, or

regulation. For this project, a contingency of 20 percent was used. The estimated cost to construct the recommended plan is \$12,311,000. The total real estate costs for this plan were estimated at \$135,000. The resulting total implementation cost for the project is \$12,446,000. A breakdown of the estimated project cost is presented in Table 3.

TABLE 3
CONSTRUCTION COST ESTIMATE FOR RECOMMENDED PLAN¹

Item	Cost
Lock Conversion Cost	\$9,160,000
Contingencies	<u>\$1,832,000</u>
Subtotal	\$10,992,000
Engineering and Design	\$769,000
Construction Management	<u>\$550,000</u>
Subtotal	\$12,311,000
Real Estate Cost	<u>\$135,000</u>
TOTAL IMPLEMENTATION COST ¹	\$12,446,000

¹Conversion of Leon Theriot Floodgate to a lock with a chamber length of 400 ft

Reduction in Delay Costs. There are significant delay costs to commercial navigation associated with closures of the existing Leon Theriot Floodgate. The floodgate is closed to prevent flooding within the project area due to high tidal stages in Bayou Lafourche. The conversion of the floodgate into a lock would result in a significant reduction in these delay costs. The reduction in delay costs represents an economic efficiency or an increase in National Economic Development (NED) because resources will be released for productive use elsewhere in the economy.

Tropical and extra-tropical events cause high stages in Bayou Lafourche forcing the closure of the Leon Theriot Floodgate to prevent the flooding of low-lying areas within the Larose to Golden Meadow project area. When the floodgate is closed under existing conditions, vessels are not able to pass and are delayed until the floodgate reopens. During the delays, vessels are incurring costs, which are assumed to be the operating costs. The tugs and oil and gas supply vessels are an integral part of the oil and gas industry in south Louisiana and must be available 365 days a year (not part-time or seasonal employment). Full vessel operating costs with adjustments for fuel consumption were used as a measure of the delay costs for these vessels. Commercial fishing vessels and “Other” vessels are not fully employed year round so only variable operating costs were used in determining the cost of the delays for these vessels. The economic analysis assumes the captains of commercial fishing vessels will likely decide to make-up for the time lost while trapped behind the floodgate by fishing extra days later in the

season. Since there will be no increased catch associated with avoiding the delays caused by closures of existing floodgate, the estimated savings in variable operating costs are an appropriate measure of the change in net income for the commercial fishing fleet.

The delay costs represent the value of labor and capitol that sits idle due to a closure. The costs associated with the delays can be grouped into three main categories, storm closure costs, non-storm closure costs, and construction delay costs. The storm closure costs, which account for approximately 94 percent of the total delay costs, include the following categories; the diversion of the oil and gas supply vessels during a storm; storm preparation and vessel damage costs for vessels trapped outside the floodgate; and the delay of vessels waiting to resume operations upon the passage of the storm.

The economic analysis assumed that all commercial fishing vessels, tugs, and “other” vessels would seek shelter behind the existing floodgate during a storm. However, because it is critical for the oil and gas supply vessels to resume operations as soon as the storm has passed, they are assumed to seek shelter elsewhere. Morgan City (which is the heart of the Oil and Gas industry in south Louisiana) in all likelihood would be the closest location with facilities that could handle the additional oil and gas supply vessels seeking shelter and is located a sufficient distance from Golden Meadow to be outside of the area most heavily impacted by storm surge. By diverting to Morgan City, the oil and gas supply vessels would incur an additional 10 hours of travel time (5 hrs each way). The delay costs that would be incurred by getting trapped behind the floodgate are almost twice as much as diverting to Morgan City. Although not all of the oil and gas supply vessels will divert to Morgan City during all storm events, it is the closest reasonable destination and is a conservative assumption. A map showing the inland waterway system that would be used by captains of oil and gas supply vessels to seek shelter is provided as Plate 4.

The stage damage curves for commercial fishing vessels developed for the Morganza, Louisiana to the Gulf of Mexico, Hurricane Protection project were used to determine the potential damage to commercial fishing vessels trapped outside the Leon Theriot Floodgate. These curves should be representative of the damages that would be incurred in both study areas. The major cause of damage to boats during a storm event is storm surge, or an increase in the water elevation where the vessels are moored. While winds and waves may bounce a boat around at its mooring, these factors alone will typically not cause major damages to a well-built vessel that is properly moored. It is the rising water level from the storm surge that uses the buoyancy of the boat to overload the mooring lines, causing them to break. If the water rises high enough, either the mooring lines must break, or the boat will be pulled onto its side and will eventually sink due to flooding of the interior of the hull. Once a boat has broken free from the mooring lines, it will be driven by the wind and waves until it hits another object or ends up in water shallow enough to stop its travel. Wind, waves, proximity to other boats, and security of moorings are factors in addition to storm surge that effect the amount of damage that vessels will incur. The wind velocity and size of the waves are factors directly related to the severity of the storm, and the best measure of the severity of the storm is storm surge. As a result, the stage damage curves use the amount of storm surge as the independent variable in determining the amount of damage likely to occur.

The Leon Theriot Floodgate does not usually remain closed for extended periods during the non-storm events, and the delay costs associated with these closures only account for 6 percent of the total delay costs. The total average annual costs of the delays under without-project conditions are estimated at \$1,479,900. A summary of the storm and non-storm delay costs is presented in Table 4. Construction delay costs would occur during the conversion of the existing floodgate into a lock, and are only applicable under the with-project conditions.

TABLE 4
SUMMARY OF TOTAL DELAY COSTS
ASSOCIATED WITH THE LEON THERIOT FLOODGATE¹

Category	Average Annual Cost ²
Diversion of Oil & Gas Vessels	\$61,500
Storm Preparation Costs	\$2,300
Vessel Damage Costs	\$132,700
Storm Closure Costs	\$1,154,100
Egress Delay Costs	\$33,000
Non-storm Closure Costs	<u>\$96,300</u>
TOTAL	\$1,479,900

¹Based on Oct 2000 price levels, an interest rate of 5.625%, and a 50-year period of evaluation.

² This report was prepared using the FY 2000 Shallow Draft Vessel Operating Costs, which are the latest available from the Institute for Water Resources (IWR).

Converting the Leon Theriot Floodgate into a lock would reduce delays to navigation caused by closures of the floodgate. Reducing the delays results in a reduction of the economic cost to navigation (a benefit). The benefits of the recommended project are the difference in delay costs between the existing conditions and the with-project conditions. Under the with-project conditions, the vessels would be able to pass through the lock until stages in Bayou Lafourche exceed 5.0 feet NGVD. This would significantly reduce the delays to navigation. The recommended project modification eliminates approximately 75 percent of the storm closure costs and all of the non-storm closure costs. In order to convert the existing Leon Theriot Floodgate into a lock, two separate two-week closures of Bayou Lafourche would be required during construction. With proper planning and notifications, the delays associated with these closures could be minimized. The construction would be scheduled for January or February, when fleet activity is at its lowest, and there is no threat of a hurricane. The construction delay costs have been included under the with-project conditions. The total average annual costs of the remaining delays under the with-project conditions are estimated at \$365,300. The reduction in delay costs (average annual benefits), or the difference between the without-project conditions and the with-project conditions, are estimated at \$1,114,600. A summary of the without- and with-project delay costs are presented in Table 5.

TABLE 5
REDUCTION IN DELAY COSTS FOR RECOMMENDED PLAN¹

	Avg. Annual Delay Cost Without-Project	Avg. Annual Delay Cost With-Project	Avg. Annual Reduction in Delay Costs
Storm Closure	\$1,383,600	\$340,000	\$1,043,600
Non-Storm Closure	\$96,300	\$0	\$96,300
Construction Delay	0	\$25,300	(\$25,300)
TOTAL	\$1,479,900	\$365,300	\$1,114,600

¹ Based on Oct 2000 price levels, an interest rate of 5.625% and a 50-year period of evaluation.

Summary of Economic Analysis of Recommended Plan. An economic analysis has been conducted to evaluate alternative measures to reduce the impacts to commercial navigation caused by closures of the Leon Theriot Floodgate. When the existing floodgate is closed, commercial navigation is delayed. The cost of these delays were determined by analyzing the characteristics of the fleet, the amount of vessel traffic moving along Bayou Lafourche, and the frequency and duration of the closures. The owners and operators of commercial fishing boats, tugboats, and oil and gas supply boats were interviewed to better define actual delays and the cost of these delays. The number of commercial fishing boats operating in the area was assumed to remain constant throughout the period of evaluation and the number of tugboats and oil and gas supply vessels were assumed to increase by 1 percent annually. The economic analysis included only those vessels greater than 26 feet in length. It was assumed that vessels shorter than 26 feet could be taken out of the water and/or transported around the floodgate.

An analysis of the costs and benefits associated with converting the Leon Theriot Floodgate into a lock is presented in Appendix B. Several of the variables used in the economic analysis have an uncertainty associated with them. This uncertainty can be due to imperfect information or changing conditions surrounding the variable's use. The economic analysis looked at the uncertainty associated with four variables, size of commercial fishing fleet, growth rate of tug fleet, annual frequency of storms, and duration of storm delay. The results of the uncertainty analysis concluded that in every case, the average annual reduction in delay costs associated with converting the Leon Theriot Floodgate into a lock continued to outweigh the average annual cost of constructing the lock.

The estimated construction cost to convert the Leon Theriot Floodgate into a lock is \$10,992,000. The engineering and design is estimated at \$769,000 and the supervision and administration is estimated at \$550,000. Adding the estimated real estate costs of \$135,000 brings the total estimated first cost to \$12,446,000. Using a 5.625 percent interest rate and a period of evaluation of 50 years, the interest during construction is estimated at \$869,900. The average annual construction cost to convert the existing floodgate into a lock is estimated at \$814,000. Operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs are estimated at \$64,900 annually. The resulting average annual cost for the recommended plan is estimated at \$878,900. The average annual reduction in delay costs is estimated at \$1,114,600.

The resulting benefit to cost ratio is 1.27. The average annual net benefits are estimated at \$235,700.

The economic analysis for the recommended plan is based on October 2000 price levels, an interest rate of 5.625 percent, a 50-year period of evaluation, and an 18-month construction period. The base year for the recommended plan is 2007. A summary of the economic analysis is provided in Table 6.

TABLE 6
SUMMARY OF ECONOMIC ANALYSIS OF RECOMMENDED PLAN¹

First Cost	\$12,446,000
Average Annual Costs	\$878,900
Average Annual Benefits ²	\$1,114,600
Benefit-to-Cost Ratio	1.27
Average Annual Net Benefits	\$235,700

¹ Based on Oct 2000 price levels, an interest rate of 5.625%, and a 50-year period of evaluation.

² The benefits are a reduction in the cost of delays to navigation.

Allocation of Costs of the Recommended Plan. All of the costs for the implementation, operation, maintenance, repair, and replacement, and rehabilitation of the recommended plan would be allocated to hurricane protection. The plan is justified by the reduction in delays to commercial navigation; however, the delays to navigation were caused entirely by the implementation of the Larose to Golden Meadow hurricane protection project (construction of the Leon Theriot Floodgate). Therefore, the recommended plan mitigates for the effects of the hurricane protection project.

Apportionment of Costs of the Recommended Plan. In accordance with Section 103(c)(5) of WRDA 1986 (hurricane and storm damage reduction), as amended, the cost sharing for converting the Leon Theriot Floodgate into a lock will be 65 percent Federal and 35 percent non-Federal. All costs for the operation and maintenance of the project are non-Federal. The total estimated cost of converting the Leon Theriot Floodgate into a lock is \$12,446,000. These costs will be allocated \$8,090,000 Federal and \$4,356,000 non-Federal. The average annual operation and maintenance costs, which include dewatering the site for rehabilitation every 10 to 12 years, are estimated at \$64,900. The South Lafourche Levee District is responsible for performing all operations and maintenance.

Summary of Environmental Effects. The environmental impacts associated with construction of the recommended plan include a total of 8.5 acres of water bottoms. The impacts would only be temporary to approximately 7.4 acres of the affected water bottoms because they would likely repopulate with benthics and associated aquatics from the surrounding area. The impacts include 4.3 acres of Bayou Lafourche water bottoms that will be deepened as a result of channel modifications to the northern approach to the lock. The floodgate structure will impact 0.3 acres

of water bottoms and the disposal of dredged material will impact 3.1 acres of water bottoms. An additional 0.8 acres of water bottoms will be affected by construction of the guide walls and dolphins. Approximately 0.4 acres of previously disturbed marsh will be shaved from the east bank of Bayou Lafourche to widen the channel to safely accommodate ship traffic. This excavation can be performed by either a floating or land-based dragline. The dredging operation will require the removal of 13,100 cubic yards of material from the channel for navigation and 20,000 cubic yards of material will be removed from the site of the new floodgate. The excavated material will be placed in the abandoned by-pass channel to create as much shallow water area as possible. The shallow water area will not only create a fishery habitat, but will also provide a habitat suitable for aquatic vegetation. The levees adjoining the new floodgate are being constructed on previously disturbed spoil areas that were impacted by the cofferdam used during construction of the original floodgate. Incorporating a technology that allows the new floodgate to be constructed off-site and floated into place has significantly reduced the environmental impacts of the recommended project.

The U.S. Fish and Wildlife Service concurred that the recommended project will not affect listed or proposed threatened or endangered species. There are no issues based on our preliminary coordination with the National Marine Fisheries Service regarding Essential Fish Habitat. The State Historic Preservation Officer has acknowledged that we will not impact any known archeological sites or historic structures either listed on, or which are eligible for listing on the National Register of Historic Places. The Section 404 (b) (1) process has been completed and water quality certificate number 830414-06, dated 13 June 2002, has been issued. A Coastal Zone consistency determination is in progress and is expected prior to construction. Site investigations have been made and the risk of encountering HTRW is minimal. The partially used drums of marine paint and solvents identified during a site inspection are located outside of the required right-of-way. An additional site inspection will be conducted prior to construction to ensure that there are not any HTRW concerns. An environmental assessment was prepared and distributed for public and agency review. No adverse comments were received and a Finding of No Significant Impact was signed on 23 August 2002.

Summary of Coordination. The South Lafourche Levee District is the non-Federal sponsor for the Larose to Golden Meadow hurricane protection project and the recommended conversion of the Leon Theriot Floodgate to a lock. In the early 1990's, the South Lafourche Levee District requested the Corps of Engineers determine the feasibility of incorporating measures into the Larose to Golden Meadow project to reduce delays to navigation on Bayou Lafourche. Increased closures of the Leon Theriot Floodgate were causing significant delays to navigation. In response to their request, a preliminary evaluation was conducted to determine the benefits of two alternative measures for reducing the delays. The two alternative measures included raising the banks of Bayou Lafourche within the protected area to provide a higher level of protection and converting the existing Leon Theriot Floodgate into a lock. Neither alternative was determined to be economically justified at the time.

In October 1996, an estimated 10 to 15 million dollars worth of commercial fishing boats and oil and gas supply vessels were trapped on the floodside of the Leon Theriot Floodgate as a hurricane formed in the Gulf of Mexico and headed for southern Louisiana. Luckily the storm did not directly impact the area. However, this event did highlight the problem and provided an

actual event upon which to base the analysis. A reevaluation of the previous findings indicated that converting the Leon Theriot Floodgate into a lock was likely to be economically justified. The recent growth of Port Fourchon and a resurgence in the offshore oil and gas industry has significantly increased the traffic in Bayou Lafourche resulting in higher benefits. Recent design experience with float-in structures also resulted in a reduction in the estimated cost of a new structure. In September 1998, the South Lafourche Levee District requested the Corps of Engineers to proceed with a study to authorize the conversion of the existing floodgate to a lock. Funding limitations prevented the initiation of a study until 1999.

The South Lafourche Levee District hired a local engineering firm to prepare a preliminary design for a float-in structure. A copy of the design report was provided to the New Orleans District for review and is enclosed as part of Appendix A. The South Lafourche Levee District provided information on all closures of the Leon Theriot Floodgate since 1985. Bridge tender records for openings of the Golden Meadow Bridge were also provided. Local shrimpers, seafood processing plants, boat repair facilities, barge companies, and oil and gas supply companies were asked to provide information on the extent of the impacts closures of the Leon Theriot Floodgate have on their existing operations. The information provided by the South Lafourche Levee District and other interested parties has been incorporated into the design and economic analysis presented in this report. Without this information, it would have been very difficult to accurately determine the economic impact closing the Leon Theriot Floodgate has on operations along Bayou Lafourche.

The South Lafourche Levee District scheduled a public meeting to discuss the recommended project and accept comments. The meeting was held on 22 April 2002 at the South Lafourche Levee District office. A press release for the meeting was issued and announcements were printed in the Lafourche Gazette newspaper and mentioned on the local radio station. There were approximately 20 people in attendance. The list of attendees included State Senator Reggie Dupre. Comments on the recommended project were generally very favorable. Concern was expressed about the need to evaluate alternative alignments to offset problems caused by constructing the original floodgate in a bend in Bayou Lafourche. It was agreed that alternative chamber configurations would be considered during the detailed design phase. The availability of Federal and non-Federal funds was also discussed. The South Lafourche Levee District has already initiated efforts to obtain the additional non-Federal funds that will be required to convert the existing floodgate into a lock. A copy of the Assessment of Financial Capability is provided in Appendix C. These efforts demonstrate the level of public support that exists. Another public meeting will be scheduled during the detailed design phase.

As previously discussed, changed local conditions have resulted in a significant increase in the number and duration of closures of the Leon Theriot Floodgate and in the adverse impacts of the closures. The South Lafourche Levee District decided they could not wait for final approval of the evaluation report to initiate detailed design efforts. Picciola & Associates was hired by the South Lafourche Levee District to initiate work on the detailed design report. Recent funding shortages within the construction general program throughout the Corps of Engineers have also caused the South Lafourche Levee District to consider taking on the responsibility for constructing the lock. In fact, the non-Federal sponsor intends to design and construct the entire project (conversion of the existing floodgate to a lock) with in-kind services.

Picciola & Associates has initiated preparation of plans and specifications for converting the existing floodgate to a lock. Representatives from the New Orleans District have been providing assistance to ensure that the design developed by Picciola & Associates meets Corps criteria. The South Lafourche Levee District believes they have secured the necessary non-Federal funding to convert the existing floodgate to a lock. No current authority exists to provide the non-Federal sponsor with credit or reimbursement for work-in-kind for the non-Federal performance of work described in this report. Even if such authority existed, no credit or reimbursement could be provided for work performed prior to the approval of this report and to the signing of a cost-sharing agreement by the Government and non-Federal Sponsor. In order to provide such a reimbursement, Congressional authorization will be required. Congressional authorization would need to expressly authorize reimbursement of any non-Federal costs incurred for work performed in advance of the approval of this report and the execution of a cost-sharing agreement in order for the Government to provide reimbursement of those costs. Via letter dated 23 May 2003, the District Engineer advised the non-Federal sponsor, the South Lafourche Levee District, of potential repercussions of commencing work on the Leon Theriot Lock prior to approval of this report, prior to the execution of a cost sharing agreement, and prior to obtaining authorization to perform work-in-kind. See a copy of this letter in Appendix I. The South Lafourche Levee District is pursuing Congressional action that would authorize a reimbursement for the estimated Federal share of any planning, design and construction associated with the Leon Theriot Lock, which modifies the Leon Theriot Floodgate feature of the Larose to Golden Meadow project, including reimbursement for work performed in advance of the legislative action and in advance of the Government's approval of the work performed by the non-Federal sponsor and the execution of cost-sharing agreement. In the event that such legislation is enacted, reimbursement by the Government would be subject to the Government's determination that the work performed by the non-Federal sponsor was accomplished in a manner satisfactory to the Secretary, is integral to the project, environmentally acceptable, auditable, allowable, and allocable to the project. Should such a determination be made, the Government and the non-Federal sponsor would enter into a cost-sharing agreement setting forth the Federal and non-Federal responsibilities for the construction, operation, maintenance, repair, replacement and rehabilitation of the project as set forth below, with such modifications as are necessitated by Congressional enactments subsequent to this report.

CHANGES TO THE ORIGINAL AUTHORIZED PROJECT

Changes in Scope of Original Authorized Project. The recommended plan would not change the scope of the originally authorized project. The Larose to Golden Meadow project authorized improvements along Bayou Lafourche between Larose and Golden Meadow to provide protection against hurricane and tidal flooding. The project authorized the construction of approximately 21 miles of levees and floodwalls on the west bank of Bayou Lafourche and 22 miles of levees and floodwalls on the east bank of Bayou Lafourche. The construction of two navigable floodgates, one at Larose and the other at Golden Meadow, were also included in the project to maintain navigation. The Chief's Report, on page 39, Section IV, para. 17c(1) states, “[t]he floodgate at the lower site [the Leon Theriot Floodgate] can be converted to a lock at any future date that changed local conditions make the additional work necessary and justified.” This evaluation report documents the changed local conditions at pages 10-12 and in the paragraph below. Since the purpose of the floodgates was to provide protection against tidal surges in Bayou Lafourche while maintaining navigation and the purpose of the conversion of the Leon Theriot floodgate to a lock will be likewise, then there is no change in scope of the authorized project.

The Leon Theriot Floodgate is being closed more often and for longer durations as a result of more active storm seasons in southeast Louisiana and sea level rise and ground subsidence. The growth of Port Fourchon and increased activity in the offshore oil and gas industry has significantly increased traffic along Bayou Lafourche. The adverse impacts to navigation caused by closures of the Leon Theriot Floodgate have increased dramatically in recent years as a result of these factors. Converting the existing floodgate into a lock to mitigate for the impacts to navigation does not represent a change in the scope of the authorized project. The original project was authorized in 1965 and the effects of sea level rise and ground subsidence and the potential increase in traffic along Bayou Lafourche could not have been predicted during the initial design of the project. The deauthorization of the Bayou Lafourche and Lafourche-Jump Waterway project also eliminated an alternate route that the initial design documents assumed would be in place prior to construction of the Larose to Golden Meadow project. The conversion of the Leon Theriot Floodgate into a lock is needed to ensure that the project will, as originally authorized, continue to provide hurricane protection while allowing for navigation along Bayou Lafourche.

Changes in Project Purpose. The recommended plan does not represent a change in the project purpose. The purpose of the Larose to Golden Meadow project is to provide a 100-year level of hurricane protection to the area along Bayou Lafourche between Larose and Golden Meadow. The project provides for a system of levees and floodwalls surrounding the project area, with floodgates in Bayou Lafourche near Larose and Golden Meadow, where the levee/floodwall system crosses the bayou. The floodgates are minimal facilities that provide for navigation on Bayou Lafourche that would have been interrupted by a levee across the bayou. The recommended project modification, that is, the conversion of the floodgate into a lock, is an upgrade of the minimal facilities required for navigation.

Construction of the Leon Theriot Floodgate was completed in 1985. The purpose of the floodgate is to provide for navigation on Bayou Lafourche and prevent tidal flooding of

residential and commercial property within the project area. The floodgate is closed when a tropical storm is approaching or when a strong southerly wind produces stages in Bayou Lafourche capable of overtopping the banks and flooding areas within the Larose to Golden Meadow project area. Any vessel traffic on Bayou Lafourche trying to move past the Golden Meadow area would be delayed during periods when the floodgate is closed. The delays to navigation are caused by closures of the Leon Theriot Floodgate, a feature of the Larose to Golden Meadow project. Without the Larose to Golden Meadow project, navigation would be able to move freely along Bayou Lafourche between the Gulf Intracoastal Waterway and Port Fourchon. The proposed conversion of the existing floodgate into a lock would mitigate for delays to navigation that are being caused by closures of the Leon Theriot Floodgate.

The plan originally proposed by local interests for the Larose to Golden Meadow project included a floodgate at Larose and a lock at Golden Meadow. This combination would have prevented tidal flooding from a hurricane surge while allowing for uninterrupted navigation access at the southern end of the project. The construction of a lock at Golden Meadow was evaluated in the report entitled "Grand Isle and Vicinity, Louisiana," and contained in House Document Number 184, Eighty Ninth Congress. The recommendations of the District and Division Engineers provided for the construction of a navigable floodgate at both Larose and Golden Meadow. The report states that the construction of the Bayou Lafourche bypass west of Bayou Lafourche from Larose to Leeville would offer an alternative channel and significantly reduce the need for a lock at Golden Meadow. The report also says that the floodgate at the lower site could be converted to a lock at any future date if changing conditions make the additional work necessary and justified (see page 39 of House Document Number 184, Eighty Ninth Congress). The portion of the 12- by 125-foot auxiliary channel parallel to and west of Bayou Lafourche and the Lafourche Jump bypass were never constructed and were deauthorized under the authority of Section 1001(a) of the Water Resources Development Act of 1986 (Public Law 99-662) on 1 January 1990. The Bayou Lafourche auxiliary channel would have provided an alternative inland route allowing vessel traffic to bypass the Larose and Leon Theriot Floodgates. The extensive growth of Port Fourchon during the past 10 years has also led to an increase in vessel traffic well beyond what could have been anticipated at the time the original Larose to Golden Meadow project was authorized. The other changed condition is the increase in the frequency and duration of closures of the Leon Theriot Floodgate resulting from the effects of sea level rise and ground subsidence.

Converting the existing Leon Theriot Floodgate into a lock via this evaluation report as the recommended plan, would not change the scope, purpose nor location of the original authorized project. In an attempt to speed-up construction, the non-Federal sponsor lobbied Congress to provide a directive to expeditiously convert the floodgate to a lock. This effort culminated in Section 325 of Public Law 106-53 (Water Resources Development Act of 1999) and related legislative history to Public Law 106-60 (Energy and Water Development Appropriations Act of 2000), in the Congressional Record Conference Report – House Report 106-336 (Conference Report on House Resolution 2605, dated 27 September 1999), 145 Cong. Rec. H8677-02, Corps of Engineers - Construction General, at page 27, wherein the Corps of Engineers was urged to expedite, to the fullest extent possible, the completion of the report for the Larose to Golden Meadow (Hurricane Protection), Louisiana, project.

Section 325 of WRDA 1999 conditions authorization of the Leon Theriot Lock upon a requirement that the Secretary (i.e., ASA (CW)) determine that the project is technically feasible, environmentally acceptable, and economically justified. Costs should be allocated totally to flood control as per the original authorization for the hurricane protection project for reasons noted above and due to changed conditions documented in this report.

Changes in Local Cooperation Requirements. The original authorized project requires the non-Federal sponsor to bear 30 percent of total project costs for the Larose to Golden Meadow project. The conversion of the Leon Theriot Floodgate into a lock is authorized via Section 325 of Public Law 106-53 (WRDA 1999), and the non-Federal responsibilities are governed by WRDA 1986, as amended, cost sharing provisions. Section 103(c)(5) of WRDA 1986 (hurricane and storm damage reduction purpose) requires a non-Federal cost sharing at 35 percent of total project costs, including Lands, Easements, Right-of-way, Relocations and Dredged Material Disposal Areas (LERRDS), and 100 percent of the Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R.)”

In accordance with Federal policy, non-Federal sponsors must assure the Secretary of the Army that they will, without cost to the United States:

a. Provide 35 percent of project costs assigned to hurricane and storm damage reduction, as further specified below:

(1) Enter into an agreement which provides, prior to construction, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Should the Federal Government determine that the value of contributions provided under this paragraph is less than 35 percent of the total project cost, then the non-Federal sponsor shall provide, during the period of construction, an additional cash contribution to bring the non-Federal share equal to 35 percent of the total project costs;

b. Operate, maintain, repair, replace, and rehabilitate, as necessary, all features of the project (except those features described as Federal responsibilities), 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 including regulations prescribed by the Secretary of the Army. Such features include, but are not limited to levees, floodwalls, floodgates and approach channels, drainage structures, drainage ditches or canals, and all mitigation features;

c. Give the Federal Government the right to enter, at reasonable time and in a reasonable manner, upon property that the non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal Sponsor of responsibility to meet the non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Assure that construction, operation, maintenance, repair, replacement, and rehabilitation of any non-Federally constructed flood features do not diminish the flood protection provided by or jeopardize the structural integrity of the project;

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

f. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

g. Perform, or cause to be performed, 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 the 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 investigation unless the Federal Government provides the non-Federal Sponsor with prior specific written direction, in which case the non-Federal Sponsor shall perform such investigations in accordance with such written direction;

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

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

j. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17),

and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands easements, and rights-of-way, required for the construction, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

k. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to 40 U.S.C. 3141-3148 and U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

l. Within one year after the date of signing a Project Cooperation Agreement (PCA), prepare a floodplain management plan designed to reduce the impact of future flood events in the project area. This plan shall be prepared in accordance with guidelines developed by the Government. The plan must be implemented no later than one year after completion of construction of the project;

m. Provide 35 percent of that portion of total historic preservation mitigation and data recovery costs attributable to hurricane and storm damage reduction that are in excess of 1 percent of the total amount authorized to be appropriated for hurricane and storm damage reduction;

n. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

o. Do not use Federal funds to meet the non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

p. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder the operation and maintenance of the project;

q. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

r. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

s. Be solely responsible for all costs due to project betterments and shall pay all such costs. The non-Federal sponsor shall identify all betterments and may request the Government accomplish such betterments, in writing. If the Government elects to accomplish the requested betterments, or any portion thereof, it shall so notify the non-Federal sponsor in writing that sets forth any applicable terms and conditions; and

t. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

In the event that the project authority is amended to authorize the Government to reimburse the non-Federal Sponsor for the performance of work-in-kind on the project herein described, it is possible that the non-Federal obligations set forth above will change. If the non-Federal Sponsor continues in its determination to design and construct the project with non-Federal funds, the Government, given the lack of work-in-kind and reimbursement authority for this project, will not enter into a cost-sharing agreement with the non-Federal sponsor. If Congressional action amends the project authority to authorize the performance of work-in-kind by the non-Federal sponsor and the Government's reimbursement of the non-Federal sponsor for the work that it performs, the Government will enter into a cost-sharing agreement in accordance with the obligations set forth above, subject to any changes to such obligations as the Congressional enactment requires.

The Local Cooperation Agreement for the Larose to Golden Meadow Project specifically provided for in-kind services. However, the modification authorizing the construction of the Leon Theriot Lock, Section 325 of WRDA 1999, is silent as to the Government's authority to provide a credit or reimbursement for non-Federal work-in-kind and the Non-Federal sponsor is seeking authorization from Congress to provide reimbursement authority pertaining to the conversion of the floodgate into a lock. The non-Federal sponsor will still be required to hold and save the United States free from damage, etc. arising from the construction, operation and maintenance of the project. The South Lafourche Levee District fully supports the conversion of the Leon Theriot Floodgate; however, they do not support the present cost-sharing requirements for the project and the lack of work-in-kind and reimbursement authority. They have commenced design of the project and anticipate constructing the project with local funds. They are presently seeking work in kind and reimbursement authority (see Appendix J).

Changes in Location of Project. There is no change in the location of the project with the recommended project modification. The existing Leon Theriot Floodgate is located in the line of hurricane protection provided by the project. The floodgate, floodwalls, and levees needed to convert the existing floodgate into a lock will be located in an area that was previously impacted by the construction of an earthen cofferdam and bypass channel during construction of the original floodgate. Constructing the new structure offsite eliminates the need for a cofferdam and a bypass channel and minimizes additional impacts to the area. A minimal amount of excavation will be required to prepare the foundation and to realign a small section of the

channel in the second bend north of the floodgate. Any material excavated from Bayou Lafourche will be used either to construct the chamber levees or will be placed in the old bypass channel located adjacent to the existing floodgate. Converting the Leon Theriot Floodgate into a lock will require the acquisition of 1.77 acres of new right of way. This includes 1.24 acres along the east bank of Bayou Lafourche and 0.53 acres along the west bank of Bayou Lafourche. The South Lafourche Levee District will be responsible for acquiring all additional rights of way. Any borrow material required for construction of the levees will come from the approved borrow canals within existing rights of way.

Design Changes. This evaluation report recommends converting the existing Leon Theriot Floodgate into a lock to reduce delays to navigation on Bayou Lafourche. The conversion would be accomplished by constructing a new floodgate to the north, or on the protected side of the existing floodgate. The floodgate would be constructed off-site, floated into place, and tied to the existing floodgate to form a lock. The new floodgate would provide a clear opening of 56 feet, the same as the existing floodgate. The length of the chamber would be 400 feet to allow for the passage of the maximum sized tow allowed on Bayou Lafourche (350 feet). The total first cost for this alternative is estimated at \$12,446,000. The entire project will take an estimated 18 months to construct.

Changes in Total Project First Costs. The Larose to Golden Meadow, Louisiana, Hurricane Protection Project, was authorized in 1965 at a total project cost of \$7,857,000. The latest approved total project cost estimate is \$116,000,000. The total estimated cost for the recommended project is \$128,446,000. The authorized project cost, last presented to Congress, current estimated cost, and recommended project cost are presented in Table 7.

TABLE 7
PROJECT FIRST COSTS

	Authorized Project ¹	Last Presented To Congress ²	Current Estimate ²	Recommended Project ²
Larose to Golden Meadow Hurricane Protection Project	\$7,857,000	\$116,000,000	\$116,000,000	\$128,446,000

¹ From House Document No. 184, Dec 1960 price levels

² Oct 2000 price levels

The project was initially authorized at a total cost of \$7,857,000. Between 1965 and 1982, the estimated project cost was reported as an incremental cost. The method of reporting the total project cost estimate was changed from incremental to fully funded in 1982. This change caused the total project cost to increase from \$74,300,000 to \$87,000,000, a difference of \$12,700,000. Price level increases between 1965 and 2002 resulted in increases of \$42,829,000.

The total project cost increased by \$22,172,000 between 1965 and 2002 as a result of design changes. The required levee heights were raised and stability berms were added during the preparation of the General Design Memorandum in 1973. These changes increased the cost by \$4,922,000. More detailed analyses were required in 1974 and 1975, which increased the cost by an additional \$2,304,000. The Detailed Design Document No. 2, dated 28 October 1977, the Detailed Design Document No. 3, dated 16 January 1978, and Letter Report Dated 12 April 1978, resulted in additional increases of \$8,639,000. In 1981, a reanalysis of the levee design was conducted and the levee alignment was extended in a letter report dated 15 September 1980, which resulted in an additional increase of \$4,307,000. The last cost increase as a result of a design change occurred in 1983, when the cost increased by \$2,000,000.

The last category of project cost increases is listed as “Other Changes” in the funding history presented in Appendix G. “Other Changes” include increases for any re-analysis of requirements for engineering and design and for supervision and administration along with any increases in the actual cost of completed construction contracts. The total project cost increased by \$30,442,000 between 1965 and 2002 as a result of these changes. Adding all of the increases (\$42,829,000 for price level increases, \$22,172,000 for design changes, \$30,442,000 for other changes, and \$12,700 for fully funding) to the authorized project cost of \$7,857,000 results in a current project cost of \$116,000,000.

Changes in Project Benefits. The Larose to Golden Meadow, Louisiana, Hurricane Protection Project, was authorized in 1965 to provide protection against flooding from hurricanes having a return frequency of once every 100 years. The average annual benefits at the time of authorization (1965) were estimated at \$381,500. These benefits were apportioned \$329,300 for the prevention of tidal flood damages and \$52,200 for land enhancement. The average annual benefits at the time funds were first appropriated for construction (1972) were \$3,583,000, with \$3,559,000 allocated to flood control and \$24,000 allocated to area redevelopment. The total average annual project benefits (indexed from October 1971 price levels to October 2000 price levels) are \$13,900,000. Converting the Leon Theriot Floodgate into a lock would reduce delays to navigation caused by closures of the floodgate. Reducing the delays results in a reduction of the economic cost to navigation (a benefit). The benefits of the recommended project are the difference in delay costs between the existing conditions and the with-project conditions. The incremental average annual benefits for the recommended project modification, which are allocated entirely to hurricane protection, are \$1,114,600. The project benefits for the authorized project, last presented to Congress, and recommended project are presented in Table 8.

TABLE 8
PROJECT BENEFITS

	Authorized Project ¹	Last Presented To Congress ²	Recommended Project ²
Larose to Golden Meadow Hurricane Protection Project	\$381,500	\$13,900,000	\$15,014,600

¹From House Document No. 184, Dec 1960 price levels

²The benefits last presented to Congress, are by definition the remaining benefits, which for the currently authorized project are \$1,500,000. The total project benefits are presented in the table for comparison to the total benefits for the authorized project and the recommended project. The total project benefits and the remaining project benefits are based on Oct 2000 price levels at an interest rate of 5.625%.

Benefit to Cost Ratio. The Larose to Golden Meadow hurricane protection project was authorized in 1965 with a benefit to cost ratio of 1.3 to 1, based on a life of 100 years and an interest rate of 2-7/8 percent. The benefit to cost ratio at the time funds were first appropriated for construction was 1.4 to 1 at an interest rate of 3-1/4 percent. The remaining benefit to cost ratio for the Larose to Golden Meadow project last presented to Congress was 11 to 1 at an interest rate of 6-3/8 percent. The incremental benefit to cost ratio for the recommended project modification is 1.27 to 1 at an interest rate of 5.625 percent.

Changes in Cost Allocation. There is no change in the allocation of costs among project purposes with the recommended project modification. All of the costs for the Larose to Golden Meadow hurricane protection project are allocated to hurricane protection. All of the costs for the conversion of the Leon Theriot Floodgate into a lock are also allocated to the project purpose of hurricane protection. This is discussed in additional detail in paragraph, Changes in Project Purpose.

Changes in Cost Apportionment. The latest approved total project cost is \$116,000,000. These costs are allocated \$81,000,000 Federal and \$35,000,000 non-Federal. The total estimated cost of converting the Leon Theriot Floodgate into a lock is \$12,446,000. In accordance with Section 103(c)(5) of WRDA 1986 (hurricane and storm damage reduction), as amended, the cost sharing for converting the existing floodgate into a lock will be 65 percent Federal and 35 percent non-Federal. The estimated project costs will be allocated \$8,090,000 Federal and \$4,356,000 non-Federal. The average annual operation, maintenance, repair, replacement, and rehabilitation costs, which include dewatering the site for rehabilitation every 10 to 12 years, are estimated at \$64,900. The South Lafourche Levee District is responsible for performing all operations and maintenance. A breakdown of the cost apportionment is presented in Table 9. Fully funded costs for the recommended plan are shown by fiscal year in Table 10.

TABLE 9
COST APPORTIONMENT

	Originally Authorized Project ¹	Recommended Project ¹	Leon Theriot Lock Increment ¹
Federal	\$81,000,000	\$89,090,000	\$8,090,000
Non-Federal	<u>\$35,000,000</u>	<u>\$39,356,000</u>	<u>\$4,356,000</u>
Total	\$116,000,000	\$128,446,000	\$12,446,000

¹ Based on Oct 2000 price levels.

TABLE 10
FULLY FUNDED COST ESTIMATE

Fiscal Year	Fully-Funded Cost ¹	65% Federal Share	35% Non-Federal Share
2004	\$500,000	325,000	\$175,000
2005	\$3,000,000	\$1,950,000	\$1,050,000
2006	\$7,000,000	\$4,550,000	\$2,450,000
2007	\$2,570,000	\$1,670,000	\$900,000
Totals	\$13,070,000	\$8,495,000	\$4,575,000

¹ The cost is based on 2006 as the mid point of construction. Inflation factors used were 1.044 for construction and 1.150 for engineering and design. Real estate costs have not been inflated.

CONCLUSIONS

The recommended plan to mitigate for delays to navigation along Bayou Lafourche by converting the Leon Theriot Floodgate into a lock is based on a thorough analysis and evaluation of all practicable alternatives, in view of applicable economic, engineering, and environmental criteria.

The cost of the delays to commercial navigation caused by closures of the Leon Theriot Floodgate were determined by analyzing the characteristics of the fleet operating along Bayou Lafourche, the amount of vessel traffic, and the frequency and duration of the closures. The alternative plans were evaluated on the ability to provide hurricane protection for the study area, protect the natural resources, reduce adverse impacts to commercial navigation, and be accepted by the public. Constructing the structure off-site eliminates the need for a cofferdam and bypass channel and the construction duration is reduced. Converting the existing Leon Theriot Floodgate into a lock by constructing a second floodgate with a clear opening of 56 feet and a chamber length of 400 feet provides the greatest net benefits, causes the fewest adverse impacts, and is the recommended plan.

Implementing the recommended plan would significantly reduce delays to navigation along Bayou Lafourche, and would reduce the number of boats that might be trapped outside the protection as a hurricane approaches the area. The total project first cost of the recommended modification is \$12,446,000. The recommended modification, with estimated average annual costs of \$878,900 and a mean equivalent annual reduction in delay costs of \$1,114,600, provides a benefit-cost ratio of 1.27, with average annual net benefits of \$235,700.

The environmental impacts associated with construction of the recommended plan include a total of 8.5 acres of water bottoms. The impacts would only be temporary to approximately 7.4 acres of the affected water bottoms because the areas would likely repopulate with benthics and associated aquatics from the surrounding area. Approximately 13,100 cubic yards of material will be removed from the channel for navigation and 20,000 cubic yards of material will be removed from the site of the new floodgate. The excavated material will be placed in the abandoned by-pass channel to create as much shallow water area as possible. The shallow water area will not only create a fishery habitat, but will also provide a habitat suitable for aquatic vegetation. The levees adjoining the new floodgate are being constructed on previously disturbed spoil areas that were impacted by the cofferdam used during construction of the original floodgate. The environmental impacts of the recommended plan have been significantly reduced by incorporating a technology that allows the new floodgate to be constructed off-site and floated into place.

The location of the existing floodgate precludes the development of a plan with straight approach channels. The approach channels and lock chamber designs will be addressed further in detailed design studies to assure that the optimum chamber and channel alignments are developed and that the approaches are reasonably safe.

The recommended modification to convert the Leon Theriot Floodgate into a lock was authorized by Section 325 of the Water Resources Development Act of 1999 (Public Law 106-53), dated 17 August 1999 which states “The project for hurricane protection Larose to Golden Meadow, Louisiana, authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1077), is modified to authorize the Secretary to convert the Golden Meadow floodgate into a navigation lock if the Secretary determines that the conversion is technically feasible, environmentally acceptable, and economically justified.” This evaluation report describes the changing conditions that have taken place to make the recommended modification necessary and justified and demonstrates the conversion is technically feasible, environmentally acceptable, and economically justified.

RECOMMENDATIONS

As District Engineer, I have considered the significant environmental, social, and economic effects, the engineering feasibility, and input received from the public and have determined that the recommended plan presented in this report is technically feasible, environmentally acceptable, economically justified and in the overall public interest.

I recommend that the existing, Larose to Golden Meadow, Louisiana, Hurricane Protection Project, authorized by Section 204 of Public Law 89-298 (Flood Control Act of 1965), be modified via this evaluation report as changed local conditions make this work necessary. This evaluation report is in conformance with the requirements of Section 325 of the Public Law 100-53 (Water Resources Development Act of 1999), to convert the Leon Theriot Floodgate into a lock with chamber dimensions of 56- by 400-feet. This plan is being recommended with such modifications thereof as in the discretion of the Commander HQUSACE, may be necessary.

The total first cost of the recommended modification is \$12,446,000 based on October 2000 price levels, an interest rate of 5.625 percent, and a period of evaluation of 50 years. Operation, maintenance, repair, replacement, and rehabilitation costs are estimated to be \$64,900 annually. The recommended plan produces net excess benefits over costs and has a favorable benefit to cost ratio. All of the implementation and operation and maintenance costs are allocated to hurricane protection to mitigate for the effects of the Leon Theriot Floodgate on commercial navigation. In accordance with Section 103 of WRDA 1986, as amended, the cost sharing for converting the Leon Theriot Floodgate into a lock will be 65 percent Federal and 35 percent non-Federal. The \$12,446,000 cost to convert the Leon Theriot Lock into a floodgate would be apportioned \$8,090,000 Federal and \$4,356,000 non-Federal.

The non-Federal sponsor for the Larose to Golden Meadow, Louisiana Hurricane Protection Project, the South Lafourche Levee District, strongly supports the recommended project modification. The non-Federal sponsor intends to design and construct the entire project (lock) with in-kind services. Since no current authority exists to provide the non-Federal sponsor with credit for work-in-kind for the lock, the South Lafourche Levee District is seeking Congressional authorization to provide work-in-kind and reimbursement authority. If Congress authorizes work in kind and reimbursement for design and construction of the project, a separate report concerning reimbursement will be coordinated with the Assistant Secretary of the Army

(Civil Works). Until such time as Congress enacts work in kind and reimbursement authority, the Government and the non-Federal Sponsor will not enter into a cost-sharing agreement for this project for so long as the non-Federal Sponsor continues to design and construct the project with non-Federal funds.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Until such time as Congress enacts work in kind and reimbursement authority, the Government and the non-Federal sponsor will not enter into a cost-sharing agreement for this project for so long as the non-Federal sponsor continues to design and construct the project with non-Federal funds.

PETER J. ROWAN
Colonel, EN
Commanding