**State of Louisiana**
The Honorable Bobby Jindal, Governor

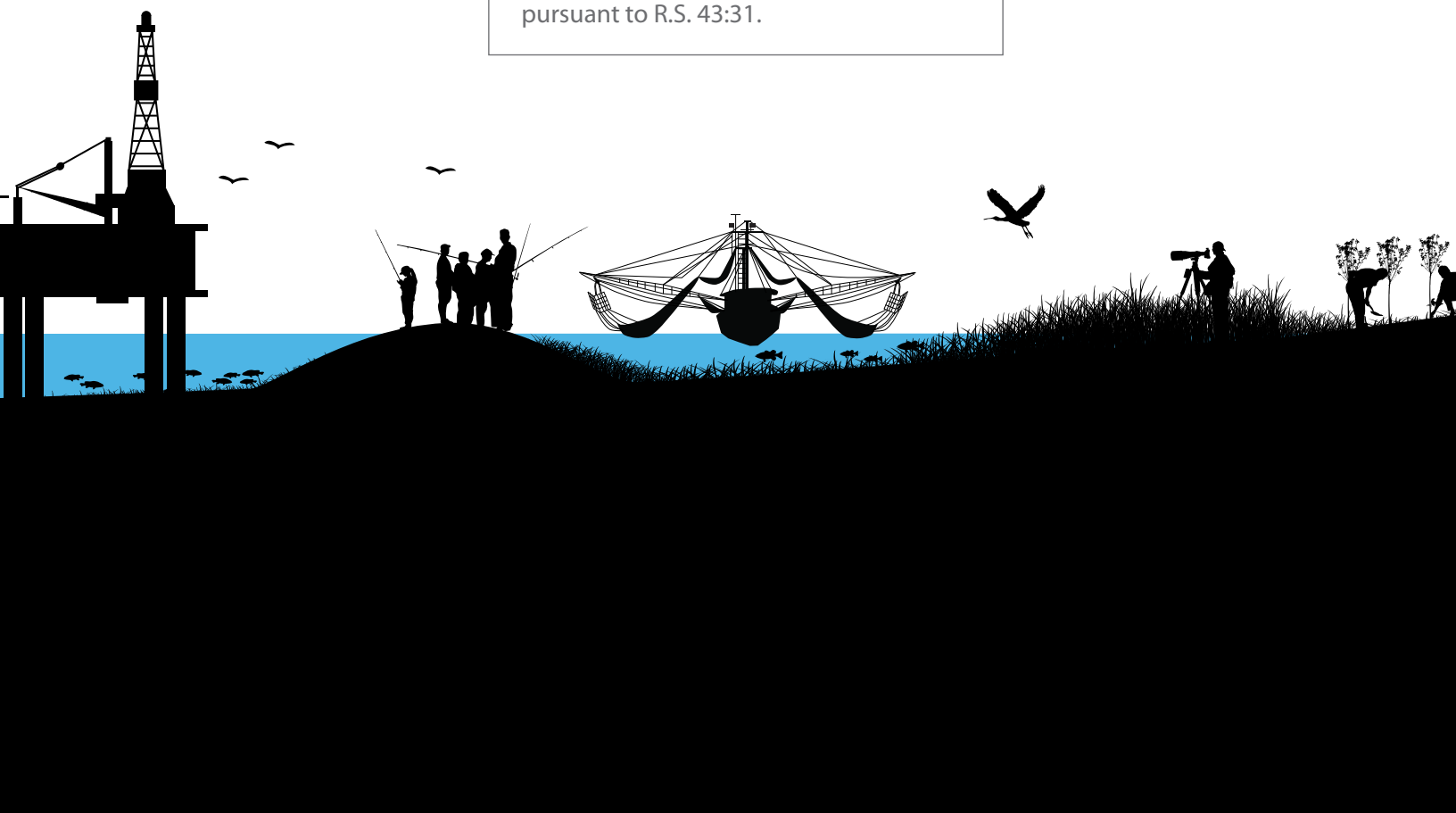
# Louisiana's Comprehensive Master Plan for a Sustainable Coast

committed to **our coast**



**DRAFT** JAN 2012

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E. Decision Support Tools – Planning Tool
F. Alternative Development
G. Implementation and Adaptive Management
H. Outreach and Engagement
I. Review and Coordination
J. Cultural Heritage
K. Benchmarking the Master Plan
L. Data Compilation Report



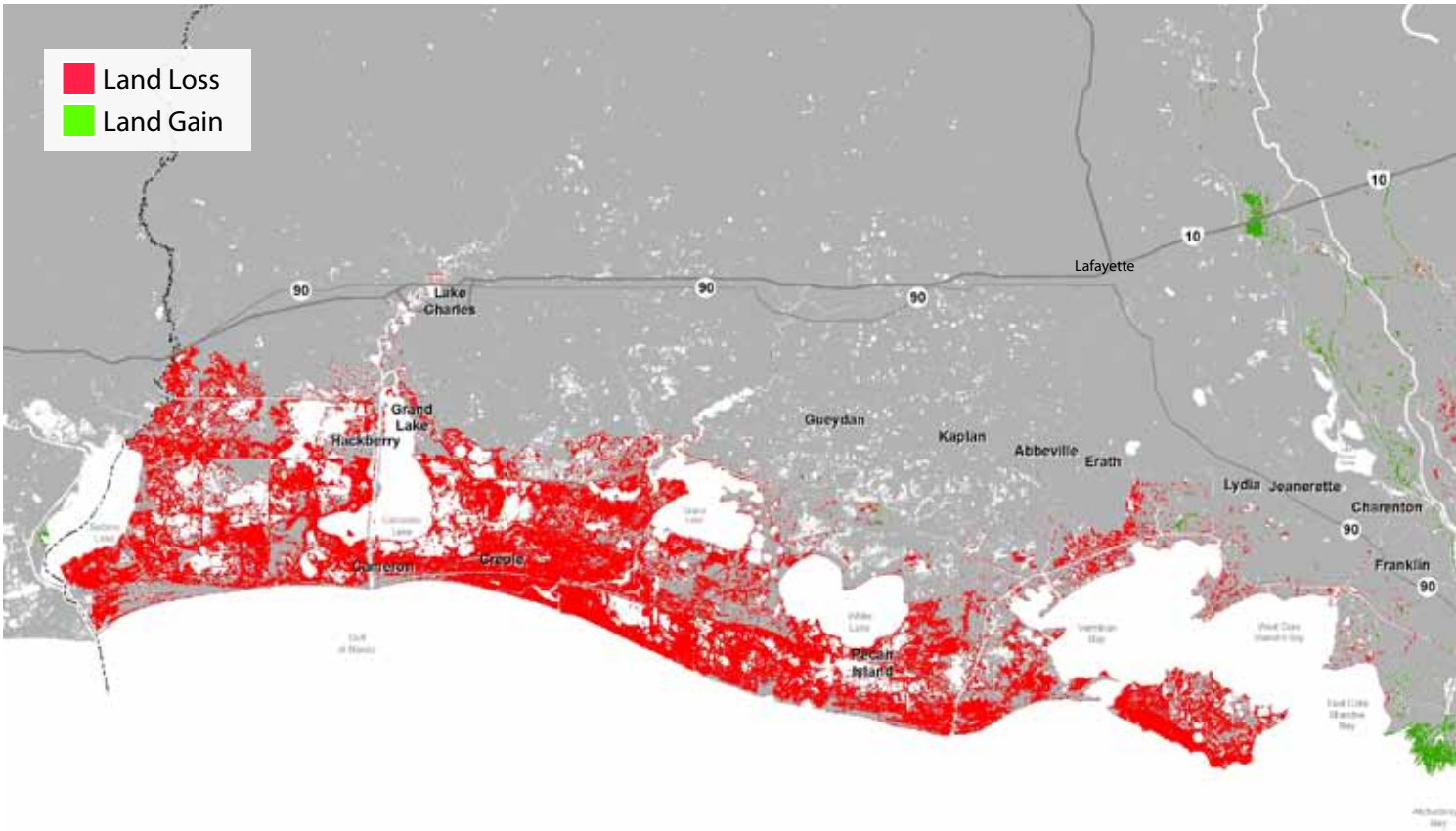


# Introduction

Construction of Inner Harbor Navigation Canal Surge Barrier.

# Louisiana is Experiencing a Coastal Crisis

## Predicted Land Change over the Next 50 Years




Louisiana is in the midst of a land loss crisis that has claimed 1,883 square miles of land since the 1930s. Given the importance of so many of south Louisiana's assets—our waterways, natural resources, unique culture, and wetlands—this land loss crisis is nothing short of a national emergency.

If we don't aggressively address this crisis, the problem intensifies. Our analysis confirmed that if we do nothing more than what has been done to date, we have the potential to lose up to an additional 1,756 square miles of land. This land loss will increase flooding risk with disastrous effects. Put simply: the status quo cannot be maintained, and we must take bold action now to save our coast. At the same time, our analysis demonstrated that we do have the opportunity, if we continue to build upon current successes, to avert an otherwise bleak future.

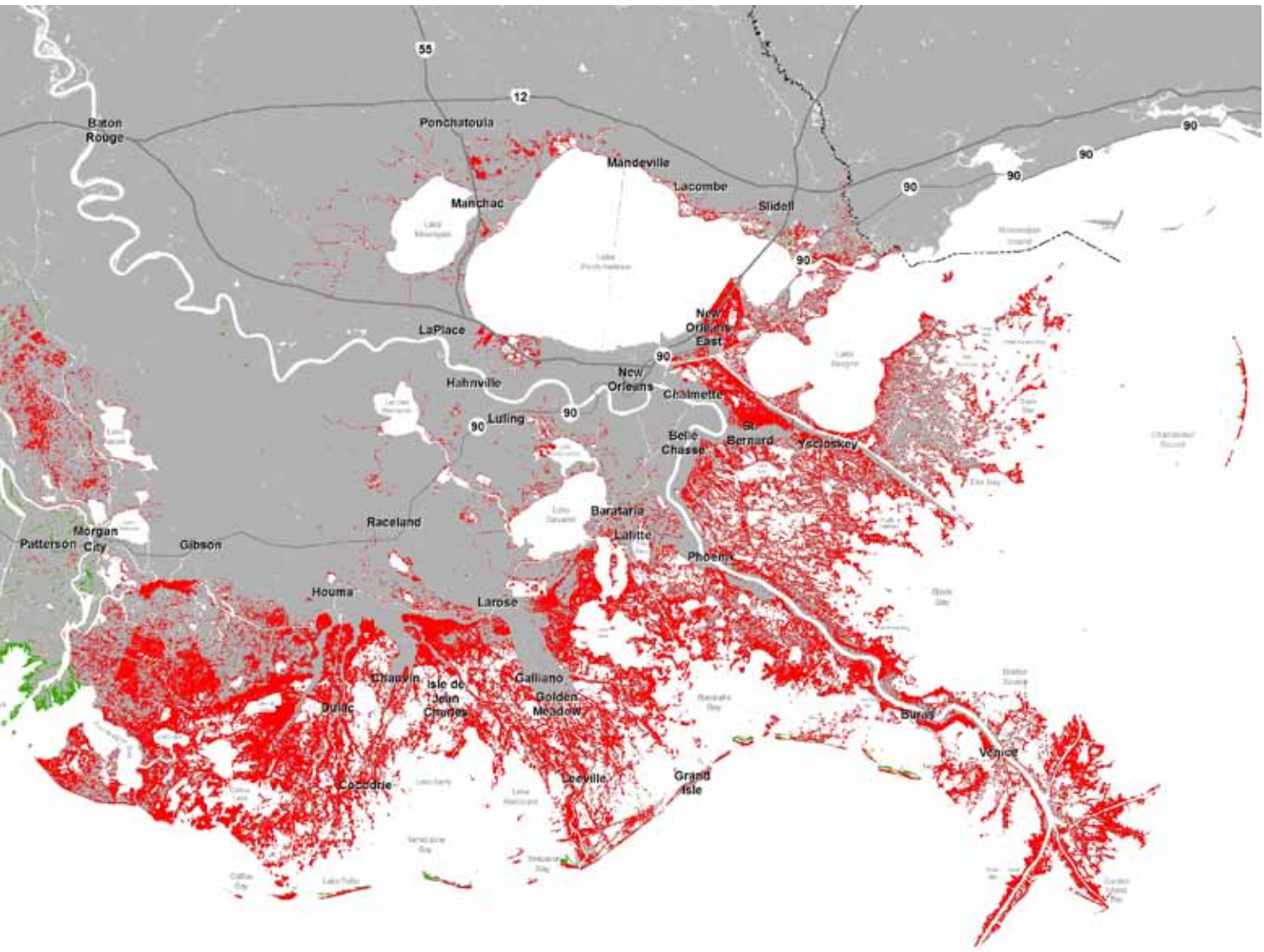
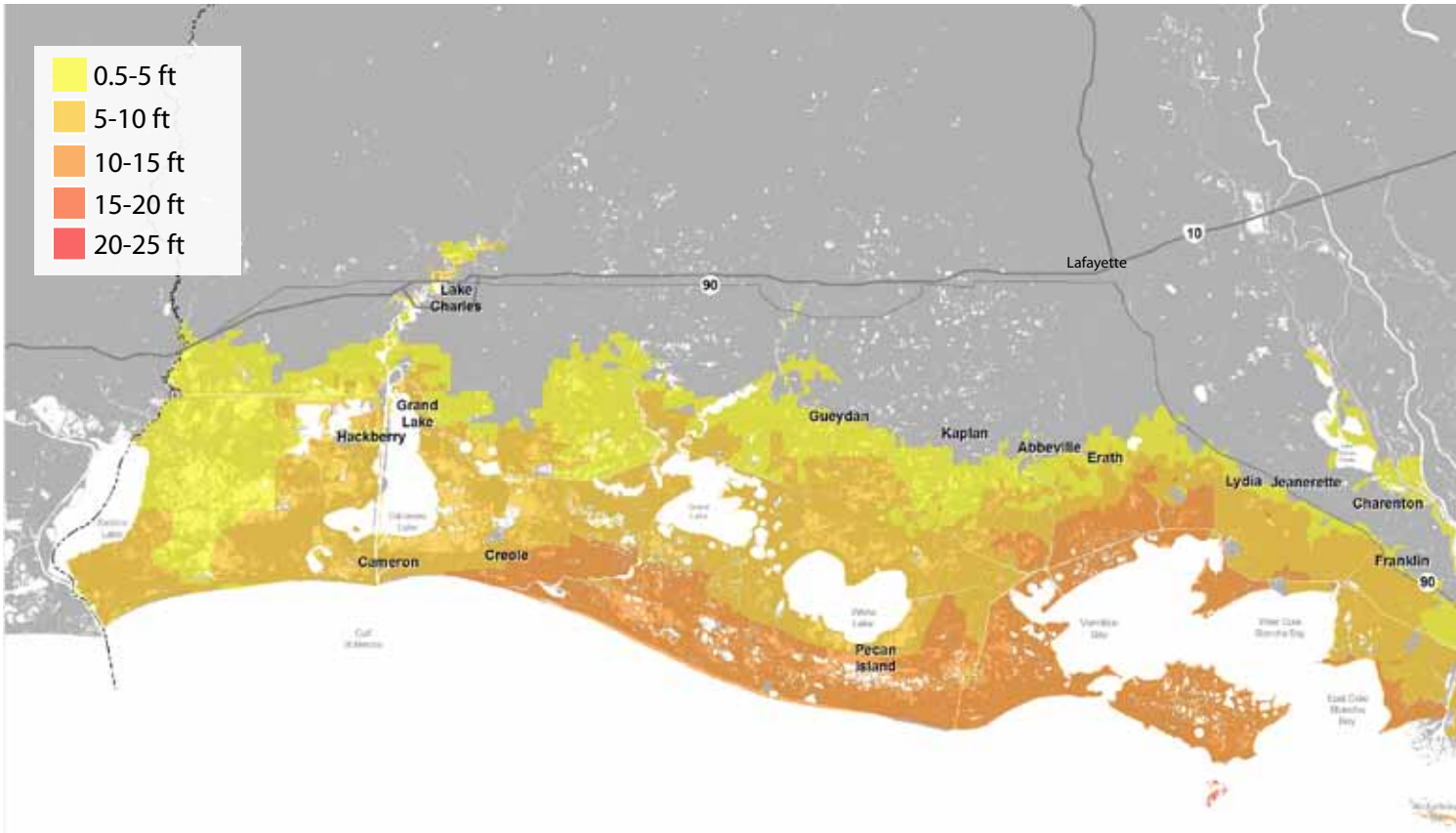



**Figure 1**
Predicted land change along the Louisiana coast over the next 50 years if we do nothing more than we have done to date. Red indicates areas likely to be lost, and green indicates areas of new land. This map is based on assumptions about increases in sea level rise, subsidence, and other factors. (Estimate based on less optimistic scenario of future coastal conditions. See Appendix C for more information.)

# Communities and Livelihoods at Risk

## Predicted Future Flooding from a 100-Year Flood Event




Barrier islands, marshes, and swamps throughout our coast reduce incoming storm surge, helping to reduce flooding impacts. If we continue to lose these habitats, the vulnerability of communities, nationally important navigation routes, and energy infrastructure will increase substantially. In addition, our flood protection systems will become more vulnerable as the land around them erodes. Our analysis shows if we do nothing more than we have done to date, our expected annual damage from flooding in 50 years could increase almost 10 fold, from a coast wide average of about $2.4 billion to a coast wide average of $23.4 billion.

Every day Louisiana citizens are affected by this catastrophe in ways small and large. Whether it is families that must leave cherished communities to move out of harm's way, local businesses that have trouble obtaining insurance, or investments that lose value because of uncertainty about the future of our landscape, Louisiana's land loss disaster takes a heavy toll.

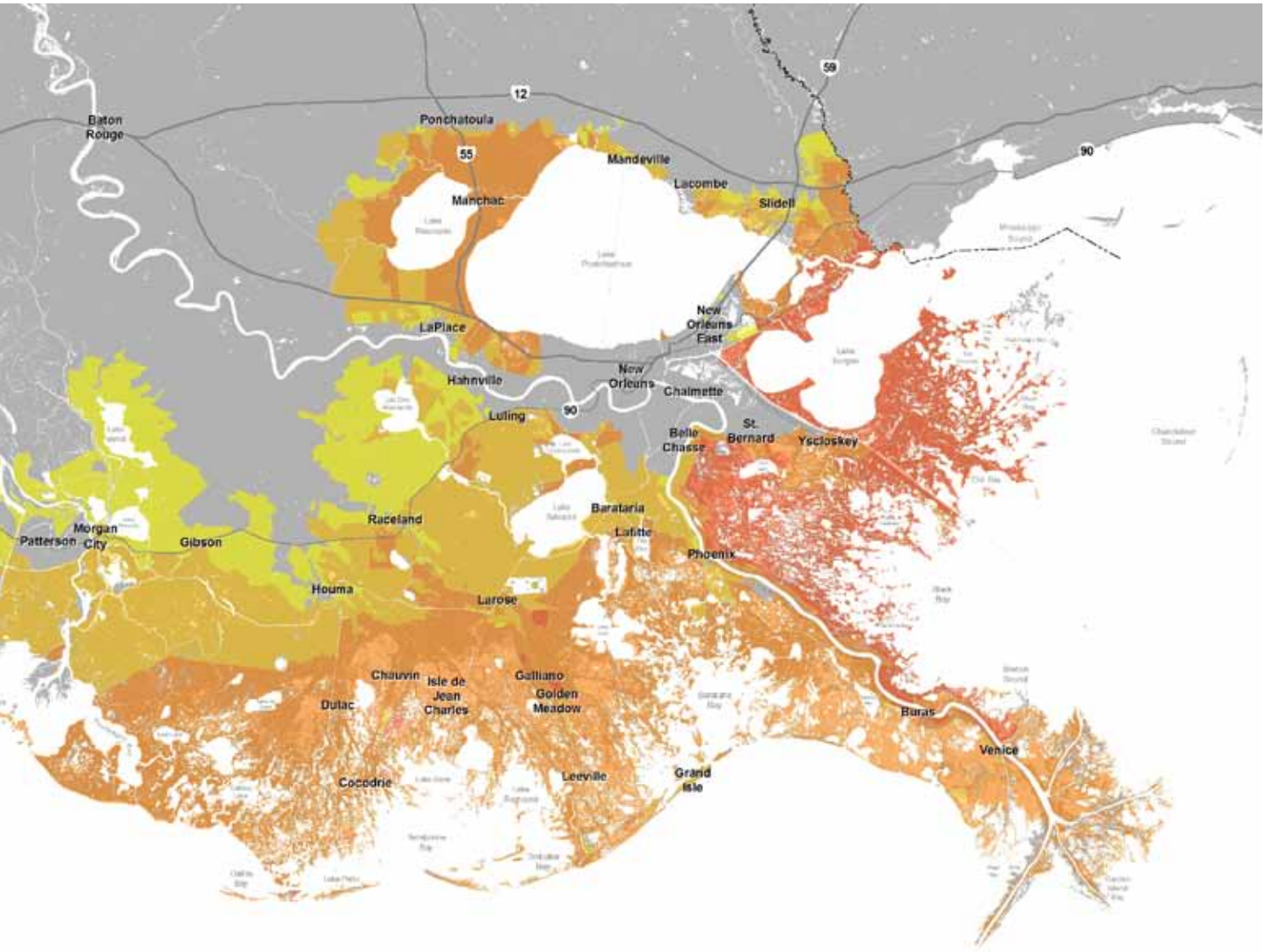
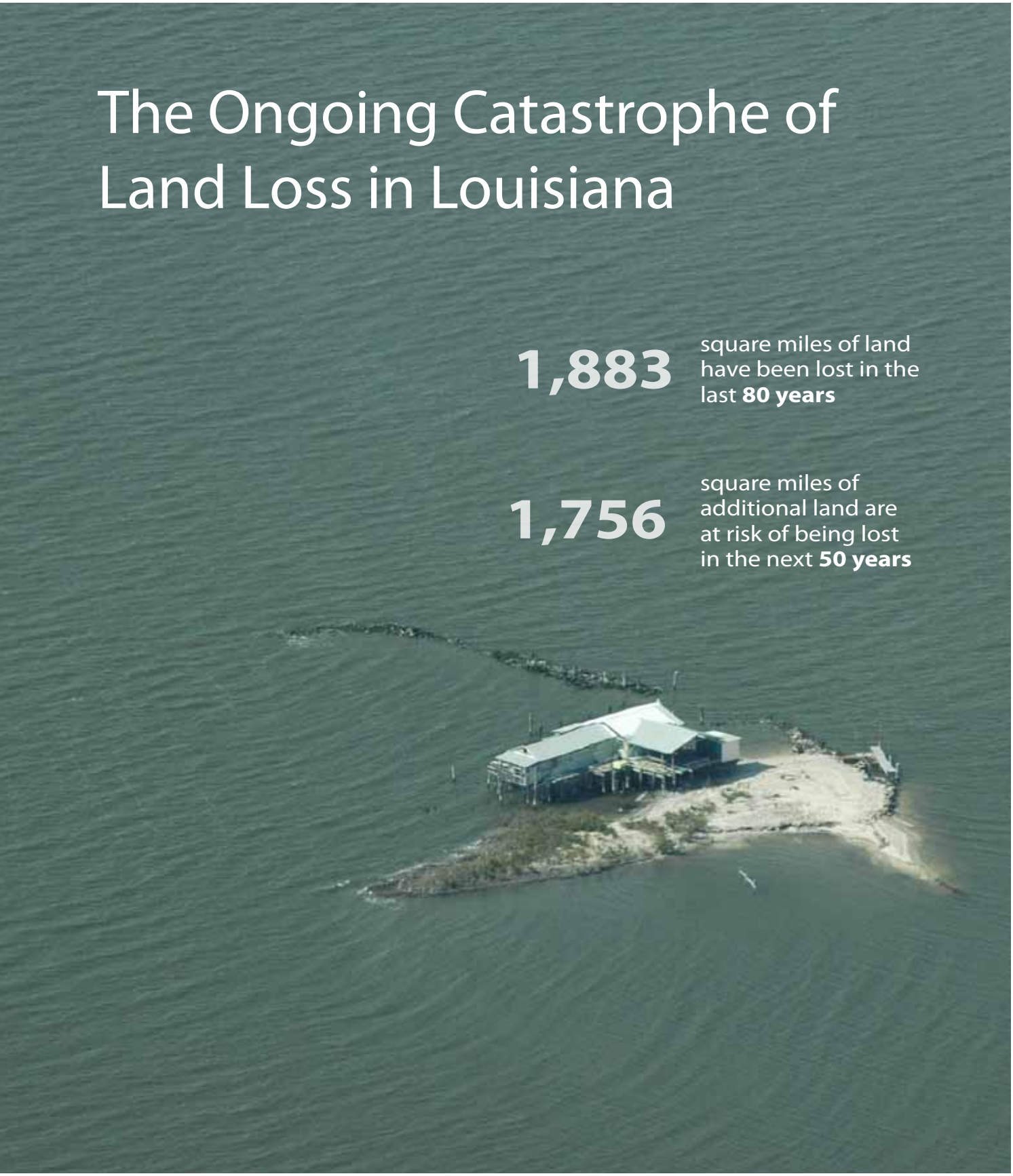



**Figure 2**
This figure shows generalized estimates of flood depths for a 100 year flood 50 years from now, once the landscape has degraded and with no additional flood protection. These flood depths represent a broad planning level evaluation of overall flooding risk. This map is based on assumptions about increases in sea level rise, subsidence, and other factors. (Estimate based on less optimistic scenario of future coastal conditions. See Appendix C.)

# The Ongoing Catastrophe of Land Loss in Louisiana

**1,883** square miles of land have been lost in the last **80 years**

**1,756** square miles of additional land are at risk of being lost in the next **50 years**



# What Continued Land Loss Means

**Hackberry, LA**

Hackberry is a town of a few thousand people that is immensely important to our nation's energy security. The salt domes just west of Hackberry house one of just four Strategic Petroleum Reserves in the country, with capacity to hold over 228 million barrels of crude oil. Having already been severely impacted by Hurricanes Rita and Ike, the continued deterioration of the Chenier Plain wetlands will only increase flooding risks on this small community, nearly doubling the flood depths experienced in past hurricanes.



**Lafitte, LA**

Lafitte, a culturally significant town in the Barataria Basin, is experiencing the effects of land loss every day. In the future, with no action, Lafitte could experience flood depths up to 12 feet from a 50-year storm flood event. This increased risk and continued land loss would be devastating to a fishing community that relies on living close to the coastal ecosystem.



**Louisiana Highway 1**

LA Highway 1 is the key connection from Port Fourchon, which supplies 18% of the nation's oil. The loss of the surrounding landscape has threatened the viability of this highway, which has experienced repeated closures at high tide events and storm induced flooding lasting days. The loss of LA Highway 1 would not only mean a loss of jobs and livelihoods, but a total economic impact to the nation of over $7 billion.



# A Vital National Asset

*The coast's intrinsic value, as a working coast, home to millions of citizens, and as critical habitat makes it one of the nation's most unique and valuable landscapes.*

Land loss in Louisiana is caused by many different factors both natural and man made. Levees and floodgates on the Mississippi River have provided national flood control and economic benefits. But this river management has also channeled the Mississippi River and its tributaries into the Gulf of Mexico, depriving the coastal ecosystem of the fresh water and sediment it needs to survive. Dredging canals for oil and gas exploration and pipelines provided our nation with critical energy supplies, but these activities also took a toll on the landscape, weakening marshes, and allowing salt water to infiltrate north into our basins. Sea level rise, subsidence, and storms add further stress. The largest environmental disaster in U.S. history, the 2010 Deepwater Horizon oil spill, directly and significantly impacted Louisiana's coast. Responding to the oil spill also diverted critical resources from the state's ongoing efforts to reverse this land loss trend.

Approximately two million people reside in south Louisiana, many of whom gain their livelihoods from the resources of the coast. Louisiana's coastal habitats also protect the homes and businesses of these residents from storm flooding. The infrastructure that produces 90% of the nation's outer continental shelf oil and gas is similarly protected by the coastal ecosystem. In addition to flood protection, the coast supports 20% of the nation's annual waterborne commerce and provides 26% (by weight) of the commercial fisheries landings in the Continental U.S. Our coast also provides winter habitat for more than five million migratory waterfowl and offers stopover habitat for millions of neotropical migratory birds. The coast's intrinsic value, as a working coast, home to millions of citizens, and as critical habitat makes it one of the nation's most unique and valuable landscapes. Saving this landscape is imperative for Louisiana and the nation.



Port Fourchon is strategically important to the Gulf Coast and the nation as a whole. It provides a vital port and supply point for 90% of the offshore drilling operations in the Gulf of Mexico.

# State Leadership

Since 2007, the Coastal Protection and Restoration Authority has:

- Built or improved 159 miles of levees
- Benefited 19,405 acres of coastal habitat
- Secured approximately $17 billion in state and federal funding for protection and restoration
- Identified and used dozens of different federal, state, local, and private funding sources for projects
- Moved over 150 projects into design and construction
- Constructed projects in 20 parishes
- Constructed 32 miles of barrier islands/berms



Although people and businesses all over the country are affected by this ongoing catastrophe, the impacts of land loss and storm flooding hit us here at home first. Today, citizens don't know what to expect when storm flooding hits. We want all citizens to be able to return with certainty to their communities and jobs immediately after a storm. Instead of waiting for others to decide our future, the state has taken a leadership role and identified specific projects that will sustain coastal communities, habitats, and the south Louisiana culture we all treasure.

After Hurricanes Katrina and Rita, the Louisiana Legislature directed our state to respond to the land loss crisis in a new way. Act 8 of the First Extraordinary Session of 2005 created the Coastal Protection and Restoration Authority of Louisiana and required that it develop a plan for a safe and sustainable coast. The legislature required that this plan be updated every five years to ensure that the state was building on success and taking maximum advantage of new science and innovation. The legislature further directed that the plan include large scale projects and take the needs of the entire coast into account. Most importantly, the plan had to prepare the way for action. The 2007 Coastal Master Plan was the first such plan, and it helped support the many protection and restoration projects that have since been implemented.

Since 2007 the state has exponentially increased its financial commitment to the coast. Some of these dollars provided the state's match for repairs and revisions to the Greater New Orleans area levees, allowing the state to leverage over $14 billion in federal dollars for this vital hurricane protection system. In addition, the federal Coastal Impact Assistance Program (CIAP) is providing approximately $496 million to Louisiana to mitigate impacts from Outer Continental Shelf oil and gas production. Many of the projects address coastal restoration needs through shoreline protection, marsh creation, and other strategies. Approximately 90% of the CIAP program's projects are underway or complete.

We've achieved good things and learned a great deal from our efforts; we need to keep the momentum and think even bigger. Most important of all, we understand that trying to maintain the status quo is not only futile, it is a recipe for disaster. However, by embracing the need for constructive change, we can protect our communities and provide for a sustainable coast. In so doing, we can provide for safe and prosperous communities across the coast.

# Progress on the Ground: Achievements Since 2008









# Before & After

Since 2007 the state has exponentially increased its financial commitment to the coast. Some of these dollars provided the state's match for improvements to the Greater New Orleans area levees, allowing the state to leverage over $14 billion in federal dollars for this vital hurricane protection system. In addition, the federal Coastal Impact Assistance Program (CIAP) is providing approximately $496 million to Louisiana to mitigate impacts from Outer Continental Shelf oil and gas production.





## Dedicated Dredging on the Barataria Basin Landbridge

Approximately 5.5 million cubic yards of material was placed in two contained marsh creation areas to create 1,211 acres of intertidal marsh. An additional 4 million cubic yards of material was placed in adjoining fill areas to nourish 1,578 acres of marsh. This project was completed in 2010 at a total cost of $36.3 million, and funded through CWPPRA, CIAP, and state surplus funds.





## East Grand Terre Island Restoration

This project constructed in 2010 restored 2.8 miles and 620 acres of barrier shoreline and 450 acres of marsh by dredging 3.3 million cubic yards of offshore material and rebuilding the island. The project was designed under the CWPPRA Program and the $31 million in construction was funded through CIAP, Plaquemines Parish CIAP, and state surplus.





## Goose Point Marsh Restoration

Constructed in 2009, this project created 437 acres of marsh and nourished 114 acres of degraded marsh along the northern shoreline of Lake Pontchartrain. The project was implemented through CWPPRA at a cost of $20.8 million.

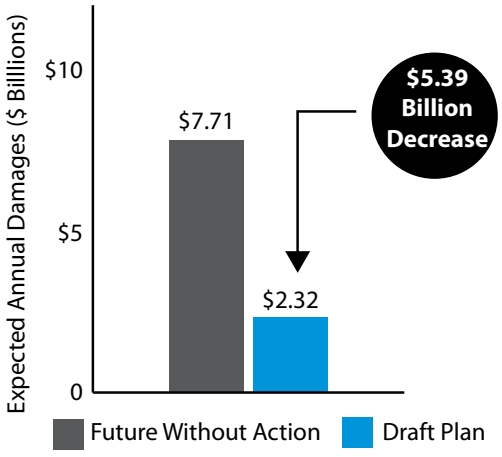
# The 2012 Master Plan is the Way Forward

Making realistic, on the ground progress toward restoring coastal habitats and protecting communities—demonstrating our commitment to the coast—is at the heart of the 2012 Coastal Master Plan. We developed the plan by taking a look 50 years into south Louisiana's future and building world class science and engineering expertise into understanding what we could achieve. The plan presents the best use of dollars based on what we know today—the first time the state has identified specific large scale actions to achieve a sustainable coast.

Given the rapid pace of change that is part of our landscape, we can neither turn back the clock and return the coast to its to historic conditions, nor can we keep the coast just as it is today. As we confront the challenge of living in a dynamic coastal system, we must create a new and vibrant coast—one with sustainable communities, infrastructure, and ecosystems. Our analysis has shown that with the right mix of projects and funding we can offer substantially improved risk reduction to our communities and make strides toward building a sustainable ecosystem that is resilient over time. Since the 2007 master plan was released, we have built more levees, restored more land, and invested more dollars than any time in the state's history. Now is the time to use this momentum and take our coastal program to the next level. When we do, we will be ensuring that current and future generations will enjoy the protection and natural resource benefits that a sustainable system provides.

**Figure 3**
Potential expected annual damages for Future Without Action and future with the draft plan at Year 50. Values are based upon a moderate scenario of future coastal conditions.

## Potential Expected Annual Damages from Flooding at Year 50 Future Without Action



## Potential Annual Rates of Land Change over the Next 50 Years

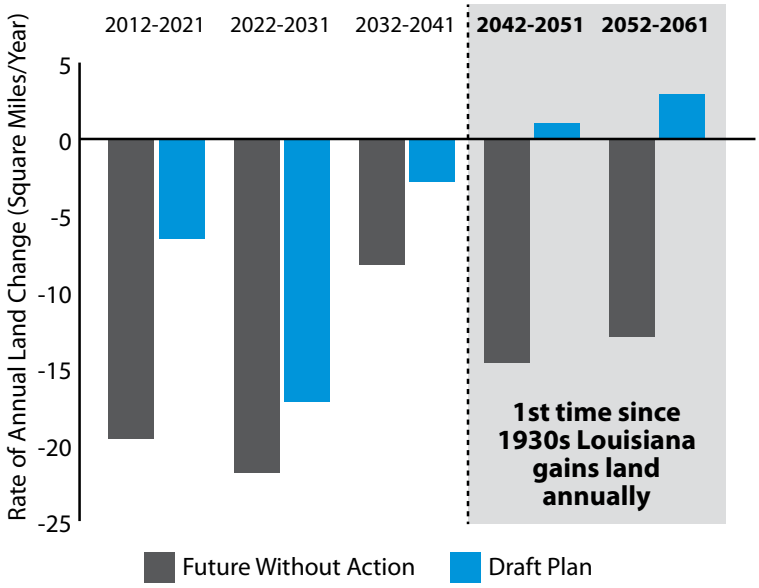



**Figure 4**
According to the U.S. Geological Survey, Louisiana currently loses over 16 square miles of land per year. This figure depicts potential changes in the annual rate of land loss or land gain every 10 years based upon a moderate scenario of future coastal conditions. Implementation of projects in the draft plan may result in annual land gain after 30 years.

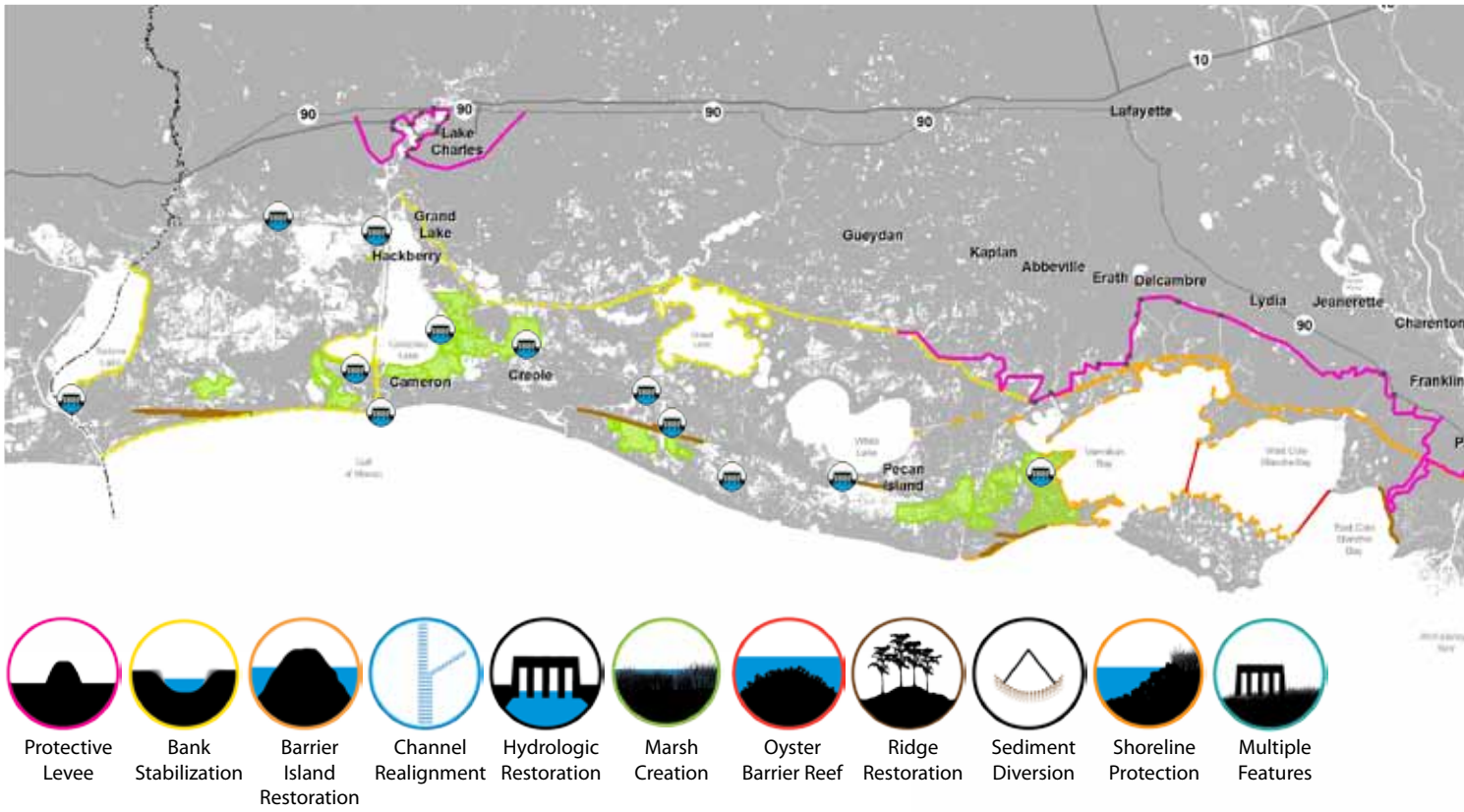
### What If…Evaluating Future Conditions

We evaluated two scenarios of future conditions to gain a better idea of how our projects would perform in coming years. Possible results according to our moderate scenario are presented in Figures 3 and 4. Results for the less optimistic scenario are below:

- Without further action, expected annual damages from storm flooding could increase up to a total of $23.4 billion. The draft plan would provide a three fold decrease in these expected damages, reducing future flood damage losses by $18 billion annually.
- Without further action, over the next 50 years we could experience land loss rates ranging from 15 to 51 square miles every year, for a total loss of 1,756 square miles. This would result in a doubling of the land loss that we have experienced from the 1930s to today.
- With the draft plan, we make steady improvements in land gain until we reach 33 square miles of land gain in Year 50. Over the 50 years of project implementation, the draft plan could potentially build up to 859 square miles of land. We do not completely offset land loss in those 50 years under less optimistic conditions, but we significantly improve our resilience by building this land.

*For more information about scenarios, see p. 82.*

# 2012 Coastal Master Plan




Project Types Included: Colors on the icon correspond to color key on map.

**Figure 5**
Projects included in the 2012 Coastal Master Plan.

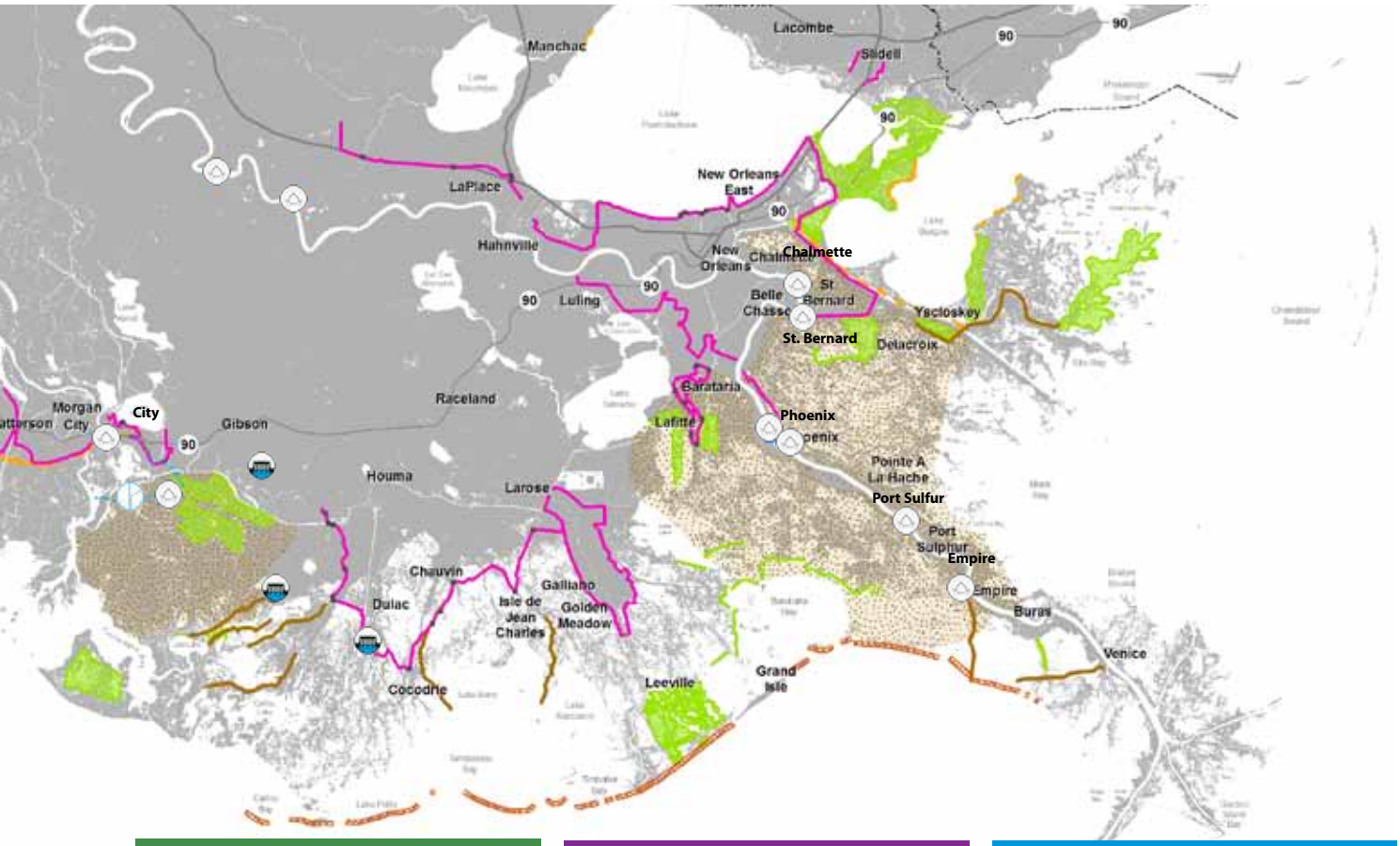
**Note**
Map does not show nonstructural projects that the plan provides in each coastal parish. Structural measures mainly refer to levees, flood walls, and pumps that protect large areas. Nonstructural measures refer mainly to risk reduction actions that homeowners and businesses can individually take, such as elevating or flood proofing. See pp. 65-67.

The 2012 Coastal Master Plan was developed through a ground breaking technical effort and extensive public outreach. Through this effort, we identified the projects shown here. These projects will substantially increase protection for communities and make great strides toward achieving a sustainable coast. They include a diverse mix of projects throughout the coast, from the Chenier Plain to the Mississippi border.

## Overall Goals

**Protection.** Use a combination of restoration, nonstructural, and targeted structural measures to provide increased flood protection for all communities.

**Restoration.** Use an integrated and synergistic approach to ensure a sustainable and resilient coastal landscape.




## Southwest Coast

### Protection
Levees are proposed for large, densely populated, at risk communities, such as Lake Charles and Abbeville. Nonstructural measures are proposed for all parishes in this region. Restoration of chenier ridges and healthy wetlands contribute additional storm protection.

### Restoration
Restore wetlands and chenier ridges while limiting saltwater intrusion. Maintain and increase, where possible, the input of fresh water to maintain a balance among saline and fresh wetlands.

## Central Coast

### Protection
Levee protection is proposed for large, densely populated, at risk communities, including Morgan City, Franklin, New Iberia, and Houma. Nonstructural measures are proposed for all parishes in this region. Restoration of barrier islands, marshes and ridges contribute additional protection.

### Restoration
Maintain the land building capacity of the Atchafalaya region, while increasing the use of Atchafalaya River sediment and water east to Terrebonne Parish to sustain the coastal ecosystem. Rebuild barrier islands and ridges.

## Southeast Coast

### Protection
Sustain key levee protection systems, such as Greater New Orleans area and Larose to Golden Meadow. New levees are proposed for large, densely populated, at risk communities, such as LaPlace and Slidell. Nonstructural measures are proposed for all parishes in this region.

### Restoration
Use sediment and water from the Mississippi River to maintain and rebuild land. Sustain a diversity of coastal habitats including cypress swamps, marshes, ridges, and barrier islands.

# What the 2012 Coastal Master Plan Delivers

- The plan improves flood protection for every community in coastal Louisiana, at a minimum through nonstructural programs. These improvements, along with the information about remaining flood risks that the plan provides, will provide added certainty to coastal residents about the benefits they can expect in the future.

- The plan's projects would reduce expected annual damage from flooding throughout Louisiana's coast by $5.4 to $18.1 billion.

- Levees that significantly reduce or eliminate risk from a 100 year storm are provided for communities such as Abbeville, New Iberia, Morgan City, Houma, Golden Meadow, and Lafitte. This level of protection will reduce risks for residents and provide more certainty for businesses and industries.

- Levees that significantly reduce or eliminate risk from a 500 year storm are included for the Lake Charles and Greater New Orleans areas.

- Nonstructural programs are designed to help residents improve their resilience in the face of storms. The plan provides options for flood proofing and residential elevations. It also allows for voluntary acquisition, but this aspect represents only 3% of the master plan's nonstructural recommended actions.

- According to our moderate scenario of future conditions, the projects in the plan have the potential to reduce our annual land loss rate to zero and, after 30 years, provide for annual land gain. This fundamental change in our coast's condition is the building block for a secure future.

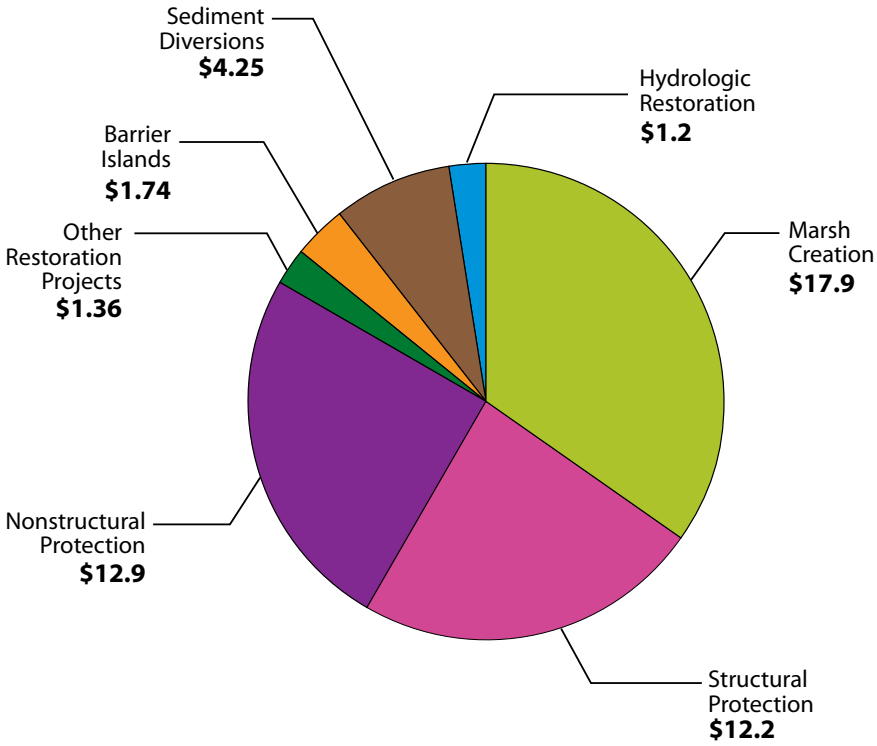
- The restoration projects in the plan have the potential to build between 545 to 859 square miles of land over 50 years. This translates into new habitats, improved storm buffering capacity, and more security for coastal residents and businesses.

- The land building benefits identified in the plan will accelerate at 50 years and will continue well beyond. These long term benefits will support the continued international prominence of Louisiana's navigation industry as well as the increased competitiveness of our ports.

- The plan includes the nation's largest investment, $17 billion, in sediment mining and marsh creation projects that will provide land building benefits quickly for areas in dire need.
- The projects in the plan would use up to 50% of the Mississippi River's peak flow for sediment diversions, in addition to using water and sediment from the Atchafalaya River.
- By increasing flood protection and building land, the plan supports coastal industries and the workforce they depend on.
- The ecosystem sustainability provided by the plan will support robust commercial and recreational fisheries coast wide, along with habitat for other coastal wildlife.
- The plan will allow us to transition with our changing environment, sustaining our unique cultural heritage, communities, and livelihoods.
- The plan invests in restoring barrier islands, headlands, and shorelines, not only as critical habitats, but as first lines of defense against storm surge.
- The plan includes a wide variety of project types distributed throughout the coast. We are using every tool in the toolbox to protect and restore Louisiana's coast.

**Figure 6**
The master plan is based on a total budget of approximately $50 billion. This chart shows the distribution of funding in the draft plan by project type. "Other Restoration Projects" include bank stabilization, shoreline protection, ridge restoration, oyster barrier reefs, and multiple features projects.

## Distribution of Funding by Project Type (Approximately $50 billion)




## Project Types



## Long Term Land Building and Investment by Project Type

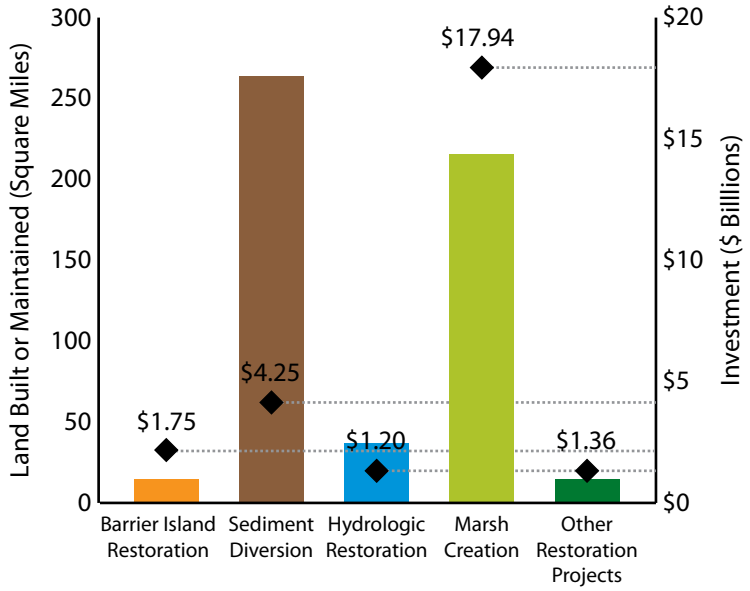
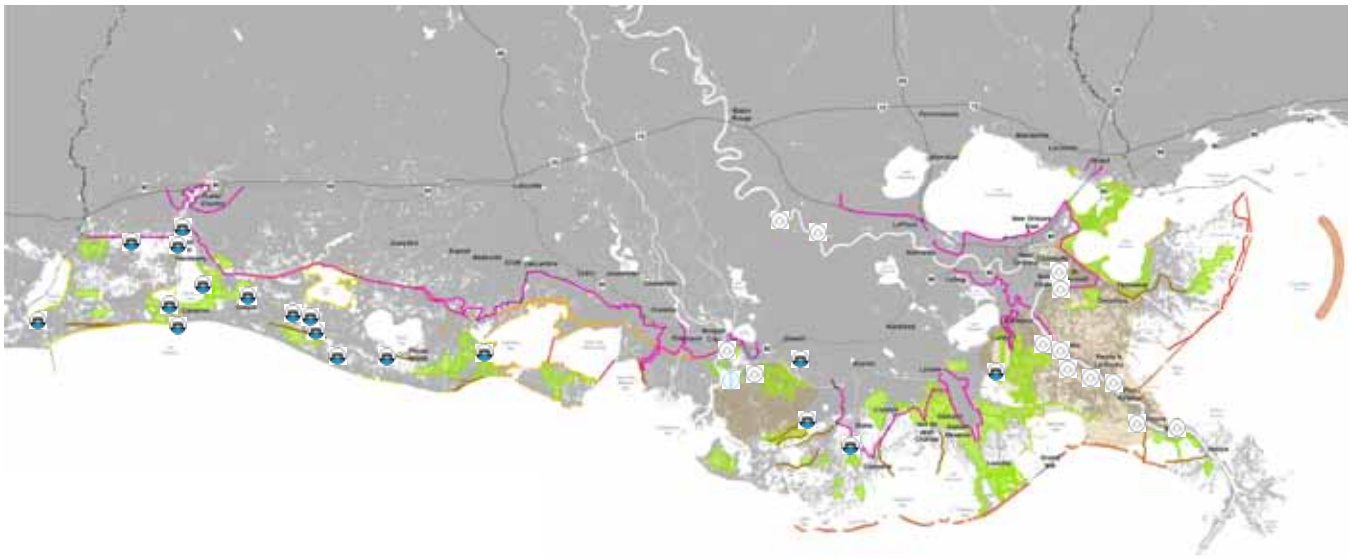



**Figure 7**
Total land building over 50 years by project type and the investment required to implement projects. (Estimates based on moderate scenario of future costal conditions.)

# Greater Possibilities

## Potential Projects with $100 Billion Investment



The 2012 Coastal Master Plan is a solid foundation on which to continue building Louisiana's coastal program. The budget we used for the plan, $50 billion, reflected existing and potential funding sources. Targeted use of these dollars as described in this plan will allow us to improve protection for communities and, depending on how future conditions change, turn the tide of land loss in Louisiana for the first time in a century. With all the good this plan could achieve, we won't be able to completely compensate for the land loss that will occur over the next 50 years.

The Coastal Protection and Restoration Authority is committed to making the most of every opportunity to secure south Louisiana's future. For this reason, we evaluated what we could deliver for coastal citizens with a budget larger than $50 billion. Our goal in doing so was to see how much funding it would take to build large amounts of land and maximize protection of our communities beyond what we accomplish in this plan.

Our analysis showed that additional funds would increase our ability to protect at risk communities and build coastal land. For example, by 2061 a budget of $100 billion would allow us to achieve a net gain of up to 17 square miles of land per year; building between 934 and 1148 square miles of land.

▲ **Figure 8**
Map represents the $50 billion worth of projects selected in the 2012 Coastal Master Plan, plus an additional investment of $50 billion for the coast.

## Potential Annual Rates of Land Change over Next 50 Years $100 Billion Investment

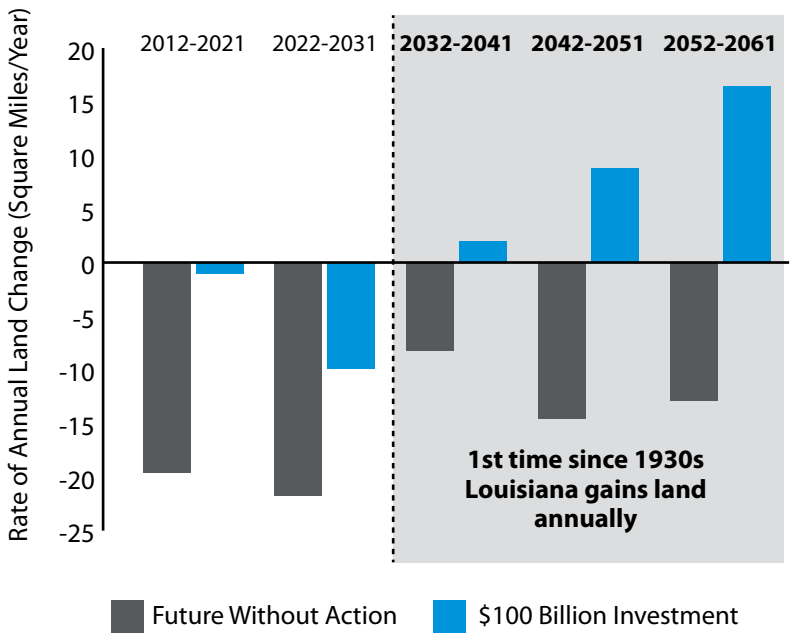



**Figure 9**
Potential changes in the annual rate of land loss and land gain every 10 years with a $100 billion investment under the moderate scenario of future coastal conditions. A larger investment provides the potential for annual land gain after only 20 years.

# Committed to Our Coast: Creating a Better Future Together

This plan presents a wealth of detail so that readers can be informed about the rigorous analysis we performed. Underneath the complicated graphs and tables is a simple purpose—to combat the catastrophe engulfing our state and create a secure future for our citizens. When all is said and done, that is what the master plan is all about.

The Coastal Protection and Restoration Authority welcomes close scrutiny of the work that is the foundation of this plan. This document traces our analysis, and it is supplemented by appendices that provide further technical detail (available at www.coastalmasterplan.la.gov).

Our analysis confirmed what those in Louisiana already know: our coast and our people are in the midst of a land loss crisis that requires immediate and large scale action. Our analysis revealed good news too: we have tools that can combat land loss and flooding and make a difference for Louisiana citizens.

Given all that is at stake and all the opportunities we have to make a real difference for our coast, we hope these documents do more than just provide a wealth of information and pictures. We hope that this plan will encourage all of us who live in coastal Louisiana to come together and chart a new future. Change is upon us. We can either embrace it or become victims of the challenges we face.

As we confront these challenges, we know that we must look forward not back, and that we must take advantage of every opportunity to create a sustainable and vibrant coast for our people and businesses. This plan offers a path to reach that goal, one that is supported by world class science. We welcome your review and comment as we fine-tune the way forward.



# Getting Involved is Easy

## 1 Public Meetings

| New Orleans | Houma | Lake Charles |
|---|---|---|
| January 23, 2012 | January 24, 2012 | January 25, 2012 |
| 1-7:30 PM | 1-7:30 PM | 1-7:30 PM |
| University of New Orleans Lindy Boggs Conference Center Auditorium 2045 Lakeshore Drive New Orleans, LA 70122 | Houma Terrebonne Civic Center - Room 3 346 Civic Center Boulevard Houma, LA 70360 | Lake Charles Civic Center Contraband Room 900 Lakeshore Drive Lake Charles, LA 70601 |

Learn more about what is in the plan. Open house throughout the day, with a presentation and formal public comment from 5:30-7:30. Enter comments in the public record on-site anytime during the meetings or by sending written comments by February 25, 2012 to:

The Coastal Protection and Restoration Authority of Louisiana
450 Laurel Street, Suite 1200
Baton Rouge, LA 70804-4027

## 2 Public Input

| Comment Period Ends | Submit Public Comment Form | Email Us | Call Us |
|---|---|---|---|
| February 25 | coastalmasterplan.la.gov | MasterPlan@la.gov | 225-342-4123 |

After the January public meetings, we will summarize key themes of citizens' feedback and post this summary on our website. Public comments received will be included in an appendix to the 2012 Coastal Master Plan document. After the formal public comment period has ended, citizens can still provide ideas, via email or phone, to inform our work as we finalize the master plan.

## 3 Developing the Final Plan

| CPRA Reviews Final Plan | CPRA submits 2012 Coastal Master Plan to Louisiana Legislature |
|---|---|
| March 21 | March 26 |

Contact your local elected officials and representatives. Coastal Protection and Restoration Authority meetings and Louisiana legislative hearings will provide additional opportunities for public comment.


DOOSAN
M&L



# Chapter 1
# Guidelines for the Master Plan

Marsh restoration at Bayou Dupont.

# Guidelines for the Master Plan

## Chapter Preview

This chapter explains the guidelines that shaped the 2012 Coastal Master Plan, including the broad planning concepts we used, our public outreach approach, and the technical underpinnings of our analysis.

The 2007 Coastal Master Plan established the foundation for our work, particularly its emphasis on improving the lives of coastal residents by improving protection from storm flooding and creating a sustainable ecosystem. The 2007 master plan's comprehensive approach was reflected in its objectives, principles, and conceptual project ideas. We built on this foundation for the 2012 Coastal Master Plan, but we went one step further and identified specific projects that represent sound investments for Louisiana.

The 2012 Coastal Master Plan was developed using extensive scientific analysis. The master plan also reflects what we have learned in conversations with coastal residents and local leaders. The new plan thus reflects in depth technical inquiry informed by an ongoing conversation with the citizens of Louisiana.

## Features of the 2007 Plan that We Carried Forward

- Comprehensive look at how to protect and restore Louisiana's coast.
- Integration of hurricane protection and ecosystem restoration measures.
- Broad concepts and strategies for moving forward.
- Improved coastal modeling effort.
- Focused objectives.
- Stakeholder ideas.

## What's New in the 2012 Coastal Master Plan

- Detailed assessment of the future if we take no new action.
- Expanded portfolio of solutions available to coastal residents through nonstructural protection measures.
- Evaluation of hundreds of candidate project ideas.
- Use of innovative tools to identify the best projects and the most effective use of dollars.
- Large scale solutions that address the root causes of land loss and reduce flooding risk for coastal communities.
- Additional guiding objective that reflects the importance of Louisiana's working coast.

## Master Plan Mission

The 2012 Coastal Master Plan is designed to provide the leadership needed to save our coast.

**Comprehensive Scope**

The state has used cutting edge technical analysis to think big and evaluate the needs of the entire coast. This analysis has helped us make sound decisions about how taxpayer dollars should be most effectively invested. The resulting plan will deliver results and is fiscally responsible.

**Broad Based Collaboration**

The plan represents the results of a working collaboration among local, state, and national stakeholders—all representing the millions of people who live, work, and play in Louisiana's working coast.

**Providing for Future Generations**

The projects in the plan move us closer to a sustainable coast, one that provides a thriving, resilient landscape for human and natural communities into the future.

To anchor the mission statement in more detail, we oriented our efforts around objectives. Four of these objectives were carried over from the 2007 Coastal Master Plan. A new, fifth objective reflects the special character of Louisiana's Working Coast.

## Master Plan Objectives

The objectives reflect the key issues affecting people in and around Louisiana's coast. The objectives seek to improve flood protection for families and businesses, recreate the natural processes that built Louisiana's delta, and ensure that our coast continues to be both a Sportsman's Paradise and a hub for commerce and industry.

**Flood Protection**

Reduce economic losses from storm surge based flooding to residential, public, industrial, and commercial infrastructure.

**Natural Processes**

Promote a sustainable coastal ecosystem by harnessing the natural processes of the system.

**Coastal Habitats**

Provide habitats suitable to support an array of commercial and recreational activities coast wide.

**Cultural Heritage**

Sustain, to the extent practicable, the unique cultural heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment.

**Working Coast**

Promote a viable working coast to support regionally and nationally important businesses and industries.

## Master Plan Principles

The following principles serve as guidelines for fulfilling the plan's mission and objectives. They reflect guidance from years of coastal planning work in Louisiana, including principles reflected in the Coast 2050 document, the Louisiana Coastal Area Study, and the 2007 Coastal Master Plan.

### Long-term solutions

The 2012 Coastal Master Plan is charged with providing a sustainable long-term solution for coastal protection and restoration. In keeping with this charge, our projects' tangible effects should be of long duration. For planning purposes, projects were evaluated, prioritized, and integrated using a planning horizon of 50 years. Beyond 50 years, uncertainties about sea level rise, project costs, and other factors become too great to maintain reliable evaluation results.

### Seeking sustainability

The master plan seeks the long-term sustainability of the coast while recognizing the urgent need for action. A sustainable system is one characterized by consistent levels of productivity and resilience (the ability to withstand naturally variable conditions and/or recover from disturbances). Creating a sustainable system will reduce the long-term costs of projects, both in terms of energy use and operation and maintenance expenses. The plan relies, to the maximum extent possible, on natural cycles and processes. This will be done while keeping limited funding and resource budgets in mind.

### Systems approach

The master plan was developed using a systems approach to flood risk reduction and restoration, whereby benefits of actions and the most effective portfolio of solutions were identified.

### Clear expectations

Evaluations were made with the understanding that we cannot recreate the coast of the 20th Century. Instead, we must seek to fashion a new landscape that will support viable natural and human communities into the future.

### Acknowledging residual risk

The master plan acknowledges that protection systems (both structural and nonstructural) and restored costal habitats cannot eliminate all flooding risks, and that some degree of residual storm related risk will be inevitable in coastal Louisiana. The plan supports and promotes close coordination among all jurisdictional authorities to minimize the risk of property damage, and inform stakeholders of ongoing residual risk.

### Public's role

The master plan acknowledges the leadership that the state and its federal partners must show in defining the path forward. At the same time, achieving a sustainable coast is a collective endeavor. In addition to effective government action, success will require citizens to offer their ideas as planning proceeds and make informed decisions about living and working in south Louisiana. Strong flows of information between agencies and the public are essential to continued progress.

### Providing for transitions

Louisiana's coastal crisis is currently displacing resources, infrastructure, and communities. As we address this crisis, sensitivity and fairness must be shown to those whose homes, lands, livelihoods, and ways of life may be affected, in the near-term and long-term, by master plan projects or by continued land loss and flooding.

### Participatory process

The master plan was developed with the participation of the many diverse interests that live, work, play, and own property in coastal Louisiana, along with national interests that have a stake in coastal Louisiana's landscape.

### Accounting for uncertainties

The master plan considers how both financial and scientific/technical uncertainties influence the selection of projects. Although our protection and restoration efforts must be based on sound and robust science, we must also acknowledge that substantial uncertainties remain. For example, we do not know with certainty the rate of sea level rise we can expect over the life of a restoration project, nor can we fully predict all ecological responses to actions such as sediment diversions. We do know, however, that dramatic land loss will continue unless we act boldly. In many cases, the risk of doing nothing is far greater than the risk of acting with incomplete knowledge. Thus, we used high-quality science, while recognizing that the quest for perfect knowledge may be both fruitless and ultimately counterproductive. Calculated risks will need to be taken.

### Adapting to changing circumstances

To accommodate the dynamic nature of coastal processes, reducing flood risks and the restoration of coastal Louisiana is an evolving process. The master plan should lay the groundwork for an effective monitoring and evaluation process that seeks to reduce scientific and engineering uncertainty, assesses the success of the plan, and supports the adaptive management program. The plan will be revisited regularly, as mandated by legislation, and after exceptional events such as hurricanes. The plan will also be refined as necessary to respond to changing economic, social, and environmental conditions.

**Efficient use of resources**

The master plan was developed in a way that acknowledges the need for efficient use of resources, such as funding, fresh water, and sediment. The plan's analysis seeks to capitalize on synergies among projects, resolve overlaps and conflicts, and promote sound management of resources.

**Sediment for restoration**

At present, limited supplies of, or access to, renewable sediment constrain the restoration efforts we can undertake. As a result, we have also considered dredging options if natural processes do not offer us the sediment we need. The master plan recognizes the need to maximize use of sediment sources outside the system. Possible sources of sediment outside the system include the Mississippi River, the Atchafalaya River, Calcasieu Ship Channel, and areas offshore in the Gulf of Mexico.

**Ensuring consistency**

Given the emergency facing coastal Louisiana, it is imperative that all government agencies act quickly and in accord with the master plan. Governor Jindal's Executive Order BJ 2008-7 highlights the need for the plan to drive and expedite state action across agencies. The same need applies to the state's partners at the local and federal levels, consistent with their mandates and missions.

**Regulatory effects**

Revisions to some laws and regulations may be needed to help the state's coastal program achieve its goals. The master plan highlights where such changes may be needed so that local, state, and federal partners are able to act in concert with the plan.

**Role of private sector**

Because the majority of Louisiana's coast is privately owned, close working relationships with private landowners are essential, not only for their support but to gain from their knowledge about private coastal lands. Since Louisiana's is also a working coast, partnerships with businesses and industries are also required for the success of the coastal program. The support of all of these entities is essential for providing coast wide consistency with the master plan's objectives and outcomes.

# Working With Partners



## Outreach and Engagement Principles

**Scope**
Citizens should be given opportunities to learn about and comment on the tools and processes that create the plan and not just the finished plan itself.

**Timing**
Citizens' comments and ideas should be received, reviewed, and incorporated while the plan is being developed, not after the fact.

**Fair hearing**
Not every citizen preference will be included in the plan. However, the state can promise that each idea will receive a fair hearing, and that questions will be answered promptly and honestly.

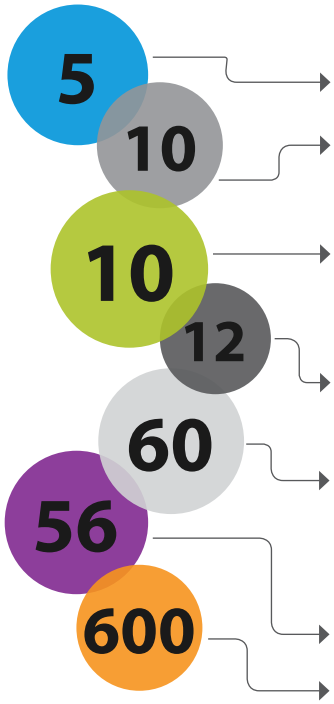
**Access**
The state must provide a variety of ways for citizens to learn about and participate in the master planning process, including small group gatherings, web offerings, direct communication with local and state government, and public meetings.

We live within one of the world's great estuaries. We have huge concentrations of natural resources, internationally vital industry, and resilient people. Because the 2012 Coastal Master Plan captures our resolve to build a strong future for coastal residents, we needed community members and local leaders to help us develop the plan. We gathered their ideas in several ways.

## Seeking Ideas from Citizens and Local Leaders

We began our outreach efforts by meeting with 40 state legislators as well as coastal parish officials to gain their perspective about how coastal action affects communities. We also met with community groups throughout the coast, including rotary clubs, advocacy organizations, and school groups. These meetings were particularly important for engaging audiences that have not before been involved in coastal planning. Additional meetings with Louisiana scientists allowed us to exchange ideas about how to protect and restore the coast.

### Key Statistics




- 5 — Briefings with official parish representatives
- 10 — Presentations to the CPRA and the Governor's Advisory Committee for Coastal Protection, Restoration, and Conservation
- 10 — Regional Community Meetings held throughout the coast July – September 2011
- 12 — Meetings with Fisheries, Oil and Gas, and Navigation Focus Groups
- 60 — Meetings with Framework Development Team Members, Representing Community, Industry, Federal, State, NGO, and Academic Organizations
- 56 — Presentations to Civic or Professional Groups
- 600 — Number of Attendees at the Regional Community Meetings

## A Sample of Groups Consulted*

- Abbeville Rotary
- Chenier Plain Committee
- Coast Builder's Coalition
- Iberia Levee District
- Global Green
- Governor's Advisory Commission on Coastal Protection, Restoration, and Conservation
- Lafourche Chamber of Commerce
- Louisiana Charter Boat Association
- Louisiana Landowners Association
- Louisiana Oyster Task Force
- Greater New Orleans Regional Planning Commission
- SASSAFRAS
- Save Our Wetlands – Getting it Done Together
- Southeast Louisiana Flood Protection Authority – East
- South Lafourche Levee District
- United Houma Nation Tribal Council
- Vermilion Rice Growers Association

*Appendix H contains a complete list.

# 2011 Community Meetings

At ten community meetings held between July and September 2011, we learned more about residents' ideas and concerns. Approximately 600 citizens attended these meetings. Both at the meetings and online, a total of 800 citizens took part in an exercise that asked for their views about coastal priorities. The exercise results showed that regardless of where they lived, citizens were particularly concerned about land loss as well as reducing risk from flooding and securing the availability of fresh water. The exercises also revealed citizens' concern for the future of fisheries. We considered these preferences as we developed the draft plan.

Citizens' exercise results were catalogued and posted on the master plan website, which includes detailed information on our planning process and information about how the public can be involved: www.coastalmasterplan.la.gov.







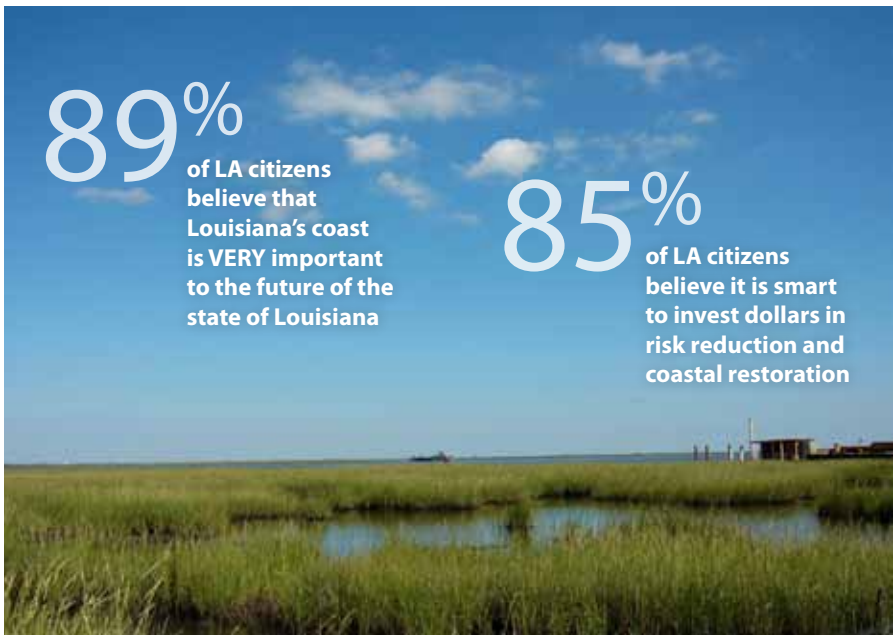
Community meetings in Lake Charles, Chauvin, and New Orleans.

# Coastal Poll

In order to learn even more about Louisiana citizens' knowledge, preferences, and concerns regarding the coast, we conducted a statewide poll. The poll was based on a telephone survey of 1,002 adult residents: 802 residents in the coastal area and 200 residents outside the coastal area. Appendix H provides more information about how the poll was conducted.

## Overview of Poll Results

- Eighty-nine percent of Louisiana citizens statewide believe that the coast is very important.
- The jobs and resources generated in south Louisiana drive citizens' views about why the coast is important.
- Citizens strongly believe that it makes sense to invest in protecting and restoring the coast.
- People were not willing to give up on the coast, nor were they willing to write off areas at risk.
- Citizens believe that we know what to do to save coastal Louisiana. They want leaders to get the job done.



# Groups That Provided Guidance




Logos shown above represent the diversity of organizations represented on the Framework Development Team.

In addition to our work with citizens and local leaders, we wanted to receive structured and ongoing advice from key businesses and industries, federal agencies, non-profits, and local organizations as well as coastal scientists and planning experts. We organized several groups to provide this advice. These groups did not formally or informally endorse the master plan, and their participation should not be interpreted as implying such endorsement. Instead, the role of these groups was to provide recommendations and guidance as the plan was developed, so our finished product would reflect broad perspectives and a world class technical approach. We will look at ways to keep these vital groups active in the coastal program as we move forward. Appendix I lists the groups' participants.

## Framework Development Team

This group consists of 33 representatives and their alternates from business and industry, federal, state, and local governments, nongovernmental organizations, and coastal institutions. The group was responsible for offering specific guidance to the state on all of the major elements of 2012 Coastal Master Plan. The Framework Development Team worked to confront, discuss, and come to a common understanding about the issues that lie at the heart of protecting and restoring Louisiana's coast. Framework Development Team members also reached out to citizens who share their interests, brought these citizens' ideas to the table, and reported back to these citizens about how these ideas were discussed. We have met with the Framework Development Team almost every month since mid-2010. In addition, ad hoc Framework Development Team workgroups were convened to tackle specific issues, such as river use, sediment, nonstructural protection measures, outreach and engagement, and project modeling.

## Focus Groups

Large-scale coastal protection and restoration will affect businesses and industry in south Louisiana. In order to integrate the perspectives of those in key business sectors we created three focus groups each dealing with a key coastal industry: ports and navigation, fisheries, and oil and gas. Leaders in each sector met multiple times with the Coastal Protection and Restoration Authority to discuss in detail the issues facing their industries and explore productive options for the coast.

## Science and Engineering Board Members

**William Dennison, Ph.D. (Co-Chair)**
University of Maryland Center for Environmental Science

**Charles Groat, Ph.D. (Co-Chair)**
University of Texas, Austin

**Greg Baecher, Ph.D.**
University of Maryland

**Edward Barbier, Ph.D.**
University of Wyoming

**Philip Berke, Ph.D.**
University of North Carolina

**Virginia Burkett, Ph.D.**
United States Geological Survey

**Robert Dalrymple, Ph.D., P.E.**
Johns Hopkins University

**Jozef Dijkman, M.Sc., P.E.**
Dijkman Delft

**Katherine Ewel, Ph.D.**
University of Florida

**Edward Houde, Ph.D.**
University of Maryland Center for Environmental Science

# Science and Engineering Board

Our Science and Engineering Board is made up of experts with national and international experience. This group provides a high level of input and assessment of the main technical planning components. The Science and Engineering Board participates in multi-day meetings, as well as conference calls and webinars. Individual board members worked intensively with the planning team on focused elements of the plan, providing guidance at every juncture of the process.

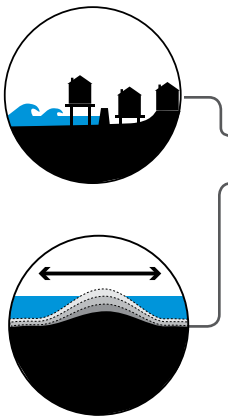
# Technical Advisory Committees

Our Technical Advisory Committees are three to five member groups of nationally known experts who are responsible for advising us on how to conduct our analysis in the most technically sound manner. We have three technical advisory committees: one that assists us with our modeling analysis, one that advises us on the development of our Planning Tool, and one that gives us advice about incorporating cultural heritage appropriately in the plan. Each of these committees has met multiple times with the team to provide in depth feedback. The committees will continue to provide guidance as the master plan is finalized. See list of members in Appendix I.



The Framework Development Team holds a round table discussion.

# Decision Drivers



Two primary factors drove our decisions about the projects that should be in the 2012 Coastal Master Plan.

1. **How well did the projects reduce flood risk?**
2. **How well did the projects build new land or maintain the land we already have?**

The prominence we gave these two factors reflected the master plan's mission as affirmed by citizens and local leaders. As anyone who lives in south Louisiana can attest, our communities need flood protection and our coast needs sustainable land. Putting these two factors front and center ensured that the projects we selected addressed the priority needs of the coast.

## Flood Risk Reduction

The state would like to provide 100 year protection to all communities and businesses. However, it is not feasible to do so given the inherent risk of living in a hurricane prone area, as well as current funding levels and engineering constraints. We can, however, provide significant risk reduction across the coast, with some type of protection provided for every parish. Just as coastal Louisiana is comprised of several unique landscapes that support particular functions, the type of flood risk reduction projects provided in this plan differs depending on the unique needs and features of specific communities. Our objective is the same coast wide: to reduce economic losses from storm surge based flooding so that we may support the culture, communities, and people of coastal Louisiana.

The 2012 Coastal Master Plan, like its 2007 predecessor, focuses on reducing risk of flooding to properties from hurricane wave and surge. It does not include measures that protect against river flooding or measures that protect life and limb. The plan's protection measures were developed using the assumption that people must leave affected areas if human life is to be protected during a severe storm.

## Expected Annual Damages

When looking at protection, we had to assess flood risk in a way that was consistent across the coast. To do this, we used what is known as expected annual damages. This concept takes into account that we don't know when floods will occur. Communities may go years without a serious flood, they may experience minor floods, or they may be severely flooded several years in a row—any number of variations is possible.

Our analysis of expected annual damages took a 50 year look at the likelihood of floods occurring and predicted an average amount of flood damages for each community. These averages were expressed as dollars of damage per year. They do not imply that every community will flood every year. They are statistical 50 year averages of a given community's likely flood risk and the damage that would be associated with that risk. Having this information allows us to evaluate how risk changes over the 50 year planning timeframe.



## Land Building

This decision driver helps us assess our projects' performance according to an important benchmark: how well our projects build or maintain land. Making this one of our two primary decision drivers helped us keep this crucial benefit front and center as we selected projects for the 2012 Coastal Master Plan. We used a project's ability to build or maintain land, along with cost, to evaluate that project's effectiveness.

We measured land built by evaluating each restoration project's ability to build or maintain land. Our modeling was able to capture the different types of land building that will occur with different project types. Marsh creation projects will build most of their land as soon as the project is constructed, and then over time, that land may erode and subside. Sediment diversions, in general, do not build substantial land early, but their land building potential continues to grow into the future. Barrier island restoration projects will provide land quickly, but waves and currents will redistribute this sediment and nourish adjacent islands. In time, the islands will roll back.

# Decision Criteria

Louisianans have different but equally valid ways of viewing what should be done for their coast. To better take this range of preferences into account, we created a set of criteria that represent what is important to coastal residents and business owners. Using these criteria allowed us to consider different ways that risk reduction and restoration projects could affect the coast. When evaluated, these criteria were evaluated as equally important. Appendix B includes more details about the decision criteria.



## Support of Cultural Heritage

This criterion reflects our ability to support the people who live in coastal communities and use ecosystem services/natural resources for work or recreation. The criterion puts a higher value on collections of risk reduction and restoration projects that reduce risk for coastal communities and provide, within a reasonable distance, high levels of traditional natural resources to the people living and working along the coast.




## Distribution of Flood Risk Reduction Across Socioeconomic Groups

This criterion reflects concerns about how flood risk reduction is distributed among varying levels of income. The criterion puts a higher value on risk reduction projects that distribute risk reduction across diverse income levels.



## Flood Protection of Historic Properties

This criterion puts a higher value on risk reduction projects that reduce the level of flooding on historic properties, which are defined as historic standing structures, historic districts, historic landmarks, and archaeological sites.



## Flood Protection of Strategic Assets

This criterion puts a higher value on risk reduction projects that reduce the level of flooding for assets of state or national significance. Strategic assets include critical chemical plants, natural gas facilities, strategic petroleum reserves, power plants, petroleum refineries, ports and terminal districts, airports, military installations and other federal facilities.



## Support of Navigation

This decision criterion reflects a risk reduction or restoration project's ability to enhance or impede navigation, both shallow and deep draft, in federally authorized channels. Risk reduction and protection projects can enhance navigation, interrupt navigation, or have no affect at all. This criterion puts a higher value on projects that benefit the navigation industry (i.e., bank stabilization, shoreline protection), while placing a lower value on projects that may impede navigation, such as locks and large sediment diversions.



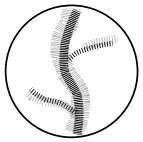
## Support of Oil and Gas

This criterion puts a higher value on collections of risk reduction and restoration projects that improve coastal conditions for oil and gas infrastructure and increase the viability of coastal communities that support the industry.



## Sustainability

This criterion puts a higher value on restoration projects that maintain or increase land area built between years 40 to 50 after project construction.



## Use of Natural Processes

This criterion reflects a risk reduction or restoration project's ability to enhance or impede natural processes along the coast. Risk reduction and protection projects can enhance natural processes, interrupt them, or not affect them at all. This criterion puts a higher value on projects that use natural processes to advance our goals, such as sediment diversions and oyster reefs. This criterion places a lower value on projects that impede natural processes, such as levees that block natural flows.




## Operations and Maintenance

This criterion puts a higher value on restoration projects that cost less to operate and maintain. This value is only calculated for restoration projects, as the operations and maintenance costs of protection projects are the responsibility of the local sponsor.

# Ecosystem Services

Ecosystem services are benefits provided to us by nature. In our analysis ecosystem services refer to things like the provision of habitat for natural resources that support fishing and other activities. These services make our coast a Sportsman's Paradise and provide hundreds of thousands of jobs. When developing the master plan, we wanted to understand how implementing projects would affect these services.

A comprehensive evaluation of ecosystem services includes a dollars and cents component that captures how much these services are worth monetarily. Our analysis for the 2012 Coastal Master Plan does not include this economic aspect. Instead, we focused on how a project, or group of projects, might affect characteristics of the coast.

Sometimes we were able to directly evaluate changes in ecosystem services, such as when we analyzed the availability of fresh water for human uses. In other cases, we couldn't directly evaluate an ecosystem service, such as fisheries harvest. In those cases, we used proxies to estimate ecosystem services. Many of these proxies involved evaluating a habitat suitability index, which is a model that estimates the ability of a given habitat to support various fish and wildlife. Regardless of whether we directly evaluated a service or used a proxy of the service, we refer to these coastal benefits throughout this document as ecosystem services.



# Definitions: Ecosystem Services



**Alligator**

To predict the effects of restoration projects on alligator habitat, we utilized a habitat suitability index based on appropriate combinations of water, vegetation, and land characteristics that support alligator habitat.



**Crawfish**

We developed a crawfish habitat suitability index to predict project effects based on water, land, and vegetation characteristics. The model is currently undergoing additional refinement and will be included in the ongoing analysis.



**Storm Surge/Wave Attenuation**

We developed an index to reflect the ability of the coastal landscape and restoration projects to reduce the effects of storm surge and waves on coastal communities. The index is based on the location and amount of land in proximity to population centers, type of vegetation and land elevation. The model is currently undergoing further refinement to better distinguish between the effects of different project types. In addition, the Coastal Protection and Restoration Authority will be pursuing storm surge/wave modeling through ADCIRC to more accurately depict the contributions of the restored landscape.



**Other Coastal Wildlife**

To understand the effects of restoration projects on coastal wildlife, other than consumptive species, habitat suitability models for muskrat, river otter, and roseate spoonbill were developed based on water, vegetation, and land characteristics.



**Freshwater Fisheries**

A habitat suitability index for largemouth bass was used to understand project effects on freshwater fisheries. Water and submerged aquatic vegetation characteristics were utilized in this model.



**Oysters**

To predict changes in oyster habitat, a habitat suitability index was developed that accounted for land change, water, and bottom characteristics.



**Saltwater Fisheries**

A habitat suitability index for the juvenile speckled trout was used to reflect changes to saltwater fisheries, based on water and vegetation characteristics.



**Shrimp**

Habitat suitability indices were developed for juvenile brown shrimp and juvenile white shrimp to predict changes in habitat based on water and vegetation characteristics.

**Waterfowl**

A combination of habitat suitability indices for mottled duck, gadwall, and green winged teal were used to estimate waterfowl habitat changes based on predicted changes to water, vegetation and land characteristics.

**Agriculture**

To estimate changes to potential agriculture and aquaculture activities, an index was developed that evaluated salinity characteristics and frequency of flooding in upland areas. This index includes lands that are in production for rice, sugarcane, cattle, farmed crawfish, and other agricultural and aquacultural activities.

**Carbon Sequestration**

The Wetland Morphology Model was used to estimate project effects on carbon storage potential. Carbon storage varies with the type of wetland, the acreage, and the annual vertical accretion of soil.

**Freshwater Availability**

A suitability index was developed to evaluate salinities in close proximity to strategic assets or populated areas.

**Nature Based Tourism**

An index was developed to estimate the potential for nature based tourism. The index measured access to high quality habitats for wildlife and vegetation near major population centers or other coastal tourism centers, such as barrier islands and wildlife management areas. The species used to describe this service included: alligator, roseate spoonbill, river otter, muskrat, neotropical migrants, and waterfowl, and diverse vegetation types.

**Nutrient Uptake**

A model was developed to predict project effects on nitrogen removal in open water, sediment, and wetlands.



# Using New Tools, Breaking New Ground



Before 2007, separate state agencies were in charge of restoring the coastal ecosystem and providing flood protection for coastal citizens. The 2007 Master Plan brought these two functions together and explored how they could most effectively be combined. Using this foundation, the 2012 Coastal Master Plan identified projects we should construct to provide a sustainable coast. Some of the projects will have large footprints, others will be smaller in scale, but all were selected because they deliver practical benefits for people, businesses, and the environment.

In defining specific solutions, we confronted some real world limitations. There currently isn't enough money available to build all of the projects we have identified. There are also limits to the river water and sediment we can use to rebuild the landscape in different locations. In addition, different communities throughout the coast need and want different things. In a time of acute need and restricted budgets, good science and engineering helped us sort through our options and decide which projects should be part of the plan.

In order to select projects that will provide the greatest return on our investments, we used a series of Predictive Models to provide data and a Planning Tool to help us sort through the models' output. The models and Planning Tool helped us better understand how the coast works as well as the practical implications of different project options. With this information, we were better able to identify high performing projects.

The Predictive Models and Planning Tool are exciting new developments in coastal planning. But it is important to put them in perspective. Our tools did not make decisions for us. They simply informed the choices we made. In addition, our coastal modeling effort is not over. To date, we have used the models to evaluate project and landscape effects for this plan, and we have identified many aspects of this analysis that we want to further develop. We will continue to upgrade the models and the Planning Tool in coming years, so that we may keep improving our ability to make wise investments in support of a sustainable coast.





# Chapter 2
# Identifying Projects

Barrier shoreline restoration along Pass Chaland to Grand Bayou, Louisiana.

# Developing Ideas for Analysis

## Chapter Preview

This chapter explains the first steps we took in our analysis of projects and how we took stock of the coastal protection and restoration ideas that had come before. This chapter also describes the kinds of projects we examined and how they can help the coast.

We chose the projects in the plan because they offered the most effective and balanced path forward. Before we could identify those projects, however, we had to fully understand all of the options available to us. For this reason, one of our first steps as we began working on the master plan was to take stock of the many project ideas that have been proposed for reducing flood risks and restoring ecosystems in south Louisiana. We created a comprehensive list of these project ideas, learned all we could about them, and used that list as the basis for our analysis. This approach reflected the countless hours that citizens, scientists, and policy makers have spent over the last decades working on ways to create a sustainable coast. We wanted to build on these ideas, so that our final plan would leverage the hard work and good ideas that had come before.

To develop our comprehensive project list, we mined studies, reports, presentations, and a variety of plans, including local parish plans. Some of these ideas may have been approved by the state or federal agencies for study or design, but none had been funded for construction. Using these sources, we compiled a list of more than 1,500 project ideas. (Projects with construction funding were not included because they already are, or will soon be, a physical part of the landscape.) We recognize that many coastal planning efforts are ongoing and that new project ideas may emerge in the future. Our adaptive management program will examine and integrate these new ideas as we go forward.

## Screening the Projects

The 2012 Coastal Master Plan's project list needed to be large enough to represent the breadth of thinking on coastal protection and restoration in Louisiana. At the same time, the list had to be small enough so that every project could be individually evaluated. Given these considerations, we screened the initial list of over 1,500 project ideas to a more manageable number of candidate projects. Our screening criteria focused on eliminating duplications; ensuring that, as a general rule, projects were at least 500 acres in size; and making sure that every project on the list was described with enough detail that it could be evaluated by our models. We did not screen out projects based on state or stakeholder preferences. For details on the 1,500 projects and the rationale for screening, see Appendix A.

## A Consistent Approach to Sediment Diversions

We assembled an initial list of sediment diversion projects that included a variety of ideas. The list was too broad to allow a consistent, comparative analysis of the diversions' effects. With the help of the Framework Development Team's River Use Workgroup, we established locations, discharges, and flow regimes for the diversion projects.

The workgroup members proposed that we consider three maximum discharge capacities: 5,000 cubic feet per second (cfs), 50,000 cfs, and 250,000 cfs, as well as larger scale use of the Mississippi River (i.e, channel realignments) in some locations. Other diversion sizes were also considered in a few cases, where individual projects had already been planned in some detail. The workgroup also defined a consistent operational regime for each diversion.

# Sources of Project Ideas

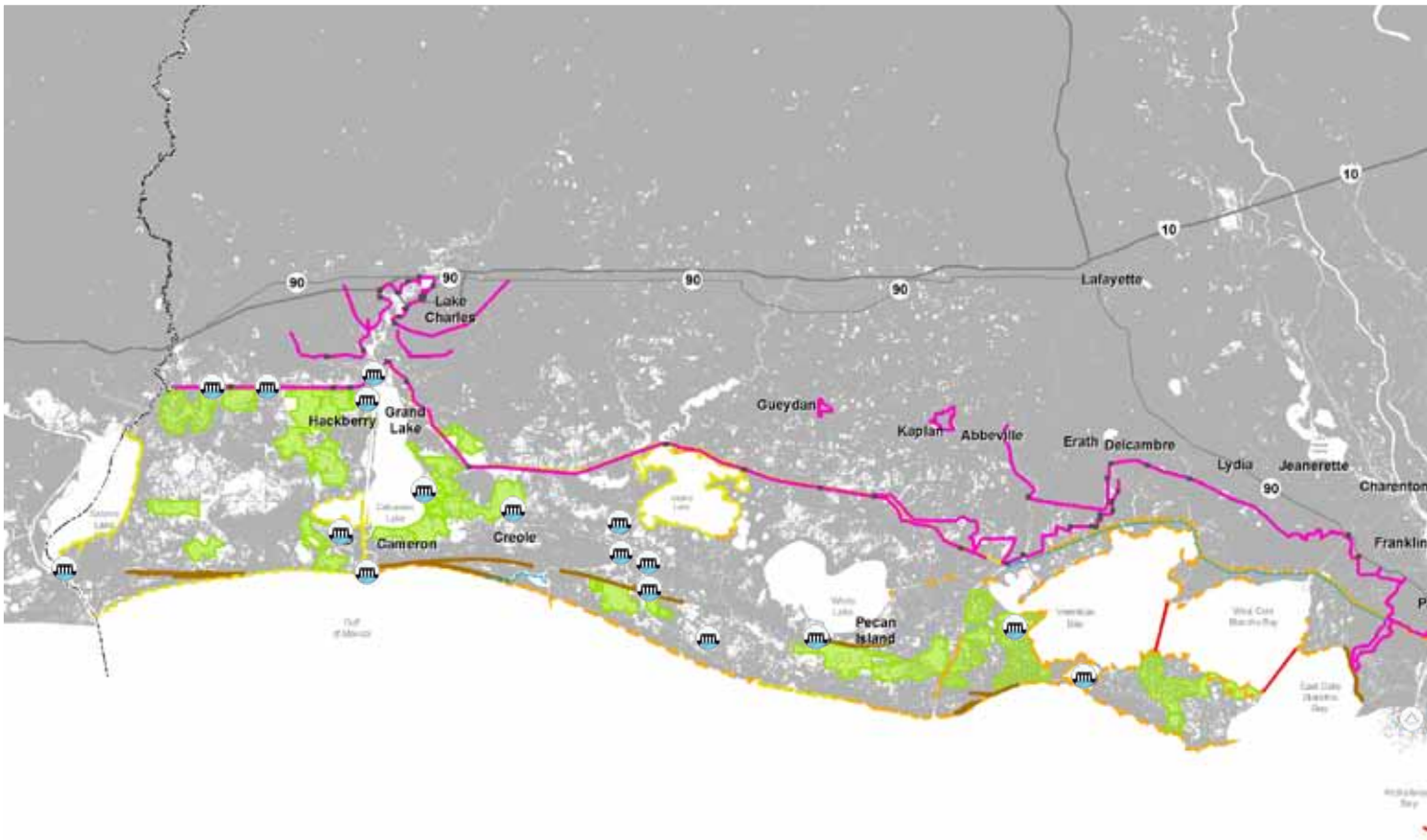
More than 23 large scale studies and planning efforts for coastal Louisiana have been conducted since the 1920s, and they have helped lay the foundation for our work today. In developing the 2012 Coastal Master Plan, we focused on studies produced in the last 15 years. They are listed below.

In addition to the 1,500 project ideas, we developed a list of nonstructural projects coast wide. The following pages provide additional discussion about how we developed this list and the kinds of projects that are included.

- *2007 CPRA Louisiana Master Plan*
- *A Dutch Perspective on Coastal Louisiana Flood Risk Reduction and Landscape Stabilization*
- *A Plan to Sustain Coastal Louisiana Using the Multiple Line of Defense Strategy*
- *Barataria Terrebonne National Estuary Program Comprehensive Conservation Management Plan*
- *Coast 2050: Toward a Sustainable Coastal Louisiana*
- *Coastal Impact Assistance Program Tier II Projects*
- *Coastal Sustainability Studio Concepts*
- *Coastal Wetland Planning, Protection, and Restoration Act Finalists*
- *Comprehensive Habitat Management Plan For The Lake Pontchartrain Basin*
- *Envisioning the Future of the Gulf Coast*
- *Louisiana Coastal Area Comprehensive Study*
- *Louisiana Coastal Protection and Restoration Final Technical Report*
- *Mississippi River Gulf Outlet Ecosystem Restoration Study*
- *Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study*
- *Parish Master Plans (St. Bernard, Plaquemines, Jefferson, Terrebonne, St. Mary, Vermilion)*
- *Southwest Coastal Louisiana Feasibility Study*
- *Third Delta Phase II Reconnaissance Study*

# Projects Considered

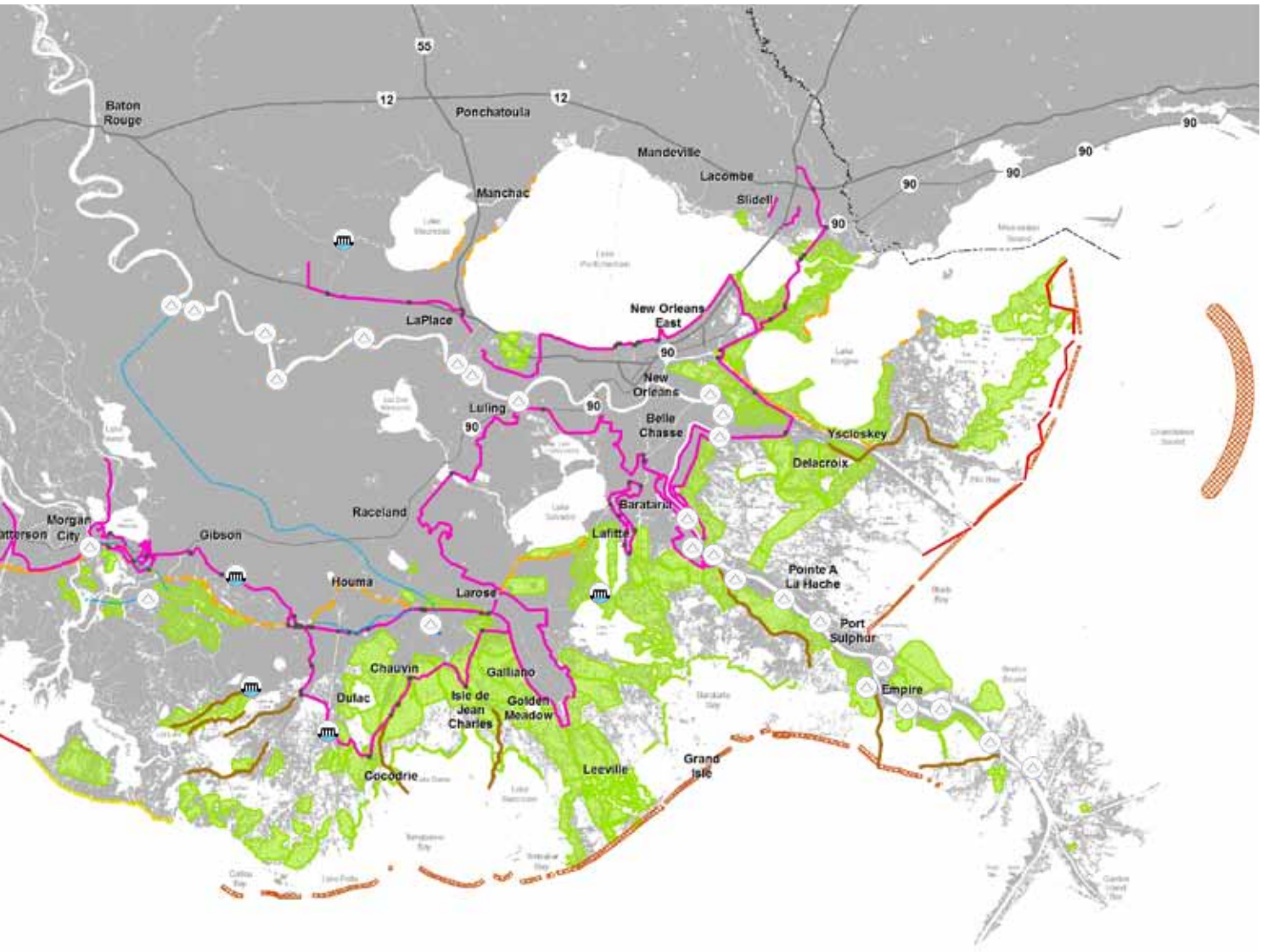
## Projects Identified for Analysis as Part of the Master Plan Process





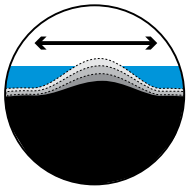


Project Types Included: Color corresponds to location on map.




▲ **Figure 2.1**
Comprehensive list of projects analyzed in the project. Not all projects were selected for inclusion in the draft plan. Detailed information on all projects can be found in Appendix A.

# Types of Projects



Using the process described above, we ultimately developed a list of 381 projects for evaluation in the 2012 Coastal Master Plan. Included within this project list are restoration projects, structural risk reduction projects, such as levees, and nonstructural risk reduction projects, such as elevating homes.

## Restoration Projects

The 238 restoration projects on our list can be grouped into the following categories:



### Bank Stabilization

Onshore placement of earthen fill and vegetative plantings designed to reduce wave energies and maintain shorelines in open bays, lakes, and bayous. Bank stabilization projects include work on navigation channels. It is the state's policy that funding for federally authorized navigation channels is the sole responsibility of the federal government. The state will work to secure funding for projects shown to be important to the overall coastal program.



### Barrier Island/Headland Restoration

Creation and restoration of dune, beach, and back barrier marsh to restore or augment Louisiana's offshore barrier islands and headlands.



### Hydrologic Restoration

Installation of features that restore natural hydrologic patterns either by conveying fresh water to areas that have been cut off by man-made features or by preventing the intrusion of salt water into fresh areas through man-made channels and eroded wetlands.



### Marsh Creation

Creation of new wetlands in open water areas through sediment dredging and placement. Most projects involve pipeline conveyance of sediment.



## Oyster Barrier Reefs

Establishment of bioengineered oyster reefs to improve oyster propagation and serve as breakwaters to attenuate wave energies.



## Ridge Creation

Re-establishment of historic ridges in basins through local dredging, sediment placement, and vegetative plantings to restore natural ridge functions.



## Sediment Diversion

Use of new channels and/or structures to divert sediment and fresh water from the Mississippi and Atchafalaya Rivers into adjacent basins.



## Channel Realignment

Structures and channels to divert all the river water and sediment in the Mississippi River into adjacent basins. Projects would include the dredging of a new navigation channel.



## Shoreline Protection

Installation of nearshore rock breakwaters to reduce wave energies on shorelines in open bays, lakes, sounds, and bayous. Shoreline protection projects include work on navigation channels. It is the state's policy that funding for federally authorized navigation channels is the sole responsibility of the federal government. The state will work to secure funding for projects shown to be important to the overall coastal program.



## Multiple Feature Projects

Projects that combine one or more of the above features.

Additional information about the restoration projects evaluated is presented in Appendix A.

# Protection Projects: Structural

Structural risk reduction projects reduce flood risk in coastal communities by acting as physical barriers against storm surge. We viewed protection through the lens of reducing communities' expected flooding risk to either the 50 year, 100 year, or 500 year level. To this end, the 31 structural projects evaluated in the 2012 Coastal Master Plan include one or more of the following basic components:



## Earthen Levee

The principal component of structural projects is the earthen levee. These structures consist of pyramidal banks of compacted earth that provide a barrier against storm surge for coastal communities and assets. Levees can either be linear in shape or ringed. Ring levees form a closed risk reduction system that encircles a protected area, and the protected area is referred to as a polder. Linear levees create a closed system by tying into other linear levees or by extending inland to high ground.



## Concrete Wall

These are typically located at points along an earthen levee that have a high potential for erosion or insufficient space for the wide slopes of an earthen levee. Concrete walls were specified at junctions with water crossings, railroads, and major roadways (i.e., interstates and state highways).



## Floodgate

Floodgates are needed where levees or concrete walls cross a road or railroad or where they intersect waterways. Floodgates were established for each of these crossings for the structural projects in the master plan.



## Pumps

Pumps are needed in enclosed risk reduction systems to allow water that enters a polder to be pumped out. Pumps were included as features of most of our protection features.

Additional information about the structural risk reduction projects evaluated in the master plan is presented in Appendix A.

# Protection Projects: Nonstructural

Nonstructural projects reduce storm related flood risk by modifying individual residential and commercial structures. Nonstructural measures include: 1) floodproofing of residential and commercial properties, 2) elevation of residential properties, and 3) voluntary acquisitions of residential properties. Although many parishes have already implemented nonstructural measures to reduce flood risk within communities, we did not have a complete list of these projects, nor did we have a study of coast wide nonstructural measures to work from. To fill this gap and provide a comprehensive approach to nonstructural protection in the master plan, we developed a list of 112 possible nonstructural projects. This list was conceptual, but it allowed us to fully integrate nonstructural measures into our analysis and provide as many risk reduction options for communities as possible.

We developed nonstructural projects for all inhabited areas at the parish or community level. Each nonstructural project consisted of a combination of the three measures below. Measures were applied depending on the average flood depth that area could reasonably expect. We used several criteria for estimating this level of flooding, including ground elevations and the Federal Emergency Management Agency's new Digital Flood Insurance Rate Maps. See Appendix A for more information.



## Elevation

Raising residential structures so that their lowest floors are higher than projected flood depths. For residential structures, this measure was considered for areas with a projected flood depth of between 3 and 18 feet.



## Floodproofing

Refitting structures to be resistant to flood damages. Residential and commercial floodproofing was considered for structures in areas with projected flood depths of 3 feet or less.



## Voluntary Acquisition

Voluntary acquisition of structures in areas where projected flood depths make elevation or floodproofing infeasible. We considered this option for residential structures that would need to be elevated higher than 18 feet. Less than 3% of the nonstructural projects recommended in the draft plan falls into this category.

# Understanding Nonstructural Projects

The analysis evaluated floodproofing for commercial properties for up to three feet of flooding only. This means that if the recommended nonstructural projects are implemented for these properties, any flooding greater than three feet will cause damages. To account for the varying degrees in which all nonstructural projects may be adopted, we analyzed a variety of participation rates. We used a participation rate between 70% and 80%, depending on the kind of property or nonstructural action considered. Both the participation rate and the inability to fully protect commercial properties means that all nonstructural projects include residual risk to the community and do not provide 100% damage reduction.

We developed two variations of each nonstructural project based on two target elevations: base flood elevation, as found on the Federal Emergency Management Agency's preliminary Digital Flood Insurance Rate Maps plus one foot, and base flood elevation plus four feet. The extra elevation height allows for sustained risk reduction in the face of uncertain future conditions.

The list of nonstructural projects in the 2012 Coastal Master Plan is intended to offer voluntary options only for residents and communities. It does not preclude additional structural or nonstructural projects not identified in the master plan. Additional information about the nonstructural risk reduction projects evaluated in the master plan is presented in Appendix A, including the geographic distribution of projects in inhabited areas of the coast.

## Nonstructural Project Types and Flood Depths

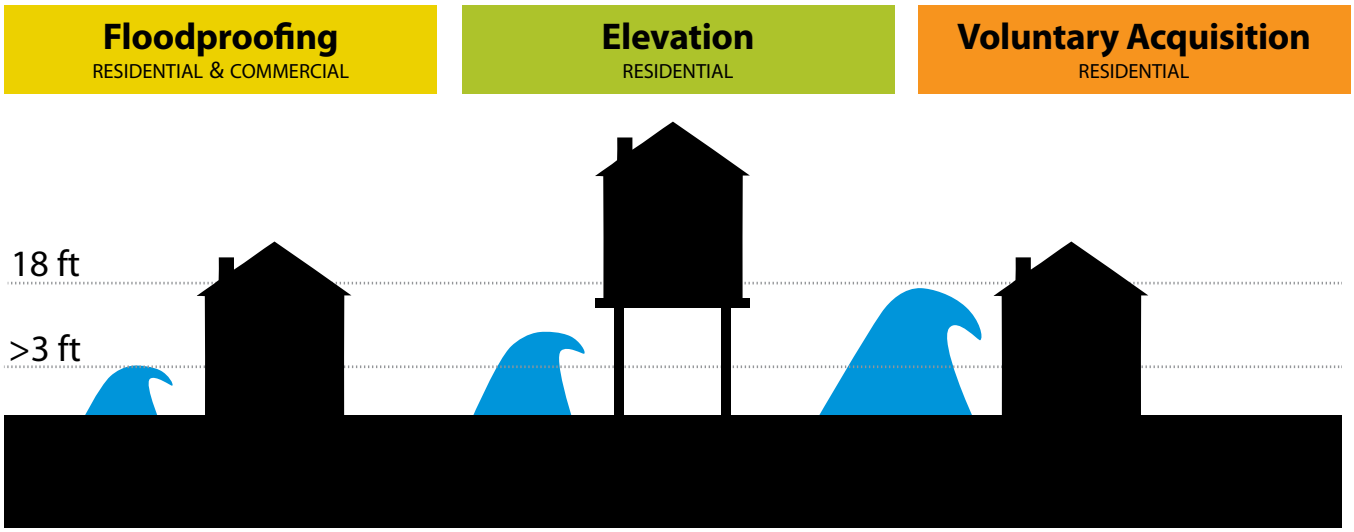



**Figure 2.2** Three types of nonstructural measures are proposed in the master plan. A measure is selected based on flood depth.

# Understanding Levels of Risk

A 50 year level of protection would reduce nearly to zero the flood damage created by a storm that has a 2% chance of occurring in any given year. A 100 year level of protection would reduce nearly to zero the flood damage created by a storm that has a 1% chance of occurring in any given year. A 500 year level of protection would reduce nearly to zero the flood damage created by a storm that has a 0.2% chance of occurring in any given year.

Another way to think about this concept is to consider a typical 30 year mortgage. Fifty year protection equates to protection from a storm that has a 45% chance of occurring over a 30 year mortgage. One hundred year protection equates to protection from a storm that has a 26% chance of occurring over a 30 year mortgage. Five hundred year protection provides protection from a storm that has a 6% chance of occurring over a 30 year mortgage.

## What Do 50-100-500 Year Protection Levels Mean?

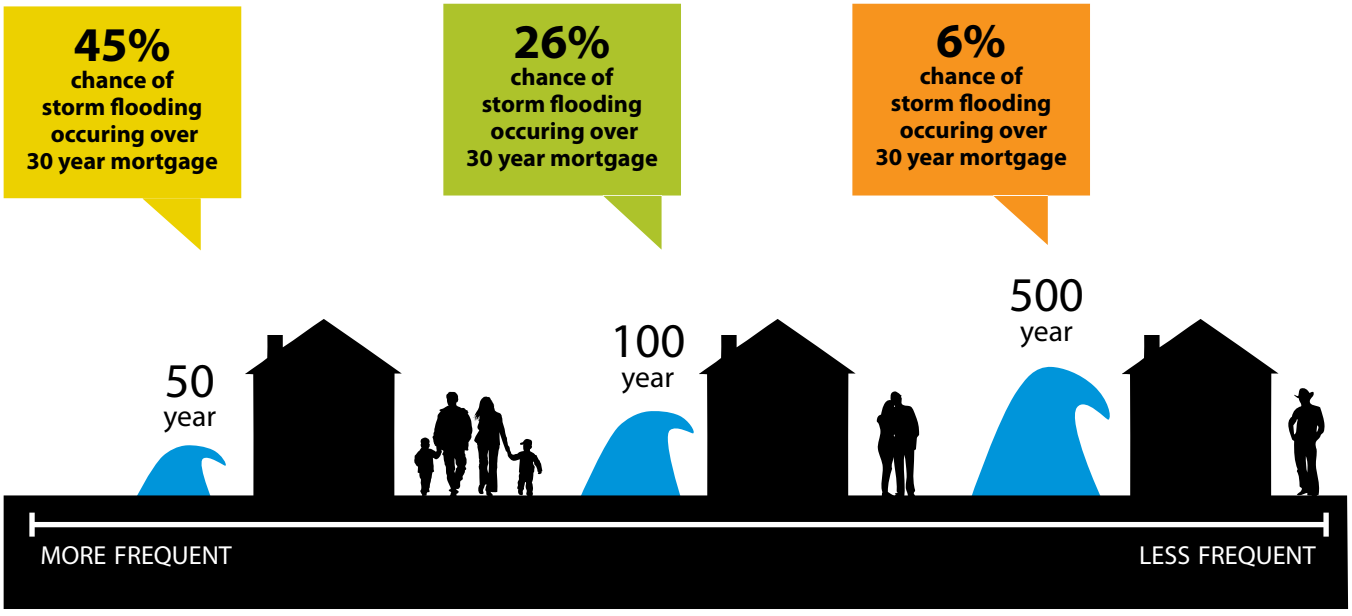



**Figure 2.3** Protection levels still include the chance of 50, 100, and 500 year flood events affecting a home over the life of a 30 year mortgage.

# Describing the Projects

We assembled hundreds of project ideas of varying sizes, designs, and budgets. We had to find a way to describe these projects in a consistent way so they could be evaluated on a level playing field. First we identified the kinds of information we wanted to have and established categories for each project type. These categories included different information fields—for example, project location, size, and duration—that when added together would provide complete project profiles. We chose these categories in consultation with our modeling team and other experts since the attribute categories had to mesh with what the Predictive Models and Planning Tool could analyze.

We then began a several month process to find all of the necessary information specified in these categories. Whenever possible, we took attribute details directly from the original studies that had proposed the projects. Often, however, the studies either did not contain detailed project information or used different assumptions than we did about the projects' lifespans and designs. For example, the source studies often used varying elevations for marsh creation projects, and some studies presented projects designed to function for a shorter time than the master plan's 50 year timeframe. In most of those cases, we took the project footprint and applied our own design templates for each project type.

We used a standard system for assigning costs and developing estimates for each category of projects. For construction costs, we estimated construction bid items, unit costs, and quantities. We used historical data to guide us, and we referenced unit costs from recently bid projects in other coastal programs. The final estimated construction cost for projects included contingencies (dollar amounts that allow for expected costs not already identified). Planning, design, and construction management costs were determined as a percentage of the estimated construction cost. Operation and maintenance costs were calculated differently, depending on project type. For projects the state has experience building, such as marsh creation, barrier island restoration, and structural risk reduction projects, operation and maintenance costs were developed to cover specific activities. For project types that have not yet been implemented in coastal Louisiana, such as large scale diversions, operation and maintenance costs were estimated as a percentage of construction cost. The complete project attributes tables in Appendix A offer a wealth of standardized information about the project ideas available to protect and restore coastal Louisiana.







# Chapter 3
# Evaluating Projects

Earthen levee along Lake Pontchartrain shore.

# Evaluating Projects

## Chapter Preview

With so many projects to consider, how did we systematically explore our options? This chapter explains how we used technical tools to ground the plan in the best available science. The chapter also explores many of the elements of our analysis, including our methods for assessing sea level rise, subsidence, and other important factors.

*The coast is a complex system. We needed to better understand how it is changing today and the kinds of changes we could expect in the future.*

Our purpose for the 2012 Coastal Master Plan was to identify projects that improve the lives of coastal residents by creating a more a resilient south Louisiana. Achieving this goal required new tools that would help us better understand our coast and how projects could provide benefits. The coast is a complex system. We needed to better understand how it is changing today and the kinds of changes we can expect in the future. We also had hundreds of project ideas and different views about how to go forward. We needed a way to sort through our many options and find those that would work best for us.

To meet these needs, we used Predictive Models and a Planning Tool. These science based tools helped us understand the practical implications of different project options and how gains in one area might create losses in another. Based on the preferences we wanted to explore, our tools helped identify strategies for investing in coastal protection and restoration projects. This analysis improved our understanding of how projects were affected by constraints: our budget and the river water and sediment that we have to work with. We also used the tools to consider possible future conditions that will affect the way our projects operate, along with other factors such as construction time.

## The Predictive Models

The Predictive Models developed for the master plan performed two different functions. First, the models assessed how Louisiana's coastal landscape may change and how much damage communities may face from storm flooding over the next 50 years if we take no further action. Second, the models assessed how the coastal ecosystem and our level of risk will change over 50 years if certain risk reduction and restoration projects are constructed.

The models incorporated what we know about the way the coast works, and they made it easier to identify projects that best achieve our objectives. Most of the models can be run on a desktop computer. Others, especially the storm surge model, can only be run on computer clusters or on supercomputers.

The 2012 Coastal Master Plan analyzed both protection and restoration, which influenced the models we selected and how they work. To reflect restoration outcomes, the models looked at how land changes throughout the coast—where land is building and where it's disappearing. To do this, the models examined how water moves through the coastal system as well as how flows of salt and fresh water affect vegetation and habitats for key species and ecosystem services. Ecosystem services are benefits

provided to people by Louisiana's coast. These range from providing the right habitats for oysters and shrimp, to nature based tourism. Our analysis did not account for the monetized values represented by ecosystem services, but instead focused on proxy characteristics of the coast, such as provision of habitat (i.e. habitat suitability indices) and other factors that can support these services. To reflect risk reduction outcomes, we used models that evaluated storm surge and the risk of expected annual damages from flooding.

The Predictive Models used in the master plan were organized into seven linked groups, involving the work of over 60 scientists and engineers. Each group worked on a different aspect of how the coastal system changes over time. Some of these groups included many individual models. Besides the habitat models, many of which were based on existing models, new models were developed to reflect potential for nature based tourism, fresh water availability, and support for agriculture/aquaculture.

The models were designed to work together, following the precedent set by earlier state planning efforts, such as the Coastal Louisiana Ecosystem Assessment and Restoration work conducted for the Louisiana Coastal Area Study. For our analysis, we developed new models covering vegetation, barrier shoreline, and risk assessment. We also found new ways to link the expanded set of models to more fully capture how the coast works as a system. The level of modeling in the 2012 Coastal Master Plan is a significant technical achievement, in the systems approach, the linked nature of the models, and in the breadth of subjects evaluated. See Appendix D for more detail.

## Modeling in a Systems Context

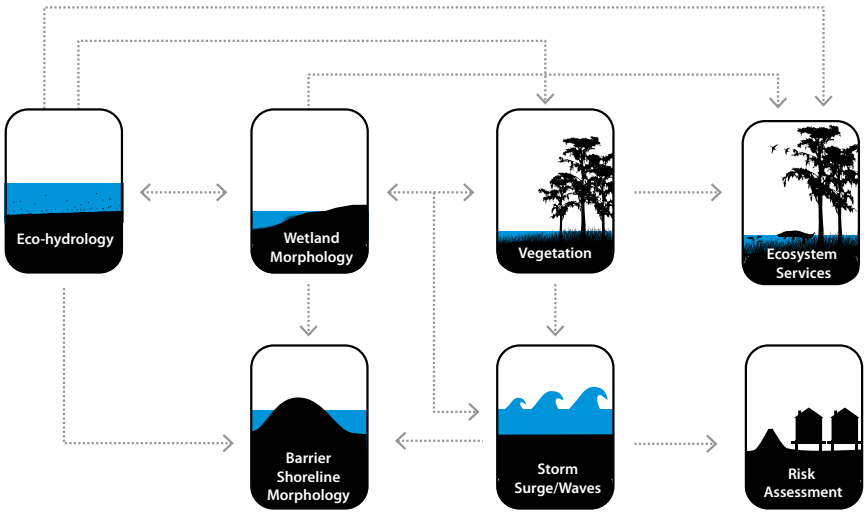
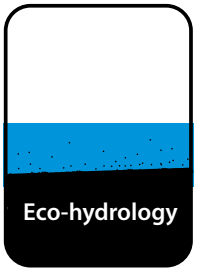



**Figure 3.1**
The seven predictive models used in the master plan and their linkages. For more information about this modeling system, see Appendix D.

# Predictive Model Groups



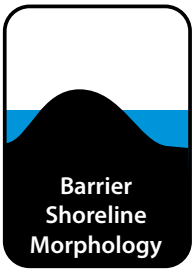

## Eco-Hydrology

Predicts changes in water characteristics within estuaries. This group of models predicts water levels, salinity patterns, sediment delivery, and some aspects of water quality. They use output from the Wetland Morphology group to determine the shape and size of open water bodies. Output from the Eco-hydrology model group is used by the Wetland and Barrier Shoreline Morphology, Vegetation, and Ecosystem Services model groups.




## Wetland Morphology

Predicts changes in wetland areas, taking into account the loss of existing wetlands, the creation of wetlands by both natural and mechanical processes, and the fate of those newly created wetlands. This model has been improved over past efforts to consider more characteristics of the landscape as predictors of land change. This group of models uses salinity and water level data from the Eco-hydrology group, as well as data from the Vegetation group, and provides information on land configuration to the Storm Surge/Waves, Vegetation, and Ecosystem Services model groups. It also produces outputs that reflect the potential for carbon sequestration in coastal wetlands.



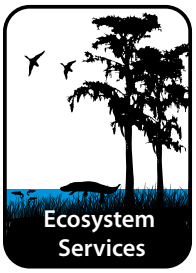

## Barrier Shoreline Morphology

Predicts changes in the shape, location, and elevation of barrier islands and the size of tidal inlets over time, including land gains resulting from restoration activities, as well as land loss from wave erosion, sea level rise, and subsidence. It is based on understanding gained from the Barrier Island Comprehensive Monitoring program as well as years of other research. It uses inputs from the Wetland Morphology and Eco-hydrology groups to predict the volume of tidal waters moving through inlets. Data on how these inlets change in size is then fed to the Eco-hydrology group. Data on land configuration is fed to the Storm Surge/Waves model group. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.



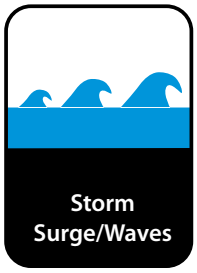

## Vegetation

Predicts the location and type of vegetation that will be found throughout the coast, including submerged aquatic vegetation. It provides information about the conditions influencing plant growth, based on newly available data from the Coast wide Reference Monitoring System. This model receives input on landscape and water quality characteristics from the Wetland Morphology, Barrier Shoreline Morphology, and Eco-hydrology groups, respectively. Its output is used by the Storm Surge/Waves and Ecosystem Services model groups. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.




## Ecosystem Services

Predicts how well Louisiana's future coast will provide habitat for commercially and recreationally important coastal species and habitats for other key services. This group of models uses inputs from all other model groups. It includes habitat suitability indices for American alligator, muskrat, river otter, spotted sea trout, brown shrimp, white shrimp, largemouth bass, gadwall, green-winged teal, mottled duck, neotropical migrants, roseate spoonbill, wild-caught crawfish, and eastern oyster. These species were selected for one or more of the following reasons: they are thriving in coastal Louisiana, they are of commercial or recreational importance, and/or their habitat would likely be either increased or decreased by restoration and protection projects. In addition to habitat models, many of which were based on existing models, new models were developed to reflect potential for storm surge/wave attenuation, nature based tourism, freshwater availability and support for agriculture/aquaculture.




## Storm Surge/Waves

Predicts the effects of structural protection (i.e. levees and floodgates) projects on storm surge depth and wave height from hurricanes with a range of size and intensities. This model group uses output from the Wetland and Barrier Shoreline Morphology and Vegetation groups to determine landscape characteristics and provides information on flood depths for use by the Risk Assessment group. This group also evaluates changes in flood depths. This output was used to evaluate nonstructural options.




## Risk Assessment

Predicts asset damage that would be caused by storm surge flooding and waves. It estimates the flooding that would result from levee overtopping and/or inundation in areas without structural protection. For enclosed structural protection systems (polders) it also factors in the possible failure of flood protection structures. This model receives input from the Storm Surge/Waves model, and its output is used to estimate the reduction in asset damages that could occur in given locations if a given structural or nonstructural project is implemented. This is a new model created to support the Coastal Protection and Restoration Authority and the 2012 Coastal Master Plan.

# Assessing the Baseline: The Future Without Action

## Why We Did It

The 2012 Coastal Master Plan presents a 50 year plan for the coast, which required us to estimate the effects of projects decades into the future. Because Louisiana's coast is a dynamic, ever-changing system, the conditions 50 years from now will be different from those today. In addition, many projects proposed in the plan will not be implemented for several years, or even decades, as further design is undertaken and funding is obtained over time. Given these issues, the most accurate way to predict the effects of projects in the master plan is to compare them against the future landscape that would occur without the plan. To capture this comparison, we investigated what we called "Future Without Action" conditions for the next 50 years, meaning conditions that would be present throughout south Louisiana if we do nothing further to protect and restore the coast.

We used the Predictive Models to evaluate what the Future Without Action will look like. To inform this effort, the models used two scenarios of environmental conditions further described in the Elements of the Analysis section of this chapter: "moderate" and "less optimistic."

In order to better estimate Future Without Action conditions, our models included projects that are already constructed, so that we could account for work that we have done to date. We also factored in projects that have not yet been constructed but will be in the near future because they have received construction funding.

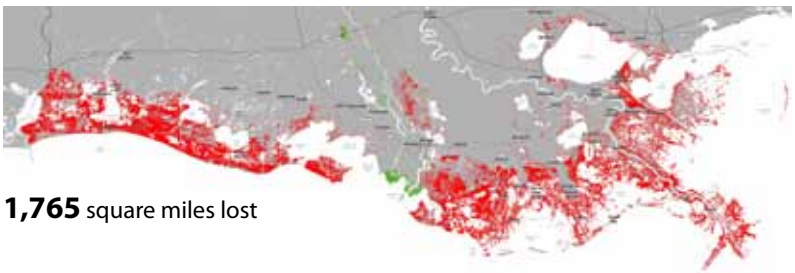
**Comparison of Predicted Land Change Over the Next 50 Years**

Moderate Environmental Scenario



**771** square miles lost

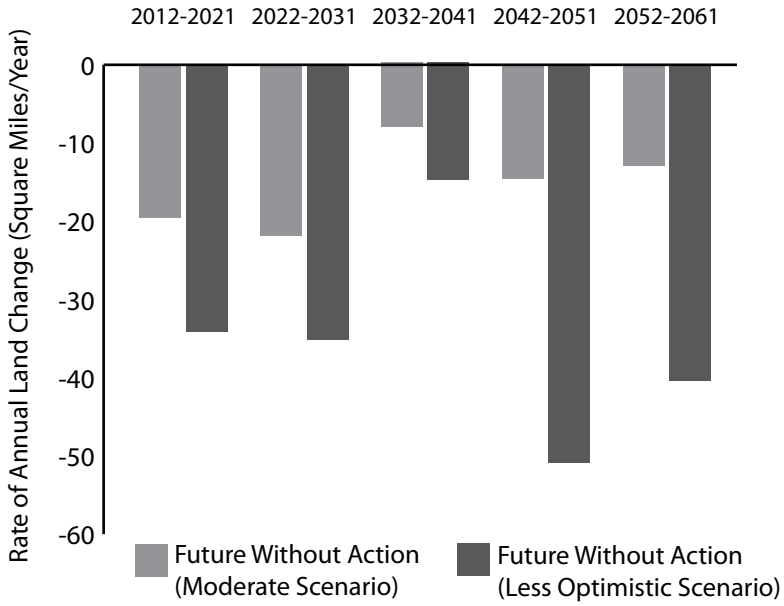
Less Optimistic Environmental Scenario



**1,765** square miles lost

**Figure 3.3**
Predicted annual rate of land loss and land gain every 10 years under moderate and less optimistic scenarios of future coastal conditions.

### Predicted Annual Rates of Land Change with No Action over Next 50 Years




## Future Without Action Results

The results below reflect what will happen if we do nothing further than what we have done to protect communities and restore the ecosystem.

- Under the moderate scenario, our analysis shows that we could lose 771 square miles of land. This amount rises to 1,756 square miles of land loss under the less optimistic scenario of future conditions. See Figure 3.2.
- The rate of land loss varies over the 50 year planning timeframe. Under moderate conditions, the average annual rate of loss varied from 8 to 22 square miles per year. Under less optimistic conditions, the land loss rate varied from 15 to 51 square miles per year. This is consistent with the dynamic nature of the coastal landscape and historic land loss variability.
- Flooding to communities will increase substantially. Some high risk communities could experience an average of nine feet of additional flooding with a 50 year storm event, resulting in flood depths of up to 17 feet in some places.

**Figure 3.2**
A comparison of estimated land change along the Louisiana coast over the next 50 years under moderate and less optimistic scenarios of future coastal conditions. Green indicates areas of new land created if we do nothing more than what we have done to date and red indicates land that is likely to be lost.

- More populated areas, like Houma, Lake Charles, or Morgan City, could experience an average increase of up to four feet of flooding in a 100 year event under the moderate scenario. Associated flood depths for this event range up to 21 feet.
- A 500 year event today would cause substantial damage across the coast. In the Future Without Action, a 500 year event would flood communities that currently do not flood, and some communities could expect up to 26 feet of inundation under the moderate scenario.
- The additional risk of flooding can be calculated as coast wide expected annual damages, which are predicted to increase from $2.4 billion today to $7.7 billion under moderate future conditions. If we experience less optimistic future conditions, the average annual flood damages could reach $23.4 billion.

Ecosystem services each respond differently to moderate and less optimistic future conditions. Below are some general trends we observed:

- Services such as saltwater fisheries and shrimp will increase under both sets of future conditions as salinities increase in the basins and more edge habitat is created through marsh deterioration.
- Other ecosystem services, like freshwater fisheries and waterfowl, will increase under moderate conditions due to an increase in open water availability as we lose land. These services will decrease, however, if we experience less optimistic future conditions and higher salinities infiltrate our basins.
- Services that depend on fresh water or freshwater habitats, such as alligator, other coastal wildlife, or freshwater availability showed significant decreases under moderate and less optimistic future conditions.
- Oyster habitat showed little change under moderate conditions, but showed an increase in habitat under less optimistic conditions due to significantly higher land loss that opens up water bottoms for oyster habitat.
- Agriculture is another important ecosystem service, specifically in Southwest Louisiana. Vermilion Parish, for instance, is consistently rated as Louisiana's top three rice producer. Salinity and storm surge flooding were the primary variables evaluated for this service. For agriculture, the analysis indicates a decline in agricultural lands under Future Without Action conditions. This is due to an increase in flood risk in combination with increasing salinities in the basins.

# How the Models Analyzed Projects

## Model Work Group Leaders

**Eco-hydrology**
Ehab Meselhe, Ph.D., P.E.
University of Louisiana at Lafayette

**Wetland Morphology**
Greg Steyer, Ph.D.
United States Geological Survey

**Barrier Shoreline Morphology**
Mark Kulp, Ph.D.
University of New Orleans

**Vegetation**
Jenneke Visser, Ph.D.
University of Louisiana at Lafayette

**Ecosystem Services**
Andy Nyman, Ph.D.
Louisiana State University and LSU AgCenter

**Storm Surge/Waves and Risk Assessment**
Joseph Suhayda, Ph.D.
Independent Consultant

**Storm Surge/Waves**
Hugh Roberts, P.E.
Arcadis, Inc.

**Risk Assessment**
David Ortiz, Ph.D.
RAND Corporation

**Data Integration**
Craig Conzelmann
United States Geological Survey

Along with the Future Without Action analysis, we also focused on evaluating individual projects. Using the project attributes we developed, the models evaluated the 381 projects on our list, predicting the effects of each project on the coastal system for the next 50 years. This modeling effort was considerably comprehensive and took over a year to complete.

During this phase of the analysis, we looked at the effects of individual projects on the coastal system. We were not evaluating multiple projects at the same time to see how the projects within the draft plan interacted. We are conducting a second round of modeling to refine our analysis and evaluate how the projects in the draft plan work together. The results of this additional analysis will be an important part of our adaptive management program and will guide future improvements to the plan.

## Key Assumption: Individual Project Effects

The modeling done for the 2012 Coastal Master Plan made great strides in explaining the effects of risk reduction and restoration projects on the coastal system. However, our analysis focused on capturing individual project effects on the coastal system. Although we have not captured the effects of project interactions—for instance the effects of two restoration projects together or the effects of risk reduction and restoration projects working in tandem—we have shed light on a tremendous amount of information by analyzing the effects of individual projects and how they affect the system. For example, our models show that diverting sediment and water from the Atchafalaya River eastward into Terrebonne Parish reduces the land building rate of the Wax Lake Delta.

We modeled individual projects for several reasons. First, hundreds of projects have been proposed for the protection and restoration of our coast, and it would be nearly impossible to model all combinations of all possible projects. We therefore had to identify the high performing projects on an individual project level before we could attempt to model projects together.

As we formulated the draft plan, our working assumption was that effects among projects were additive. In some instances, this resulted in an overestimation of benefits. For instance, multiple small diversions modeled together had a slightly lower land building potential than the same diversions modeled individually and added together. On the risk reduction side, there may be some overlap between proposed structural and nonstructural projects that are reducing risk in the same areas.

On the other hand, we are probably also underestimating benefits resulting from the interactions of projects. A marsh creation project that erodes and sinks over time and results in reduced land building at the end of 50 years could be nourished and sustained by a sediment diversion. Together, the two projects would provide greater sustainability of the land mass than both their combined individual effects would suggest. Our analysis did not account for this synergy. We were also not able to fully account for the effects restoration projects have on flood risk reduction. We know that if we allow our landscape to continue to degrade, we face much higher flooding risks. Fully quantifying the contribution of restoration to flood risk reduction is a priority for our ongoing modeling and planning efforts.

# The Planning Tool: An Overview

The Predictive Models examined hundreds of projects to assess their possible effects on the coast. The model results, terabytes of data, are the building blocks of the 2012 Coastal Master Plan. We needed a user friendly way to sort and view these results so that we could propose groups of projects to examine in greater detail. Our computer based Planning Tool displayed model output for us so that we could systematically consider many variables, such as project costs, funding, landscape conditions, and stakeholder preferences, to name a few. The tool showed detailed groupings of projects sorted by factors of importance to us as well as stakeholders. It also showed groupings of projects that were estimated to work together to best achieve the state's goals. These results could be viewed to illustrate project effects individually or summed across groups.

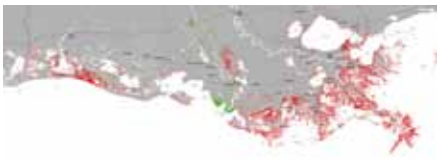
The Planning Tool was designed to translate the models' scientific output and show the practical implications of different options. However, the tool did not make decisions. It did not generate simple answers or a sole ranking of projects. Instead, the tool provided information about how groups of projects met one or more of our objectives. Decision making for the plan followed directly from this analysis, as described in Chapter 4. For more information on the Planning Tool, see Appendix E.



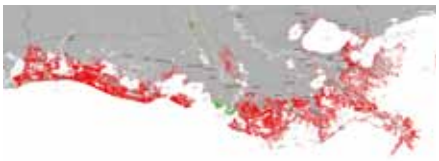
The Framework Development Team reviews information from the Predictive Models and Planning Tool.

# Environmental Scenarios

Moderate Scenario



Less Optimistic Scenario



Many factors that will have a profound effect on the future of Louisiana's coast cannot be easily predicted or are outside of our control. These factors include future sea level rise, subsidence, and storm intensity. To account for these factors in our technical analysis, we worked with experts to develop different sets of assumptions or scenarios. These scenarios reflect different ways that future conditions may unfold in south Louisiana.

We used two scenarios to capture changes in the physical factors that could affect our ability to achieve protection and build land:

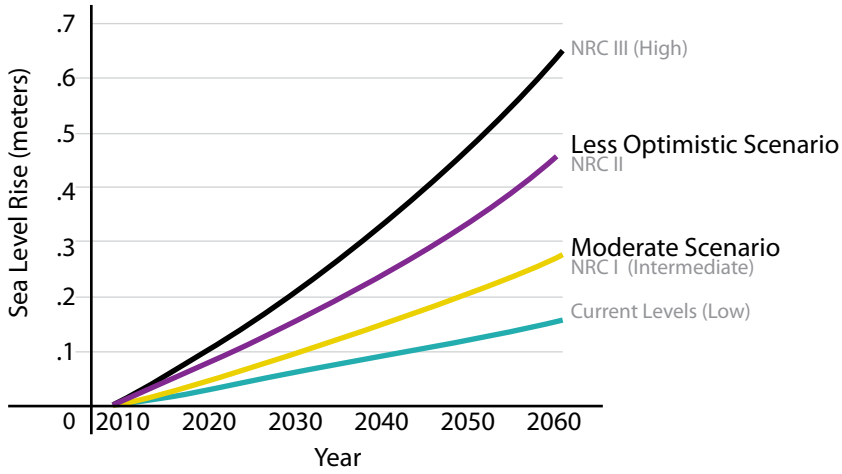
- A moderate scenario that assumed limited changes over the next 50 years in the factors listed below.
- A less optimistic scenario that assumed more dramatic changes in these factors over the next 50 years.

**Figure 3.4** Factors Evaluated Under Environmental Scenarios.

| Uncertainty | Plausible Range<br>OVER 50 YRS | Moderate Value<br>CPRA DERIVED | Less Optimistic Value<br>CPRA DERIVED | Range Source |
|---|---|---|---|---|
| Sea Level Rise | 0.12 m to 0.65 m of sea level rise over 50 years | 0.27 m of sea level rise over 50 years | 0.45 m of sea level rise over 50 years | Literature, USACE guidance |
| Subsidence (varies spatially) | 0 to 35 mm/yr | 0 to 19 mm/yr | 0 to 25 mm/yr | Expert panel |
| Storm Intensity | 0% to +30% | + 10% of current storm intensities | + 20% of current storm intensities | Literature, global model predictions |
| Storm Frequency | -20% to +10% | Current storm frequency (One Category 3 or greater storm every 19 years) | + 2.5% of current storm frequency (One Category 3 or greater storm every 18 years) | Literature, global model predictions |
| River Discharge / Sediment Load | -7% to + 14% (annual mean discharge, adjusted for seasonality) | 534,000 cubic feet per second | 509,000 cubic feet per second (-5%) | Literature |
| River Nutrient Concentration (Nitrogen and Phosphorus) | -45% to +20% | -12% of current concentrations | Current concentrations | EPA reduction target vs. current trajectory |
| Rainfall (varies spatially) | +/-1 standard deviaton of historical monthly range | Mean annual values of the historical record | -0.4 Standard Deviation from the historical mean monthly values | Eco-hydrology Modeling Team |
| Evapotranspiration (varies spatially) | +/-1 standard deviaton of historical monthly range | Mean monthly values of the historical record | +0.4 Standard Deviation from historical mean monthly values | Eco-hydrology Modeling Team |
| Marsh Collapse Threshold | Swamp salinity: 4-7 ppt<br>Fresh marsh salinity: 6-8 ppt<br>Intermediate marsh inundation: 31-38 cm depth<br>Brackish marsh inundation: 20-26 cm depth<br>Saline marsh inundation:16-23 cm depth | Swamp: 6 ppt<br>Fresh: 7 ppt<br>Intermediate: 34 cm<br>Brackish: 23 cm<br>Saline:21 cm | Swamp: 5 ppt<br>Fresh: 7 ppt<br>Intermediate: 33 cm<br>Brackish: 21 cm<br>Saline: 18 cm | Expert panel |

**Figure 3.5**
Scenarios of future eustatic sea level rise based on Corps guidance (2011) were used to develop the moderate and less optimistic sea level rise rates over the next 50 years.

**Estimates of Sea Level Rise over Next 50 Years**




## Factors Accounted for by Our Scenarios

- Sea Level Rise
- Subsidence
- Storm Intensity
- Storm Frequency
- River Discharge / Sediment Load
- River Nutrient Concentration
- Rainfall
- Evapotranspiration
- Marsh Collapse Threshold

## Sea Level Rise

When estimating sea level rise for the project level analysis, we based our two scenarios on the scientific literature. The first, moderate scenario assumes an increase in sea level rise of 0.27 meters (.81 feet) by 2060. The second, less optimistic scenario assumes a 0.45 meter (1.4 feet) increase by 2060. The range of sea level rise rates we are considering is within the bounds of current scientific projections.

## Marsh Collapse

In order to predict future land loss or gain in coastal Louisiana, it is necessary to try and predict the ability of a given marsh type to persist in response to sea level rise, subsidence and changing storm patterns. We convened an expert panel to help us determine the best way to address this uncertainty. Based on their recommendation, a marsh collapse threshold was established for fresh, intermediate, brackish, salt and swamp wetlands. Marsh collapse means that the wetland vegetation can no longer persist and the area will rapidly lose elevation (land loss) and be overcome by water.

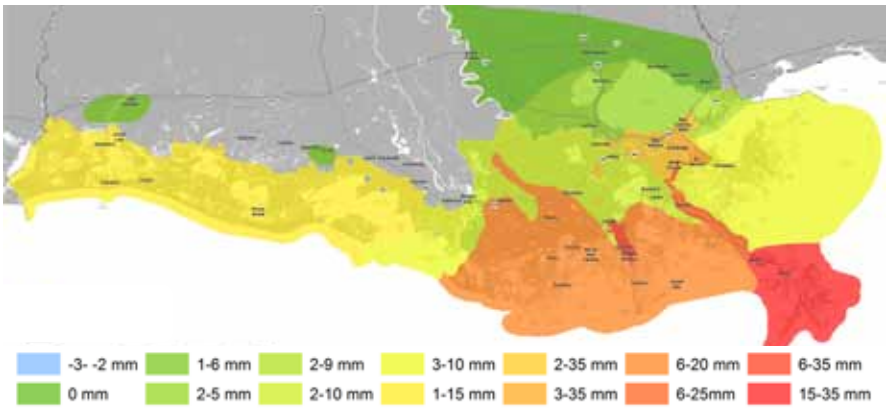


## Subsidence

We convened a panel of locally and nationally acknowledged experts to help us make well grounded predictions of future subsidence trends. Instead of only using historical rates to guide us, we used a range of subsidence estimates. Rates across the moderate and less optimistic scenarios listed above were selected from within these ranges. We are also using different rates of subsidence for different parts of the coast, since rates in the west differ from those in the east. This approach helped us account for variations in Louisiana's complex geology.

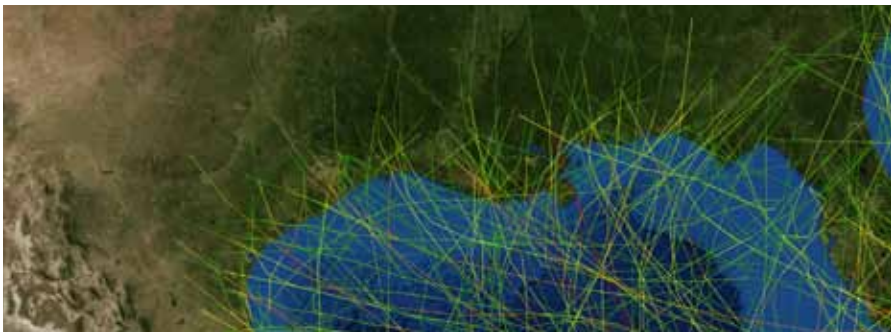
### Ranges of Coast Wide Annual Subsidence Rates

**Figure 3.6**
Regional ranges of subsidence rates in mm/yr were used as inputs into the modeling analysis. The ranges depict both current values and predicted future values over 50 years.




## Flood Frequency

To estimate flooding frequency for our risk calculations, we began with a set of 40 storm simulations defined by the Corps of Engineers for the Louisiana Coastal Protection and Restoration Study. The simulations included a range of storm intensities, sizes, and landfall locations. Using these 40 simulations as a starting point, we then broadened our analysis to estimate surge levels for 720 possible storms. These simulations, along with the relative likelihood of each storm occurring, gave us a rough idea of how flooding could occur in Louisiana's coast over the next 50 years.



Storm tracks in the Gulf of Mexico.

# Assessing Risk

## Potential Failure of Levees and Floodwalls

We wanted to better understand the likelihood that storm surge and waves would cause levees and floodwalls to fail. We analyzed three types of failures: overtopping, seepage, and slope stability. Overtopping failure occurs when a storm surge overtops a levee or floodwall and erodes its foundation on the protected side, causing the structure to collapse. Seepage failures occur when enough water flows through the soil under the levee or floodwall to compromise the structure. Slope stability failure occurs when the forces exerted by the floodwater overcome the levee or flood wall's base. By performing hundreds of storm simulations, we were able to identify patterns of when these kinds of failures might occur.



## Assessing Trends, Economic Trends, and Demographics

Our assessment of risk from flooding used demographic ranges to account for possible patterns of change in where people live. The risk assessment model assumed an average growth rate that was constant over time based on pre- and post-Katrina rates for each census block and asset class, adjusted for a range of factors. This analysis used data from the 2010 Census and a growth rate of 0.67% per year, which is equal to the annual rate of population growth from 1990 to 2000. Additional information about the risk analysis is available in Appendix D.



# Setting a Budget

Possible sources of funds include:

- Gulf of Mexico Energy and Security Act
- Energy and Water Act (Corps funding)
- Coastal Wetlands Planning Protection and Restoration Act
- Deepwater Horizon Natural Resources Damage Assessment
- Deepwater Horizon Clean Water Act Penalties
- Carbon and Nutrient Credits
- Future State Funding
- Louisiana's Coastal Protection and Restoration Fund

Given that we need to tie our plan to a budget, we evaluated the funding we may be receiving and determined a range between $20 and $50 billion (in present value dollars) over the next 50 years. This is the funding amount that we believe has a good chance of coming to the state from various state and federal sources over the coming decades. For our work on the master plan, therefore, we are estimating that our coastal program will receive between $400 million and $1 billion a year for the next 50 years. Because of the large scale needs of Louisiana's coast, the 2012 Coastal Master plan is based on a budget of $50 billion. This is the upper end of our estimates and better reflects the scope of the challenge facing Louisiana. It is important to emphasize the following:

- These funds are not guaranteed; the funding levels above represent estimates only.
- If the funds are allocated, they will not arrive all at once, but will instead be spaced over the next 50 years.
- Much of the funding that we are expecting is tied to programs that have been phased in over the past decades: CWPPRA (about $80M per year) and LCA (about $150M per year). The Gulf of Mexico Energy and Security Act will also provide about $110M per year. The state may have the opportunity to receive new sources of funding related to the 2010 oil spill. However, the exact amounts and timing of these funds are still very uncertain. The state is also evaluating new potential funding streams that may arise in the future, including credits for carbon and nutrient trading.

## Estimated Funding For Implementation of the Master Plan Over Next 50 Years

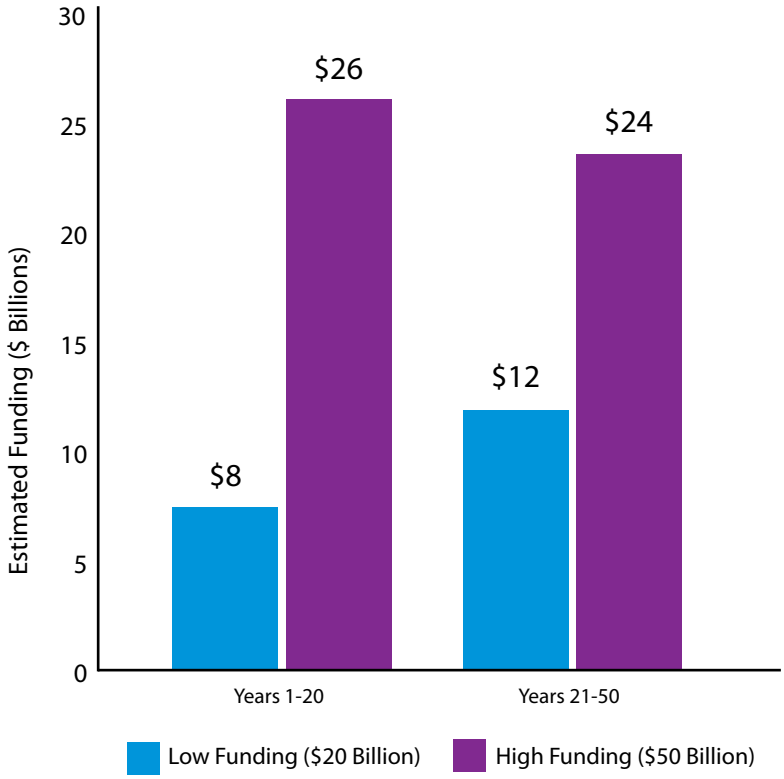



**Figure 3.7**
Projection of anticipated state and federal funding needed to implement the master plan over the next five decades.

# Issues Not Addressed in Our Analysis

Many factors that influence the coast could not be addressed in the master plan. Improving our technical capabilities will be an ongoing task, and we acknowledge the limitations below as preparation for future improvements.

## Model Limitations

The Predictive Models developed for the master plan are broad planning level models, not design level models. Their assessments of how the coast will change are meant to apply coast wide for 50 years. The models do not predict exactly how small, localized areas will look in the future. In other words, the models predict effects at the large community scale; they don't show what areas the size of individual backyards could look like in the future.

In addition, technical limitations restricted what the models could capture. For example, some of the ecosystem services models were used to estimate the effects of projects on fisheries habitat. While the models were able to capture a project's effects on habitat for a given species, they were not able to capture the project's effect on access to this habitat. For example, a hydrologic restoration project could conceivably improve habitat for shrimp in a given area while providing no mechanism for shrimp to reach the improved habitat.

Similarly, hurricanes may severely damage coastal marshes through surge and wave action, but they also introduce sediment into these marshes. This sediment can assist with land building. The models captured sediment introduction because those trends have been estimated over regions based on past research. However, the destructive effects of hurricanes on marsh, otherwise known as marsh tearing, could not be captured because these effects are usually localized, highly variable, and storm dependent. We discussed this limitation with our Predictive Modeling Technical Advisory Committee, and our Science and Engineering Board. They agreed that there was not a readily available solution, since the models cannot predict the paths of future storms. The modeling teams will continue to explore this and other issues, expanding our capability as new data and technologies emerge.

# Socioeconomic Analysis

The projects selected for the 2012 Coastal Master Plan will have enormous consequences for the lives and livelihoods of coastal residents. Many of these effects are beneficial. Providing risk reduction for communities can lead to greater population growth and economic development. Similarly, restoration projects may alter fisheries, job opportunities, and other aspects of community and business life. According to the Louisiana Workforce Commission's 2011 report, coastal restoration could create up to 10,300 jobs for residents, with average annual wages of $56,000. These jobs, in turn, would create an economic a ripple effect of between $720 million and $1.35 billion per year.

However, much more analysis on these topics is needed. To meet this need, the state is undertaking several studies to further evaluate the socioeconomic value of coastal resources. For example, the state is working with the University of New Orleans to gain a more precise idea of how changes in resources are affecting fishers. This study is compiling oral histories and using site visits to ensure that all findings reflect the realities citizens face. The findings of studies like these will provide the underpinnings for a more robust socioeconomic analysis in the 2017 update of the master plan.

## Number of Louisiana Commercial Fishing Licenses By Coastal Land Loss Experienced Since 1987

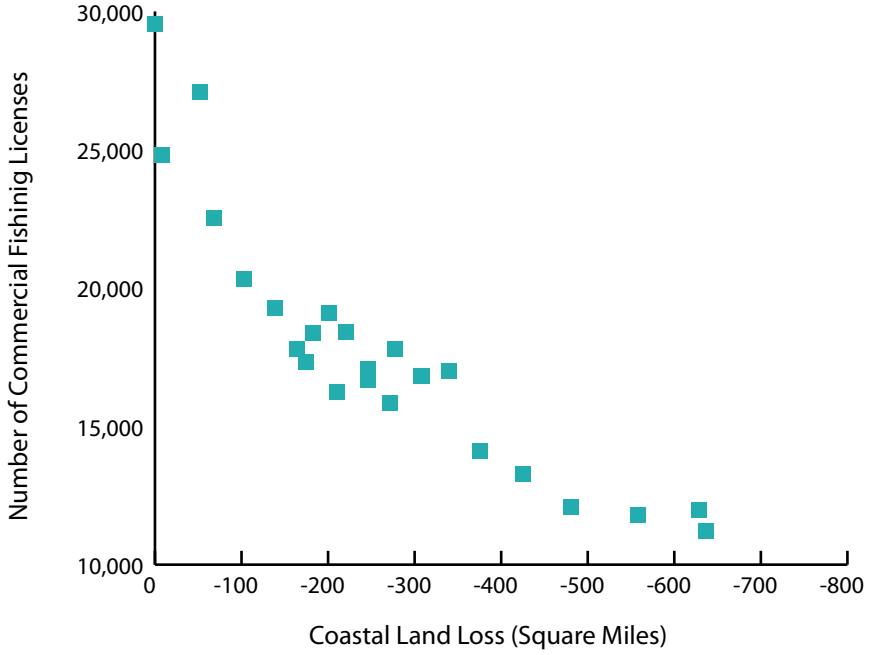



**Figure 3.8**
Total number of Louisiana commercial fishing licenses from 1987 through 2010 shows a decline with increasing loss of land that has occurred over the same time period.

# Quality Review & Validation of Tools

As part of analyzing projects for the 2012 Coastal Master Plan, we developed and ran new computer based tools with many complex interconnections. We also compiled information about the attributes of hundreds of risk reduction and restoration projects. Since the results of the master plan analysis will guide Louisiana's coastal investments for decades, it was essential that we undertake a rigorous quality review of our tools and data.

## Validating the Predictive Models

Many of the Predictive Models used for the 2012 Coastal Master Plan had been developed before our effort began or were based on existing, published models. However, linking some of the newer models was a first for Louisiana. Each group of models was handled by a separate modeling team under the guidance of a workgroup leader. Workgroup leaders were responsible for conducting a quality review of all input datasets used by their team as well as the output generated by their assigned models. Several modeling teams also established a set of external reviewers to provide feedback on model logic and calculations. Review team members and procedures are presented in Appendix D. To facilitate file handling and use, we used a standardized file naming convention, and file acquisition was automated when possible.

In addition to the review teams, a Predictive Models Technical Advisory Committee met monthly while the models were being developed and run. This committee provided guidance on model assumptions, inputs, and other technical details. The Science and Engineering Board also provided broad evaluations of the modeling effort's overall direction. Members of these groups are listed in Appendix I and on our website: www.coastalmasterplan.la.gov.

We have cross checked our models through various technical review teams and are in the process of conducting an analysis of model uncertainty. When this analysis is complete, we will have a thorough understanding of the strengths and weaknesses of the models in the analysis. This will also refine our understanding of how the assumptions in the models affect our results.

In addition, once the 2012 Coastal Master Plan is complete, the state would like to begin validation of the Predictive Models according to the U.S. Army Corps of Engineers Planning Model Certification procedure. Besides giving the state a useful quality check, this procedure will ensure that the 2012 Coastal Master Plan models pass muster with the Corps and can be used in tandem with the Corps's own planning efforts.

# Validating the Planning Tool

As part of the Planning Tool development there was a rigorous quality assurance process whereby the tool's approach and computations underwent internal peer review by technical experts. In addition, the Planning Tool Technical Advisory Committee that focuses exclusively on the tool met quarterly with the project team and will continue to do so until the final plan is complete.







# Chapter 4
# Developing the Plan

◀ Restoration project in Goose Point, LA.

# Evaluating Project Options

## Chapter Preview

As we sought to identify the best performing projects for the master plan, we had an enormous amount of technical information to draw from. This chapter traces the process we used to incorporate this information into our decision making. A list of decision points at the end of the chapter summarizes how we used science to create the draft plan.

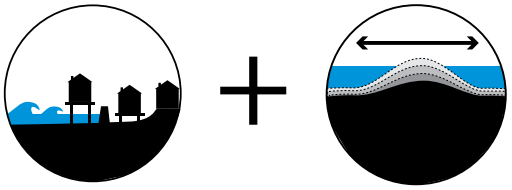
With the analysis of the Future Without Action condition and the results of individual project modeling in hand, we were ready to consider which projects should be included in the 2012 Coastal Master Plan. The challenge? We had hundreds of projects to consider and seemingly unlimited ways to combine them. To begin sorting through our options, we assembled projects into groups of projects that could be implemented over time to meet the master plan's objectives.

We assembled and evaluated hundreds of groups of projects. The Planning Tool helped us do this quickly; we set the parameters and the tool scanned the list of projects, selecting those that met our specifications. The tool did this by examining the terabytes of data created by the Predictive Models and putting this output in a form we could easily view and analyze. The specifications we used and the lessons we learned from considering these many projects are described below.

## Decision Drivers

As anyone who lives in south Louisiana can attest, our communities need flood protection and our coast needs sustainable land. Therefore, in order to be included in the plan, projects had to perform well in at least one of the two areas: (1) making significant reductions in community flood risk, or (2) building or maintaining land effectively. Putting these two factors front and center ensured that the projects we selected addressed the priority needs of the coast.

To represent these drivers, we used the Planning Tool to assemble two groups of projects: one that maximized risk reduction and one that maximized land building. These groups were assembled without considering any other preferences. As clear cut examples of how to achieve our primary decision drivers, these groups of projects served as benchmarks for considering other project options.



FLOOD RISK REDUCTION

LAND BUILDING

# Funding

As we began examining projects, we had to decide how the state's coastal budget should be allocated between risk reduction and restoration projects. Would a 50/50 split make sense, or would another split, perhaps 40/60 or 70/30, be more effective? To answer this question, we used the Planning Tool to view the risk reduction and restoration results that could be expected from different allocations of funding, so that we could determine the best way to use our financial resources. Using information from the Planning Tool as a guide, we chose a 50/50 funding split, which balanced risk reduction and restoration benefits.

Specifically, our analysis showed that we could not achieve substantially more risk reduction benefits by spending more than 50% of our available funding on risk reduction. While we can achieve significantly more restoration benefits with continued investment, we did not want to diminish the high level of risk reduction benefits we could achieve at the 50% level. In future years, as we gain more information about the funds we can expect, we may consider altering this split. Doing so would make sense if we found that we had larger and more secure funding streams than what we are expecting now.

This split is intended to guide our spending over the next 50 years. Year to year, we may spend more than 50% on either protection or restoration based on the types of funding we receive and their authorized purposes.

Although our funding analysis showed that Louisiana could receive anywhere between $20 and $50 billion over the next 50 years for coastal protection and restoration, we used the top end of this range to constrain our selection of projects. We did this because we found that the lower end of the funding range did not provide the resources needed to significantly reduce coastal land loss, nor did it adequately reduce storm surge flood risk.

## Near Term and Long Term Benefits

Once we decided to use a $50 billion budget and a balanced funding split, we then needed to consider another factor for restoration: how quickly should projects deliver results? For example, some projects build land almost immediately, but this land may degrade with time. Other projects take longer to start building land, but once they do, the land continues to grow. Was it better to put a premium on getting results more quickly (within 20 years), even if these results wouldn't last as long? Or was it more important to invest in projects that might take more than 20 years to deliver benefits but would continue providing value beyond our 50 year planning timeframe? We used the Planning Tool to review our project list and show us the results that could be expected if we put more or less importance on near and long term options. As with the funding split, we reviewed various combinations, from a primarily near term focus (90/10) to a primarily long term focus (10/90).

We knew that we had to provide some benefits immediately given the severity of Louisiana's land loss crisis. However, when we focused only on near term benefits, the land building potential at the end of the 50 year planning timeframe was over 272 square miles less than our maximum long term potential. When focusing only on projects with immediate benefits, we never reached sustainability in the landscape because we continued to experience overall land loss each year.

Using an approach that invested equally in near term and long term projects (50/50), land building potential at the end of 50 years was only 26 square miles less than our maximum land building potential. At the end of Year 50, the near and long term benefits showed a positive trajectory of land building, indicating that many of the projects selected will continue to build land past the 50 year analysis period. We decided to pursue this approach because it balanced our need to respond quickly without compromising our long term effectiveness. Investing equally in near and long term projects will provide the land building that is urgently needed for today's generation, while also providing benefits for future generations.

On the protection side, risk reduction projects, once constructed, are designed to sustain their benefits throughout the master plan's 50 year planning timeframe. For instance, a levee constructed in the near term would be maintained at the necessary elevation to provide benefits in the long term. Therefore, near term versus long term factors did not affect our selection of risk reduction projects.

# Selecting Projects for an Uncertain Future

The best investments for the state are projects that perform well under a range of future conditions. To find out how project performance might change depending on shifts in future conditions, we evaluated how groups of projects that performed well under moderate future conditions performed when future conditions worsened. We also did the reverse; we looked at how groups of projects that performed well under less optimistic conditions performed if future conditions were more moderate. This evaluation allowed us to understand the built in robustness of some projects while identifying others that did not perform well under varying future conditions.

We determined that the selection of risk reduction projects did not vary greatly between the moderate scenario and the less optimistic scenario. We did, however, see a difference in the selection of the restoration projects. One of the important outcomes of this evaluation concerned project locations. Projects that were built higher in the system, closer to existing land, were much more robust in the face of worsening future conditions than projects built closer to the gulf. This finding is one of the important outcomes of our evaluation and influenced our selection of projects for the draft plan. One caveat: these robust projects did not build quite as much land under the moderate scenario compared to our maximum land building potential, yet they were still very effective land building projects.

## Restoration Highlight

The first step in understanding the effect of future environmental conditions on our ability to maintain the coast was to select two groups of projects: one set that maximized land building under the moderate scenario (Maximize Land Moderate Group) and one set that maximized land under less optimistic future conditions (Maximize Land Less Optimistic Group).

Under the moderate scenario, the Maximize Land Moderate Group offset land loss by 87%, resulting in eventual land gain of 9.5 square miles per year at Year 50. Under the less optimistic scenario, the Maximize Land Less Optimistic Group provided less land building, offsetting land loss by only 63%, and resulting in 1.5 square miles gained per year at Year 50.

We then looked at how these two groups of projects performed under different future conditions. For instance, a marsh creation project selected to build substantial land under moderate conditions could be less effective under worsening future conditions, such as higher sea level rise, subsidence, and marsh collapse thresholds. To account for this, we examined how the projects in the Maximize Land Moderate Group would perform under less optimistic conditions. When we did so, we found that the associated land change was an unacceptable loss of 11.4 square miles per year at Year 50.

Finally, we looked at how the Maximize Land Less Optimistic Group fared when future conditions were moderate. In this case, the land gain we saw was 7.4 square miles per year at Year 50, only 2.1 square miles per year less than the moderate project group. Because it performed reasonably well under the moderate scenario and much better if future conditions worsen, we used the Maximize Land Less Optimistic Group as a reference point for selecting restoration projects. In so doing, we heeded the old adage, "Hope for the best but plan for the worst."

| **Future Scenario is..** | **Maximize Land** MODERATE GROUP | **Maximize Land** LESS OPTIMISTIC GROUP |
|---|---|---|
| Moderate | Gain 9.5 SQ MI/YEAR | Gain 7.4 SQ MI/YEAR |
| Less Optimistic | Lose 11.4 SQ MI/YEAR | Lose 1.7 SQ MI/YEAR |

**Figure 4.1**
Groups of projects—those formulated to perform best under the moderate scenario and those formulated to perform best under the less optimistic scenario—vary in annual land loss or land gain rates depending on the actual future conditions experienced by the projects at year 50.

# Decision Criteria

Louisianans have different but equally valid ways of viewing what should be done for their coast. We used the Planning Tool to evaluate how some of these preferences could change the selection of projects. We configured the Planning Tool to work toward outcomes measured by the two decision drivers mentioned above: reducing community flood risk and building and maintaining land. But we also added other master plan decision criteria to the mix so that we could consider additional coastal uses and concerns.

For example, we conducted an experiment that required the decision criterion "support of navigation" to be considered in conjunction with the decision drivers. We evaluated a group of projects that would reduce storm flooding risk and build coastal land while also taking navigation concerns into account. We performed similar experiments with a variety of decision criteria combinations. The results of these experiments helped us understand the pros and cons of different approaches for minimizing flood risk and building land.

As we went through this process, we found some general patterns among the decision criteria. All of these experiments were viewed relative to our maximum land and maximum risk reduction project groups, recognizing that imposing any preferences on these drivers would decrease the amount of land built and/or the risk reduction provided.

We found that increasing the preference for certain decision criteria had no significant impact on our ability to achieve our decision drivers. In other words, modifying projects in the maximize risk reduction or maximize land building decision driver project groups to account for certain criteria did not significantly alter outcomes. In many cases, increasing support of these decision criteria was not possible because they were already fully accounted for. These decision criteria were:




- Distribution of Risk Across Socioeconomic Groups
- Flood Protection of Historic Properties
- Flood Protection of Strategic Assets
- Operation and Maintenance Costs

In other cases, we found that as we increased the preference for a specific decision criterion, we saw a significant decline in risk reduction or land building potential. We were able to identify the point at which we could increase the preference without unduly affecting our decision drivers, and we used this information to modify the selection of projects. The decision criteria that we used in this way were:



- Use of Natural Processes
- Support of Navigation
- Sustainability

Other decision criteria could only be evaluated after the draft plan was formed. The decision criteria below were evaluated to ensure that the draft plan did not have drastic negative impacts in these areas of interest:



- Support for Cultural Heritage
- Support for Oil and Gas

We found that, overall, many of the same projects were selected regardless of which decision criteria we focused on. This helped us hone in on projects that met the needs and preferences of many coastal users while supporting our decision drivers. Selected projects that have negative implications for certain preferences, particularly those that are conceptual in nature, may be explored further through the Adaptive Management Framework to minimize impacts.

# Ecosystem Services









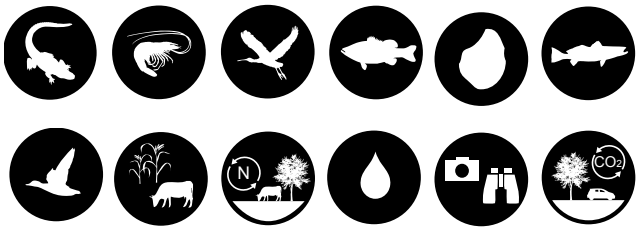


The variety of benefits the coast provides are what we refer to in this plan as ecosystem services. For the purposes of this plan, we evaluated the outcomes of habitat suitability indices and other variables. This gave us an idea of how projects might affect associated services.

Not only did we evaluate an individual project's effect on ecosystem services, we looked at the collective coast wide effect of groups of projects on those services. Our aim in doing so was to ensure that the projects we selected did not cause drastic reductions to ecosystem services coast wide. This approach was in keeping with the master plan objective that seeks to provide an array of coastal uses in south Louisiana.

Projects affected different services in different ways in different areas of the coast. Although we were able to capture general trends in ecosystem service levels, the relationships were complex. This analysis used large scale planning level models to provide output about general trends and project effects. The models did not provide site specific details needed for project design. We recognize the need for continued investment in measurement and analytic tools that improve our assessments of changing coastal conditions. To thoroughly demonstrate the value of ecosystem services, we must also take into account the human use and economic effects of projects.

Despite the limits of our analysis, we were able to discern large patterns of how services are affected, and this helped us more thoroughly evaluate different groups of projects. Ultimately, we found that the groups of projects we considered did not have significant impacts on the level of ecosystem services provided coast wide.



# In Depth Look: Land Building Experiments

Our analysis indicates that sediment diversions, potentially including channel realignment, are essential to sustaining coastal Louisiana. The overwhelming majority of scientific literature on the subject comes to the same conclusion. We understand that viewpoints regarding diversions vary among coastal residents. Some people want to see several large diversions in order to build sustainable coastal land. Others believe that the state should use other strategies besides diversions. Still others support the idea of diversions but fear that if diversions are put in the wrong place or operated in the wrong way, the projects will harm important industries such as oyster farming.

One lesson learned from previous experience is that future diversions should focus on land building. As such, the 2012 Coastal Master Plan focused on sediment diversions and did not evaluate the use of freshwater diversions as a restoration tool. Our tools evaluated sediment diversions to maximize land building, but we do not expect to run large sediment diversions at full capacity year round. Instead, the operation of sediment diversions will balance the need to maximize land building with the need to reduce impacts to saltwater dependent resources. Operation strategies for diversions will be developed using more detailed modeling efforts and additional coordination with key stakeholders.

## No Diversions

We conducted an experiment to maximize land building without the use of diversions or channel realignments. This involved selecting the best group of projects that builds land mechanically. When we compared the effects of these projects on species based ecosystem services, we found that the projects caused very little change in the level of ecosystem service provided compared to Future Without Action conditions. This approach cut our land building potential by 340 (moderate scenario) to 633 square miles (less optimistic scenario), thus decreasing our total land gain by half compared to results predicted for our maximum land building project group. In addition, we continued to experience annual land loss at Year 50 ranging from -3.4 square miles/year to -23.7 square miles/year depending on future conditions. These results indicate that sustainable restoration of our coast without sediment diversions is not possible.

## Potential Land Area Change Over Next 50 Years
Moderate Scenario

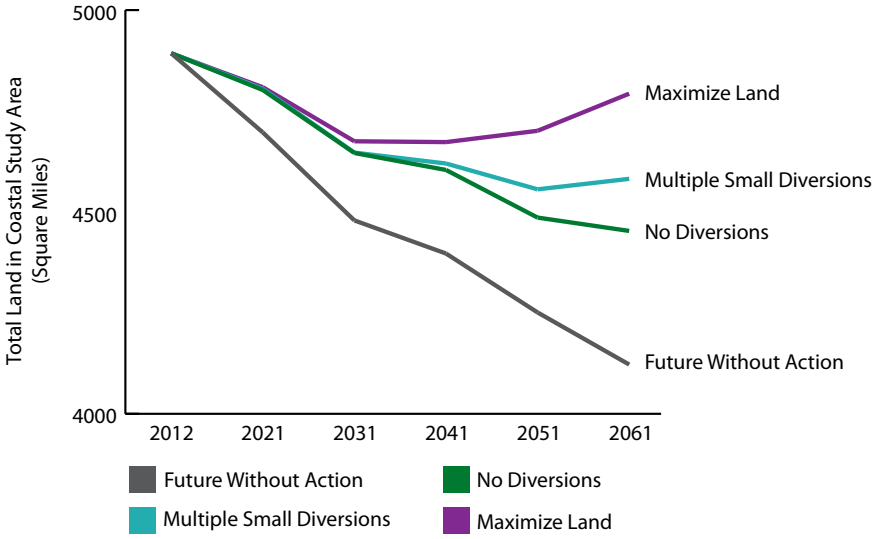



**Figure 4.2**
Comparison, under moderate scenario, between the change in total land in the coastal study area over time to Future Without Action using different restoration strategies. Future Without Action under moderate future conditions is also depicted for comparison purposes.

## Potential Land Area Change Over Next 50 Years
Less Optimistic Scenario

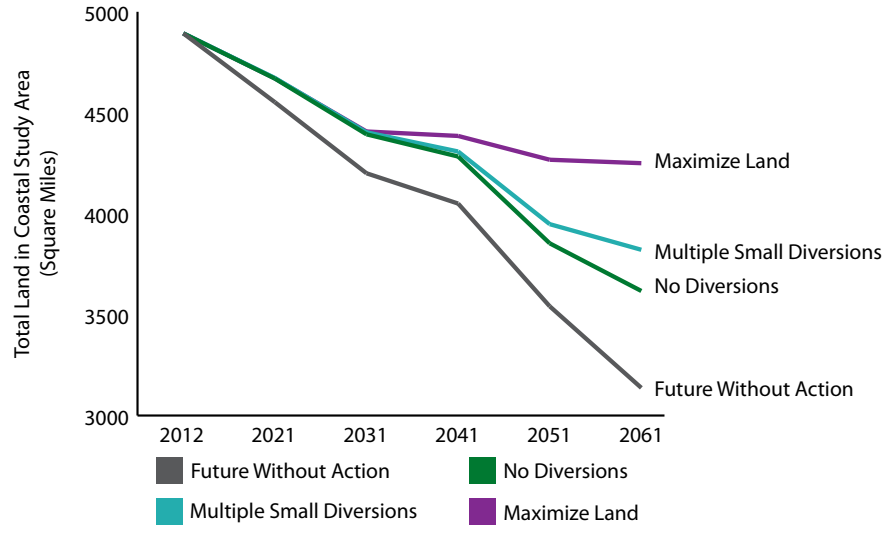



**Figure 4.3**
Comparison, under less optimistic scenario, between the change in total land in the coastal study area over time to Future Without Action using different restoration techniques.

# In Depth Look: Land Building Experiments

## Multiple Small Diversions

We explored the land building and ecosystem service effects of using multiple small sediment diversions from the Mississippi River. The theory behind this approach is that multiple small diversions could nourish and build land effectively while also maintaining ecosystem services at their current levels in their current locations. The multiple small diversion project modeled as part of our analysis actually decreased the level of several ecosystem services, such as oysters, as much or more than the few large sediment diversions found in our maximum land building project group. Other ecosystem services, such as waterfowl and freshwater fisheries, showed an equal or slightly increasing level of service compared to our maximum land building project group. After a thorough analysis, we found that neither the multiple small diversion project nor our maximum land building project group produced large variances overall in the balance of ecosystem services coast wide. However, using multiple small diversions as our restoration technique reduced our land building by 211 to 429 square miles from our maximum capacity. This was not an acceptable option.

## Large-Scale Land Building

Our models evaluated each project's ability to build and sustain land, whether from mechanical means or by using the river. When we evaluated the top 25 land building projects, we found they included 11 sediment diversion projects, seven channel realignment projects, and seven marsh creation projects.

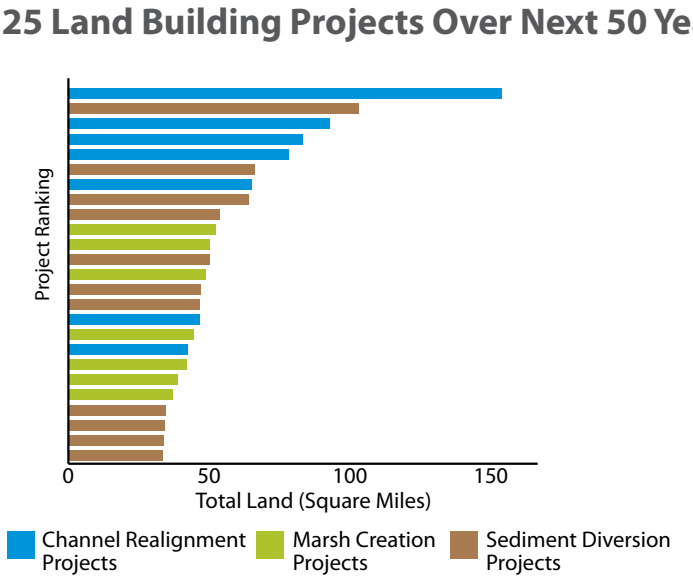
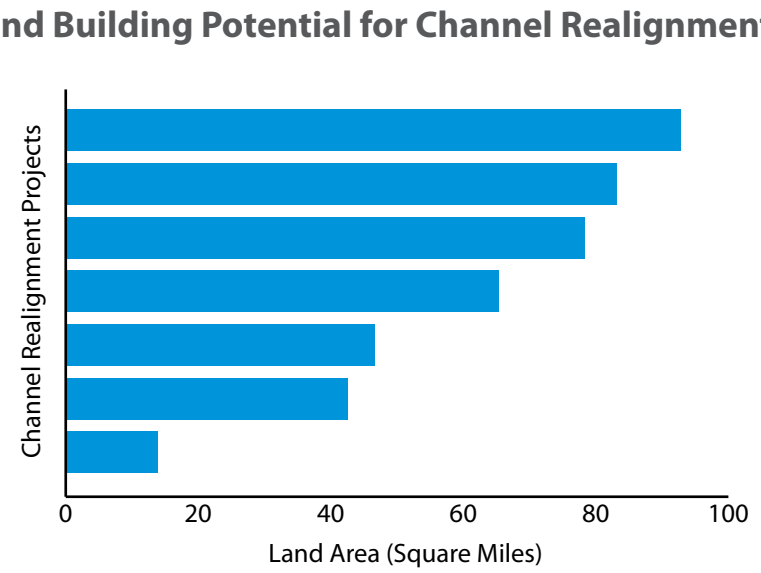



**Figure 4.4**
The top 25 land-building restoration projects under the moderate scenario are comprised of three project types: sediment diversions, channel realignments, and marsh creation. Each bar represents an individual project.

**Figure 4.5**
Channel realignment projects have great individual land building potential as demonstrated by this bar chart. Each bar represents an individual project. Land building can range from 14 to 93 square miles in 50 years under the moderate scenario. Does not include the Pass a Loutre project, which is a channel realignment with multiple diversions.




# Channel Realignment

Our analysis indicates that channel realignment projects have strong land building benefits, the best of any individual restoration project type we evaluated (see Figure 4.5). Seven of the eight channel realignment projects evaluated in the analysis were among the top 25 land building projects. A group of projects that includes a channel realignment also has a large annual land building growth rate at the end of 50 years (+6 square miles/year). However, these projects are highly conceptual, and there is significant uncertainty about their costs, design, and constructability. We did not feel, therefore, that it was reasonable to include funding for construction of a channel realignment project in the 2012 Coastal Mater Plan.

However, a project that has such large land building benefits warrants further evaluation, and the state is committed to undertaking this process. The 2012 Coastal Master Plan recommends that channel realignment projects undergo further analysis as part of the state-Corps Mississippi River Hydrodynamic and Delta Management Study. This additional level of evaluation will address the multi-purpose benefits projects of this scale could have, including aid to navigation by reducing dredging requirements when sediment is exported from the river channel. These projects could also benefit flood control by shunting excess water flows into adjacent wetlands, thereby reducing pressure on the levee system. New information from this study regarding channel realignment projects will be evaluated in the 2017 Coastal Master Plan. The state will continue to work with our partner state and federal agencies (including the Corps of Engineers), our Navigation Focus Group, and other experts in large river management to explore the potential of these projects within the broader framework of other river activities.

# Working in a Complex World

## Reality Check

As we made these decisions and narrowed our project options, we had to confront real world constraints and challenges. These influenced the projects we included in the draft plan.

### Limits of Analysis

During the project analysis, limitations of the modeling effort prevented us from including the Lake Pontchartrain Barrier and a Mississippi River channel realignment in the draft plan (see additional discussion of these projects in this chapter).

### Implementation Challenges

The feasibility of implementing other projects presented a different set of challenges. Rerouting the GIWW south of Houma has long been considered as a way to move Atchafalaya River water to the east. Our analysis showed that this project could achieve some positive benefits. However, there are great challenges involved, including the need to build a new channel through a suburban area, as well as the need for a number of new road crossings. These challenges were not fully considered during the analysis but are considered obstacles that would inhibit the state from implementing this project. Given these challenges, we did not include this project in the draft plan.

### Variation in Methods

The draft plan includes every type of risk reduction and land building tool we have available, including sediment diversions, marsh creation, levees, and other flood protection measures. We tested other options that focused on a single restoration or risk reduction method. For instance, we conducted an experiment that focused on marsh creation projects without diversions. This reduced our land building capacity by half, and the land that was built was not sustainable. We also conducted an experiment that focused on nonstructural protection only. This did not provide adequate levels of flood risk reduction. Another experiment favored projects that focused land building efforts on critical landforms that could provide both benefit to habitats and flood risk reduction. This experiment provided sound risk reduction and land building benefits. We incorporated many of the projects selected in this experiment into the draft plan.

### Limits of Analysis: Lake Pontchartrain Barrier

The Lake Pontchartrain Barrier project involves building an earthen levee along the New Orleans East Land Bridge with floodgates on the Rigolets and Chef Menteur Passes to prevent storm surge from entering Lake Pontchartrain. Our analysis indicated this project held great promise for reducing risk throughout the North Shore of Lake Pontchartrain and the Greater New Orleans area. The project was also one of the most cost effective risk reduction projects analyzed, providing expected annual damage reduction in Year 50 between $2.1 and $10.4 billion, depending on future conditions. However, the project also increases storm surge flood levels along the Mississippi coast. Our analysis did not calculate the cost of increased flood damages outside Louisiana's boundaries. Therefore, we could not account for flood damages to Mississippi when evaluating this project, which ultimately will affect the project's cost effectiveness.

The state did not want to rely on this single, conceptual project to provide risk reduction to communities such as Slidell, Mandeville, and LaPlace, as the project may take many years to build. Instead the draft plan includes other structural and nonstructural projects, such as the Slidell Ring Levee, that can provide near term risk reduction while the Lake Pontchartrain Barrier project is more fully developed. We expect that further investigation of this project will take place in partnership with the Corps and the State of Mississippi. Due to this limitation of our analysis and the conceptual nature of the project, we did not include the Lake Pontchartrain Barrier in the draft plan.

# Decision Points: Using Science to Make Decisions

## Policy Level

- Maximize community flood risk reduction and land building.
- Assume a $50 billion budget for planning purposes.
- Allocate 50% of projected funding to risk reduction and 50% to restoration.
- Divide investment equally between near and long term benefits.
- Choose projects that are more robust should future conditions track our less optimistic scenario.
- Ensure that positive and negative effects of projects on ecosystem services are balanced and that negative effects are not significantly detrimental.
- Focus marsh creation efforts on "critical landforms," or key landscape features that provide both land building and storm surge reduction.
- Incorporate projects in draft plan based on a realistic review of the limits of our analysis, implementation challenges, and variations in methods.

# Decision Points

## Project Level

- Removed Lake Pontchartrain Barrier because we could not account for increased asset damage to the Mississippi coast. To be further investigated for potential future inclusion.
- Recommended that the state further develop the concept of a channel realignment of the Mississippi River as part of the state-Corps Mississippi River Hydrodynamic and Delta Management Study for potential future inclusion.
- Removed SW GIWW Levee because it did not substantially increase flood protection and it disrupted natural processes.
- Reduced the overall number of diversions to focus use of the Mississippi River's resources at optimal locations and take fisheries and navigation concerns into account.
- Removed a lock on the GIWW based on navigation analysis.
- Removed GIWW Bypass south of Houma based on challenges to implementation.
- Removed Little Pecan Bayou Hydrologic Restoration because it is being deauthorized by CWPPRA and is not considered implementable.
- Modified some marsh creation and barrier island projects based on the critical landforms analysis.
- Selected the Mid-Barataria 50,000 cubic feet per second (cfs) sediment diversion for the draft plan. Based on our scenario analysis, under less optimistic conditions, it would be more effective for our land building potential to construct a 250,000 cfs sediment diversion at this location. To account for this uncertainty, the project is proposed for expansion after 20 years to a 250,000 cfs sediment diversion.

# Toward a Draft Plan

The step by step choices and experiments documented in this chapter helped us learn which projects delivered benefits regardless of which future scenarios we considered. Many of the projects in the draft plan fit this "high performer" category. However, some of the high performing projects, like the Lake Pontchartrain Barrier, had to be left out of the draft plan as we considered the limits of our analysis and the implementation obstacles associated with them. We selected other projects in the plan to reflect the various uses of the coast, as described above. The draft plan thus represents the results of exhaustive analysis and common sense judgments about a system of protection and restoration measures the State of Louisiana should pursue.







# Chapter 5
# 2012 Coastal Master Plan

◀ Sediment deposion at beneficial use project in Sabine Marsh in Calcasieu, Louisiana.

# A Robust Plan

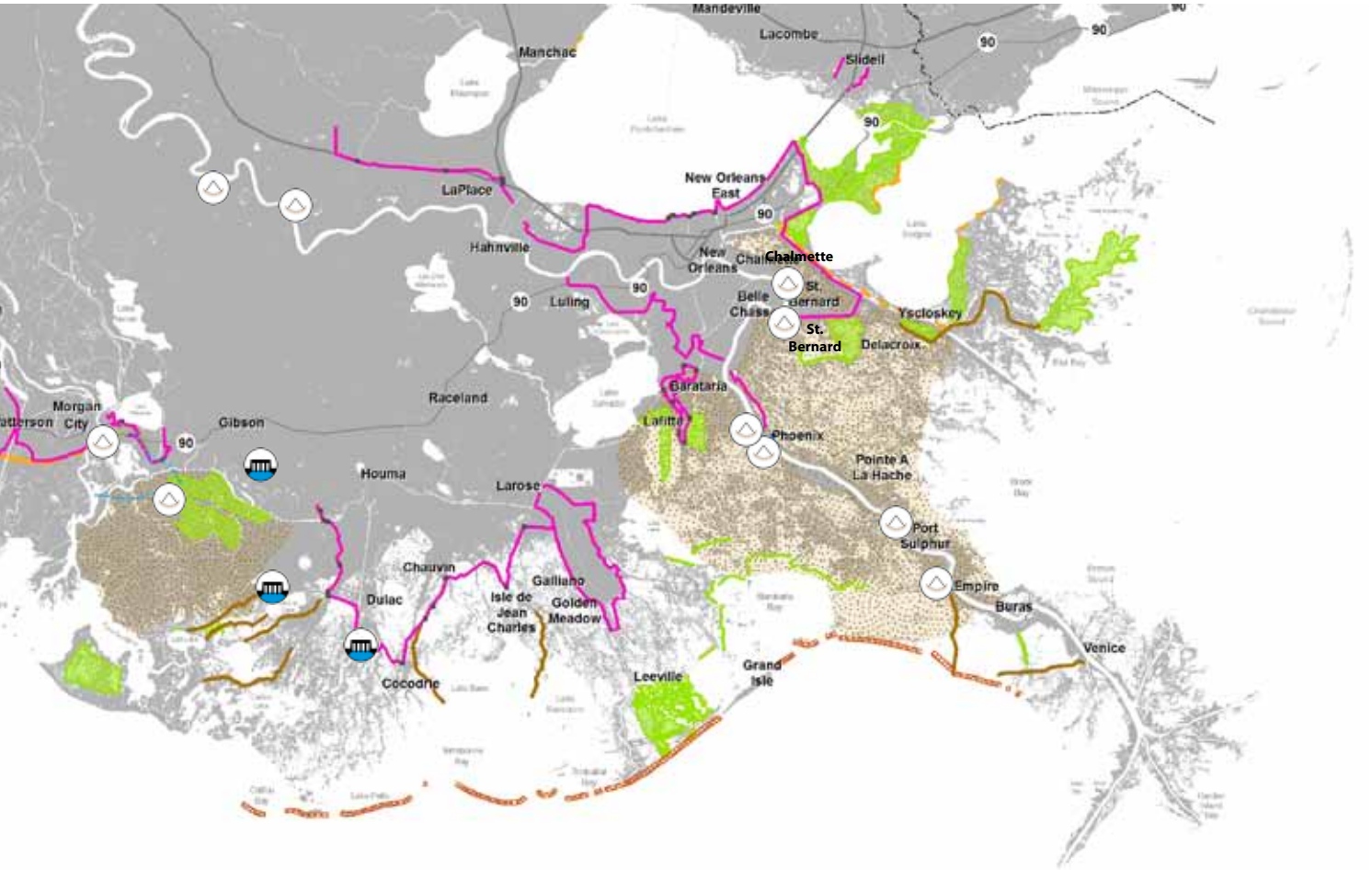
## Projects Included in the 2012 Coastal Master Plan




## Chapter Preview

This chapter presents the projects proposed for the 2012 Coastal Master Plan. Project lists are included, as are detailed descriptions of the flood protection and land building benefits the draft plan provides. The final section provides an overview of our implementation and adaptive management approach.

The 2012 Coastal Master Plan has done something new for our state: offer a path forward based on the latest innovations in science. No planning process can claim to be completely objective, and we have been clear about the limitations of our process. We can say with confidence, however, that the projects presented in this document are the result of an unbiased analysis of the best information available to us. The majority of the projects in this plan performed well under both scenarios of future conditions, and they satisfied multiple stakeholder preferences. We have backed up this assertion with data in our appendices. When we deviated from our science based results because of real world challenges that had to be taken into account, we have thoroughly documented those decisions in our technical appendices.




**▲ Figure 5.1**
As described in the Introduction, there are 145 projects in the master plan, representing a variety of project types across the coast.

Using this approach, we learned that certain projects are essential for the future of our coast. We tested hundreds of options. In the end we found that certain projects, such as levees and large diversions, had to be part of the solutions we offered. We also found that it was necessary to use a variety of project types in targeted locations. Finally, we were able to put to rest certain long standing proposals, such as eliminating diversions, using only small diversions, or even relying solely on levees to secure our future. These ideas do not work, as documented in Chapter 4, and they are not reflected in this draft plan. The plan does reflect the many promising projects available to help coastal residents and businesses thrive. The projects listed on the following pages thus represent the results of more than two years of exhaustive analysis in support of the resilient and secure future that all Louisianans want.

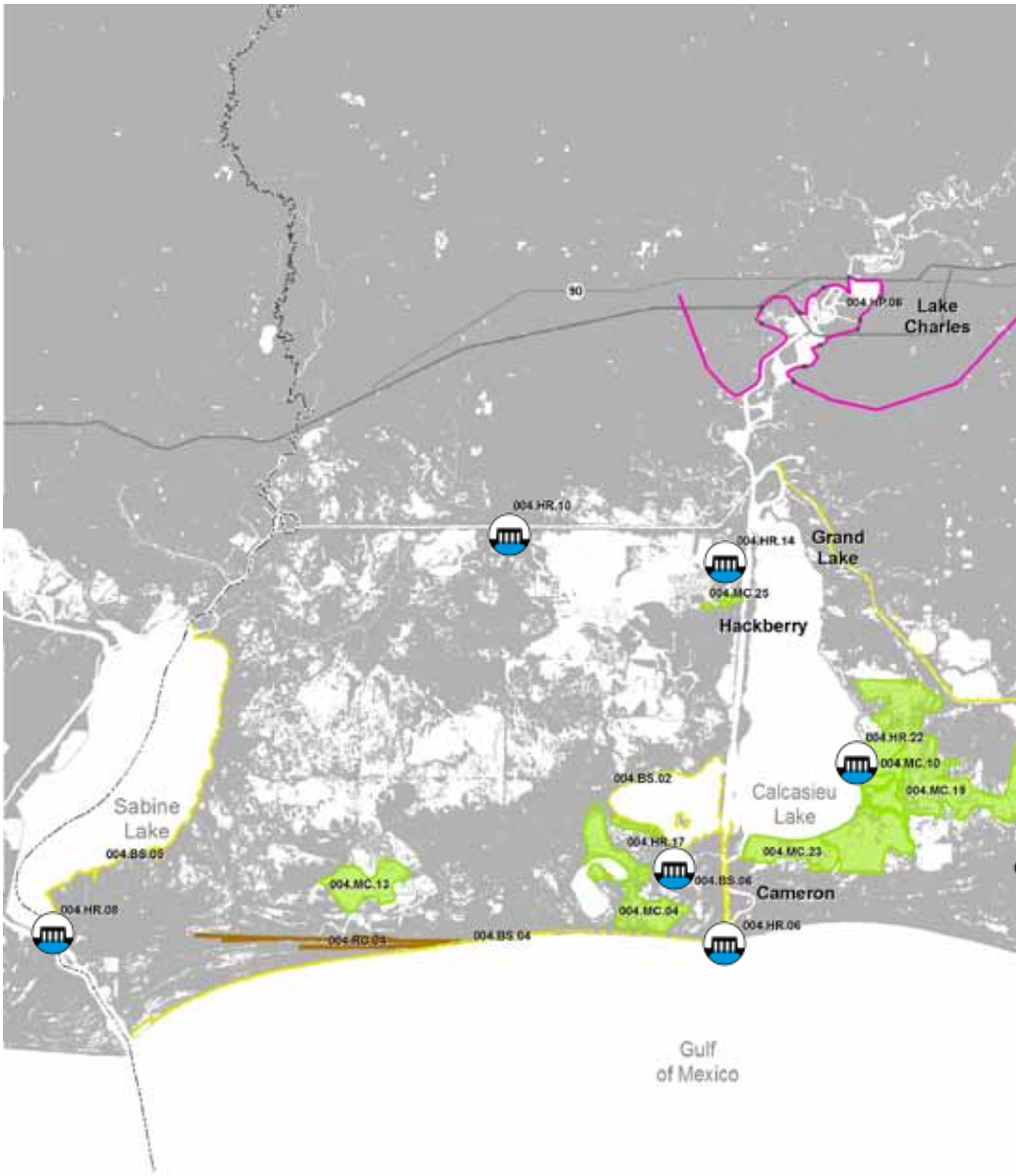
# Southwest Coast

## Protection

Levees are proposed for large, densely populated, at-risk communities, such as Lake Charles and Abbeville. Nonstructural measures are proposed for all parishes in this region. Restoration of chenier ridges and healthy wetlands contribute additional storm surge protection.

## Restoration

Restore wetlands and chenier ridges while limiting saltwater intrusion. Maintain and increase, where possible, the input of fresh water to maintain a balance among saline and fresh wetlands.







Project Types Included: Colors on the icon correspond to color key on the map.




▲ **Figure 5.2**
Southwest Coast Project Map

| First Implementation Period (2012-2031) | | | |
|---|---|---|---|
| **Project Type** | **Project Name / Description** | **Project Costs** | **Project No.** |
| Bank Stabilization | Grand Lake Bank Stabilization: Shoreline stabilization at Grand Lake | $76.84M | 004.BS.01 |
| | Calcasieu-Sabine Bank Stabilization: Bank stabilization of the Gulf shoreline between Sabine River and Calcasieu Ship Channel | $25.92M | 004.BS.04 |
| | Sabine Lake Bank Stabilization: Bank stabilization along the shore of Sabine Lake | $21.17M | 004.BS.05 |
| | Calcasieu Ship Channel Bank Stabilization (Gulf to Calcasieu Lake): Bank stabilization along the Calcasieu Ship Channel from the Gulf of Mexico to Calcasieu Lake | $12.30M | 004.BS.06 |
| Hydrologic Restoration | Calcasieu Ship Channel-Gulf Salinity Control Structure: Salinity control structure in Calcasieu Ship Channel at the Gulf of Mexico | $380.73M | 004.HR.06 |
| | Little Pecan Bayou Sill: Freshwater introduction/retention structure on Little Pecan Bayou | $5.23M | 004.HR.07 |
| | Sabine Pass Hydrologic Restoration: Salinity control structure at Sabine Pass | $10.35M | 004.HR.08 |
| | Gum Cove Ridge Hydrologic Restoration: Structure on GIWW at Gum Cove Ridge | $5.82M | 004.HR.10 |
| | Deep Lake Hydrologic Restoration: Spillway structures north of Deep Lake | $2.32M | 004.HR.13 |
| | Alkali Ditch Area Hydrologic Restoration: Salinity control structure at Alkali Ditch, Crab Gully, and Black Lake Bayou | $39.21M | 004.HR.14 |
| | Oyster Bayou Hydrologic Restoration : Salinity control structure at Oyster Bayou | $5.20M | 004.HR.17 |
| | Mermentau Basin Hydrologic Restoration (East of Calcasieu Lake): Hydraulic improvements in Mermentau Basin at Highways 82 and 27 east of Calcasieu Lake | $7.01M | 004.HR.18 |
| | Mermentau Basin Hydrologic Restoration (South of Grand Lake): Hydraulic improvements in Mermentau Basin at Highways 82 and 27 south of Grand Lake | $7.01M | 004.HR.19 |
| | Mermentau Basin Hydrologic Restoration (South of White Lake): Hydraulic improvements in Mermentau Basin at Highways 82 and 27 south of White Lake | $7.01M | 004.HR.20 |
| | East Calcasieu Lake Hydrologic Restoration: Spillway structures at East Calcasieu Lake | $5.60M | 004.HR.22 |
| Marsh Creation | East Rainey Marsh Creation: Creation of 3,079 acres of marsh in the eastern portion of Rainey Marsh | $443.39M | 03b.MC.07 |
| | South Grand Chenier Marsh Creation: Creation of 7,325 acres of marsh at South Grand Chenier | $732.10M | 004.MC.01 |
| | Mud Lake Marsh Creation: Creation of 3,905 acres of marsh at Mud Lake | $601.12M | 004.MC.04 |
| | West Rainey Marsh Creation: Creation of 3,548 acres of marsh in the western portion of Rainey Marsh | $636.50M | 004.MC.07 |
| | Southeast Calcasieu Lake Marsh Creation: Creation of 7,604 acres of marsh southeast of Calcasieu Lake | $689.04M | 004.MC.10 |
| | Cameron Meadows Marsh Creation: Creation of 3,292 acres of marsh at Cameron Meadows | $299.79M | 004.MC.13 |
| | East Pecan Island Marsh Creation: Creation of 7,340 acres of marsh at East Pecan Island | $1,221.95M | 004.MC.16 |
| | Calcasieu Ship Channel Marsh Creation: Creation of 2,639 acres of marsh near Calcasieu Ship Channel | $191.41M | 004.MC.23 |
| Nonstructural Protection | Cameron Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $300.97M | CAM.050.2 |

**▼ Figure 5.3**
Projects are organized by implementation period and project type. See Appendix A for additional information.

| | | | |
|---|---|---|---|
| Ridge Restoration | Grand Chenier Ridge Restoration: Restoration of 783 acres of historic ridge along Grand Chenier Ridge | $10.86M | 004.RC.01 |
| | Cheniere au Tigre Ridge Restoration: Restoration of 523 acres of historic ridge along Bill Ridge and Cheniere au Tigre | $10.08M | 004.RC.02 |
| Shoreline Protection | Gulf Shoreline Protection (Freshwater Bayou to Southwest Pass): Shoreline protection along Gulf shoreline from Freshwater Bayou to Southwest Pass | $112.68M | 03b.SP.05 |
| Structural Protection | Iberia/Vermilion Upland Levee | $1573.63M | 03b.HP.06 |

## Second Implementation Period (2032-2061)

| Project Type | Project Name / Description | Project Costs | Project No. |
|---|---|---|---|
| Bank Stabilization | West Cove Bank Stabilization: Shoreline stabilization in the West Cove area of Calcasieu Lake | $16.97M | 004.BS.02 |
| | GIWW Bank Stabilization (Freshwater Bayou to Calcasieu Ship Channel): Bank stabilization along the GIWW between Freshwater Bayou and Calcasieu Ship Channel | $65.37M | 004.BS.03 |
| Hydrologic Restoration | Tom's Bayou Hydrologic Restoration: Control Structure at Tom's Bayou | $0.89M | 004.HR.12 |
| Marsh Creation | East Calcasieu Lake Marsh Creation: Creation of 14,843 acres of marsh in East Calcasieu Lake | $2,572.13M | 004.MC.19 |
| | Kelso Bayou Marsh Creation : Creation of 260 acres of marsh near Kelso Bayou | $33.33M | 004.MC.25 |
| Nonstructural Protection | Acadia Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $121.73M | ACA.050.1 |
| | Calcasieu Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 1 foot, and voluntary acquisition of residential structures within rural areas of the Parish. | $415.29M | CAL.050.1 |
| | Jefferson Davis Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $164.33M | JED.050.1 |
| | Lake Charles/Prien: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the communities of Lake Charles and Prien. | $509.42M | LCH.500.1 |
| | Sulphur: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Sulphur. | $113.63M | SUL.100.1 |
| | Vermilion Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $95.12M | VER.050.3 |
| Ridge Restoration | Pecan Island Ridge Restoration: Restoration of 404 acres of historic ridge along Pecan Island Ridge | $8.12M | 004.RC.03 |
| | Hackberry Ridge Restoration: Restoration of 1,193 acres of historic ridge at Blue Buck and Hackberry | $1.76M | 004.RC.04 |
| Shoreline Protection | Southwest Pass Shoreline Protection (West Side): Shoreline protection along Southwest Pass immediately west of Marsh Island | $48.99M | 03b.SP.08 |
| | Schooner Bayou Canal Shoreline Protection: Shoreline protection along Schooner Bayou Canal from Highway 82 to North Prong | $27.89M | 004.SP.02 |
| | Freshwater Bayou Canal Shoreline Protection: Shoreline protection along Freshwater Bayou Canal | $15.64M | 004.SP.03 |
| | Northeast White Lake Shoreline Protection: Northeast White Lake shoreline protection and marsh creation | $5.06M | 004.SP.07 |
| Structural Protection | Lake Charles Ring (north) | $1130.67M | 004.HP.06 |

# Central Coast

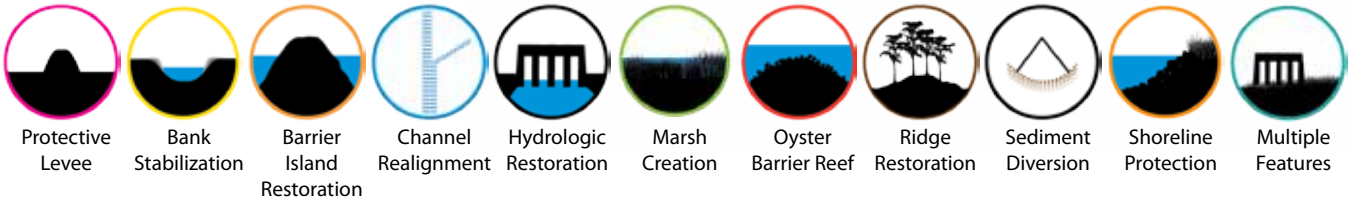
## Protection

Levee protection is proposed for large, densely populated, at-risk communities, including Franklin, New Iberia, Morgan City and Houma. Nonstructural measures are proposed for all parishes in this region. Restoration of barrier islands, marshes and ridges contribute additional protection.

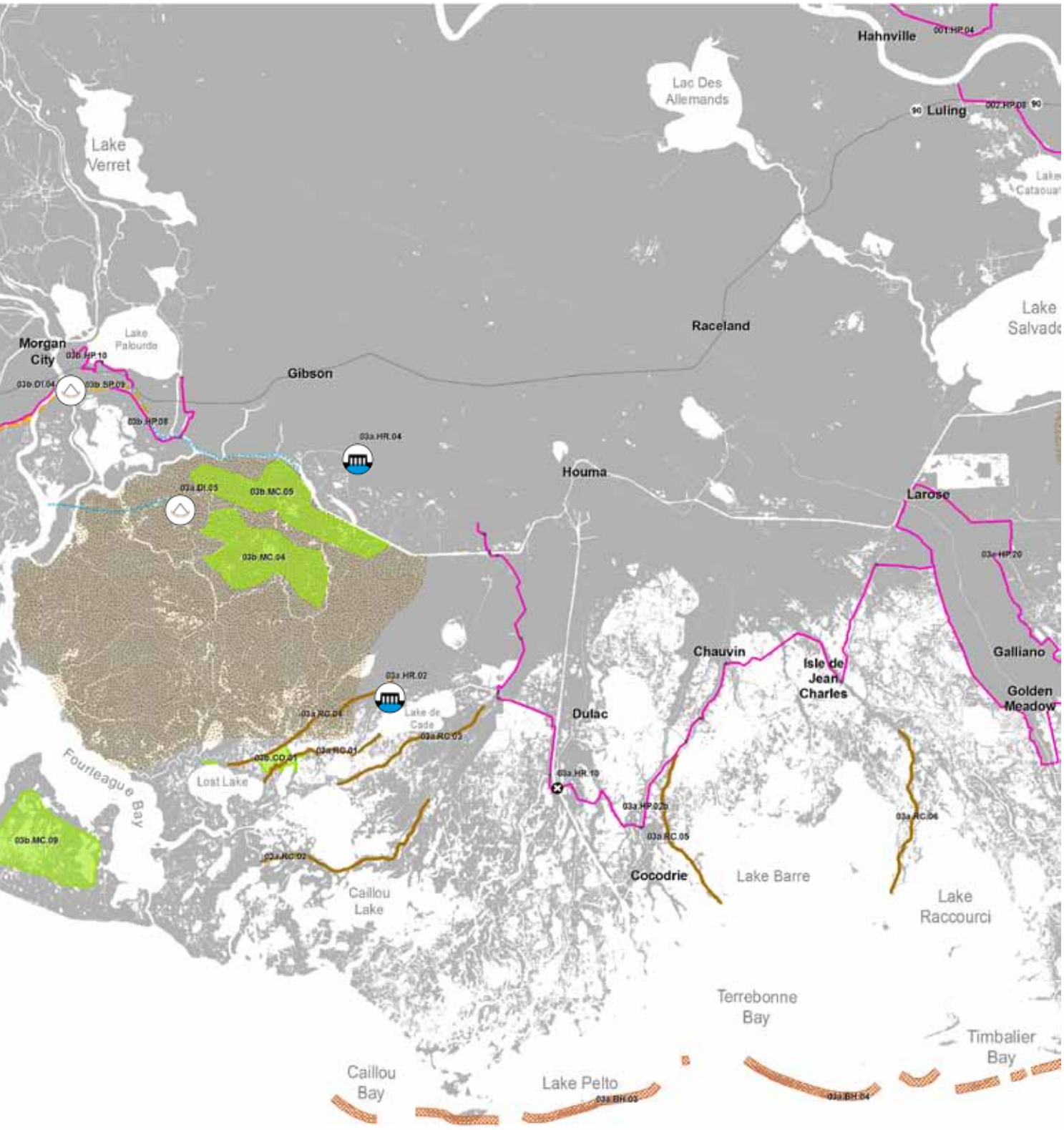
## Restoration

Maintain the land building capacity of the Atchafalaya region, while increasing the use of Atchafalaya River sediment and water east to Terrebonne Parish to sustain the coastal ecosystem. Rebuild barrier islands and ridges.




Project Types Included: Colors on the icon correspond to color key on the map.




▲ **Figure 5.4**
Central Coast Project Map

| First Implementation Period (2012-2031) | | | |
|---|---|---|---|
| **Project Type** | **Project Name / Description** | **Project Costs** | **Project No.** |
| Barrier Island/Headland Restoration | Isles Dernieres Barrier Island Restoration: Restoration of 5,013 acres of dune, beach, and back barrier marsh in Isles Dernieres barrier islands | $355.55M | 03a.BH.03 |
| | Timbalier Islands Barrier Island Restoration: Restoration of 5,073 acres of dune, beach, and back barrier marsh in Timbalier barrier islands | $543.57M | 03a.BH.04 |
| Sediment Diversion | Upper Penchant Diversion (150,000 cfs): Diversion into Upper Penchant Basin south of Avoca Island, 150,000 cfs capacity. The diverted flow is to be 60% of southward Atchafalaya flow exceeding 50,000 cfs. | $808.60M | 03a.DI.05 |
| | Increase Atchafalaya Flow to Eastern Terrebonne: Increase freshwater flows from Atchafalaya River to Terrebonne marshes (maintain a minimum of 20,000 cfs east along GIWW towards HNC) | $301.48M | 03b.DI.04 |
| Hydrologic Restoration | Central Terrebonne Hydrologic Restoration: Freshwater enhancement in Central Terrebonne | $14.60M | 03a.HR.02 |
| | Chacahoula Basin Hydrologic Restoration: Comprehensive hydrologic restoration in the Chacahoula Basin | $7.28M | 03a.HR.04 |
| | HNC Lock Hydrologic Restoration: Operation of the HNC Lock for hydrologic restoration | $700.80M | 03a.HR.10 |
| Marsh Creation | Terrebonne GIWW Marsh Creation: Creation of 1,190 acres of marsh along the GIWW in Terrebonne | $101.55M | 03b.MC.05 |
| | Pointe Au Fer Island Marsh Creation: Creation of 5,834 acres of marsh on Pointe au Fer Island | $635.90M | 03b.MC.09 |
| Nonstructural Protection | Houma: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Houma. | $1151.01M | HOU.100.1 |
| | Saint Martin Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $108.73M | SMT.050.1 |
| | Terrebonne Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $1130.29M | TER.050.2 |
| Oyster Barrier Reef | East Vermilion Bay Oyster Barrier Reef Restoration: Oyster barrier reef in the vicinity of Dead Cypress Point | $20.99M | 03b.OR.02 |
| | West Vermilion Bay Oyster Barrier Reef Restoration: Oyster barrier reef in the vicinity of Marone Point | $22.54M | 03b.OR.03 |
| Ridge Restoration | Bayou DeCade Ridge Restoration: Restoration of 108 acres of historic ridge along Bayou DeCade from Lake Decade to Raccourci Bay | $39.57M | 03a.RC.01 |
| | Bayou DuLarge Ridge Restoration: Restoration of 243 acres of historic ridge along Bayou DuLarge | $57.65M | 03a.RC.02 |
| | Small Bayou LaPointe Ridge Restoration: Restoration of 126 acres of historic ridge along Small Bayou LaPointe | $30.24M | 03a.RC.03 |
| | Mauvais Bois Ridge Restoration: Restoration of 139 acres of historic ridge at Mauvais Bois | $37.75M | 03a.RC.04 |
| | Bayou Terrebonne Ridge Restoration: Restoration of 126 acres of historic ridge along Bayou Terrebonne | $39.54M | 03a.RC.05 |
| | Bayou Pointe au Chene Ridge Restoration: Restoration of 130 acres of historic ridge along Bayou Pointe au Chene | $30.58M | 03a.RC.06 |
| | Bayou Sale Ridge Restoration: Restoration of 83 acres of historic ridge along Bayou Sale | $22.97M | 03b.RC.01 |
| Shoreline Protection | Vermilion Bay and West Cote Blanche Bay Shoreline Protection: Shoreline protection at Vermilion Bay and West Cote Blanche Bay | $581.3M | 03b.SP.06 |
| | GIWW Shoreline Protection (Intracoastal City to Amelia): Shoreline protection along the GIWW between Intracoastal City and Amelia | $805M | 03b.SP.09 |

**▼ Figure 5.5**
Projects are organized by implementation period and project type. See Appendix A for additional information.

| | | | |
|---|---|---|---|
| Structural Protection | Morganza to the Gulf (high) | $3988.1M | 03a.HP.02b |
| | Maintain Larose to Golden Meadow | $257.54M | 03a.HP.20 |
| | Amelia Levee Improvements (3E) | $262.52M | 03b.HP.08 |
| | Morgan City Back Levee | $151.72M | 03b.HP.10 |
| | Abbeville and Vicinity | $1442.12M | 004.HP.04 |

## Second Implementation Period (2032-2061)

| Project Type | Project Name / Description | Project Costs | Project No. |
|---|---|---|---|
| Combined | North Lost Lake Marsh Creation: Creation of 750 acres of marsh in the vicinity of Lost Lake | $115.11M | 03b.CO.01 |
| Marsh Creation | Bayou Penchant Marsh Creation: Creation of 1,348 acres of marsh near Bayou Penchant | $380.19M | 03b.MC.04 |
| Nonstructural Protection | Assumption Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $290.14M | ASU.050.1 |
| | Baldwin/Charenton: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the communities of Baldwin and Charenton. | $7.69M | BAL.100.1 |
| | Bayou Blue: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Bayou Blue. | $47.46M | BBL.100.1 |
| | Bayou Vista: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the community of Bayou Vista. | $93.09M | BVI.100.2 |
| | Franklin: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the community of Franklin. | $227.27M | FRA.100.2 |
| | Iberia Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $15.72M | IBE.050.3 |
| | Morgan City: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Morgan City. | $385.66M | MOR.100.1 |
| | Patterson: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Patterson. | $10.08M | PAT.100.1 |
| | Saint Mary Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $301.39M | STM.050.2 |
| Structural Protection | Berwick to Wax Lake | $285.14M | 03b.HP.11 |
| | Franklin and Vicinity | $1092.77M | 03b.HP.12 |

# Southeast Coast

## Protection

Sustain key levee protection systems, such as Greater New Orleans area and Larose to Golden Meadow. New levees are proposed for large, densely populated, at risk communities, such as LaPlace and Slidell. Nonstructural protection measures are proposed for all parishes in this region.

## Restoration

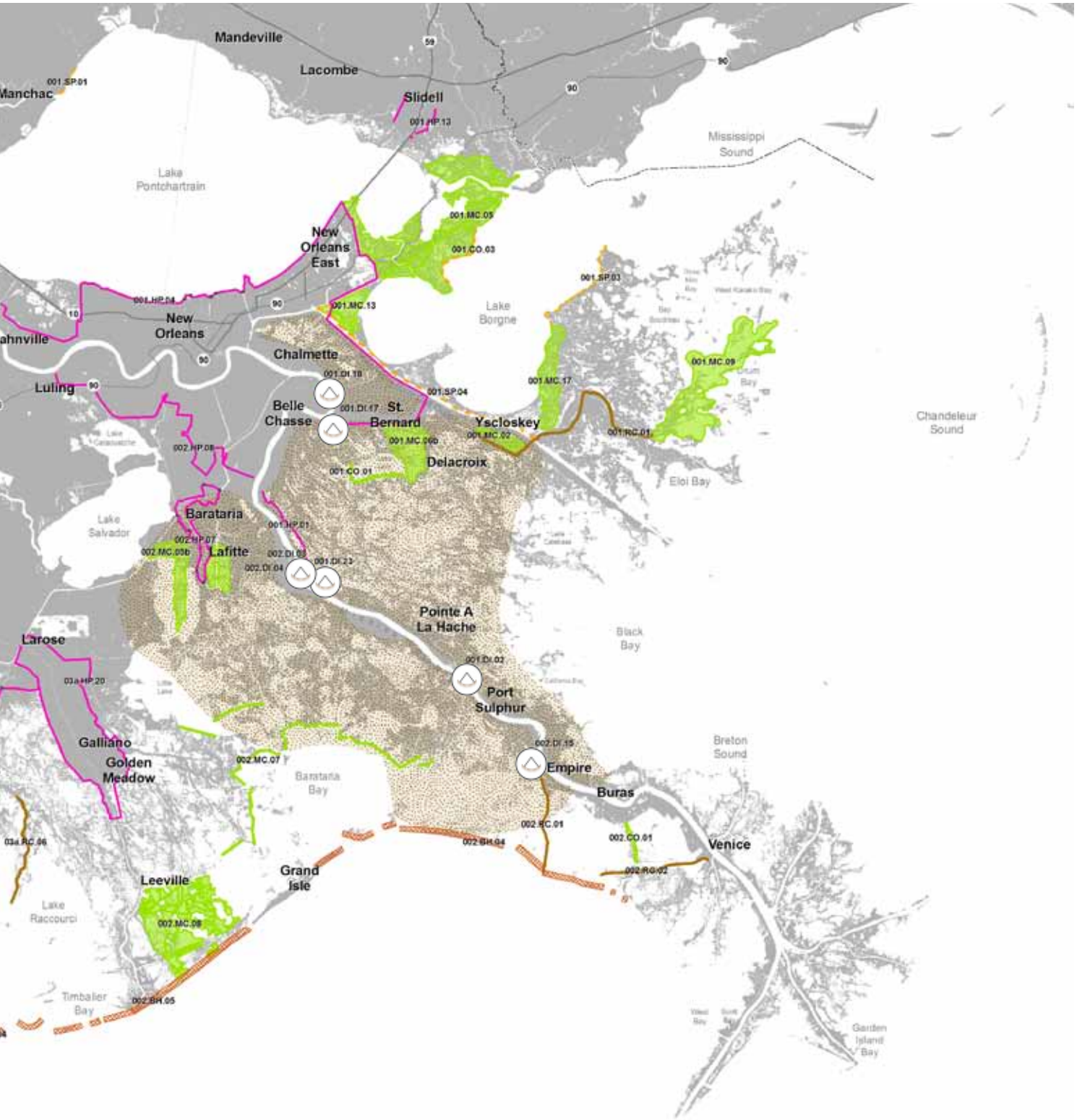
Use sediment and water from the Mississippi River to maintain and rebuild land. Sustain a diversity of coastal habitats including cypress swamps, marshes, ridges, and barrier islands.







Project Types Included: Colors on the icon correspond to color key on the map.




▲ **Figure 5.6**
Southeast Coast Project Map

# Southeast Coast

| First Implementation Period (2012-2031) | | | |
|---|---|---|---|
| **Project Type** | **Project Name / Description** | **Project Costs** | **Project No.** |
| Barrier Island/Headland Restoration | Barataria Pass to Sandy Point Barrier Island Restoration: Restoration of 13,472 acres of dune, beach, and back barrier marsh in barrier islands Between Barataria Pass and Sandy Point | $553.89M | 002.BH.04 |
| | Belle Pass to Caminada Pass Barrier Island Restoration: Restoration of 4,614 acres of dune, beach, and back barrier marsh in barrier islands between Belle Pass and Caminada Pass | $291.26M | 002.BH.05 |
| Combined | Grand Liard Marsh/Ridge Restoration: Restoration of 561 acres of marsh and historic ridge in the vicinity of Grand Liard | $35.86M | 002.CO.01 |
| Sediment Diversion | Lower Breton Diversion (50,000 cfs): Diversion into lower Breton Sound in the vicinity of Black Bay, 50,000 cfs capacity (operation at capacity when Mississippi River flow exceeds 600,000 cfs; operation at 8% of river flow from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs) | $219.07M | 001.DI.02 |
| | Upper Breton Diversion (250,000 cfs): Diversion into upper Breton Sound in the vicinity of Braithwaite, 250,000 cfs capacity (operation at capacity when Mississippi River flow exceeds 900,000 cfs; operation at 50,000 cfs for flows from 900,000 cfs to 600,000 cfs; operation at 8% of river flow for river flows from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs) | $913.33M | 001.DI.17 |
| | Central Wetlands Diversion (5,000 cfs): Diversion into Central Wetlands in the vicinity of Violet, 5,000 cfs capacity (continuous operation at capacity for river flows above 200,000 cfs, no operation below 200,000 cfs) | $195.39M | 001.DI.18 |
| | Mid-Breton Diversion (5,000 cfs): Diversion into mid Breton Sound in the vicinity of White Ditch, 5,000 cfs capacity (continuous operation at capacity for river flows above 200,000 cfs, no operation below 200,000 cfs) | $126.57M | 001.DI.23 |
| | West Maurepas Diversion (2,000 cfs): Diversion into Maurepas Swamp in the vicinity of Convent/Blind River, 2,000 cfs capacity | $95.82M | 001.DI.29 |
| | Mid-Barataria Diversion (50,000 cfs): Diversion into mid Barataria Bay in the vicinity of Myrtle Grove, 50,000 cfs capacity (operation at capacity when Mississippi River flow exceeds 600,000 cfs; operation at 8% of river flow from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs) | $283.95M | 002.DI.03 |
| | Lower Barataria Diversion (50,000 cfs): Diversion into lower Barataria Bay in the vicinity of Empire, 50,000 cfs capacity (operation at capacity when Mississippi River flow exceeds 600,000 cfs; operation at 8% of river flow from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs) | $209.94M | 002.DI.15 |
| | Bayou Lafourche Diversion (1,000 cfs): Diversion at Bayou Lafourche, 1,000 cfs capacity (continuous operation at capacity) | $195.00M | 03a.DI.01 |
| Marsh Creation | New Orleans East Landbridge Restoration: Creation of 8,513 acres of marsh in the New Orleans East Landbridge | $2,447.53M | 001.MC.05 |
| | Golden Triangle Marsh Creation: Creation of 2,443 acres of marsh in the Golden Triangle area | $303.54M | 001.MC.13 |
| | Eastern Lake Borgne Marsh Creation: Creation of 1,887 acres of marsh along the eastern shore of Lake Borgne | $230.74M | 001.MC.17 |
| | Large-Scale Barataria Marsh Creation- Compartment B: Creation of 5,378 acres of marsh in Barataria Basin from Myrtle Grove to GIWW (component of 002.MC.05) | $1,714.08M | 002.MC.05b |
| Nonstructural Protection | Jefferson Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet within rural areas of the Parish.<br>Lacombe: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the community of Lacombe. | $242.73M<br>$106.04M | JEF.050.2<br>LAC.100.2 |

**▼ Figure 5.7**
Projects are organized by implementation period and project type. See Appendix A for additional information.

| | | | |
|---|---|---|---|
| | Lafitte/Jean Lafitte/Barataria: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the communities of Lafitte, Jean Lafitte, and Barataria. | $167.68M | LFT.100.2 |
| | Lafourche Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $376.65M | LAF.050.2 |
| | Livingston Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet within rural areas of the Parish. | $181.2M | LIV.050.2 |
| | Mandeville: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Mandeville. | $262.48M | MAN.100.1 |
| | Orleans Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $76.03M | ORL.050.2 |
| | Plaquemines Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $418.61M | PLA.050.2 |
| | Slidell: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of Slidell. | $1483.24M | SLI.100.1 |
| | Saint Bernard Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 1 foot, and voluntary acquisition of residential structures within rural areas of the Parish. | $63.03M | STB.050.2 |
| | Saint James Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $2.77M | STJ.050.1 |
| | Saint Tammany Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish.. | $250.9M | STT.050.2 |
| Ridge Restoration | Bayou Long Ridge Restoration: Restoration of 112 acres of historic ridge along Bayou Long/Bayou Fontanelle | $37.76M | 002.RC.01 |
| Structural Protection | Alliance Area Levee | $510.06M | 001.HP.01 |
| | Greater New Orleans Laplace Extension | $468.87M | 001.HP.05 |
| | Slidell Ring Levees | $71.93M | 001.HP.13 |

## Second Implementation Period (2032-2061)

| Project Type | Project Name / Description | Project Costs | Project No. |
|---|---|---|---|
| Sediment Diversion | Mid-Barataria Diversion (250,000 cfs): Diversion into mid Barataria Bay in the vicinity of Myrtle Grove, 250,000 cfs capacity *extension of 50,000 cfs diversion at Myrtle Grove (operation at capacity when Mississippi River flow exceeds 900,000 cfs; operation at 50,000 cfs for flows from 900,000 cfs to 600,000 cfs; operation at 8% of river flow for river flows from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs) | See Cost for 002.DI.03 | 002.DI.04 |
| Marsh Creation | South Lake Lery Marsh Creation: Restoration of 580 acres of marsh in the vicinity of Lake Lery | $48.71M | 001.CO.01 |
| | Hopedale Marsh Creation: Creation of 546 acres of marsh in the vicinity of Hopedale | $152.00M | 001.MC.02 |
| | Breton Marsh Creation- Compartment B: Creation of 3,833 acres of fringe marsh from Caernarvon to Phoenix, also along Bayou Terre au Boeufs | $798.36M | 001.MC.06b |
| | Biloxi Marsh Creation: Creation of 15,972 acres of marsh in Biloxi Marsh | $1,639.07M | 001.MC.09 |
| | Barataria Bay Rim Marsh Creation: Creation of 2,009 acres of fringe marsh along northern rim of Barataria Bay | $223.02M | 002.MC.07 |

| | | | |
|---|---|---|---|
| | North Caminada Marsh Creation: Creation of 16,727 acres of marsh north of Caminada headland to Leeville | $1,936.37M | 002.MC.08 |
| Nonstructural Protection | Destrehan/New Sarpy/Norco: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures in the communities of Destrehan, New Sarpy, and Norco. | $952.78M | DES.100.2 |
| | Luling/Boutte: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the communities of Luling and Boutte. | $588.66M | LUL.100.2 |
| | Laplace/Reserve: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the communities of Laplace and Reserve. | $297.12M | LAP.100.1 |
| | Larose/ Cut Off/ Galliano/ Golden Meadow: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures in the communities of Larose, Cut Off, Galliano and Golden Meadow. | $1097.3M | LAR.100.2 |
| | Mathews/Lockport: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the communities of Mathews and Lockport. | $231M | MAT.100.2 |
| | Raceland: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the community of Raceland. | $173.03M | RAC.100.2 |
| | Saint Charles Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot within rural areas of the Parish. | $203.46M | STC.050.1 |
| | Saint John the Baptist Parish: Combination of floodproofing to 3 feet, elevating to the Base Flood Elevation plus 4 feet, and voluntary acquisition of residential structures within rural areas of the Parish. | $18.56M | SJB.050.2 |
| | Saint Rose: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet in the community of Saint Rose. | $169.55M | STR.100.2 |
| | South Vacherie: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 1 foot in the community of South Vacherie. | $21.76M | SVA.100.1 |
| | Tangipahoa Parish: Combination of floodproofing to 3 feet and elevating to the Base Flood Elevation plus 4 feet within rural areas of the Parish. | $102.41M | TAN.050.2 |
| Ridge Restoration | Bayou LaLoutre Ridge Restoration: Restoration of historic ridge along Bayou LaLoutre | $63.32M | 001.RC.01 |
| | Spanish Pass Ridge Restoration : Restoration of 122 acres of historic ridge along banks of Spanish Pass near Venice | $43.87M | 002.RC.02 |
| Shoreline Protection | East New Orleans Land Bridge Shoreline Protection: Shoreline protection on the east side of the New Orleans Land Bridge in the vicinity of Alligator Bend | $44.32M | 001.CO.03 |
| | Manchac Landbridge Shoreline Protection: Lake Pontchartrain shoreline protection north of Pass Manchac | $13.31M | 001.SP.01 |
| | Eastern Lake Borgne Shoreline Protection: Shoreline protection along eastern shore of Lake Borgne | $86.50M | 001.SP.03 |
| | MRGO Shoreline Protection: Shoreline protection along banks of MRGO | $199.24M | 001.SP.04 |
| Structural Protection | Greater New Orleans High Level | $1752.99M | 001.HP.04 |
| | Lafitte Ring Levee | $855.52M | 002.HP.07 |
| | Maintain West Bank Levees | $161.36M | 002.HP.08 |

# Benefits of the Master Plan: Flood Risk Reduction

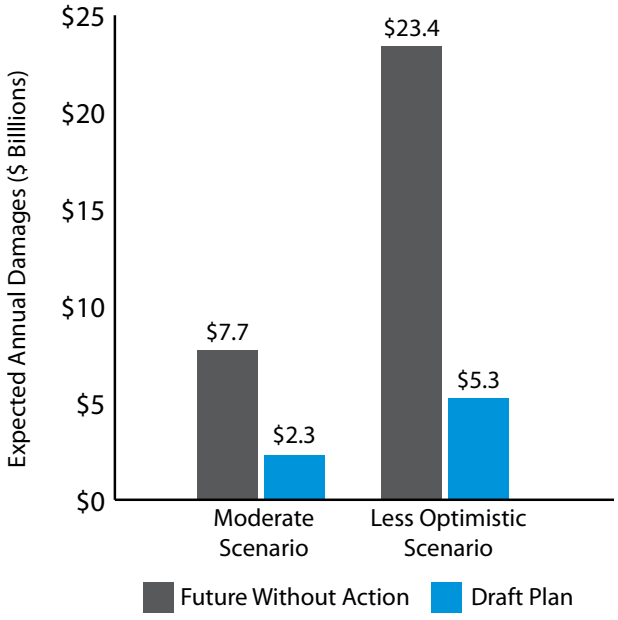


As the residents of coastal Louisiana know, it is not possible to completely eliminate the risk of flooding in a hurricane prone, low lying region. But this built in vulnerability to coastal flooding is greatly increased as Louisiana loses more coastal land. Our Future Without Action analysis showed that we could experience estimated annual damages from flooding coast wide totaling $7.7 to $23.4 billion over the next 50 years, depending on future conditions. In the face of these mounting risks, communities need action today to bring the threat of flooding down to more manageable levels.

The projects in the draft plan can substantially reduce community expected annual flood damages. The plan's proposed investment of $25 billion in increased levels of protection could prevent $100 billion to $220 billion in direct asset damages to individuals, communities, and industry over the next 50 years. This savings figure does not account for reaction and recovery costs, which alone cost over $170 billion for the 2005 hurricanes, not counting the incalculable human costs. These estimates do not account for improvements to the landscape by ongoing restoration measures. Future risk reductions could be larger if we implement the land building projects proposed in the draft plan.

**Figure 5.8**
Potential change in risk, represented by expected annual damages with Future Without Action and with the Draft Plan at Year 50.

**Expected Annual Damages from Floods At Year 50**
Under Different Future Scenarios



## Risk Reduction Projects by Type Across the Coast

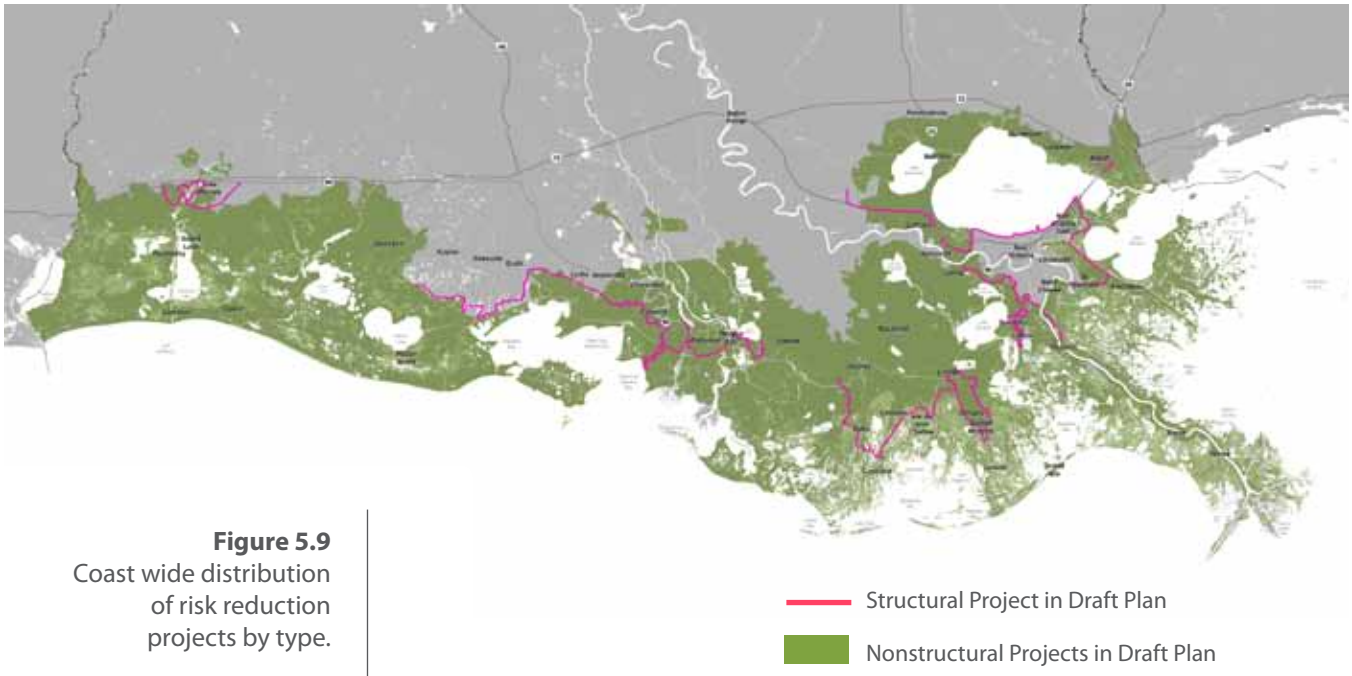



**Figure 5.9**
Coast wide distribution of risk reduction projects by type.

*The plan's proposed investment of $25 billion in increased levels of protection could prevent $100 billion to $220 billion in direct asset damages to individuals, communities, and industry over the next 50 years.*

The draft plan includes projects that will reduce flood damages coast wide by varying levels. Specifically, under the moderate scenario of future coastal conditions, the draft plan provides 500 year protection for metropolitan areas, such as New Orleans, Metairie, Kenner and Lake Charles, by using primarily structural measures. The plan provides 100 year protection for smaller urban areas, such as Abbeville, Algiers, Arabi, Avondale, Baldwin, Barataria, Bayou Vista, Chalmette, Charenton, Franklin, Houma, Jean Lafitte, Jeanerette, Lafitte, Laplace, Meraux, Morgan City, Moss Bluff, Patterson, Poydras, Reserve, Sulphur, Violet, Waggaman, and Westlake, through structural protection augmented by nonstructural measures. Risk reduction to rural communities is provided in large part through coast wide nonstructural projects. As discussed previously, nonstructural projects do not eliminate all risk since they depend on voluntary participation. Furthermore, elevation is available solely for residential properties; businesses can only be flood proofed up to 3 feet.

## The Lake Charles Levee

Lake Charles could experience a three fold increase in risk from storm flooding over the next 50 years without restoration of the landscape. One way to address this risk is to build a levee that would provide the city protection from a 500 year event. However, this idea is conceptual and we would need to further investigate how to implement it with the concerns of Lake Charles's citizens in mind, including the need to avoid impeding navigation or trapping water behind the levee. The master plan recommends that this option be further explored as part of the State-Corps Southwest Louisiana Feasibility Study. With more understanding of the project's engineering and design requirements, stakeholder input, and the ability of a restored landscape to reduce risk, we can best address Lake Charles's current and future flooding risk.

Voluntary acquisition is part of the master plan's nonstructural strategy, however it accounts for less than 3 percent of the recommended actions. When looking at protection, we had to assess flood risk in a way that was consistent across the coast. To do this, we looked at what is known as "expected annual damages." This concept takes into account uncertainty about when floods will occur. Communities may go years without a serious flood, they may experience minor floods, they may be severely flooded several years in a row—any number of variations is possible.

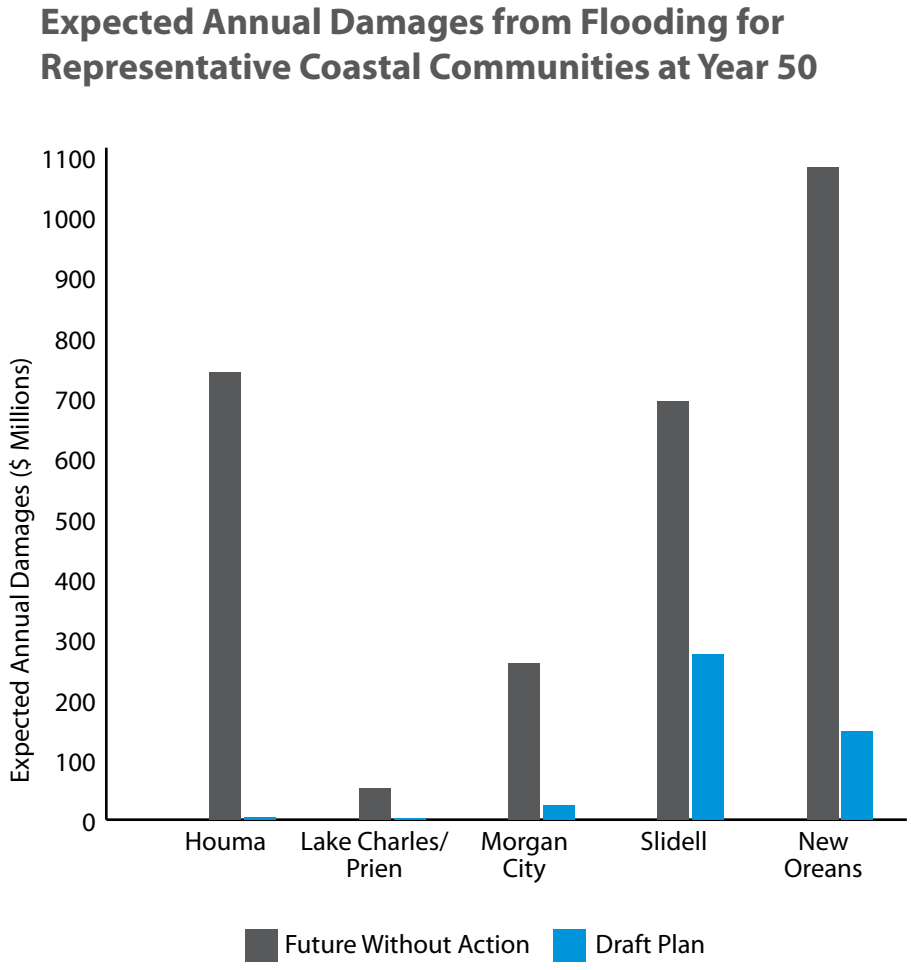
Our analysis of expected annual damages took a 50 year look at the likelihood of storm surge flooding occurring and determined an average amount of flood damages that every community could expect. This average was expressed as dollars of damage per year. These averages do not imply that every community will flood every year. They are statistical 50 year averages of communities' likely flood risk and the damage that would be associated with that risk. Louisiana residents know what the numbers mean: lost jobs, ruined homes, and higher insurance.

Given the severity of the risks borne by our communities, the draft plan aims to achieve a reduction in the frequency and depth of flooding along the coast, even under scenarios of increasing sea level rise and higher storm intensity and frequency. In addition to the overall risk reduction mentioned above, the draft plan provides for the following under moderate conditions:

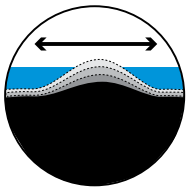
- Near elimination of expected annual damages predicted for some communities and parishes in the Future Without Action analysis. A few examples include Abbeville, Chalmette, LaPlace, Lafitte, Iberia Parish, and Vermilion Parish.
- Reduces expected annual damages by more than 75% over Future Without Action conditions in select communities and parishes, such as Houma, Lake Charles, Raceland, Morgan City, New Orleans, and Metairie.
- Reduces by half the expected annual damages predicted in the Future Without Action analysis for the rural areas of numerous parishes, such as Jefferson and Terrebonne.

Other communities will still experience some residual risk, partly due to the lack of viable projects to address their risk and partly due to the location of commercial assets that are difficult to protect with nonstructural measures.

**Figure 5.10**
Average expected annual damages estimated for Future Without Action and future with the draft plan at Year 50 for representative coastal communities under moderate scenario of future coastal conditions. The Future Without Action analysis includes added risk created in coming decades by growth and increased assets at risk. For details on damages for additional communities, see Appendix D.



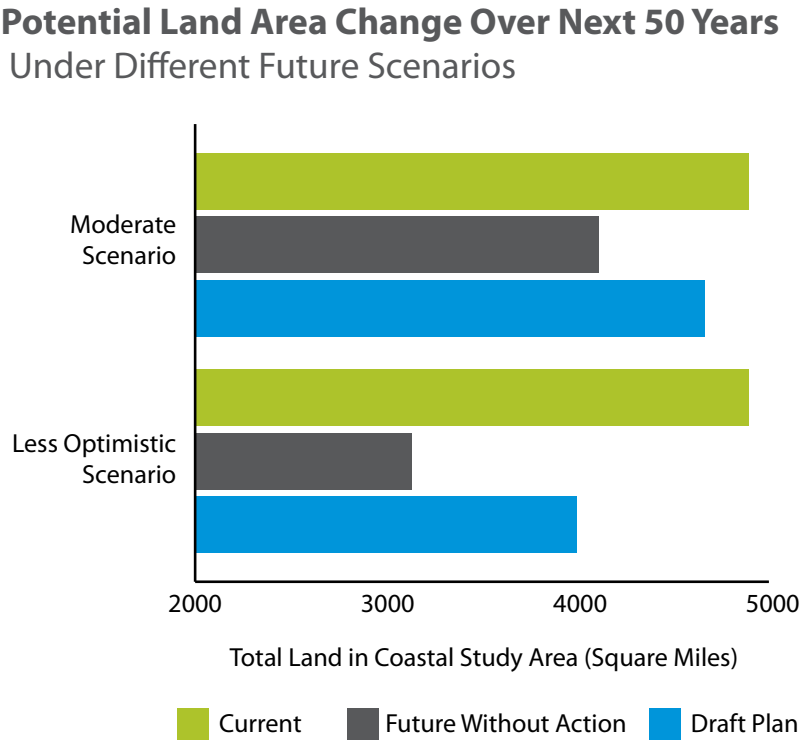
# Benefits of the Master Plan: Land Building



The projects in the draft plan have the potential to build between 545 and 859 square miles of land over the next 50 years, depending on future conditions.

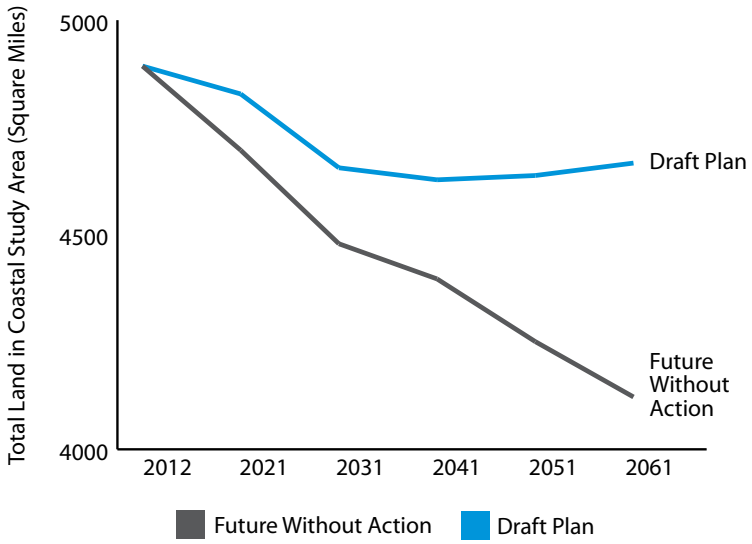
Although we are not able to prevent all the predicted land loss with the draft plan in the 50 year planning period, the draft plan will change the trajectory of land loss, providing a positive land change into the future. After 2042, the trajectory of land building becomes positive under the moderate scenario, which indicates we are building more land than we are losing in the Future Without Action. Under the less optimistic scenario, we predict a land loss rate of 40 square miles per year at Year 50 under Future Without Action conditions. With the draft plan, we make significant strides in building land, reaching a rate of 33 square miles per year in Year 50. Although we do not achieve net land gain under the less optimistic scenario, taking no action would be devastating to our coastline. For this effort, we took a snapshot of land building at Year 2061, but based on the analysis, the projects in the draft plan will continue building significant land beyond 2061 under both scenarios.

**Figure 5.11**
Current land in the coastal study area, as well as future conditions under moderate and less optimistic scenarios. The green bars depict the current land in the coastal study area and the gray bars depict the loss predicted in the future if we take no further action. The blue bars depict the draft plan's performance to prevent large-scale loss of land in the coastal study area.



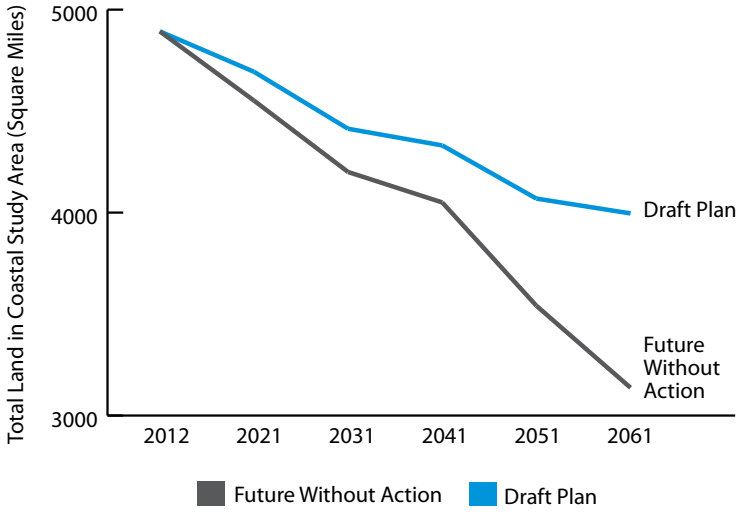
**Figures 5.12**
Change to the total land in the coastal study area over time for the draft plan compared to Future Without Action under the moderate scenario of future coastal conditions.

## Potential Land Area Change Over Next 50 Years
Moderate Scenario




**Figures 5.13**
Change to the total land in the coastal study area over time for the draft plan compared to Future Without Action under the less optimistic scenario of future coastal conditions.

## Potential Land Area Change Over Next 50 Years
Less Optimistic Scenario



Another way to look at the draft plan's effects on the coastal landscape is to evaluate the predicted average annual rate of change. In the Future Without Action, we continue to lose between 8 to 22 square miles per year. With the implementation of the draft plan, we reduce the land loss rate over the Future Without Action. After 30 years of implementing projects, we are able to overcome future loss and provide an average annual increase in land area.

**Potential Rate of Land Change Over Next 50 Years**
Moderate Scenario

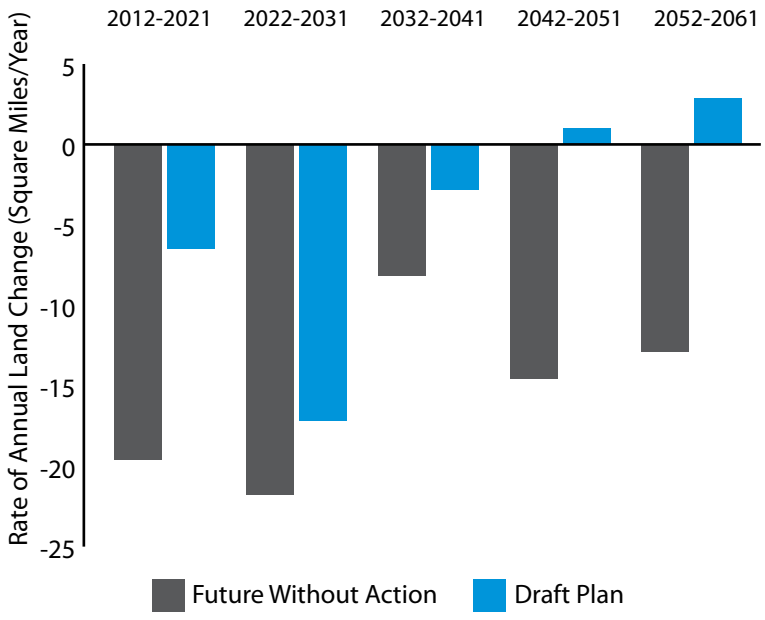



**Figure 5.14**
Potential changes in the annual rate of land loss or land gain every 10 years based upon a moderate scenario of future coastal conditions and compared to the Future Without Action. Implementation of projects in the draft plan may result in annual land gain after 30 years.

## Potential Rate of Land Change Over Next 50 Years
Less Optimistic Scenario

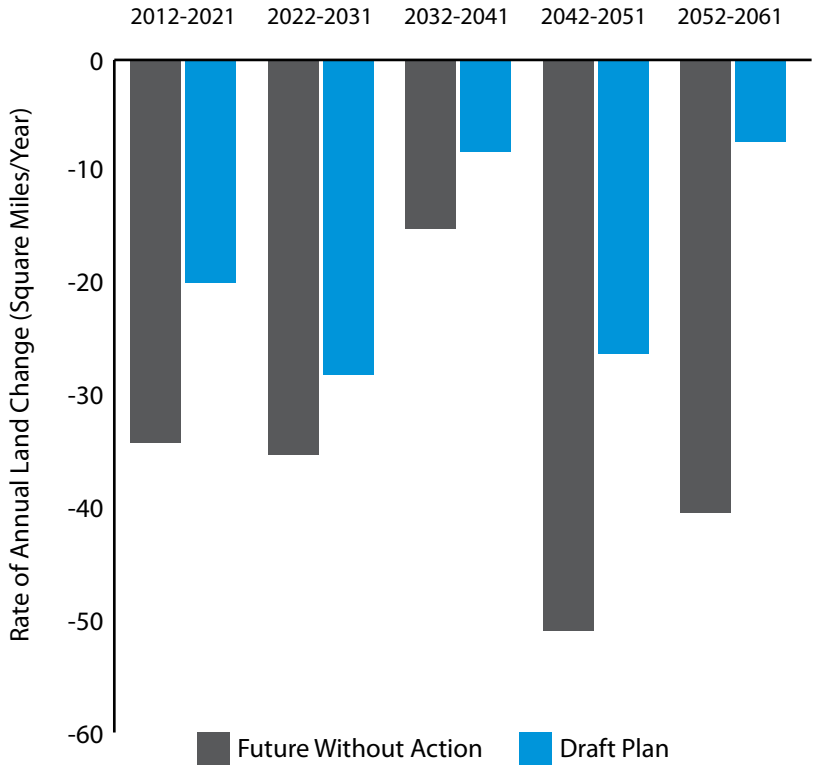



**Figure 5.15**
Potential changes in the annual rate of in land loss every 10 years based under a less optimistic scenario of future coastal conditions and compared to the Future Without Action. Average annual rate of land change only reaches net positive numbers under moderate conditions.

# Benefits of the Master Plan: Additional Decision Criteria

In addition to the risk reduction and land building benefits of the draft plan, we can gain insight into the effects the plan will have on other important components of the coast. These potential outcomes are described below.

## Support for Cultural Heritage



The draft plan supports the ability of coastal residents to use important natural resources for their livelihoods, such as fisheries, and live in their traditional communities without the risk of catastrophic flooding. This decision criterion evaluated the availability of fish, shrimp, and oysters as well as opportunities for agicultural, including rice, sugarcane, and cattle farming. By increasing the support for cultural heritage, the draft plan will reduce impacts to traditional communities compared to what they would experience under Future Without Action. See Appendix J for more information.



## Distribution of Risk Across All Socio-Economic Groups




This decision criterion took into account reduction of flooding risk in areas of the coast with low-income citizens. The intent of this criterion was to make sure that the draft plan did not increase flooding risks for low income citizens, and instead, distributed risk reduction across income levels. Our analysis showed that coast wide expected annual damages from flooding for low income areas would be reduced by approximately $95 million with the draft plan in place. The analysis further showed that we were not disproportionately increasing flood risk for low income communities coast wide as a result of our proposed risk reduction measures. Please see Appendix B for more information.

## Flood Protection of Historic Properties



This decision criterion was designed to assess flooding risks to the over 5,000 historic properties throughout the coast. Historic properties consist of historic standing structures, historic districts, historic landmarks, and archaeological sites. Projects that reduce historic properties' flooding risk performed better according to this criterion. As we analyzed project results, we learned that if we take no further action to protect or restore the coast, 1,775 properties would flood during a 50 year storm. The draft plan could reduce the number of flooded properties by about 10%. See Appendix J for more information.



## Flood Protection of Strategic Assets



Strategic assets, such as ports, refineries, and airports, are important economic assets, and we evaluated 179 strategic assets in the master plan analysis. The analysis indicated that 94 of these facilities would be flooded under Future Without Action conditions. With the draft plan, we could reduce the number of strategic assets flooded to 69. Many of these assets are located in highly vulnerable areas based on the location of resources, so complete protection of all strategic assets is not feasible. Please see Appendix B for more information.

## Support of Navigation



Maintaining the international prominence and future competitiveness of the port and navigation industry is vital for the economic vitality of the state and the nation. The draft plan has accounted for navigation concerns by reducing the overall number of sediment diversions from the Mississippi River and reducing the number of constrictions, such as locks, in other federally authorized channels. The draft plan also supports navigation by including marsh creation, bank stabilization, and shoreline protection projects that restore coastal habitats in the vicinity of federally authorized channels. These projects will help sustain channels, particularly in vulnerable areas that are currently predicted to coalesce with the Gulf of Mexico. As specific projects, such as sediment diversions, locks and floodgates, move toward implementation, navigation interests will be full participants in the planning, engineering and design phases. Please see Appendix B for more information.



## Support for Oil & Gas



This decision criterion took into account the many coastal Louisiana communities whose citizens work predominantly in the oil and gas industry. The draft plan supports this criterion by providing additional flood risk reduction to key oil and gas communities, as well as building and maintaining land, which will serve to protect valuable oil and gas infrastructure. Please see Appendix B for more information.



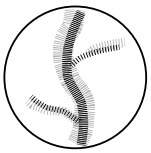


### Sustainability



It is imperative that the draft plan incorporate projects that will provide long term land building benefits, meaning benefits that will not require large reinvestments of dollars to sustain or rebuild in the future. For restoration, the draft plan has the potential to create an annual net gain of land, thereby reversing the trajectory of land loss experienced on the Louisiana coast since the 1930s. An annual rate of land gain means that Louisiana's coast will continue to grow into the future. Utilizing land building diversions and strategically placed marsh creation projects, the draft plan has the potential to produce a positive trajectory of land building that will continue beyond 50 years. This decision criterion was only evaluated for restoration projects, although sustainability of risk reduction projects is equally important and has been incorporated into the project design. For instance, long term risk reduction in the nonstructural program was incorporated by using freeboard (base flood elevation plus one foot or four feet) for residential elevation. Please see Appendix B for more information.

### Use of Natural Processes



Our current coastal crisis is due in large part to past decisions that have altered the natural processes of the coast. Both protection and restoration projects can support or impede these processes. In order to restore these processes and maintain those we have, the draft plan includes a wide array of restoration tools, focused on using river resources and restoring the coast as a system of barrier islands, wetlands, ridges, and swamps. The draft plan also minimizes cross-basin levee alignments that would block natural exchanges. Projects in the draft plan that may negatively impact natural processes, such as Morganza to the Gulf, will be designed to minimize those impacts as much as possible. Please see Appendix B for more information.

### Project Operations & Maintenance Costs over 50 Years




The master plan should not confine the coastal program to long term, costly operations and maintenance programs that are a burden to taxpayers. The draft plan has an operations and maintenance cost of 7% of the total program budget. General operations and maintenance expenses for levee construction will be the responsibility of the local sponsor. Please see Appendix B for more information.

# Benefits of the Master Plan: Ecosystem Services










Ecosystem services are benefits provided by nature. Our analysis of ecosystem services focused on proxy characteristics of the coast, such as provision of habitat (i.e. habitat suitability indices) and other factors that can support these services. Our ecosystem service evaluation only partially describes our complex coastal ecosystem. We did not, for example, account for harvest, economic value, or predation. However, we were able to arrive at the following conclusions:

- We developed a draft plan that did not cause drastic changes to species specific habitats coast wide. Although the location of these services along the coast may shift, overall the restored coastal landscape should still provide a substantial level of habitats to support a wide array of coastal activities.
- The draft plan and our projected Future Without Action both cause an array of complex increases and decreases in ecosystem services associated with vegetation type, percent of open water, edge habitats, salinity, water levels, location in the system, and numerous other variables.
- Through the community survey conducted in the fall of 2011, the public told us that one of the ecosystem services they cared most about was fresh water availability. The analysis found that the draft plan could provide a 26% increase in this service over Future Without Action conditions.
- The ecosystem services of carbon sequestration and nitrogen uptake were also evaluated because of their potential to provide funding streams in the future. The projects in the draft plan will provide 97% of the current carbon levels and realize 91% of the potential for the coastal landscape to uptake nitrogen.
- Nature-based tourism was evaluated as an important aspect of our coastal economy. For example, Grand Isle was recently named by Yahoo! as one of the nation's top 5 island destinations. The draft plan provides a slight increase in this service over Future Without Action.

# Other Aspects of the Plan

## Phasing

The 2012 Coastal Master Plan presents a mix of risk reduction and restoration projects spread across the entire Louisiana coast. We want to begin work on some of these projects immediately. These projects are included in the first 20 years of the plan and will be implemented depending on funding received. Implementation of these projects will be presented each year in the Coastal Protection and Restoration Authority (CPRA) annual plan, which will identify specific projects, schedules, and funding streams.

## Notes on Projects

- Although we have selected projects that protect the banks of navigation channels as well as shoreline protection projects, it is the state's policy that the protection of federally authorized channels is a federal responsibility. Funding for those projects should come at full federal expense. The state will work to secure federal funding for projects shown to be important to the overall coastal strategy.
- Similarly, the state views funding for Mississippi River Gulf Outlet Ecosystem Restoration as described in the 2007 Water Resources Development Act as a federal responsibility. The state will work to secure federal funding for projects shown to be important to the overall coastal strategy.
- The state envisions operating the Caernarvon and Davis Pond Diversions, as well as other siphons such as Naomi and West Pointe a la Hache in order to maximize the projects' ecosystem benefits. These projects were not included in the master plan because they are already operational, however the state feels these projects are important to our overall restoration strategy.
- The Louisiana Coastal Area Authorizations made in the 2007 Water Resources Development Act will remain in force; there will be no deauthorizations of LCA projects. The state will, however, focus its resources on LCA projects that show the most benefits, based on our analysis for the master plan. Appropriate modifications to certain LCA projects, such as Myrtle Grove Diversion and Point au Fer Shoreline, will also be made so that these projects can be fully consistent with the state's path forward.

# Project Implementation

The state is committed to expediting implementation of the 2012 Coastal Master Plan, beginning with the allocation of funding in the FY2013 Annual Plan, to begin preliminary engineering and design of projects as appropriate. Once the 2012 Coastal Master Plan has been adopted by the Louisiana Legislature, we must take the ideas in the plan and begin to implement them. Because each project has its own timeline and budget, the implementation process will vary. For example, many projects already have significant engineering and design work completed and can move to construction immediately. Other projects will need to undergo engineering and design. We will carry forward each project based on where it is in the process.

## Starting Up Projects

The Project Management Division of the Coastal Protection and Restoration Authority (CPRA) is the state's lead in implementing projects. The staff of this division have expertise in project management and have access to other CPRA professionals in planning, engineering, and land rights. These staff members will form teams tailored to the needs of each project. We will also seek out partners in local or federal government as well as other interested parties to take part in the project teams.

Each project team will build on the project description found in Appendix A. Teams will be responsible for the following tasks: defining the process to develop the actual footprint and features of each project, beginning the environmental permitting process, identifying real estate needs, assessing local impacts, and beginning the design process. We understand that time is of the essence and that these tasks must be completed efficiently. Each project identified will be appropriately staffed to maintain a streamlined schedule. We will also explore alternative permitting and regulatory approaches to speed up implementation.

The Coastal Protection and Restoration Authority's annual plan will be the vehicle for outlining how projects are implemented. Each annual plan will provide project and funding details for the current year as well as two years in the future. In this way, the annual plan can closely track funding received and how this translates into project schedules. The annual plan will thus provide an easy way to track progress of the 2012 Coastal Master Plan.

# Adaptive Management Framework

## Overview

We cannot predict with complete certainty how the Louisiana coast will change under future conditions, with or without additional risk reduction and restoration projects. The dynamic nature of the coast requires that we use an Adaptive Management Framework to implement the projects recommended in the 2012 Coastal Master Plan using procedures or techniques that are flexible, agile, and based on the best available technical, economic and social information. The Adaptive Management Framework will identify lessons learned and by doing so will integrate project design and construction with system level monitoring, which will allow the coastal program to stay abreast of key innovations. We can then apply this knowledge when we implement the master plan.

## Developing an Adaptive Management Framework

The Coastal Protection and Restoration Authority is committed to developing a programmatic Adaptive Management Framework that will ultimately incorporate all aspects of the coastal program. The overall goal of the Adaptive Management Framework is to ensure that the master plan objectives are achieved by guiding adjustments to planning, policy, and implementation over the next 50 years.

To successfully build an Adaptive Management Framework, input is needed from key experts, partners and constituents. Although an initial framework has been identified, the Coastal Protection and Restoration Authority proposes to continue refining the framework over the upcoming months, building on past adaptive management efforts, and incorporating new aspects of the coastal program to achieve a programmatic Adaptive Management Framework. The Adaptive Management Framework will be facilitated by the annual plan and master plan updates, which are legislatively required every one and five years, respectively. These plans will provide opportunities to report on the progress of the Adaptive Management Framework by assessing overall program effectiveness, reviewing stakeholder engagement, and making necessary adjustments.

## Adaptive Planning

Prior to the FY14 Annual Plan, we will develop the first phase of the full Adaptive Management Framework, with the goal of improving the decision making process and increasing stakeholder knowledge about the current and subsequent master plans. This phase will focus on evaluating the planning process used to develop the 2012 Coastal Master Plan, incorporating lessons learned, and identifying a strategy for developing the 2017 Coastal Master Plan. Specific actions that will be undertaken as part of this evaluation include, but are not limited to:

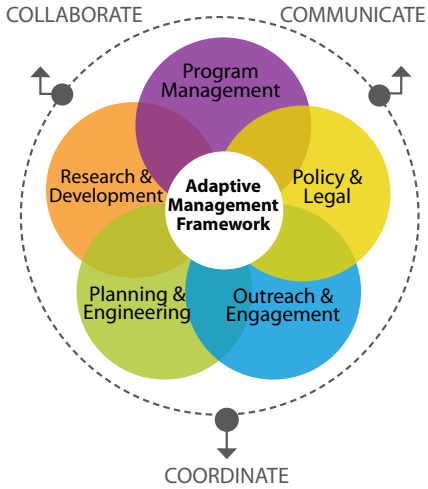
- Evaluate acceptance of the 2012 Coastal Master Plan
- Evaluate models, tools, and key uncertainties
- Develop a planning strategy for the 2017 Coastal Master Plan
- Develop a budget and priorities for research and development
- Identify a governance structure and key roles and responsibilities

## Adaptive Implementation

The second phase of developing the Adaptive Management Framework involves identifying elements that will facilitate program implementation. The goal of the Adaptive Implementation phase is to understand the ability of master plan projects to meet the objectives when implemented in the coastal system. Understanding the complexities of the Louisiana coast requires the work of experts and stakeholders from many disciplines, and it requires that we continually monitor our work. Ongoing studies, like the Mississippi River Hydrodynamic and Delta Management Study, will provide critical information for this effort. Independent research institutions, such as the Water Institute of the Gulf, in conjunction with other research, academic and engineering institutions could provide a high level of expertise to build the knowledge needed to support quality project performance. Specific tasks included in further development of the Adaptive Management Framework include, but are not limited to:

- Develop a panel of experts to guide the Adaptive Management Framework
- Catalog on-going monitoring and data collection / identify gaps
- Develop key questions for implementation
- Prioritize and budget research and development
- Develop feedback loops, roles, and responsibilities

# Key Roles and Responsibilities




▲ **Figure 5.16**
The components of the Adaptive Management Framework will build upon the existing structure of CPRA and link all aspects of the coastal program to aid in implementing the 2012 Coastal Master Plan.

The complexity and magnitude of master plan implementation requires that state resources be organized and focused. Although developed as a key component of the 2012 Coastal Master Plan, the Adaptive Management Framework is intended to identify roles and responsibilities for all aspects of the coastal program, and thus will need to be implemented throughout the state via the broad agency membership in the Coastal Protection and Restoration Authority. The Adaptive Management Framework will also rely on collaborative partnerships with federal and local agencies, other state agencies, and research institutions to participate as members of the Adaptive Management Framework.

The state will build the Adaptive Management Framework into the current structures of the Coastal Protection and Restoration Authority. The state has identified five key focus areas (program management, planning and engineering, research and development, policy and legal, and outreach and engagement) to deliver the program and maximize collaboration, coordination, and communication. Each of the five focus areas is instrumental to the successful implementation of the master plan, and key feedback loops to the master plan and other coastal program efforts are essential. The Adaptive Management Framework will focus on integrating risk reduction and ecosystem restoration efforts with the institutional knowledge that the program builds over time. This knowledge will support a highly effective program that confronts the unexpected, avoids repeating mistakes, and increases our ability to share our successes with others.

The Adaptive Management Framework will be a living document that is updated to reflect new understanding and information. The framework should improve implementation of the master plan and continue to move the entire coastal program forward. More detailed information on the Adaptive Management Framework is included in Appendix G.





# Chapter 6
# Policies & Programs

Elevated residential house being constructed in Gentilly, New Orleans.

# Policy & Programs

## Chapter Preview

This chapter presents key policies and programs necessary for the successful implementation of the 2012 Coastal Master Plan. Some of these initiatives involve ongoing efforts, such as regulatory programs. Other initiatives need to be developed in order to support the successful protection and restoration of Louisiana's coast.

The intent of the Master Plan is to propose projects that will significantly reduce risk to vulnerable communities and reverse the pattern of land loss in coastal Louisiana. The state recognizes that a collaborative planning environment is essential, one that integrates disparate initiatives into a comprehensive and cohesive approach. The state also recognizes that it is not possible to be successful in this effort without altering the condition of the current coastal landscape. We will work during project implementation timeframes to help communities, businesses, and individuals transition and adapt to changes in the landscape.

## Planning

The 2012 Coastal Master Plan presents a mix of protection and restoration projects spread across the entire Louisiana coast. The projects will be implemented based on funding received and associated constraints. These funding decisions and allocations will be presented each year in the Coastal Protection and Restoration Authority annual plan. Some projects are shovel ready, while others will require the work of experts and stakeholders from many disciplines. These will require implementation through ongoing studies, such as the Mississippi River Hydrodynamic and Delta Management Study, to provide critical information and address potential project impacts to communities and resources. Both near term shovel ready and long term large scale projects that require further study must be funded in order to advance the goals of the master plan as quickly as possible. Details of these initiatives are described below.

### Annual Plans

The Coastal Protection and Restoration Authority's annual plan will be the vehicle for outlining how projects are implemented. Each annual plan will provide project and funding details for the current year as well as two years into the future. In this way, the annual plan can closely track funding received and how this translates into project schedules. The annual plan will thus provide an easy way to track progress of the 2012 Coastal Master Plan.

### Adding New Projects

For this analysis, we focused on examining existing project concepts proposed over the past 15 years. We have performed a thorough search for these ideas, and have come up with what we think is a comprehensive list of projects. Barring a major shift in the coastal landscape, large, new projects would not be added until the next master plan in 2017. New,

smaller projects that represent components of larger master plan projects will be adopted and implemented as funding becomes available.

We understand that local officials or others may develop new project ideas before the next master plan update is due. We hope the adaptive management process will encourage the development of new technologies and new project concepts that will allow us to achieve greater results, more quickly and with less investment. We welcome these ideas and will set up a process that will allow them to be thoroughly analyzed.

A first step will involve establishing guidelines for new ideas to make sure that the concepts we receive are fully described. If new projects are analyzed and found to provide superior benefits, we will then decide how to integrate the project into the coastal program. Our adaptive management program will provide one avenue for managing this integration, determining how and under what conditions the project could best be used.

## Mississippi River Hydrodynamic and Delta Management Study

Louisiana's economy, and that of the nation, is tied to the viability of the Mississippi River, one of the world's leading avenues of commerce. The State of Louisiana must not only maintain this commercial capacity but ensure that it prospers in the future. The state is also committed to finding ways to better use the resources of the Mississippi River to restore our coast and protect our citizens from flooding.

Since the late 1930s, the Mississippi River has been controlled by federally built levees. By reducing river flood risks and providing reliable navigation, the levees have allowed communities throughout the river's watershed to thrive. But the levees have also deprived Louisiana's wetlands of the sediment and fresh water that once built and sustained them. One of the many severe effects of this land loss disaster has been an increase in hurricane based flooding risk to communities. We must allow more river water and sediment to spread across the delta if we are to provide a sustainable future for the ecosystem, navigation, industry, and communities. Nevertheless, we recognize that we must reintroduce this water and sediment carefully. Millions of citizens and nationally important industries depend on the current uses and configuration of the river and their needs must be addressed.

Sponsored by both the U.S. Army Corps of Engineers and the State of Louisiana, the Mississippi River Hydrodynamic and Delta Management Study has begun to lay the groundwork for these changes. A physical

model as well as 1-, 2-, and 3-dimensional numeric models will be built as part of this study. Together, these models will help us learn where and how to build the most effective sediment diversions, how to approach constructing a channel realignment, and how not only to build wetlands but also to reduce dredging costs, increase the sustainability of the navigation channel, and increase flood protection for communities threatened by high rivers. The study will also synthesize current science and engineering so that we can better understand the river and its water and sediment resources. In particular, we expect that the study will provide the technical underpinning for implementing large scale sediment diversion and channel realignment projects here in Louisiana. We expect the 2017 Coastal Master Plan to contain valuable information from this effort.

## High River Events



It is imperative that we use the river water and sediment brought by high river events. The floods of 2008 and 2011 provided occasions to put significant amounts of these resources into the system for land building, and we must be prepared to take advantage of future opportunities. Our analysis indicates that more than one 250,000 cubic feet per second (cfs) sediment diversion would be beneficial to long term land building, especially in the face of higher sea level rise and subsidence. The draft plan recommends two 250,000 cfs sediment diversions in addition to multiple smaller diversions to take advantage of these occasional land building opportunities off the Mississippi River and an additional two diversions off the Atchafalaya River.

The state understands the need for additional information on the design, construction, and most importantly, operation, of these structures before

they can be constructed. These sediment diversions could not only build land during high river events, but also reduce flooding pressure on the Mississippi and Atchafalaya River levees. As we learn more about how to design and build sediment diversions through the Mississippi River Hydrodynamic and Delta Management Study, we can identify how best to customize our use of restoration options to take advantage of land building opportunities and potentially relieve flooding pressures within the system.

## Effects on Navigation

The master plan includes several large sediment diversion projects and a recommendation that channel realignment projects be further evaluated. We have included these projects in recognition of the need to take large scale action for our coast using the resources of the Mississippi River. Our project modeling shows that large scale sediment diversions and channel realignments have the greatest land building potential of all the individual restoration projects we considered. Because they are so effective, it is no longer a question of whether we will do these types of large scale diversion projects, but how we will do them.

At the same time, we understand that diverting water and sediment can affect navigation, and we want to ensure that the navigation industry continues to have safe, reliable, unimpeded waterways. The network of waterways in Louisiana's coast is as important to commerce as the interstate highway system, and the state and the nation will need for them to continue functioning as highly efficient trade arteries.

Sediment diversions can help not only support this functioning but enhance the competitiveness of the navigation industry in Louisiana. For example, the dredging of sediment to maintain waterways requires millions of dollars each year. Many believe that future environmental conditions significantly threaten the sustainability of the Lower Mississippi River navigation channel. Properly situated and operated diversions could both reduce dredging costs by removing sediment from the channel and build up the wetlands that protect navigation routes from storm surge damages. We expect these and other design features of large scale sediment diversions to be the focus of the Mississippi River Hydrodynamic and Delta Management Study.

## Addressing Hypoxia

The multi-state Mississippi River watershed is the third largest in the world, and it spans all or parts of 31 states and two Canadian provinces. Louisiana's position at the base of this watershed has created the abundant natural

resources found in south Louisiana's delta plain. However, when it reaches Louisiana, the Mississippi River also contains the runoff of 41% of the continental United States. Large amounts of nitrogen and phosphorus, which flow into the river from sources upstream, are channeled directly into the Gulf of Mexico. Once in gulf waters, these nutrients lower oxygen levels. This fosters a hypoxic zone off Louisiana's coast each summer that threatens Louisiana's coastal fisheries and water quality.

State agency staff participated in the writing of the "Gulf Hypoxia Action Plan 2008 for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin." This action plan stated that "… at least a 45% reduction in riverine total nitrogen load and in riverine total phosphorus load … may be necessary…" to reverse hypoxia in Louisiana's offshore waters. The Gulf Coast Ecosystem Task Force presented recommendations for reducing hypoxia as well. The nitrogen reductions we need can be achieved through a variety of actions, including improved agricultural management practices, municipal and industrial source reductions, and watershed and wetland restoration. Given the immense size of the Mississippi River watershed, the solution to the hypoxia problem cannot be limited to Louisiana.

Implementing the 2012 Coastal Master Plan will address this problem on several fronts. The draft plan recommends multiple sediment diversions that will divert the river's water into sediment and nutrient deprived wetlands. This will put nutrients where they are needed—in the wetlands—and reduce the amount of nutrients spilling into the gulf. The state is establishing a water quality credit program that assesses the effectiveness of wetlands to filter nutrients. The master plan also supports the Louisiana Department of Environmental Quality and the Louisiana Department of Agriculture and Forestry's efforts to implement the state's nutrient reduction strategy under the Gulf Hypoxia Action Plan. The master plan will be a key component of this ongoing strategy.

### U.S. Army Corps of Engineers (Corps) Section 7002 Comprehensive Plan

As part of the Water Resources Development Act of 2007, Congress directed the Corps to prepare a comprehensive plan and to integrate its work with Louisiana's own coastal planning efforts. However, Congress has not yet appropriated funds for the plan, and therefore the Corps has yet to begin work on this task. To prepare the way for the Corps's plan and at the Coastal Protection and Restoration Authority's request, Corps staff have been working directly with us as we developed the 2012 Coastal Master Plan. Corps representatives also serve on the master plan's Framework Development Team. We expect to maintain this close working

relationship as the 2012 Coastal Master Plan is finalized. The 2012 Coastal Master Plan will guide the Corps as it develops the 7002 Comprehensive Plan, and the state will work with policymakers to support appropriations necessary for the effort. Together, the state's master plan and the Corps's plan will serve as companion documents that guide federal investments.

## Transition Assistance

All coastal communities should have a bright and safe future, and we want to secure the longevity of traditional industries, such as shrimping and fishing. In terms of community protection, the master plan has recommended nonstructural protection for all coastal parishes, which includes raising and floodproofing homes, as well as voluntary acquisition (3% of the recommended nonstructural actions in the master plan). For other areas, the plan will recommend a combination of nonstructural, structural (levees and other built options), and wetland restoration options.

The purpose of this plan is to support the long term sustainability of south Louisiana so that our citizens have certainty about the future. The action we need requires changing the landscape, not just tweaking what we already have. As our Future Without Action analysis showed, the landscape and conditions we have now are not sustainable. In fact, as coastal residents well know, change is happening already. If we don't take large scale action, land loss and flooding will grow so severe that ours will be the last generation that benefits from Louisiana's working coast. We should also keep in mind that while some view large coastal restoration projects as having short term detrimental impacts, these projects also have positive and significant long term economic and ecosystem effects. By bolstering wetlands over time, these projects will ensure that the coast continues to support activities, such as fishing, that require healthy coastal habitats.

In some cases change creates dislocations small and large. Some of these dislocations are happening now as a result of our land loss crisis. We take these dislocations seriously and understand they represent real costs for real people.

Understanding that large scale projects may often be accompanied by long implementation timeframes, the state is committed to utilizing this period to help communities and user groups adapt to a changing coast in the following ways:

- Developing a planning framework to help communities, businesses and individuals adapt to anticipated changes in the landscape.
- Working with affected communities and stakeholders to design

projects that consider ways to minimize unavoidable impacts while still meeting project, and master plan objectives.

- Identifying public and private tools that may assist communities, businesses, and individuals in the transition process.
- Assessing possible impacts and consulting with those affected, as the projects identified in the master plan move through project planning and design phases.

### Landowners as Key Partners

Approximately 80% of the coast is privately owned, and the rights of these landowners, including mineral rights, must be acknowledged as coastal projects are designed, constructed and operated. As stated in the master plan principles, we also need to engage landowners to incorporate local knowledge about private coastal lands.

Landowner assistance will be essential in understanding the complexities of land ownership and stewardship of natural resources. There are many options for navigating these complexities in order to build projects on private land. These measures could range from acquisition and easements, to separating surface rights from mineral rights and allowing the landowner to retain the latter while the state obtains the former. The state's clear preference is to work in partnership with landowners to implement the projects required to sustain our coast. The state will be responsible for actively working with landowners, and providing guidance and feedback as projects are designed and implemented.

## Policy and Legal

Given the emergency facing coastal Louisiana, it is imperative that all government agencies, from federal to local, act quickly and in accord with the master plan. Revisions to some laws and regulations may be needed to help the state's coastal program achieve its goals.

### Gulf Coast Ecosystem Restoration Task Force

The Gulf Coast Ecosystem Restoration Task Force was created by President Obama on October 5, 2010 to spur the gulf region's long term recovery following the Deepwater Horizon Oil Spill. The task force issued a final report in early December 2011 that endorses the overall approach of Louisiana's 2012 Coastal Master Plan and seeks ways to support our state's efforts.

## Beneficial Use of Dredged Material

A great deal of sediment is dredged in south Louisiana, and much of it could be used to rebuild marshes. However, this sediment is usually dumped in upland disposal sites or in the Gulf of Mexico. Using dredged material to rebuild wetlands is a strategy whose widespread adoption is long overdue in Louisiana. In recognition of this fact, since 2009 the state has required private applicants who want to dredge more than 25,000 cubic yards of sediment to place the dredged material in a coastal restoration project or pay a fee.

However, the state's new regulations do not affect the Corps of Engineers when it dredges sediment in the coastal zone. Because it maintains national navigation channels, particularly along the Mississippi River, the Corps dredges more sediment than any other entity in Louisiana: 58 million cubic yards a year. Very little of this material is used to create new wetlands. The Corps contends that current authorizations and budgets do not allow them to undertake widespread beneficial use of dredged material. Funds from the federal Harbor Maintenance Trust Fund could be used to supplement the Corps budget for this purpose, and the state recommends that this and other options be fully explored.

Bringing in sediment from outside the system, by mining sediment from major rivers and navigation channels, is a fundamental principle of this plan. As the state implements the large scale marsh creation projects laid out in the draft plan, it is imperative that we use the sediment from Corps dredging activities.



## Deepwater Horizon Oil Spill

The effects of the Deepwater Horizon spill continue to be felt in Louisiana and will affect coastal planning. The traditional Natural Resource Damage Assessment (NRDA) process usually takes many years and is strictly governed by a team of state and federal agencies, called the trustees. Ideally, project concepts identified as critical by the master plan process will inform the trustees as they design projects to repair injuries caused by the spill. Louisiana may receive other sources of compensation, whether from fines assessed under the Clean Water Act or from payments issued by British Petroleum or other responsible parties to state agencies for costs incurred as a result of the spill. It is too early to tell how much of either source of funds will be directed to coastal protection or restoration projects.

The master plan will guide how funds from NRDA and other sources are used. Once the funds come in, we will determine which of our master plan projects most readily conform to the mandates of the funding source, and then fast track those projects for implementation.

In the coming year, five affected Gulf states and two federal agencies (NOAA and DOI) will share a $1 billion "down payment" to restore areas of the coast damaged by the Deepwater Horizon oil spill. Louisiana will receive $100 million of these funds outright, and we expect that another $300 to $400 million will be used to implement projects in Louisiana. This money will be used to build projects for the coast, using the master plan as guidance.

## Mitigation Policy

Many coastal communities are facing the reality of "restore or retreat." As a result, mitigation for wetland impacts as a result of development or other actions in sensitive coastal areas must meet not only the letter but the spirit of the law. The state's mitigation program must contribute to the comprehensive sustainability of the coastal wetlands and communities, rather than simply compensating for short-term impacts to wetlands. Clearly defined goals for a compensatory mitigation program must align with and complement the master plan.

Some of the recommendations that have evolved to handle this issue include:

- Developing new mitigation regulations that select the most effective and equitable means to accomplish mitigation goals.
- Working with the appropriate federal agencies and the mitigation banking community to locate banks that are consistent with the objectives of the master plan. Mitigation banks could be given

additional habitat credits for locations that are consistent with the master plan. The mitigation bank maintenance obligation could be reduced accordingly.

- Including in Louisiana's Mitigation Program a robust in-lieu fee program as an option. This would offer a flexible alternative for mitigation when responsible development takes place in the coastal zone.
- Ensuring mitigation credits can be applied to restoration projects highlighted in this plan.
- Monitoring the implementation of mitigation to ensure that the program is achieving the desired results. This may require revisions to laws, rules, and procedures.

## Congressional and Legislative Actions

The State will identify and monitor Congressional actions needed to streamline and expedite the implementation of the master plan with federal coordination. The state will also identify and monitor actions needed by the Louisiana Legislature to ensure that state regulations and policies are consistent with the master plan objectives and implementation.

As we implement the 2012 Coastal Master Plan, we must evaluate coastal regulatory programs and policies that could impact land loss rates to ensure that these programs support the objectives of the master plan. Sound resource management practices and policies must be implemented at the state and local levels so that coastal resources are used in ways that support our working coast and our protection and restoration efforts.

## Sound Management of Limited Resources in the Coastal Zone

The Louisiana Legislature should consider an updated inland boundary for the coastal zone based on findings and recommendations of the 2010 Coastal Protection and Restoration Authority document: "Defining Coastal Louisiana: A Science-based Evaluation of the Adequacy of the Inland Boundary of the Louisiana Coastal Zone."

## Consistency and Endorsement of Local Efforts

The 2012 Coastal Master Plan grows out of the state's responsibility to make wise investments for Louisiana's coast based on good science. In addition to guiding state action, the 2012 Coastal Master Plan will also help guide local and federal projects, as well as initiatives undertaken by

private organizations and Indian tribes. We will, therefore, encourage all of these entities to support the plan, with the understanding that leveraging all resources to implement master plan projects is the most efficient way to protect and restore the coast.

At the same time, many good projects that would benefit the coast are not in the master plan because of the projects' smaller scale, a lack of information about the projects, and so on. We recognize that local parish leaders and other groups may wish to use their funds for these or other projects of their own choosing. (e.g. The Plaquemines Parish Plan, the Iberia-Vemilion Parish Plan, and the Terrebonne Parish Plan.) We will endorse these projects, recognizing that state support will, in many cases, be essential if local initiatives are to secure federal and other funds. However, if a locally proposed project directly conflicts with the master plan, we will not support the effort. If for example, an entity wanted to impound and isolate an area that was a target for marsh creation in the master plan, we would have to address that conflict. We expect that the strong lines of communication we have with local leaders will reduce the need for such discussions.

### Operations and Maintenance Costs

We have considered risk reduction projects in the master plan with the assumption that local sponsors must take full responsibility for operation and maintenance costs for flood protection systems. These features will be built as systems and must be maintained as systems that span communities and individual parish resources.

## Programs

In addition to a robust mix of protection and restoration projects identified for implementation, the master plan identified programs that improve community resilience and conserve coastal forests, unique habitats, and intrinsically valuable landscapes.

### Coastal Forests

Our modeling indicates that many of Louisiana's cypress forests will be lost in the next 10 to 20 years unless we take action now. The iconic forests that are the symbol of our coast for people around the world are not just unique habitats and intrinsically valuable landscapes, they also help protect communities from storm surge flooding. The state's Coastal Forest Conservation Initiative aims to support these and other coastal forests by acquiring land rights (fee title or conservation servitude) from willing landowners. A secondary aspect of the program involves funding small scale projects that enhance the forests' sustainability. The program



has received $16 million from the Coastal Impact Assistance Program and has been extremely popular with coastal landowners. It recently received more applications for participation in the land rights program than it had funds to support. Citizen interest in this program reflects the willingness of coastal residents to explore innovative options for preserving our coastal resources. The 2012 Coastal Master Plan supports the ongoing investment in and management of this program.

## Nonstructural Program Development

Nonstructural measures include raising a building's elevation or flood proofing residential and nonresidential structures. We view these measures as key components of protecting communities, knowing that we cannot reduce flood risks purely by building levees. Nonstructural measures can, in some instances, provide results more quickly than can levees. In other cases, using nonstructural and structural approaches together can provide risk reduction most efficiently.

In addition to elevation, voluntary aquisition measures may be made available to residents as options in areas that will continue to have high flood risk levels even after actions recommended in the master plan are implemented. The master plan makes no recommendations for relocation of specific communities and acknowledges the need to support citizens facing change by handling disruptions with sensitivity and fairness.

**Nonstructural Measures in the Master Plan**

For the 2012 Coastal Master Plan, we evaluated nonstructural projects for each of the coastal parishes and communities. Our analysis identified areas where these measures could be useful and assets for which nonstructural measures would reduce risks. Chapter 2 describes how we structured this analysis.

As part of this work, we reviewed local hazard mitigation plans as well as other state and federal mitigation plans to see the types of measures that had been used in the past and how well they performed. We also gathered information on lessons learned through regional stakeholder meetings and discussions with parish governments, the Louisiana Office of Community Development, the U.S. Army Corps of Engineers, and others. Our Framework Development Team had a workgroup dedicated to reviewing the analysis of the nonstructural measures. The workgroup also offered suggestions to the state for supporting nonstructural measures at the program level. Appendix G provides more information about how nonstructural activities can support the coast.

Some of the recommendations that could be applied to nonstructural protection include:

- Increase coordination among the many state and parish agencies working on nonstructural issues in Louisiana. As in many states, Louisiana's nonstructural issues are managed by a variety of entities. No other state; however, has a nonstructural program that is as comprehensive or as large as the approach described in the 2012 Coastal Master Plan. In order to effectively implement a nonstructural program of this nature, and make this program easy for citizens and communities to use, there should be a single working group or entity to act as a clearinghouse and single point of contact.

- Consider amending regulatory requirements, as appropriate, to ensure that goals are met in four areas: 1) local land use planning, 2) building codes, 3) flood damage prevention ordinances, and 4) risk reduction project funding.

- Many groups are developing nonstructural projects, programs, and tools. Identify the needs of Louisiana residents and encourage the development of projects, programs and tools that meet these identified needs and gaps. In some instances, financial support with state funding may be appropriate to address an identified need or support parish level implementation.

- Train those responsible for the program's success and inform the public about the nonstructural options available to them.

**Land Use, Smart Growth, and Other Programmatic Nonstructural Measures**

Other examples of nonstructural measures include informing the public about the risk of living in a flood hazard area, enacting local ordinances that require appropriate risk reduction standards, and adopting land use plans that integrate floodplain management concepts. These programmatic measures are particularly important given the need for wise development in Louisiana's coastal zone, and our nonstructural program was developed with the assumption that these kinds of measures are important.

We do not want construction of new hurricane protection systems to encourage unwise development in high risk areas, as has occurred in the past. Such development increases overall levels of risk and diminishes the effectiveness of the protection structures themselves. This phenomenon is called "Induced Risk," and it runs counter to the master plan's objectives of sustaining coastal habitat and reducing the flooding risks borne by coastal communities. Similarly, wetland areas inside the hurricane protection system need to remain intact and undeveloped. The most state of the art hurricane protection system can actually increase the assets at risk if it encourages development in wetlands or areas near the levee footprint. Land use ordinances that contain nonstructural risk reduction measures can ensure that our coastal investments bring maximum benefits while providing for economic growth.



# Conclusion

## Responding to an Emergency

The coastal crisis we are experiencing in south Louisiana means there is no time to waste. People need solutions, and they need them now. Given this urgency, this plan's charge was clear: present specific, achievable actions that will protect households and businesses and reverse our state's catastrophic loss of land. The five master plan objectives set the bar high; the benefits of this plan had to be felt across a wide variety of people, communities, ecosystems, and economic sectors. From communities at risk, to habitats under threat, to business owners who are uncertain about the future, the range of needs in coastal Louisiana is huge, and the plan had to address that complexity.

The master plan cannot do it all; it does not promise to maintain current conditions, much less rebuild the coast of 100 or even 20 years ago. Nor can it endorse every project idea that has popular support. But the plan does something more crucial—it presents a new way to think about protecting and restoring our coast. Previous plans talked about useful strategies, but they did not explore the details of what we could do and what it would cost. Citizens were left wondering what the future would hold, even as gulf waters encroached more on their land every day.

The 2012 Coastal Master Plan provides the information citizens need as they seek to take care of their families, manage businesses, and plan for the future. Since 2007, the state has made unprecedented investments in our coast, and the plan builds on this momentum. The projects outlined in the plan strike a balance between providing immediate relief to hard hit areas and laying the groundwork for the large scale projects that are needed if we are to protect communities and sustain our landscape into the future. This approach reflects the need to build projects now while also investing in more conceptual efforts that must ultimately be part of the solution.


CAPT. TOBY

# A New Way Forward

This plan is something new for our state. It offers a path forward based on an unbiased examination of the best available scientific information, and it builds on Louisiana's recent success in accelerating the pace of coastal protection and restoration. In addition, the plan is designed to offer something that coastal residents have long been needing: more certainty about what to expect. Our assessments of the Future Without Action, coupled with the estimated future effects of the projects we have selected, offer coastal residents a preview of the improvements to flood protection they can expect and how the coast will change as we continue to bring projects on line.

Many parts of this document describe the technical analysis in depth, but this level of detail about engineering and environmental factors was intentional. We wanted readers to be able to follow and have confidence in the rigorous analysis we performed, an analysis that identified a path for creating a sustainable future for south Louisiana. Although our process may seem complicated, our purpose was simple: to protect Louisiana communities so they could rebound quickly from floods and provide an ecosystem that thrives over the long term.

A good plan is a blueprint for effective action, and financial realities are a big part of bringing a plan from concept to reality. For this reason, we considered the financial aspect at every stage of our process. Every proposed project has an estimated cost. We also identified an overall budget based on what the state can reasonably expect to receive in coming decades and evaluated projects with cost effectiveness in mind. This approach allowed us to describe how we would spend the dollars we have in hand, and how we would use new dollars that are allocated for Louisiana's coast. If new funding becomes available, the plan is designed to be scaled up quickly so that we can take maximum advantage of every opportunity.

# Committed to Our Coast



If we are to secure the future of south Louisiana, our state must speak with one voice about our commitment to the coast. The sooner we can come to agreement about the projects we want to build, the more quickly we can tackle the crisis that has gripped our coast for so long. Division, on the other hand, will perpetuate a disastrous status quo.

Our choice is simple: embrace a robust suite of solutions that address our crisis head on, or give up on the coast. If we do the former, our children and grandchildren will thank us. If we do the latter, our descendants will never know the bounty and beauty that we have been fortunate enough to enjoy.

For the next two months, this plan will be discussed in living rooms and town halls across the coast. The importance of this civic exploration goes far beyond that of a typical public comment period. The great amount of detail in this plan means that citizens have more information to consider. The unrelenting crisis outside our doors means that we must make decisions today. We hope that this plan will spur good discussion and even better choices. Our future and the future of Louisiana's coast depend on it.

# Next Steps

This plan builds on what has come before and sets the path for the future, but it is not the last word. We will continue to upgrade our tools and our understanding of coastal processes and how projects can work most effectively. Louisiana citizens will see this progress reflected in upcoming annual plans and in the next master plan we develop in 2017. We encourage citizens to stay in touch with us as we implement this new path to a sustainable Louisiana and plan for ever greater improvements. We can best tailor our recommendations to the needs of coastal communities if we hear from you.

**Check website for updates**
coastalmasterplan.la.gov

**Attend public meetings**
January 23 - 24 - 25

**Submit public comment**
Fill out form electronically at
coastalmasterplan.la.gov

**Write to us**
MasterPlan@la.gov

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**Stay informed**
Talk to your elected officials



The 2012 Coastal Master Plan was developed by an interdisciplinary team from the CPRA, academia, and the private sector, which was led by William "Kirk" Rhinehart.

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**Back Cover (left-right)**
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