



State of Louisiana

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KATHLEEN BABINEAUX BLANCO
GOVERNOR

April 30, 2007

Dear Members of the Louisiana Legislature,

I am proud to submit for your consideration and approval, the state's coastal master plan, entitled Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast. The completion of this plan is an historic step in a journey which promises safer communities, a more sustainable coastal landscape, and a brighter future for Louisiana.

Based on years of coastal research and on lessons learned after the hurricanes of 2005, this Master Plan represents a bold vision for the complete integration of coastal protection and restoration. For the first time in Louisiana's history, state and local governments will be truly focused on the comprehensive, long term protection of our coastal communities and the sustainable restoration of our coastal landscape, working closely with the Congress to ensure a high level of federal coordination and support.

Over the past eighteen months, the Coastal Protection and Restoration Authority marshaled, through its integrated planning team, the best expertise available in developing this Master Plan. During almost five months of public review of the plan, they engaged members of the Louisiana Legislature, local governments, critical state and national stakeholders, and key leaders in the Congress and the federal Executive Branch of government. This plan embodies an open and credible process that will continue as it is implemented and adapted, using the best science and engineering here and throughout the world.

The death and devastation caused by hurricanes Rita and Katrina have strengthened our resolve to establish a lasting legacy of coastal protection and restoration for south Louisiana. The passage of this Master Plan is the first step in making that legacy a reality for our coastal communities today.

Sincerely,

A handwritten signature in black ink that reads "Kathleen Babineaux Blanco".

Kathleen Babineaux Blanco
Governor

Coastal Protection and Restoration Authority Members

Sidney Coffee, Chair,
Governor's Executive Assistant for Coastal Activities

Scott Angelle, Secretary,
Department of Natural Resources

Johnny Bradberry, Secretary,
Department of Transportation and Development

Bryant Hammett, Secretary,
Department of Wildlife and Fisheries

Karen Gautreaux, Deputy Secretary, Department of Environmental Quality (Designee of the Secretary)

Michael Olivier, Secretary,
Department of Economic Development

Brad Spicer, Assistant Commissioner,
Department of Agriculture and Forestry (Designee of the Commissioner)

Jerry Luke Leblanc, Commissioner,
Division of Administration

R. King Milling, Chair, Governor's Advisory Commission on Coastal Protection, Conservation, and Restoration

Colonel (Ret.) Perry "Jeff" Smith,
Acting Director, Governor's Office of Homeland Security and Emergency Preparedness

Ben Moss,
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Steve C. Wilson, Levee Region 3 Representative – President, Pontchartrain Levee District

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Tina Horn, Non-Levee Parish Representative – Parish Administrator, Cameron Parish

Mike Grimmer, Non-Levee Parish Representative – Parish President, Livingston Parish

The Authority recognizes the contributions of Year 2006 members who contributed their time and effort to this critical effort:

Benny Rousselle, former President, Plaquemines Parish, Non-Levee Parish Representative

Gerry Spohrer, Executive Director, West Jefferson Levee District

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Executive Summary

Setting the Bar Higher

The Master Plan was developed to fulfill the mandates of Act 8, which was passed by the Louisiana Legislature in November 2005 and signed into law by Governor Blanco. The act created the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, state, and federal agencies to achieve long-term and comprehensive coastal protection and restoration. In so doing, the CPRA must integrate what had previously been discrete areas of activity: flood control and wetland restoration. Act 8 also requires that the CPRA establish a clear set of priorities for making comprehensive coastal protection a reality in Louisiana.

The Master Plan is the principal means for achieving this goal. As such, the plan is informing several ongoing efforts, including the Louisiana Recovery Authority's Louisiana Speaks planning process and the development of the U.S. Army Corps of Engineers' Louisiana Coastal Protection and Restoration Report, which will be completed in December 2007.

The Master Plan presents a series of recommended hurricane protection and coastal restoration measures. Maps and explanations about the measures, as well as a management strategy for implementing them are also provided. Taken together, the Master Plan presents a conceptual vision of a sustainable coast based on the best available science and engineering.

The need for this comprehensive, integrated approach is acute. Since the 1930s, coastal Louisiana has lost over 1.2 million acres and is still losing land at the rate of 15,300 acres per year. This extreme rate of loss threatens a range of key national assets and locally important communities. Pipelines, navigation channels, and fisheries as well as centuries-old human settlements and priceless ecosystems are all at risk.

Hurricanes Katrina and Rita intensified the problem. Approximately 200 square miles of marsh were destroyed, over 200,000 homes were damaged, over 1,400 Louisianians died, and more than one million state residents were displaced by the storms. The hurricanes also disrupted the national economy, spiking fuel prices, lowering energy reserves, and slowing grain shipments to world markets. The hurricanes' effects highlighted the need to improve Louisiana's hurricane protection systems and restore the wetlands upon which so much of our national economy depends.

Goals of the Master Plan

- Present a conceptual vision for a sustainable coast.
- Be a living document that changes over time as our understanding of the landscape improves and technical advances are made.
- Emphasize sustainability of ecosystems, flood protection, and communities.
- Integrate flood control projects and coastal restoration initiatives to help both human and natural communities thrive over the long-term.
- Be clear about what we don't know. In some areas, scientific and technical advancements will be needed before we can make definitive pronouncements as to what will happen.

What Coastal Louisiana Provides

- **Energy infrastructure:** The wetlands protect critical oil and gas infrastructure from storm surge. This infrastructure produces or transports nearly one-third of the nation's oil and gas supply, and is tied to 50% of the nation's refining capacity (LA Department of Natural Resources, 2006).
- **Shipping:** Ten major navigation routes are located in south Louisiana. Five of the busiest ports in the U.S., ranked by total tons, are also located here. These facilities handle 19% of annual U.S. waterborne commerce (USACE, 2003).
- **Fisheries and wildlife habitat:** Louisiana provides 26% (by weight) of the commercial fish landings in the lower 48 states (US Department of Commerce, 2005). More than five million migratory waterfowl spend the winter in Louisiana's marshes (LA Department of Wildlife & Fisheries, 2000). The coastal landscape also provides stopover habitat for millions of neotropical migratory birds and 17 threatened or endangered species.



- **Water quality:** If river water flows through them, wetlands can filter nutrients that would otherwise flow directly into the Gulf of Mexico. Concentrations of these nutrients in the northern Gulf of Mexico contribute to the growing problem of hypoxia, or low oxygen conditions, in offshore coastal waters.
- **Culture:** The diverse peoples of south Louisiana have created a multi-faceted culture known throughout the world. Moreover, coastal Louisiana is home to two million residents, or over half of the state's population.

Assumptions and Technical Challenges

The planning team used several assumptions to guide their work.

1. This version of the Master Plan is a first cut at what will be a living document that changes over time.
2. A sustainable landscape is a prerequisite for both storm protection and ecological restoration.
3. Change is inevitable; the ecosystem is degrading now, and restoring sustainability will bring changes of its own.
4. Plans for hurricane protection must rely on multiple lines of defense.

Such assumptions lead to difficult choices, and the Master Plan enumerates several tradeoffs implicit in its proposals. For example, not every community will receive the same level of hurricane protection. The plan also discusses the shifts in fisheries and other traditional uses of the coast that are likely to occur when major river diversion projects are constructed.

Technical unknowns pose challenges as well. Questions remain about the ways in which climate change will affect the coast, as well as how to best balance the effects of diversions, levees, and restoring marshes using dredged sediments. Although we do not yet have all the answers, we do know that many of our existing protection and restoration techniques are effective.

We must begin creating a sustainable coast without delay, using methods that we know can work, while also field testing new concepts and learning as we go. Given the magnitude of the task at hand, a stepwise process based on sound science and engineering is the only way forward.

The Master Plan

An Integrated Planning Team made up of employees from the Department of Natural Resources and the Department of Transportation and Development took the lead in developing the Master Plan. The team, working in consultation with stakeholders, scientists, engineers, and the public, identified four objectives that define what the plan seeks to achieve:

- reduce risk to economic assets
- restore sustainability to the coastal ecosystem
- maintain a diverse array of habitats for fish and wildlife
- sustain Louisiana's unique heritage and culture

The full text of the objectives, as well as principles that guided the group's work, are presented in Appendix A.

Timeline: How the Master Plan was Developed

Act 8 Signed	Nov. 2005
Integrated Planning Team established	Feb. 2006
First plan formulation workshops held	May 2006
Plan formulation report completed	June 2006
Plan formulation report included in USACE report to Congress	July 2006
Six LA Recovery Authority Louisiana Speaks workshops held, providing input to Master Plan process	July-Aug. 2006
Over 50 stakeholder workshops and meetings held	July-Nov. 2006
Decision process workshop held with agency partners, science advisors, and NGOs	Sept. 2006
Second plan formulation workshops held	Oct. 2006
Preliminary Draft Master Plan presented for public review; 9 public meetings held	Nov.-Dec. 2006
Technical review panels meet and offer comments on Preliminary Draft Plan	Dec. 2006-Jan. 2007
Draft Master Plan presented for public review; 3 public hearings and 1 public meeting held	Feb.-March 2007
Technical review panels meet and offer comments on Draft Master Plan	March 2007
Final Master Plan submitted to legislature	April 2007



The measures contained in the plan can be broken down into three groups, based upon the broad outcomes they deliver:

- Restoring sustainability to the Mississippi River Delta
- Restoring sustainability to the Atchafalaya River Delta and Chenier Plain
- Hurricane protection—both structural and non-structural measures

Restoring Sustainability to the Mississippi River Delta

Creating a sustainable deltaic system requires that we reestablish the processes that originally created the landscape.

Reconnecting the Mississippi River to the wetlands through controlled diversions will restore flows of water through the wetlands so that the ecosystem can retain sediment and nutrients. We also need to act quickly to restore critical landforms before they are lost.

Land building diversions. Commonly referred to as the Mississippi River Delta Management plan, this concept involves building very large diversions that will use the majority of the river's sediment and fresh water to both create new delta lobes and nourish existing wetlands. We do not yet know where, how big, or how numerous these diversions will be, but some possible scenarios are presented in Figures 7 and 8. As this concept is studied further, we must consider not only how to sustain new wetlands but also how navigation and natural resource interests will be affected.

Land sustaining diversions. These diversions are not designed to build wetlands in large areas of open water, rather they are designed to reduce loss and restore the sustainability of existing wetlands. The proposed diversions are envisioned as parts of an interconnected system that will be operated as a whole; individual projects will not be operated in isolation. Along these lines, it is important to review the operation of Davis Pond, Caernarvon, and other land sustaining diversions already in place to ensure that these diversions are providing maximal ecosystem restoration benefits.

Marsh restoration with dredged material. Diversions distribute sediments to areas of need, rather than allowing the sediments to be channeled out of the coastal ecosystem into offshore waters. Another important tool for "getting the sediment right" is distributing these lost sediments through dredging and pipeline conveyance to restore wetlands. One way to

accelerate the benefits of diversions would be to mechanically restore lost marsh by pumping sediments via pipeline from the bed of the Mississippi River, offshore, or from navigation channels.

Navigation channels. The plan recommends using existing navigation channels, such as the Gulf Intracoastal Waterway and the Houma Navigation Canal, as “new distributaries” that could channel water to more remote areas of the coast.

Barrier shoreline restoration. Barrier shorelines are important habitat for many bird species as well as threatened and endangered animal species. They also serve as a first line of defense against storm surge. Barrier shoreline restoration is recommended in the Terrebonne and Barataria Basins because these ecologically important habitats are close enough to marsh and human settlements to diffuse wave energy and storm surge. In the Chandeleur Islands, the state will work with the Department of the Interior as it continues to develop a restoration and management plan to maintain the area as a national wildlife refuge.

Ridge habitat restoration. Ridges are natural elevated features that support woody vegetation and provide habitat for a variety of wildlife species, including migratory species crossing the Gulf. These features can also deflect storm surge, particularly during lower energy winter and tropical storms.

Shoreline stabilization. The plan recommends stabilizing selected shorelines near critical land masses as well as marsh fringes near flood protection works. This can be accomplished either by rock structures or by establishing living reefs. Securing shorelines will help preserve the boundaries of waterbodies and protect areas such as the Biloxi Marshes, the bay side of Grand Isle, and the Jefferson Parish levee system.

Closure of the Mississippi River Gulf Outlet. The plan calls for the immediate closure of the MRGO to deep draft navigation and for the construction of a closure dam at Bayou LaLoutre. The plan's intent is to restore the integrity of the Bayou LaLoutre ridge and use the remainder of the channel to convey fresh water from the Mississippi River to the Biloxi Marshes and other areas of St. Bernard Parish. The plan also includes restoration of wetlands and swamps in the Central Wetlands and Golden Triangle areas. Since this strategy will affect deep and shallow draft navigation industries, appropriate economic mitigation plans will be needed after the channel is closed. In this regard, the status of the Inner Harbor Navigation Canal lock must be resolved.



Restoring Sustainability to the Atchafalaya River Delta and Chenier Plain

The Atchafalaya River Delta is the only region of coastal Louisiana that is building land naturally, and the Master Plan seeks to take maximum advantage of this resource. Further west in the Chenier Plain, navigation channels and canals have allowed salt water to penetrate inland, destroying fragile marsh and impinging on freshwater lakes. The Chenier Plain Freshwater and Sediment Management and Reallocation Plan, recommended in the Master Plan, will help fine tune appropriate measures for the region.

Managing water and sediment. In order to reduce the impacts of periodic saltwater intrusion, the plan suggests managing river and surface fresh water supplies to ensure the availability of fresh water throughout the year. Such management will also permit the delivery of fresh water to areas that may be exposed to saltwater stress while also reducing reliance on groundwater resources.

- Navigation channels provide opportunities to distribute fresh water from the Atchafalaya River. For example, the GIWW could be used as a conduit to move the river's water to the west.
- The plan recommends that drainage be wisely managed in the Mermentau Basin. Such management would ensure that fresh water is available where needed for ecosystem and agriculture needs, but that communities are not placed at greater risk of flooding.
- The plan seeks to maintain the integrity of freshwater resources by shoring up the banks of selected navigation channels, fortifying and maintaining spoil banks along the GIWW and Freshwater Bayou Canal, raising and armoring critical sections of highways, and placing saltwater barriers at deep draft shipping channels to manage salinity levels.

Marsh restoration using dredged material. New land can be created by using dredged material from maintenance dredging of navigation channels. This is a particularly viable strategy in areas near the Calcasieu Ship Channel and the Atchafalaya River Navigation Channel. In other areas, material dredged and transported from offshore could be used to restore lost marsh.

Barrier shoreline restoration. Restoring the barrier shorelines of the Chenier Plain in areas of severe shoreline retreat will be accomplished using a combination of two methods: sand; placement and use of hard structures, such as offshore segmented breakwaters. These methods will help ensure that the shoreline maintains its integrity and protects interior marshes while continuing to allow tidal exchange.

Lake shoreline stabilization. The plan recommends stabilizing key areas along the Chenier Plain's bay and lake shorelines that, if breached, would have catastrophic results for the landscape. By preventing lakes from growing in size, stabilization will also protect surrounding marsh, cheniers, and coastal prairie from wave induced erosion.

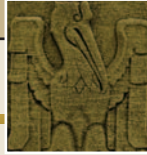
Hurricane Protection

If the state and nation are to continue enjoying the benefits provided by the communities of south Louisiana, new and upgraded hurricane protection systems are necessary. The level of protection provided will be proportional to the assets at risk. There is concern that levees built across swamp and marsh would stop the flow of water, leading to further wetland loss and creating impoundments that flood communities. These concerns must be addressed as projects are developed.

Consider the entire system. Water, sediment and nutrients must be delivered to the wetlands, and overall hydrology must be improved by minimizing impediments to water flow. Protection and restoration actions must be designed to work together to ensure that they do not induce flooding in low-lying communities, and that flood water is not trapped within the system.

Levees, or some other form of flood control structure, are recommended for high risk areas that must be protected in order to avoid severe consequences for the state and nation.

Hurricane protection structures must be built and maintained so that the ecosystem remains dynamic and functional.



Use non-structural measures to reduce risk. Given that levees and restored wetlands cannot eliminate all damage from flooding and storms, non-structural solutions offer tools that communities can use now to reduce their risks. In this regard, keeping wet areas wet is important, both for safety and flood control reasons. Approved evacuation plans must be followed, and evacuation routes must be properly maintained and armored as necessary. Communities must also follow FEMA-approved hazard mitigation plans and consider compartmentalization plans.

Non-Structural Solutions: Tools Citizens Can Use

- **Flood insurance.** Because of its low lying topography, Louisiana has the highest rate of repetitive flood losses in the nation. Given the base risk, all residents of coastal Louisiana should purchase flood insurance.
- **Elevating and retrofitting structures.** Residents of south Louisiana can improve their homes in ways that reduce the risk of storm damage. Hazard mitigation funds are available to citizens for this purpose.
- **Building codes.** The 2007 Louisiana State Uniform Construction Code is designed to ensure that new construction can better withstand hurricane force winds. Citizens must comply with the provisions of this code.

Focused structural solutions. Restoration and non-structural measures can reduce the risk from storm surge. But in most areas of coastal Louisiana, the number of people and assets at risk warrants higher degrees of protection. The Master Plan recommends building hurricane protection systems in the following areas.

- *Lake Pontchartrain Barrier Plan.* To increase protection in metro New Orleans, including areas such as the North Shore of Lake Pontchartrain that have no protection today, an outer barrier must be built. This barrier should raise protection over the level needed to withstand a storm that has a 1% chance of occurring in

any given year. Figures 13-15 show some concepts being considered for this project, but additional planning and design is needed in order to select the appropriate alignment.

- *Barataria Basin and West Bank.* Additional hurricane protection structures must be built to increase protection to the West Bank of metro New Orleans and to provide protection to central and western Barataria Basin communities that have no protection today. The upgraded hurricane protection system would work with projects already underway to provide the West Bank with protection over the level needed to withstand a storm that has a 1% chance of occurring in any given year. In addition, the project would provide protection to Lafourche Parish and the communities in the central Barataria Basin sufficient to withstand a storm with a 1% chance of occurring in any given year.

The state is awaiting the results of further modeling to refine alternative alignments for this project (see Figures 16-18 for some possibilities now under consideration). In addition, new engineering options are needed in order to design flood control structures that will work in conjunction with diversions north of the alignment. Together, these structures should be planned and designed to maximize sustainability while providing needed hurricane protection. All of these issues will be explored in depth as feasibility studies for the project are conducted.

- *Plaquemines Parish.* The plan recommends a multi-faceted protection plan for Plaquemines Parish. All sections of levees intended to provide hurricane protection would become federal levees under this plan. Levees south to Oakville would be raised to provide a greater than 100 year level of protection, meaning protection over the level needed to withstand a storm that has a 1% chance of occurring in any given year. Levees between Oakville and Myrtle Grove on the west bank and between Caernarvon and White Ditch on the east bank would be improved to improve to withstand a storm that has a 1% chance of occurring in any given year. As stated above, these stretches of levees would be made part of the federal hurricane protection system.



The drainage levee south of Myrtle Grove would also be federalized and brought to the same elevation as the current federal hurricane protection levees in southern Plaquemines Parish. South of St. Jude on the west bank and south of Phoenix on the east bank, the levees would be maintained at their currently authorized heights. This plan would protect concentrations of industry and populations, while respecting the limitations imposed by the unique geography of Plaquemines Parish.

- *Terrebonne Parish and Atchafalaya Delta.* The plan recommends construction of the existing alignment for the Morganza to the Gulf project, which has been approved after more than 15 years of study by citizens, scientists, and federal agencies. The project will protect the Houma/Thibodaux area, which has a growing population of over 200,000 residents and is currently unprotected. An inner barrier to provide a second line of defense south of Houma may also be needed, pending further study. Regardless, the Morganza to the Gulf project must proceed without delay.
- *LA 1 Highway Corridor.* Louisiana's southernmost port is Port Fourchon, strategically located in the central Gulf region where it serves as a focal point for deepwater oil and gas activities. However, the only roadway connecting the port to the rest of the nation is the vulnerable, two-lane LA 1 highway. Efforts are underway to upgrade and raise on concrete structure the sections of LA 1 that are outside of the existing levee system. To protect the portion of this federally recognized energy corridor that lies within the levee system, the levee between LaRose and Golden Meadow should be raised significantly to provide a 1% level of protection. This means that the protection would be sufficient to withstand a storm with a 1% chance of occurring in any given year. Completion of the Morganza to the Gulf and Donaldsonville to the Gulf projects, together with restoration activities, would further increase levels of protection to this highway. If ongoing modeling and analysis show that risks to assets in this area remain unacceptably high, the Master Plan recommendations will be modified accordingly.

- *Acadiana*. In this region, the highest concentrations of assets are found in Lafayette, New Iberia, and Abbeville. The plan recommends that these areas receive a greater than 100 year level of protection, meaning protection over the level needed to withstand a storm that has a 1% chance of occurring in any given year. Areas between New Iberia and Berwick/Patterson should be protected to withstand a storm with a 1% chance of occurring in any given year. However, much planning and analysis remain to be done before deciding how best to protect this region.
- *Chenier Plain*. The plan recommends that the Lake Charles/Sulphur area receive a greater than 100 year level of protection. This may be achieved with a ring levee that surrounds population centers as well as critical oil and gas infrastructure. Much planning and analysis remain to be done before deciding how best to protect this region.

Areas between Abbeville and Lake Charles, where the human population is large but dispersed, would initially be protected by fortifying spoil banks and raising highways in critical locations. If the highway is located on or at the base of a chenier, raising it further is likely unnecessary. The plan recommends improving protection to homes and properties located on cheniers by armoring highway embankments in certain vulnerable locations. In selected low spots, such as along the eastern edge of Highway 82 south of Forked Island, the highway will need to be raised in order to protect the Mermentau Freshwater Basin. If further analysis shows that these measures will not provide enough protection, a levee would be considered along the GIWW. This analysis is ongoing.

Next Steps: Implementing the Master Plan

Some of the measures described above must be implemented before others for a variety of reasons, including: funding constraints, institutional barriers, technical unknowns, and the requirements of individual projects. The state's *Annual Plan: Ecosystem Restoration and Hurricane Protection in Coastal Louisiana* will be the vehicle for presenting yearly scheduling and cost information about projects. The Annual Plan will also offer yearly updates on progress, strategies, technical challenges, and priorities.



An adaptive management strategy underlies every aspect of what the program will accomplish in the coming years. This strategy uses a science and performance based process for assessing how the plan and its projects need to change over time so that the best available practices are consistently used. The use of adaptive management also presupposes strong engagement from citizens and other affected constituencies. Such engagement involves enhanced dialogue with a range of stakeholders, including landowners, fishers, and the navigation community, as well as scientific, engineering, and other technical experts.

We must also resolve important challenges, from scientific and technical uncertainties to institutional constraints. For example, we need better models so that we may better assess how to balance the many interests involved as we build flood protection systems, create marsh, and use multiple river diversions in the same estuarine basin. Changes in laws and policies are also needed to ensure successful implementation of the plan.

Plan Recommendations for Removing Institutional Constraints

- **Increase awareness and use of non-structural protection measures**
- **Improve land use planning, zoning, and permitting**
- **Develop fair and equitable processes for acquiring surface land rights**
- **Foster the sustainability of coastal forests**
- **Obtain dedicated funding for coastal protection and restoration**
- **Address challenges at the federal level**

We are living in a historic moment, one that presents us with a stark choice: either make the bold and difficult decisions that will preserve our state's future, or cling to the status quo and allow coastal Louisiana and its communities to wash away before our eyes.

As the coastal program moves ahead, the plan recommends that a Coastal Assessment Group be made part of the state's management structure, along with an Applied Coastal Engineering and Science Program. These groups would be responsible for making sure that advancements in science and technology are integrated into the state's program.

Stringent inspections of hurricane protection systems, assessments of the effects of restoration and protection actions, and regular updates of the Master Plan are also important tools for keeping the program on track.

These recommendations assume as their point of departure that saving coastal Louisiana and the critical services it provides requires the same basic commitment from all concerned: the resolve to achieve and maintain an unprecedented level of excellence in our stewardship of coastal Louisiana. This commitment does not seek to elevate one set of needs over another, but rather to balance the many interests—cultural, economic, and ecological—that together make America's Wetland one of the most unique and vital coastal regions in the world.