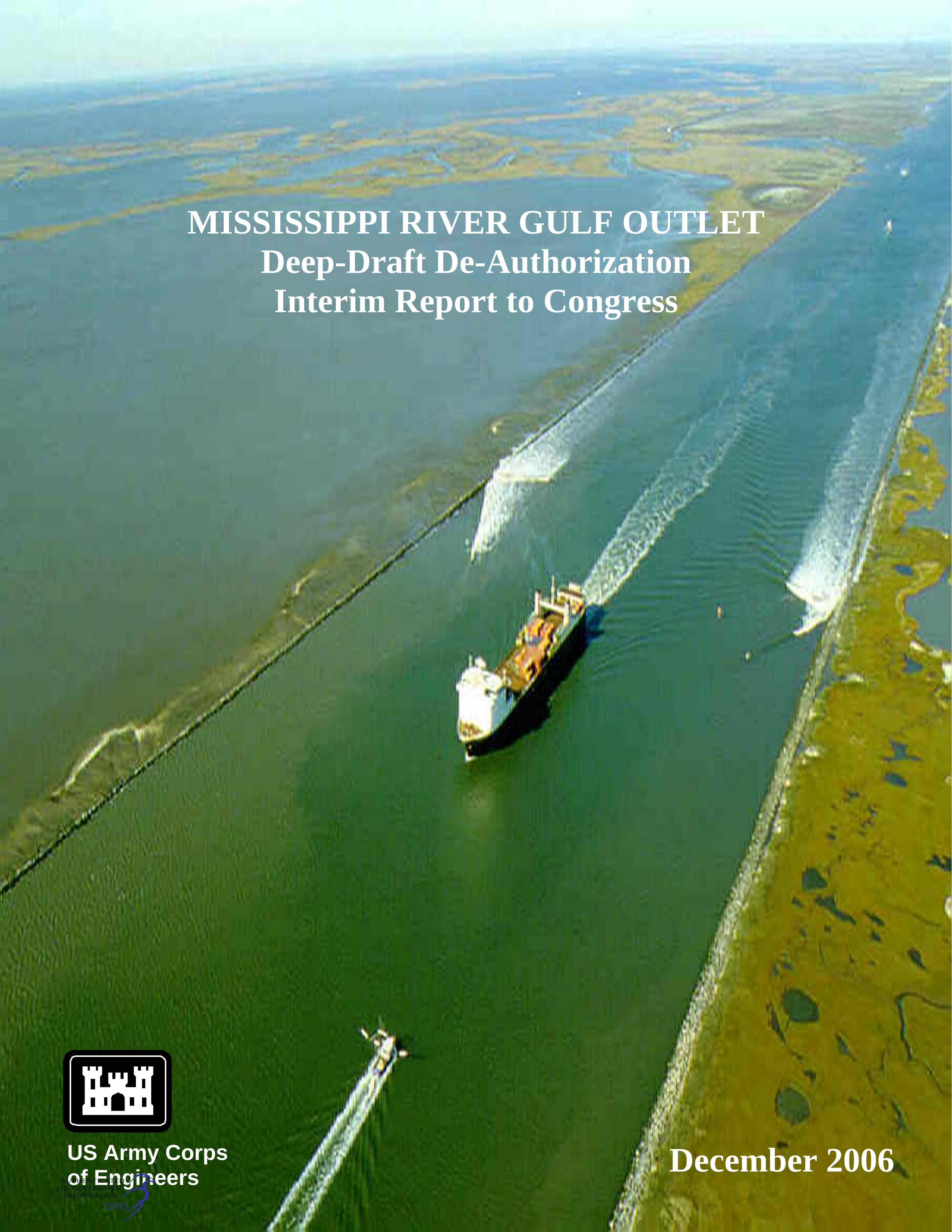


MISSISSIPPI RIVER GULF OUTLET
Deep-Draft De-Authorization
Interim Report to Congress

US Army Corps
of Engineers

December 2006

EXECUTIVE SUMMARY

Congressional Direction and Purpose

This interim report to Congress is prepared to aid in identifying a comprehensive plan for de-authorizing deep-draft navigation on the Mississippi River-Gulf Outlet (MRGO) from the Gulf Intracoastal Waterway (GIWW) to the Gulf of Mexico. The interim report offers a general analysis of local conditions, presents options for a plan to de-authorize the MRGO channel for deep-draft navigation, and provides a foundation for any required additional detailed analysis. This interim report does not contain a final recommendation for construction but does evaluate the feasibility of integrating each of the options presented under the Louisiana Coastal Protection and Restoration (LACPR) efforts. While the December 2007 LACPR report will include a final detailed plan, based on the current level of analysis, it appears that full integration into LACPR could be best achieved by closing the MRGO to both deep and shallow-draft navigation via an armored earthen dam in the vicinity of Hopedale, Louisiana.

Public Law 109-234, the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery, 2006, reads in part:

> *"…the Secretary of the Army, acting through the Chief of Engineers, utilizing $3,300,000 of the funds provided herein shall develop a comprehensive plan, at full Federal expense, to de-authorize deep-draft navigation on the Mississippi River-Gulf Outlet, Louisiana, extending from the Gulf of Mexico to the Gulf Intracoastal Waterway: Provided further, That, not later than 6 months after the date of enactment of this Act, the Secretary shall submit an interim report to Congress comprising the plan: Provided further, That the Secretary shall refine the plan, if necessary, to be fully consistent, integrated, and included in the final report to be issued in December 2007 for the Louisiana Coastal Protection and Restoration Plan."*

A manager's statement accompanying the legislative language accepted in the Congressional Conference Committee report further directs that:

> *"The plan shall include recommended modifications to the existing authorized current use of the Outlet, including what navigation functions, if any, should be maintained and any measures for hurricane and storm protection. The plan shall be developed in consultation with St. Bernard Parish, the State of Louisiana, and affected Federal Agencies."*

Background

In 1948, Governor Davis of Louisiana wrote in support of the development of the MRGO as follows:

> *"Reference is made to the review of reports on the Mississippi River-Gulf and Mobile to New Orleans Intracoastal Waterway as proposed by the Chief of Engineers, United States Army. I am familiar with the provisions of this proposed report and thoroughly concur in the views and recommendations expressed therein. The project recommended will be of inestimable benefit to the State of Louisiana and to the Nation. A tidewater channel to the sea will permit rapid development of sorely needed additional port facilities by the Board of Commissioners, Port of New Orleans, and will provide great additional benefits to the port. Support of the State of Louisiana for a tidewater canal from New Orleans to the Gulf on the eastern side of the Mississippi River is well shown by Concurrent Resolution No. 18 of the Louisiana Legislature of 1944, in which it was resolved that the Governor of Louisiana be specifically empowered to aid and assist the Federal Government in obtaining and completing such a project."*

The MRGO is a Federally-authorized 36-foot deep, 500-foot bottom width waterway which allows deep-draft access to New Orleans area port facilities via a shorter route than using the Mississippi River. Congress authorized MRGO channel construction in the River and Harbor Act of 1956. Public Law 84-445, 70 Stat. 65 states:

> *"Be it enacted by the Senate and House of Representatives of the United States of America Congress assembled, that the existing project for the Mississippi River, Baton Rouge to the Gulf of Mexico, is hereby modified to provide for the Mississippi River-Gulf outlet to be constructed under the direction of the Secretary of the Army and supervision of the Chief of Engineers, substantially in accordance with the recommendation of the Chief of Engineers contained in House Document 245, Eighty-Second Congress, at an estimated cost of $88,000,000…"*

The MRGO extends from the Inner Harbor Navigation Canal (IHNC) to the 38-foot depth contour of the Gulf of Mexico. Construction of the channel began in 1958 and was completed in 1968. The channel was built across shallow bays and coastal marshes along the southern rim of Lake Borgne and through open water in Breton and Chandeleur Sounds.

In a June 2006 letter to Major General Riley, Director of Civil Works, Governor Blanco of Louisiana requested a "*plan for closure, restoration of the extensive wetlands lost as a direct result of the MRGO, and the integration of this closure into the comprehensive hurricane protection plan.*" The Governor's letter was provided during the development of the LACPR Preliminary Technical Report but is relevant in stating the position of the State of Louisiana regarding planning in this study.

Collaborative Planning Approach

In response to Congressional direction to develop a MRGO de-authorization plan, the U.S. Army Corps of Engineers (USACE) established a plan of action for developing this interim report. Federal, State and local government parties and other organizations were invited to assist in preparation of the report. Invited stakeholder participants included:

- St. Bernard Parish
- Governor's Office of Coastal Activities
- Louisiana Department of Natural Resources
- Louisiana Department of Transportation and Development
- State and Federal Resource Agencies
- Port of New Orleans
- Gulf Intracoastal Canal Association
- Lake Pontchartrain Basin Foundation
- Coalition to Restore Coastal Louisiana
- Biloxi Marshlands Corporation
- Steamship Association of Louisiana
- Bring New Orleans Back Commission
- New Orleans Business Council
- LSU Hurricane Center
- National Aeronautic and Space Administration
- Businesses
- Private citizens

A series of public stakeholder forums were held to identify various plans and proposals for the future of the MRGO. Meetings included technical presentations and open discussions on topics including wetlands, navigation, storm protection, and the local economy. Each stakeholder group was invited to make detailed presentations on their plans. In addition to holding regular stakeholder forums and opening an official public comment period for the interim report, an independent team of technical experts was chartered to review the report.

Additional measures to incorporate public input included an internet web page (http://www.swg.usace.army.mil/mrgo/) and hosting of a large public meeting. The project web page offered interactive capability allowing visitors to submit information and opinions via email. A public meeting was held on a weekend and involved an open house where stakeholder groups were offered display space to present their points of view. The public meeting included a formal presentation of the study process and preliminary results from the USACE and an open comment period for public statements from citizens, organizations, and elected officials. Over 150 people attended the meeting. The collaborative planning effort attempted to identify a consensus plan for de-authorizing the channel but in the end resulted in only identifying common measures or features supported by many stakeholders.

Development of Options and Opportunities

This report provides a qualitative analysis based on coordination with the State of Louisiana, St. Bernard Parish Government, stakeholders, resource agencies and the general public. Studies related to navigation, ecosystem restoration and storm damage prevention for the area have been conducted by Federal and non-Federal agencies over many years. This interim report builds upon past analyses and identifies some of the general considerations associated with MRGO deep-draft de-authorization options. For this report, the USACE defines deep-draft as vessels requiring depths greater than 14 feet. Compliance with the National Environmental Policy Act (NEPA) for any deep-draft de-authorization option or opportunities selected as a recommended alternative will be done through incorporation of that alternative into the Programmatic Environmental Impact Statement accompanying the December 2007 LACPR Final Technical Report.

A USACE technical team evaluated potential modifications to the current uses of the navigation channel with the intent of determining if any uses should be maintained. The evaluation included information presented in the stakeholder meetings, data gathered through a maritime business survey, and government statistics of annual channel utilization. Based on the process outlined above, several options were identified for development of the MRGO deep-draft de-authorization plan. These include:

Option 1 – Maintain a shallow-draft MRGO navigation channel. Several variations of Option 1 would facilitate integration of the de-authorization plan into LACPR:

- Option 1a – Maintain a shallow-draft navigation channel without a structure.
- Option 1b – Construct a salinity control weir at Bayou La Loutre;
- Option 1c – Construct a salinity control gate at Bayou La Loutre (normally closed);
- Option 1d – Construct a storm protection gate at Bayou La Loutre (normally open).

All of the shallow-draft channel options would include maintenance dredging of a 12 feet deep by 125 feet wide channel to match the dimensions of the GIWW.

Option 2 - Close the MRGO channel to deep-draft and shallow-draft vessels. Closure of the MRGO to all vessel traffic could be realized by blocking the channel via any of the following variations:

- Option 2a – Construct an armored earthen dam across the MRGO at Bayou La Loutre;
- Option 2b – Restore both banks of Bayou La Loutre across the MRGO at Hopedale, Louisiana; or
- Option 2c – Fill in the entire MRGO channel from the GIWW to the Gulf of Mexico.

Option 3 - Cease all MRGO operations and maintenance activities (dredging, jetty repairs, and navigation aids). If Congress chooses to discontinue all activities related to maintaining the MRGO, several relic project features would need to be addressed. These features include navigation aids such as buoys and lights and the offshore jetties located in Breton and Chandeleur Sounds. Development of a complete de-authorization plan should include disposal of these relic features.

Under LACPR and other independent authorities, opportunities for ecosystem restoration and hurricane storm surge risk reduction could complement the MRGO de-authorization options. These opportunities include:

- Freshwater diversion into the MRGO and surrounding marshes (possibly in the vicinity of Violet Canal);
- Shoreline protection to prevent wetlands erosion (including maintenance of existing projects);
- Habitat creation through the placement of sediment for rebuilding marshes, barrier islands, and ridges;
- Increase existing levee heights to new hurricane protection levels; and/or
- New hurricane protection levee alignments or surge protection structures.

Evaluation of Options and Opportunities

Although the primary purpose of this interim report is to identify measures that could be included in a plan to de-authorize deep-draft navigation on the MRGO, the report also documents the costs private businesses dependent upon deep-draft navigation might incur. All of the businesses that require the deep-draft access previously provided by the MRGO are located on the most inland portion of the channel that coincides with the GIWW. Businesses along the MRGO currently report experiencing inefficiencies due to the lack of deep-draft access to their facilities.

Preliminary analysis of deep-draft navigation indicates that maintaining the authorized dimensions of the MRGO is not cost-effective. Average annual Operations and Maintenance (O&M) costs to dredge the MRGO deep-draft channel are $12.5 million. However, maintaining the authorized dimensions only produces approximately $6.2 million per year in transportation efficiencies.

The economic information available indicates that shallow-draft traffic on the MRGO is not cost-effective in terms of National Economic Development (NED). The total average annual costs for the various shallow-draft alternatives (including construction and maintenance dredging) range between approximately $6 million and $9 million. Estimated annual benefits associated with maintaining shallow-draft depths are approximately $3.7 million.

This interim report discusses various options for shallow-draft navigation. The MRGO serves as an alternate route to the GIWW for inland barge traffic when the IHNC Lock is either impassable or congested. The 83-year old lock, which is the oldest in the system of locks on the GIWW, is well beyond its original design life of 50 years, increasing the likelihood of a catastrophic failure. Since 2001, there have been four lock through stoppages of greater than one-day with the longest being during Hurricane Katrina. Although construction activities have commenced on the new IHNC Lock, the advancement of the lock construction has been delayed, primarily due to funding provisions. A total navigation closure of the GIWW alternate route at MRGO could be of national significance due to the effect it would have on industries and national security. Without an alternate route, inland navigation would be affected for routine IHNC Lock closures as well as by a possible failure of the aging lock. One means of avoiding this effect would be a closure or modification sequencing plan for the MRGO. A sequenced approach to de-authorizing the MRGO would mitigate the risk to continued navigation on the GIWW.

The relationship between the MRGO and hurricane storm surge has been the topic of study and debate before and after Hurricane Katrina. The hypothesized link between the channel and surge has received a great deal of media and public attention. A number of engineering and hydraulic modeling studies have evaluated these reported connections. These studies have reached similar conclusions that the inland reach of the MRGO does not contribute significantly to peak storm surge during severe storms because the surrounding wetlands are overwhelmed with water. Studies also demonstrated that the most noticeable effect of the MRGO occurs for small surge events where the surrounding marsh areas are not completely inundated. These studies have implications for plan selection especially in regards to the intended purpose of features or their potential design performance during storm events. This reasoning highlights the need to integrate plans for the future of the MRGO into long-term plans currently under development in the LACPR.

Linking plans for the de-authorization of the MRGO into the LACPR and other ongoing USACE and State of Louisiana work is important. A number of activities in the vicinity of the MRGO are pertinent to future plans for the channel. These activities involve coastal restoration, levee repairs and upgrades, navigation infrastructure maintenance and replacement, and flood control. A systems analysis offers the best evaluation approach for determining the complex interactions of these activities. This analysis may be especially important in sequencing the design and construction of interrelated projects such as levees, navigation features and coastal protection and restoration efforts.

Interim Report Conclusions

Preliminary analysis indicates that it is not cost effective to maintain shallow-draft navigation on the channel between the GIWW and the Gulf of Mexico. Preliminary analysis of deep-draft navigation indicates that maintaining the authorized dimensions of the MRGO is not cost-effective. Based on this preliminary analysis, closure of the MRGO channel to both shallow and deep-draft navigation by an armored earthen dam just south of Bayou La Loutre near Hopedale, Louisiana appears to be particularly viable. Through incorporation into LACPR, additional measures to provide opportunities for hurricane storm surge protection and ecosystem restoration may complement MRGO channel closure, including wetland shoreline protection, freshwater diversion, and dedicated dredging for coastal habitat creation. These preliminary options will be further developed and coordinated for NEPA compliance through the LACPR final planning efforts. These measures have been supported by stakeholders and are consistent with most existing Federal and non-Federal plans for ecosystem restoration and hurricane risk reduction in the area.

The LACPR Final Technical Report will provide the design of the closure of the MRGO by a structure in the area of the Bayou La Loutre Ridge as well as any other opportunities for hurricane storm damage protection and ecosystem restoration. Additionally, several major, ongoing efforts (navigable gates to protect the IHNC, emergency supplemental erosion protection along the MRGO, and the IHNC Lock replacement project) that address key aspects of the project are documented in this interim report. Completing a de-authorization plan includes full development and coordination of the MRGO closure project through LACPR.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION AND BACKGROUND

This report, based on direction from Congress, compares options for a comprehensive plan for de-authorization of deep-draft navigation on the Mississippi River-Gulf Outlet (MRGO). The report contains information on the economic and environmental considerations associated with this de-authorization plan. The report identifies options and opportunities that will be further evaluated and integrated under the on-going Louisiana Coastal Protection and Restoration Study (LACPR).

Congressional Direction

Congress has directed the Secretary of the Army, acting through the Chief of Engineers, to plan for de-authorization of deep-draft navigation on the MRGO. Public Law 109-234, the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery, 2006, reads in part:

> *"…the Secretary of the Army, acting through the Chief of Engineers, utilizing $3,300,000 of the funds provided herein shall develop a comprehensive plan, at full Federal expense, to de-authorize deep-draft navigation on the Mississippi River-Gulf Outlet, Louisiana, extending from the Gulf of Mexico to the Gulf Intracoastal Waterway: Provided further, That, not later than 6 months after the date of enactment of this Act, the Secretary shall submit an interim report to Congress comprising the plan: Provided further, That the Secretary shall refine the plan, if necessary, to be fully consistent, integrated, and included in the final report to be issued in December 2007 for the Louisiana Coastal Protection and Restoration Plan."*

House Report 109-494 provides a Congressional Conference Committee manager's statement accompanying the legislative language further directing that:

> *"The plan shall include recommended modifications to the existing authorized current use of the Outlet, including what navigation functions, if any, should be maintained and any measures for hurricane and storm protection. The plan shall be developed in consultation with St. Bernard Parish, the State of Louisiana, and affected Federal Agencies."*

Congress has authorized the United States Army Corps of Engineers (USACE) to prepare a plan to de-authorize deep-draft navigation on the MRGO channel and has also encouraged USACE to identify any measures for hurricane and storm damage reduction. Federal and State resource agencies were invited to assist in preparation of the report, along with St. Bernard Parish and other local stakeholders.

Background on the MRGO

In 1948, Governor Davis of Louisiana wrote in support of the development of the MRGO as follows:

> *"Reference is made to the review of reports on the Mississippi River-Gulf and Mobile to New Orleans Intracoastal Waterway as proposed by the Chief of Engineers, United States Army. I am familiar with the provisions of this proposed report and thoroughly concur in the views and recommendations expressed therein. The project recommended will be of inestimable benefit to the State of Louisiana and to the Nation. A tidewater channel to the sea will permit rapid development of sorely needed additional port facilities by the Board of Commissioners, Port of New Orleans, and will provide great additional benefits to the port. Support of the State of Louisiana for a tidewater canal from New Orleans to the Gulf on the eastern side of the Mississippi River is well shown by Concurrent Resolution No. 18 of the Louisiana Legislature of 1944, in which it was resolved that the Governor of Louisiana be specifically empowered to aid and assist the Federal Government in obtaining and completing such a project."*

The MRGO is authorized as a 36-foot deep, 500-foot bottom width, waterway which allows alternate deep-draft access to the city of New Orleans (Figure 1). Channel construction was authorized by the River and Harbor Act of 1956. The MRGO extends from the Inner Harbor navigation Canal (IHNC) in New Orleans to the 38-foot depth contour in the Gulf of Mexico. Construction of the channel began in 1958 and was completed in 1968. The channel was constructed through part of the Gulf of Mexico, shallow sounds and coastal wetlands. The MRGO provides a shorter navigation route from the Gulf of Mexico to the Port of New Orleans tidewater facilities compared to using the Mississippi River to access the ports.

Figure 1. Mississippi River Gulf Outlet De-Authorization Plan Area.

The MRGO is approximately 76 miles long. Located south and east of New Orleans it begins 9.4 miles out in the Gulf of Mexico where it is authorized to a depth of 38 feet and a bottom width of 600 feet. These dimensions extend from mile -9.4 to mile 0 (bar channel). The authorized dimensions for the remaining 66 miles of the MRGO are a depth of 36 feet and a bottom width of 500 feet. From mile 0 to mile 23, it extends through the shallow waters of Breton Sound. This section of the MRGO is often referred to as the Sound Reach. From mile 23 to mile 60, the MRGO extends further to the north and west, through coastal wetlands. This section of the MRGO is often referred to as the Inland Reach.

At mile 60 the MRGO connects with the Gulf Intracoastal Waterway (GIWW), and the two run contiguously westward for six miles to the IHNC, also called the Industrial Canal, in New Orleans. This section of the MRGO is often referred to as the GIWW Reach. At the direction of Congress, this report considers only de-authorization of the MRGO south of its confluence with the GIWW (Inland Reach, Sound Reach, and Bar Channel). The Inner Harbor tidewater port area is a complex interconnected system of waterways that are authorized at varying depths under different Congressional authorities (from the IHNC Lock to the Turning Basin is authorized at 32 feet deep and from the Turning Basin to Michoud Canal is authorized at 36 feet deep – the same as most of the MRGO).

Operation and Maintenance (O&M) of the authorized MRGO channel width and depth is dependent on Congressional appropriations, which since the mid 1990s have not been sufficient to maintain the channel at full authorized dimensions. This funding limitation has been compounded by additional needs for emergency dredging of shoaled areas in the MRGO following tropical storms or hurricanes and the construction and repair of bank-line protection and created wetlands.

Through discussions with members of the local maritime industry, a consensus was reached to start maintaining the channel to narrower widths than authorized without affecting safe vessel passage or delaying industry. These pre-Katrina dimensions would have provided a single lane of traffic in the MRGO for deep-draft vessels. These dimensions were a 36 feet deep by 300 feet wide (minimum) channel from Mile 66 to Mile 0 and 38 feet deep by 450 feet wide channel from Mile 0 to Mile -9.4. Advanced maintenance and allowable over-depth were included, which increased the depth of dredging by six feet between Miles 66 and 23, eight feet across the Sound Reach, and four feet through the Bar Channel. No maintenance dredging of MRGO has occurred since Hurricane Katrina.

Direct costs of construction, operation, and maintenance of the MRGO have been funded by the Federal government. These direct costs have totaled over $578 million since 1958 as shown in Table 1.

Table 1. Federal Investment in the MRGO.

Years	Federal Investment in MRGO
1958-1965	$43,304,000
1966-1973	$102,857,000
1974-1981	$73,992,000
1982-1989	$78,886,000
1990-1997	$109,040,000
1998-2005	$170,580,000
Total	$578,659,000

Note: Values are in actual dollars.
Source: USACE Operations Division.

Appropriations during 1958 to 1968 reflect initial construction costs. Subsequent expenditures are for operations and maintenance, primarily dredging activities (LCA, 2004). The average annual operations and maintenance expenditures for the MRGO is $12.5 million (in 2000 dollars). However, following tropical storms and hurricanes supplemental expenditures have often been required to return the MRGO to the authorized dimensions. Since 1998, the $12.5 million annual O&M appropriation has not allowed for dredging of the channel to its full authorized dimensions.

Vessel Utilization of the MRGO

Vessels traversing the MRGO carry a wide variety of commodities, including petroleum products, chemicals, forest products, manufactured goods, food and farm products, and machinery. Waterborne Commerce Statistics Center (WCSC) data for 2002-04 shows that the greatest tonnage was for transport of commodities in three categories (Table 2).

Table 2. Transportation Commodities on the MRGO for 2002-2004.

Major Commodity Group	Tons		
	2002	2003	2004
Chemicals and related products	567,000	590,000	109,000
Agricultural products	465,000	398,000	292,000
Soil, sand, gravel, rock, cement, glass	484,000	535,000	317,000

Historical data from the WCSC also show that use of the MRGO steadily increased, until reaching a peak in terms of tonnage carried in 1978, and in terms of the number of vessels in 1982. Proportionally, the number of trips has decreased more than the tonnage, presumably because ships today are larger and carry greater amounts of cargo. In the last 20 years for which comparable data are available, use of the MRGO has generally been decreasing (Table 3).

In some cases (1983-1997), these data may represent trips anywhere along the MRGO, including that section from Mile 60 to Mile 66, which is contiguous with the GIWW. Information in Table 3 for 1998-2005 shows MRGO vessel trips only between Mile 60 to Mile -94 (i.e., GIWW to the Gulf of Mexico). The actual number of trips along the southernmost part of the MRGO, from Mile 60 into the Gulf of Mexico, has been estimated at fewer than two deep-draft vessels per day.

Table 3. Navigation on the MRGO (includes GIWW traffic).

Time periods	Average tonnage carried on the MRGO	Average vessel trips on the MRGO per year (1983 – 1997); Actual vessel trips 1998 -2005
1983-1987	7,247,000	5,708
1988-1992	6,304,000	4,437
1993-1997	5,144,000	5,980
1998	4,007,000	2,240
1999	5,369,000	1,886
2000	5,850,000	2,104
2001	4,173,000	2,083
2002	3,290,000	2,445
2003	2,847,000	3,766
2004	1,206,000	2,370
2005	Not available	982

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., IWR-WCUS, Part 2.

WCSC data show that from 1970 to 1995, foreign tonnage on the MRGO represented less than 75 percent of total tonnage. This includes both inbound and outbound tonnage. Since 1998, tonnage bound for foreign ports has increased. For example, in 2002 it represented 85 percent of the total tonnage and 86 percent in 2004.

The draft of vessels utilizing the MRGO is important when evaluating its value to navigation interests. Vessel trips may be grouped into shallow and deep-draft trips. WCSC data defines deep-draft trips as vessels reporting over 18 feet in draft. These data show, for example, that on the entire length of the MRGO in 2002, approximately 61 percent of the trips were by shallow-draft vessels, and 39 percent were by deep-draft vessels (Note: For this report, the USACE is using the definition of deep-draft vessels contained in ER-1105-2-100. This defines deep-draft as vessels requiring greater than 14 feet).

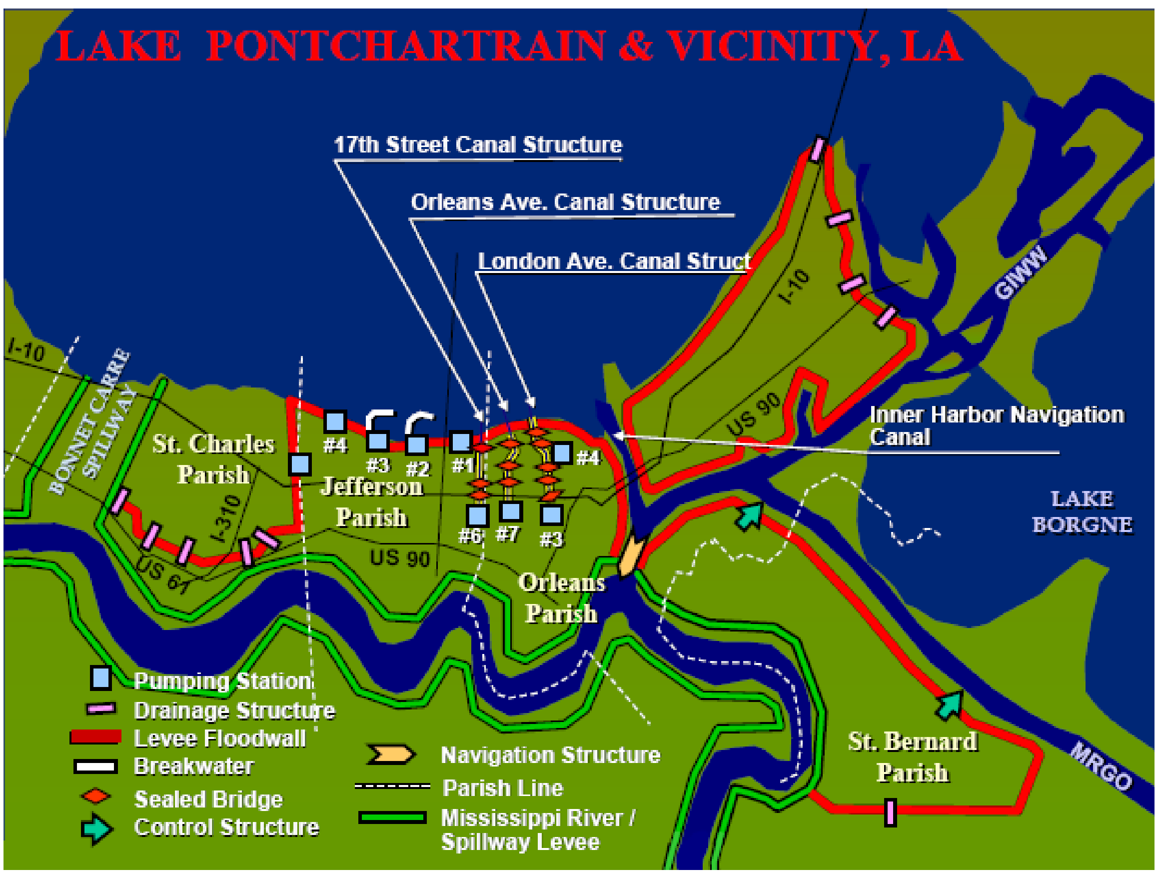
Future Operation and Maintenance of the MRGO

Sections of the MRGO experienced severe shoaling during Hurricane Katrina, leading to a current controlling channel depth of approximately 22 feet. The estimated cost to return the channel to its authorized dimensions (36 feet deep by 500 feet wide, 38 feet deep by 600 feet wide in bar channel) is $130,250,000, which includes advanced maintenance dredging and over-depth dredging. For this de-authorization study, although no current plans exist to dredge the MRGO, it is important to estimate these costs for comparison purposes in evaluating future options for modifying the channel.

Relationship Between the MRGO and Levees

The Lake Pontchartrain and Vicinity Hurricane Protection Project generally covers the parishes of St. Charles, Jefferson, Orleans and St. Bernard between the Mississippi River and Lake Pontchartrain. The project includes levees and floodwalls located on the disposal area on the south bank of the MRGO (including the area where it is contiguous with the GIWW), along the IHNC and north bank of the GIWW (including the area where it is contiguous with the MRGO). Figure 2 shows the general relationship between the MRGO and the Lake Pontchartrain and Vicinity hurricane protection system.

Figure 2. Hurricane Protection System for City of New Orleans.



Relationship Between IHNC Lock and MRGO

Completed in 1921, the current IHNC Lock was designed for a working life of 50 years. Currently 35 years past its design life, the lock is one of the Nation's most congested, with an average wait of 10 hours, but often as much as 24-36 hours (Table 4). The lock is too small to accommodate the volume of existing and projected future traffic. A deep-draft replacement lock was originally authorized in 1956, but legal issues and community involvement problems delayed construction until 1998. Since 1998, the new lock has not been funded to full construction capability. The lack of a definitive idea about the future of the lock has caused uncertainty amongst companies in the study area that use the lock and has had significant impacts on their planning.

Table 4 indicates the number of vessels delayed at the IHNC Lock and the hours of delay. Delays were the result of congestion, breakdowns, maintenance work or other factors such as Hurricane Katrina in 2005. Most of the delayed vessels are towboats with barges.

Table 4. IHNC Lock Vessel Delay Periods 2000-2005.

Year	24 hours - 29 hours	29 hours – 36 hours	36 hours and greater
2000	228	47	75
2001	157	13	23
2002	271	58	16
2003	195	46	20
2004	600	186	175
2005	312	204	206

An important consideration when discussing options for the MRGO is its use as an alternative route for shallow-draft vessels when the IHNC Lock is not functioning or when encountering lock through delays. When the lock is not functioning, some vessels will take the Mississippi River to Baptiste Collette Bayou and cross Breton Sound to the MRGO to by-pass the lock (or vice versa). This route was used following Hurricane Katrina (which closed the lock for 16 days) to supply petroleum, coal, and other products to locations along the Gulf Coast. Therefore, completion of the deep-draft replacement lock between the Mississippi River and the IHNC would help mitigate the economic effects of closing the MRGO to deep-draft navigation. The IHNC Lock and its authorized replacement are essential components of any discussion about the de-authorization of the MRGO.

Relationship Between MRGO and Storm Surge

One much-studied relationship before and after Hurricane Katrina is that of the contribution of MRGO to hurricane storm surge. The hypothesized relationship between the MRGO and storm surge has received a great deal of media and public attention.

A 1966 engineering study prepared for USACE (Bretschneider and Collins, 1966) examined six different storm scenarios using one-dimensional numerical modeling, and concluded that Hurricane Betsy, which occurred in 1965 during the construction of the MRGO, would have produced the same storm surge elevations with or without the MRGO.

In 2003, a study was completed using two-dimensional Advanced Circulation (ADCIRC) modeling for storm surge (USACE, 2003). The ADCIRC model is used to calculate the amount of storm surge under different conditions on ocean shelves, coasts, and estuaries. In this study, nine different storm scenarios were modeled, both with and without the MRGO (shallow marsh in place of the channel). The nine scenarios were combinations of slow, medium, and fast moving storms with weak, moderate, and strong intensity winds, and one of these models used the Hurricane Betsy track. The model runs demonstrated that the maximum difference in storm surge with and without the MRGO was just over 6 inches. These models also demonstrated that with the MRGO, drainage of Lake Pontchartrain following a surge event was accelerated.

Following Hurricane Katrina, the Interagency Performance Evaluation Task Force (IPET) of USACE studied the New Orleans hurricane protection systems, storm surge, performance of flood protection measures, and the consequences of the hurricane. It found that the MRGO had little influence on water levels in the IHNC during Katrina, because when the marshes are inundated, the water conveyed through the channel is a relatively small part of the total surge. The report states that "during Katrina, MRGO was far from the 'hurricane highway' moniker with which it has been branded." It found that the MRGO levees were overtopped by high surge and high, long-period waves before the hurricane made landfall, and that the high velocities of water movement over the levees caused scouring and breaching of levees along the MRGO.

In 2006, USACE analyzed the Southeast Louisiana Hurricane Protection System and found that "[t]he southeast trending leg of the Mississippi River Gulf Outlet (MRGO) had little influence on the water levels in the IHNC during Katrina" (USACE, 2006b). This conclusion was reached after comparing the results of ADCIRC models runs, assuming the MRGO channel existed in its pre-Katrina conditions, and then assuming that the MRGO did not exist.

A 2006 study by the Louisiana Department of Natural Resources also evaluated the impact of the MRGO on storm surge using ADCIRC modeling. This study considered seven different scenarios. These included a 124-knot fast-moving storm, Hurricane Betsy conditions, and Hurricane Katrina conditions, both with and without the MRGO, and Hurricane Katrina conditions with higher levees. The conclusions were that the MRGO does not contribute significantly to peak storm surge during severe storms where the wetland system is overwhelmed with water, and that closure will not provide significant, direct mitigation of severe hurricane storm surge. However, closure of the MRGO may, according to the LDNR study, modestly delay the onset of surge in a few locations and "would significantly reduce storm surge scour velocities at some locations" (LDNR, 2006). Again, this study provided evidence that closure of the MRGO may impede drainage of Lake Pontchartrain following a surge event.

Studies also demonstrated that the most noticeable effect of the MRGO occurs for small surge events, where the marsh areas are not completely inundated (USACE, 2006a; LDNR, 2006). Further storm surge modeling analyses are underway through LACPR to consider scenarios with new structural flood protection features, such as levees and floodgates. Solutions to the impact of storm surge that have been posed by the public include barrier construction, such as floodgates at some points along the MRGO and partially or completely filling in the channel.

Public Views on the MRGO

USACE has conducted a number of studies associated with the MRGO from various points of view including ecosystem restoration, navigation, and hurricane protection. Based upon previous studies, numerous citizen letters, and interactions with local governments and the public, the following points have been noted:

- Construction and use of the MRGO caused the loss of wetlands habitat.
- Some parties believe that the MRGO exacerbates storm surges in the region.
- Maintenance dredging costs outweigh the promised economic benefits of the MRGO.

In a letter dated June 2, 2006, Governor Blanco of the State of Louisiana made a request for a “plan for closure, restoration of the extensive wetlands lost as a direct result of the MRGO, and the integration of this closure into the comprehensive hurricane protection plan.” See Appendix 2 for the full text of Governor Blanco’s letter.

Related Authorities and Plans

The following sections give a brief background on existing authorities and plans relevant to the development of a comprehensive plan for de-authorization of MRGO.

Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), 1990

The Coastal Wetlands Planning Protection and Restoration Act (Public Law 101-646) provides funding for projects to restore coastal ecosystems in Louisiana and other states. In 1993, the CWPPRA Task Force produced the Louisiana Coastal Wetlands Restoration Plan. Projects suggested for the Pontchartrain Basin relating to the MRGO included:

- Close or move the MRGO to prevent erosion and preserve marsh.
- Stabilize the MRGO banks and create marsh to prevent erosion and preserve marsh.
- Stabilize shorelines, improve hydrology, and manage marshes to preserve the landbridges.
- Introduce and manage freshwater to reduce salinity and preserve marsh and swamp throughout the basin.

Under CWPPRA, individual plans and projects are constructed to preserve and restore wetlands. Projects addressing the area surrounding the MRGO include the MRGO Disposal Area Marsh Protection (PO-19), Lake Borgne Shore Protection (PO-30), and Lake Borgne and MRGO Shoreline Protection (PO-32). Other candidate projects have been proposed under the CWPPRA to address coastal erosion problems in the project area.

Coast 2050: Toward a Sustainable Coastal Louisiana, 1998

The Louisiana Coastal Wetlands Conservation Task Force and the State of Louisiana’s Wetlands Conservation & Restoration Authority prepared this plan for the Louisiana Department of Natural Resources. It addresses the problem of depletion of coastal land across Louisiana, and recommends ecosystem management strategies designed to restore wetlands and prevent continued deterioration.

Among the ecosystem management strategies recommended in the plan are:

- Close MRGO to deep-draft navigation when adequate container facilities exist on the river.
- Stabilize the entire north bank of the MRGO.
- Constrict breaches between MRGO and Lake Borgne with created marshes
- Construct a sill at Seabrook.
- Wetland sustaining diversion from the Mississippi River near Violet once the MRGO is closed.
- Create marsh in southern lobes of Lake Borgne (by beneficial use of dredged material).
- Dedicated delivery of sediment for marsh building (Eloi Bay and Biloxi Marshes).

Continuing Authorities Program

Sections 204 of the Water Resources Development Act (WRDA) 1992, section 206 of WRDA 1996, and section 1135 of WRDA 1986 are "continuing authorities" that authorize the Secretary of the Army to plan, design, and implement certain ecosystem restoration measures, subject to specified cost sharing, without additional project specific Congressional authorization. Section 204 authorizes the beneficial use of dredged material to restore, protect, and create aquatic and ecologically related habitats, including wetlands, in connection with construction or maintenance dredging of an authorized navigation project. Additionally, section 206 authorizes certain aquatic ecosystem restoration projects that will improve the quality of the environment and that are in the public interest. Finally, section 1135 authorizes modification of structures or operations at existing USACE projects for the purpose of improving the quality of the environment in the public interest. Projects performed under these continuing authorities include the placement of dredged material from the MRGO (miles 14 to 12) adjacent to the south jetty for wetland creation and the placement of dredged material from mile -2 to -4 on Breton Island for island restoration.

Louisiana Coastal Area (LCA) Ecosystem Restoration Study, 2004

The USACE and the State of Louisiana prepared a study to identify the most critical ecological needs of the coastal area and to describe alternative restoration strategies. The MRGO was identified as one of the five specific areas with significant near-term needs, and environmental restoration costs for shoreline protection projects in the area are estimated at $121,736,000 (2004 dollars).

The report recommended the construction of rock breakwaters along 23 miles of the north bank of the MRGO, and along 15 miles of the southern shore of Lake Borgne. This was defined as part of the critical near-term plan for LCA.

Louisiana Coastal Protection and Restoration, 2006

Following the severe hurricane season of 2005, Congress directed the USACE to conduct an analysis and design on a full range of hurricane risk reduction measures against a surge equivalent to "Category 5" storm intensity. The effort spans across all of coastal Louisiana and comprehensively integrates the water resource objectives of hurricane protection, flood control, and coastal restoration. Working closely with the State of Louisiana, a Preliminary Technical Report was prepared by the USACE for the Congress in July 2006. In addition to the preliminary analysis and design, the Preliminary Technical Report included the following "Prime Points:"

- Coastal Features and Storm Surge
- Hurricane Threat to New Orleans
- Technical Collaboration with the Dutch
- Strong Houses Resist Storms
- Coastal Engineering Design Challenges

The Final LACPR Technical Report will be submitted to Congress in December 2007.

Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery, 2006

In addition to providing funding to develop a comprehensive plan to de-authorize deep-draft navigation on the MRGO, this legislation provided nearly $4 billion for levee improvements and flood control projects in the New Orleans area. Funds include $1.5 billion to reinforce or replace floodwalls, $495 million for levee projects, $350 million for construction of navigable closures on the IHNC and the GIWW, and $170 million to armor critical areas of the levees. Figure 3 details shoreline protection projects on the north and south shorelines of the MRGO and on the southeast shore of Lake Borgne funded under this appropriation.

In consideration of construction of navigable closures on the IHNC and GIWW, the USACE is evaluating a floodgate at Seabrook that would remain open except under severe weather conditions. Gates on the GIWW east of Michoud Canal and on the MRGO south of Bayou Bienvenue with a connecting levee is one of the alternatives being considered.

Figure 3. Shoreline Protection Projects Funded by Supplemental Appropriations.

CONDITIONS IN THE PONTCHARTRAIN BASIN

The following sections describe the historic and present conditions of the MRGO project area and the middle Pontchartrain Basin.

Historical Land/Habitat Conditions

The MRGO project area is located within the middle Pontchartrain Basin of the coastal Louisiana deltaic plain. The Pontchartrain Basin has been in a destructional phase for approximately 1,800 years, during which submergence of the coastal lands has been the dominant process (Frazier, 1967; Britsch and Dunbar, 1993; Barras *et al.*, 2003). This process is caused by subsidence, sea level rise, and lack of sediment and organic matter deposition. For much of coastal Louisiana, including the MRGO area, the amount of sediment and organic matter deposition is not sufficient to keep pace with the rate of subsidence and sea level rise, causing net submergence of the coastal zone. This is a natural part of the deltaic process that has been accelerated by human activity.

About 700 years ago, the Mississippi River was established in its present channel (Sikora and Kjerfve, 1985). Since that time, subsidence has been occurring in the Pontchartrain Basin. The construction of Mississippi River levees protects inhabited areas, but prevents periodic flooding and sedimentation from replenishing adjacent wetlands. Coastal wetlands depend on flooding of the marsh surface and accompanying sediments for growth (Cahoon, 1991). Since the leveeing of the river, subsidence has increased due to the absence of seasonal river flooding and the influx of sediments (Cahoon *et al.*, 1995). Other factors also directly and indirectly influence wetland loss including the construction of oil and gas canals and their associated disposal areas (Turner, 1987), subsurface faulting (Gagliano, 2005), hydrocarbon extraction (White and Morton, 1997), storm events, changes in the relationship between mineral and organic composition in the soils (Nyman et al., 1994), and plant dieback associated with phytotoxin accumulation (Mendelssohn and McKee, 1988, Webb and Mendelssohn, 1996).

Britsch and Dunbar have calculated land loss in the basin over various time periods by comparing the amount of land in aerial photographs. In the early 1930’s there were 730,339 acres of land in the basin. Table 5 indicates the changes from land to water in the indicated time periods and also shows the percent loss of land.

Table 5. Land Loss in Pontchartrain Basin: 1930s to 2001.

Interval	Acres Lost	% Loss/year
1930's-58	24,349	0.11%
1958-74	31,751	0.24%
1974-83	12,914	0.18%
1983-1990	7,826	0.14%
1990-2001	13,969	0.17%

(Data compiled from Britsch and Dunbar, 2005.)

Wetland habitat types occur along the eastern Louisiana coast in bands that roughly parallel the shoreline. Salinity and elevation are the principal factors regulating plant distribution. Penfound and Hathaway (1938) subdivided the marshes in the MRGO project area into four salinity types: saline, brackish, slightly brackish (now commonly called intermediate), and fresh.

In 1949 when O'Neil mapped the coastal marshes, he found no fresh marsh in the Pontchartrain Basin. He indicated some intermediate marsh in the southern La Branche wetlands, eastern New Orleans marshes and the Central Wetlands. Marshes along the north and south shores of Lake Pontchartrain were brackish as were the New Orleans East and Lake Borgne Land Bridges, most of the Central Wetlands, and the western Biloxi Marshes. The eastern Biloxi Marshes were saline. Freshwater areas along the shores of Lakes Maurepas and Pontchartrain likely contained cypress-tupelo swamps even though O'Neil did not indicate them. In 1998, USGS analyzed 1956 aerial photography which indicated 10,200 acres of cypress swamp in the Central Wetlands.

From 1968 through 2001, fresh and intermediate marshes were found on the western shores of Lake Pontchartrain and near the mouth of the Pearl River. The exact locations and acreages fluctuated, probably depending on annual rainfall. In 1968, the marshes just north of Bayou La Loutre were intermediate. In 1968 and again in 1997 and 2001, there were varying amounts of intermediate marsh in the Central Wetlands. Since 1968, brackish marsh has been present along the north shore of Lake Pontchartrain, the New Orleans East Land Bridge, in the Central Wetlands and in the western Biloxi Marshes. The Lake Borgne Land Bridge was all brackish in 1968 and 1978. By 1988, saline marsh had encroached up the MRGO to Bayou Dupre. Saline marsh has consistently been present in the outer Biloxi Marshes (Chabreck et. al. 1968, 1978, and 1997).

Construction of the MRGO converted nearly 3,400 acres of intermediate marsh, over 10,300 acres of brackish marsh, over 4,200 acres of saline marsh and 1,500 acres of cypress and levee forest to open water or disposal area (USACE for Environmental Subcommittee of the EPA Technical Committee, 1999). Bank erosion on the MRGO has been estimated to occur at rates of between 6 and 36 feet per year on the Inland Reach (Coastal Environments, 1984). Bank stabilization efforts to prevent erosion and shoaling in the channel have included placement of rock dikes and concrete mats along the banks of the MRGO in some areas. Material dredged from the channel has been beneficially used to restore and nourish over 1,000 acres of wetlands adjacent to the Inland Reach of the channel especially between Lake Borgne and the MRGO.

Historical Salinity Conditions

Over the past 6,000 to 7,000 years, the salinity of the study area has shifted with the major deltaic meandering of the Mississippi River. Modern efforts to control flooding and improve navigation included numerous bank stabilization, channel alignment, dredging, lock, dam, levee, and spillway projects on the Mississippi River. Such alterations to the Mississippi River and surrounding wetlands have increased salinity in the study area by altering the flow of freshwater in the region (LCA, 2004).

Over 80 percent of the annual freshwater inflow to the Pontchartrain Basin is provided by precipitation. The flow of water into the lower reaches of the MRGO is predominantly driven by tides and winds. While the annual salinity in Lake Pontchartrain increased after construction of the MRGO, at least one study found the increase to be statistically insignificant (Sikora and Kjerve, 1985).

A study by Tate et al. (2002) showed that monthly average salinity increased from the 1951-1963 period to the 1963-1977 period (Table 6).

Table 6. Comparison of Monthly Summaries of Salinity: 1951-1963 and 1963-1977.

	Salinity (ppt)		
Location	**1951-1963**	**1963-1977**	**Increase**
Pass Manchac	1.2	1.6	0.4
North Shore	3.5	4.6	1.1
Little Woods	3.3	5.2	1.9
Chef Menteur	3.8	6.1	2.3
Alluvial City	7.8	12.2	4.4

(Data compiled from Tate et al 2002.)

According to Tate et al, "Salinity in the region has stabilized, and no significant increase in average annual salinity is projected in the foreseeable future for Lake Maurepas and Lake Pontchartrain. Salinity is expected to increase in the Lake Borgne region and surrounding marshes due to land loss in the area."

Present Conditions

The following sections describe both the navigation and environmental conditions after Hurricane Katrina.

Present Navigation Conditions

During Hurricane Katrina, approximately five miles of the authorized channel in the Breton Sound area was reduced in depth to approximately 22 feet or less. No maintenance dredging activities have taken place on the MRGO since Hurricane Katrina. The current channel depth has limited the use of the MRGO to vessels with a draft of 22 feet or less. Current users of the channel are primarily sportsmen, shrimp boats, and shallow-draft tows, although some inbound deep-draft vessels are entering the IHNC area via the MRGO.

With the channel too shallow for some deep-draft navigation, businesses that relied upon the MRGO for vessels to reach them have found alternative means of operation. Some vessels are able to use the Mississippi River and IHNC Lock to reach the MRGO tidewater port facilities. Other users are able to dock vessels on the river and commodities are transported from facilities on the MRGO to and from these vessels by trucks. Some businesses now bring ships into the MRGO unloaded and then transit outbound through the IHNC loaded with cargo. Other users have closed or moved their facilities to other locations.

Present Land/Habitat Conditions

Before Hurricane Katrina, *Coast 2050* predicted that between 2000 and 2050, 45,400 acres of marsh would be lost in the Pontchartrain Basin. It is likely that Hurricane Katrina deposited a measurable amount of sediment throughout the Pontchartrain Basin area (Turner et. al., 2006). Despite this, between fall 2004 and October 2005, the Pontchartrain Basin apparently lost 12,160 acres of wetlands. Habitat analysis indicates that over 640 acres each of forested wetlands and fresh marsh was converted to open water. About 2,560 acres of intermediate marsh, 3,840 acres of brackish marsh, and 4,480 acres of saline marsh also became open water (USGS-SWRC-BRPO, 2006). Thus, the total amount of marsh lost as a result of Hurricane Katrina was over one third the total predicted wetland losses expected by 2050. The storm surge and strong winds from Hurricane Katrina also severely damaged the Chandeleur and Breton Islands and adjacent seagrass beds according to the USGS.

PLAN FORMULATION

Public interest in the future of the MRGO is high across academic, environmental, and business sectors as well as with citizens and local governments. In conducting this study, the USACE emphasized efforts to allow open and broad participation in the planning process. The goal of the effort is to carry out a transparent and interactive planning initiative. From the beginning the team shared views about the goals, scope, and constraints of the study. The following sections detail the planning process and results.

Collaborative Planning Approach

In response to Congressional direction to develop a de-authorization plan, the USACE established a plan of action for developing this interim report. Federal, State and local government parties and other organizations were invited to assist in preparation of the report. Invited stakeholder participants included:

- St. Bernard Parish
- Governor's Office of Coastal Activities
- Louisiana Department of Natural Resources
- Louisiana Department of Transportation and Development
- State and Federal Resource Agencies
- Gulf Intracoastal Canal Association
- Port of New Orleans
- Lake Pontchartrain Basin Foundation
- Coalition to Restore Coastal Louisiana
- Biloxi Marshlands Corporation
- Steamship Association of Louisiana
- Bring New Orleans Back Commission
- New Orleans Business Council
- LSU Hurricane Center
- National Aeronautic and Space Administration
- Businesses
- Private citizens

Stakeholder Meetings

A series of eight public stakeholder forums were held to identify various plans and proposals for the future of the MRGO. Meetings included technical presentations and open discussions on topics including wetlands, navigation, storm protection, and the local economy. Each stakeholder group was invited to make detailed presentations on their plans. In addition to holding regular stakeholder forums and opening an official public comment period for the interim report, an independent team of technical experts was chartered to review the report.

The State of Louisiana, environmental organizations, planning groups, businesses, and individuals have developed plans for coastal protection and restoration that include MRGO related components. In some cases, the plans are specific to the MRGO and in others the channel is merely a component of larger proposals. In conducting this study the USACE invited stakeholders to present their plans as part of efforts to identify common approaches to help achieve consensus. The following non-federal plans and studies are highlighted given their relevance to this de-authorization study.

The features of the St. Bernard Parish Plan in the vicinity of MRGO are summarized below and the plan is available on the internet at http://www.sbpg.net/.

- Construct Five New Floodgates: at Seabrook, on the GIWW, on MRGO near Bayou Bienvenue, on Bayou Dupree at Lake Borgne, and on the MRGO near Verret.
- New Bankline Stabilization on the entire shore of Lake Borgne.
- Breakwaters in Lake Borgne.
- Restore the Bayou La Loutre Ridge to +8 feet.
- Total Closure of MRGO by a structure at the Bayou La Loutre Ridge.
- Rock Dike Closure of MRGO near Lake Athanasio.
- Total Closure of Alabama Bayou at MRGO.
- Freshwater Diversion from Mississippi River at Violet and another site.

The Lake Pontchartrain Basin Foundation has developed a comprehensive habitat management plan that includes measures related to the MRGO. Those features are highlighted below and the full plan is available on the internet at http://www.saveourlake.org/.

- Constriction of the MRGO channel at the Bayou La Loutre Ridge to 12 feet by 125 feet.
- Introduction of freshwater into the system through a diversion off of the Mississippi River at the Violet Canal.
- Armoring of eroding shorelines on the north bank of MRGO and on Lake Borgne
- Reduction of ship speed on the Inland Reach.
- Constriction of Bayou Dupre at Lake Borgne.
- Utilization of previously dredged material for marsh creation.
- A sill at Seabrook.
- Discontinuation of advanced maintenance on the MRGO.
- Utilization of dredged material in a beneficial manner.

The features of the Bring New Orleans Back Commission recovery plan located in the vicinity of MRGO are summarized below and the plan is available on the internet at http://www.bringneworleansback.org/.

- Sector gates Seabrook, GIWW, and MRGO at Bayou Dupre with leaky levee between the latter two.
- Heightening and armoring of existing levees on the MRGO.
- A new levee on the eastern shore of the MRGO or the placement of surge barriers across Lake Borgne.

- A normally closed deep-draft sector gate in the MRGO with a draft of approximately 28 feet.
- Reintroduction of freshwater.
- Rebuilding the Bayou La Loutre landbridge.
- Restoration of the Biloxi Marsh.
- Armoring the MRGO banks to stop erosion.
- Aggressive use of dredged material to build land.
- Vessel speed control.

A private company, the Biloxi Marshlands Corporation, owns large tracts of wetlands in the vicinity of the MRGO and has developed a conservation and management plan for their holdings. Features of the company's plan in the vicinity of MRGO are summarized below and the plan is available on the internet at http://www.biloximarshlandscorp.com/.

- Bayou La Loutre Ridge bank armament on both sides of the bayou.
- Marsh creation and terracing.
- Two water control structures in the MRGO.
- Ridge refurbishment.
- Vegetative plantings.
- Massive freshwater diversion.
- Restore the MRGO to "original" 500-ft width and fill the rest.

The items noted below represent consensus features either common to all of the non-federal plans or supported by some of the stakeholder groups. These items were developed through a series of independent meetings organized by key stakeholders and presented later to the broader audiences attending the USACE-hosted stakeholder sessions. The collaborative planning effort attempted to identify a consensus plan for de-authorizing the channel but in the end resulted in only identifying common measures or features supported by many stakeholders. De-authorization of deep-draft navigation on the MRGO would allow the full incorporation into LACPR some of the stakeholder consensus such as:

- Restore the Bayou La Loutre Ridge.
- Restoration and protection of the lower Chandeleur Islands.
- River reintroduction.
- Shoreline protection on a portion of the shoreline of Lake Borgne.
- Long distance transport of sediment.

Additional USACE measures to incorporate public input into the study included an internet web page and the hosting of a public meeting. The study web page (http://www.swg.usace.army.mil/mrgo/) offers interactive capability allowing visitors to submit information and opinions via email and includes a digital library of publications related to the history of the channel and maps depicting the area. The information was intended to serve as a resource for the study team and interested stakeholders.

A public meeting was held on October 28, 2006 at the University of New Orleans and involved an open house where stakeholder groups were offered display space to present their points of view. More than 150 people attended the public meeting, which included a formal presentation of the study process and scope from the USACE and an open comment period for public statements from citizens, organizations, and elected officials. The collaborative planning effort attempted to identify a consensus plan for de-authorizing the channel but in the end resulted in only identifying common measures or features supported by many stakeholders.

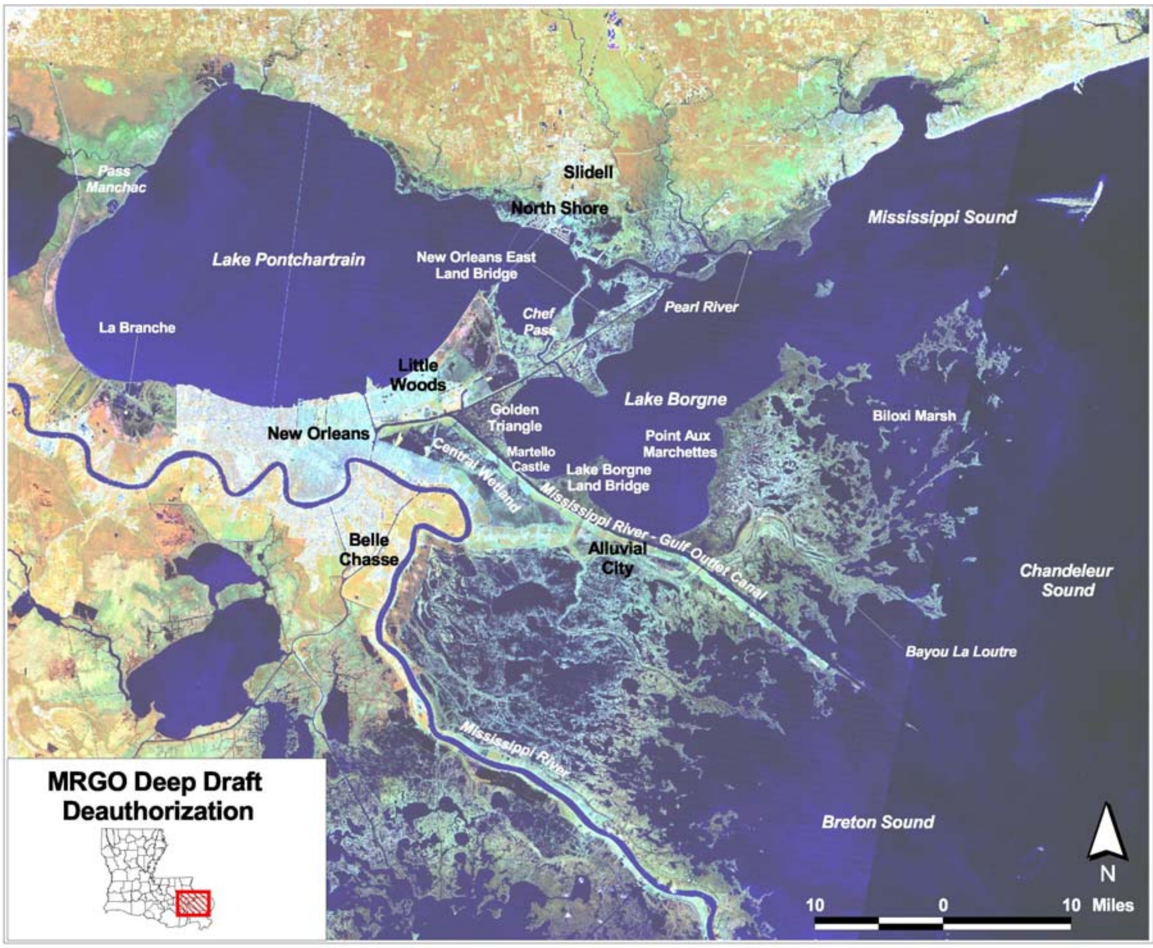
State of Louisiana's Comprehensive Coastal Protection Master Plan

The Louisiana Coastal Protection and Restoration Authority is developing a Master Plan to integrate hurricane protection and coastal restoration. Features of their preliminary draft plan in the vicinity of MRGO include:

- Closure of MRGO at the Bayou La Loutre Ridge, do not fill in the MRGO channel.
- MRGO shoreline stabilization.
- Maintenance of the MRGO-Lake Borgne Land Bridge, including shoreline protection.
- Restoration of the Bayou La Loutre Ridge.
- Construction of large Violet Reintroduction to sustain the Biloxi Marshes.
- Sediment delivery by pipeline into Central Wetlands and establishment of cypress swamp through hydrologic management.
- Sediment delivery by pipeline into Golden Triangle.
- Accelerate completion of the IHNC Lock.
- Integration of the MRGO closure plan into the larger hurricane protection plans for the area.

Figure 4 shows the area in the vicinity of MRGO with reference to many of the local place names mentioned in this report.

Figure 4. Area in the Vicinity of MRGO



Louisiana Coastal Protection and Restoration Planning

As directed by Congress, the MRGO deep-draft de-authorization plan will be integrated into the LACPR plan, which is also being prepared at Congressional direction. As required, the Secretary of the Army, through the Chief of Engineers is conducting:

> *"a comprehensive hurricane protection analysis and design…to develop and present a full range of flood control, coastal restoration, and hurricane protection measures…(and) the Secretary shall consider providing protection for a storm surge equivalent to a Category 5 hurricane…(and) the analysis shall be conducted in close coordination with the State of Louisiana."*

Compliance with the National Environmental Policy Act (NEPA) for any deep-draft de-authorization option or options selected as a recommended alternative will be done through incorporation of that alternative into the Programmatic Environmental Impact Statement accompanying the December 2007 LACPR Report.

Options Developed

This report provides a qualitative analysis based on coordination with the State of Louisiana, St. Bernard Parish Government, stakeholders, resource agencies and the general public. Studies related to navigation, ecosystem restoration and storm damage prevention for the area have been conducted by Federal and non-Federal agencies over many years. This interim report builds upon past analyses and discusses some of the general considerations associated with channel de-authorization options.

A USACE team evaluated potential modifications to the current uses of the navigation channel with the intent of determining if any uses should be maintained. The evaluation included information presented in the stakeholder meetings, data gathered through maritime business surveys, and government statistics of annual channel utilization.

During the investigation of a plan to de-authorize deep-draft navigation on the MRGO, three distinct options were evaluated that limit shallow-draft or close deep-draft navigation. The navigation gates and the shoreline protection on the north and south shorelines of the MRGO authorized in the 2006 Supplemental Appropriations are part of the future project condition and will not be considered part of any option.

MRGO deep-draft de-authorization options identified for this study are listed below:

Option 1 – Maintain a shallow-draft MRGO navigation channel. Several variations of Option 1 would facilitate integration of the MRGO de-authorization plan into LACPR:

- Option 1a – Maintain a shallow-draft navigation channel without a structure.
- Option 1b – Construct a salinity control weir at Bayou La Loutre;
- Option 1c – Construct a salinity control gate at Bayou La Loutre (normally closed); and
- Option 1d – Construct a storm protection gate at Bayou La Loutre (normally open).

All of the shallow-draft channel options would include maintenance dredging of a 12 feet deep by 125 feet wide channel to match the dimensions of the GIWW.

Option 2 - Close the MRGO channel to deep-draft and shallow-draft vessels. Closure of the MRGO to all vessel traffic could be realized by blocking the channel via any of the following variations:

- Option 2a – Construct an armored earthen dam across the MRGO at Bayou La Loutre;
- Option 2b – Restore both banks of Bayou La Loutre across the MRGO at Hopedale, Louisiana; or
- Option 2c – Fill in the entire MRGO channel from the GIWW to the Gulf of Mexico.

Option 3 - Cease all MRGO operations and maintenance activities (dredging, jetty repairs, and navigation aids). If Congress chooses to discontinue all activities related to maintaining the MRGO, several relic project features would need to be addressed. These features include navigation aids such as buoys and lights and the offshore jetties located in Breton and Chandeleur Sounds. Development of a complete de-authorization plan should include disposal of these relic features.

Additional Opportunities

In addition to the navigation options, additional opportunities were identified that are components of LACPR and other plans. Under LACPR and other independent authorities, opportunities for ecosystem restoration and hurricane storm surge risk reduction could complement the MRGO de-authorization options. These opportunities include:

- Freshwater diversion into the MRGO and surrounding marshes (possibly in the vicinity of Violet Canal);
- Shoreline protection to prevent wetlands erosion (including maintenance of existing projects);
- Habitat creation through the placement of sediment for rebuilding marshes, barrier islands, and ridges;
- Increasing existing levee heights to new hurricane protection levels; and/or
- New hurricane protection levee alignments or surge protection structures.

These opportunities could be implemented to provide ecosystem restoration and hurricane storm protection in the study area. Ecosystem restoration opportunities focus on reducing salinity and maintaining or increasing marsh acreage so that the natural system can better protect the area during storm events.

A report prepared for USACE (Tate et. al., 2002) quantified the salinity reductions that could be gained in the Lake Pontchartrain estuary from creating a localized channel constriction on the MRGO at the Bayou La Loutre Ridge. Using three-dimensional hydrodynamic modeling of conditions at different times of the year and with different tides and wind effects, the study showed that a constriction to a 125 foot width and 12 foot depth could achieve salinity reduction but not as much as a total blockage of the MRGO.

Another way to reduce salinity in estuaries is the construction of diversion(s) that would move freshwater from the Mississippi River to the MRGO and surrounding wetlands and waterways. *Coast 2050* recommended diversion of Mississippi River water into the wetlands surrounding the MRGO near the Violet siphon. Another recommendation presented was to construct a sill near Lake Pontchartrain to limit the influx of saltwater carried to the area through the MRGO. The 1997 McAnally and Berger report considered diversion of river water through the Bonnet Carre spillway and concluded that peak springtime diversions of 10,000 to 30,000 cfs (cubic feet per second) would be required to achieve desired salinity levels in the Biloxi Marshes and Mississippi Sound. A diversion of this size through Bonnet Carre is not supported by the State of Louisiana.

MRGO DEEP-DRAFT DE-AUTHORIZATION OPTIONS

Each of the three deep-draft de-authorization options and their variations were evaluated based on environmental and navigation considerations, and their relationships to other projects. None of the options provides for a channel allowing deep-draft navigation. The level of shallow-draft navigation provided by each option is discussed.

Option 1a - Maintain a Shallow-Draft MRGO Navigation Channel Without a Structure

Under Option 1a, the MRGO would be maintained for commercial and recreational shallow-draft navigation only with a maintained depth and width of 12 feet by 125 feet for the Inland and Sound Reaches. Sedimentation would be allowed to occur in the channel until maintenance dredging would be required. Table 7 shows the different channel miles and the projected years when dredging would be necessary. No navigation structures would be placed in the MRGO channel.

Table 7. MRGO Dredging Areas and Estimated Date of First Required Dredging.

Channel Miles	Estimated Year Dredging Would Begin
36 to 27	2045
27 to 23	2022
23 to 6	2012
6 to -8	No dredging required
-8 to -9	No dredging required

Environmental Considerations

In 2000, Tate modeled what effects reducing the channel depth would have on salinity within the Lake Pontchartrain Basin. The results of that study showed reducing the channel depth without reducing the width would have only a small effect; reducing the salinity by 0.5 to 0.8 ppt in the basin. As a result, little or no change in vegetation, land loss, or wildlife and fisheries would be expected.

The implementation of Option 1a would not limit access within the MRGO for fish species moving to deeper water depths because a 12 foot channel depth would be maintained. There are no available data to indicate that the implementation of this option would impact threatened or endangered species. Sea turtles would no longer be impacted by hopper dredging in the bar channel. The MRGO is not the preferred habitat of Gulf sturgeon, and implementing this option would not have an impact on the species. The piping plover might lose future wintering habitat on the remains of Breton Island until maintenance dredging resumes (because beneficial use of dredged material would be reduced).

Other Considerations

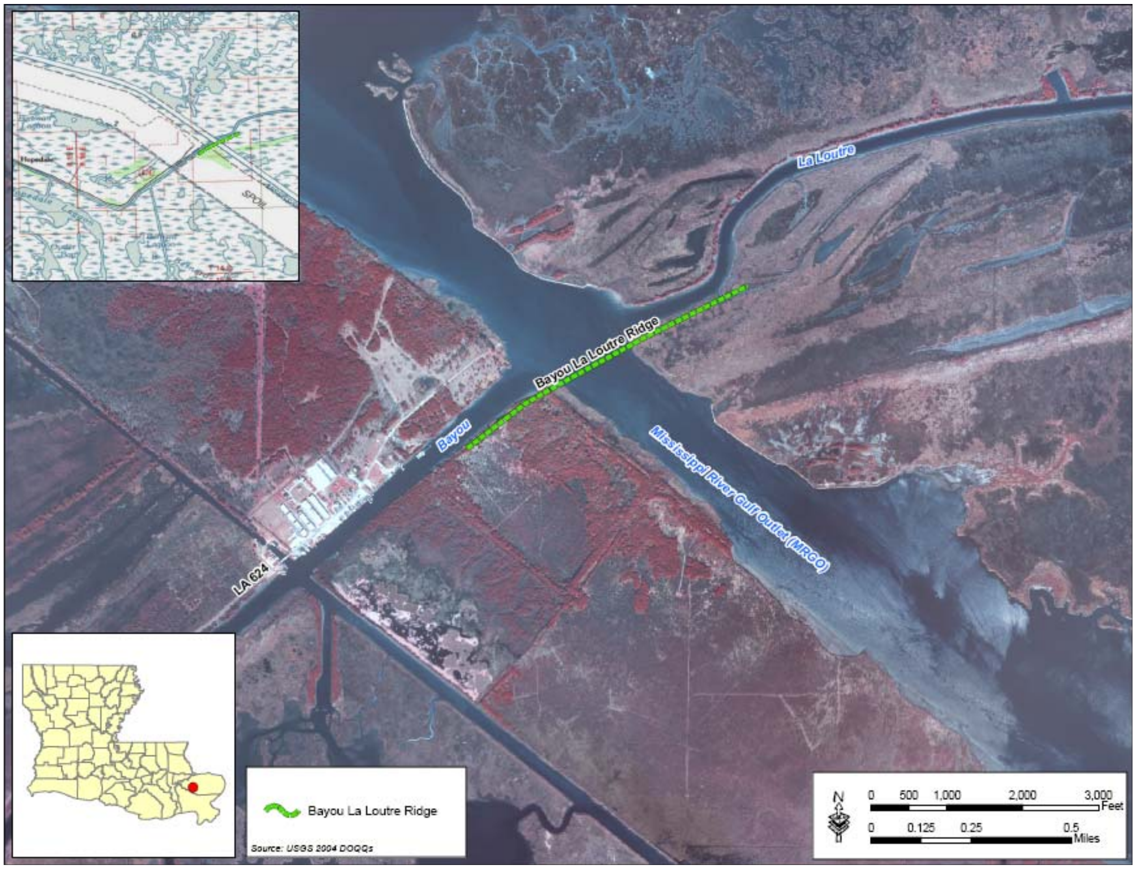
Under Option 1a, available sediment for future beneficial uses would be very limited. In the future, available sediment for dedicated dredging would be more costly than piggy-backing such projects onto maintenance dredging contracts where the cost to mobilize and demobilize would be born by the maintenance dredging contract.

The construction of new bank stabilization along the north and south banks of the MRGO, as funded by the 2006 Emergency Supplemental Appropriations, is currently underway. Following the completion of the bank stabilization projects, the entire north and south banks will be protected to the extent practicable. Option 1a would limit benefits of the proposed diversion of freshwater from the Mississippi River at Violet because freshwater benefits would not extend past the Central Wetlands. Most of the freshwater would be carried up and down MRGO by tides. In addition, MRGO would act as a sink for any sediment that might reach it from the diversion. This option would be compatible with shoreline protection and habitat creation opportunities. The new floodgates on the MRGO to be built under the 2006 Emergency Supplemental Appropriations would not be impacted.

Option 1b – Construct a Salinity Control Weir at Bayou La Loutre

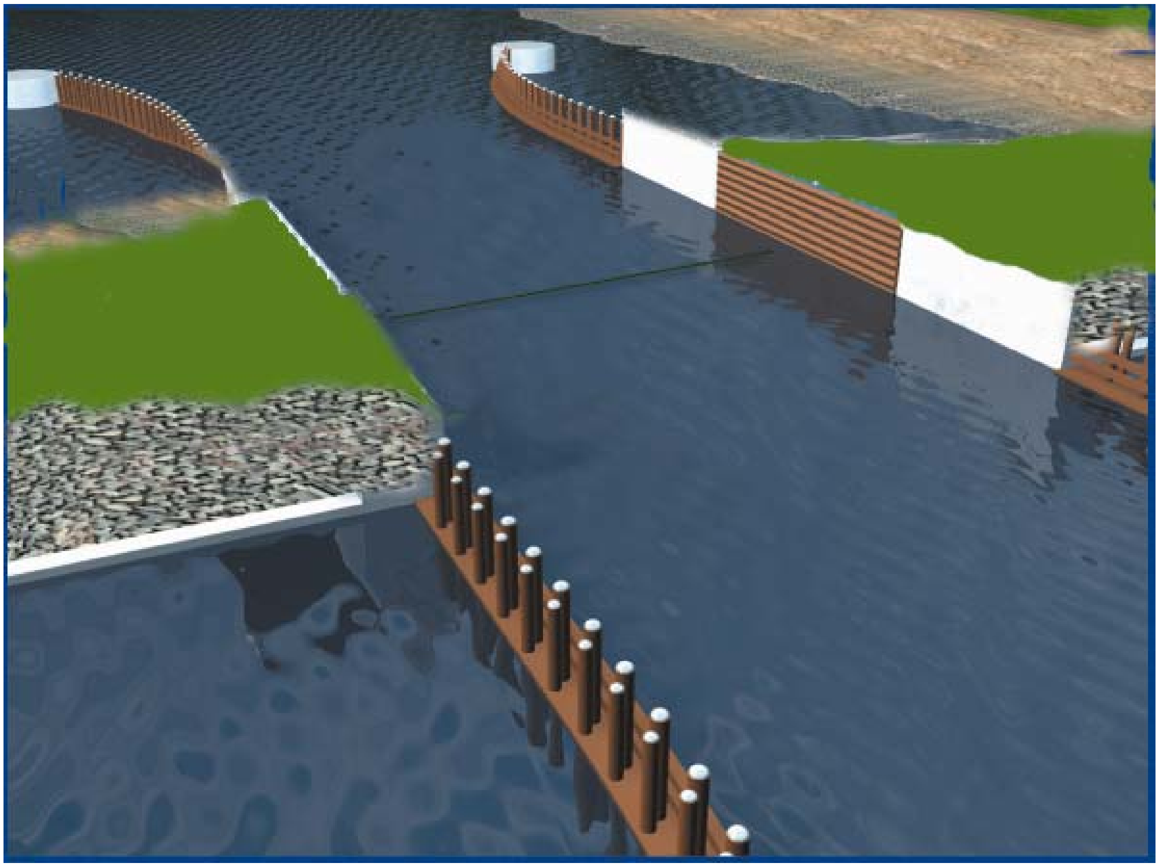
Under Option 1b, a weir would be constructed just south of Bayou La Loutre to allow passage of shallow-draft vessels (Figure 5). This option would not only close the channel to deep-draft navigation, but would reduce salinity upchannel of the weir. The MRGO would be constricted at the weir to 125-feet wide by 14 feet deep (Note: The weir would have to be set at 14 feet to allow safe passage of 12-foot draft vessels—providing a 2-foot Keel/Hull clearance over the structure). The weir configuration likely would consist of earthen dam sections and pile-supported, reinforced concrete T-wall structures that extend from the shorelines and tie into a weir structure (Figure 6).

Figure 5. Proposed Construction Location of Option 1b.



The earthen dam, concrete T-wall structures, and weir structure would have steel sheet pile, cut-off walls beneath them. It is envisioned that the dam would be constructed in the wet by first depositing rock starter dikes underwater to contain fill material. The fill material would consist of clay material, ideally dredged by bucket from a nearby location, and brought to the site by barge. Because the dam would be built in the wet, significant settlement would occur, so the dam would need to be overbuilt to allow for expected future settlement. The dam would be rock armored.

Figure 6. Conceptual Plan for Proposed Option 1b.



The reinforced concrete T-wall structures would transition from the earthen dam to the weir structure, which would be located in the existing channel. Because the weir would constrict storm surge waters moving in the MRGO during a storm event, the T-wall structures would need to be designed to a level of storm surge caused by waters backing up at the weir.

The weir structure would be a concrete U-frame, or flume, structure consisting of a base slab and walls. The clear opening would be 125-feet wide and between 100- and 150-feet long. Guide walls and dolphin cells would be needed on both sides of the weir to funnel marine traffic through the weir. Design optimization, including possible physical modeling, would be required to assess hydraulic performance and ensure safe navigability through such a structure.

The T-walls and U-frame could be constructed either in the wet or pre-cast and floated to the site and sunk in place in a controlled manner. Dewatering exacerbates settlement, so this would need to be carefully investigated during the design phase of the project, before finalizing the method of construction. Settlement concerns may require using a circular-cell wall, in lieu of the earthen dam and T-wall, to tie into the weir structure. The estimated cost to construct the control structure is between $50 and $60 million, which is an average annual cost of $3 million over the 50-year period of analysis.

The remainder of the MRGO would be maintained for shallow-draft navigation (minimum channel dimensions of 12 feet depth by 125 feet wide). Sedimentation would be allowed to occur in the channel until maintenance dredging is required. Table 6 shows the different reaches and year when dredging would first be necessary. Hydraulic and geotechnical investigations would be required prior to construction to assure that this is a viable option.

Environmental Considerations

Using the Tate et al. (2002) model as guidance, Option 1b which reduces channel width and depth to 12 feet by 125 feet would result in an average reduction of salinity greater than simply reducing the channel depth as in Option 1a. The reductions would not be as great as completely closing the channel (see Table 8). By reducing salinity north of the gate, stratification in Lake Pontchartrain could be reduced improving benthic habitat.

Table 8. Comparison of Modeled Salinity.

Location	April, May, Sept, Oct Average Monthly Parts Per Thousand		
	Base Salinity	12’ x 125’ Salinity Change	Closure Salinity Change
Pass Manchac	0.6-1.1	-0.1 to -0.3	-0.1 to -0.9
Frenier	4.6-5.4	- 0.4-1.2	-0.6-1.3
North Shore	5.4-7.4	-0.8 to -1.0	-0.9 to -1.4
Little Woods	5.9-8.1	-1.4 to -2.4	-1.6 to -3.1
Chef Menteur	8.4-11.7	-1.3 to -1.6	-1.7 to -2.2
Martello Castle	15.4-19.3	-3.9-5.1	-5.4-7.2
Alluvial City	16.5-20.2	-3.9 to -4.4	-6.0 to -6.6
Pt aux Marchettes	13.9-17.3	-0.2 to -0.5	-0.5 to – 1.1

(Source: Data compiled from Tate 2002)

Although data are not available to permit quantifying changes in vegetation, it is unlikely that the changes in salinity mentioned above would cause large-scale changes in vegetation types within the Pontchartrain Basin. Some changes to less saline marsh types may occur in marshes along the western shoreline of Lake Borgne and perhaps in the Central Wetlands. The land loss impacts and impacts to threatened and endangered species are similar to Option 1a. The wildlife and fisheries impacts are also similar to Option 1a, but with greater salinity reduction.

Other Considerations

Option 1b would be more compatible with the LACPR than Option 1a for the proposed freshwater diversion at Violet. It would slightly reduce baseline salinity, but MRGO would still act as a sediment sink. However, freshwater would be less likely to be carried up and down MRGO with the tide and some would be able to reach the Biloxi Marshes. Compatibility with other restoration opportunities is similar to Option 1a.

Option 1c – Construct a Salinity Control Gate at Bayou La Loutre (Normally Closed)

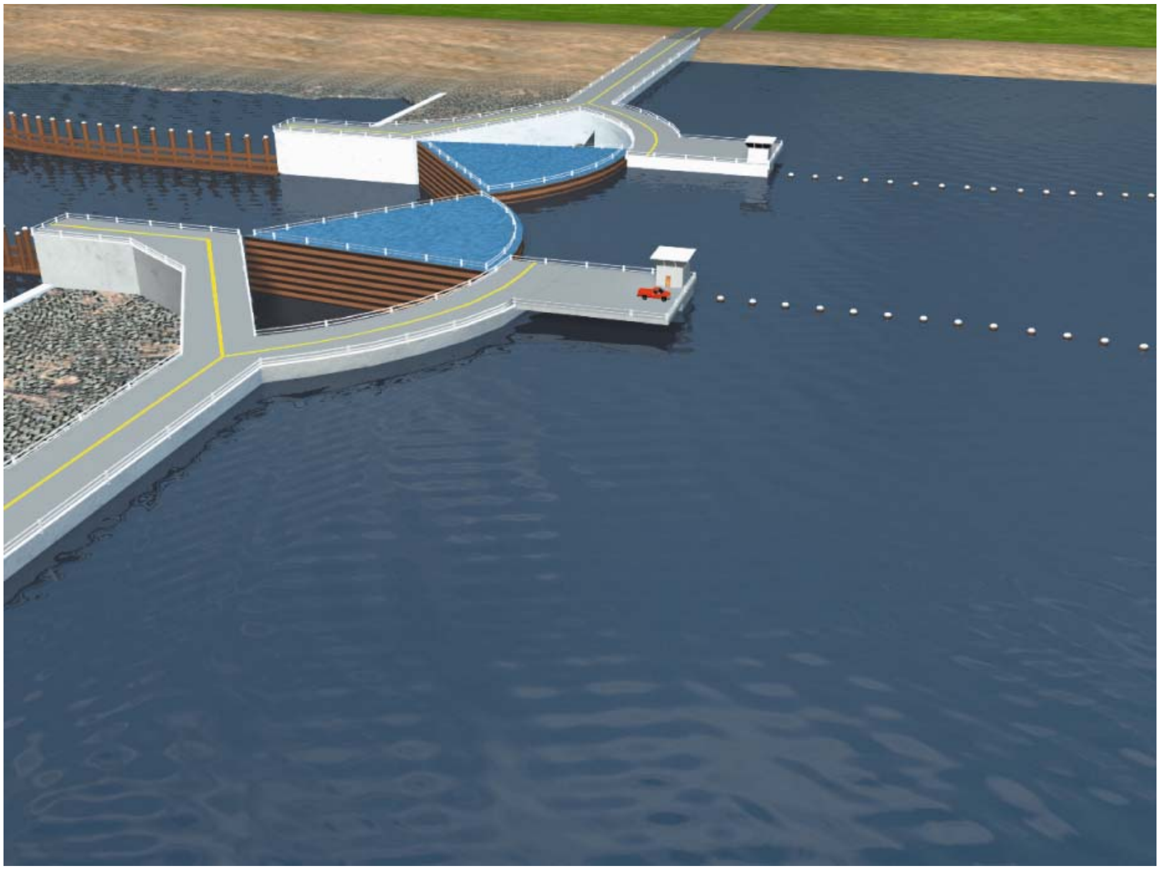
Under Option 1c, a gated structure would be constructed just downstream of Bayou La Loutre (Figure 7) that would allow passage of shallow-draft vessels. The gated structure would have a sill depth of 14 feet and a 125-foot wide opening, and would be designed for hydraulic loadings proportional to its height.   The gate would normally be closed to reduce saltwater intrusion, but would be opened for passage of commercial and recreational shallow-draft vessels; however, details regarding an operational plan for the structure would have to be developed.

The gate would need to be able to operate under both direct and reverse heads; so it is envisioned that the gate would either be a sector gate or a barge gate. The sector gate option is presented in this report because its use is more widespread throughout south Louisiana, but during the feasibility phase of design, the barge gate option would be explored. The gate could be operated on-site by a gate master, or remotely with the use of video cameras and controls.

The gate configuration would consist of earthen dam sections and pile-supported, reinforced concrete T-wall structures that tie the gate structure into the Bayou La Loutre Ridge. The gate structure would be a pile-supported, reinforced concrete monolith structure that houses a pair of pie-shaped, space trussed gate leafs called sector gate leafs. The gate leafs are operated with a rack and pinion drive system. The monolith also houses the gate machinery.

The earthen dam, concrete T-wall structures, and gate structure would have steel sheet pile, cut-off walls beneath them. It is envisioned that the dam would be constructed in the wet by first depositing rock starter dikes underwater that would contain fill material. The fill material would consist of clay material, ideally dredged by bucket from a nearby location. Because the dam would be built in the wet, significant settlement would occur, so the dam would need to be overbuilt several feet to allow for expected future settlement. The dam would be rock armored.

Figure 7. Conceptual Plan for Proposed Option 1c.



The reinforced concrete T-wall structures would transition from the earthen dam to the gate structure, which would be located in the existing channel. Because the gate would block storm surge waters moving up the MRGO during a storm event, the T-wall structures would be need to be designed to a level of storm surge to the top of the structures.

The gate monolith would be a concrete structure with recesses into which the gates would retract to create the 125-foot clear opening. Guide walls and dolphin cells would be needed on both sides of the weir to funnel marine traffic through the weir. Every 10-20 years, the structure would need to be dewatered for maintenance and the gates removed and refurbished. Routine maintenance would be required as well.

The T-walls and gate monolith could be constructed using in-the-wet methods or float-in methods where a precast unit is floated to the site and sunk in place in a controlled manner. Dewatering costs will be a significant portion of the overall construction costs. Technically, the principal disadvantage of traditional construction methods is that dewatering significantly increases settlement in a marsh environment, so settlement would need to be carefully investigated during the design phase of the project. Settlement is a particular concern for gate structures because excessive settlement interferes with the proper operation of the gates. Potential settlement countermeasures may include using a circular-cell tie-in floodwall, in lieu of the earthen dam and T-wall. The estimated cost to construct the control structure is estimated to be between $60 and $70 million. In addition, personnel would be required to operate the gate for vessel traffic. The average annual cost is estimated at $3.6 million over the 50-year period of analysis.

The remainder of the MRGO would be maintained for shallow-draft navigation (minimum dimensions of 12 ft depth by 125 ft width). Sedimentation would be allowed to occur in the channel until dredging is required. Hydraulic and geotechnical investigations would be required prior to construction to assure that this is a viable option.

Environmental Considerations

This option was not modeled by Tate for salinity impacts. Since the gate would be closed except for passage of vessels, salinity would be closer to that found with the closure in Table 8. On the north shore of Lake Pontchartrain, the gate might allow intermediate marsh to develop in inland areas during some years. The area east of MRGO could convert to brackish marsh and the Central Wetlands could show a change from brackish to intermediate marsh with a gate. Land loss, wildlife, threatened and endangered species, and fisheries impacts are similar to Option 1b, but with greater salinity reduction.

Other Considerations

This option would be the most compatible of the shallow-draft options for freshwater diversion opportunities. Compatibility with other restoration opportunities would be similar to Option 1a.

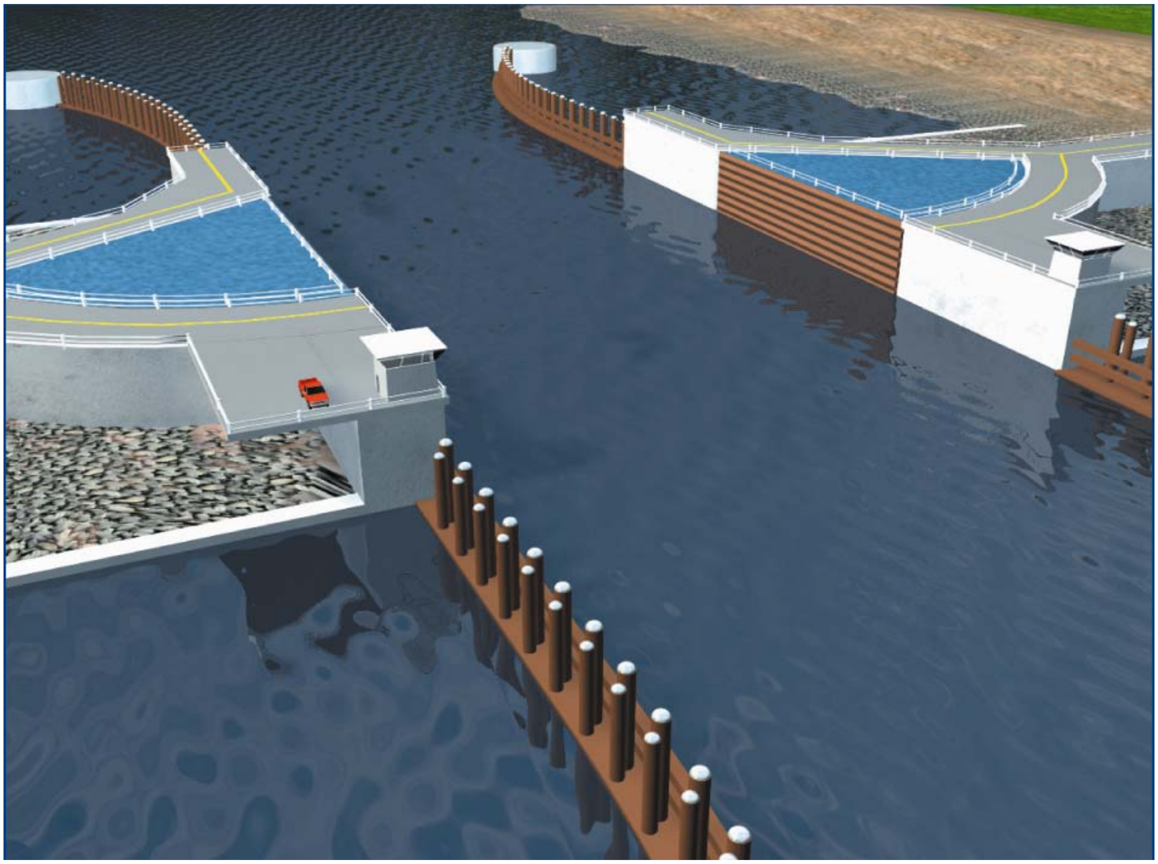
Option 1d – Construct a Storm Protection Gate at Bayou La Loutre (Normally Open)

This option comprises similar structural components and earthwork as Option 1c: a sector gate with tie-in T-wall and earthen dam (Figure 8). The difference between this option and Option 1c is the gate operating parameters. For Option 1d, the gate would not be operated to control salinity, but would only be operated to close the canal for any tropical storm event and associated storm surge. Therefore, commercial and recreational shallow-draft vessels could still use the MRGO except during storm events.

The structure would be constructed to the same elevation as the adjacent Bayou La Loutre Ridge and would be effective during weak storm events but would likely be overtopped during large storms. Because the gate would be operated infrequently, there are some cost savings relative to Option 1c. The most significant cost savings should be with respect to the maintenance cost of the gates and the gate monoliths. Since the gates would be operated less frequently compared to Option 1c, there should be a longer interval between dewaterings of the monolith to perform major maintenance work on the gates. Another advantage of Option 1d is that it may be possible to operate the gates using a diesel-powered generator instead of having to supply power to the site. However, this would likely preclude remote operation of the gates since the generator would need to be started on-site to power the gate drive systems. The estimated cost to construct the control structure is between $60 million to $70 million. The average annual cost is estimated at $3.6 million over the 50-year period of analysis.

The remainder of the MRGO would be maintained to a controlling depth of 12 feet by 125 feet wide. Sedimentation would be allowed to occur in the channel until maintenance dredging is required. Hydraulic and geotechnical investigations would be required prior to construction to assure that this is a viable option.

Figure 8. Conceptual Plan for Proposed Option 1d.



Environmental Considerations

Since this gate would only be closed for strong southerly or easterly winds and/or approaching tropical storms, the salinity reduction would be similar to Option 1a (see Table 8). Vegetation, land loss, wildlife, threatened and endangered species, and fisheries impacts are similar to Option 1a.

Other Considerations

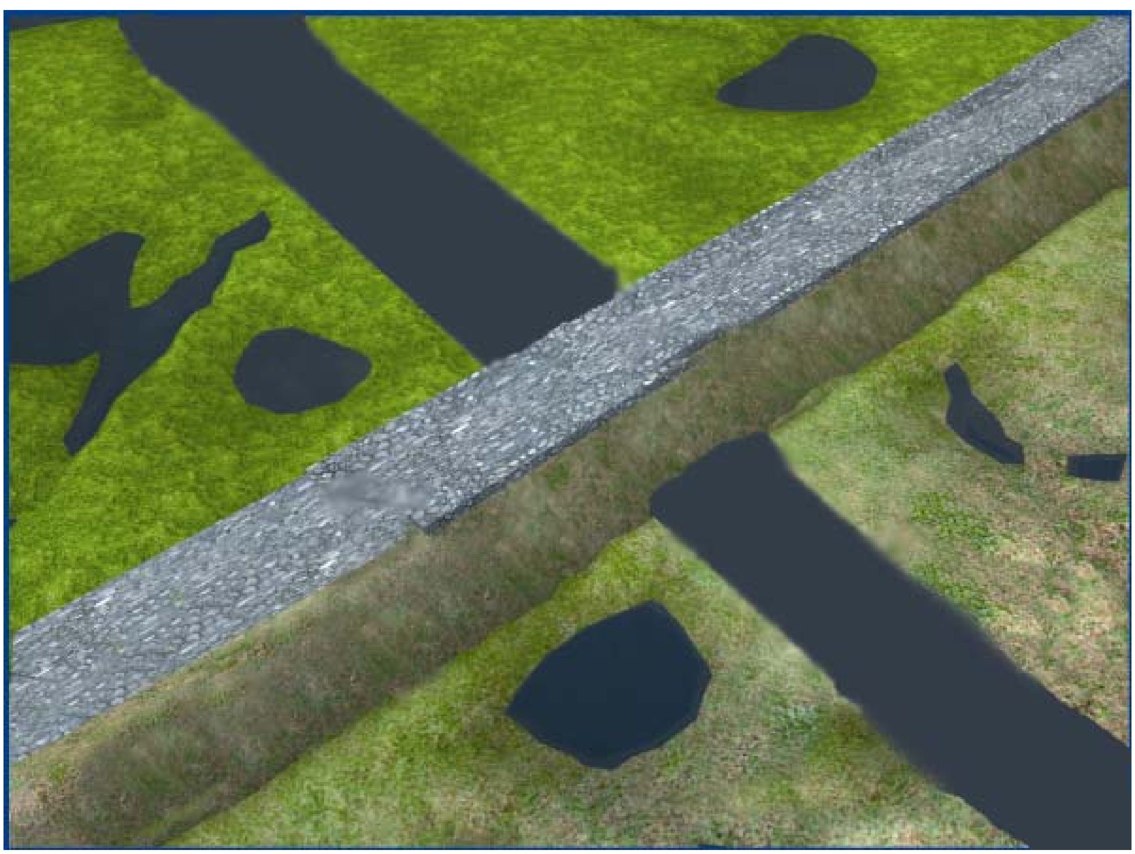
Compatibility of Option 1d with restoration opportunities would be similar to Option 1b.

Option 2a – Construct an Armored Earthen Dam Across the MRGO at Bayou La Loutre

Under Option 2a, an armored earthen dam would be constructed just south of Bayou La Loutre and would tie in with the southern Bayou La Loutre Ridge (Figure 9) to totally block the MRGO channel. The structure would not allow passage of any vessels traveling the length of the MRGO. Recreational craft that could use the MRGO to reach Breton Sound would have to reach the area via Bayou La Loutre or the Back Levee Canal, a longer distance. This option would also mean the loss of a detour route for shallow-draft traffic when the IHNC Lock is not operational for long periods of time.

It is envisioned that the dam would be constructed in the wet, and would be constructed of clay fill material dredged nearby, transported by barge, and deposited un-compacted, underwater. Rock starter dikes would be constructed first to contain the clay fill material subsequently deposited underwater. Average side slopes for the dam could be as shallow as 10-foot horizontal:1-foot vertical. As a result, the base of the dam is expected to be approximately 960 feet in cross-section at the channel thalweg. Since the dam fill material would be un-compacted, a sheet pile cut-off wall would be installed to stop seepage below the dam. The dam will be rock armored to prevent erosion. Several feet of settlement could be expected both during and after construction, so the dam should be overbuilt to allow for this consideration.

Figure 9. Conceptual Plan for Proposed Option 2.



The estimated fill volume for the earthen dam is 650,000 cubic yards of clay material. There would also need to be approximately 200,000 tons of rock to armor the dam. The estimated shoreline protection on the dam is 2,400 feet. The estimated cost to construct the earthen dam is $45 to $50 million, which is an average annual cost of $2.7 million over the 50-year period of analysis. No costs to maintain channel depth would be required, but O&M would be required for the armored dam.

Sedimentation would be allowed to occur in the remainder of the MRGO. No additional activities to maintain channel depth would occur. Hydraulic and geotechnical investigations would be required prior to construction to assure that this is a viable design option.

Environmental Considerations

Using the Tate et al. (2002) model as guidance, damming the MRGO would provide the greatest reduction in salinity (Table 8). It would return salinity toward the historical conditions throughout the basin. Salinity reduction would reduce stratification and thus decrease the low dissolved oxygen zones in Lake Pontchartrain. A dam might help reduce salinity spikes at Pass Manchac. Closure might allow intermediate marsh to develop in inland areas during some years on the north shore of Lake Pontchartrain. The area east of MRGO could be converted from saline to brackish marsh and the Central Wetlands could show some conversion to intermediate marsh and possibly cypress swamp. Land loss rates, and fisheries and wildlife populations would be similar to Option 1b, but with greater salinity reduction. An earthen dam would also potentially provide wildlife access to both sides of the MRGO at the Bayou La Loutre Ridge, allowing some wildlife species to forage and to breed with populations on both sides of the channel. Threatened and endangered species impacts would be similar to Option 1a, except that any piping plovers that might use Breton Island would probably not be able to since maintenance dredging in the Sound would cease.

Other Considerations

Many of the proposed LACPR freshwater diversion projects would benefit from Option 2a. The Violet freshwater diversion project would become more viable as the primary source of freshwater and nutrients to restore the Biloxi marshes. Compatibility with other restoration opportunities would be similar to Option 1a.

Additionally, some user groups are concerned that if the MRGO is not maintained for shallow-draft traffic from the GIWW to the Gulf, the inland waterway tows that use the MRGO when the IHNC Lock is severely congested or impassable would not have that option available. The routine practice is that eastbound shallow-draft tows use the GIWW and the IHNC Lock except when the lock and approaches are either impassable or congested. During these periods of extreme congestion some tows will travel outbound on the Mississippi River to Baptiste Collette where it connects with the MRGO. Eastbound tows then travel back inland on the MRGO to the GIWW before continuing eastbound to locations in Mississippi, Alabama, and Florida. Westbound tows use the reverse route to avoid the IHNC Lock when it is impassable. If the MRGO were closed to shallow-draft navigation, this alternative would not be available. The resulting trip around the IHNC Lock takes approximately 24 hours. Due to the distance and the uncertainty of the weather in Baptiste Collette, few vessels elect to travel along the MRGO to by-pass the lock. However, vessels can save time if the lock is down for a period of greater than 24 hours and/or there is a long queue. This and the effects of the deep-draft de-authorization are discussed in the navigation impacts section of the Economics Appendix.

If the MRGO were not available as an alternative to the IHNC Lock, it has been suggested that some tows might divert through the Mississippi River northward to its junction with the Ohio River at Cairo, Illinois before connecting back down to the GIWW by way of the Tennessee and Tombigbee rivers; however, the time necessary to complete this loop currently exceeds even extreme IHNC Lock delay times. The Tennessee and Tombigbee route may be advantageous to tows traveling between mid- and upper points on the Mississippi and Ohio Rivers but not for GIWW east-west movements or for Lower Mississippi-GIWW eastward traffic.

Option 2b – Restore Both Banks of Bayou La Loutre Across the MRGO at Hopedale, Louisiana

Under Option 2b, two earthen dams would be constructed to restore the banks of Bayou La Loutre. One dam would connect the ridge on the north side of Bayou La Loutre on the Hopedale side with the north ridge on the Biloxi Marsh side. The second dam would connect the south ridges across the MRGO. This would totally block the MRGO channel with two structures. The structures would not allow passage of any vessels traveling the length of the MRGO. Recreational craft traveling from Shell Beach that could use Bayou La Loutre or the Back Levee Canal under Option 2a would not be able to use these waterways. They would need to exit into Lake Borgne and cross it or launch at Hopedale and use the Back Levee Canal. This option would also mean the loss of a detour route for shallow draft traffic when the IHNC Lock is not operational for long periods of time.

It is envisioned that the dams would be constructed in the wet, and would be built with clay fill material dredged nearby, transported by barge, and deposited un-compacted, underwater. Rock starter dikes would be constructed first to contain the clay fill material. Average side slopes for the dams could be as shallow as 10-foot horizontal:1-foot vertical. As a result, the base of each dam is expected to be approximately 960 feet in cross-section at the channel thalweg. Since the fill material would be un-compacted, sheet pile cut-off walls would be installed to stop seepage below the dams. The dams will be rock armored to prevent erosion. Several feet of settlement could be expected both during and after construction, so the dams should be overbuilt to allow for this settlement.

The estimated fill volume is 650,000 cubic yards of clay material for each dam. There would also need to be approximately 200,000 tons of rock to armor each dam. The estimated shoreline protection for the restored banks is 4,800 feet. The estimated cost to construct the dams is $90 to $100 million, which is an average annual cost of $5.4 million over the 50-year period of analysis. No costs to maintain channel depth would be required.

Sedimentation would be allowed to occur in the remainder of the MRGO. No additional activities to maintain channel depth would occur. Hydraulic and geotechnical investigations would be required prior to construction to assure that this is a viable option.

Environmental Considerations

The environmental impacts of Option 2b are the same as Option 2a.

Other Considerations

Other considerations for Option 2b are the same as Option 2a.

Option 2c –Fill in the Entire MRGO Channel from the GIWW to the Gulf of Mexico

Under Option 2c, the entire MRGO would be filled from the intersection of the GIWW to Breton Sound. This option has been requested by several stakeholders and was frequently noted in public comments. Recreational craft would not be able to use any portion of the Inland Reach of the MRGO. This option would also mean the loss of a detour route for shallow draft traffic when the IHNC lock is not operational for long periods of time.

Environmental Considerations

Option 2c could take many years to complete because it would take time to find the well over 300 million cubic yards of dredged material needed to fill the channel. The dredged material in the disposal area that was removed when the MRGO was built has oxidized so it no longer contains sufficient material to refill the channel. In addition, portions of the south bank provide the base for a hurricane protection levee. It is uncertain where the amount of material needed to fill the channel could be found – especially at a time when vast quantities of material are needed to restore hurricane protection levees and create wetland habitats throughout coastal Louisiana. In addition, this material could be far better used to improve hurricane protection levees in the aftermath of Hurricane Katrina or for pressing coastal restoration needs.

Salinity impacts would be the same as for Option 2a. Assuming that the Inland Reach of the MRGO is an average of 1,000 feet wide and the filled area is 39 miles long, about 4,800 acres of marsh could be created, if the height were controlled carefully. However, the cost of creating marsh in a place that is up to 40 feet deep is probably at least eight to ten times the cost of creating marsh in an area 5 feet deep. It would take several years to find such an amount of fill material since it is likely that hurricane protection projects would have a higher priority. Creation of marsh would reduce land loss rates in the lower Pontchartrain Basin, benefit wildlife, fisheries and threatened and endangered species, but there are likely far less costly ways to receive the same benefit.

Other Considerations

To extend the benefits of the freshwater diversion across the filled channel, a new small channel would have to be dredged. Marsh creation would be adversely impacted because they would be in competition for the limited amount of fill material available. If this option is chosen, the navigable flood gates and the shoreline protection under the Supplemental Appropriations would not be necessary.

Option 3 - Cease All MGRO Operations and Maintenance Activities

Under Option 3, no additional Federal funds would be used to maintain a minimum channel depth on of the MRGO between the GIWW and the Gulf of Mexico. There would be neither construction nor operation and maintenance costs for this option. However, the shoreline protection features could be modified as part of LCA or LACPR. Relic features, such as jetties and aids to navigation would be considered for removal and/or reapplication. Under this option, commercial and recreational shallow-draft vessels could still use the MRGO until the MRGO channel filled in to a depth that prohibited their navigation.

Environmental Considerations

No published literature is currently available to make confident projections on the salinity impacts if the USACE ceased dredging of the MRGO. At this stage, it would be assumed that salinity would be reduced similar to Option 1a. Impacts to vegetation, land loss, wildlife, threatened and endangered species, and fisheries would be similar to Option 1a.

Other Considerations

Compatibility with other restoration opportunities would be similar to Option 1a. Following completion of the bank stabilization projects under the Supplemental Appropriation, the entire north and south banks of the MRGO would be protected. However, no maintenance of these features would be done by the Federal government unless incorporated into LCA or LACPR plans.

OPPORTUNITIES FOR ECOSYSTEM RESTORATION AND STORM SURGE REDUCTION

A statement accompanying the legislative language accepted in the Congressional Conference Committee requests the identification of "any measures for hurricane and storm protection" (House Report 109-494). For this study, measures were identified that would prevent or reduce impacts associated with storm surge traveling across the MRGO area marshes or potentially overtopping existing levees. The opportunities described below are being considered in the development of LACPR plans and may complement options in the MRGO Deep-Draft De-authorization plan.

These opportunities include various levee improvements and coastal restoration measures such as:

- Freshwater diversion
- Habitat creation by sediment placement
- Shoreline protection
- Increasing existing hurricane protection levee heights
- New hurricane protection levee alignments and surge protection structures

Freshwater Diversion into MRGO and Surrounding Marshes

This opportunity involves the diversion of freshwater into the MRGO area via an enlarged Violet Canal (Figure 10) or an adjacent site. Diversion of freshwater into the area is anticipated to require constructing a pile-supported, sluice-gated, reinforced concrete culvert structure with a cut-off wall system in the existing Mississippi River levee. The diversion structure would be able to pass up to 15,000 cfs of river water by gravity into the canal. The canal would transport the river water approximately 1.5 miles to feed the marshes between the Mississippi River and the MRGO. The Mississippi River diversion flow rates would be controlled by raising and lowering the sluice gates. Portions of the Violet Canal would be widened and lined with either concrete or rock to improve the canal's hydraulics. Diverting 15,000 cfs would require widening the Violet Canal from widths of approximately 10 to 25 feet to between 160-feet and 200-feet in width at the bank line, depending on whether concrete or rock is used to line the canal.

Figure 10. Photo of Violet Diversion Canal.

Widening the Violet Canal also could require the relocations of most of the existing facilities located adjacent to the canal. Construction of the freshwater diversion project would require the temporary relocation of East St Bernard Highway and possibly the LA 39 (East Judge Perez Drive) bridge over the Violet Canal. The latter is a high level, four-lane bridge over the canal. Depending on the additional canal width required and the location of the bridge abutments, the bridge may have to be relocated. This could be a significant potential relocations expense. The preliminary estimated cost of such a diversion is $250 million, which is an average annual cost of $12.6 million.

Environmental Considerations

A large-scale freshwater diversion project in the vicinity of Violet would greatly increase fine sediment transport and deposition into the marshes located between the Mississippi River and the MRGO. Although increased fine sediment deposition would create some marsh and reduce losses in other marshes in this area, it is unlikely that sediments would be transported across the MRGO into Lake Borgne and the Biloxi Marshes because the deep water MRGO would trap most of these sediments.

The introduction of large volumes of freshwater from the Mississippi River would substantially lower salinity in the Central Wetlands. Some freshwater from a diversion near Violet would likely cross the more dense saline waters of the MRGO and reduce salinity in Lake Borgne and the Biloxi Marshes. Coastal marsh vegetation to the east of the diversion would greatly benefit from the influence of freshwater, sediment, and nutrients; plant productivity would substantially increase. It is likely that much of the brackish and intermediate marsh vegetation located in the Central Wetlands would convert to intermediate and fresh marsh. In areas immediately adjacent to the diversion outfall it is likely that cypress-tupelo swamp could be reestablished if other conditions were managed, such as nutria herbivory.

Some new marsh creation and reduction of future wetlands loss would occur as a result of the freshwater diversion. However, the construction of a conveyance channel would cause some direct loss of coastal wetlands. Wildlife and threatened and endangered species would generally benefit from increased marsh area and plant productivity. Some commercial and recreational fisheries in the region would be impacted as saltwater-dependent species were displaced. However, in the long-term, increased wetland area would provide additional habitat for juvenile saltwater-dependent fishes.

Other Considerations

Because the MRGO would trap most of the sediments and some of the freshwater diverted eastward from the Mississippi River, the beneficial effects of freshwater and sediment to the estuary would be primarily limited to the Central Wetlands for all of the de-authorization options except for the complete closure of the MRGO option (Option 2). The complete closure option could provide opportunities to allow for some sediment and more freshwater to be transported east of the MRGO into Lake Borgne and the Biloxi Marshes.

A freshwater diversion project near Violet is compatible with all of the proposed ecosystem restoration projects and plans. Additionally, the diversion project could provide storm surge reduction benefits to compliment proposed hurricane and flood protection projects. The additional marsh provided by this option could reduce the impacts of small storm surges over the marsh on the adjacent Forty Arpent Levee system by preserving the existing marsh that is one of the lines of defense against wave action. Some businesses along the Violet Canal, however, could be substantially impacted by such a diversion project. As a result, project planning would have to include an assessment of potential business relocation requirements.

Shoreline Protection

This opportunity includes construction of shoreline protection features such as rock dikes at or near the edge of waterways, lakes or bays to prevent the erosion of adjacent marshes. Maintenance of existing shoreline protection features has also been identified as an opportunity.

Rock shoreline protection dikes would be designed in shallow offshore waters. Fisheries access would be assured by gapping the dikes approximately every 1,000 feet. The 3rd Emergency Supplemental Appropriation authorized construction of rock shoreline protection all along the Inland Reach of the MRGO and on the shoreline of Lake Borgne from Doullut's Canal to Jahnecke's Ditch. No future maintenance money has been appropriated for these projects. There is one project authorized by CWPPRA that provides rock on MRGO and Lake Borgne; this project includes maintenance for 20 years. There are significant opportunities to protect other portions of the Lake Borgne shoreline or shorelines in the Biloxi Marshes. Also, if the MRGO is de-authorized, it may be possible to move and utilize the jetty rock for shoreline protection. This material could be placed to protect the marsh between Fiddler Point and the MRGO created marsh on the west or between the MRGO and Deadman Island on the east.

The maintenance of existing shoreline protection projects on the MRGO and Lake Borgne is estimated to cost $250 to 500 per foot (based upon CWPPRA 20-year life cycle). Placement of new dikes on lake or bay shorelines is estimated to cost $1,500 per foot (also based upon CWPPRA jobs). Site specific evaluation is required to develop better cost estimates.

Environmental Considerations

Shoreline protection that is offshore in shallow water generally allows sedimentation to occur between the dike and the shore. As it attained marsh elevation, this area would naturally vegetate creating a small amount of marsh. The existing marsh behind the shoreline protection would be protected and eroded far more slowly. This would slightly reduce land loss in the basin. Shoreline protection would rarely change salinity. Wildlife and fisheries would benefit from the marsh that would be saved and created and preserved. These wetlands would provide feeding, nesting and resting habitat for wildlife. Fisheries access within the estuary would not be affected by the shoreline protection projects because of the designed gaps. The rocks and shallow area between the rock and shore would provide valuable edge habitat for some fish species.

Other Considerations

The three de-authorization options evaluated earlier in this report would not be affected by the shoreline protection projects. Shoreline protection is compatible with all other flood protection and ecosystem restoration opportunities. The additional marsh preserved by this option could help reduce the impacts of small storm surges over the marsh.

Habitat Creation by Sediment Placement

Vegetated marsh lands serve as a damper to storm-induced surges and help to reduce storm impacts to human structures, such as homes and businesses. Therefore, numerous strategies could be utilized to create or restore marsh, barrier islands, and ridges. Material could be obtained by mining of sounds, Bayou La Loutre and the Mississippi River and the MRGO, or the MRGO spoil bank. It is clear that marsh habitat in the area is on the decline due to both natural and man-made factors. It is also clear that marsh habitat is important in reducing the potential for damages during a storm event. Opportunities should be identified that utilize any or all of these strategies to create or restore marsh, barrier island, and ridge habitat in the Middle Pontchartrain Basin to help reduce storm damages. Habitat creation or enhancement is anticipated to cost a minimum of $10,000/acre, on average.

Environmental Considerations

Marsh and island creation would rarely change salinity. Restoration of the Bayou La Loutre Ridge in conjunction with a dam in the MRGO could reduce salinity in the Biloxi Marshes. Created habitat would vegetate with plants similar to those surrounding it at the same elevation. All habitat creation projects would reduce land loss rates. These projects have substantial direct long-term ecosystem benefits and can have the indirect benefits of providing wind and wave erosion protection for nearby wetlands and levees.

Most wildlife would directly benefit from habitat creation projects such as the restoration of marshes and barrier islands. Neotropical migrant birds would benefit from the ridge habitat restoration. Shorebirds and waterfowl especially benefit from increased nesting sites and foraging areas associated with island creation. Some threatened and endangered species, such as sea turtles and piping plovers, could benefit from the creation of additional nesting habitat such as beach on Breton, Grand Gosier or Curlew Islands. Fisheries access within the estuary would not be affected by the habitat creation projects. Most fish and shellfish would benefit from the creation of marsh and island habitat.

Other Considerations

The three de-authorization options are not affected by additional habitat creation projects such as marsh, ridge, and barrier island creation. The creation of additional marsh, barrier island, and ridge habitat is compatible with all other flood protection and ecosystem restoration opportunities analyzed. The additional marsh preserved by this option could help reduce the impacts of small storm surges over the marsh.

Increase Existing Hurricane Protection Levee Heights to New Protection Levels

One method of improving hurricane protection for southeast Louisiana is to increase the heights of existing levees. Higher levees result in some degree of storm surge risk reduction. The advantage of levee raisings over constructing new levee alignments may include reduced real estate requirements, fewer construction materials, and smaller impacts to wetlands and other coastal habitats. In the MRGO area, some levee raisings have been completed along the south bank of the channel as part of Task Force Guardian work and additional increases in height to 100-year protection levels are authorized. As part of LACPR, teams are evaluating and designing potential levee raisings along existing alignments in the vicinity of the MRGO.

Borrow materials will be required, levee footprints will encroach into adjacent habitats, it will be necessary to construct access roads, and there will be associated noise and traffic resulting from heavy vehicles and machinery. The levees might include gates or culverts to restore hydrology.

Environmental Considerations

Raising existing levees would generally have no impact on salinity. It is likely that wetlands would be destroyed as the levee footprints expanded. Removal of borrow material could also turn wetlands to open water. This would increase land loss rates in the basin. These impacts would need to be mitigated. Gates or culverts in a levee could allow a more natural hydrology. Raising the levees on the MRGO spoil bank would not impact wetland vegetation in most cases. Wetlands that were enclosed behind a "leaky" levee might have a reduced loss rate due to less edge erosion. Most wildlife and fisheries would be adversely impacted by raising levees higher.

Other Considerations

Freshwater diversion, habitat creation, and shoreline protection would need to be done with consideration of levee raisings, but should not be impacted. The levees would provide storm surge protection to people and their homes, personal property and businesses.

New Hurricane Protection Levee Alignments and Surge Protection Structures

Planning and design efforts underway as part of the LACPR are considering new levee alignment alternatives for increased hurricane protection in South Louisiana. The alternatives under consideration include new levee and flood gate options in the vicinity of Lake Borgne and the MRGO. In relation to the MRGO, all of the current proposed alternatives for the LACPR include features that would cross the channel at various locations. As such, determination of the future authorized depth of the MRGO is a key consideration in planning, evaluating, and designing new alignments and surge protection structures as part of the LACPR. Design requirements and construction costs are highly dependent upon associated navigation needs, if any, that may remain on the MRGO.

Environmental Considerations

Impacts to salinity, vegetation, land loss, wildlife, threatened and endangered species and fisheries would be significantly more than those described above for options to raise existing levees. Since these would be new levees, the levee and borrow footprints would impact significantly more wetlands. This impact would mean that mitigation would have to be significantly increased over the opportunity for raising levees.

Other Considerations

Identifying, designing and building new alignments in the vicinity of MRGO should be carefully coordinated with efforts to conserve and restore coastal resources. Planners should seek to identify new alignments that minimize direct and indirect impacts to wetlands and that are neutral or complimentary with regards to plans for wetlands restoration. For example, new alignments should be devised to contribute to the distribution of diverted freshwater rather than in locations that would prevent beneficial outfall management of freshwater and sediments. If designed in concert, new levee protection and coastal restoration features are more likely to support long-term goals of both hurricane protection and coastal restoration programs. Such considerations are a key guiding factor in ongoing planning efforts for the LACPR.

MRGO AREA SYSTEMS EVALUATION

A systems evaluation for the comprehensive plan to de-authorize deep-draft navigation on the MRGO should include a direct comparison of deep-draft de-authorization options, economic benefits of deep-draft navigation, a financial analysis of deep-draft navigation, a financial analysis of shallow-draft navigation, and an analysis of the compatibility between the deep-draft de-authorization options and other opportunities for ecosystem restoration and storm surge reduction.

Comparison of Deep-Draft De-authorization Options

Table 9 on the following page provides comparisons of the economic, social, and environmental considerations of each MRGO de-authorization option. These options are discussed in detail in earlier sections of the report but the table provides a side-by-side comparison of the multiple evaluation factors considered. Although this information is preliminary, it is very useful in identifying options and opportunities for inclusion in the LACPR evaluations. In particular, at this stage of evaluation Option 2a - an armored earthen dam at Bayou La Loutre - appears to offer multiple benefits and opportunities with the lowest annual estimated construction costs and operations and maintenance costs.

Economic Benefits of Deep-Draft Navigation

One benefit of the MRGO is lower shipping costs, as ships require less time and fuel to reach their destination when using the MRGO instead of the Mississippi River. This benefit is a national economic development (NED) consideration and is used when determining cost effectiveness and justification in the Federal water resources development planning process.

Additional benefits provided by the MRGO include the direct jobs created by the shipping industry and other industries that rely on vessels utilizing the MRGO, as well as the indirect impact of these jobs on the local economy. Prior to Hurricane Katrina, businesses located along the MRGO that relied upon the outlet provided approximately 1,000 direct jobs. The benefits associated with an increased number of jobs are a local or regional benefit and not utilized during effectiveness and justification evaluations.

Table 9. Comparison of Deep-Draft De-Authorization Options.

DESCRIPTION	Option 1a: No Structure (maintain for shallow-draft)	Option 1b: Salinity Control Weir at La Loutre	Option 1c: Salinity Control Gate at La Loutre (normally closed)	Option 1d: Storm Protection Gate at La Loutre (normally open)	Option 2a: Armored Earthen dam at La Loutre Ridge to close MRGO	Option 2b: Restore Both Banks of B. La Loutre at Hopedale LA	Option 2c: Fill the Entire Channel	Option 3: No channel maintenance
Economic Considerations								
1)Business Reestablishment	$13.6M	$13.6M	$13.6M	$13.6M	$13.6M	$13.6M	$13.6M	$13.6M
2)Annual Construction	$0	$3,071,000	$3,629,000	$3,629,000	$2,652,000	$5,404,000	Unknown, but high	$0
- Annual O&M	$6,101,000	$6,101,000	$6,101,000	$6,101,000	$0	$0	$0	$0
3)Impacts to Local Communities	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state	Some companies along MRGO might choose to relocate, possibly out of state
Social Effects								
1) Life, Health, and Safety	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
2) Community Cohesion	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts	Potential beneficial impacts
3) Recreation	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
4) Environmental Justice	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
5) Socio-economics	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Environmental Consider.								
1) Salinity	Small future reduction	Moderate reduction	Substantial Reduction	Moderate reduction	Substantial Reduction	Substantial Reduction	Substantial Reduction	Small future reduction
2) Vegetation	No substantial change	Some possible local changes to less saline marsh	Possible change to less saline marsh over wider area than 1a	No substantial change	Possible change to less saline marsh over wider area than 1a	Possible change to less saline marsh over wider area than 1a	Possible change to less saline marsh over wider area than 1a	No substantial change
3) Land Loss	No change in basin land loss rates	No change in basin land loss rates	No change in basin land loss rates	No change in basin land loss rates	No change in basin land loss rates	No change in basin land loss rates	Slight reduction in basin loss rates, but at a great cost	No change in basin land loss rates
4) Wildlife	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change
5) Threatened and Endangered Species	Coordination if necessary	Coordination if necessary	Coordination if necessary	Coordination if necessary	Coordination if necessary	Coordination if necessary	Coordination if necessary	Coordination if necessary
6) Fisheries	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change	No substantial change
7) Hazardous-Toxic-Radioactive Waste	No impact	Phase 1 ESA will be done	Phase 1 ESA will be done	Phase 1 ESA will be done	Phase 1 ESA will be done	Phase 1 ESA will be done	Phase 1 ESA will be done	No impact
8) Cultural Resources	No impacts	Surveys needed	Surveys needed	Surveys needed	Surveys needed	Surveys needed	Surveys needed	No impacts

Financial Analysis of Deep-Draft Navigation

By maintaining navigation at a 12-foot draft, companies whose businesses are dependent on deep-draft navigation in the MRGO could be adversely affected. Under all options evaluated, up to eight businesses could be impacted by de-authorization of deep-draft navigation. Through interviews and a survey, business reestablishment costs were determined. The affected firms were asked what depth would have an impact on their business and would perhaps prompt them to reestablish facilities elsewhere. Each surveyed business estimated its own reestablishment costs. Reestablishment estimates provided by these businesses do not reflect depreciation but rather actual purchase for a new or used facility with comparable infrastructure and transportation networks. The costs presented in this document, in particular those associated with business reestablishments, were not prepared using NED procedures. These estimates are not based on federal relocation assistance principles. These reported business reestablishment costs are not the responsibility of the Federal government.

Four of the interviewed companies are dependent on the fully authorized dimensions of the MRGO to maintain the operation modes they employed prior to Hurricane Katrina. These companies estimate that costs to reestablish comparable facilities on the Mississippi River or other area waterways would be approximately $244 million or an average annual cost of $13.6 million.

Preliminary analysis of deep-draft navigation suggests that maintaining the authorized dimensions of the MRGO is not cost effective. Average annual O&M costs to dredge the waterway are $12.5 million while maintaining the authorized dimensions produces approximately $6.2 million in transportation efficiencies.

Two types of inefficiencies were evaluated for this study: transportation inefficiencies associated with increased travel time of a vessel and business inefficiencies that involve additional steps in these processes. Increased travel time occurs when vessels are unable to use the MRGO and are required to use the Mississippi River. These transportation inefficiencies for vessels requiring drafts of greater than 12 feet are estimated by the effected businesses to be $2.5 million a year. If companies are unable to dock deep-draft vessels at their facilities, they often transport their product to an alternative location or light-load their vessels. Businesses that remain in the MRGO-serviced area currently face transportation inefficiencies of $2.5 million per year associated with modified marine operations. The businesses themselves estimated that these business inefficiencies are $10 million a year because of modified land operations at their facilities, although the USACE has not verified these reported costs.

It was assumed that business reestablishments would take about four years and during this time businesses would have to incur the added costs of light-loading or trucking their commodities to/from the river to MRGO facilities. Once the facilities were moved to the River these inefficiencies would end but the businesses may incur added costs to travel to their new facilities.

Financial Analysis of Shallow-Draft Navigation

As part of the analysis, benefits and costs of maintaining a 12-foot channel depth for shallow-draft navigation were estimated. If any option of maintaining the channel for shallow-draft navigation is selected, the maintenance dredging would occur at different times for different sections of the channel. These estimates use the current depths, past maintenance dredging requirements and sedimentation rates to determine when dredging would first occur in each reach of the channel. Refer back to Table 7 for a list of locations along the channel and the estimated time it would take for the channel to fill to a point where shallow-draft maintenance dredging would be required.

The benefits of authorizing the MRGO to 12 feet are the reduction in the transportation inefficiencies over the total closure option for the channel. According to the WCSC data, an average of 1,407 vessels with depths of 12 feet or less have a one-way passage on the Inland and Sound reaches of the MRGO each year. If the MRGO were to be closed, those trips would have to be taken by a longer alternate route along the Mississippi River. In addition, if the MRGO were to be closed, the MRGO would no longer be available as an alternative route to the GIWW for shallow-draft traffic when the IHNC Lock is not functioning or is congested. Taking these two issues into account, it is estimated that the average annual benefits of authorizing the MRGO to 12 feet is $3.7 million.

Table 10 is a summary of the shallow-draft options. This preliminary information suggests that, with an annual cost of maintenance exceeding $6 million, and annualized benefits of approximately $3.7 million, shallow-draft navigation is not cost effective.

Table 10. Shallow-Draft Navigation for Different Options.

Option	Construction Costs	Average Annual Costs [1]	Average Annual Benefits	Significant Ecosystem Restoration Benefits
No Structure	$0	$6,101,000	$3,674,000	Some long-term reduction in salinity and erosion; continued BU marsh creation
Salinity Control Weir at La Loutre	$50,000,000	$8,629,000	$3,674,000	Reduction in salinity and enhancement of freshwater diversions
Salinity Control Gate at La Loutre- normally closed	$60,000,000	$9,135,000	$3,674,000	Greater salinity reduction and enhancement of freshwater diversions
Storm Protection Gate at La Loutre- normally open	$60,000,000	$9,135,000	$3,674,000	Reduction in salinity and enhancement of freshwater diversions

[1] Includes construction and O&M costs. The O&M includes maintenance of existing shoreline protection and additional dredging required after tropical storms and hurricanes.

Analysis of Compatibility Between Options and Opportunities

All three de-authorization options relate at different levels with the hurricane protection and ecosystem restoration opportunities also identified in this report (shoreline protection, freshwater diversion, habitat creation, raising existing levees, new levee alignments, and storm surge structures) (Table 11).

For instance, if the MRGO channel is not reduced in width or closed, freshwater and sediments diverted from the Mississippi River would have less benefit to the marshes located east of the channel. In terms of habitat creation, fresher marsh types would result if the channel is restricted or closed

Table 11. Relationship Between Deep-Draft De-Authorization Options and LACPR.

Option	Fresh-water Diversion	Shoreline Protection	Habitat Creation	Increase Existing Levee Heights	New Levee Alignments or Surge Reduction Structures	Stakeholder Consensus Items
Option 1a - Maintain 12' navigation	Not Consistent	Consistent	Consistent	Consistent	Consistent	Consistent
Option 1b – Weir	Some connection Mutual goals	Some connection Mutual goals	Some connection Mutual goals	Consistent	Consistent	Some connection Mutual goals
Option 1c – Gate mostly closed	Strong connection Mutual goals	Strong connection Mutual goals	Strong connection Mutual goals	Consistent	Consistent	Strong connection Mutual goals
Option 1d – Gate mostly open	Some connection Mutual goals	Some connection Mutual goals	Some connection Mutual goals	Consistent	Consistent	Some connection Mutual goals
Option 2a – Earthen Closure	Strong connection Mutual goals	Strong connection Mutual goals	Strong connection Mutual goals	Consistent	Consistent	Strong connection Mutual goals
Option 2b – Double earthen closure	Strong connection Mutual goals	Strong connection Mutual goals	Strong connection Mutual goals	Consistent	Consistent	Strong connection Mutual goals
Option 2c – Fill in channel	Barely Consistent	Consistent	Consistent	Consistent	Consistent	Consistent
Option 3 – No Maintenance	Not Consistent	Consistent	Consistent	Consistent	Consistent	Not Consistent

RESULTS AND CONCLUSIONS OF INTERIM REPORT

For this report, the USACE executed a collaborative planning effort with multiple stakeholders. The collaborative planning effort attempted to identify a consensus plan for de-authorizing the channel but in the end resulted in only identifying common measures or features supported by many stakeholders.

Implementation of any of the deep-draft de-authorization options presented in this report would require additional hydraulic modeling, possible physical modeling, detailed engineering design, and completion of environmental compliance evaluations. This additional analysis will be conducted as part of the final LACPR Report due to Congress in December 2007. Congress directed USACE to "refine the plan, if necessary, to be fully consistent, integrated, and included" in the final LACPR plan.

Preliminary analysis of deep-draft navigation suggests that maintaining the authorized dimensions of the MRGO is not cost-effective. Average annual O&M costs to dredge the MRGO deep-draft channel are $12.5 million. However, maintaining the authorized dimensions only produces approximately $6.2 million per year in transportation efficiencies.

Preliminary economic analysis of the three shallow-draft navigation options in this report suggests that maintaining GIWW dimensions is not cost effective due to the irregular use of the MRGO by shallow-draft traffic. The average annual costs for construction and maintenance dredging range between $6 million and $9 million while estimated benefits associated with maintaining shallow-draft depths are approximately $3.7 million.

Based on the above economic information, this report suggests that constructing an armored earthen dam at Bayou La Loutre may present the best option to ensure full incorporation into LACPR. Some variation of this option would likely generate the greatest benefits by reducing salinity, restoring marshland, and offering some protection against minor storm surges. Further analysis should be performed on the location and design to ensure the most cost-effective and sound engineering plan. Design optimization, including possible physical modeling, would be required to assess hydraulic performance.

Erosion protection options on the banks of the MRGO will be implemented by coastal restoration measures directed by emergency supplemental appropriations acts, and any remaining erosion protection can be designed as part of the LACPR Report. Freshwater diversion can be modeled and designed as part of the LACPR Report. The navigable closure on the GIWW will be implemented as directed by the Emergency Supplemental Appropriations Act dated June 15, 2006. Habitat creation by the placement of sediment can be finalized as part of the LACPR Report, CWPPRA projects, and resumption of the LCA study of MRGO features.

PRELIMINARY COMPREHENSIVE PLAN FOR DE-AUTHORIZING THE MRGO

Preliminary analysis indicates that it may be appropriate to close the MRGO channel to both deep-draft and shallow-draft navigation. Maintaining shallow-draft or deep-draft navigation is not cost-effective according to current data. Based on this preliminary analysis, closure of the MRGO channel to both shallow and deep-draft navigation by an armored earthen structure just south of Bayou La Loutre near Hopedale, Louisiana appears to be a particularly viable option and may be the best option to support full integration into LACPR.

Through incorporation into LACPR, additional measures to provide opportunities for hurricane storm surge protection and ecosystem restoration may complement MRGO channel closure. Such opportunities include:

- Freshwater diversion into the MRGO and surrounding marshes (possibly in the vicinity of Violet Canal);
- Shoreline protection to prevent wetlands erosion (including maintenance of existing projects);
- Habitat creation through the placement of sediment for rebuilding marshes, barrier islands, and ridges;
- Increasing existing levee heights to new hurricane protection levels; and/or
- New hurricane protection levee alignments or surge protection structures.

These preliminary options will be further developed and coordinated for NEPA compliance through the LACPR efforts. These opportunities have been supported by stakeholders and are consistent with many existing Federal and non-Federal plans for ecosystem restoration and hurricane protection.

The LACPR Final Technical Report will provide the design for a comprehensive plan for MRGO deep-draft de-authorization as well as any other opportunities for hurricane storm damage protection and ecosystem restoration. Additionally, several major, ongoing efforts (navigable storm gates to protect the IHNC area, erosion protection along the MRGO, and the IHNC Lock replacement project) that address key aspects of the project and surrounding system are documented in this interim report.

Completing a de-authorization plan includes full development and coordination of the MRGO de-authorization project with LACPR plans. This report is an important step in completing and integrating the MRGO de-authorization into the LACPR because of the need to evaluate these plans with other components of the LACPR plans. Evaluation steps would include modeling of storm surge interaction with project features, evaluation of environmental benefits and impacts, and fully developing initial designs and costs for inclusion in a final plan.

List of Acronyms

ADCIRC	Advanced Circulation Model
cfs	cubic feet per second
CHL	Coastal and Hydraulics Laboratory
Coast 2050 Plan	Coast 2050: Toward a Sustainable Coastal Louisiana Report
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESA	Environmental Site Assessment
ft	feet
GIWW	Gulf Intracoastal Waterway
IHNC	Inner Harbor Navigation Canal
IWR	Institute for Water Resources
LCA	Louisiana Coastal Area
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
MLG	Mean Low Gulf
mph	miles per hour
MRGO	Mississippi River-Gulf Outlet
NED	National Economic Development
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
O & M	Operations and Maintenance
OSA	Office of the Secretary of the Army
PEIS	Programmatic Environmental Impact Statement
ppt	parts per thousand
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WCSC	Waterborne Commerce Statistics Center

Appendix 1 – References

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Appendix 2 – Letter from Governor Blanco

KATHLEEN BABINEAUX BLANCO
GOVERNOR

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June 2, 2006

Major General Don T. Riley
Director of Civil Works
United States Army Corps of Engineers
441 G Street, NW
Washington, DC 20314

Dear General Riley:

I am encouraged by the historic partnership formed between the U.S. Army Corps of Engineers and the State of Louisiana to develop a comprehensive master plan for the protection and restoration of our fragile coast, as mandated by the Congress and our state Legislature. I am pleased that the Corps and the State have responded quickly and are committed to making these two plans become one vision for coastal Louisiana.

Last November, our Legislature created the Coastal Protection and Restoration Authority (CPRA) of Louisiana to develop, implement and enforce a comprehensive coastal protection master plan that for the first time in our state's history will truly integrate coastal restoration and hurricane protection. By law, this single state entity will be your partner, representing the State in the long journey to establishing a safe and sustainable coast.

Our integrated team, comprised of Corps leadership and the CPRA, has been hard at work on the comprehensive coastal protection and restoration plan, with the interim report due to Congress on June 30. I understand that this report will recommend that certain projects be advanced to bring immediate solutions for our most vulnerable coastal areas and that the final report on comprehensive protection will be made in December 2007. As we work together as partners on this critical planning effort, I believe it is essential that we communicate clearly and openly on each and every aspect of this plan.

Therefore, I write to unequivocally express the policy of this State regarding the future of the Mississippi River Gulf Outlet (MRGO). Our people have spoken, our Legislature has made its will clear, and my Advisory Commission on Coastal Protection, Restoration and Conservation has recommended the immediate closure of this channel.

Over the years, MRGO has compromised the safety of countless communities and contributed to the loss of vital coastal marsh areas. The closure of the MRGO must ensure that communities are safe and our ecosystems are protected from further saltwater intrusion and coastal land loss.

Specifically, our work must include a more precise plan for closure, restoration of the extensive wetlands lost as a direct result of the MRGO, and the integration of this closure into the comprehensive hurricane protection plan. We must also consider the navigation needs that will be affected by closing the MRGO to deep draft navigation, including expediting the construction of the new IHNC Lock and relocation of businesses currently depending on the MRGO.

As this report is formulated, I will be communicating this policy on MRGO through the CPRA directly to our Congressional Delegation. I urge you to join me in advocating with one voice on this issue, as well as on other critical near term aspects of our plan.

I understand, as do the people of Louisiana, that there will be many tough decisions in the coming months and years. Implementing these policy choices and determining their long term sustainability will not be easy. However, I am confident that working together, with a strong commitment to public input and thoughtful direction from our legislative leaders, we will set Louisiana on the right path for a safe and prosperous future.

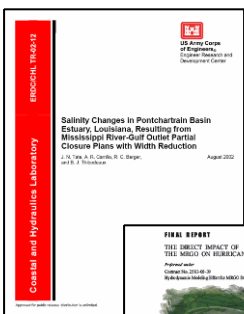
Sincerely,

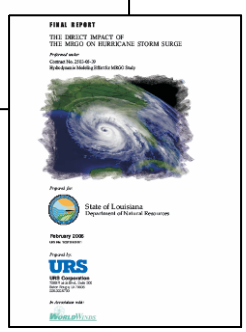
Kathleen Babineaux Blanco

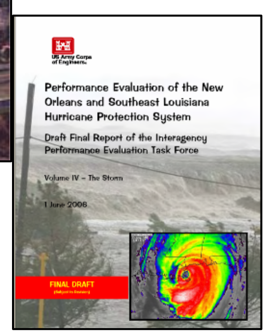
Kathleen Babineaux Blanco
Governor

Appendix 3 – Synopsis of Modeling Reports

Hydrology & Hydraulics Synopsis of MRGO Modeling Studies For Surge, Salinity, Shoreline Stability, and Sediment Deposition







Hydrology & Hydraulics Synopsis of MRGO Modeling Studies For Surge, Salinity, Shoreline Stability, and Sediment Deposition

1. General. - This write-up reviews recent hydraulic modeling reports that document the effects of the Mississippi River Gulf Outlet (MRGO) on the following factors:

- storm surge
- salinity
- bank/shoreline stability
- sediment deposition /dredging

A brief description of each modeling study is provided including assumptions, parameters, and results. The exhibits section at the end of this report includes excerpts of the conclusions of each modeling analysis.

2. Storm surge modeling. – There are three modern modeling studies of the MRGO and adjacent tidal system for storm surge effects as follows:

- Numerical Modeling of Storm Surge Effect of MRGO Closure; MRGO Reevaluation Study (EPA Sponsored), Westerink and Luettich Consulting , May 2004 (pre-Katrina)
- The Direct Impact of the Mississippi River Gulf Outlet on Hurricane Storm Surge; URS for Louisiana Department of Natural Resources, Feb 2006
- Interagency Performance Evaluation Task Force (IPET), Final Draft, Volume IV, June 2006 and Appendix E - Westerink, Ebersole, Winer; February 21, 2006

These studies have all employed the ADCIRC model (ADvanced CIRCulation model) developed by Westerink and Luettich. ADCIRC is a two-dimensional depth integrated finite element hydrodynamic circulation code for ocean shelves, coasts, and estuaries. The computational mesh used for the first two studies was the S08 mesh which includes 600,331 elements and 314,442 nodes. Node spacing in the S08 mesh varies from 15.5 miles in distant areas to 330 feet in the New Orleans area. The most recent ADCIRC analysis (IPET) used a more detailed mesh identified as TF01.

The general conclusion of the three ADCIRC modeling studies is that the impact of the long, southeast-trending section of the MRGO on storm surge propagation into the New Orleans vicinity is very small. Thus, complete filling of the MRGO—or blockage or partial filling—will not provide significant *immediate, direct* mitigation of severe storm surge. The principal factor given for this result is that the added flow area provided by the MRGO is small compared to the expanse of flow area provided by the adjacent estuaries and marshes during large surge events. Thus, the most noticeable impact occurs for small surge events where propagation over the marsh areas is not a factor.

Finally, additional ADCIRC surge modeling is being conducted for the ongoing FEMA map modernization program. This will delineate surge elevations in the study area for flood insurance purposes. Excerpts of the conclusions of each of the completed surge modeling studies are provided in the Exhibit 1 of this report.

3. Salinity modeling - The MRGO is known to have had significant salinity impacts to Lake Pontchartrain and Lake Borgne starting in 1963 during initial construction through completion in 1968 and continuing to the present. TABS-MD modeling studies at ERDC have investigated the salinity impacts of the MRGO and various salinity management schemes such as freshwater diversions and salinity control structures. The models utilize a three dimensional code and apply tide, wind, and freshwater inflows representing the simulation periods. Three studies were reviewed for this report as follows:

- Salinity Changes in Pontchartrain Basin Estuary Resulting from Bonnet Carré Freshwater Diversion, (ERDC/CHL TR-97-02), William McAnally, R.C. Berger, February 1997.
- Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississippi River-Gulf Outlet Partial Closure Plans with Width Reduction, (ERDC/CHL TR-02-12), J. N. Tate, A. R. Carrillo, R. C. Berger, August 2002.
- Louisiana Coastal Area 3-D Hydrodynamic and Salinity Modeling, Jennifer N. Tate, S. Keith Martin, and Tate O. McAlpin, August 2006 Draft.

The February 1997 salinity modeling study considered the effects of freshwater diversions from the Mississippi River to Lake Pontchartrain by way of the Bonnet Carré spillway near New Orleans. Four conditions were modeled for April through August of a typical year:

- Base condition with no freshwater diversion
- Diversions up to 20,000 cfs.
- Diversions up to 8,500 cfs.
- No diversions but with the connections between MRGO and Lake Borgne closed.

Some paraphrased conclusions:

- The estuary salinity profile responds very slowly to diversions at Bonnet Carré.
- The MRGO is a significant contributor to salinity via connections to Lake Borgne.
- A Bonnet Carré discharge capacity of 30,000 cfs is required to achieve the desired salinity of 6 ppt in the Biloxi Marshes.
- Diversions to 20,000 cfs reduced salinities up to 4.2 ppt.
- Diversions up to 8,500 cfs reduced salinities up to 3.4 ppt.
- Closure of Lake Borgne-MRGO connections reduced salinities by about 2 ppt.
- It may be possible to approach target salinities by combining control of MRGO salinity with freshwater diversions at reduced rates.

The August 2002 salinity modeling study considered the effects of three different combined depth and width reductions on the MRGO at La Loutre ridge as follows:

- Base condition with no constriction

- Constricted to 20-ft depth and 200-ft width
- Constricted to 16-ft depth and 160-ft width
- Constricted to 12-ft depth and 125-ft width
- Complete closure at La Loutre (from earlier 2001 study)

The combined depth and width reductions were more successful in reducing salinity than depth reductions alone. (Depth reductions were considered in an earlier 2001 study.) The narrowest reductions accomplished over half the effects of complete closure. The reductions also resulted in higher current velocities at the constriction that could negatively impact navigation. Extreme current velocities would occur through the constriction for occasional events driven by strong winds

The final salinity modeling analysis reviewed for this synopsis (Tate, Martin, and McAlpin) was only available as a draft report. The modeling characterizes the salinity regime within the study area for a low, normal and high runoff year from the local tributaries. The salinity results for four modeled years – 1983, 1985, 1996, and 2000 are described. The provided figures show average monthly salinity contours for each month of the four years at the bottom of the water column.

Excerpts of the conclusions of all three of the salinity modeling studies are provided in Exhibit 2 section of this report. Additional salinity modeling will be performed for the IHNC Floodgates analysis to model the impacts of the three proposed gates being considered. The scope for that modeling effort is included in the Exhibit 1.

4. Bank/shoreline stability - The MRGO is a confined, deep draft navigation channel, so its banks can be impacted by vessels moving through the channel. The following study analyzing vessel effects was reviewed for this report:

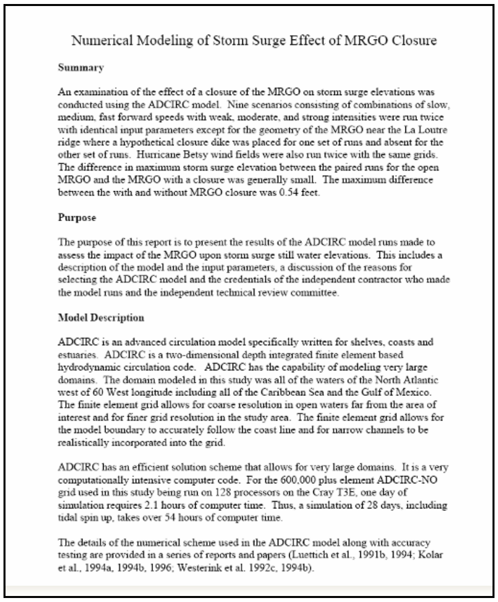
> *Mississippi River Gulf Outlet (MRGO) Hydraulic Engineering Study of Channel Bank and Shoreline Response to Deep Draft and Container Barge Traffic; Technical Memorandum, Vladimir Shepsis, Coast & Harbor Engineering for Louisiana Department of Natural Resources, August 26, 2005*

The report presents modeling results of vessel effects on wave generation and bank erosion using proprietary models developed by Coast and Harbor Engineering. Model alternatives included a base condition of a fully loaded vessel traveling at 10 knots and two alternative conditions where the same vessel is light loaded traveling at 10 knots and fully loaded traveling at 5 knots. The analysis showed that vessel speed was the predominant factor in wave generation and bank erosion. The report recommends that limiting velocities be determined for successive reaches along the entire channel as a method of reducing bank erosion.

Exhibit 1
ADvanced CIRCulation (ADCIRC)
Storm Surge Modeling Studies

1.1 - Numerical Modeling of Storm Surge Effect of MRGO Closure

for MRGO Re-evaluation Study (EPA Sponsored), Westerink and Luettich Consulting, May 2004



Numerical Modeling of Storm Surge Effect of MRGO Closure

Summary

An examination of the effect of a closure of the MRGO on storm surge elevations was conducted using the ADCIRC model. Nine scenarios consisting of combinations of slow, medium, fast forward speeds with weak, moderate, and strong intensities were run twice with identical input parameters except for the geometry of the MRGO near the La Loutre ridge where a hypothetical closure dike was placed for one set of runs and absent for the other set of runs. Hurricane Betsy wind fields were also run twice with the same grids. The difference in maximum storm surge elevation between the paired runs for the open MRGO and the MRGO with a closure was generally small. The maximum difference between the with and without MRGO closure was 0.54 feet.

Purpose

The purpose of this report is to present the results of the ADCIRC model runs made to assess the impact of the MRGO upon storm surge still water elevations. This includes a description of the model and the input parameters, a discussion of the reasons for selecting the ADCIRC model and the credentials of the independent contractor who made the model runs and the independent technical review committee.

Model Description

ADCIRC is an advanced circulation model specifically written for shelves, coasts and estuaries. ADCIRC is a two-dimensional depth integrated finite element based hydrodynamic circulation code. ADCIRC has the capability of modeling very large domains. The domain modeled in this study was all of the waters of the North Atlantic west of 60 West longitude including all of the Caribbean Sea and the Gulf of Mexico. The finite element grid allows for coarse resolution in open waters far from the area of interest and for finer grid resolution in the study area. The finite element grid allows for the model boundary to accurately follow the coast line and for narrow channels to be realistically incorporated into the grid.

ADCIRC has an efficient solution scheme that allows for very large domains. It is a very computationally intensive computer code. For the 600,000 plus element ADCIRC-NO grid used in this study being run on 128 processors on the Cray T3E, one day of simulation requires 2.1 hours of computer time. Thus, a simulation of 28 days, including tidal spin up, takes over 54 hours of computer time.

The details of the numerical scheme used in the ADCIRC model along with accuracy testing are provided in a series of reports and papers (Luettich et al., 1991b, 1994; Kolar et al., 1994a, 1994b, 1996; Westerink et al. 1992c, 1994b).

(Slide Presentation, October 2003)

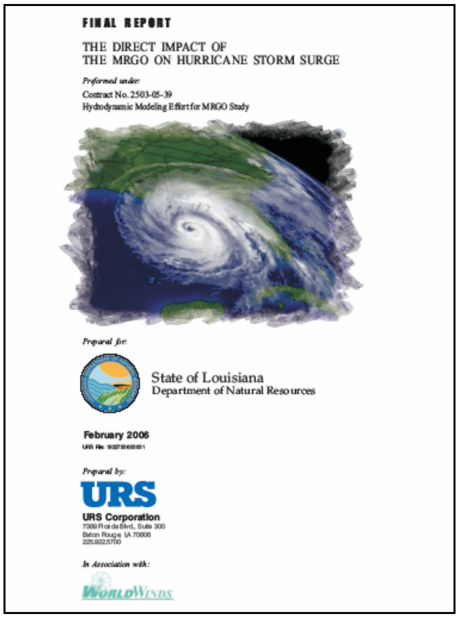
Excerpts:

Page 1: Summary - An examination of the effect of a closure of the MRGO on storm surge elevations was conducted using the ADvanced CIRCulation (ADCIRC) model. Nine scenarios consisting of combinations of slow, medium, fast forward speeds with weak, moderate, and strong intensities were run twice with identical input parameters except for the geometry of the MRGO near the La Loutre ridge where a hypothetical closure dike was placed for one set of runs and absent for the other set of runs. Hurricane Betsy wind fields were also run twice with the same grids. The difference in maximum storm surge elevation between the paired runs for the open MRGO and the MRGO with a closure dike at La Loutre Ridge was generally small. The maximum difference between the with- and without-closure was 0.54 feet.

Page 37: Conclusions - The ADCIRC model was used to test the influence of the MRGO upon storm surge in the areas outside of the federal protection levees. Several storm scenarios were run twice with identical runs except for a closed MRGO for one run and an open MRGO for the other run. Except for the changed geometry, all other factors were the same for the two runs, i.e. same wind forcing, same input files, and same computer configuration, etc. Of the storm scenarios tested, the largest difference between the open and closed MRGO runs was 0.54 feet, which occurred in a small area near the hypothetical closure at the LaLoutre ridge. The conclusion of this report has to be that the MRGO has a minimal influence upon storm surge propagation

1.2 - The Direct Impact of the Mississippi River Gulf Outlet on Hurricane Storm Surge

URS for Louisiana Department of Natural Resources, Feb 2006,
Used S08 mesh. Tested closure barrier at Bayou La Loutre ridge and also with entire channel filled to +1 MSL.


FINAL REPORT

THE DIRECT IMPACT OF
THE MRGO ON HURRICANE STORM SURGE

Preformed under:
Contract No. 2503-05-39
Hydrodynamic Modeling Effort for MRGO Study

Prepared for:
State of Louisiana
Department of Natural Resources

February 2006

Prepared by:
URS
URS Corporation
225.922.5700

In Association with:
WorldWinds

Excerpts:

Page ES-2: Major conclusions of this study are:

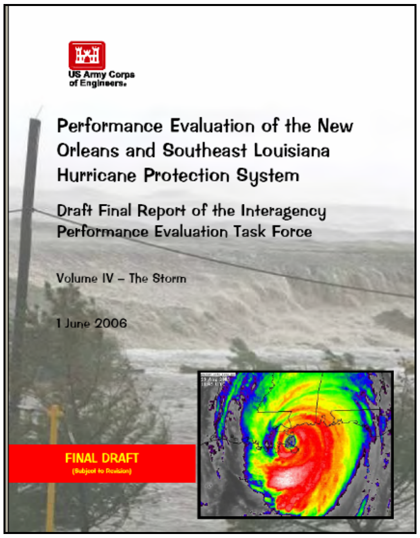
• The MRGO channel does not contribute significantly to peak surge during severe storms, when the conveyance of surge is dominated by flow across the entire surface of the coastal lakes and marsh. Nor does the channel contribute significantly to wave run-up.

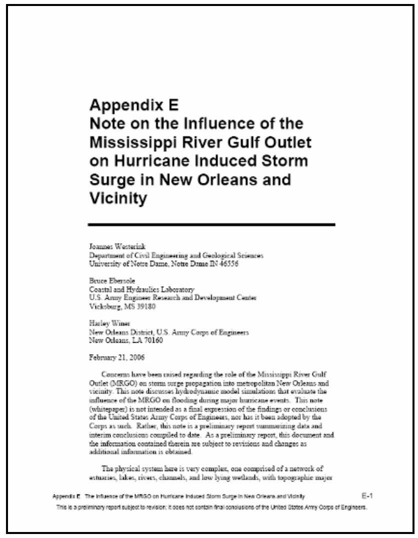
• Complete filling of the MRGO—or blockage or partial filling—will not provide significant *immediate, direct* mitigation of severe storm surge.

• For a few locations outside the Hurricane Protection System closure of the MRGO may reduce the peak surge for certain fast-moving, low-to-moderate storms, when the surge is not dominated by flow across the open lakes and marsh, and may modestly delay the onset of surge.

1.3 - IPET Volume IV and Appendix E

Interagency Performance Evaluation Task Force, Final Draft, Volume IV, June 2006
also Appendix E - Westerink, Ebersole, Winer; February 21, 2006





Appendix E
Note on the Influence of the Mississippi River Gulf Outlet on Hurricane Induced Storm Surge in New Orleans and Vicinity

Joannes Westerink
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Bruce Ebersole
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Harley Winer
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New Orleans, LA 70160

February 21, 2006

Concerns have been raised regarding the role of the Mississippi River Gulf Outlet (MRGO) on storm surge propagation into metropolitan New Orleans and vicinity. This note discusses hydrodynamic model simulations that evaluate the influence of the MRGO on flooding during major hurricane events. This note (whitepaper) is not intended as a final expression of the findings or conclusions of the United States Army Corps of Engineers, nor has it been adopted by the Corps as such. Rather, this note is a preliminary report summarizing data and interim conclusions compiled to date. As a preliminary report, this document and the information contained therein are subject to revisions and changes as additional information is obtained.

The physical system here is very complex, one comprised of a network of estuaries, lakes, rivers, channels, and low lying wetlands, with topographic major

Appendix E The Influence of the MRGO on Hurricane Induced Storm Surge in New Orleans and Vicinity E-1
This is a preliminary report subject to revision; it does not contain final conclusions of the United States Army Corps of Engineers.

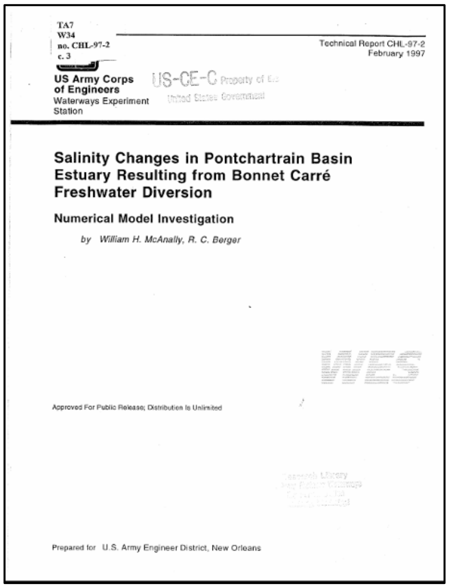
Excerpts:

Page 7 of Appendix E : The fact that all studies show a larger proportional influence of the presence of the MRGO/Reach 2 for low intensity (low peak surge magnitude) events is related to the fact that the proportional increase in conveyance due to Reach 2 is greater when the surge is small and the water levels in Breton Sound and Lake Borgne are generally low. This also explains why we see a more rapid drop in post-storm Lake Pontchartrain levels for large-scale events with the MRGO in place. Waters typically withdraw relatively rapidly from Breton Sound and Lake Borgne due to the direct connection to open waters. The total combined conveyance of the Rigolets, Chef Menteur Pass and the IHNC/GIWW/MRGO system is increased with the MRGO in place under the lower post-storm levels on the Mississippi-Alabama shelf.

Exhibit 2
Salinity Modeling Studies

2.1 Salinity Changes in Pontchartrain Basin Estuary Resulting from Bonnet Carré Freshwater Diversion

(ERDC/CHL TR-97-02), William McAnally, R.C. Berger, February 1997



Technical Report CHL-97-2
February 1997

US Army Corps of Engineers
Waterways Experiment Station

Salinity Changes in Pontchartrain Basin Estuary Resulting from Bonnet Carré Freshwater Diversion

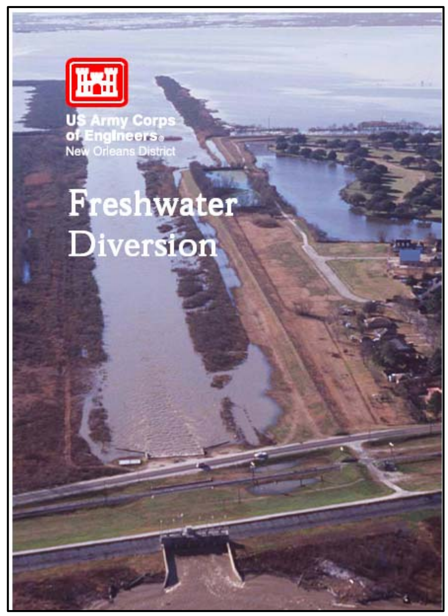
Numerical Model Investigation

by William H. McAnally, R. C. Berger

WES

Approved For Public Release; Distribution Is Unlimited

Prepared for U.S. Army Engineer District, New Orleans



Excerpt from page viii:

Numerical model experiments were performed to predict salinity changes that will occur in the Lake Pontchartrain basin estuary, Louisiana and Mississippi, as a result of proposed Mississippi River freshwater diversions through the Bonnet Carré Spillway near New Orleans. One purpose of the diversion is to reduce salinities in the Biloxi Marshes by 2 to 8 parts per thousand (ppt) in order to improve oyster productivity. A range of monthly salinities has been identified as the desired product of the project. Those salinities, called the Chatry salinities in this report, consist of a narrow band of "optimum" salinities and a somewhat wider band of "range limits."

(CTH = Committee on Tidal Hydraulics)

e. These results support the CTH suggestion that the Lake Borgne-MRGO connections make a major contribution to salinity of the basin. Totally closing them generated salinity reductions of about 2 ppt near Line 2, so some fraction of that reduction is probably attainable by applying some more limited measure of control to those outlets. Such a control could, in combination with Bonnet Carré diversions lower than those proposed in the original design, achieve or approach target salinities at or near Line 2. Control of the connections could range from rock or pile structures to simpler measures such as creation of dredged material sills and dams that are periodically replenished. Since the connections were represented schematically in the model, they should be evaluated in a revised model before a firm decision is made.

f. Other salinity reducing measures suggested by the CTH could be used in combination with Bonnet Carré diversions on the order of MBPJ and Lake Borgne connections control to achieve target salinities, including the following:

(1) Closing the IHNC at Seabrook or the MRGO south of Lake Borgne.

(2) Constructing a jetty and sill in Lake Pontchartrain at the end of the IHNC to trap higher salinity intrusions during periods of stratification.

(3) Artificial destratification of the MRGO by water or bubble curtains.

(4) Supplemental freshwater diversions into the IHNC-MRGO via or adjacent to the Mississippi River lock.

2.2 Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississippi River-Gulf Outlet Partial Closure Plans with Width Reduction

(ERDC/CHL TR-02-12), J. N. Tate, A. R. Carrillo, R. C. Berger, August 2002

ERDC/CHL TR-02-12

Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississippi River-Gulf Outlet Partial Closure Plans with Width Reduction

J. N. Tate, A. R. Carrillo, R. C. Berger, and B. J. Thibodeaux

August 2002

Approved for public release; distribution is unlimited.

Excepts from page 6:
Monthly summaries of salinity for pre- and post-MRGO indicate that salinity has increased on the average by the following amounts:
• 1.1. ppt at Lake Pontchartrain, North Shore.
• 1.9 ppt at Lake Pontchartrain, Little Woods.
• 0.4 ppt at Pass Manchac near Pontchatoula.
• 2.3 ppt at Chef Menteur Pass near Lake Borgne.
• 4.5 ppt at Bayou LaLoutre, Alluvial City.

Results and Discussion

The purpose of this investigation was to determine the effect of the combined depth and width closures of MRGO on salinities in Lake Pontchartrain, Lake Borgne, and Biloxi Marsh. The results are contained in Plates 1-4. These plates contain the monthly average isohalines for the bottom depth for each plan. The isohalines shown for each plan represent the change from the base conditions. The base conditions are the month's average salinity. The plan isohalines are then changes from base, where a negative sign (-) indicates the closure reduced the salinity and a positive sign (+) indicates an increase in salinity. The averages are given for April, May, September, and October. Tables 4-7 give the values for specific station locations (approximate); all locations are given on Figure 1. The spring months are representative of the low salinity period and the autumn months, the high salinity period. The complete closure results from the prior study are included in this report as well to make comparisons easier.

Table 4 April Monthly Average Salinity (ppt) Changes					
Location	Base	200 ft by 20 ft	160 ft by -16 ft	125 ft by -12 ft	Closure
Alluvial City	16.5	-1.8	-3.1	-3.9	-6.0
Chef Pass	8.4	-0.7	-1.1	-1.3	-1.7
Fenler	4.6	-0.2	-0.4	-0.4	-0.6
Little Woods	5.9	-0.8	-1.2	-1.4	-1.6
Martello Castle	15.1	-2.5	-3.9	-4.8	-6.6
North Shore	5.4	-0.5	-0.7	-0.8	-0.9
Pass Manchac	0.7	-0.1	-0.1	-0.1	-0.1
Pointe Aux Marchettes	13.9	0.1	-0.1	-0.2	-0.5

Table 5 May Monthly Average Salinity (ppt) Changes					
Location	Base	200 ft by 20 ft	160 ft by -16 ft	125 ft by -12 ft	Closure
Alluvial City	16.1	-1.6	-2.7	-3.5	-5.7
Chef Pass	8.9	-0.8	-1.3	-1.6	-2.2
Fenler	4.7	-0.3	-0.5	-0.6	-0.8
Little Woods	6.2	-1.0	-1.5	-1.7	-2.1
Martello Castle	15.1	-2.2	-3.5	-4.4	-6.6
North Shore	5.7	-0.6	-0.9	-1.0	-1.2
Pass Manchac	0.6	-0.1	-0.1	-0.1	-0.1
Pointe Aux Marchettes	14.3	0.0	-0.2	-0.3	-0.8

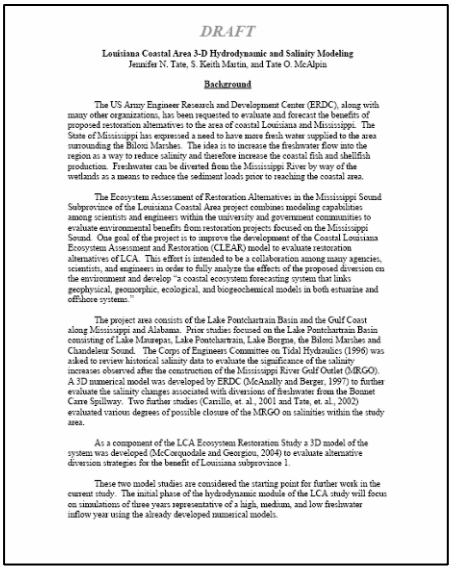
Excepts from page 20:

Conclusions: This investigation is concerned with various combinations of depth and width reduction of the MRGO channel from the Gulf of Mexico to the city of New Orleans. Historical records indicate that when the channel was built, the salinity in Lake Pontchartrain and Lake Borgne increased. A previous study concluded that the effects of depth reduction alone along the La Loutre Ridge in the MRGO were insignificant in the reduction of the salinity in Lake Borgne and Lake Pontchartrain. This numerical model study used a sill along the same ridge near the connection of MRGO to the Gulf of Mexico with an elevation of -20 ft mlw for a contraction width of 200 ft, -16 ft mlw for a 160-ft contraction, and -12 ft mlw for a 125-ft contraction. The study is intended to investigate the restoration of the historical salinity regime. The study includes the base condition of a fully open channel and the completely closed MRGO channel.

The salinity reduction in Lake Pontchartrain and Lake Borgne with the partial depth and width closure was much greater than that for the previous study of depth reduction alone. All of the closure plans reduced the salinities in the region and two of the three partial closure plans averaged salinity reductions that exceeded half of the complete closure reduction. The velocities in the contraction region did increase from the base plan. High wind events can cause large velocities in the MRGO contraction.

2.3 Louisiana Coastal Area 3-D Hydrodynamic and Salinity Modeling,

(Report in draft phase), Cooperative effort between ERDC, MVN, and the CLEAR group (LCA) including the University of New Orleans; Draft provide August 2006



DRAFT

Louisiana Coastal Area 3-D Hydrodynamic and Salinity Modeling
Jennifer N. Tate, S. Keith Martin, and Tate O. McAlpin

Background

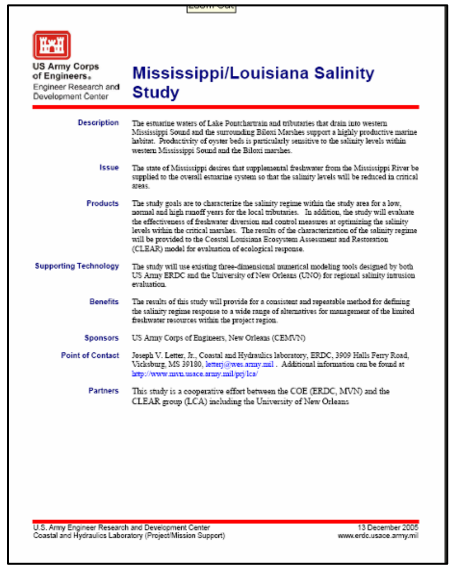
The US Army Engineer Research and Development Center (ERDC), along with many other organizations, has been requested to evaluate and forecast the benefits of proposed restoration alternatives to the area of coastal Louisiana and Mississippi. The State of Mississippi has expressed a need to have more fresh water supplied to the area surrounding the Biloxi Marshes. The idea is to increase the freshwater flow into the region as a way to reduce salinity and therefore increase the coastal fish and shellfish production. Freshwater can be diverted from the Mississippi River by way of the wetlands as a means to reduce the sediment loads prior to reaching the coastal area.

The Ecosystem Assessment of Restoration Alternatives in the Mississippi Sound Subprovince of the Louisiana Coastal Area project combines modeling capabilities among scientists and engineers within the university and government communities to evaluate environmental benefits from restoration projects focused on the Mississippi Sound. One goal of the project is to improve the development of the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) model to evaluate restoration alternatives of LCA. This effort is intended to be a collaboration among many agencies, scientists, and engineers in order to fully analyze the effects of the proposed diversion on the environment and develop "a coastal ecosystem forecasting system that links geophysical, geomorphic, ecological, and biogeochemical models in both estuarine and offshore systems."

The project area consists of the Lake Pontchartrain Basin and the Gulf Coast along Mississippi and Alabama. Prior studies focused on the Lake Pontchartrain Basin consisting of Lake Maurepas, Lake Pontchartrain, Lake Borgne, the Biloxi Marshes and Chandeleur Sound. The Corps of Engineers Committee on Tidal Hydraulics (1996) was asked to review historical salinity data to evaluate the significance of the salinity increases observed after the construction of the Mississippi River Gulf Outlet (MRGO). A 3D numerical model was developed by ERDC (McAnally and Berger, 1997) to further evaluate the salinity changes associated with diversions of freshwater from the Bonnet Carre Spillway. Two further studies (Carillo, et. al., 2001 and Tate, et. al., 2002) evaluated various degrees of possible closure of the MRGO on salinities within the study area.

As a component of the LCA Ecosystem Restoration Study a 3D model of the system was developed (McCorquodale and Georgiou, 2004) to evaluate alternative diversion strategies for the benefit of Louisiana subprovince 1.

These two model studies are considered the starting point for further work in the current study. The initial phase of the hydrodynamic module of the LCA study will focus on simulations of three years representative of a high, medium, and low freshwater inflow year using the already developed numerical models.



US Army Corps of Engineers. Engineer Research and Development Center

Mississippi/Louisiana Salinity Study

Description	The estuarine waters of Lake Pontchartrain and tributaries that drain into western Mississippi Sound and the surrounding Biloxi Marshes support a highly productive marine habitat. Productivity of oyster beds is particularly sensitive to the salinity levels within western Mississippi Sound and the Biloxi marshes.
Issue	The state of Mississippi desires that supplemental freshwater from the Mississippi River be supplied to the overall estuarine system so that the salinity levels will be reduced in critical areas.
Products	The study goals are to characterize the salinity regime within the study area for a low, normal and high runoff years for the local tributaries. In addition, the study will evaluate the effectiveness of freshwater diversion and control measures at optimizing the salinity levels within the critical marshes. The results of the characterization of the salinity regime will be provided to the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) model for evaluation of ecological response.
Supporting Technology	The study will use existing three-dimensional numerical modeling tools designed by both US Army ERDC and the University of New Orleans (UNO) for regional salinity intrusion evaluation.
Benefits	The results of this study will provide for a consistent and repeatable method for defining the salinity regime response to a wide range of alternatives for management of the limited freshwater resources within the project region.
Sponsors	US Army Corps of Engineers, New Orleans (CEMVN)
Point of Contact	Joseph V. Letter, Jr., Coastal and Hydraulics laboratory, ERDC, 3909 Halls Ferry Road, Vicksburg, MS 39180, letterj@wes.army.mil . Additional information can be found at http://www.mvn.usace.army.mil/prj/lca/
Partners	This study is a cooperative effort between the COE (ERDC, MVN) and the CLEAR group (LCA) including the University of New Orleans

U.S. Army Engineer Research and Development Center
Coastal and Hydraulics Laboratory (Project/Mission Support)
13 December 2005
www.erdc.usace.army.mil

Products – The study goals are to characterize the salinity regime within the study area for a low, normal and high runoff year for the local tributaries. In addition the study will evaluate the effectiveness of freshwater diversion and control measures at optimizing the salinity levels within the critical marshes. The results of the characterizations of the salinity regime will be provided to the Coastal Louisiana Ecosystem Assessment and Restoration (CLEAR) model for evaluation of ecological response.

Results

The salinity results for all four modeled years – 1983, 1985, 1996, and 2000 – are given in Plates 1-24. These figures show average monthly salinity contours for each month of the four years at the bottom of the water column. The bottom salinity is often greater than that at the surface due to the density gradient generated from the higher density salt water and stratification when mixing is limited. Therefore, the bottom salinity will give the maximum values. The contours are scaled at 2 parts per thousand intervals.

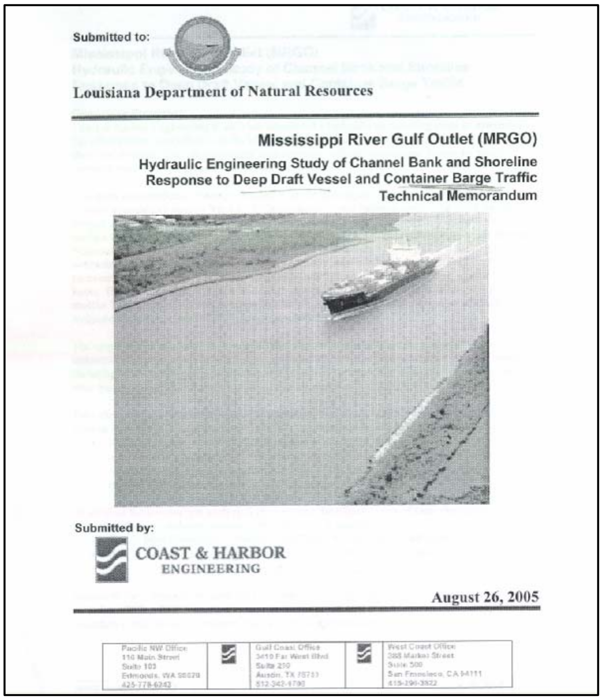
Conclusions

On average, the low flow years show higher salinities in Lake Pontchartrain than the high flow years due to less fresh water entering the system. Most of the monthly averages show variations of 6-10 ppt in the salinity in Lake Pontchartrain between the high flow year (2-4 ppt) and the low flow year (10-12 ppt). The 32 ppt contour tends to shift gulfward as the flow increases. The overall salinity variation when compared to freshwater flow into the system is typical in that with less freshwater inflow, the salinity of the system increases.

Exhibit 3
Channel Bank and Shoreline Erosion Modeling Studies

3.1 Mississippi River Gulf Outlet (MRGO) Hydraulic Engineering Study of Channel Bank and Shoreline Response to Deep Draft and Container Barge Traffic

Technical Memorandum, Coast & Harbor Engineering for Louisiana Department of Natural Resources, August 26, 2005


Submitted to:
Louisiana Department of Natural Resources
Mississippi River Gulf Outlet (MRGO)
Hydraulic Engineering Study of Channel Bank and Shoreline Response to Deep Draft Vessel and Container Barge Traffic
Technical Memorandum
Submitted by:
COAST & HARBOR ENGINEERING
August 26, 2005

Excerpts from executive summary – The study was conducted through simulation of the hydrodynamic effects using the advanced numerical computer models VH-LU (2-Dimensional vessel hydrodynamic long wave unsteady model) and VH-PU (3-Dimensional vessel hydrodynamic propwash unsteady model).

Numerical modeling was conducted for observed conditions using a deep draft container ship with a fully-loaded draft of 32 feet and cruising speed of 10 knots.

Results of the combined pressure field and bed erosion modeling showed that by reducing vessel draft from 32 feet to 24 feet, the pressure field erosion is reduced approximately 30%. This reduction is insufficient to prevent channel bottom and banks from scouring.

Results of the modeling have demonstrated that by reducing speed of the fully loaded deep draft vessel from 10 knots to 5 knots, the pressure field erosion is reduced by more than 90%. This reduction results in almost no erosion of the channel banks.

Based on the results of the numerical modeling, the study has concluded that the most promising approach to reduce vessel impacts on the MRGO shoreline and bank erosion would be to control vessel speeds in the channel to the level of below impact. This speed is preliminarily estimated at 5 knots for deep draft vessels. However, it is likely that some areas of the channel may allow a higher vessel speed with no impact on the shoreline.

Appendix 4 – Engineering

MRGO Deep-Draft De-authorization
Engineering Appendix

As part of the MRGO de-authorization plan investigations, a few engineering related tasks were investigated; namely, O&M cost determinations and development of conceptual level options and opportunities for navigation, ecosystem restoration, and hurricane storm protection. The reach of the channel that was studied, as directed by Congress, was from the GIWW southeast of the Gulf of Mexico. This analysis does not consider the reach of the channel from Mile 60 to 66 which is contiguous with the GIWW. While some of the findings of these investigations are reported in the main report, this appendix details the procedures and assumptions that were followed to reach those findings. This appendix is intended as supporting information and does not include fully formulated plans or other information considered during the preliminary phase of the study.

O&M Costs Determinations

Prior to initiating ongoing operations and maintenance, the channel must first be returned to the depth at which it will be maintained. For this study we looked at several depths and widths:

- 36’ x 500’ (mile 0.0 to 60); 38’ x 600’ (mile -9.4 to 0.0) [authorized dimensions];
- 32’ x 500’ (mile -9.4 to 60);
- 28’ x 500’ (mile -9.4 to 60);
- 24’ x 500’ (mile -9.4 to 60);
- 20’ x 500’ (mile -9.4 to 60);
- 16’ x 500’ (mile -9.4 to 60);
- 14’ x 500’ (mile -9.4 to 60);
- 12’ x 500’ (mile -9.4 to 60);

- 36’ x 300’ (mile -9.4 to 60);
- 32’ x 300’ (mile -9.4 to 60);
- 28’ x 300’ (mile -9.4 to 60);
- 24’ x 300’ (mile -9.4 to 60);
- 20’ x 300’ (mile -9.4 to 60);
- 16’ x 300’ (mile -9.4 to 60);
- 14’ x 300’ (mile -9.4 to 60);
- 12’ x 300’ (mile -9.4 to 60);

The dimensions above relate to channel bottom dimensions. Side slopes of 1V:2H were applied to all the templates emanating from the toe of the channel until it intersects natural bay bottom elevation.

In addition to computing dredge quantities for returning the channel to the above dimensions an additional quantity was included to provide for advanced maintenance dredging, which is conducted to sustain navigable dimensions between dredging events, and allowable over-depth which accounts for the inaccuracies of the dredging process. Based upon past dredging practices which in turn are based upon historical shoaling rates, the following additional depths were added to the depths above for various reaches of the channel.

- 6' (mile 60 to 23)
- 8' (mile 23 to 0)
- 4' (mile 0 to -9.4)

Figure ENG1 shows the template employed for the 36'x300' channel between miles 0 and 23.

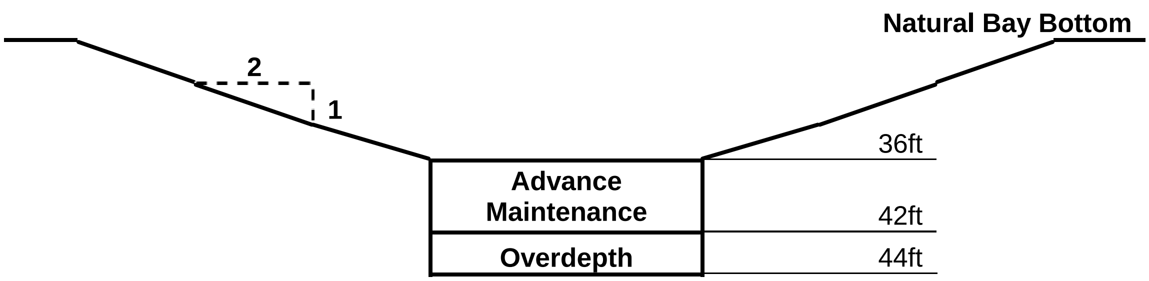


Fig ENG1: Dredging template for 36x300 channel between mile 0 and 23.

Channel surveys taken between May and June 2006 were used to create a surface indicative of the current elevations within the channel. Any material that is contained within the template would be dredged, and thereby forms the quantity reported under the initial construction to return the channel to a given operating depth.

<u>Channel Restoration Costs</u>:

During an MRGO Stakeholders meeting held at the Corps' New Orleans District, the New Orleans District was requested to determine what the cost would be to restore navigation within the channel and enable users to navigate a 30' channel in the MRGO. The New Orleans District, prepared cost estimates for dredging two shoaled areas within the channel: Mile 16.4 to 8.0 (cutterhead dredge) and mile -4.6 to -6.8 (hopper dredge). Depths considered were -30', -32', -34' and -36'. For each of these depths, dredging cost per cubic yard and mobilization and demobilization (mob/demob) costs for both cutterhead and hopper dredges were calculated. For the cutter head dredge the mob/demob cost was approx $1,100,000 and the dredging cost per cubic yard ranged from $1.83 at -36 feet to $4.36 at the -30 feet alternatives. For the hopper dredge, the mob/demob cost was approx $250,000 and the dredging costs ranged from $3.61 at -36 feet to $4.73 at the -30 feet alternatives.

The unit costs above were utilized in determining costs for returning the channel to an operating depth of -36 feet. Prior to using these costs a couple assumptions were made:

- Disposal operations for this contract represent typical disposal operations for the entire channel. In other words, a cutter head dredge is used for dredging the channel from mile 60 to 0 and hopper dredge is used for dredging of material from 0 to -9.4. Although costs associated with cutter head dredging different segments of the channel will vary based upon specific disposal plans (i.e. some reaches requiring dikes whereas others will be unconfined and within open waters; and variances in pumping distances), these differences were not considered under this report. This report assumed a variance in costs based solely on quantity.

- Dredges operate under a minimum cost; thereby, preventing the continued reduction in the unit cost to dredge beyond a certain quantity. It is assumed this limiting quantity was being approached for both types of dredges under the 36 foot cost estimate prepared by MVN. For this reason, it was assumed the lowest cost for the cutterhead was $1.80/CY and $3.50/CY for the hopper.
- The unit prices to dredge quantities that fell between those quantities determined in the estimates prepared by MVN would be prorated.
- A time constraint for returning the channel to an operating depth was not considered. Therefore, the assumption was made that a single cutter head dredge and a single hopper dredge would be utilized. Once time constraints are set and production rates for various dredges assumed, a determination as to the number of dredges required to complete the work can be determined.

Table ENG1 and ENG2 show the calculations (quantities and unit costs) that were used in determining costs for restoration of the channel to widths of 300’ and 500’ and at varying depths.

Table ENG1: Initial Construction Quantities and Costs for 300ft wide channel.

Depth	Quantity	Type	Mob/Demob	Unit $ per Cubic Yard	Total Cost
300x36:	3,500,000	hopper	250000	3.5	$12,500,000.00
	27,100,000	cutter	1000000	1.8	$49,780,000.00
	30,600,000				$62,280,000.00
300x32:	1,500,000	hopper	250000	3.5	$5,500,000.00
	12,900,000	cutter	1000000	1.8	$24,220,000.00
	14,400,000				$29,720,000.00
300x28:	500,000	hopper	250000	4	$2,250,000.00
	6,300,000	cutter	1000000	1.8	$12,340,000.00
	6,800,000				$14,590,000.00
300x24:	0	hopper	0	--	$0.00
	2,400,000	cutter	1000000	2.5	$7,000,000.00
	2,400,000				$7,000,000.00
300x20:	0	hopper	0	--	$0.00
	400,000	cutter	1000000	5.8	$3,320,000.00
	400,000				$3,320,000.00
300x16:	0	hopper	0	--	$0.00
	87	cutter	1000000	--	$0.00
	87				$0.00

Table ENG2: Initial Construction Quantities and Costs for 500ft wide channel.

Depth	Quantity	Type	Mob/Demob	Unit $ per Cubic Yard	Total Cost
500x36:	10,000,000	hopper	250000	3.5	$35,250,000.00
	52,500,000	cutter	1000000	1.8	$95,500,000.00
	62,500,000				$130,750,000.00
500x32:	3,400,000	hopper	250000	3.5	$12,150,000.00
	29,900,000	cutter	1000000	1.8	$54,820,000.00
	33,300,000				$66,970,000.00
500x28:	1,200,000	hopper	250000	4	$5,050,000.00
	14,500,000	cutter	1000000	1.8	$27,100,000.00
	15,700,000				$32,150,000.00
500x24:	300,000	hopper	250000	5	$1,750,000.00
	5,600,000	cutter	1000000	1.8	$11,080,000.00
	5,900,000				$12,830,000.00
500x20:	0	hopper	0	--	$0.00
	1,200,000	cutter	1000000	4.4	$6,280,000.00
	1,200,000				$6,280,000.00
500x16:	0	hopper	0	--	$0.00
	78,414	cutter	1000000	9	$1,705,726.00
	78,414				$1,705,726.00

<u>Ongoing O&M Quantities:</u>

A key component in determining future O&M dredging quantities is deciding on a future shoaling rate or rate at which material will be deposited in the channel. This rate can sometimes be determined through system modeling which often takes years to perform. Given the time constraints imposed on this study, shoaling rates determined by the New Orleans District, USACE in 2004 for use in the MRGO re-evaluation Study, and based off of historical dredging events, were incorporated into this study. These shoaling rates were determined for each mile of the channel for various depths and widths and then summarized into reaches. In other words, the rate of shoaling between mile 6 and mile 23 was approximately the same so an average shoaling rate for this reach of channel was assumed. A review of these summaries revealed little differences in the rates amongst the different channel configurations. For this reason, this study assumed a constant shoaling rate for various reaches that are independent of channel depth and width. These reaches and their associated average shoaling rates are shown in Table ENG3.

Once the shoaling rate is determined, the frequency in which dredging must occur to maintain the required depth is calculated. For this, two assumptions were made. First each reach would shoal uniformly at the shoaling rate for that reach. Second the entire dredging prism (advance maintenance and allowable overdepth) would shoal to project depth before dredging occurred.

Table ENG3: Average shoaling rates and dredging frequencies by mile.

Mile Marker	Shoaling rate (ft/yr)	Prism (ft)	Freq (yrs)
-8 to -9	0.7	4	5.7
6 to -8	1.7	6	3.5
23 to 6	2.5	8	3.2
27 to 23	1.2	6	5
35 to 27	0.6	6	10

After determining the shoaling rate, the year at which the first cycle of dredging will begin must be determined. This year was determined in two parts. The first part was determining how many years shoaling would occur in the channel before deposition filled the channel to the bottom of the dredging prism. The second part was applying the time frame for the dredging prism to shoal to project grade; in other words, the frequency between contracts.

To determine part one, the centerline elevation of the channel was determined at each mile using May/June 2006 survey data. These centerline elevations were then averaged to determine an average channel elevation for a given reach. Refer to Table ENG4

Table ENG4: Average channel depths by reach in June 2006.

Mile Marker	Avg C/L Elevations (MLG)
-8 to -9	- 36.5
6 to -8	-34.8
23 to 6	-31.2
27 to 23	-38.7
35 to 27	-39.3

These average depths were then compared to the bottom elevation of the dredging prism for various depths to determine whether immediate dredging of that reach was required and if not how many feet the channel needed to shoal before deposition entered the dredging prism. If the current elevation was deeper than the bottom elevation of the dredging prism, the difference in these two elevations were divided by the shoaling rate for that reach to determine how soon before deposition entered the dredging prism. The results of this analysis are reported in Table ENG5:

Table ENG5: No. of years before shoaling starts taking place within the dredging prism.

	Channel Depth							
Mile	36	32	28	24	20	16	14	12
-8 to -9	0	0.8	7.5	0	0	0	0	0
6 to -8	0	0	0.7	4.1	7.4	10.8	0	0
23 to 6	0	0	0	0	1.3	2.9	3.7	4.5
27 to 23	0	0.4	2.8	5.1	7.5	9.8	11.0	12.2
36 to 27	0	1.9	7.6	13.3	19.0	24.7	27.6	30.4

Part two for determining when dredging would be required for any given reach or depth is to add together the years shown in Table ENG5 to the frequency of dredging shown in Table ENG3. As an example, for a 24 ft deep channel between mile 36 and 27 the first dredging contract would be required in year 23.3 [(13.3 + 10) {*Table ENG5 + Table ENG3)]*. For calculation purposes the assumption was made that if Congress directed the channel to be dredged as a result of this report, dredging would not commence until 2008. Therefore, for those depths that shoaling to the bottom of the dredging prism will take at least 2 years, the base year from which the first contract will begin was assumed to be 2006. For those depths that shoaling to the bottom of the dredging prism will take less then 2 years, the base year for from which the first contract will begin is assumed to be 2008.

<u>Ongoing O&M dredging costs:</u>

To determine ongoing O&M dredging costs, the same costing information used for the initial construction cost was utilized. Due to the overlap of data regarding the dredging prism and dredging quantity calculations, a sensitivity analysis of the cost versus quantities was undertaken to determine if the hopper dredge and cutter head quantities could be combined into a single quantity at a given rate. The result of this analysis showed that a combined quantity at $2.00/CY, using the mob/demob cost for a cutter head dredge, resulted in a less then 3% difference in the total cost then if the quantities are separated using different unit prices per dredge. With the exception of the change in the unit price to a constant $2.00/CY all the same assumptions outlined above still apply.

The cost of each contract per reach per depth was then computed by multiplying the total volume within the dredging prism by $2.00/CY and adding the mob/ demob cost. For reaches such as mile 26 to 6, at the 12 foot depth, an assumption was made that the entire reach would no longer require dredging. In these cases, only half of the dredging prism quantity was used in determining the contract cost for that reach. This assumption was based upon a review of natural bay bottom elevations within Breton Sound. Differences in elevations reported by various resources did not allow for a definitive extent for calculating quantities for dredging. However, to capture the effects of deeper water across Breton Sound, especially when considering shallow depth plans, a percentage approach was adopted.

The last step in determining yearly contract costs is to recognize that O&M funding typically is linear for maintenance dredging of channels such as the MRGO. For this reason, high dollar contracts such as would exist for channel mile 23 to 6 at 36 ft ($16.9M), especially when combined with a contract for mile 6 to -8 ($10.8M) in the same year would be broken up into two or three years.

Options Cost Determinations

The following sections detail the procedures employed in determining the costs of the various options and opportunities investigated.

Option 1b: Salinity Control Weir at La Loutre:
Under Option 1b, a weir would be constructed near the Bayou La Loutre Ridge to allow passage of shallow-draft vessels. The MRGO would be constricted to 125-feet wide by 14 feet deep. The weir configuration likely would consist of earthen dam sections and pile-supported, reinforced concrete T-wall structures that extend from the shoreline and tie into a weir structure. The weir would be a pile-supported, reinforced concrete U-frame structure with a 125-foot wide clear opening and a sill at Elevation -14.0 NAVD.

Table ENG6 outlines the items that were considered in estimating the cost of this structure.

Table ENG6: Cost data for Option 1b, Salinity Weir.

WEIR STRUCTURE (Sill El -14) **Comparative Quantity and Cost Data Per Sector Gate**					
Item No.	**Description**	**Unit**	**Unit Price**	**Quantity**	**Amount**
1	Mobilization and Demobilization	Lump Sum	Lump Sum	1	$1,140,000
2	Cofferdam-Steel Sheet Piling 70'	SF	$35	326,000	$11,410,000
3	Cofferdam-Sand Fill	CY	$40	12,709	$508,356
3	Cofferdam-Dewatering	Lump Sum	Lump Sum	1	$760,000
4	Structure Excavation	CY	$12	54,889	$658,667
5	Piling-24"diameter steel pipe piles	LF	$200	20,267	$4,053,333
6	Pile Test	Each	$50,000	1	$63,333
7	Tension Connectors	Each	$250	63	$15,833
8	Sheetpile Cutoffs - Gate Structure	SF	$30	8,000	$240,000
9	Stabilization Concrete	CY	$250	1,100	$275,000
10	Crushed Stone	Ton	$40	1,600	$64,000
11	Concrete in Base Slabs	CY	$650	3,399	$2,209,278
12	Concrete in Walls	CY	$900	1,056	$950,000
13	Crushed Stone Bedding	Ton	$60	3,589	$215,333
14	Armor Stone	Ton	$60	8,867	$532,000
15	Tie-in Floodwall 200 ft ea side for 400 ft total	LF	$15,200	400	$6,080,000
16	Structure Backfill	CY	$15	25,333	$380,000
17	Treated Timber Piling in Guidewalls	LF	$26	10,556	$274,444
18	Treated Fender Timbers	BF	$4	63,333	$228,000
19	Fender System Hardware	Lump Sum	Lump Sum	1	$29,556
20	Steel Sheet Pile Dolphins	Each	$460,000	4	$1,840,000
21	Needle Beams and Needles	Lump Sum	Lump Sum	1	$211,111
22	Earthen Dam Fill	CY	$30	300,000	$9,000,000
	Construction Cost (incl. 25% contingency)				**$51,422,800**
	Engineering and Design				**$2,850,800**
	Total Cost				**$54,273,600**

Option 1c: Salinity Control Gate at La Loutre:

Under Option 1c, a gated structure would be constructed downstream of the La Loutre Ridge that would allow passage of shallow-draft vessels. The gated structure would have a sill at Elevation -14.0 NAVD and a 125-foot wide opening, and would be designed for hydraulic loadings proportional to its height. The gate would normally be closed to reduce saltwater intrusion, but would be opened for passage of vessels. The gate would need to be able to operate under both direct and reverse heads; so it is envisioned that the gate would either be a sector gate or a barge gate. The sector gate option is presented in this report because its use is more widespread throughout south Louisiana, but during the feasibility phase of design, the barge gate option should be explored. The gate could be operated on-site by a gate master, or remotely with the use of video cameras and a PLC system configured to operate via the internet. Depending on how often the gate is operated, power will need to be supplied to the site.

Table ENG7 outlines the items that were considered in estimating the cost of this structure.

Option 1d: Storm Protection Gate at La Loutre:

This option comprises the same structural components and earthwork as Option 1c: a sector gate with tie-in T-wall and earthen dam. The difference between this option and Option 1c is the gate operating parameters. For Option 1d, the gate would not be operated to control salinity, but would only be operated to close the canal for a tropical storm event. Because the gate would be operated infrequently, there are some cost savings relative to Option 1c. The most significant cost savings should be with respect to the maintenance cost of the gates and the gate monoliths. Since the gates would be operated less frequently compared to Option 1c, there should be a longer interval between de-waterings of the monolith to perform major maintenance work on the gates. Another advantage of 1d is that it may be possible to operate the gates using a diesel-powered generator instead of having to supply power to the site. However, this would likely preclude remote operation of the gates since the generator would need to be started on-site to power the gate drive systems.

With minimal differences between this option and that of Option 1c, at this level of cost estimating the construction costs are assumed to be the same as those for Option 1c as reflected in Table ENG7.

Table ENG7: Cost data for Option 1c, Salinity Gate

Item No.	Description	Unit	Unit Price	Quantity	Amount
SECTOR GATE STRUCTURE (Sill El -14)					
Comparative Quantity and Cost Data Per Sector Gate					
	-				
1	Mobilization and Demobilization	Lump Sum	Lump Sum	1	$1,140,000
2	Cofferdam-Steel Sheet Piling 70'	SF	$35	326,000	$11,410,000
3	Cofferdam-Sand Fill	CY	$40	12,709	$508,356
3	Cofferdam-Dewatering	Lump Sum	Lump Sum	1	$760,000
4	Structure Excavation	CY	$12	54,889	$658,667
5	Piling-24"diameter steel pipe piles	LF	$200	20,267	$4,053,333
6	Pile Test	Each	$50,000	1	$63,333
7	Tension Connectors	Each	$250	63	$15,833
8	Sheetpile Cutoffs - Gate Structure	SF	$30	8,000	$240,000
9	Stabilization Concrete	CY	$250	1,100	$275,000
10	Crushed Stone	Ton	$40	1,600	$64,000
11	Concrete in Base Slabs	CY	$650	10,626	$6,906,900
12	Concrete in Walls	CY	$900	2,111	$1,900,000
13	Crushed Stone Bedding	Ton	$60	3,589	$215,333
14	Armor Stone	Ton	$60	8,867	$532,000
15	Tie-in Floodwall 200 ft ea side for 400 ft total	LF	$15,200	400	$6,080,000
16	Structure Backfill	CY	$15	25,333	$380,000
17	Treated Timber Piling in Guidewalls	LF	$26	25,000	$650,000
18	Treated Fender Timbers	BF	$4	150,000	$540,000
19	Fender System Hardware	Lump Sum	Lump Sum	1	$70,000
20	Steel Sheet Pile Dolphins	Each	$460,000	4	$1,840,000
21	Needle Beams and Needles	Lump Sum	Lump Sum	1	$500,000
22	Steel Sector Gates	Tons	$6,000	211	$1,266,667
23	Mechanical Systems	Lump Sum	Lump Sum	1	$358,889
24	Electrical Systems	Lump Sum	Lump Sum	1	$190,000
25	Control House	Each	$50,000	1	$50,000
26	Earthen Dam Fill	CY	$30	300,000	$9,000,000
	Construction Cost (incl. 25% contingency)				**$62,085,400**
	Engineering and Design				**$3,405,800**
	Total Cost				**$65,495,100**

Option 2a: Plug channel - Construct closure dam for MRGO:

Under Option 2a, an earthen dam would be constructed near La Loutre Ridge to totally block the MRGO channel. The earthen dam would consist of un-compacted clay, a steel sheet pile wall to prevent undermining and rock armoring for erosion control.

The costs for the control structure to close the MRGO at La Loutre Ridge are primarily associated with the fill material, the armoring, and the steel sheet pile.

Clay fill is estimated to cost $30/cy based on recent estimates developed for levee raise work in the New Orleans East area. This is clay material delivered by truck and assumes that borrow pits are located nearby. The $30/cy is used for this project because while the fill material will likely be delivered by barge, which is more cost effective, it will likely require longer transport, which will increase the cost. This cost may increase if borrow sources become depleted in the New Orleans area and it becomes necessary to transport fill material from greater distances.

Rip rap is estimated to cost $60/ton. This is also based on recent cost estimating being done for New Orleans East work. Costs should be about the same because the delivery on the New Orleans East projects will likely be by barge as it would be for the MRGO project. The distance to the MRGO project may be further from a rip rap source than the New Orleans East projects but the value was not modified because the difference cannot be quantified.

Again, based on recent cost estimates for work to be done in the New Orleans East area, the cost for sheet pile is $60/ft^2. The unit price for driving sheet pile for New Orleans East projects is estimated to be $55/ft^2. The unit price is increased for work in the MRGO due to the fact that the sheet pile will need to be driven from floating plant.

<u>Clay Fill Material</u>
Volume of fill = 650,000 cubic yards
Cost of fill = (650,000 cy) x ($30/cy)
= $19,500,000

<u>Rip Rap</u>
Weight of rip rap = 200,000 tons
Cost of rip rap = (200,000 cy) x ($60/ton)
= $12,000,000

<u>Sheet Pile (PZ-22)</u>
Area of sheet pile = 82,000 ft^2
Cost of sheet pile (installed) = (82,000 ft^2) x ($60/ft^2)
= $4,920,000 ≈ $5,000,000

<u>Contingency (25%)</u> = $9,125,000
<u>Engineering and Design (6%)</u> = $2,190,000

Total cost = $19.5M + $12.0M + $5.0M + $9.125M + $2.19M
= $47,815,000

<u>Freshwater diversion pumping station opportunity:</u>
Diversion of freshwater into the MRGO is anticipated to require constructing a pile-supported, sluice-gated, reinforced concrete culvert structure with a cut-off wall system that would be built into the existing Mississippi River levee. The diversion structure would be able to pass 15,000 cubic feet per second (cfs) of river water by gravity into the

canal. The canal would transport the river water approximately 1.5 miles to feed the marshes between the Mississippi River and the MRGO. The Mississippi River flow rates would be controlled by raising and lowering the sluice gates. The canal would be widened and lined with either concrete or rock to improve the canal's hydraulics.

Recently, the CWPPRA program evaluated a proposal calling for a 4,000-5,000 cfs freshwater diversion at Violet. Initial estimates for this proposal were $53-$70 million.

The Davis Pond Freshwater Diversion structure was completed in 2002 at a cost of almost $120 million. The capacity of the Davis Pond structure is 10,650 cfs. Assuming a diversion structure at Violet would be designed for flows reaching 15,000 cfs, the following computations were used in developing the costs estimate:

Use the $120 million as the base cost and adjust it by two factors:

- Factor 1, larger capacity (15,000 cfs vs. 10,650 cfs)
  Factor 1 = 15,000/10,650 = 1.41, use 1.4

- Factor 2, post-Katrina prices
  Factor 2 = 1.5 (assumed)

Estimated cost = $120 million x 1.4 x 1.5
= $250 million

These numbers are considered only as a rough estimation of potential Violet freshwater diversion costs. Detailed design and cost estimates will be developed if the opportunity is pursued.

There are a couple alternative locations for a diversion channel; however, these locations would require the construction of another open water canal from the Mississippi River to the MRGO that would need to be maintained. The alignment of this canal could be such to utilize the existing storm surge gate at the intersection of the Violet Canal and the MRGO; however, a second breach in the 40 Arpent levee may be required. In addition, these other locations would prevent the need for relocating businesses impacted by widening the Violet Canal. The primary difference in costs between a second channel and that of using Violet Canal is the cost of relocating businesses versus the cost of digging a second channel.

Appendix 5 – Economics

MRGO Deep-Draft De-Authorization
Economics Appendix

This appendix presents the Mississippi River Gulf Outlet (MRGO) economic and financial de-authorization costs and outlines the methodology used for the cost calculations. The economic appendix consists of four components. The first component of the analysis is a description of the study area. This component contains a descriptive information about the project area, the base condition, and the without and with project futures. Discussion of these components is presented to help facilitate understanding of the more detailed applications contained in the appendix. The second involves identifying the considerations for the businesses located along the MRGO. This was accomplished through surveying potentially affected companies and determining what, if any, impacts they anticipate. The third component of this analysis involves identifying the vessels that use the MRGO for navigational purposes. This component relied on analysis of the Waterborne Commerce Statistics Center (WCSC) data to determine vessel traffic. The final component discusses the economic impact of flood damage reduction that can be attributed to the MRGO.

Costs and impacts to deep-draft and shallow-draft navigation are presented and, to the extent possible, the costs are classified as NED, financial, or other. Where applicable, costs are presented in average annual equivalent terms using a 50-year period of analysis and the U.S. Army Corps of Engineers vessel operating costs contained in the Economic Guidance Memorandums (EGM 05-01, Deep-Draft Cost and EGM 05-06, Shallow-Draft) were utilized.

I. Project Area, Vessel Traffic and Commodity Movements

The analysis of transportation costs and industry impacts approaches the study by comparing the transportation costs for the base condition with discontinuance of maintenance of the MRGO federal deep-draft navigation project. In addition to discontinuation of MRGO deep-draft, the transportation costs and benefits for alternate shallow draft channel depths were evaluated. Alternative transportation mode and business reestablishment costs are discussed as well.

Project Area

As presented in the main report, the MRGO is approximately 76 miles long. It begins 9.4 miles into the Gulf of Mexico to the south east of New Orleans where it is authorized to a depth of 38 feet and a bottom width of 600 feet. These are designated as miles -9.4 to mile 0. The authorized dimensions for the remaining 66 miles of the MRGO are a depth of 36 feet and a bottom width of 500 feet. From mile 0 to mile 23 it extends through shallow bays of Breton Sound. From mile 23 to mile 60, the MRGO extends further to the north and west through coastal wetlands. At mile 60 the MRGO connects with the Gulf Intracoastal Waterway (GIWW) and the two run contiguously westward for 6 miles to the IHNC, also called the Industrial Canal, in New Orleans. From the westernmost point of the MRGO, the IHNC extends north to Lake Pontchartrain and south to the IHNC Lock, which connects it with the Mississippi River. The lock between the IHNC and the Mississippi River was built in the 1920s and is relatively narrow and shallow. It measures 74.5 feet in width, 640 feet in length and 31.5 feet in depth.

The IHNC Lock presents an obstacle for most of the deep-draft ships using the Mississippi River and the IHNC. The alternate route from the Gulf of Mexico to the IHNC is the MRGO. The IHNC Lock dimensions are significantly smaller than the dimensions of the Panama Canal, and this is mentioned because the Panama Canal and "panamax vessels" with their associated width restriction of 106 feet and depth limit of 36.9 feet, represents a major benchmark in the shipping industry. The panamax vessel design is a significant factor in the design of cargo ships, with many ships being built to exactly the maximum allowable size. Panamax vessels or anything larger cannot transit past mile 60 of the MRGO due to the IHNC Lock restriction.

Vessel Traffic

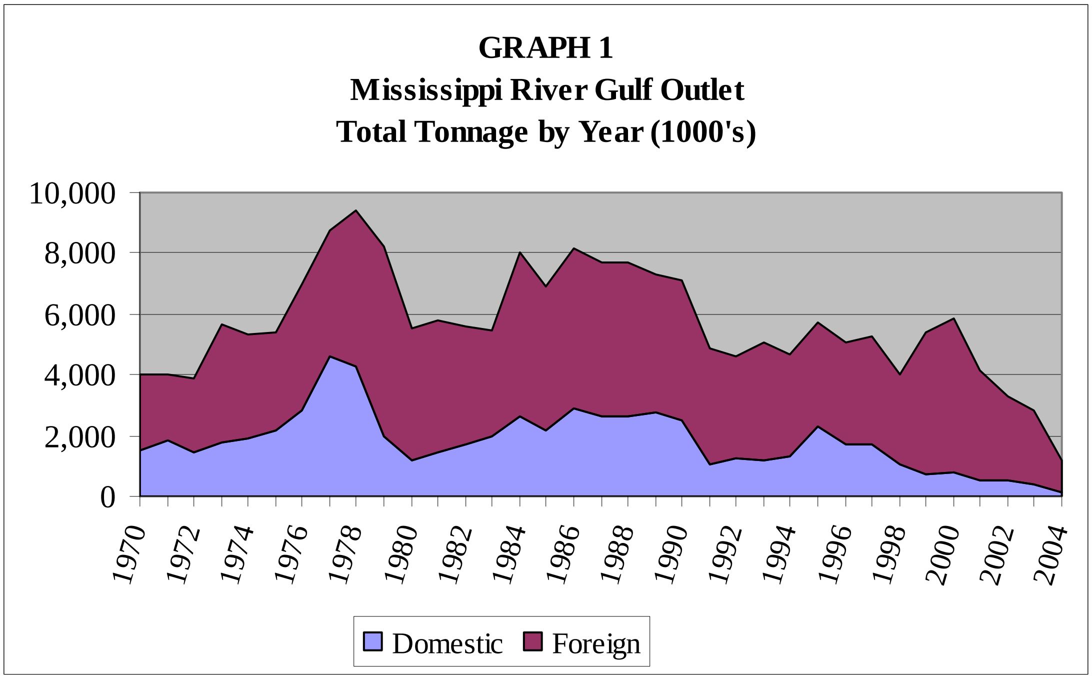
Traffic records from the WCSC show MRGO utilization steadily increasing until reaching a peak in terms of tonnage carried in 1978 and in terms vessel trips in 1982. Table 1 and Graph 1 display MRGO total domestic and foreign tonnage for the period 1997-04. The table contains data from 4-year increments from 1970-94 and 1995-04 continuous records. The graph displays the complete 34-year time line.

Foreign-flag deep-draft vessel movements consist of self-propelled ocean-going vessels. Maximum loaded vessel drafts were approximately 36 feet with vessels taking advantage of advance maintenance and tides. For the period 1995-04, approximately 20 percent of vessels traveled with loaded drafts over 30 feet. Domestic cargo on the MRGO consists of shallow-draft barge traffic and coastwise ocean-going vessels. The maximum loaded drafts for the tow vessels are 12 feet or less and domestic coastwise vessels have maximum drafts in excess of 30 feet.

TABLE 1
Mississippi River-Gulf Outlet, Total Tonnage by Year (1000's of short tons)

Year	Total Tonnage	Foreign	Domestic
1970	4,013	2,522	1,491
1974	5,308	3,386	1,922
1978	9,411	5,136	4,275
1982	5,572	3,878	1,694
1986	8,145	5,254	2,891
1990	7,084	4,611	2,473
1994	4,690	3,347	1,343
1995	5,701	3,416	2,285
1996	5,042	3,314	1,728
1997	5,253	3,552	1,701
1998	4,007	2,974	1,033
1999	5,369	4,619	750
2000	5,850	5,065	785
2001	4,173	3,634	539
2002	3,290	2,786	504
2003	2,847	2,442	406
2004	1,206	1,045	161

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.



Comparison of tonnage volumes for the most recent period of record (2002-04) with the previous comparable period (1992-94) shows current volumes down by nearly 60 percent, with drops in both domestic and foreign freight volumes. While total tonnage declined, the percentage of foreign freight maintained a larger share of total tonnage than domestic freight. The percentage of foreign freight represents 86 percent of 1999-04 total tonnage. In spite of distributional changes, the overall trendline illustrates a downturn for all traffic, with 2004 volumes representing an historical low before declining further in 2005 after Hurricane Katrina. While the pre-Katrina declines were driven by a variety of factors, the MRGO authorized depth of 36 feet, which is recognizably shallow in comparison to other U.S. Gulf Coast deep-draft channels, and the current dimensions of the IHNC Lock are contributors. The IHNC Lock dimensions are 640 by 75 by 31.5 feet. The limitations of the MRGO, in terms of its 36-foot depth and the IHNC likely impeded commercial navigation growth during periods of significant increases in the sizes of large vessels serving U.S. ports. The lack of funds for operation and maintenance dredging during the 1990s, and the need to direct funds for emergency dredging during the pre-Katrina years, is also likely to have contributed to declining trends. As previously noted, no dredging has occurred since Hurricane Katrina on MRGO.

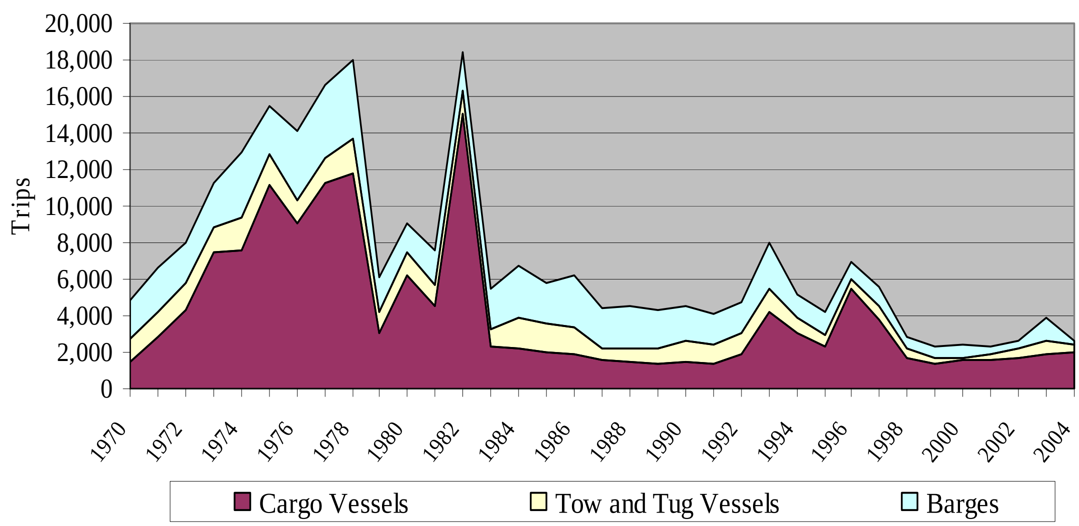
Annual vessel trip totals are displayed in Table 2 and Graph 2. Table 2 shows that cargo vessels have predominated as the primary vessel type. The number of trips decreased since peaking in 1982 to a greater extent than has the tonnage, presumably representing a move toward larger ships and bigger loads. National trends, as evidenced at other

TABLE 2: Mississippi River Gulf Outlet
Number of Trips by Vessel Type (1970-2004)

Year	Total Trips	Passenger & Cargo Vessels (Dry and Liquid)	Tow or Tugboat	Barge (Dry and Liquid Cargo)
1970	4,809	1,476	1,220	2,113
1974	12,941	7,551	1,837	3,553
1978	17,956	11,828	1,841	4,287
1982	18,419	15,084	1,190	2,145
1986	6,212	1,941	1,460	2,811
1990	4,479	1,486	1,110	1,883
1994	5,130	3,006	903	1,221
1995	4,263	2,300	628	1,335
1996	6,934	5,433	519	982
1997	5,591	3,797	696	1,098
1998	2,827	1,700	462	665
1999	2,368	1,420	296	652
2000	2,386	1,541	188	657
2001	2,341	1,550	377	414
2002	2,590	1,693	488	409
2003	3,897	1,902	692	1,303
2004	2,584	1,972	448	164

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

GRAPH 2
Mississppi River Gulf Outlet, Number of Trips by Vessel Type



Major U.S. ports, towards larger more fully loaded vessels also contribute to the downward trend in vessel trips. Declines in annual MRGO vessel trip counts are also, of course, directly associated with the declining tonnage volumes as shown in Table 1. Since its authorization, the size and draft of vessels using the MRGO tended to increase to meet the competitive demand for more efficient movements of bulk commodities. Table 3 presents the number of vessel trips by general draft group. The WCSC

TABLE 3
Mississippi River Gulf Outlet
Trips by Vessel Draft (1970-04)

Year	Total	Trips by Vessels Less than or equal to 18 ft		Trips by Vessels Greater than 18 ft	
1970	4,809	4,355	91%	454	9%
1980	8,959	7,806	87%	1,153	13%
1990	4,310	3,384	79%	926	21%
1995	3,009	2,132	71%	877	29%
1996	2,563	1,634	64%	929	36%
1997	5,591	4,468	80%	1,123	20%
1998	2,827	1,922	68%	905	32%
1999	2,368	1,327	56%	1,041	44%
2000	2,386	1,193	50%	1,193	50%
2001	2,341	1,447	62%	894	38%
2002	2,590	1,964	76%	626	24%
2003	3,897	3,400	87%	497	13%
2004	2,584	2,278	88%	306	12%

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

defines shallow-draft trips as trips having loaded drafts of less than or equal to 18 feet, while deep-draft trips are defined as trips having loaded drafts over 18 feet. Note: For this report, the USACE is using the definition of deep-draft vessels contained in ER-1105-2-100. This defines deep-draft as vessels requiring greater than 14 feet.

Graph 3 displays a comparison of total tonnage by draft class and helps illustrate the transition to more fully loaded vessels that occurred and would most likely continue in the absence of a shoaled channel and the IHNC Lock restriction. As mentioned, cargo vessels are the predominant vessel type. The type of cargo vessel most often found on the MRGO is one that carries dry cargo, with very few tanker vessels. Table 4 presents distribution of 2000-04 freight tonnage by approximate vessel DWT range, type, and beam width.

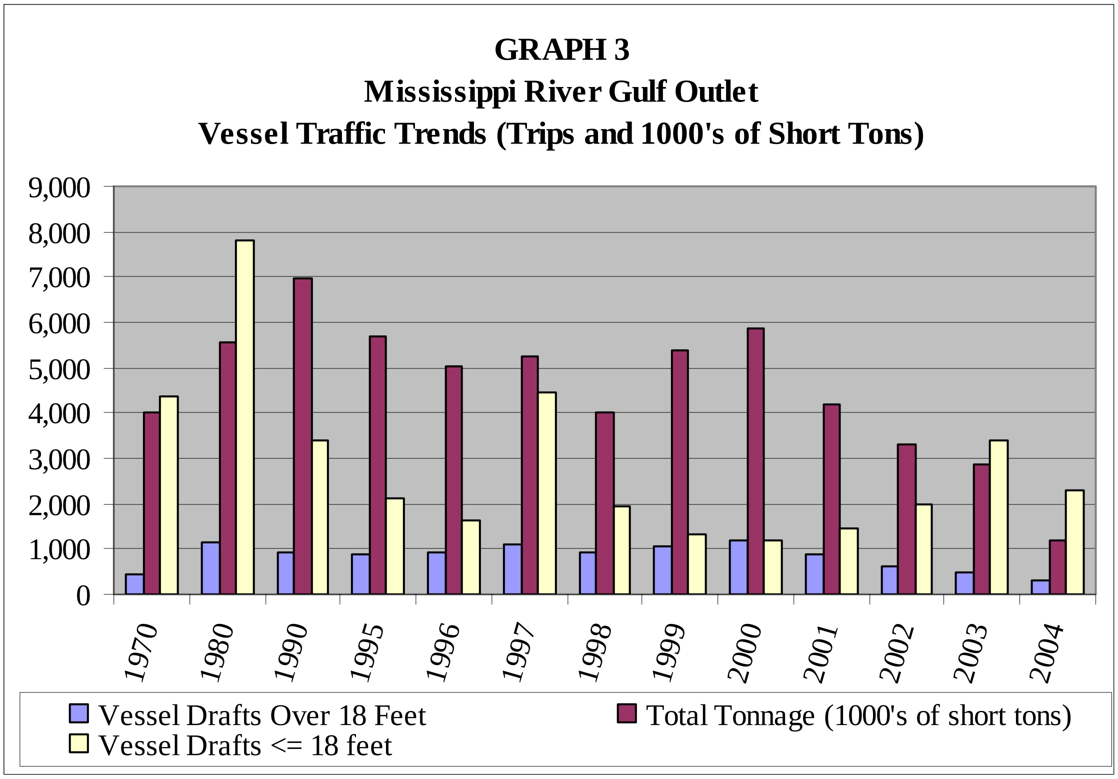
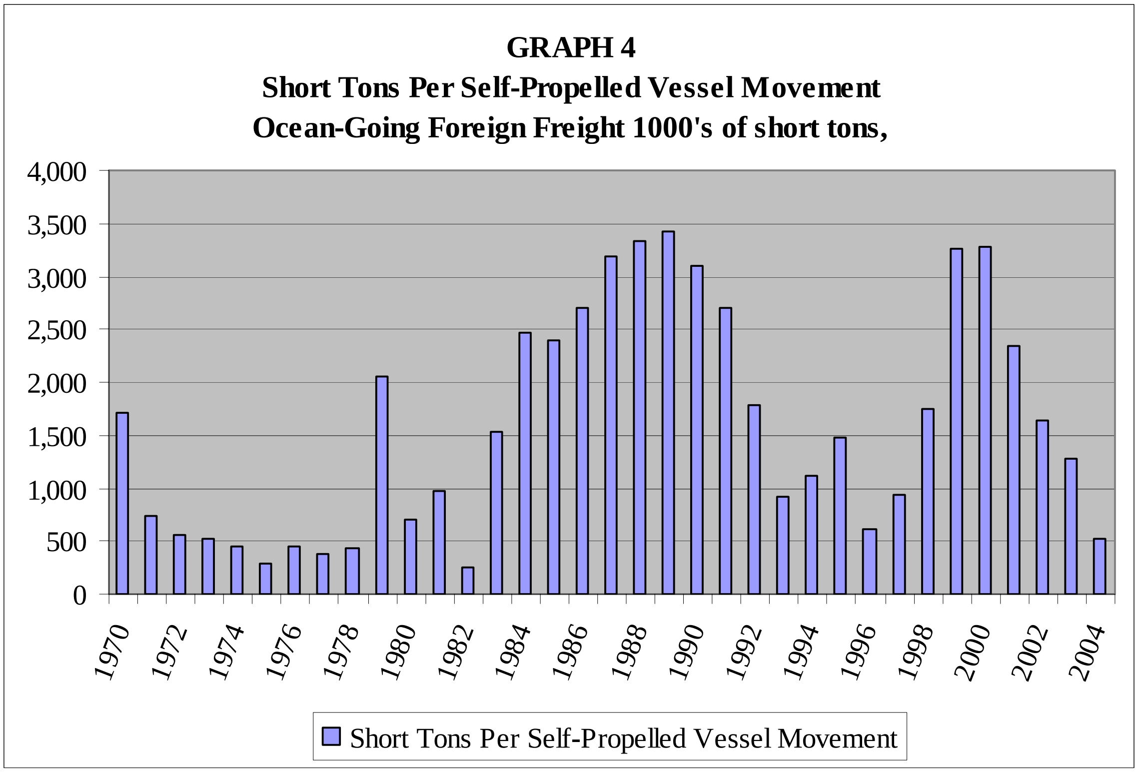


TABLE 4
MRGO Approximately Percentage of Foreign Freight by General DWT Range
Calendar Years 2000, 2002 and 2004

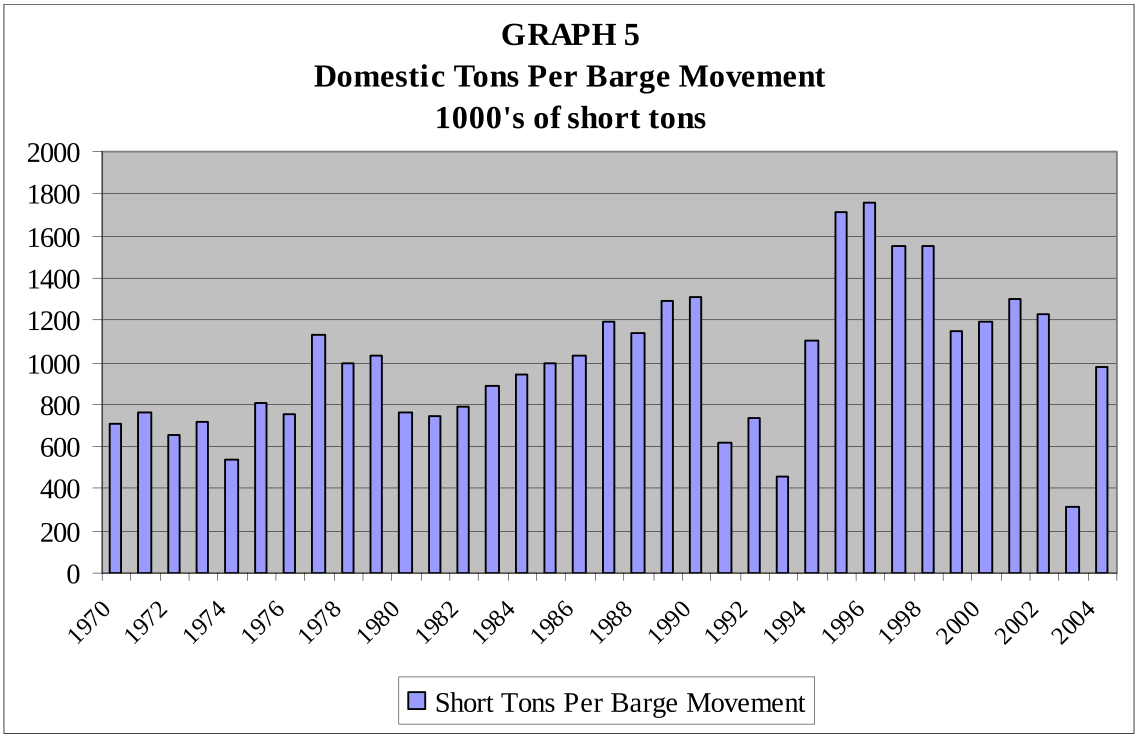
DWT Range Estimate	% of Short tons	Beam (ft)	Predominant Vessel Type
<10,000	16%	40-75	Refrigerate red Cargo Vessel
10,000-19,999	14%	76-106	General Cargo, Containership
20,000-39,999	29%	89-106	Containership, General Cargo
40,000-59,999	19%	105-106	Containership, Chemical Carrier
60,000-75,000	22%	106	Bulk Carrier
Total	100%		

Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

Examination of the 1970-94 historical trendline for ocean-going freight indicates general upward movement in volume of cargo per vessel trip. The 1970-04 trendline of the average number of short tons, for foreign freight cargo, per self-propelled vessel trip is displayed in Graph 4. A general upward trend, with recognizable annual fluctuations, was evident until 1988.



In addition to ocean-going freighters, a large number of tugs and towboats use the MRGO. Towboats push barges, and the general increase in barge trips relative to tow trips suggests transition towards larger volumes per barge and per tow-barge movement. Tank barges of 298x54-feet are the most frequent size. The largest tows are generally 4-barge tow consisting of three 298x54-foot barges and one 150x54-foot barge pushed by towboats generally ranging from 1,800 to 3,000 horsepower. A trendline of the average number of short tons, for domestic cargo, per barge movement is displayed in Graph 5. As with foreign freight, a general upward trend, with recognizable annual fluctuations, was evident until 2000.



Tables 5 and 6 present detailed information about the type of commodities shipped through MRGO. In 2004, the three commodity groups with the greatest number of tons transported on the MR-GO are “Manufactured Equipment, Machinery and Products”, “Food and Farm Products”, and “Primary Manufactured Goods”. For the three groups, foreign commerce represented more than 80% of the total commerce.

For the purpose of the analysis, it is important to distinguish between two sections of the MRGO. The first one is the east-west oriented section that runs between the intersection with the GIWW at mile 60 of MRGO and the IHNC, hereafter referred to as GIWW Reach. The second one is the section that runs southeast-northwest from mile 60 into the Gulf of Mexico, hereafter referred to as Inland Reach. The Sound Reach extends from the Gulf of Mexico across Breton Sound. Based upon Congressional direction, this de-authorization study of the MRGO would affect only the portion of the channel that runs below the mile 60, that is from the GIWW to the Gulf of Mexico, and therefore only the trips that go through that portion of the channel are relevant to the analysis.

TABLE 5: Mississippi River-Gulf Outlet, Commodities by year (in thousand of short tons)

Industry Group	1997			1998			1999			2000			2001			2002			2003			2004		
	ton	D	F	ton	D	F	ton	D	F	ton	D	F	ton	D	F	ton	D	F	ton	D	F	ton	D	F
Coal	7	0%	100%	48	6%	94%	5	60%	40%	9	22%	78%	3	67%	33%	0	-	-	0	-	-	0	-	-
Crude Petroleum	13	100%	0%	10	90%	10%	316	2%	98%	54	15%	85%	8	100%	0%	47	100%	0%	63	100%	0%	4	100%	0%
Petroleum Products (1)	184	58%	42%	166	82%	18%	243	28%	72%	182	27%	73%	180	64%	36%	215	47%	53%	73	59%	41%	44	80%	20%
Crude Materials (except fuels) (2)	1755	25%	75%	1260	22%	78%	1022	27%	73%	1659	19%	81%	918	14%	86%	928	5%	95%	657	2%	98%	166	7%	93%
Food and Farm Products (3)	866	30%	70%	658	13%	87%	1766	2%	98%	1458	2%	98%	632	0%	100%	465	0%	100%	405	2%	98%	292	0%	100%
Primary Manufactured Goods (4)	1091	45%	55%	695	29%	71%	832	19%	81%	1051	12%	88%	810	3%	97%	788	0%	100%	337	1%	99%	251	14%	86%
Chemicals (5)	798	16%	84%	651	7%	93%	695	5%	95%	738	0%	100%	938	1%	99%	567	0%	100%	590	0%	100%	109	18%	82%
Manufactured Equipment, Machinery and Products (6)	531	49%	51%	506	53%	47%	475	36%	64%	659	39%	61%	644	39%	61%	686	44%	56%	674	40%	60%	323	17%	83%
All Others	8	0%	100%	14	0%	100%	15	0%	100%	40	0%	100%	40	0%	100%	51	0%	100%	48	0%	100%	17	0%	100%
TOTAL	5253	32%	68%	4007	26%	74%	5369	14%	86%	5850	13%	87%	4173	13%	87%	3290	15%	85%	2847	14%	86%	1206	13%	87%

D: domestic participation.
F: foreign participation.

(1) "Petroleum products" includes gasoline, distillate fuel oil, residual fuel oil, lube & greases, naphtha & solvents, liquid natural gas, among others.
(2) "Crude Materials (except fuels)" includes forest products (wood and chips), pulp and waste paper, soil, sand, gravel, rock, stone, iron ore and scrap, non-ferrous ores and scrap, sulphur, clay, salt, slag, among others.
(3) "Food and Farm Products" includes fish, grain, oilseeds, vegetable products, processed grain and animal feed, among others.
(4) "Primary Manufactured Goods" includes paper products, lime, cement, glass, primary iron and steel products, primary non-ferrous products, primary wood products, among others.
(5) "Chemicals" includes fertilizers and other chemical and related products.
(6) "Manufactured Equipment, Machinery and Products" includes textile products, machinery, electrical machinery, vehicles and parts, ships and boats, manufactured wood products, rubber and plastic products, among others.
Source: Waterborne Commerce Statistics Center.

TABLE 6: Mississippi River-Gulf Outlet, "Dropping off / Picking up" Traffic, Commodities by year (in thousand of short tons)

Industry Group	1997			1998			1999			2000			2001			2002			2003			2004		
	ton	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**	**ton**	**D**	**F**
Coal	0	-	-	3	100%	0%	4	100%	0%	8	25%	75%	2	100%	0%	0	-	-	0	-	-	0	-	-
Crude Petroleum	0	-	-	0	-	-	222	0%	100%	46	0%	100%	0	-	-	0	-	-	0	-	-	0	-	-
Petroleum Products (1)	40	100%	0%	67	97%	3%	50	90%	10%	105	43%	57%	96	100%	0%	68	100%	0%	35	100%	0%	35	100%	0%
Crude Materials (except fuels) (2)	664	62%	38%	804	32%	68%	370	71%	29%	466	68%	32%	209	61%	39%	46	100%	0%	3	100%	0%	12	100%	0%
Food and Farm Products (3)	0	-	-	66	3%	97%	554	0%	100%	800	3%	97%	2	100%	0%	0	-	-	108	2%	98%	0	-	-
Primary Manufactured Goods (4)	281	62%	38%	150	59%	41%	332	40%	60%	244	41%	59%	10	100%	0%	0	-	-	1	100%	0%	3	100%	0%
Chemicals (5)	92	75%	25%	112	19%	81%	35	60%	40%	47	0%	100%	8	100%	0%	0	-	-	2	100%	0%	0	-	-
Manufactured Equipment, Machinery and Products (6)	2	100%	0%	1	100%	0%	1	100%	0%	2	0%	100%	0	-	-	2	100%	0%	1	0%	100%	1	100%	0%
All Others	0	-	-	0	-	-	0	-	-	2	0%	100%	0	-	-	0	-	-	0	-	-	0	-	-
TOTAL	1079	65%	35%	1203	37%	63%	1568	30%	70%	1720	28%	72%	327	75%	25%	116	100%	0%	150	29%	71%	51	100%	0%

D: domestic participation.
F: foreign participation.

(7) "Petroleum products" includes gasoline, distillate fuel oil, residual fuel oil, lube & greases, naphtha & solvents, liquid natural gas, among others.
(8) "Crude Materials (except fuels)" includes forest products (wood and chips), pulp and waste paper, soil, sand, gravel, rock, stone, iron ore and scrap, non-ferrous ores and scrap, sulphur, clay, salt, slag, among others.
(9) "Food and Farm Products" includes fish, grain, oilseeds, vegetable products, processed grain and animal feed, among others.
(10) "Primary Manufactured Goods" includes paper products, lime, cement, glass, primary iron and steel products, primary non-ferrous products, primary wood products, among others.
(11) "Chemicals" includes fertilizers and other chemical and related products.
(12) "Manufactured Equipment, Machinery and Products" includes textile products, machinery, electrical machinery, vehicles and parts, ships and boats, manufactured wood products, rubber and plastic products, among others.
Source: Waterborne Commerce Statistics Center.

Table 7 depicts the actual number of trips along the Inland Reach of MRGO. On average, and for the years for which information was available, they represented 89% of total trips on the GIWW and Inland Reaches, totalizing an average of 2,254 trips per year.

TABLE 7: Mississippi River-Gulf Outlet, Number of Trips by Reach

Year	Total trips (GIWW and Inland Reaches)	MRGO below mile 60 (Inland Reach)	Percentage
2000	2,386	2,088	88%
2002	2,590	2,357	91%
2004	2,584	2,318	90%
Total	7,560	6,763	
Annual Average	**2,520**	**2,254**	**89%**

Source: Waterborne Commerce Statistics Center.

A traffic forecast was not prepared for this analysis. While the reasons for not preparing a forecast primarily relate to practicality, they also relate to the physical impediment of the IHNC Lock limited dimensions. As previously noted, “panamax vessels” cannot transit the IHNC Lock restriction. Additionally, the limitations of the MRGO, in terms of its 36-foot depth likely impeded commercial navigation growth during periods of significant increases in the sizes of large vessels serving U.S. ports. The reasons for not preparing a forecast also relate to an existing condition where some businesses have already chosen to move away from the MRGO. The USACE has been asked to identify the reestablishment costs for business that are still located on the MRGO and are dependent upon deep-draft navigation. For purposes of the USACE’s economic analysis procedures, the reestablishment costs for businesses that have already moved are “sunk costs.” Several of the businesses located along the MRGO are involved in the rebuilding of New Orleans and are forecasting increasing business. At the base condition depth, the businesses located along the IHNC/MRGO would not experience any transportation inefficiencies and would not likely choose to relocate. While certain businesses have left their facilities along the MRGO since Hurricane Katrina, it is possible that comparable businesses may establish operations at those locations.

MRGO traffic has experienced an overall decline, particularly since calendar year 2000. The most recent 3-year average was used as the base condition for the cost calculations.

II. Business Considerations

This section presents discussion of the business considerations of the MRGO de-authorization. The first step in determining the business conditions was to identify the companies that had the potential to be affected if the MRGO were not maintained at a depth of 36 feet. This step was accomplished through analysis of the WCSC data to identify where vessels had docked along the MRGO, and a review of past USACE reports and studies. A search of published articles on the MRGO was performed to find additional companies which may be affected. Aerial photographs were reviewed to determine facilities with operations along the MRGO. After an initial list of companies was developed, that list was shown to selected stakeholders for input. Using stakeholder feedback, a list of affected companies was finalized. The final list included not only the large companies with operations along the MRGO, but smaller companies in surrounding areas. The nature of the businesses contacted ranged from towing companies to cement and construction aggregate yards to scrap facilities.

The potentially affected companies were contacted by telephone for preliminary screening interviews to determine which companies could be potentially impacted by the de-authorization. In preparation for those interviews, a copy of the survey was sent out to the companies with a letter of introduction. Table 8 lists the companies consulted.

Interviews were conducted with companies both inside and outside of the study area. The interviews outside the study area focused on the towing and other companies that used the MRGO and the potential impacts of de-authorization on that aspect of business. During the interviews, the companies were asked questions about the nature of their operations and their reliance on the MRGO. Interviewers attempted to determine the vessels that the companies used for their operations, and the type and quantity of commodities each facility was transporting. Incremental analysis was performed to determine the impacts of different channel depths on each firm. The full survey is attached to this Appendix.

TABLE 8: Companies Consulted

All American Crewboats	Crosby Tugs	Michoud Assembly Facility
Antill Pipeline Construction	Delta Towing	New Orleans Cold Storage
APM Terminals	Dupre Brothers	Noble Energy
Bertocci Contracting	Dupuy Storage	O'Meara Inc
Biloxi Marsh Lands	Ensco Marine	Parker Drilling
Bisso Marine	Estis Well Company	Pearl River Navigation
Blanchard Towing	International Shipholding Corporation	Peltex
Boh Brothers	Jefferson Marine	Ponchatrain Materials Corporation
Bollinger Gulf Repair	Joseph Domino	Port of New Orleans
Buzzi Unicem	Kearney Companies	Settoon Towing
Caillou Island Towing	Lafarge Cement	Shell Beach Marina
Cenac Towing	LeBoueff Brothers Towing	Southern Scrap
Central Gulf Towing	Lee Marine	St. Ann Boat Service
CG Railways	Maersk	Tipco
Corcoran Towing	Manson Construction	US Gypsum

Through the industry interviews, it was found that some of the companies currently experienced transportation inefficiencies because the MRGO has not been maintained since Hurricane Katrina. For those companies, the interviewers attempted to determine what the impacts were, and their estimated dollar values. The inefficiencies reported by each company, along with a brief description and dollar value are listed as follows:

- Company 1: Container ships currently are docking at locations along the Mississippi River because they cannot access the terminal. Moving a container from the river to the terminal costs $185.
- Company 2: Deep-draft vessels can no longer dock at this company's facility and they have to receive shipments of product via barge. The company estimates that there is $7.50-per-ton increase in handling costs from using barges.
- Company 3: Certain vessels are unable to dock at this company's facility, and as a result, the company has to truck their product to terminals on the Mississippi River, resulting in additional labor, overtime, security, and equipment rental costs. The company estimates additional costs are $15 per ton.
- Company 4: Since deep-draft vessels are unable to dock at this company's facility, the company experiences additional costs due to unloading two products off ships in midstream. The additional costs are estimated as $13 per ton for one product and $15.90 per ton for the other product. These costs include stevedoring, demurrage, lost dock revenue, barge rentals, and fuel charges.

The costs estimated by businesses of moving facilities to another location that are presented in this document do not reflect depreciation but rather actual purchase for a new or used facility with comparable infrastructure and transportation networks. Assessing the reliability of the cost estimates presented by the affected businesses is difficult. The wind damages from Hurricane Katrina and the subsequent flooding have changed the effective age of structures in the study area. Lack of channel dredging since Hurricane Katrina has further compounded the analysis.

For the remaining structures, a depreciated structure value could be found using the Marshall and Swift system of valuation. This value is based on the type of construction, effective age of the structure, quality of construction, facility improvements, expected useful life of the facility, and area of the state the improvement is in. Along the water there were several steel warehouses which were inundated in water and suffered rust damage. While some of these warehouses are now used for storage of raw materials and spare parts, others are empty. Some of the other facilities are considered "special purpose" facilities and the only remaining value of their buildings is scrap. For example, while silos on a property are an asset for a cement company, they serve no other purpose and may need to be removed for the land to function as a factory.

III. Navigation Considerations

To calculate the impact of de-authorizing deep-draft navigation of the MRGO on transportation costs, the first step was to identify the number of trips going through the channel for both deep-draft and shallow-draft vessels. To accomplish this, the vessel origin-to-destination routings through the Inland Reach of the MRGO were extracted from the Corps detailed vessel records for the years 2000, 2002, and 2004. For purposes of analysis, the average of the three periods of detailed routings was held constant through the 50-year period of analysis. Based on mileage and industry verification, all deep-draft trips diverting from the MRGO would have to use the Mississippi River - adding 4 hours per one-way trip to their travel time. The extra time is found by taking the additional distance from the Mississippi River to the Gulf of Mexico (37 miles), and dividing that by the average vessel operating speed (9.2 miles per hour). An overview of annual traffic variation is contained in Table 9. The table displays total MRGO trips by vessel draft and boat type for the period after project construction through 2004. While ship traffic has declined over the past 34 years, it is difficult to predict the future amounts of traffic on the MRGO. Since there is no clear forecast, a conservative practice is to use the three-period average.

Shallow-draft trips were divided into two groups: those that use the MRGO as an alternative route when the IHNC Lock is not operable[1], and others that use it on a regular basis as an alternative to the Mississippi River. According to the Corps Lock Performance Monitoring System (LPMS) data and industry information, there are about three major events per year during which shallow-draft vessels use the MRGO as an

[1] The number of trips was estimated assuming that the IHNC lock is closed for more than 24 hours at least three times per year (estimated using Lock Performance Monitoring System [LPMS] data for 2000, 2002, 2004, and 2005). That number was then multiplied by the number of towboats per day that use the IHNC lock (also obtained from LPMS data).

alternative route. Approximately 100 vessels will use the alternative route per year[2]. The resulting trip around the IHNC Lock takes approximately 24 hours. Due to the distance and the uncertainty of the weather in Baptiste Collette, few vessels elect to travel along the MRGO to by-pass the lock. However, vessels can save a considerable amount of time if the lock is down for a period of greater than 24 hours and/or there is a long queue. The additional time lost from not having access to the MRGO is 48 hours[3]. For the second group, it was assumed that the MRGO reduced travel time by four hours.

TABLE 9. Total Tonnage and Trips by Vessel Draft and Vessel Type Mississippi River – Gulf Outlet Traffic (1970-2004)

	Total Tonnage	Self-Propelled Vessel Trips Loaded Draft Increment (ft)						Tows and Barges		Total
Year	1000's	34-36	30-33	21-29	19-20	<=18	Sub-Total	Towboats	Barges	Vessels
1970	4,013	16	83	275	80	1,017	1,471	1,225	2,113	4,809
1980	5,541	62	259	744	88	4,951	6,104	1,315	1,540	8,959
1990	6,960	48	214	559	105	391	1,317	1,110	1,883	4,310
1995	5,701	18	230	589	40	186	1,063	620	1,326	3,009
1996	5,042	76	283	503	67	133	1,062	519	982	2,563
1997	5,253	136	400	520	64	2,677	3,797	696	1,098	5,591
1998	4,007	98	277	487	42	796	1,700	462	665	2,827
1999	5,369	117	342	532	48	381	1,420	296	652	2,368
2000	5,850	193	358	590	49	351	1,541	188	657	2,386
2001	4,173	117	282	468	25	658	1,550	377	414	2,341
2002	3,290	83	222	310	10	1,068	1,693	488	409	2,590
2003	2,847	34	99	346	18	1,405	1,902	692	1,303	3,897
2004	1,206	8	13	266	13	1,672	1,972	448	164	2,584

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., IWR-WCUS, Part 2.

Using the WCSC transit records, the vessels were classified as either “towboats,” “barges,” or “self-propelled.” For each of these classifications, the hourly operating costs were obtained from USACE Economic Guidance Memorandum (EGM) 05-06 for deep-draft vessels and EGM 05-01 for shallow-draft vessels. In order to determine the operating costs for each vessel, information regarding the commodities transported, vessel horse power, and dead-weight tonnage (dwt) was used. The costs from the Economic Guidance Memorandums and were calculated using the 2004 figures which represent conservative estimates. These are not conservative estimates because inflation adjustments due to higher fuel costs were not made to the figures in the EGM. Adding inflation would increase the cost per trip and the associated transportation inefficiencies. Using the average hourly rates and the estimated changes in transportation time, the transportation inefficiencies for each passage were calculated. Table 10 shows the vessel operating costs used.

[2] These vessels are in addition to the towboat trips presented in the Table 2 of this appendix. As noted in the footnote above, the estimate of 100 trips was estimated using LPMS data.
[3] The 48 hour figure is based on the time spent waiting for the lock to return to operations and was estimated at 24 hours plus the additional queue time once the lock is operational.

TABLE 10: Vessel Operating Costs

Variable	Towboats	Barges	Self-propelled (U.S. Flag)	Self-propelled (Foreign Flag)	Tanker (Foreign Flag)
Cost determinant	1800-2000 HP	Weighted average of daily operating costs by commodity transported	Weighted average of daily operating costs by commodity and tonnage transported	Weighted average of daily operating costs by commodity and tonnage transported	Dwt 20,000
Total hourly cost	$211(US$ 2004 price level)	$6.7 (US$ 2004 price level)	$1,124 (US$ 2002 price level)	$627 (US$ 2002 price level)	$ 665 (US$ 2002 price level)
	Additional time using Mississippi River (in hours)				
Additional Hrs.	4	4	4	4	4
	Additional transit cost per trip				
Additional Cost	$847	$28	$4,517	$2,520	$2,673

U.S. Army Corps of Engineers, Economic Guidance Memorandums (EGM 05-01, Deep-Draft Cost and EGM 05-06, Shallow-Draft)

For the incremental analysis, it was assumed that vessels with a draft of the incremental depth or less would continue to use the MRGO. The transportation inefficiencies are calculated only for those vessels with a draft greater than the incremental impact. For example, with a depth of 32 feet, all vessels with a draft of 32 feet or less will continue to use the MRGO, and all vessels with drafts greater than 32 feet will be assumed to divert to the Mississippi River. It was assumed that with a draft of 32 feet, there would be advanced dredging that would allow adequate underkeel clearance for vessels to pass. It was also assumed that those vessels would use an alternative route once the maintenance of the channel stops. Table 11 shows the transportation inefficiencies, as represented by the net increase in transportation cost associated with using the Mississippi River instead of the outlet channel, at each of the incremental depths alternatives. The $2,526,000 shown in Table 11 is non-inflated impact of transportation cost inefficiencies of not having the MRGO available for deep-draft navigation, and it was estimated by the businesses themselves. It includes the vessels that use the MRGO as an alternative route and also those vessels that use the MRGO as a primary route. If the channel were completely closed, average annual transportation inefficiencies would be $6,200,000. That figure includes all deep-draft vessels which use the MRGO as a quicker route from the Gulf of Mexico and all of the shallow-draft vessels which use the MRGO as an alternate route when the IHNC Lock isn't working.

TABLE 11. Transportation Inefficiencies for Selected Channel Depths (Net Transportation Cost Increase Due to MRGO Depth Reductions)

Depth	Transportation Inefficiencies (annual)
36 feet	$0
32 feet	$455,000
28 feet	$1,102,000
24 feet	$1,878,000
20 feet	$2,279,000
16 feet	$2,413,000
14 feet	$2,454,000
12 feet	$2,526,000
0 feet (not maintained) *	$2,454,000
0 feet (closed) *	$6,200,000

* Not maintained indicates that maintenance will cease and the channel will shoal over time. It is assumed that the controlling depth of the channel will be 14 feet at the end of the 50-year period of analysis. This differs from "closed" which indicates that the channel will be physically blocked and/or not accessible by a defined date.

IV. Economic Considerations of Flood Damage Reduction

Recent storm surge modeling studies (Appendix 3) suggest that the Inland Reach of the MRGO does not significantly influence the development of storm surge in the region for large storm events. As a result, complete filling of the MRGO (or blockage or partial filling), is not expected to provide a significant reduction in storm surges caused by severe events. Because studies show that the Inland and Sound Reaches of MRGO have a minor effect on storm surge during severe storm events, closing the MRGO would lead to a negligible reduction in storm damages from severe events. For less severe events, it is expected that the Hurricane Protection System would offer protection for homes and businesses located inside the levee system. Areas outside of the levee system may see increased storm surge as a result of the MRGO.

Homes and businesses in southern St. Bernard located outside of the levees system were largely destroyed during Hurricane Katrina. For those wishing to rebuild, the Department of Homeland Security's Federal Emergency Management Agency (FEMA) is providing advisory guidelines that can be used as building standards in order to minimize the flood impact in areas subject to waves and velocity floodwaters caused by hurricane storm surges. For most of these areas outside of the levees, it is recommended that structures be built to a minimum elevation of 17 feet.

It is assumed that the majority of structures that are being rebuilt outside of the levees will follow FEMA elevation guidelines. Therefore, any induced storm surge from smaller storms resulting from the MRGO would have little impact on structures located in the area outside of the levee. A reduction in storm surge resulting from closing the MRGO would have a minimal impact on the total amount of storm related damages.

V. Summary of Economic Analysis

This section provides a summary of cost estimates to shallow- and deep-draft navigation of closing the MRGO to commercial navigation. The annual cost in terms of NED annual transportation inefficiencies from not having MRGO available for shallow-draft navigation is $3,674,000. The basis for this comparison is a base condition of no navigation and assumes that if the MRGO is not available for shallow draft navigation to use when the IHNC Lock is not accessible, tows will incur delay costs. The $3,674,000 value is based on 2000-04 vessel traffic and assumes no traffic growth. A traffic forecast was not prepared and 2000-04 traffic levels were assumed to remain relatively constant over the 50-year planning period. The $3,674,000 transportation cost inefficiency can be viewed a transportation cost benefit and should be compared to the average annual MRGO channel maintenance cost ($6 to $9 million annually). The project maintenance cost is outlined in the engineering appendix.

The deep-draft benefit of maintaining the channel at 36 feet versus letting the channel shoal to inoperable depths is $5,745,000. This figure based on the difference in transportation cost between an authorized depth of 36 feet and an inoperable channel (i.e. not accessible to deep- or shallow-draft vessels). This number is contained in Table 12 and it is the difference between the zero depth transportation inefficiency of $6,200,000 and the 32-foot transportation inefficiency of $455,000. The transportation inefficiency of $5,745,000 can be compared with the channel maintenance costs of $12,500,000 presented in the Engineering Appendix.

Addendum to the Economics Appendix: MRGO Deep-Draft De-Authorization Survey Instrument

United States Army
Corps of Engineers

OMB Control Number: 0710-0001

SURVEY OF CURRENT AND FORMER USERS
Mississippi River- Gulf Outlet
New Orleans, LA

Name of Firm: ____________________________________

Nature of Business:
____
____
____

Name of Parent Firm: _______________________________

Mailing Address: ___________________________________

State: ______ Zip _______

Name of Interviewee: _______________________________

Job Title of Interviewee: _____________________________

Mailing Address: ____________________________________

State: ______ Zip ______________

Phone Number: (_____) ___________________

FAX Number: (_____) _____________________

E-Mail Address: ____________________________________

1. Please list the names and addresses of all North American terminals and docks owned by this company, their waterway location, and their port-dock codes.

   a. Dock/Terminal Name: ______________________________________

      Address: ____

      State: ______________________________________ Zip:________

      Phone Number: ____

      Waterway: ____

      River Mile Location: _____________________________________

      Port/Dock Code: _______________

   b. Dock/Terminal Name: ____

      Address:____

      State: __________________________ Zip:________

      Phone Number:____

      Waterway:____

      River Mile Location:______________________________________

      Port/Dock Code:____

2. Please list the vessels that were used in the past two years for your operations using the MR-GO

Vessel Name	Draft	Width	Height	Type of vessel	Frequency of use

3. Please give the following information for the primary commodities shipped using any method of transportation during the last full calendar year from each terminal in the study area:

Description	Code	Tons/ year	Percent by season				Modes of Transport	Terminals used
			Spring	Summer	Fall	Winter		

4. Please give the following information for the primary commodities received using any method of transportation during the last full calendar year for each terminal in the study area:

Description	Code	Tons/ year	Percent by season				Modes of Transport	Terminals used
			Spring	Summer	Fall	Winter		

.

5. In the left column, please list the major commodities that your firm ships by **water**. Then for each commodity, please list the origin, destination, typical annual tonnage, and rate per ton.

COMMODITY	MOST FREQUENT ORIGIN	MOST FREQUENT DESTINATION	ANNUAL TONNAGE	RATE/TON
1.				
2.				
3.				
4.				
5.				
6.				
7.				

6. Do you anticipate that these commodities listed in Question 5 will experience a growth or a decline in tonnage over the next 5 to 10 years? **Please indicate this for each commodity listed below**. Please provide this information for existing commodity movements and for any potential new movements.

Commodity	Current Tonnage	**Check applicable**		Projected Cost / Ton	Origin	Final Destination
		Growth	**Decline**			

7. What channel depth in the MR-GO is necessary for vessels to move products into or out of your plant based on current production / operations? ____________Feet

8. Alternative channel depths are being evaluated as part of this study. Please indicate your expected annual operations and whether you would relocate operations based on the following depths:

Depth	Number of Operations	Total Tons shipped	Primary Commodity	Would Relocate
36’				
32’				
28’				
24’				
20’				
16’				
14’				
12’				
0’ (not maintained)				
0’ (closed)				

9. Below what minimum depth would your operations be adversely impacted? How? Below what minimum depth would you be forced to relocate? Why?

10. If the MR-GO were closed and vessel traffic was prohibited, would your company still maintain operations? Yes _____No ____.

11. If you answered yes to question 9, how would your plant operations change? Please explain.

12. Would any of your ship traffic use the existing IHNC lock if the MRGO were closed to deep-draft traffic? If not why?

13. Would any of your ship traffic use the new 1200 x 110 x 36 ft IHNC lock, once it was built, if the MRGO were closed to deep-draft traffic? If not why?

14. Is it possible for your operations to be moved to a location along the Mississippi River? Yes ____ or No ____. If yes, what would the approximate cost of the relocation be?

15. If your firm decides to relocate your business away from the MRGO, would you construct new facilities of the same production capacity as your existing facilities or would they be built at a larger or smaller scale? If so, how much larger or smaller would the new facilities be, percentage wise?

16. If your operations were to relocate, what is the minimum depth for a new facility?

17. If your operations could **not** be moved to a location along the Mississippi River where would they most likely move and why? What would the approximate cost of that relocation be?

	Land Cost	Equipment Cost	Salvage Value of Equipment	Value of Equipment Which Could be Moved	Total Value
Location					
In-State					
Out-of-State					
On Mississippi River					