

Mister Go Must Go



A GUIDE FOR THE ARMY CORPS' CONGRESSIONALLY-DIRECTED CLOSURE OF THE MISSISSIPPI RIVER GULF OUTLET

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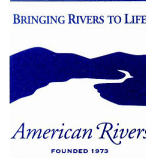
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Environmental Defense
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National Wildlife Federation
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Cover image: MRGO storm surge during Hurricane Katrina as it overtops the north MRGO/GIWW levee, just below the State Route 47 bridge in New Orleans. The image was captured by an automatic camera at an Entergy power plant that remains shut to this day because of storm damage and the loss of over 200,000 local customers.

Executive Summary

The Mississippi River Gulf Outlet (MRGO, commonly pronounced “Mister Go”) was constructed in the 1960s as a shipping shortcut between the Gulf of Mexico and New Orleans’ inner harbor. A bad idea when constructed, MRGO is lightly-used, expensive to maintain, and environmentally destructive. It was also a major contributor to the levee failures that flooded the New Orleans area after Hurricane Katrina, a fate long predicted by locals who called it a “storm surge superhighway.”

Now, Congress has directed the Army Corps of Engineers to plan closure of the channel to deep draft navigation, and possibly entirely. This document explains the problems caused by MRGO, and the opportunity presented by the directive from Congress. It also proposes a simple, scientific, and highly feasible solution. If implemented, the recommended plan would protect lives, homes, and businesses, and help restore the wetlands lost as a result of MRGO. We urge the Corps to recommend this plan, and urge Congress to enact it.

MRGO: A legacy of destruction.

Building MRGO damaged the natural hurricane buffer provided to Louisiana by wetlands and cypress forests. Construction destroyed thousands of acres of wetlands and severed the Bayou la Loutre ridge, which served as a natural barrier to saltwater intrusion from the Gulf of Mexico into Lake Borgne. After construction, extensive freshwater marshes and forests were severely degraded as MRGO’s deep, wide channel injected Gulf of Mexico saltwater into the area.^A While MRGO continues to exist, these wetlands continue to degrade and disappear at an alarming rate, further diminishing their capacity to buffer storms, shelter wildlife, and purify water.

During Hurricane Katrina and the levee failures that followed, MRGO exacerbated the damage by increasing the height and speed of the storm surge. This storm surge overtopped and undermined levees and seawalls to the point of engineering failure. MRGO had also killed historic forests, and the absence of those forests allowed hurricane-driven waves to attack and demolish formerly protected levees.

Closing MRGO: A necessary solution.

Scientists, elected officials and citizens have called for closing MRGO for decades. These calls gained new urgency in the aftermath of Hurricane Katrina. Since Katrina, citizens, the state of Louisiana, St. Bernard Parish, and the City of New Orleans have demanded a closure plan that prioritizes coastal restoration and flood protection. Congress responded by directing the Corps to “develop a comprehensive plan, at full Federal expense, to deauthorize deep draft navigation on the Mississippi River-Gulf Outlet.” Congress supported its directive with \$3.3 million in planning funds, and ordered the Corps to grant requests by the state of Louisiana, St. Bernard Parish and the

City of New Orleans to make coastal restoration and flood protection the top priorities of the closure plan.

The Corps faces a number of challenges as it develops its plan. There is, however, one decision the Corps does not have to make: Congress has directed the Corps to plan closing MRGO to deep-draft navigation. During Katrina, natural processes put an end to deep-draft operations by filling in portions of the channel to as shallow as 23 feet; Congress has not only ordered that deauthorization of deep draft navigation be planned but it has endorsed the no-deep-draft status quo by not paying for dredging. Congress' guidance, moreover, is that the Corps is only to recommend maintaining shallow-draft navigation if protection of the human and natural environment is assured and such maintenance is economically justified.

The Corps has a short time to produce a complex plan that will meet the needs of the region and satisfy the directives of Congress. To help this effort, the authors of this report have put together a reasonable and affordable solution that will eliminate MRGO's ability to increase storm surge, facilitate wave attack on exposed levees, and destroy protective wetlands.

The closure and restoration methods are described in more detail below. Our suggested solution uses a variety of methods, including but not limited to:

- closing the hole cut through the Bayou la Loutre ridge by MRGO construction thus stopping wetlands-killing saltwater intrusion;
- building and planting a vegetated buffer in front of the MRGO levee sufficient to disperse 95 percent of wave attack energy;
- reintroducing freshwater, sediment, and nutrients so that we can regrow the Central wetlands cypress forest and Lake Borgne wetlands and push back the saltwater that is eroding wetlands in the area.
- Building a series of at least four constrictions across the width of MRGO to encourage the rest of the channel to fill in naturally, allow focused use of reintroduced fresh water, and reduce the ability of the channel to transmit storm surge.

The cost of closing MRGO and restoring the cypress forests and wetlands pales next to the multi-billion dollar risk that the rebuilt New Orleans area continues to face as long as MRGO remains open. Congress and the government and people of Louisiana have spoken: Mister Go must go!

1. The problem

The Mississippi River Gulf Outlet, known locally as “Mister Go,” was a bad idea when constructed and has become a worse one every year. Construction of MRGO imposed a tremendous environmental burden on the wetlands of St. Bernard Parish and New Orleans East. MRGO was created by converting 20,000 acres (31.25 square miles) of wetlands to open water while destroying an additional 7,600 acres of wetlands and lagoon habitat through associated activity. The channel was dredged across ten miles of the shelf edge of the Gulf of Mexico, 20 miles of Breton Sound, and 35 miles of St. Bernard Parish marshes. Since MRGO’s construction, the channel has impacted 618,000 acres (922 square miles—almost three times the size of New York City’s five boroughs) either through ongoing direct wetland loss along the sides of the channel or by poisoning thousands of acres of cypress swamp in St. Bernard Parish. MRGO continues to degrade and destroy wetlands because it provides a channel that is far deeper than any natural bayou (40 feet versus 10 feet) for saltwater to intrude, which destroys freshwater wetlands.^B As the MRGO’s unstable banks have eroded, a channel that was once no more than 700 feet wide has now grown to three-times that width in some locations.

Table 1: Summary of quantified habitat impacts of MRGO in Louisiana (does not include possible effects in Mississippi Sound)

Estuarine wetland & lagoon habitat loss (to deep water or spoil)	27,600 acres ^C
Estuarine wetland habitat conversion (to higher salinity habitats)	38,000 acres ^D
Dead zone of Lake Pontchartrain (1/6 lake area benthic mortality)	64,000 acres ^E
Estuarine (Laucastrine) salinity shift: Lakes Pontchartrain (5/6 area) and Borgne	488,400 acres ^F
	Total 618,000 acres

MRGO changed water flows

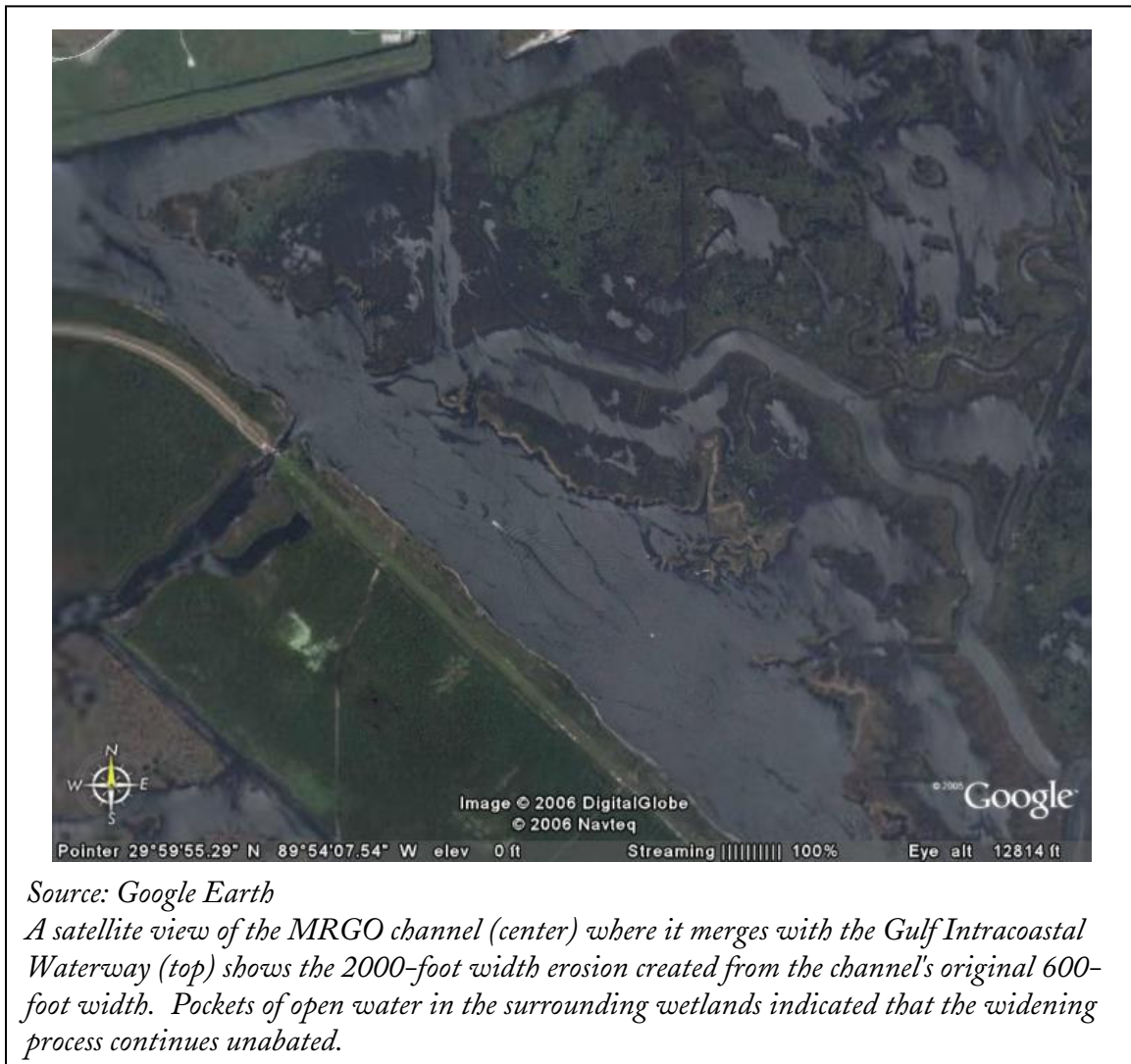
Construction of MRGO fundamentally changed water flows by cutting through the Bayou la Loutre ridge — the natural ridge that used to keep saltwater from flowing north from the Gulf of Mexico into Lake Borgne. When the Corps cut the channel through this ridge, it created a new pathway for regular and storm-driven tides. The impact was enormous, for the first time allowing salt water to flow directly from Breton Sound into Lakes Borgne and Pontchartrain. Overall Gulf tidal flow in Lake Borgne was fundamentally altered from a Lake Borgne/Mississippi Sound system to a Lake Borgne/Mississippi Sound/Breton Sound system.

This alteration is acknowledged by the U.S. Army Corps of Engineers:

Prior to construction of the MRGO, tidal flow into Lake Borgne was dominantly by flow from Mississippi Sound because the tidal flow from Breton Sound was reduced as it moved northwest across the marshes and wetlands through bayous and ponds toward Lake Borgne. Construction of the MRGO caused a reversal of the former circulation pattern, with the dominant tidal flow into Lake Borgne now coming from Breton Sound area directly via the MRGO.

U.S. Army Corps of Engineers, 2004^G

The environmental degradation caused by construction of MRGO exposed New Orleans to Katrina's wrath. Waves were one problem compounded by MRGO. Very long-period waves—similar to those experienced offshore in the Gulf of Mexico—broke against levee faces that were not designed to withstand waves.



Source: Google Earth

A satellite view of the MRGO channel (center) where it merges with the Gulf Intracoastal Waterway (top) shows the 2000-foot width erosion created from the channel's original 600-foot width. Pockets of open water in the surrounding wetlands indicated that the widening process continues unabated.

MRGO increased Katrina's storm surge

The other problem exacerbated by MRGO was storm surge. Locals have dubbed MRGO a "superhighway for storm surge," because of its role in increasing storm surge intensity and duration. On August 29, 2005, hurricane winds forced flood water through the funnel formed by the south bank of the MRGO levee and the north bank of the Gulf Intracoastal Waterway (GIWW) levee, and into the heart of New Orleans. Three months before Hurricane Katrina, Dr. Hassan Mashriqui of the Louisiana State University (LSU) Hurricane Center declared that MRGO was a "critical and fundamental flaw" in the Corps' hurricane defenses, a "Trojan Horse" that could increase storm surges 20 to 40 percent.^h The "funnel" effect was known before Hurricane Katrina and was even referenced in a report of habitat impacts developed in the Corps' study of MRGO in 1999, which stated:

St. Bernard Parish has long requested the closure of the channel because, in addition to the environmental damage, they believe that the channel serves as a funnel for hurricane surges to enter the parish.¹

Since Hurricane Katrina, Dr. Mashriqui has prepared models to assess the outlet's impact on storm surge, which confirm his predictions. These models indicate that the outlet's funnel intensified the initial surge by 20 percent, enough to raise the wall of water about three feet. Floodwalls protecting the central business district and neighborhoods, including the Lower 9th Ward and New Orleans East, were lower than they had been designed to be because of construction errors and unanticipated subsidence into poor soils that could not support the weight of the levees. The combination of lowered floodwalls and heightened surge allowed storm water to overtop the defenses and flow into neighborhoods.

Dr. Mashriqui's research also indicates that the outlet raised the velocity of the surge, which in turn contributed to the erosion and eventual failure of levee and floodwall foundations along MRGO and the Industrial Canal. Dr. Mashriqui found that Katrina's surge moved through nearby Lake Borgne at fewer than three feet per second. But the rate was about six feet per second at the convergence of the funnel, and as much as eight feet per second in the funnel itself.^j

"Without MRGO, the flooding would have been much less," Dr. Mashriqui concludes. "The levees might have overtopped, but they wouldn't have been washed away."^k The extensive loss of forested wetlands south of MRGO, caused in large part by MRGO-induced salt water intrusion, compounded the funnel effect of MRGO and its levee. Levees that were undermined and toppled by high velocity water might have survived the storm or not been as sorely compromised by their design flaws. No Southeast Louisiana levee protected by wetlands or cypress forest failed under Katrina's onslaught, while levees exposed to open water failed on a large scale, leading to massive flooding and drowning.

MRGO is an economic burden

MRGO is also an economic burden. MRGO was built as a 76-mile shortcut between the Gulf of Mexico and the New Orleans inner harbor. The canal was completed in 1965, but never supported the predicted traffic.^L Traffic along MRGO has declined by more than 50 percent since 1985. In 2003, total (foreign and domestic) traffic averaged only seven trips — either upbound or downbound — per day, carrying 2.8-million tons per year.^M The large majority — 86 percent — of this traffic was foreign.^N On an average day less than three domestic commercial barges made the round-trip through MRGO.

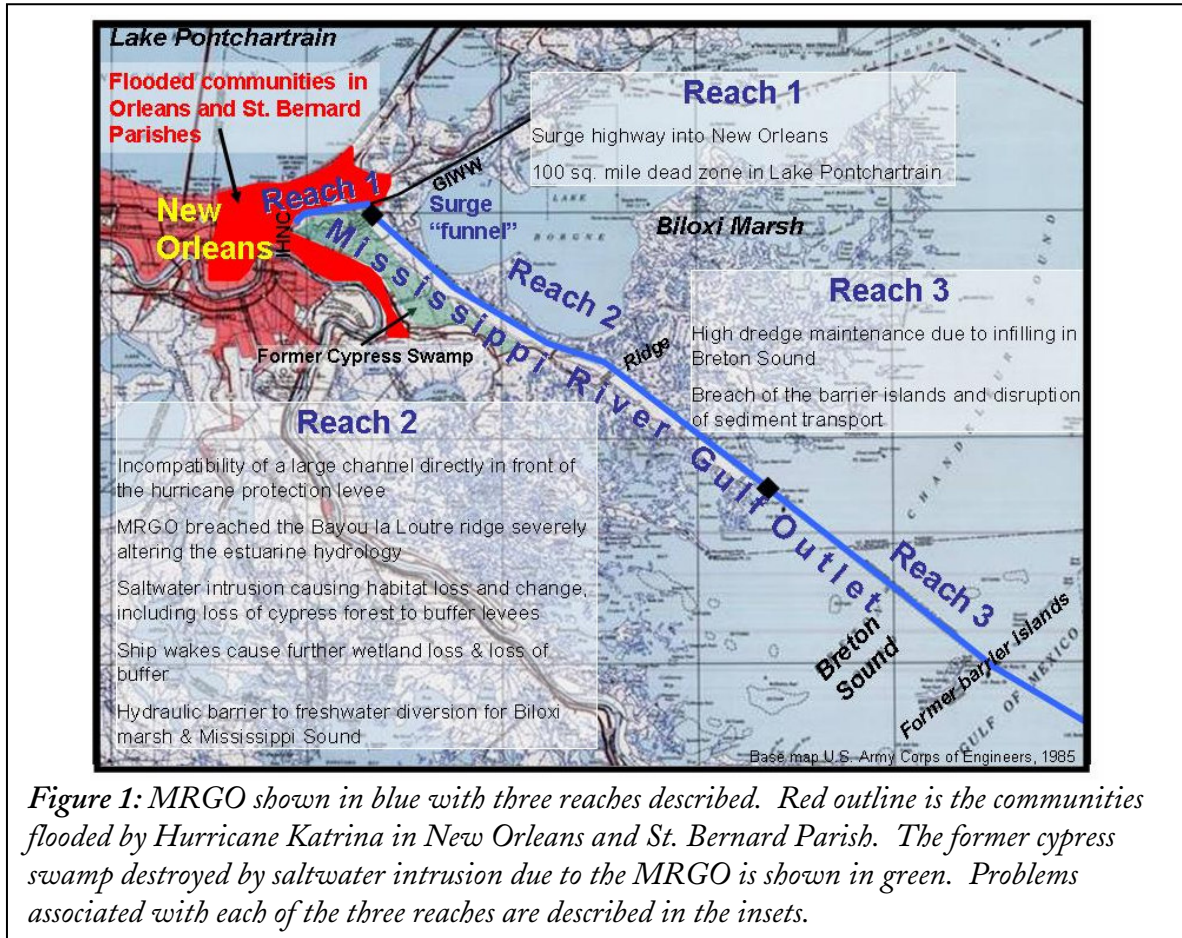


Source: USACOE

The outlet cost the Corps \$11,794,324 to maintain in 2003.^O Today, it costs the American taxpayer nearly \$20,000 for each direction a foreign vessel travels.^P Dredging after storms is an enormous cost, and as storm frequency increases keeping MRGO dredged has become a major burden to taxpayers.

MRGO's three reaches

MRGO is divided into three reaches, and the problems described above apply differently to each region (see Figure 1).



Reach 1: A section of the GIWW that was dredged deeper to the new MRGO authorized depth of 36 feet (MRGO is typically dredged even deeper for advanced maintenance).

Reach 1 provides a deep, efficient conduit for storm surge to penetrate the heart of New Orleans. This reach directly contributed to the levee and floodwall failures, and consequently the flooding of New Orleans. Surge elevations in MRGO, the connecting Inner Harbor Navigation Canal, and Lake Pontchartrain were all higher during Katrina because of Reach 1. Reach 1 is a direct conduit for water that piles up adjacent to MRGO and GIWW during a storm. This area has been called the “funnel” because the levees of MRGO and the GIWW come together, allowing vast amounts of water to flow on a “surge highway” directly into the city. Reach 1 is also a man-made pass into Lake Pontchartrain allowing saltwater intrusion. A stratified deep layer of high salinity water develops low oxygen and creates a dead zone over at least one-sixth of Lake Pontchartrain.²

Reach 2: A new channel cut through the heart of the St. Bernard estuaries and the Bayou la Loutre ridge

The construction of St. Bernard's hurricane protection levee on the MRGO spoil bank juxtaposed a broad channel of enormous energy during a hurricane with the primary hurricane protection levee. Open water in front of a levee allows hurricane-generated waves to develop and attack the levee unimpeded. This levee will always be faced with high energy from surges and waves moving across Lake Borgne. However, MRGO's location, directly abutting the levee, creates critical vulnerability at just the location where the levee should be protected, just as it was when the former wetlands and forest of St. Bernard were present. The former forests (primarily made up of cypress trees) which would have been very efficient at buffering surge and wave attack, were destroyed by salt water intrusion via MRGO. Navigation has exacerbated this problem because ships' wakes cause additional bank erosion of very poor soils, bringing open water ever closer to the levee.

Approximately four miles of levees that were exposed to open water along MRGO were destroyed during Katrina, causing enormous destruction in St. Bernard Parish.^R By contrast, no Southeast Louisiana levee protected by wetlands or cypress forest failed under Katrina's onslaught.

It is Reach 2 that breaches the Bayou la Loutre ridge, fundamentally altering the water flow and creating a south to north conduit for high salinity. The increased salinity has negatively impacted 922 square miles of the estuary through habitat changes, wetland loss, and declines in fisheries.^S It also limits the ability of freshwater diversions from the Mississippi River to restore marshes and reach the Biloxi Marsh or Mississippi Sound. This freshwater instead mostly flushes into the Gulf via MRGO.

Reach 3: A new channel cut through the barrier islands and across the open water of Breton Sound

Reach 3 is the financial albatross of MRGO. Its location in an open sound allows sediment to collect easily in the MRGO channel. Without regular dredging, the channel soon becomes useless to deep-draft navigation. Some infilling occurs continuously and requires regular and expensive annual maintenance. In addition, dramatic infilling occurs virtually every time a tropical storm or hurricane passes in the vicinity. This infilling has required regular additional appropriations to dredge the channel, with some of those appropriations reaching \$35 million for a single storm event. Reach 3 also breached the Gossier Barrier Island chain. Sediment that normally would be sustaining the barrier islands instead collects in the channel and is then dredged away by the Corps of Engineers, so the breach has disrupted the normal sediment transport system. Partially as a result, the barrier island system is today in very poor condition and provides little habitat value or surge protection.

2. The mandate: Congress and the state of Louisiana have made it clear that MRGO must be closed

Citizens, scientists and environmentalists have repeatedly called for closing MRGO. The State of Louisiana and the City of New Orleans have both formally requested its closure. Residents and the government of St. Bernard Parish, where most of MRGO is located, have long called for the channel's closure in light of the damage it caused during Hurricane Betsy four decades ago and other continuing damage. "MRGO has caused us more devastation than we care to think about," commented Larry Ingargiola, emergency preparedness director of St. Bernard Parish. Closing it, he added, has been "the No. 1 project on our agenda every year."^T Following Hurricane Katrina, calls to close MRGO have only grown.

In its Fourth Emergency Appropriations Bill (P.L. 109-234), Congress included language to initiate a \$3.3 million "comprehensive plan, at full Federal expense, to deauthorize deep draft navigation on the Mississippi River-Gulf Outlet."^U As the conference report explained, "[t]he 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."^V Congress also directed the Corps to "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 (LACPR Plan). The Corps' task in the LACPR Plan is to "conduct a comprehensive hurricane protection analysis and design" by "develop[ing] and present[ing] a full range of flood control, coastal restoration, and hurricane protection measures exclusive of normal policy considerations for South Louisiana."^W

While Congress will have to approve a comprehensive closure plan, Congress has already given the Corps the authority to begin closing MRGO. For example, in addition to the deauthorization plan, the Fourth Emergency Appropriations Bill provided clarifying language for operations and maintenance activities on MRGO set forth in a previous appropriations bill (PL 109-148). The clarifying language provides that the specified funds — \$75 million — must be used for "the repair, construction or provision of measures or structures necessary to protect, restore or increase wetlands, to prevent saltwater intrusion or storm surge."

These actions by Congress mirror the views of Louisiana residents as reflected in state legislative resolutions and other official recommendations, and make it clear that MRGO must be closed. The key question is now about the details of the closure plan.

3. The solution: A simple, scientific, highly feasible plan to close MRGO

The authors and endorsers of this report are representatives of environmental and civic groups, along with engineers and ecosystem scientists at Louisiana State University. Our solution protects human life and communities by minimizing storm surge, restoring and rebuilding wetlands, and preventing saltwater intrusion. The plan satisfies Congress' direction to close the channel to deep-draft navigation and complements restoration of coastal Louisiana by re-establishing the storm-buffering properties and environmental integrity of the wetlands damaged by construction and operation of MRGO

The measures recommended in this section are the cornerstone for providing a vital natural storm buffer for New Orleans and surrounding communities. Additional restoration needs for the Lake Borgne-Lake Pontchartrain estuary system are discussed below in a separate section and should be implemented as part of a larger coastal Louisiana restoration program. The actions described in this section, however, must be included in any plan approved by Congress.

As mentioned above, Congress presented the Corps with two questions:

1. What navigation functions, if any, should be maintained?
2. What measures for hurricane and storm protection should be taken?

Katrina made it clear that public safety must take precedence over navigation concerns. As a result, non-deep-draft navigation can be maintained only if it does not interfere with or detract from public safety and coastal restoration. Subsequent to the Katrina disaster, almost all involved elected officials and stakeholder representatives (including the major navigation interests) have stated publicly that they agree with this principle; it is essential that the Corps takes this to heart.

The Corps has announced that it will present three alternatives in its draft. Alternative 1 would maintain a shallow draft channel with dimensions of 12 feet by 125 feet. Alternative 2 would have the Corps cease maintenance dredging and close the channel in one location, Bayou la Loutre, with an earthen plug. Alternative 3 would have the Corps cease all maintenance dredging and simply walk away from MRGO without rectifying any of the damage it has caused. None of these alternatives would ensure the safety of New Orleans and surrounding communities, or ensure restoration of the wetlands lost to MRGO; the action items we present below would.

A. Scope and Purpose of the Deauthorization Plan

It is essential that the Corps' plan for the MRGO be rooted in a clear statement of objectives. Congress has directed the Army Corps of Engineers to develop, by December 2006, a comprehensive plan to deauthorize deep draft navigation on the MRGO, recommend additional changes to navigation to comply with the LACPR, recommend physical modifications to the MRGO to provide hurricane and storm protection, and integrate the plan into the LACPR. This directive establishes four objectives that we believe must form the foundation of the Corps' plan:

1. Deauthorization of MRGO as a federally maintained deep draft navigation channel
2. Deauthorization of additional navigation functions that are inconsistent with providing hurricane and storm protection.
3. Authorization of physical modifications of MRGO to provide and facilitate storm and flood protection efforts.
4. Authorization of physical modifications of MRGO to promote and facilitate coastal conservation and restoration.

B. The Elements of an Effective Deauthorization Plan

To meet these objectives, the Corps cannot simply “walk away” from the MRGO. It must take the actions described below to create multiple lines of defense that would work together to protect New Orleans and St. Bernard Parish from storm and flood risks, and dramatically improve the health of Louisiana's coastal wetlands. These actions are an integral component of the larger *multiple lines of defense* strategy^x developed by one of the authors and adopted by the Corps and Louisiana in their planning efforts to conserve and rehabilitate the natural coastal landscape of southeastern Louisiana and the Mississippi Sound area, and provide enhanced storm protection. These multiple lines of defense would work together to reduce storm surge flow, reduce storm surge velocity, and reduce wave energy. They would also reduce saltwater intrusion, promote wetland restoration, promote the filling-in of the MRGO channel, and reduce the costs associated with future maintenance and reinforcement of the MRGO levees. As discussed below, additional measures may be necessary to fully integrate the MRGO closure plan with the multifaceted coastal protection, conservation and restoration plans that are currently under development.

1. *Deauthorize MRGO as a federal navigation channel and cease maintenance dredging.* The federal navigation channel must be deauthorized to allow the necessary physical modifications described below.

2. *Restoration of the Ridge at Bayou la Loutre.* Reversing the damage caused when the MRGO channel was cut through the natural ridge at Bayou la Loutre involves plugging the ridge across the channel, restoring the ridge to its natural level, and planting the ridge. Salinity modeling done by scientists at the University of New Orleans shows that pre-

MRGO salinity conditions would be restored through combining a Bayou la Loutre closure and freshwater diversion at Violet (explained below).^y Restoring the ridge to its natural level and planting it with dense native vegetation will greatly reduce salt water and storm surge movement into this region.

3. *Channel Severance or Constriction at Other Locations.* It is essential that the MRGO channel be severed with lateral fills at four or preferably more additional locations (as the number of lateral fills decrease, the size of those fills would need to increase to provide effective storm surge protection). Constrictions would convert MRGO from a channel into a series of lakes, which would be more likely than the existing channel to fill in with sediment deposited during storms. Without the lateral fills, reach 2 of the MRGO likely will remain at, or close to, its current depth.

Constrictions within MRGO Reach 2 would keep introduced freshwater moving east into now-degraded marshes instead of north into the Industrial Canal and Lake Pontchartrain. The constrictions must be planted with dense native wetlands vegetation to root them in place. Once planted, the constrictions would create an uneven shoreline – making it more difficult for storm surge in one part of the coastline to flow sideways and take advantage of a MRGO levee breach in another part of the coastline.

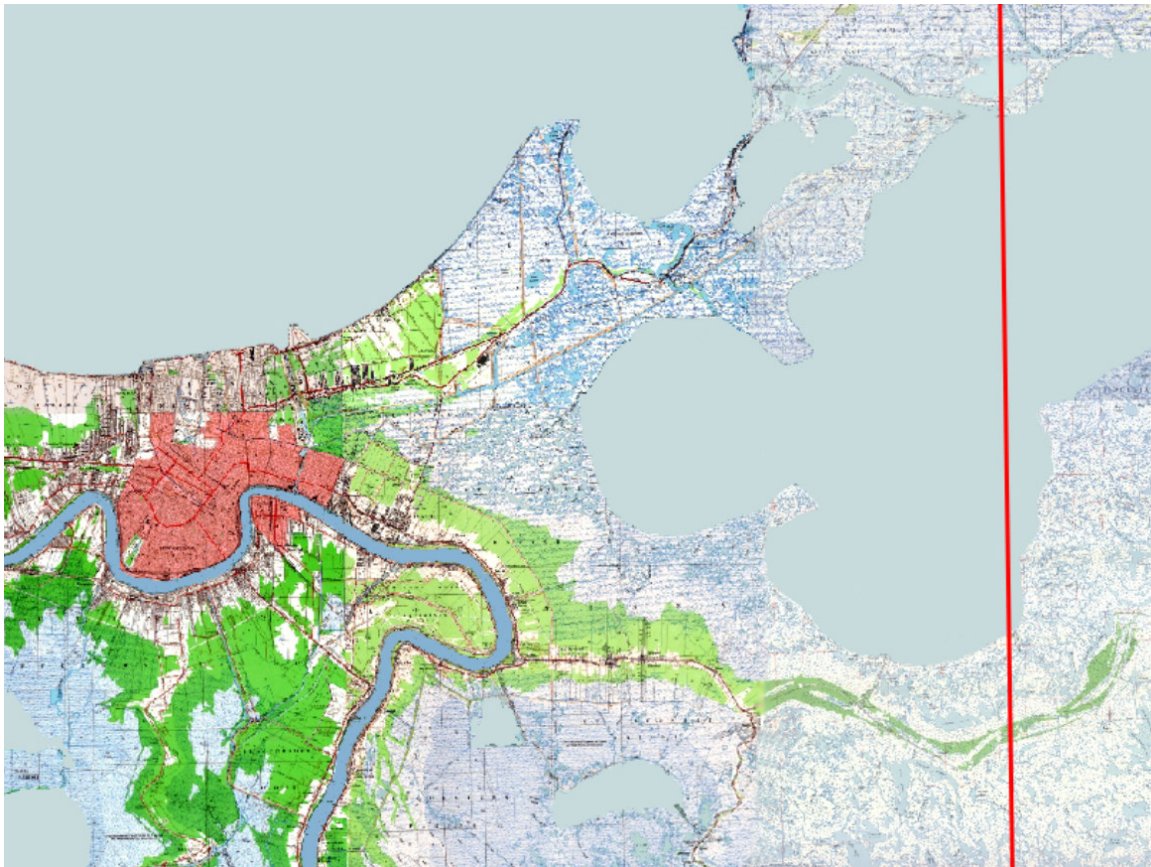
4. *Restoration/Maintenance of the Narrow Land Between Lake Borgne and the MRGO.* This thin strip of land was once part of the mainland of what is called the central wetlands. Construction of the MRGO resulted in this thin strip not only being isolated, but also more exposed to storm tides and waves as well as erosion from boat wakes. As a result, land loss of this area has been tremendously accelerated. Without full restoration of this land mass, the newly constructed levees on the southwest side of the MRGO could quickly be exposed to even greater winds, tides and surges than presently.

5. *Restoration/Rehabilitation of Bank Lines Along the MRGO.* To minimize storm surge, protect the MRGO levees from wind and wave action, and facilitate vegetation growth, it is essential to reclaim as much of the original 1965 bank lines of the MRGO as reasonable. Reclamation would be done with dredged material to the elevation needed to support native vegetation, approximately 3 to 5 feet. While reclamation of both bank lines will provide the most benefit, reclamation must take place along the west side of the MRGO to provide an essential buffer for the MRGO levees as quickly as possible.

Planting native coastal vegetation on the reclaimed banks and lateral fills will provide critical protection from storm surge, wind, and wave action. No southeast Louisiana levee protected by wetlands or cypress forest failed under Katrina's onslaught, while levees exposed to open water did fail, with catastrophic results. Studies of Asian tsunamis have shown that a football field length of dense vegetation will reduce wave energy by up to 95 percent.^z

Without bank reclamation, the MRGO will continue to widen and eventually will reach the toe of the MRGO levees, making them even more vulnerable than they are today. Bank reclamation will reduce the future costs associated with maintaining and reinforcing the MRGO levees.

6. *Natural Infill of the Channel.* The actions described above will help facilitate natural infilling of the MRGO, which will increase storm protection and facilitate wetland restoration. Reach 3 of the MRGO will fill in naturally over time through sandbar development in Breton Sound. Allowing reach 3 to fill in would provide important hurricane protection by facilitating restoration of the barrier islands that were cut through when the MRGO was constructed.



Vegetative and natural ridge protection of the Greater New Orleans area in the 1950s. Red line indicates Hurricane Katrina path.

7. *Expand Riverine Influence.* Reintroduction of freshwater from the Mississippi River is needed to restore and rehabilitate the historic water conditions and wetlands that used to provide storm surge reduction and habitat. MRGO should be modified to facilitate this restoration through an expanded river reintroduction project at Violet. Preliminary modeling of saltwater flows by the University of New Orleans suggests that approximately 7,500 cubic feet per second (CFS) of freshwater from Violet will be needed to reestablish historic salinity levels in Lake Borgne during normal rainfall

years.^{AA} The Corps plan should be designed to accommodate and take advantage of this new freshwater flow, and step in to make sure that the diversion is built to at least the needed size (and probably larger to provide for higher salinity years due to drought or hurricanes) if existing federal and state programs cannot provide sufficient funds or those programs are delayed.

C. Additional Actions to Facilitate Coastal Conservation and Restoration, and Improve Storm and Flood Protection

While it is not likely that any actions undertaken as part of this deauthorization plan would encompass the full range of conservation, restoration, and flood protection efforts that may ultimately be needed to protect New Orleans and the surrounding communities, it is vital to view the range of possible actions under this plan in that broader context and to the extent practicable favor those that best facilitate the multiple lines of defense approach. With that in mind the following specific actions should be considered:

1. *Levee Improvement.* Existing levees along the MRGO must be improved to withstand storm surge from a 500 year flood and be constructed such that overtopping does not result in levee collapse and failure.

2. *Expand Riverine Influence and Restore Habitats in the Region.* The Lake Pontchartrain Basin Foundation's Comprehensive Management Plan, a federally funded stakeholder driven process, calls for the reestablishment of a variety of habitat types and features. The MRGO should be modified to facilitate the attainment of those habitats to the greatest degree practicable.

3. *Facilitate the usage of treated effluent from wastewater plants.* Plans have been developed under other program authorities to redirect treated New Orleans and St. Bernard wastewater (currently discharged into the Mississippi River) into the central wetland area between the GIWW and the MRGO to encourage its recovery as a cypress swamp. The modification of the MRGO should facilitate this activity.

4. *Restore Marsh Landbridges of the Biloxi Marsh.* The Biloxi marsh has been impacted by the MRGO and is an important landmass for flood protection and for estuarine productivity. The landbridges are the critical feature to maintain the integrity of the Biloxi marsh.

5. *Restore Barrier Islands.* Louisiana's barrier islands provide vital hurricane protection and serve as important habitat and hydrologic controls. Among the habitat and landscape features impacted by the MRGO are barrier islands that were cut through to create the channel. The MRGO plan should contribute to the conservation and restoration of those islands by the filling of the channel in those areas.

Conclusion

Construction of MRGO, and its continued operation over 40-plus years, ravaged the Lake Borgne wetlands and cypress forests. When Hurricane Katrina hit, the wetlands and cypress forests were so degraded that they could not effectively buffer the effects of the storm. The MRGO and the funnel created by the MRGO and the GIWW also sped up and increased the height of the storm surge that ultimately overwhelmed poorly constructed levees and flood walls. The open channel of the MRGO also allowed wind and waves to attack and destroy miles of the MRGO levees. The resulting devastation is well known.

The cost of closing MRGO and restoring the cypress forests and wetlands pales next to the multi-billion dollar risk that the New Orleans area will continue to face as long as MRGO remains open. The authors, environmental and civic groups working with engineers and scientists, have proposed a solution that would restore the major landforms, water flow patterns, and ecology decimated by construction of MRGO. More modeling and engineering design efforts integrating the different restoration elements described in this report remain to be done, but this proposal is based on solid science and should provide an effective guide for the Corps' closure of MRGO.

We urge the Corps and Congress to adopt and implement our recommended plan to provide a safe and promising future to New Orleans and the surrounding communities that were so devastated by the Katrina disaster.

^A Day, J., N. Psuty, and B. Perez. 2000. The role of pulsing events in the functioning of coastal barriers and wetlands: Implications for human impact, management and the response to sea level rise. In: M. Weinstein and D. Dreeger (eds.). *Concepts and Controversies in Salt Marsh Ecology*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

^B Lake Pontchartrain Basin Foundation, 2006, Comprehensive Habitat Management Plan for the Pontchartrain Basin, <http://www.saveourlake.org/wetlands.htm> on April 2006;
Day, J., N. Psuty, and B. Perez. 2000. The role of pulsing events in the functioning of coastal barriers and wetlands: Implications for human impact, management and the response to sea level rise. In: M. Weinstein and D. Dreeger (eds.). *Concepts and Controversies in Salt Marsh Ecology*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

^C US Army Corps of Engineers, 1999, *Habitat Impacts of the Construction of the MRGO*, prepared by the USACE for the Environmental Sub-committee to the MRGO Technical Committee, December 1999. This study included a team of wetland specialists reporting to the Technical Committee composed of representatives of the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Geological Survey, Louisiana Department of Natural Resources, Louisiana Department of Wildlife and Fisheries, University of New Orleans, Louisiana State University, Nichols State University and the Lake Pontchartrain Basin Foundation.

^D *Ibid*

^E Poirrier, M. A., 1978, *Studies of Salinity Stratification in Southern Lake Pontchartrain near the Inner Harbor Navigation Canal*, The proceedings of the Louisiana National Academy of Sciences,

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^M USACE (2003) Water Borne Commerce Statistics at 138 and 298 (Available online at www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm).

^N . *Ibid.* at 138 (2,442 thousand short tons of foreign freight traffic/ 2,847 thousand short tons total traffic).

^O Civil Works Status of 3011A Funds Report 3. FY 2003, at 25.

^P MRGO cost \$4.14 per ton to operate and maintain (\$11,794,324/ 2,847 thousand tons). Because foreign vessels carry an average of 4,643 tons per vessel, operation and maintenance cost was thus \$19,220 for each direction a foreign vessel traveled. Water Borne Commerce Statistics, at 138 & 298 (2,442 thousand short tons carried on foreign vessels/ 526 foreign trips).

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