

FINAL COMMENTS AND RECOMMENDATIONS
MRGO Ecosystem Restoration Draft Feasibility Report (DFR)
3-4-2011

The following stakeholders submit these recommendations and comments to the Army Corps of Engineers in reference to the Mississippi River Gulf Outlet Ecosystem Restoration Plan Draft Feasibility Report:

MRGO Must Go Coalition Members:

Andrew Fahlund
American Rivers

John Koeferl
Coalition Against Widening the Industrial Canal

Steven Peyronin
Coalition to Restore Coastal Louisiana

Paul Harrison
Environmental Defense Fund

Beth Galante
Global Green

Cynthia Sarthou
Gulf Restoration Network

William Waiters
Holy Cross Neighborhood Association

John Lopez, Ph.D.
Lake Pontchartrain Basin Foundation

Sandy Rosenthal
Levees.org

Marylee Orr
Louisiana Environmental Action Network

Jodie Singer
Louisiana Wildlife Federation

Paul Orr
Lower Mississippi Riverkeeper

Tracy Nelson
Lower 9th Ward Center for Sustainable Engagement and Development

Diem Ngyuen
Mary Queen of Vietnam CDC

G. Paul Kemp, Ph.D.
National Audubon Society

Karla Raettig
National Wildlife Federation

Haywood Martin
Sierra Club – Delta Chapter

Additional Supporters:

R. Bruce Wallis
Bourgnemouth Realty Company, Ltd.

R. Bruce Wallis
The Livaudais Company, LLC

Rita Gue (affiliation – President, Meraux Foundation)

Floyd Gue

Sidney D. Torres, III

John W. Day, Jr.

Professor Emeritus (affiliation- Louisiana State University)

Gary P. Shaffer

Professor (affiliation- Southeastern Louisiana University)

Jennifer Coulson

Orleans Audubon Society

Contact:

Amanda Moore, National Wildlife Federation, Coordinator - MRGO Must Go Coalition
 716 Adams Street, New Orleans, LA 70118
moorea@nwf.org (225) 229-1944

Comment Organization

- A. INTRODUCTORY STATEMENT - CONGRESSIONAL MANDATE
- B. SUMMARY OF MAJOR RECOMMENDATIONS
- C. PLAN FORMULATION PROCESS
- D. REGIONAL PONTCHARTRAIN BASIN PERSPECTIVE
- E. VIOLET FRESHWATER DIVERSION
- F. OYSTER REEFS AND THE BILOXI MARSH
- G. CENTRAL WETLANDS
- H. MRGO SPOIL BANK
- I. PEARL RIVER DELTA
- J. BANKLINE RESTORATION AND MRGO CHANNEL CONSTRICTION
- K. MINIMIZATION OF DREDGING IN LAKE BORGNE
- L. MONITORING OF AFFECTED AREA OF THE MRGO
- M. FUEL ALTERNATIVES
- N. SELECTIVE CLOSURE OF OIL AND GAS CANALS
- O. IMPLEMENTATION OF A SCIENCE LIAISON COMMITTEE
- P. COST SHARE
- Q. REFERENCES CITED
- R. APPENDIX – VIOLET CANAL HYDRAULICS

A. INTRODUCTORY STATEMENT – CONGRESSIONAL MANDATE

Restoring the Mississippi River Gulf Outlet (MRGO) area ecosystem that was severely degraded by the now de-authorized and blocked-off MRGO ship channel is of great importance to local communities and environmental organizations working on coastal Louisiana restoration. While we support many elements of the Tentatively Selected Plan (TSP) as described in the Draft Feasibility Report (DFR), we believe that the plan needs significant modification. We are concerned that elements of the proposed plan or deficiencies are not “cost-effective, environmentally acceptable or technically feasible” as mandated in Implementation Guidance for Section 7013 of WRDA. In order to meet those criteria and to ensure the best restoration plan, we urge the Corps to reformulate the TSP along the lines suggested in this document. The technical details of our concerns and recommendations are discussed below. Planning must continue to be robust, transparent and with public and scientific engagement. We are willing to help in any way we can to incorporate our recommendations and avoid any further delays in moving forward with MRGO ecosystem restoration.

Herein, please find a summary and detailed comments and recommendations.

B. SUMMARY OF MAJOR RECOMMENDATIONS

Our major recommendations for modifications to the draft plan concern:

1. Maximize sustainability, functionality, and cost efficiency in restoration by allowing a shift in acreage accounting. The Corps' overly strict planning methodology of exact acre per acre replacement for each habitat is a good measure of the overall costs and gross needs of restoration, but in detail planning leads to less than optimum ecologic restoration;
2. The Biloxi Marsh is a "Critical Landscape Feature" and so the Biloxi Marsh land bridges should be included in the recommended plan and more significant restoration of the Bayou la Loutre ridge;
3. Use the Violet canal corridor for the new Violet Diversion;
4. Restore regional oyster barrier reefs along the east and north sides of the Biloxi Marsh;
5. Develop a baseline and then a comprehensive ecologic plan for the Central Wetlands, the complement of marsh or swamp creation should be designed around the future restored hydrologic conditions and not the pre-1956 conditions. The baseline should be based on further monitoring to determine the current status of the Central Wetlands;
6. Include a new channel constriction and additional bankline restoration of the MRGO channel to reduce the risk of wave re-generation during a hurricane;
7. Consider alternative fill material sources, such as the Mississippi River and Breton Sound, due to concerns with dredging extensive borrow holes in Lake Borgne.
8. Immediately implement a more robust monitoring effort that adapts as project elements are constructed;
9. Consider use of natural gas as a cheaper and more environmentally acceptable alternative fuel since considerable amounts of fuel will be required to dredge and transport fills material;
10. The Army Corps and State of Louisiana should set up and fully support a Science Liaison Team that can participate in field work and provide advice. In light of the complexity of this project, the range of the TSP revisions that we are seeking, and the interest of many in the scientific community in the design and implementation of this project, this independent team would serve as a critical resource in the planning process;
11. Make all public comments received by the comment deadline publicly available online as soon as technically feasible, in the effort to support of full transparency and a robust planning process;
12. Resolve the cost share dispute between the Army Corps and the State of Louisiana.

C. PLAN FORMULATION PROCESS

The Corps' overly strict plan formulation process of exact acre per acre replacement for each habitat is a good measure of the overall costs and gross needs of restoration, but in detail planning leads to less than optimum sound ecologic restoration. We applaud and strongly support the goal of restoring 58,861 acres of wetlands or other native habitats, but suggest the plan could be improved by not requiring a strict acre-per-acre replacement for each habitat type. For example, considering the future trajectory of the region some marsh or oyster reef restoration might be done in lieu of some swamp restoration. Therefore, greater flexibility is needed to shift the acreage accounting so that sustainability and cost efficiency are improved. The overriding principle of the MRGO Feasibility Study (FS) is to restore ecosystem debilitated or transformed from its original character by the MRGO to its pre-MRGO character to the maximum extent practicable. In the abstract, this is laudable and understandable. However, in 2011 this principal is at odds with prevailing social, economic and environmental realities. The impact of Hurricane Katrina, the succession of regional biota and inevitability of geological determinism all dictate that this overriding principal be reconsidered. Rather than seek to rigidly recreate what was lost in a strictly quantitative formulation, it is more important to restore the environment in a way that expresses the resiliency, economic importance and storm surge reduction capacity of what was destroyed by the MRGO.

St. Bernard residents, the Parish President, and others have clearly articulated the strategy that needs to be employed. They and others have insisted that the parish's eastern flank of estuarine islands and edge marshlands receive the high priority for restoration and protection and have advocated utilization of natural and artificial oyster reefs for this purpose. The MRGO DFR also identified these islands and marsh shoreline as Critical Landscape Features that "reduce or prevent damage from storm surge." However, the quantitative nature of the MRGO DFR planning framework had the effect of minimizing final "Best Buy" emphasis on the goal of storm surge reduction due to low metric values for estuarine island and marsh shoreline protection and restoration.

The MRGO analysis distorts and minimizes overall system sustainability and, in effect, misrepresents the ecological value of resiliency as a merely quantitative construct as opposed to a more nuanced balancing of quantitative and qualitative factors. Resiliency can be measured from a quantitative point of view but is not, in and of itself, a purely quantitative measure unless considered in a much broader ecological planning context than employed in the MRGO DFR. Changes to the MRGO DFR planning methodology are necessary if resiliency is to be properly valued. Of their nature, the changes would embrace a process-oriented planning approach within which the following attributes can be included and weighed accurately with other variables relative to achieving MRGO DFR goals: 1) environmental succession to stable brackish and saltwater marsh 2) various ecological attributes of the estuarine geologic framework, and 3) oyster reefs (natural and engineered) as central to habitat and geologic stability.

This necessitates changing the matrix of “Goals, Objectives, Metrics and Measures” as listed in Section 2.5.6 of the MRGO FS. The “Goals” are broad and generally inclusive. However, the inherent contradictions and undervaluing of resiliency is apparent in the “Objectives, Metrics and Measures” of the MRGO DFR matrix. Storm surge reduction is quantified based on total Annual Average Habitat Units (AAHU) and number of acres restored. Neither metric has a direct relationship to the goal of storm reduction. At best they are relative indices when one considers that some landscape structures are clearly more critical than others; and that AAHUs, such as within levees, might be entirely irrelevant to storm surge reduction considerations. The matrix illustrates how resiliency can get lost in standard Corps analysis of restoration projects.

Plan Formulation Recommendation:

Greater flexibility in planning is needed when applying the acreage accounting for impacted habitats so that a more optimal, sustainable and cost effective plan can be implemented. In lieu of a one-time build out of a rigid acreage quota, the Corps should have a long-term, phased commitment to sustaining an ecologic vision for the area impacted. This vision must be compatible with the unchangeable future condition, while efficiently configuring the malleable conditions or projects that are planned for the area regardless of whether they are part of the Corps planning or other authorities.

D. REGIONAL PONTCHARTRAIN BASIN PERSPECTIVE

The Comprehensive Management Plan (LPBF, 2006) documents the impact of the MRGO on the Pontchartrain Basin. This document relied heavily on a report by the Corps that assessed the impact to emergent wetlands, but the Corps report did not include impact to the basin’s lakes and bays (USACE, 1999). The LPBF’s report estimates to total area of marsh and natural water bodies impacted to be 618,000 acres (965 square miles). Even this estimate excludes ephemeral salinity impact to the Lake Maurepas region. It is important to consider the regional context of impacts as well as the regional influence of coastal restoration proposed, while acknowledging that the greatest extent and level of ecologic impact was near the MRGO channel in St. Bernard Parish. The final recommended plan, which requires a large investment into coastal restoration, must have broad community support, be resilient and sustainable environmentally, provide increased flood protection and restore at least some of the economic and social capital lost as a result of the construction and operation of the MRGO.

Since 2006, the Lake Pontchartrain Basin Foundation has stressed 10 priority project areas within the Pontchartrain Basin under a program called the “Pontchartrain Coastal Lines of Defense”. These project areas were given the very highest priority because of their preeminent value ecologically and as a feature to mitigate storm surge threat. These ten coastal restoration project areas were chosen from the Comprehensive Habitat Management Plan (LPBF, 2006) because of their importance to the regional habitat restoration and because they may provide important flood

protection to residents of the Pontchartrain Basin. This approach is consistent with the “Multiple Lines of Defense Strategy” proposed by LPBF (Lopez, 2006, 2009) and subsequently adopted by the US Army Corps of Engineers and the State’s Master Plan.

It is not by chance that the legislative direction by Congress (2007) on the MRGO followed in the horrific aftermath of Hurricane Katrina (2005), in which 1400 people were killed, St. Bernard Parish was nearly completely destroyed and New Orleans severely damaged. It is estimated damages may have been \$150 billion. Therefore, the consideration of flood protection as a requirement of the legislative direction authorizing the MRGO DFR should be taken to its full intent (see emphasis below):

WRDA 2007 Section 7013, the authority for this study, is provided below:

SEC. 7013. MISSISSIPPI RIVER-GULF OUTLET.

(a) DEAUTHORIZATION.-

(3) CLOSURE AND RESTORATION PLAN.-

(A) IN GENERAL.-Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives a final report on the deauthorization of the Mississippi River-Gulf outlet, as described under the heading "INVESTIGATIONS" under chapter 3 of title II of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery, 2006 (120 Stat. 453).

(B) INCLUSIONS.-At a minimum, the report under subparagraph (A) shall include-

(i) a plan to physically modify the Mississippi River-Gulf Outlet and restore the areas affected by the navigation channel;

(ii) a plan to restore natural features of the ecosystem that will reduce or prevent damage from storm surge; (emphasis added)

(iii) a plan to prevent the intrusion of saltwater into the waterway;

(iv) efforts to integrate the recommendations of the report with the program authorized under section 7003 and the analysis and design authorized by title I of the Energy and Water Development Appropriations Act, 2006 (119 Stat. 2247); and

(v) consideration of-

(I) use of native vegetation; and

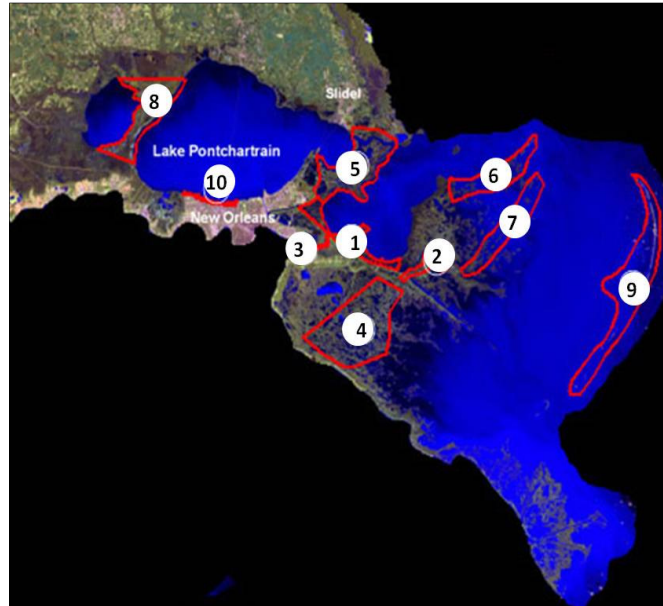
(II) diversions of fresh water to restore the Lake Borgne ecosystem.

(4) CONSTRUCTION.-The Secretary shall carry out a plan to close the Mississippi River-Gulf Outlet and restore and protect the ecosystem substantially in accordance with the plan required under paragraph (3), if the Secretary determines that the project is cost-effective, environmentally acceptable, and technically feasible.

WRDA 2007 language

The “*reduce or prevent storm damage from surge*” is more critical to the landscape restoration since the surge barrier has been built. The surge barrier at the MRGO/GIWW juncture vastly improves flood protection, but it also will cause storm surge elevations to be higher and potentially more damaging to the landscape outside of the barrier and levees. For these reasons, it seems inappropriate for the MRGO DFR Tentative Selected Plan (TSP) to have a large emphasis on projects within the Corps 100-year flood protection system. The overall TSP cost for restoration within the levee is estimated to be 38% of the overall cost. That is, 38% of the TSP cost may not address the legislative mandate in section ii, i.e. “*to reduce or prevent damage from storm surge.*” Due to the historic damage to some areas within the levee, certainly some significant restoration is justified. However, the amount in the TSP is too great especially considering some critical areas outside the levee are not included in the TSP.

We support the overall plan because it has great potential to address the Pontchartrain Coastal Lines of Defense and to address a major portion of historic damage caused by the MRGO, but adjustments must be made to vastly improve the final recommended plan.



Ten Pontchartrain Coastal Lines of Defense Project Areas. 1, 2, 3, 4, and 5 have some restoration proposed in the TSP, while 6 & 7 should be added.

Ten Pontchartrain Coastal Lines of Defense Project Areas

Prioritized Projects Utilizing the Multiple Lines of Defense Strategy in the Pontchartrain Basin, i.e. providing dual benefits of habitat restoration and flood protection.

Currently within the MRGO Tentatively Selected Plan (TSP)

1. Maintain the MRGO-Lake Borgne Land Bridge
2. Restore the Bayou la Loutre Ridge
3. Construct the Violet Diversion to maintain target salinity in the Biloxi Marsh
4. Maintain and restore the Breton Land Bridge
5. Maintain critical marsh shorelines and ridges of the East Orleans Land Bridge

Strongly recommended to be added to the MRGO TSP

6. **Maintain and restore the Biloxi Marsh Land Bridge and barrier reefs (South)**
7. **Maintain and restore the Biloxi Marsh Land Bridge and barrier reefs (North)**

Very Important but outside the scope of the MRGO FS

8. Maintain and enhance the Maurepas Land Bridge with Maurepas Reintroduction
9. Restore the Chandeleur Barrier Islands
10. Construct the Jefferson/Orleans Parish fringe marsh buffer

Regional Recommendations

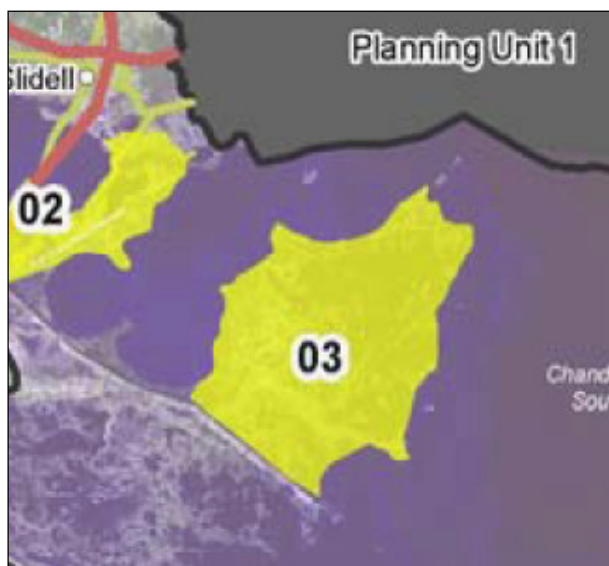
1) The two Biloxi Marsh land bridges, which are outside the levee system and part of a “Critical Landscape Feature” (6&7, see detailed comments below), must be added because of their exceptional relevance to the area of impact and critical importance to restoration and flood protection. In addition, a more significant restoration of the Bayou la Loutre ridge (2) is strongly

endorsed. It must also be noted that areas such as the Maurepas region have been impacted and were not included in the TSP because there are already authorized projects such as the Maurepas Swamp diversion (Shaffer, 2003; Shaffer et al. 2009) even though these projects are not funded.

2) A more extensive bottomland hardwood restoration of Bayou la Loutre should be included. In lieu of a “Wetland Value Assessment”, “Habitat Suitability Indexes” for appropriate forest species (gray squirrel, white tail deer, etc) should be used for metrics to guide the design and performance of this restoration type.

E. VIOLET FRESHWATER DIVERSION:

The Violet Freshwater Diversion is critical to sustaining the Biloxi Marsh. In 2009, the Corps released the LACPR Technical Report which extensively modeled and investigated storm surge. One key finding was the identification of “Critical Landscape Features,” which were characterized by significant capacity to reduce storm surge. The Biloxi Marsh was identified as a critical landscape feature by concluding that if these Biloxi Marsh wetlands were lost, storm surge would be higher and more destructive. This applies directly to the hurricane threats to St. Bernard, New Orleans and the Mississippi Coast. St. Bernard Parish officials have also requested priority on the Biloxi Marsh and reef restoration. St. Bernard Parish officials, MRGO Must Go Coalition, and LPBF have identified Biloxi Marsh and reef restoration as a storm surge reduction priority.



Biloxi Marsh (Yellow area) identified as “Critical Landscape Feature” (surge reduction) across coastal Louisiana (Corps LACPR, 2009)

Success in restoring the Biloxi Marsh hinges on management of salinity (via a Violet Diversion) and large scale reef building materials. The distal nature of this wetland area precludes utilization of the largest possible “sediment diversion” from the Mississippi River, and therefore other measures must be taken.

Georgiou (2009) suggested 7500 cfs and Dortch (2007) suggested 7500 cfs. The MRGO DFR suggests 7000 with other diversions and 9000 cfs to flow independently. Considering the general uncertainty of this type of hydrodynamic modeling, this is a well constrained estimate of the needed discharge to sufficiently manage the salinity target. We support a Violet Diversion primarily for the benefit of the Biloxi Marsh, but also for the secondary benefit to the Central Wetlands (see Central Wetland recommendations below) (LPBF, 2006, 2008).

A review of the hydraulics indicates a deeper and a narrower channel than the TSP proposal could be used at the Violet canal corridor. More information is described in a memorandum included in the appendix of these comments. The deeper channel would need to have stable slopes, and geotechnical analysis should be conducted to evaluate slope stability with a deeper channel.

Violet Diversion Recommendations:

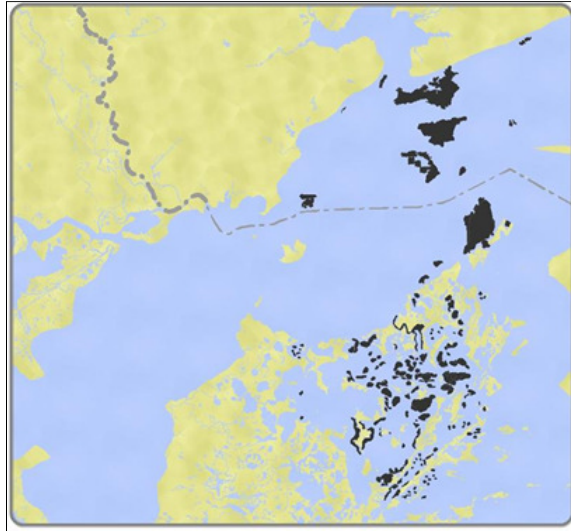
1. Locate the diversion within the corridor of the existing Violet canal. This may require deepening and widening the existing canal, but should be substantially narrower than the conveyance footprint of the diversion currently proposed in the Army Corps Draft Plan.
2. Monitor salinity and turbidity for operation of the diversion. Utilizing real-time turbidity monitoring will maximize delivery of sediment with less discharge.
3. Restore or nourish cypress swamp along the existing Violet canal corridor by utilizing diversion discharge in the immediate outfall area (see Central Wetland comments).
4. Consider an additional rock dam in the MRGO channel north of the diversion as a means to direct discharge toward the Proctor Point area (this additional closure with a small boat crossing will also help reduce wave generation from storm surge in the channel).
5. Evaluate lessons learned from Caernarvon and Davis Pond diversions for the final operation plan for the Violet Diversion. There is evidence soils near the diversion (fresh marsh) can be weakened by a freshwater diversion, but with sufficient sediment introduction this should be overcome (see Central Wetlands discussion). This is not a threat to brackish marsh, which has done well at Caernarvon and so the Biloxi Marsh habitat (brackish) should benefit as well.

F. BUILD OYSTER REEFS AND SUSTAIN THE BILOXI MARSH:

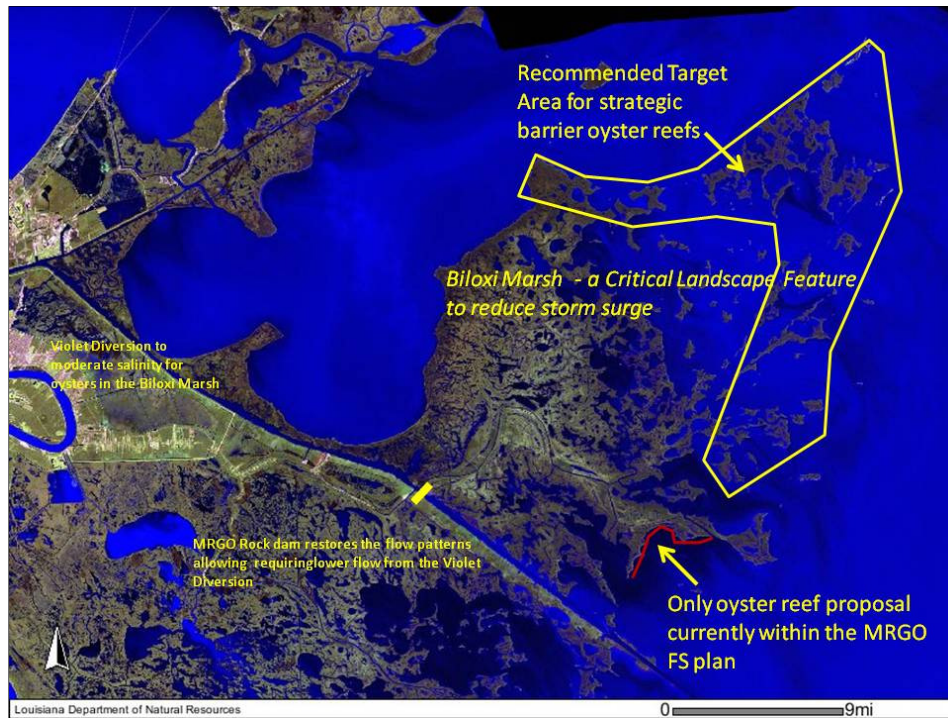
The Biloxi Marsh was once blessed with large regional oyster barrier reefs that provided huge oyster production and also anchored and largely stabilized this marsh. Restoration of the Biloxi Marsh with oyster barrier reefs and with living shoreline oyster reefs is the best restoration scenario for this region for ecologic value and flood protection enhancement. Since oysters are considered to be ecologic engineers, enhancement of oyster production and construction of oyster reefs improves the entire ecology of these wetlands. Oyster reefs will also be an important source of mineral sediment that will increase vertical accretion of nearby marsh. The oyster reef projects should be regional landscape scale projects, and not be considered demonstration projects. Numerous demonstration projects have been built providing a sound basis to scale up to the needs of the Biloxi Marsh. The MRGO DFR report addresses the diversion needs, but not the reef

building component required to sustain the Biloxi Marsh. A Corps report released in 2003 documents the economic, ecologic, and protection values of reconstructed oyster reefs (USACE, 2003).

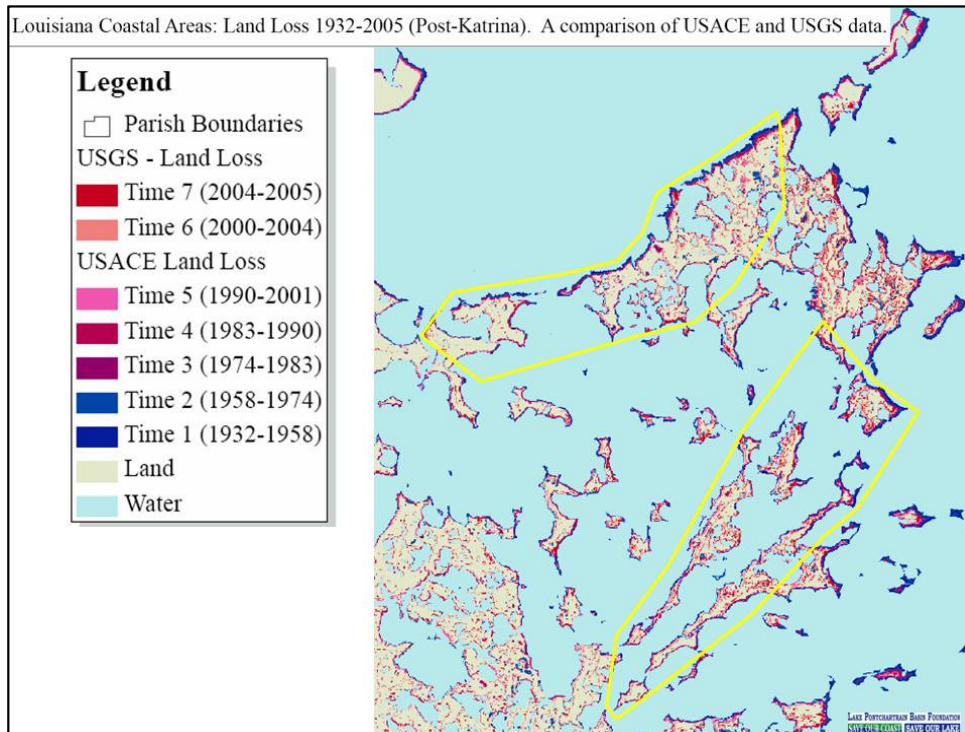
Oyster reefs will help sustain the Biloxi Marsh land bridges, which separate Lake Borgne from the Gulf of Mexico. Salinity targets in the Biloxi Marsh should promote robust and sustainable oyster reefs and brackish marsh. The oyster reefs are critical to the long term sustainability of the Biloxi Marsh because they can respond to sea level rise and create a natural buffer against storms. Furthermore, oyster reefs rebuild naturally and thus are more cost effective to maintain than rocks, which continually sink. Finally, oyster reefs create high quality wildlife habitat and help improve water quality. Several reef restoration projects have been completed and several more are under construction in Louisiana. Other gulf coast projects have been completed in Alabama, Texas and Florida. These projects should be evaluated for best practices and applied to the Biloxi Marsh oyster reef restoration.



Biloxi Marsh Historic Oyster Barrier reefs in black, circa 1930 (LPBF 2006)



The MRGO DFR does not include the out Biloxi Marsh which are essential to maintain the Biloxi Marsh’s integrity to reduce storm surge into St. Bernard, New Orleans and the Mississippi Coastline.



Land loss map of the Biloxi marsh 1932 to 2005 (post-Katrina) illustrates recent rates of loss are modest, but many areas are reaching critical size. Oyster reef enhancement can reduce the rate of loss of marsh and may transition some areas into sustainable oyster barrier reefs. Yellow areas are prime areas for oyster barrier reef enhancement which are recommended.

Biloxi Marsh Recommendations:

1. Use appropriate reef building materials to restore regional oyster barrier reefs across the Biloxi Marsh;
2. Include the outer Biloxi Marsh within the final recommended plan because of the WRDA language requires storm damage reduction and because it also fulfills the language of the WRDA language of the Violet diversion authorization to sustain coastal wetlands such as those targeted by the diversion project (see map below);
3. Enhance 3-dimensional oyster barrier reefs (reef blocks, reef balls, etc.);
4. Protect oyster barrier reefs from over harvesting while promoting other areas for robust commercial harvests;
5. Locate reefs on the east side of the Biloxi marsh where they provide shoreline protection and detritus to local marsh;
6. Evaluate other oyster reef projects in Louisiana and use best practices, such as The Nature Conservancy, and Coastal Environments Inc. reef projects;
7. Back-fill oil and gas canals where these canals continue to impair adjacent wetlands and can be returned to a functional marsh.

G. CENTRAL WETLANDS MARSH

The MRGO is the overwhelming cause of problems in the Central Wetlands. Logging had an impact on the wetlands over a century ago, but there was significant re-growth of cypress before the construction of MRGO. Habitat change analysis showed a direct impact of MRGO construction on cypress swamp by the direct removal of swamp for the canal footprint and covered by the dredged sediment in the disposal areas (FitzGerald, et al 2008). Post-MRGO, there are two overwhelming habitat change issues. First is the death of large areas of cypress and low salinity marsh due to salinity intrusion. Second, the half-century long isolation of the area by the MRGO levees has led to decline of the remaining marshes such that they are now in a very fragile state. Although the MRGO is not directly accountable for all these impacts, it is imperative that these other impacts are considered in the ecosystem restoration planning of these wetlands by the MRGO FS.



1958 Photograph: Groundbreaking ceremony for the MRGO. The cypress forest in the background was clear-cut for the MRGO corridor. (Photo: US. Army Corps of Engineers)



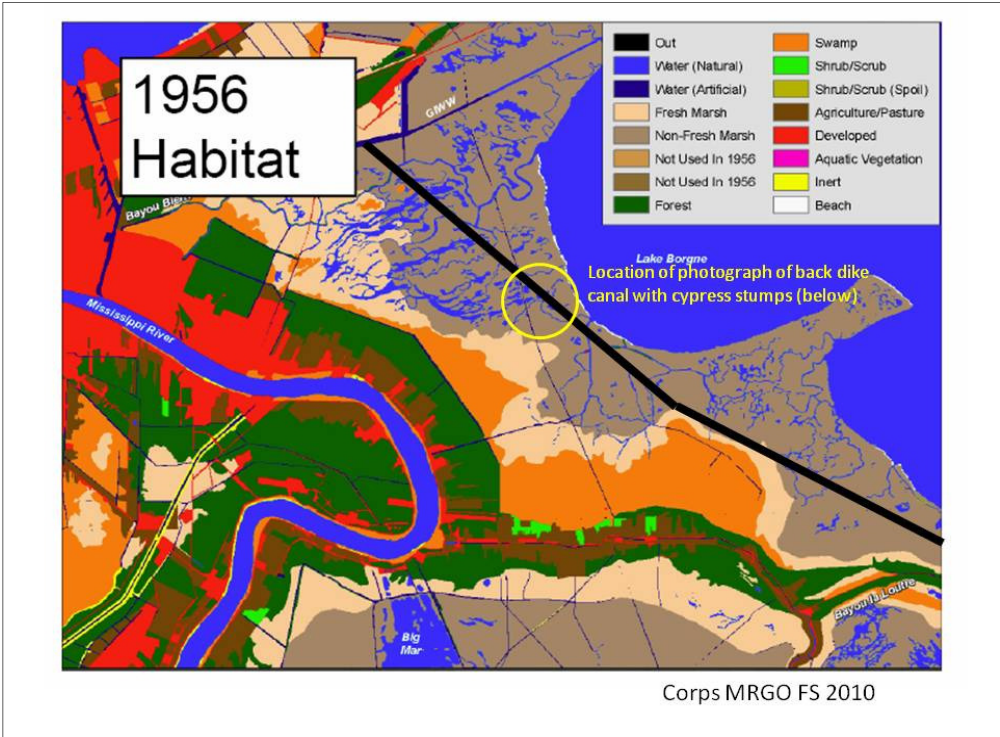
9 July 1958 Photograph: Looking due east towards Paris Road in the background. Note cypress tree removal before dredging. Based on the three story height of dredger, trees were about 40 feet tall. The figure also shows extensive cypress forest in the Central Wetlands. (Day and Shaffer, 2009)

The MRGO DFR plans in the Central Wetlands are misguided because of the undue utilization of the 1956 footprint for the cypress forest to identify particular areas for swamp restoration. The flaw in this approach is that the 1956 habitats reflect hydrologic and geologic conditions long past. The Violet Diversion at either the TSP location or the Violet canal (preferred), will introduce freshwater, but will not precisely replicate the exact pre-1956 hydrologic conditions. Therefore, the complement of marsh or swamp creation should be designed around the future restored hydrologic conditions and not the pre-1956 conditions.



Imagery illustrating areas of thinning of marsh (note contrast between east and west sides of the canal) which is not captured by typical land loss mapping. This may be indicative of weak soils and therefore this needs to be documented as part of a baseline study.

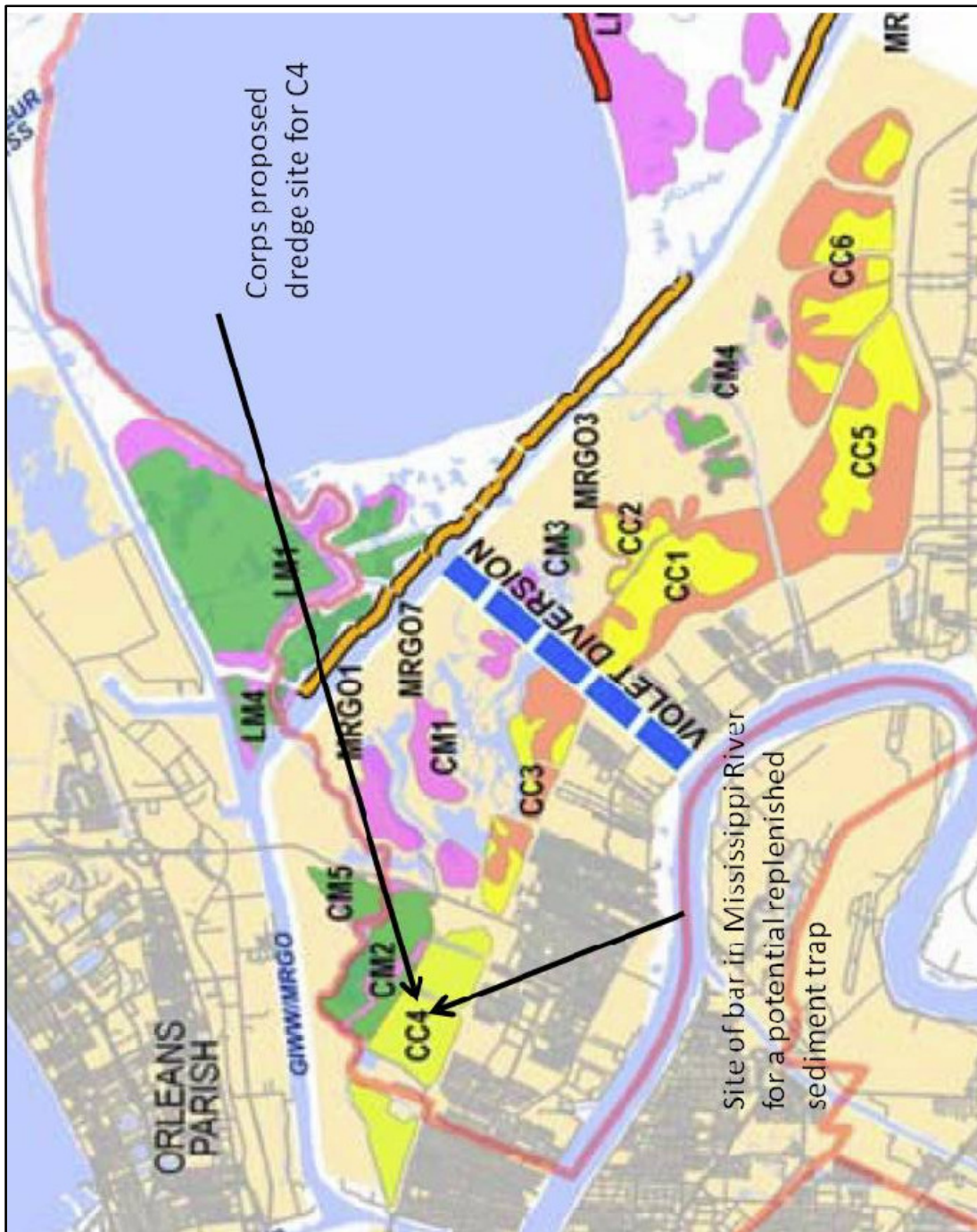
Until there is a fuller understanding of the present status of wetlands in the Central Wetlands, final restoration plans cannot be developed. The figures below illustrate this point. A conceptual plan is included to illustrate how the various restoration elements and habitats could be designed around a Violet Diversion. It also includes creation of small freshwater lakes which could add tremendous ecologic, aesthetic and recreation value, while reducing overall project cost.



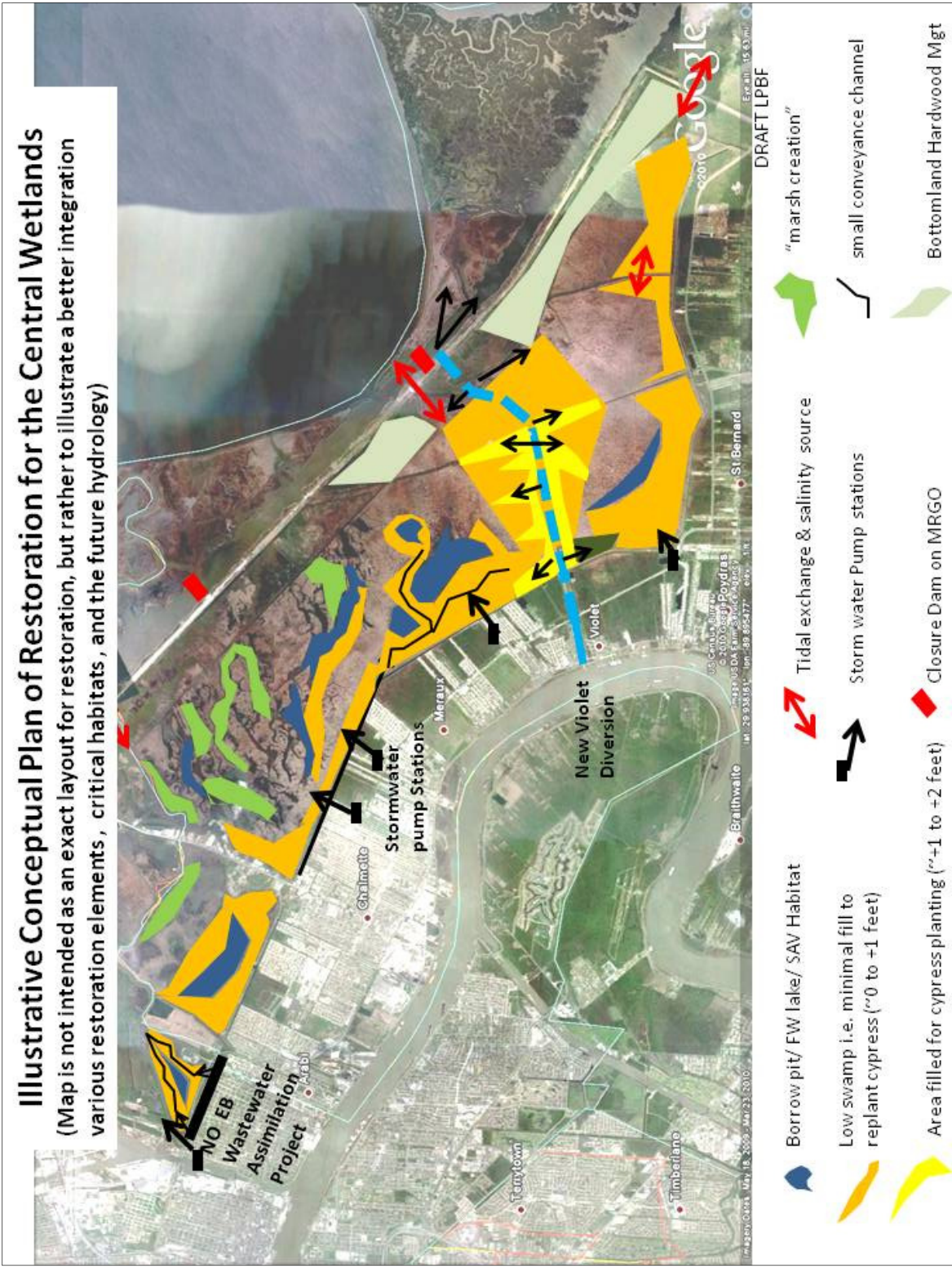
This Corps' illustration of 1956 habitat distribution reflects much earlier hydrologic conditions. This should be considered the minimum historic extent.



Photograph of cypress stumps in the Back dike canal December 2010.



The MRGO DFR restoration proposed in the TSP mimics the habitat distribution 1956. This is inconsistent with the future hydrology of Violet Diversion and/or wastewater assimilation projects. Also note the dredge distance proposed is more than twice the distance from dredging a bar in the Mississippi River, which has less volume but may be replenished.



Restoration concept map which integrates marsh and swamp creation with other habitats based on the location of the Violet canal, storm water discharge, and the demonstration wastewater assimilation project. This map is strictly tentative until a more comprehensive understanding of the Central Wetlands is determined.



Example of a small fresh water lake that could be created within the Central Wetlands adding ecologic and aesthetic value while reducing cost to pump sediment.



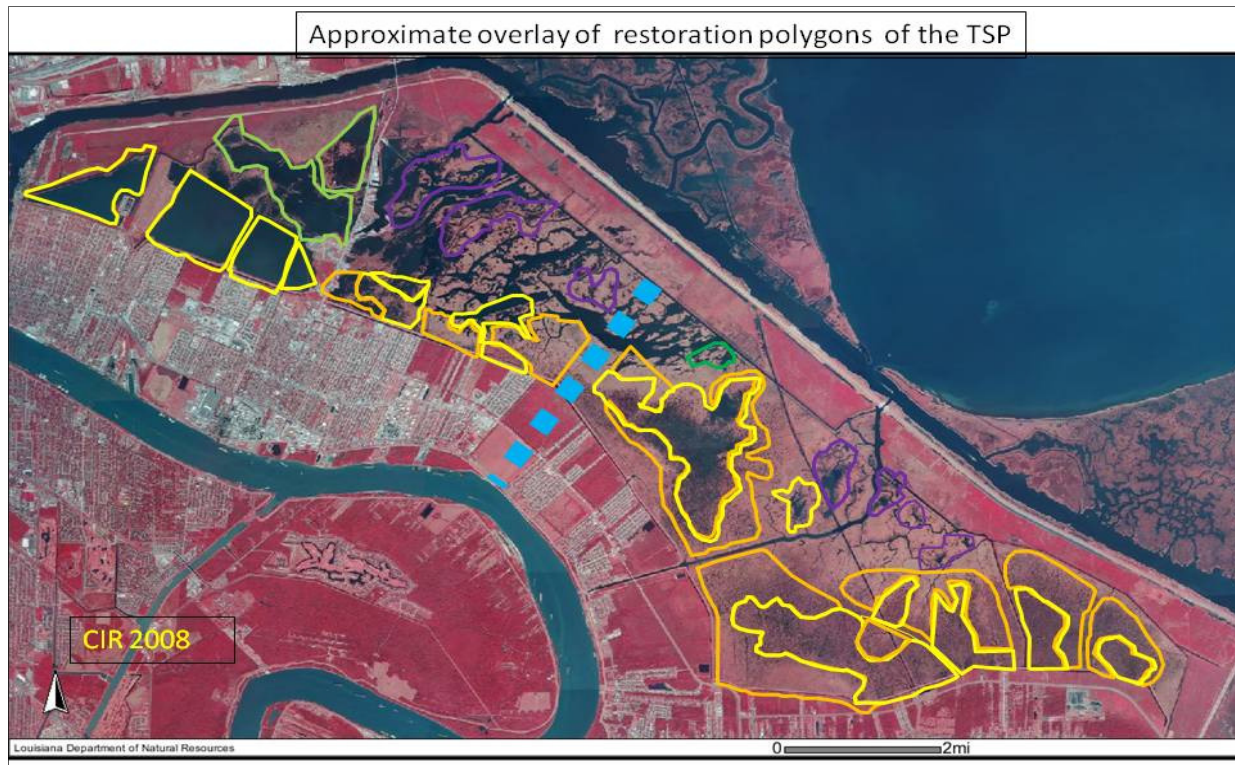
Example of a small trenasse-like channel lined with cypress trees as might be created in the Central Wetlands to direct freshwater discharge either from the Violet Diversion or from demonstration wastewater assimilation projects.

Because the Central Wetlands are within the flood protection system and because soil salinities are too high for fresh vegetation (such as cypress), restoration of this system to its historic freshwater

and intermediate habitats must be phased as higher priority elements are completed. Salinity and soil conditions must be addressed before any significant cypress reforestation can occur.

One disturbing aspect of the TSP is that some areas of proposed swamp restoration and swamp nourishment are actually where there is marsh already present (see map below). However, the majority of the marsh is in poor shape and seems to be in the process of conversion to open water. The TSP proposal of large scale filling of marsh to create swamp habitat is an unproven approach that should be implemented gradually with close scrutiny of its effects before the approach is used throughout the Central Wetlands. In any event, some restoration will have to take place on the marshes or they will convert to open water. The proposed swamp restoration elevation is +4.5 feet, which would place 3-4 feet of fill over existing marsh in some places. We are concerned that this filling of a wetland may require further mitigation for impact to the existing wetlands. This “snowball effect” that could be created as existing wetlands are destroyed and new mitigation is undertaken would be counterproductive to the goal of the project, could introduce greater uncertainties about its outcomes, and is likely to increase the costs of the project above the already high costs estimated for the TSP. However, it must again be noted that much of the marsh is in the process of converting to open water, so this must be taken into consideration in making restoration decisions.

Given these risks, we instead recommend creating a series of swamp ridges, lakes, and tributaries in the areas of the Central Wetlands - including open water and existing wetlands - to reduce the impact of restoration activities and to maintain some areas as freshwater lakes, floating marsh, and SAV habitat (see concept map). Most restoration areas in the Central Wetlands should be “nourished” to strengthen the existing wetlands rather than destroy them. The majority of fill material should be placed at very critical areas, such as along the Violet canal where a more mineral based soil is justified to avoid the potential weakening of soils at the direct outfall of the Violet Diversion. There is a dense network of cypress trunks buried at a shallow depth. These were killed by salt water intrusion when MRGO opened. Their distribution should be taken into consideration. These suggestions should be considered tentative until a more complete understanding of the Central Wetlands is achieved.



Approximate location of TSP restoration polygons – note that several polygons appear to fill over exiting wetlands. These areas should be evaluated before filling. (Yellow outlines are swamp restoration to elevation +4.5 ft. Orange outlines are swamp nourishment areas with lower final elevation.)

Central Wetlands Recommendations:

1. Conduct a baseline inventory of Central Wetlands conditions, including hydrology, wetland health, soil strength, distribution of fallen cypress stumps and other appropriate parameters for use in restoration planning.
2. Develop a comprehensive vision for Central Wetlands, including coordination of planned projects such as demonstration wastewater assimilation projects, the Violet Diversion, Bayou Bienvenue restoration, and cypress swamp and marsh restoration with native vegetation utilizing the additional information described in recommendation 1 (above).
3. Locate swamp restoration and nourishment primarily in areas of open water or very thin marsh to minimize impacts to emergent marsh already present.
4. Evaluate the source of sediment and the use of a sediment trap along the St. Bernard reach of the Mississippi River. Use of sediment from Lake Borgne for swamp projects will delay benefits since leaching of salt will require a few years and delay planting of cypress. (A sediment trap is a dredge hole on the Mississippi River bottom which will capture future bed load sediment in the river, allowing future use of the sediment for coastal restoration.) Use of a sediment trap in the river for the Central Wetlands restoration would reduce the distance to pump sediments by more than 50%. In addition, sediment mined from the river will have

zero salinity, which will allow for more rapid re-vegetation by fresh plant species such as cypress.

5. Include at least these habitats in restoration:
 - Fresh and intermediate marsh
 - High and low swamp
 - Bayou-trenasses
 - Small freshwater lakes
 - Submerged Aquatic Vegetation (SAV)
 - Bottomland hardwood forest

6. Utilize the following sources for fill to reduce cost and reduce impacts to Lake Borgne:
 - Mississippi River sediment
 - Borrow sites within Central Wetlands that are made into freshwater lakes
 - MRGO spoil bank
 - Dredge material from deepening the Violet canal

7. Remove Hurricane Katrina storm debris located in the marsh area and along the MRGO spoil bank.

8. Consider future economic development areas, such as Paris Road, in planning.

9. We support wastewater assimilation projects into swamp habitat, but not use of wastewater wetland assimilation projects into natural, coastal marsh (LPBF, 2010) until it can be shown that this can be done in a way that enhances marsh. Any demonstration wastewater wetland assimilation project in the Central Wetlands should discharge to existing or restored cypress habitat where success is more likely. Discharge into marsh should be done only if it can be demonstrated that the project can be done in a way that protects and enhances marshes. Wastewater assimilation projects must include multiple outflow options to maximize the potential for pulsing and drawdown periods, including an option to simply discharge into the Mississippi River. In addition, planning should incorporate any lessons learned from the Hammond wastewater assimilation project where problems have been documented such as: 1) assimilation wetlands will attract nutria and management needs to be incorporated from project initiation and (2) all assimilation wetlands should have at least two outfall options to enable pulsing.

H. MRGO SPOIL BANK

The MRGO spoil-bank is an ecological disruptor that now represents opportunities for restoration. It should be evaluated and included in the final recommended plan. Its presence blocks the movement of water, nutrients and estuarine organisms. It has become colonized in many cases by exotic invasive vegetation. In addition, it is an untapped sediment resource. Any modification to the spoil bank should not jeopardize the hurricane protection levee or T-wall, and done in concert with land use planning of St. Bernard and Orleans Parishes.

MRGO Spoil Bank Recommendations:

1. The entire MRGO spoil bank should be mapped topographically and ecologically to assess the current ecologic values and services.
2. The highest areas of the MRGO spoil bank outside of the Central Wetlands should be managed for bottomland hardwood forests. Exotic vegetation should be removed and replaced with site appropriate native trees and shrubs, such as live oak, Hackberry, and elderberry. In lieu of a “Wetland Value Assessment”, “Habitat Suitability Indexes” for appropriate forest species (gray squirrel, white tail deer, etc) should be used for metrics to guide the design and performance of this restoration type. In general, this would consist of bottomland hardwoods. (see link below for more information)
<http://www.mrgo.gov/ProductList.aspx?ProdType=reference&folder=763>
3. The shoreline of MRGO spoil bank along the MRGO channel outside of the Central Wetlands should be evaluated to enhance the ecologic value by creating fringing marsh edges that might be done in conjunction with other rock dam closures along this reach (any new dam closures should allow small vessel boat passage).
4. The spoil bank inside the Central Wetlands should be multi-purpose:
 - Any existing marsh, swamp or high-quality bottom land hardwood habitat should be identified and incorporated into comprehensive planning for the Central Wetlands and promote estuarine connectivity.
 - Non-wetland areas of low habitat value should be considered for modification to convert to wetlands and as a source of borrow material for further wetland creation. This would reduce the need to dredge Lake Borgne and reduce costs.
5. In all cases the costs of acquiring rights to land, either through agreement, purchase or easement, should be a project cost, and private landowners should receive just compensation.

I. PEARL RIVER DELTA

The MRGO DFR Tentatively Selected Plan includes extensive marsh restoration in the Pearl River Delta. Some restoration is needed there and should be included. However, in lieu of some of the marsh restoration by pumping sediments, the Corps should evaluate the removal of two sills on the Bogue Chitto and West Pearl Rivers which are part of an obsolete Corps navigation project (LPBF, 2006).

Negative environmental impacts have occurred in both rivers due to the Pearl River Navigation

Project authorized by the River and Harbors Act of 1938 and completed in 1956. For this project the Pearl River Canal was constructed as a lateral (bypass) canal along the west side of the lower Bogue Chitto and West Pearl Rivers. The Bogue Chitto River is a major tributary of the Pearl River. Sills were placed in the Pearl and Bogue Chitto Rivers to impede flow in the rivers and therefore create backwater in the navigation bypass canal to maintain a minimum depth for navigation. Locks were also constructed on the Pearl River Canal and have not generally been operated. In 1974, the project was nominated for de-authorization because of a decline in barge traffic. This de-authorization failed but the COE also has not been able to initiate maintenance dredging and snagging. In November 2003, the Vicksburg District of the U.S. Army Corps of Engineers completed an “Initial Appraisal Report” to de-authorize the project, and includes the following record:

- The last maintenance dredging was in 1989.
- The last recorded barge movement was in 1991.
- The project has been officially in a “caretaker” status since 1995.
- The project has no commercial traffic.
- Little prospect exists for the project to return to becoming a viable commercial waterway.
- The reach near Poole’s Bluff (near Bogalusa) sill includes three wildlife management areas (two in Louisiana), the Bogue Chitto National Wildlife Refuge, the Pearl River WMA, and five rivers (or streams) designated as “natural and scenic” by the state of Louisiana.
- The three locks were determined to be “marginally safe due to continuous erosion of the sheet pile walls” and one lock were predicted to become unsafe possibly as early as 2004.
- Accidental drowning deaths have occurred by boaters attempting to cross a partially submerged sill.
- Due to understaffing of facilities vandalism is significant.
- \$2.7 million has been spent to “minimally maintain” the West Pearl River Navigation Project over the past ten years.
- **An EIS completed in 1994, identified 23 species and 1 subspecies either threatened or endangered that possibly exist in the study area, including Gulf Sturgeon.**

Pearl River Delta Recommendation: Include removal of the sills on the Bogue Chitto and West Pearl Rivers as part of the MRGO DFR recommended plan to enhance delta wetland sustainability and improve anadromous fish habitat such as Gulf Sturgeon.

J. RESTORE BANKLINES & CONSTRICT THE MRGO

Modifying the MRGO channel (including a channel constriction north of the Violet Diversion and reclaiming shallow, eroded banks of the MRGO) will reduce the risk of wave regeneration and attack on the hurricane levee system and potentially improve the performance of the Violet Diversion. Extensive modeling after Hurricane Katrina demonstrated that during a storm, wave height is strongly influenced by the water depth of the channel. Waves and strong currents can move down the MRGO channel (Mashriqui, 2006 & La DOTD, 2007). Closures disrupt wave and current generation in the MRGO channel and so at least one additional closure is recommended (see detailed comments and conceptual map for the Central Wetlands). Any new closure dam should include a small boat vessel passage.

K. MINIMIZE IMPACT OF DREDGING IN LAKE BORGNE

The TSP currently proposes dredging over 150 million cubic yards of sediment (the vast majority sourced in Lake Borgne). Alternative sources need to be evaluated and utilized. Dredging of Lake Borgne may increase storm surge wave heights. In addition, it may create a liquefied, soft bottom that may not support shell fish (*Rangia cuneata*). For the final recommend plan map, the dredge areas should also be identified to clarify which areas are benefited and impacted.

Dredged sediment needs can be reduced (thereby reducing project costs) by implementing less stringent elevation requirements for placement of sediment. Design criteria for marsh and swamp retraction do not need to impose a strictly uniform elevation requirement for fill. A strict design elevation requires significant re-working of material and adds to cost. Less stringent elevation requirements could reduce cost and add natural variability to the restored marsh or swamp.

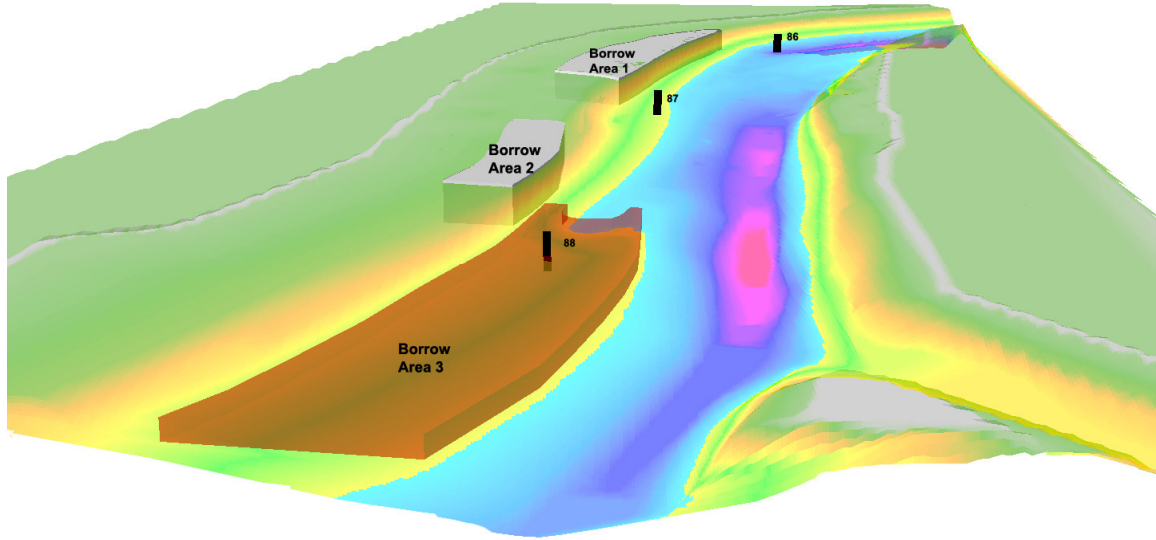
Other sources of sediment should include:

- Mississippi River sediment (dedicated dredging, beneficial use, and use of a sediment trap)
- Borrow sites within the Central Wetlands that are made into freshwater lakes (see CW comments)
- MRGO spoil bank (see section on spoil bank)
- Chandeleur Sound, Mississippi, and Breton Sounds (using natural gas for pumps – see recommendation “M” below)

Possible Mississippi River Borrow Site

A meander bar in the Mississippi River at river mile 86 to 87 may be a good source for sediment that may be mined and also to develop sediment trap. The presence of the bar suggests that the bar may be replenished so that it may provide a long term source of material. At this reach, there is a wide batture that has been previously mined. This may be used as a holding area for dredged material. A similar bar may be present at Will’s Point down river that could be mined for marsh restoration further south.

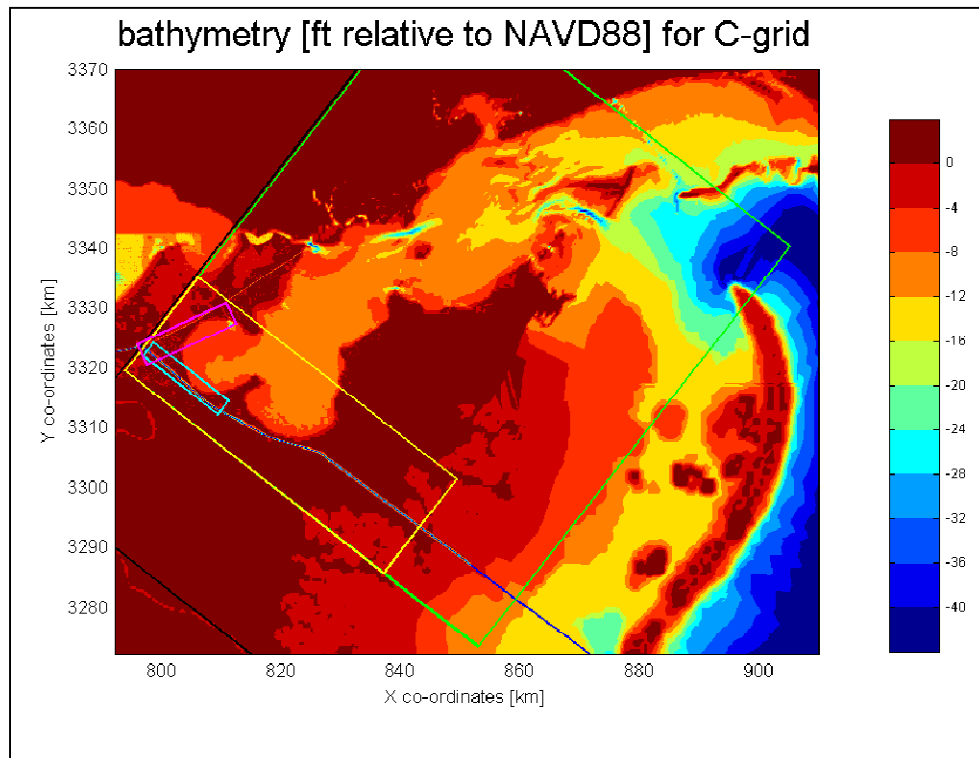
An external and renewable source of high-quality material exists in the Mississippi River adjacent to the proposed TSP diversion channel inlet at Meraux (figure below). Instead of an open channel at this location, we would recommend a pipeline to carry sediment to a staging area in the Central Wetlands. A similarly situated meander bar is being mined at River Mile 60 for the Bayou Dupont marsh creation project. It has so far produced upwards of 3 million cubic yards (mcy) and it is likely that it can do this every two years into the future. We propose that the restoration in the Central Wetlands be sourced from this location on the river between RM 86 and 88. The total volume available in place is estimated at more than 12 mcy from three borrow areas (Table below), including two on land and one in a submerged bar deposit (Figure below). Over a decade, if a renewable sediment trap was engineered, it is probably that 2 to 3 mcy could be mined every year and processed through a permanent pumping plant that would produce 20 to 30 mcy in a decade. A great deal of restoration could be accomplished using this high-quality material that will not require containment, can be mined when needed, stored locally and distributed in a cost-effective way (figures below).



View downstream of prospective borrow sites in Mississippi River at Meraux

Possible Breton Sound Borrow Site

The deeper areas of Breton Sound are known to refill rapidly, and will contain more shell and sand than will be found in Lake Borgne mud. Remember, this is the area where the MRGO channel had to be re-dredged every time a tropical system passed, due to sediment infilling the channel. The reason that Breton Sound is a better borrow source is that it can be mined in a more sustainable manner along the -12 foot contour where wave action is greater causing more lateral sediment movement (figure below). It's also possible that dredge pipe could be conveniently deployed up the MRGO channel from the sound to proximate areas of restoration.



Bathymetry of Lake Borgne/Breton Sound study area. Preferred mining locations will be along the -12 foot contour on west side of Breton Sound (Gautier et al. 2008)

Recommendations for Sediment sources:

1. Use less stringent design elevation requirements to lower cost;
2. Evaluate Mississippi River including use of a sediment trap;
3. Evaluate adjacent sounds as borrow sites including Breton, Chandeleur and Mississippi Sounds;
4. Create freshwater lakes in the Central Wetlands using sites for borrow material;
5. Evaluate section of the MRGO spoil bank inside the Central Wetlands as potential borrow material.

L. INCREASE MONITORING OF THE AREA AFFECTED BY THE MRGO

The MRGO closures have already begun to influence the salinity, wetlands, and fisheries of the study area. This is not being adequately monitored. These changes seem to be favorable, but we cannot rely on anecdotal information. A more robust monitoring effort should be implemented immediately, and one that adapts as project elements are constructed. Monitoring should include water quality, fisheries, vegetative changes, etc.

M. USE OF NATURAL GAS

Consider the use of natural gas as an alternative to diesel fuel for large engines to pump sediment for restoration. Natural gas is much less expensive than the typical diesel used for these projects and with the scale of the work to be done, a cheaper fuel will equal substantial cost savings (LPBF 2011).

On an energy equivalency basis, one barrel of oil is generally equivalent to 5.8 MCF (1,000 cubic feet of gas). Natural gas is currently selling around \$4.50 MCF, and a barrel of oil is now over \$90. Simple calculations show that the cost of an equivalent (BTU) natural gas is about one-third the cost of unrefined crude oil. The natural gas cost is also about one-third the retail cost of diesel.

There are other advantages to natural gas in addition to lower product cost. If a delivery system (flow line) was put in place, there would not be re-occurring cost to deliver fuel as would be the case with barging or trucking diesel. It is also well known that internal combustion engines which use natural gas have significantly lower maintenance since the fuel is more uniform than diesel.

Long-term contracts with fixed-pricing is common for natural gas, but not for diesel. Using the leverage of the state and incentives for a long-term contract with the oil and gas industry could induce a favorable pricing for the natural gas for 10 years or more. This would allow coastal planning to proceed with a reliable cost for its energy supply. The conversion of hydrologic dredging equipment to natural gas seems to offer enormous price advantages and could greatly expand the application of marsh creation by pumping sediment.

Natural gas is also a cleaner fuel, thereby reducing air pollution. Some consider it a transition fuel to non-fossil fuels in the future. It seems especially appropriate for coastal restoration projects to use a more environmentally-friendly fuel.

N. SELECTIVE CLOSURE OF OIL AND GAS CANALS

Oil and gas canals have documented direct and indirect impacts to wetlands (Boesch, 1994). In some cases, degradation of the adjacent spoil bank is a proven methodology to eliminate the indirect hydrologic impact and to restore some of the wetlands lost. This is a proven cost effective technique, which the TSP does not include and may not have evaluated.

Oil and Gas Canal Recommendation:

Identify oil and canals to degrade spoil banks to enhance wetland restoration and natural hydrology. Dead-end side canals that do not provide local access for small craft should be examined first. In some cases, however, even in canals that provide local access or that have become important

shortcuts, limited spoil bank gapping and backfilling can be accomplished without compromising navigation.

Backfilling should be prioritized for canals that expose interior ponds to increased tidal exchange, or that disrupt remnant natural channels. In many cases, especially where maritime forest has colonized spoil and provides habitat that is not immediately threatened by subsidence gapping, to restore hydrology may be more appropriate than wholesale spoil bank removal.

Once backfilling is complete, some canal beds that have no access value should be considered for complete filling to marsh through hydraulic placement of fill.

O. IMPLEMENTATION OF A SCIENCE LIAISON COMMITTEE

The U.S. Congress directed the U.S. Army Corps of Engineers to develop a plan for restoration of environmental damage resulting from the MRGO during more than 4 decades of construction and operation. Much time and effort has been invested by the Corps in developing the “Mississippi River Gulf Outlet Ecosystem Restoration Study: Draft Environmental Impact Statement” of December 9, 2010. This draft document, which includes the Tentatively Selected Plan, has been made available for public review and comment. Three public meetings were also held for that purpose. It is clear from oral testimony given at the public meetings that a number of issues in the TSP remain to be resolved.

The affected parishes, the State of Louisiana, involved Non-Governmental organizations, and a host of other stakeholders are undoubtedly eager to work with the Corps in developing final details of a plan. The revised plan must have broad community support, be resilient and sustainable environmentally, provide increased flood protection and restore at least some of the economic and social capital lost as a result of the construction and operation of the MRGO.

It is critical to keep forward momentum in the development, funding and implementation of MRGO-related restoration, as mandated by Congress. However, for that momentum to be maintained, the Corps must ensure that its approach, as represented in the feasibility study is realistic, cost effective and has broad support among affected community, state and other stakeholders. Ongoing communication and information exchange as the Corps reviews and decides how to respond to public comment on the Draft EIS and TSP will be essential to producing a final EIS and plan that meets these criteria.

Science Liaison Committee Recommendation:

Given the complexity and likely cost of the MRGO restoration program, the need for extensive, detailed scientific field work to devise a detailed, workable Central Wetlands restoration program in phases, the utility of regional oyster reef projects, and the potentially significant changes that may have to be made to the TSP, we recommend the Corps reach out to key scientists and experts as it

reviews comments and that it will be able to participate in any formal scientific review/advisory forums that may be established in the near future regarding MRGO ecosystem restoration. We look forward to continued discussion with the Corps about these issues.

The mission of a Science Liaison Committee would be to work closely with the Corps and the State on the scope and substance of additional analysis and field studies that are necessary for TSP revisions, and the detailed designs of specific restoration components. Another role for this Committee is to help phase studies and design work to accelerate the implementation of the MRGO restoration program. The work of the Committee should be structured around an established timeline in sync with the broader planning to expedite project implementation.

P. COST SHARE

The Corps and the State of Louisiana currently disagree about the State's obligation—or lack thereof—to share the cost of constructing projects in the MRGO ecosystem restoration plan. The Corps maintains that the State is responsible for the typical cost share of 35%, whereas the State maintains that Congress intended construction of this restoration effort to be 100% federal. This impasse threatens to delay further the restoration of this critical coastal area, thereby leaving communities at risk. Resolving this dispute should be a priority of the Interagency Working Group and Congress. We interpret the congressional intent in WRDA 2007 to be 100% federal cost share for construction. Given the extent of the restoration needs, however, we encourage the State of Louisiana, the Corps, and potentially other federal agencies to work together to identify all available funding sources.

Q. REFERENCES

- Baustian J.J., Turner R.E. 2006. Restoration success of backfilling canals in coastal Louisiana marshes. *Restor Ecol* 14:634–644.
- Baustian J.J., Turner R.E., Walters N.F., Muth, D.P. 2008. Restoration of dredged canals in wetlands: a comparison of methods. *Wetlands Ecological Management* DOI 10.1007/s11273-008-9122-6
- Boesch, D.F., M.N. Josselyn, A.J. Mehata, J.T. Morris., W.K. Nuttle, C.A. Simensted, and D.J.P. Swift, 1994, Scientific Assessment of Coastal Wetland Loss, Restoration and Management in South Louisiana, *Journal of Coastal Research*, Special Issue No. 20 103 p.
- Chatry, M., Dugas, R.J., and Easley, K.A., 1983. Optimum Salinity Regime for Oyster Production on 11 Louisiana's State Seed Grounds. *Contributions in Marine Science*. Vol. 26: 81-94.
- Day, J.W, Ford, M., Kemp, P., Lopez, J, 2006. MRGO Must Go. MRGO Must Go Coalition. New Orleans, LA
- Day, John and Gary Shafer, 2009, Effects of the Mississippi River Gulf Outlet on Coastal Wetlands and Other Ecosystems in Southeastern Louisiana Submitted by: John W. Day, Jr.1 and Gary P. Shaffer2 1Department of Oceanography and Coastal Sciences Louisiana State University, Baton Rouge, LA 70803 2Department of Biological Sciences, SLU-10736 Southeastern Louisiana University, Hammond, LA 70402 Prepared for: Plaintiffs in *Robinson v. United States* Jan. 27, 2009
- Dortch, Mark, Mansour Zakikhani, Mark R. Noel, and Sung-Chan Kim, 2007, Application of a Water Quality Model to Mississippi Sound to Evaluate Impacts of Freshwater Diversions September 2007 USACE ERDC/EL TR-07-20
- Georgiou, I., J.A. McCorquodale, A.G. Retana, D.M. FitzGerald, Z. Hughes, 2007, Hydrodynamic and Salinity Modeling in the Pontchartrain Basin: Assessment of freshwater diversions at Violet with MRGO Modifications Final Report, August 2007
- Georgiou, Ioannis Y., J. Alex McCorquodale, Jennifer Schindler, Angel G. Retana, Duncan M. FitzGerald, Zoe Hughes, Nick Howes, 2009, Optimization of the Violet Diversion in the Pontchartrain Estuary along with other upper and middle estuary diversions and MRGO modifications Final Report to: NOAA Pontchartrain Restoration Program Submitted by: Pontchartrain Institute for Environmental Sciences, University of New Orleans, New Orleans, LA 70148
- Environmental Services, Inc, 2009, Cypress Tyree Map 1930's (Central Wetlands) Prepared for: Plaintiffs in *Robinson v. United States* Jan. 27, 2009
- La. Dept of Transportation and Development, 2007, The Failure of the New Orleans Levee System during Hurricane Katrina, Final report
<http://www.dotd.louisiana.gov/administration/teamlouisiana/>
- Lake Pontchartrain Basin Foundation, 2006, Comprehensive Habitat Management Plan for the Pontchartrain Basin, Lake Pontchartrain Basin Foundation, Metairie, LA
<http://www.saveourlake.org>
- Lake Pontchartrain Basin Foundation & Coalition to Restore Coastal Louisiana, 2008, Comprehensive Recommendations Supporting the Use of the Multiple Lines of Defense Strategy to Sustain Coastal Louisiana 2008 Report (Version I) <http://www.saveourlake.org>
- Lake Pontchartrain Basin Foundation, 2010, Letter correspondence from LPBF to LA DEQ requesting a moratorium on wastewater assimilation projects into coastal marshes.
- Lake Pontchartrain Basin Foundation, 2011, Use of Natural Gas for Coastal Restoration in Coastal Louisiana, John A. Lopez, Ph.D. <http://www.saveourlake.org>

- LPBF, 2006b. A Post-Katrina Assessment of the “Freshwater Diversion to Lake Pontchartrain Basin and Mississippi Sound. Lake Pontchartrain Basin Foundation. New Orleans, LA.
- Lopez, J. A., 2009, The Multiple Lines of Defense Strategy to Sustain Coastal Louisiana, *Journal of Coastal Research*, Special Publication 54, 2009
- Lopez, J. A., 2009, The Environmental History of Human Induced Impacts to the Lake Pontchartrain Basin in Southeastern Louisiana since European Settlement – 1718 to 2002, *Journal of Coastal Research*, Special Publication 54, 2009
- Lopez, John, Amanda Moore, Juanita Constible, 2010, Mister Go Isn't Gone Yet: Creating Community and Environmental Resiliency in the Wake of a Man-Made Catastrophe MRGO Must Go Coalition April 2010
http://mrgomustgo.org/images/stories/pdf/mrgo_april_2010_report_mrgomustgocoalition.pdf
- La. Dept of Transportation and Development, 2007, The Failure of the New Orleans Levee System during Hurricane Katrina, Final report
<http://www.dotd.louisiana.gov/administration/teamlouisiana/>
- Mashriqui, H. *et al.*, 2006, Experimental Storm Surge Simulations for Hurricane Katrina, in "Coastal Hydrology and Water Quality," Y.J. Xu, & V.J. Singh, (editors), Proceedings of the AIH 25th Anniversary Meeting & International Conference, American Institute of Hydrology (AIH), May 21-24, 2006, Baton Rouge, Louisiana, USA, pp. 481-89; Working Group for Post-Hurricane Planning, p. 17.
- Neil, C., and R.E. Turner. 1987. Backfilling canals to mitigate wetland dredging in Louisiana coastal marshes. *Environmental Management* 11: 823-836.
- Shaffer, Gary P. Thais E. Perkins, Susanne Hoepfner, Susan Howell, Heath Bernard and Carol Parsons, 2003, Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion, Prepared for EPA Region 6.
- Swenson, E.M., and R.E. Turner. 1987. Spoil banks: effects on a coastal marsh water-level regime. *Estuarine, Coastal and Shelf Science* 24: 599-609.
- Turner, R.E., J.M. Lee, and C. Neill. 1994. Backfilling canals to restore wetlands: empirical results in coastal Louisiana. *Wetlands Ecology and Management* 3: 63-78.
- USACE, 2009, Louisiana Coastal Area Coastal Restoration and Protection, Technical report
- USACE, 1999. For the Environmental Subcommittee of the Technical Committee Convened by EPA in Response to the St. Bernard Parish Council Resolution 12-98. Habitat impacts of the construction of the MRGO. 83pp.
- U.S. Army Corps of Engineers, 2003, West Pearl River Navigation Project, Louisiana and Mississippi, Section 216 Initial Appraisal, Vicksburg District
- U.S. Army Corps of Engineers, 2003, Economic Values Associated with Construction of Oyster Reefs; Corps of Engineers ERDC TN-EMRRP-ER-01 September 2003 by Jim Henderson and Jean O'Neil

R. APPENDIX: Hydraulics of the Violet Canal

Memorandum regarding Violet Diversion canal hydraulics
FROM: G. Paul Kemp, Ph.D.

RE: Hydraulic and hydrographic information in Engineering Appendix and collaborative re-analysis by USACE H&H Staff

The December 2010 draft Engineering Appendix for the MRGO Ecosystem Restoration Feasibility Study provided by the U.S. Army Corps of Engineers, New Orleans District was examined. I include a HEC-RAS analysis for the Violet (Location 3) diversion alternative.

1.0 Information relevant to the choice of Location 2 for the TSP.

First, it is important to state that while four alternative alignments for the Violet Diversion are proposed, no engineering rationale is given in the appendix for choosing one over another. The operative statement is on p. 2-76:

Based on the results of this investigation and other factors such as existing infrastructure, location on the river length of outflow channel and potential for influencing the Central Wetlands alternative Location 1 was selected as part of the TSP. Further plan selection details can be found in the main report.

The TSP channel has the following elements that make it more complex than a retrofit of the Violet canal/Bayou Dupre route (p. 10-1):

10.2 VIOLET DIVERSION

Five separate contracts are planned for the Violet Diversion. All contracts are assumed to start at the same time.

Contract D1 includes the construction of the structure at the Mississippi River.

Contract D2 includes the construction of the bridge at Judge Perez.

Contract D3 includes the construction of the structure at the 40 Arpent levee.

Contract D4 includes the construction of the structure at the MRGO.

Contract D5 includes the construction of the diversion channel from the Mississippi River structure to the 40 Arpent Levee.

Contract D6 includes the construction of the diversion channel from the 40 Arpent levee to the MRGO.

If the existing Violet canal location is used, it will not be necessary to construct a new bridge at Judge Perez, and no structure is required at the 40 Arpent levee. We do not know whether a third outlet structure from the CWA is necessary or desirable and find no justification in the Engineering Appendix for construction of a third water control structure through the Chalmette Levee, though it might be more advantageous for a diversion at Location 1 than one at B. Dupre (Location 3). Omitting these elements should greatly reduce costs.

We heard many complaints at the public meeting in Chalmette on January 20 about the USACE TSP route for the Violet Diversion authorized in WRDA07. The choice of the Sinclair Tract in Meraux was met with widespread rejection -- including the landowner -- given that the existing leveed channel actually in Violet has always been envisioned for the conveyance and already serves

as a divide in the forced drainage plan. The Engineering Appendix does not provide a cogent basis for the shift. It appears from the initial work that any of the channels serve as well as another from the hydraulic standpoint. Clearly, the costs should be lower for the existing channel (Location 3), particularly as we concur with USACE H&H personnel that the footprint (top width) of all channel alternatives has been greatly overestimated (see next section). This appears to be a holdover of the original specifications for a larger channel (p. 2-73) capable of conveying twice the maximum discharge (15,000 cfs) now envisioned (7,000 cfs).

2.0 Design of the Violet Canal Diversion Alternative

Results of a HEC-RAS analysis are provided below for a diversion at the existing Violet canal/Bayou Dupre location

An overarching concern expressed was that the use of the existing Violet canal to convey 7,000 cfs should be more fully evaluated. The assumptions and boundary conditions used in preliminary design should be clearly stated and re-evaluated to determine if adjustment of these variables could influence the feasibility of the use of the existing canal. A more detailed analysis of the constraints associated with the use of the existing channel should be performed.

A preliminary analysis of the existing Violet canal indicates that with modifications, it can be used to convey the 7,000 cfs, when using the current boundary conditions (i.e. exceedance criteria). Dredging would be required to between Elev. -20 and -21 throughout the canal length compared to -12 in the TSP. The geometry used in this analysis consisted of a bottom width of 40 ft. and 3:1 side slopes. At 7,000 cfs., the top width and stage at the upstream end of the channel would be 135ft. (the approximate current width of the channel) and Elev. 3.8 ft., respectively. With 1 ft. of freeboard, the top width of the channel would be 140 ft, the cross-section just downstream of the Mississippi River culvert (when the flow is fully expanded) is shown in Figure 1 (ignore the extra cross sectional area above the water profile). The profile of the channel during this scenario is depicted in Figure 2.

The channel was allowed to expand out to an 80-ft bottom width (resulting in a 220 width top width) once downstream of the Judge Perez Bridge. The bends in the channel were neglected for this analysis, since including them would have minor impacts on the results.

For this same channel geometry, the 99% non-exceedance stage at the River (Elev. 12.3 NAVD), the same stage at Lake Borgne as in the original analysis, and assuming that the sluice gates at the culvert are left wide open; the stage at the above-mentioned cross section would be at Elev. 6.1, the top width at 230 ft., and the diversion would flow at approx. 10,393 cfs. The same cross section with this scenario is depicted in Figure 3. Of course, allowing flows greater than 7,000 cfs is not part of the current TSP.

The 40-Arpent Levee culvert structure included in the TSP appears unnecessary for a diversion at Location 3, as was noted above. Referencing Fig. 4 (note the ridges in the LIDAR), removing the culvert could be done in the TSP from a hydraulic standpoint, but this might engender more concern for hurricane protection by appearing to allow surge to intrude into canals that traverse populated areas. Of course, no provision exists in the TSP to close this opening in the 40 Arpent Levee so that is not relevant. The USACE does not believe it is authorized to beef up storm protection, so H&H doesn't see the need to put a gate here, because one isn't there now. The current levees could simply be enhanced to handle the diversion, in which stages are not extremely high.

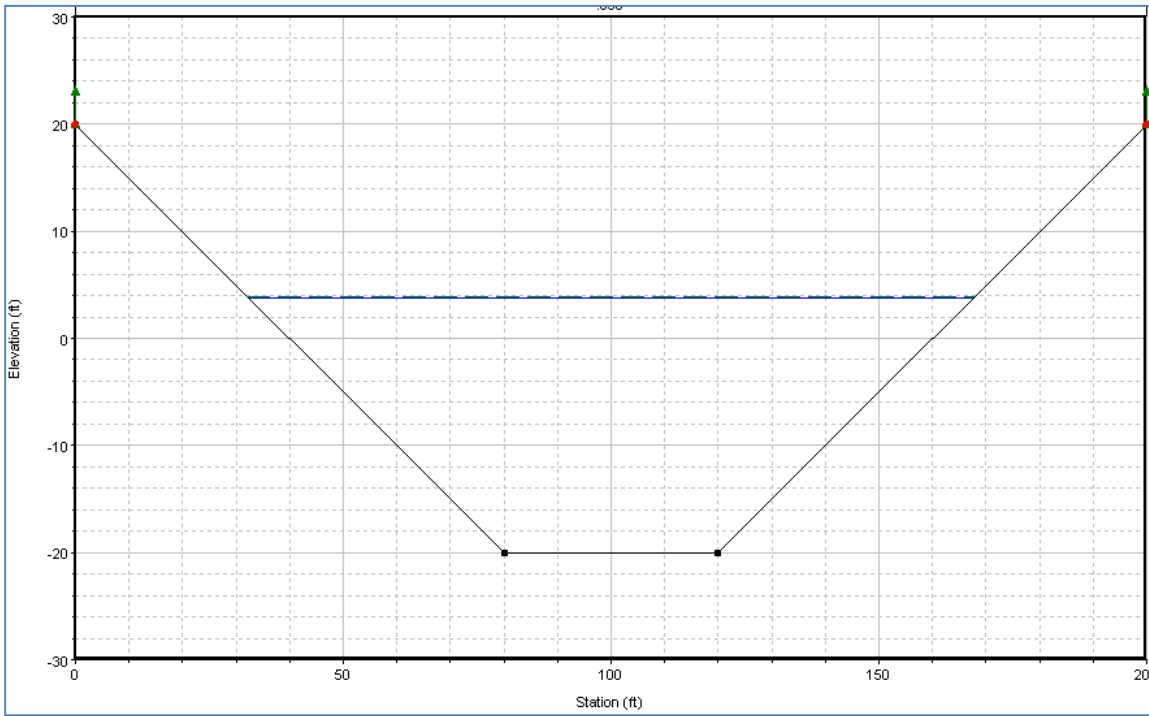


FIGURE 1. Section Downstream of Culvert – 7,000 cfs.

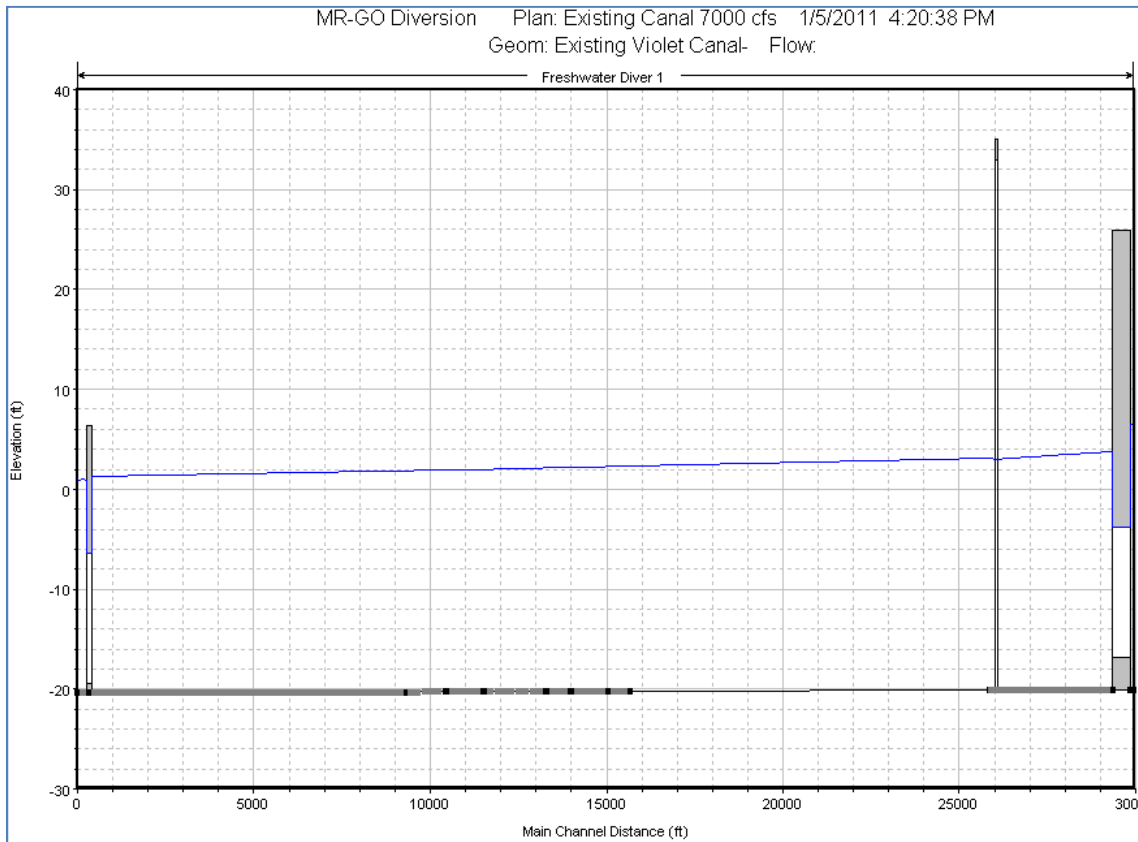


FIGURE 2: Profile of channel at 7,000 cfs.

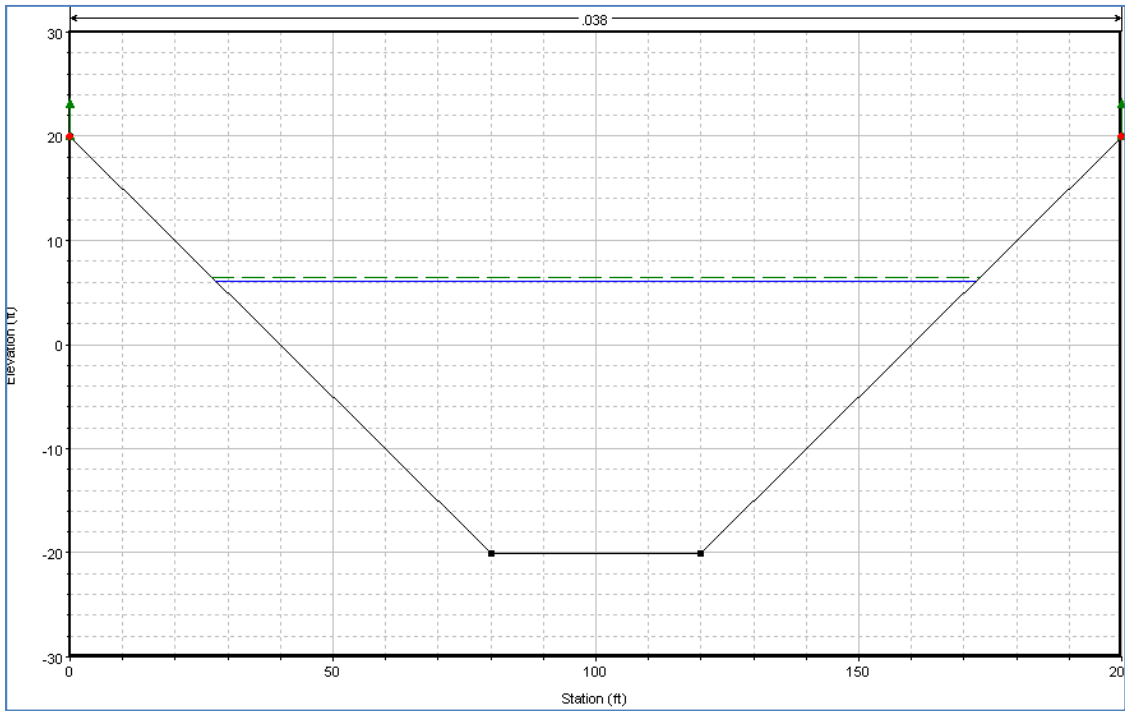


FIGURE 3. Section Downstream of Culvert – Theoretical Maximum Flow

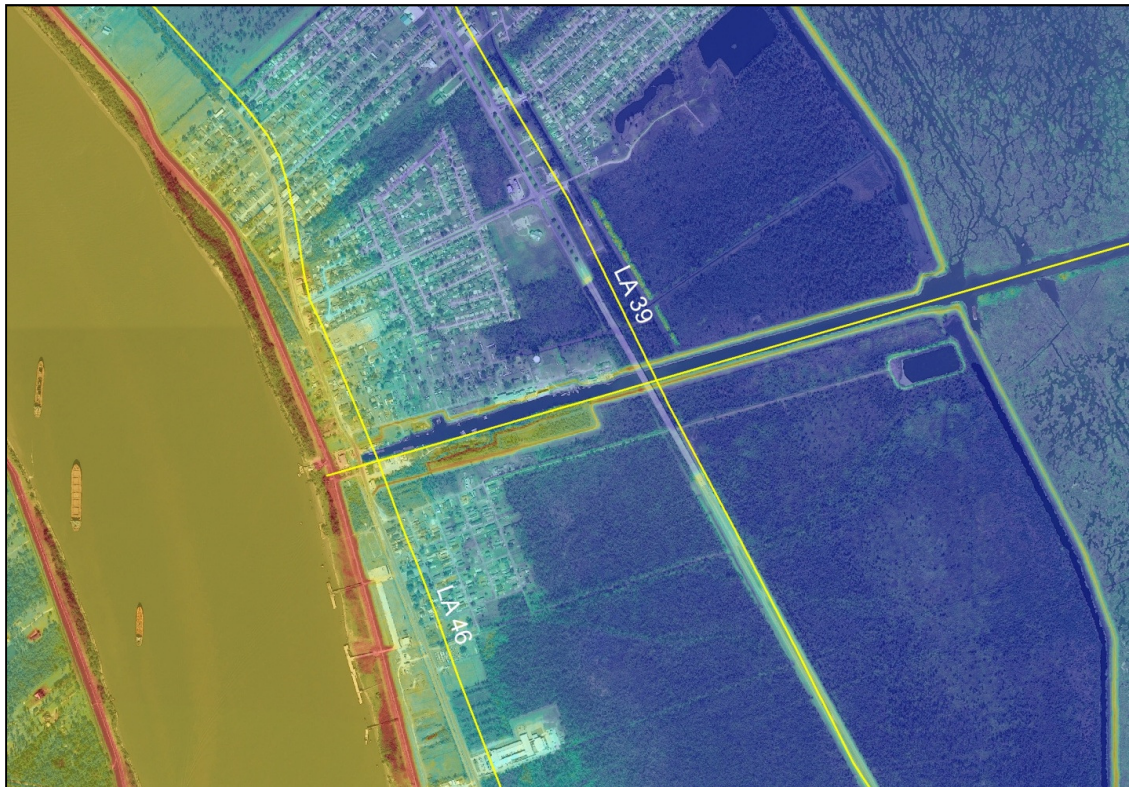


FIGURE 4. Plan View showing local levees

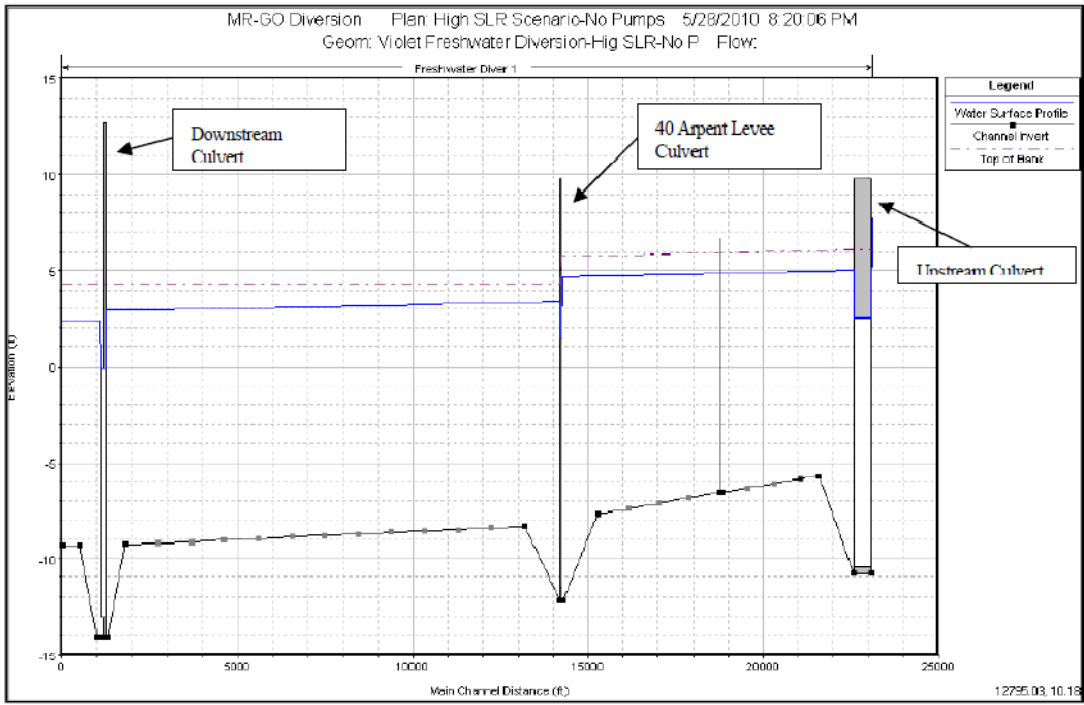
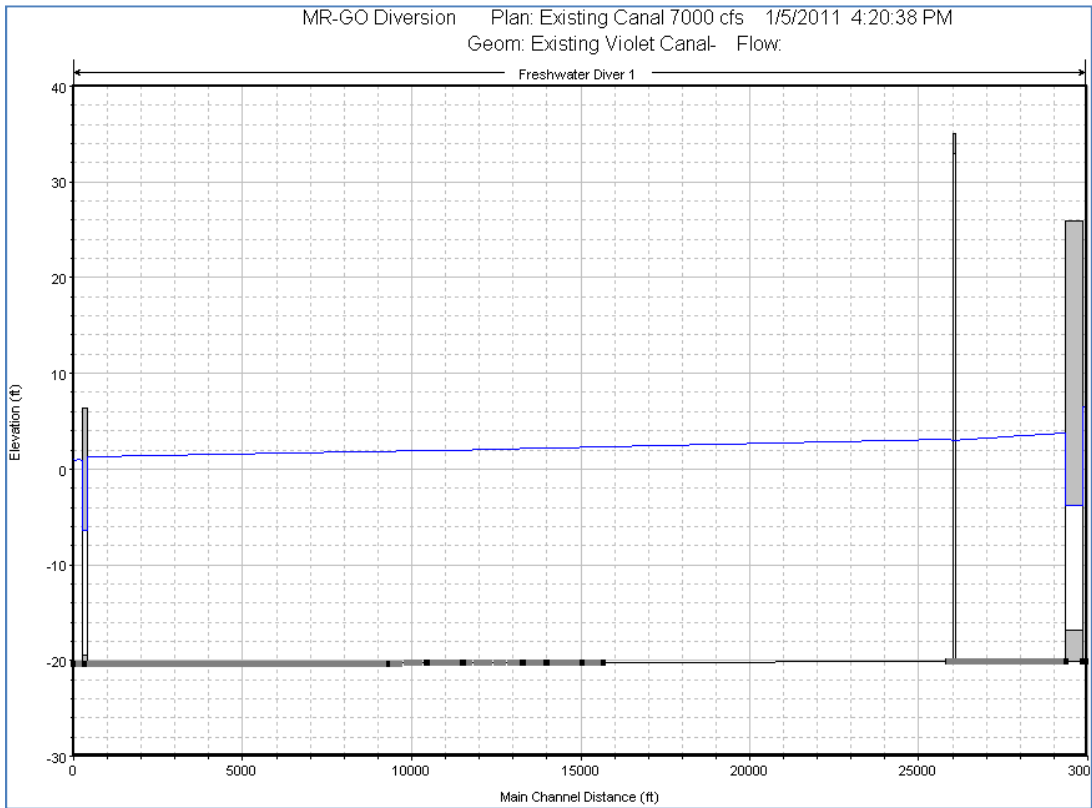


Figure 68 Channel Profile



FIGURES 5 and 6. Comparison of diversion flowline at 7,000 cfs at TSP location (above) and simpler existing Violet Canal deepened to 20 ft. (below).