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## 2017 Coastal Master Plan

# Attachment E1: Flood Risk and Resilience Program Policy Recommendations

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Prepared By: Coastal Protection and Restoration Authority

# Coastal Protection and Restoration Authority

This document was prepared in support of the 2017 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every five years) and annual plans. CPRA's mandate is to develop, implement and enforce a comprehensive coastal protection and restoration master plan.

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# 1.0 Flood Risk and Resilience Program Policy Recommendations

The Flood Risk and Resilience Program Framework document has outlined significant advancements to CPRA's Flood Risk and Resilience Program for the 2017 Coastal Master Plan. In addition to refining the methodology for the development of proposed nonstructural projects in the coastal area, it includes more detailed policies, procedures, and potential funding sources. While a major component of CPRA's Flood Risk and Resilience Program is to determine effective methods for nonstructural project prioritization and to streamline funding sources for the implementation of nonstructural projects, focusing on the mitigation of structures alone is not sufficient to meet the challenges of increasing flood risk and coastal climate adaptation. In addition to reducing flood risk through physical nonstructural projects, there are a wide range of policies and programmatic measures that can be undertaken to reduce flood risk to individuals and communities.

Building on past planning efforts, CPRA understands that effectively reducing storm surge flood risk through nonstructural efforts requires implementation of both physical and programmatic measures. Implementation of a coast wide nonstructural program will typically include a combination of one or more physical measures such as: 1) floodproofing of commercial properties, 2) elevation of residential properties, and 3) voluntary acquisition of residential properties. These measures are able to reduce flood risk to existing buildings and infrastructure. Programmatic measures such as land use planning, hazard mitigation planning, flood ordinances, and building codes can reduce risk to future development within communities, and therefore are integral elements of achieving risk reduction goals across coastal Louisiana. An effective, comprehensive nonstructural strategy will include these measures among a variety of others.

This attachment expands the 2012 Coastal Master Plan's broad recommendations to support nonstructural and resilience related policies in the overall Flood Risk and Resilience Program. These policy recommendations aim to further the progress and support and enhance the ongoing resiliency efforts made by the Governors' Office of Homeland Security and Emergency Preparedness (GOHSEP), Office of Community Development (OCD), and coastal parishes. The intent of this attachment is to describe key policy recommendations which can advance communities' collective ability to reduce flood risk through methods beyond the mitigation of individual structures. The recommendations are categorized into six sections and include:

1. Planning: Comprehensive, Multi-Jurisdictional, Land Use, and Recovery Plans
2. Hazard Mitigation Plans
3. Regulatory Tools: Local Ordinances, National Flood Insurance Program, and Coastal Zone Management Program
4. Infrastructure and Building Standards
5. Capital Improvement Plans and Incentives

Within each topic, various recommendations are specifically addressed to a relevant entity that may be best able to enact change including the Louisiana Legislature, other state agencies, parish/municipal governments, and academic/nonprofit groups. The aim is to provide a robust resource of information about the range of pertinent policies and opportunities for action, to frame the flood risk and resilience programmatic recommendations that most urgently need to be addressed, and to generate new ideas about the actionable steps that could be implemented to promote a more resilient coastal Louisiana.

The formulation of this attachment was based on extensive research synthesizing the recommendations of many local and national agencies whose work pertains to planning, hazard mitigation, flood risk reduction, design, and economic development. Policy sources include:

- **American Planning Association**- *Hazard Mitigation: Integrating Best Practices in to Planning; Sustaining Places: The Role of the Comprehensive Plan; Best Practices for Comprehensive Plans; Growing Smart Legislative Guidebook: Model Statutes for Planning and the Management of Change*
- **American Society of Engineers**- *Flood-Resistant Design and Construction Standard*
- **Center for Planning Excellence**- *View from the Coast; Best Practices Manual for Development in Coastal Louisiana; Coastal Louisiana Land Use Toolkit*
- **Georgetown Climate Center**- *Adaptation Tool Kit: Sea Level Rise and Coastal Land Use*
- **Federal Emergency Management Agency**- *Integrating Hazard Mitigation into Local Planning; Local Mitigation Planning Handbook; Mitigation Assessment Team Reports for Hurricane Katrina and Isaac; National Flood Insurance Program: Community Rating System; State Mitigation Plan Review Guide*
- **Florida Division of Emergency Management**- *Public Facilities Flood Hazard Mitigation Assessment Manual*
- **Intergovernmental Panel on Climate Change**- *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*
- **Louisiana Recovery Authority**- *Louisiana Speaks Regional Plan: Vision and Strategies for Recovery and Growth in South Louisiana*
- **Louisiana Sea Grant**- *Louisiana Coastal Hazard Mitigation Guidebook; Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations for the Future; Regulatory Best Practices to Make Louisiana Coastal Communities More Resistant to Natural Hazards; Is Sea Level Rise 'Foreseeable'? Does it Matter?*
- **Louisiana State University (LSU) Coastal Sustainability Studio**- *Louisiana Resiliency Assistance Program*
- **Mississippi-Alabama Sea Grant Legal Program**- *Resilient Coastal Development Through Land Use Planning: Tools and Management Techniques in the Gulf of Mexico*
- **National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center**- *What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure; Achieving Hazard-Resilient Coastal and Waterfront Smart Growth*
- **RESTORE the Mississippi River Delta**- *Achieving Resilience in Coastal Communities: Resources and Recommendations*
- **Texas Sea Grant**- *The Resilient Coast: Policy Frameworks for Adapting the Built Environment to Climate Change and Population Growth in Coastal Areas of the US Gulf of Mexico*
- **The Data Center**- *The Coastal Index: The Problem and Possibility of Our Coast*
- **University of North Carolina (UNC) Coastal Hazards Center**- *Impacts of Federal and State Hazard Mitigation Policies on Local Land Use Policy; Evaluating Local Hazard Mitigation Plan Quality; Do Planners Matter?*
- **University of New Orleans**- *Flood Mitigation Decision Tool for Target Repetitive Loss Properties in Jefferson Parish*
- **U.S. Army Corps of Engineers**- *Louisiana Coastal Protection and Restoration Final Technical Report: Nonstructural Plan Component Appendix*
- **Other city/state plans**- *Resilient New Orleans: Strategies to Shape Our Future City; A Region Responds to a Changing Climate: Southeast Florida Regional Climate Change Compact Counties. Regional Climate Action Plan; plaNYC: A Stronger, More Resilient New York*

# 2.0 Planning: Comprehensive, Multi-Jurisdictional, Land Use, and Recovery Plans

There exists a range of local planning tools and techniques available for promoting safer development and lowering flood risk as communities continue to grow. These various tools are useful at different scales from parish or municipal comprehensive plans, to more specific land use plans, to broader multi-jurisdictional plans that focus on achieving regional goals. All of these documents aim to assess a community's needs and articulate a community's ambitions, and then translate these into specific spatial designs, development or redevelopment strategies, and other processes or actions necessary to achieve community goals. As such, they can all be useful approaches for reducing communities' future flood risk.

These planning techniques are described in the specific context of coastal Louisiana, including an overview of what is being done, highlighting successes, and making suggestions for improvement. This attachment first discusses one of the most common types of plans in coastal Louisiana – comprehensive plans – which often include a holistic assessment of the challenges a community faces and provides a vision for the future. Next discussed are multi-jurisdictional plans, which focus on regional transportation and economic development strategies; land use plans, which spatially delineate different types of development and enable communities to resolve competing interests; and recovery plans, which enable the management of more thoughtful redevelopment after disaster events. Lastly, it is recognized that communities may not be certain what type of plan they should focus on pursuing or improving given limited budgetary resources. In order to provide a mechanism of obtaining greater insight and clarity to formulate next steps, a planning and capacity gap analysis is discussed.

## 2.1 Comprehensive Plans

Comprehensive plans, master plans, and general plans are similarly related initiatives that strive to assist communities with better addressing current challenges and planning for future needs. Addressing a wide range of issues, such planning documents guide communities' growth, encourage economic development, focus infrastructure investment, and organize the built environment in furtherance of community goals. These local planning efforts are often undertaken by parishes and/or cities and municipalities. In Louisiana, various parishes have framed local plans using a range of different terms including "comprehensive plan" or "comprehensive master plan" (i.e., Ascension, Assumption, Lafourche, Livingston, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Tammany, Tangipahoa, Terrebonne, and Vermilion Parishes), and to a lesser extent "master plan" (i.e., Orleans and Iberia Parishes). While there may be some ambiguity that results from the terminology used to describe parish and city planning efforts, there is general agreement that comprehensive and master plans are intended to provide a holistic vision for community development and a framework to resolve competing needs. In this document, these plans will be referred to collectively as comprehensive plans.

In addition to variation in terminology, there are a variety of approaches to define what constitutes or should be included within the scope of a comprehensive plan. Through legislative directives, states and local governments are at liberty to determine the governing body with authority to develop a comprehensive plan, define a comprehensive plan's scope and content, and establish processes for developing, implementing, and enforcing the plan. *Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations for the Future,* notes

that in a 2002 guidance the American Planning Association (APA) recommends that the following elements be included in a comprehensive plan:

REQUIRED ELEMENTS

- Issues and Opportunities
- Land Use
- Transportation
- Community Facilities
- Telecommunications
- Housing
- Economic Development
- Critical and Sensitive Areas
- Natural Hazards
- Program of Implementation

OPTIONAL ELEMENTS

- Agriculture, Forest, and Scenic Preservation
- Human Services
- Community Design
- Historic Preservation

These recommendations have been more recently expanded and revised in the APA's *Sustaining Places: Best Practices for Comprehensive Plans* (PAS Report 578) which "define[s] the role of comprehensive plans in addressing the sustainability of human settlements… [and] explore[s] the role of the comprehensive plan as the leading policy document and tool to help communities of all sizes achieve sustainable outcomes" (Godschalk & Rouse, 2015, p. 2). While comprehensive plans can be considered "top-down" policy documents that address land use and physical development, comprehensive planning should emphasize resilience, systems thinking, community engagement, equity, implementation, and adaptation in order to meet the challenges today's communities face.

The state of Louisiana ascribes parishes and municipal governing bodies the authority to develop a master plan through the institution of a planning commission in the *Louisiana Revised Statues, Title 33 Municipalities and Parishes, Part IV. Physical Development of Parishes and Municipalities*. While a master plan does not contain specific requirements, the statutory language advises a comprehensive approach to considering a community's current and future needs, and frames the plan's purpose around guiding a community's development in a range of areas including transportation, infrastructure, environment, health and safety, and economic development. The Louisiana statutes detail that a master plan should consider both the "present conditions and future growth" of the parish or municipality and adjacent areas. It should be noted that while a master plan serves as a guiding framework, it does *not* carry the force of law. Plans must then be implemented through zoning maps, ordinances, and other regulations that do carry binding legal mechanisms (to be discussed in subsequent sections).

Comprehensive plans are required of parishes and cities that have a planning commission; however, if a jurisdiction does not have a planning commission, they are not required to develop a comprehensive plan. Thus, not every coastal parish and community has developed a comprehensive plan or has an up-to-date plan. Table 1 lists the coastal Louisiana parishes, the status of their comprehensive plan, and information describing additional planning activities.

**Table 1: Parish Comprehensive Plans and Other Planning Efforts.**

| Parish | Comprehensive Plan | Other Planning and Implementation Tools |
|---|---|---|
| Acadia | None | *Acadia Parish: Coming Full Circle - The Road to Recovery* (2007), Flood Damage Prevention Ordinance and Drainage and Flood Control Ordinance |
| Ascension | *Plan Ascension-The Blueprint for Our Future* (2011) | *Zoning Map (2014), Unified Land Development Code* (2013), *Master Plan & Land Use Plan* (2009) |
| Assumption | *Assumption Parish Comprehensive Plan* (2008) | Land Development Regulations and Flood Damage Prevention Regulations |
| Calcasieu | None | *Calcasieu Parish Drainage Mission, Guiding Principles and Objectives* (2015), Zoning Ordinance and Map |
| Cameron | None | *Cameron Parish Redevelopment Plan* (2006), *Cameron Parish Long-Term Community Recovery & Gustav-Ike Recovery Proposal* (CDBG), Flood Damage Prevention Ordinance |
| Iberia | None | Subdivision Regulations (Updated 2007), Zoning Ordinance (2009) |
| Iberville | *Iberville Parish Community Master Plan* (2005) | Unified Development Code, Development & Land Use Regulations, Drainage and Flood Protection Ordinance, Subdivision Ordinance |
| Jefferson | *Implementing Envision Jefferson 2020: Mixed-Use and Smart Growth Alternatives* (2006) | Zoning Map for Unincorporated Areas, Comprehensive Zoning Ordinance, Flood Damage Prevention Ordinance |
| Jefferson Davis | None | Zoning and Flood Damage Prevention Ordinances |
| Lafourche | *The Lafourche Parish Comprehensive Resiliency Plan* (2014) | *Lafourche Parish Master Drainage Plan* (2012), Planning and Zoning, Land Development, and Flood Damage Prevention Ordinances |
| Livingston | *Envision Livingston Comprehensive Master Plan for Investing in Our Future* (2013) | *Livingston Parish Recovery Plan* (2008, currently in review for updating), Planning and Development and Flood Damage Prevention Ordinances |
| Orleans | *Plan for the 21st Century* (2010)[1] | *Greater New Orleans Urban Water Plan* (2013)[2], *Resilient New Orleans: Strategic Actions to Shape Our Future City* (2015), *Comprehensive Zoning Ordinance of the City of New Orleans* (2015) |
| Plaquemines | *Plaquemines Parish Comprehensive Master Plan* (2014) | *St. Bernard & Plaquemines Parishes Land Use and Transportation Vision Plan* (2008), *The Plaquemines Parish Government Long Term Community Recovery Plan* (2015), Drainage and Flood Control, Planning and Development, Subdivisions, and Zoning Ordinances |

| Parish | Comprehensive Plan | Other Planning and Implementation Tools |
|---|---|---|
| St. Bernard | *St. Bernard Parish Comprehensive Plan Draft – June 2014* (2014) | *St. Bernard & Plaquemines Parishes Land Use and Transportation Vision Plan* (2008), Flood Damage Prevention, Planning and Development, and Zoning Ordinances, Subdivision Regulations |
| St. Charles | *St. Charles Parish 2030 Comprehensive Plan* (2011)[3] | *St. Charles Parish Disaster Recovery Plan* (2015), Drainage and Flood Control, Planning and Development, Zoning, and Subdivision Ordinances |
| St. James | *St. James Parish Government Comprehensive Plan 2031* (2011) | Floods and Flood Damage Prevention Ordinances, Planning and Subdivision Ordinances |
| St. John the Baptist | *St. John the Baptist Parish Comprehensive Plan – One Parish, One Future* (2014) | *Community Recovery Strategy: One Parish, One Future: Building Back Better and Stronger* (2013), Land Use Report, and Land Development Regulations |
| St. Martin | None | Flood Damage Prevention, Planning and Development, and Zoning Ordinances |
| St. Mary | *St. Mary Parish Comprehensive Plan* (2002) | *St. Mary Parish Long Term Community Recovery Plan* (2007)*, St. Mary Unified Development Code* (2014) including Zoning Districts and Land Use, and Site Design and Development |
| St. Tammany | *New Directions 2025 – St. Tammany Parish Comprehensive Plan* (2003) | Unified Development Code (including Subdivision Ordinances), Zoning Map, Urban Growth Boundary |
| Tangipahoa | *Tangipahoa Parish Comprehensive Plan* (2008)[4] | *Tangipahoa Parish Long Term Recovery Plan* (2008), Flood Prevention and Protection Ordinances, Planning and Development Ordinances, and Subdivision Regulations (2015) |
| Terrebonne | *Terrebonne Parish Comprehensive Plan Update – Vision 2030* (2013)[5] | *TPCG Long Term Recovery Plan* (2007), *Terrebonne Parish Gustav/Ike Recovery Plan* (2009), Planning and Zoning Ordinances, Subdivision Regulations, Stormwater Drainage and Detention Design Manual in Code of Ordinances |
| Vermilion | *Our Plan – Vermilion Parish Comprehensive Resiliency Plan* (2014) | Vermilion Parish Flood Prevention and Protection Ordinance, Vermilion Parish Subdivision Ordinance |
| Note: Past winners of the Louisiana Chapter of the American Planning Association's "Outstanding Plan" awards: [1] Orleans- Large Jurisdiction Plan (2011); [2] Orleans- Excellence Award for a Plan (2014); [3] St. Charles- Excellence Award for a Plan (2012); [4] Tangipahoa- Parish Plan (2011); [5] Terrebonne- Excellence Award for Implementation | | |

While many parishes in coastal Louisiana have recently created comprehensive plans, several have not yet done so. The consistent development and implementation of comprehensive plans in all parishes is a challenge as they require an investment of resources, personnel, and funding. A parish or municipality must engage someone to develop the initial plan, approve and adopt

the plan, enforce the requirements of the plan, and revise the plan over the course of time. Effective plans also require support from citizens.

Additionally, there are no state standards mandating the content of comprehensive plans or formal recommendations that comprehensive plans should include elements that address land loss, flood risk, natural hazards, or post-disaster recovery. The Louisiana statutes only offer general guidance framing the purpose of such a plan. As noted above, many parishes have developed excellent documents. For instance New Orleans' *Plan for the 21st Century: New Orleans 2030* won the national APA's "Planning Achievement Award for a Hard-Won Victory" (City of New Orleans, 2010). However, despite such achievements, there is considerable variability among the scope and content of many parish plans. Augmenting existing state requirements and utilizing the APA's recommended standards or local best practices for the development and implementation of comprehensive plans is a key step to make communities safer from future flood risk. This will enhance the strength and consistency of local planning, as well as support consistency with the state's 2017 Coastal Master Plan.

## 2.2 Multi-Jurisdictional Plans

In addition to the planning activities that take place at the parish and municipal level, jurisdictions may join together to address regional issues that cut across localities and require a broader collaborative scope. This often occurs through a Metropolitan Planning Organization (MPO) or a Regional Planning Commission (RPC). An MPO is a federally mandated and federally funded transportation policy-making organization required for urbanized areas with a population greater than 50,000. Regional planning commissions are a collection of local governments that carry out activities as determined by their members. It is common practice, and the case in Louisiana, that members and the function of an MPO and RPC are integrated into the same commission. As a result of the 2010 U.S. Census, Louisiana has designated nine MPOs, five of which are located in the coastal zone including the New Orleans Metropolitan Regional Planning Commission (NORPC), Capital Region Planning Commission (CRPC), South Central Planning and Development Commission (SCPDC), Lafayette Metropolitan Planning Area, and the Imperial Calcasieu Regional Planning and Development Commission (Table 2).

**Table 2: Louisiana Coastal Zone MPOs.**

| Regional Planning Commission/Metropolitan Planning Organization | Coastal Parishes Included | Planning Document |
|---|---|---|
| New Orleans Metropolitan Regional Planning Commission (NORPC) | Orleans, Jefferson, Plaquemines, St Bernard, St Tammany | MTP for the New Orleans Urbanized Area FY 2015–2044, MTP FY 2015 – 2044 for the St. Tammany urbanized area, MTP for the Tangipahoa Urbanized Area Fiscal Years 2014–2043, St. Bernard & Plaquemines Parishes: Land Use & Transportation Vision Plan |
| Capital Region Planning Commission (CRPC) | Tangipahoa, Livingston, Ascension, Iberville (and others) | Baton Rouge Metropolitan Transportation Plan 2037, CRPC 2014 Comprehensive Economic Development Strategy |

| Regional Planning Commission/Metropolitan Planning Organization | Coastal Parishes Included | Planning Document |
|---|---|---|
| South Central Planning and Development Commission (SCPDC) | Terrebonne, Lafourche, St Charles, St John, St James, Assumption | Comprehensive Economic Development Strategy (2014), Coordinated Human Services Transportation Plan, DRAFT Lafourche Parish Transit Feasibility Study (2015) |
| Lafayette Metropolitan Planning Area | Vermilion, Iberia, St. Mary, St Martin, Lafayette, Acadia, (and others) | 2040 Transportation Plan, 2035 Bikeway Plan, 2040 Financially Constrained Thoroughfare Plan, 2040 Freight Plan, 2035 Pedestrian Plan, 2035 Safety Plan, 2035 Transit Plan, Complete Streets Policy, Congestion Management Process, Metropolitan Thoroughfare Plan |
| Imperial Calcasieu Regional Planning and Development Commission (IMCAL) | Cameron, Calcasieu, Jefferson Davis (and others) | 2040 Metropolitan Transportation Plan, 2015 Southwest Louisiana Comprehensive Economic Development Strategy |

The multi-jurisdictional plans undertaken by MPOs/RPCs can focus on sectors with regional impacts such as transportation, housing, growth management, environmental review, waste management, as well as regional climate change and adaptation planning. State governments can harness these planning entities and charge them with specific responsibilities such as with emergency management or mitigation activities. For instance, California mandates planning commissions address climate change. In Louisiana, various MPOs/RPCs have dealt tangentially with flood risk reduction and resilience issues; NORPC has been active in working with USACE in flood control planning and SCPDC has a division that addresses building code enforcement. However, due to their multi-jurisdictional orientation and broader ability to impact future development and infrastructure, Louisiana RPCs could have a more central and vital role to play in long range planning for climate change adaptation and increased flood resilience. The state should harness these entities' wide ranging influence and mandate that MPOs and RPCs incorporate climate change into the regional transportation planning and coordinate ongoing planning activities with CPRA's 2017 Coastal Master Plan.

## 2.3 Land Use Plans

Land use planning determines where and how people should develop and redevelop land. Effective land use plans can direct development away from high hazard areas and can help to preserve the natural functions of floodplains and other critical areas. Land use planning is an essential ingredient in reducing flood risk to future building inventory. Researchers from the UNC Department of City and Regional Planning lament land use planning's unfulfilled potential noting, "[l]and use policies hold the greatest long-term risk reduction potential, but are under-utilized" (Lyles et al., 2014).

In terms of planning for future growth, a particularly challenging issue facing many communities in coastal Louisiana is induced development. Induced development occurs when the construction of structural risk reduction projects (e.g., levees) unintentionally encourages development in flood hazard areas as these projects can provide a false sense of protection. If the residual flood risk associated with structural projects is not considered in land use planning, development may gravitate to areas behind levees rather than in areas that are less hazardous to build. Limiting induced development during the planning, design, and implementation of

structural protection projects can be accomplished by implementing a land use plan, creating stricter development standards for areas protected by levees, or maintaining pre-structural project flood damage prevention standards.

*Resilient Coastal Development through Land Use Planning: Tools and Management Techniques in the Gulf of Mexico* describes the many practical benefits to communities including "improved storm readiness.... In addition to a more resilient community, coastal communities may also reap the benefit of very tangible outcomes like a higher Community Rating System score for flood insurance or a third party certification that allows the city to easily promote its accomplishments" (Pace, 2013, p.13).

## 2.4 Recovery Plans

Recovery planning offers an opportunity to incorporate hazard mitigation strategies into the recovery process after a disaster. Because disaster recovery is often a stressful and reactionary response, there can be missed opportunities to rebuild in a way that promotes a community's goals. Having a post-disaster recovery plan before an event occurs allows for both a faster and more efficient recovery, but also provides opportunities to rebuild better than before.

There are several good precedents of post-disaster recovery plans for various jurisdictions in the Gulf Coast. For instance, the Florida Post-Disaster Recovery Planning effort requires that all coastal counties and municipalities develop a disaster recovery plan. As part of this initiative, the Florida Division of Community Planning and the Division of Emergency Management developed a post-disaster recovery guidebook (Post-Disaster Redevelopment Planning: A Guide for Florida Communities, 2010). This guidebook notes there are several new "opportunities" afforded during post-disaster recovery, including:

- Disaster-resilient land use patterns
- Hazard mitigation construction techniques
- Energy-efficient buildings
- Healthy community design
- Affordable or workforce housing
- Alternative transportation networks
- Environmental preservation and habitat restoration
- Sustainable industry recruitment

Because it offers many long-term benefits, recovery planning should be incorporated into parish and community comprehensive plans and/or hazard mitigation plans. Rebuilding restrictions can be used where local governments want to limit reconstruction, or higher design standards can require substantially improved structures (new construction) be built in a more resilient manner.

## 2.5 Gap Analysis

As noted above, there are a variety of planning tools and techniques available to parishes and municipalities to further flood risk reduction and hazard mitigation goals, each with a particular focus and scope. While comprehensive, multi-jurisdictional, land use, and recovery plans are all important as they can address different scales of planning and development, the most important factor is that these tools are developed to meet communities' local needs, and plans are then implemented to create on the ground impacts. Furthermore, it is critical that these efforts are integrated with one another, as well as with other types of planning activities including Hazard Mitigation Plans (Section 3.0) and Capital Improvement Plans (Section 6.0).

Depending on its unique needs and capabilities, parishes or municipalities will need to take different steps to embark upon or augment existing planning efforts. In order to prioritize limited funding and staff resources, communities should consider conducting a comprehensive risk, capability, and planning gap analysis. This gap analysis can clarify needs and help to prioritize the most urgent challenges that should be addressed, and will help communities develop new programs, or modify and unify existing planning processes and programs. For example, a comprehensive risk and vulnerability assessment could provide the framework and foundation upon which most other plans can base their actions. This risk and vulnerability assessment should take into account the projections of land loss and flood risk developed for the 2017 Coastal Master Plan. All plans the community must complete can be tied to resiliency and future viability and should be based on a unified vision toward the future in order to be implemented most effectively.

As all parishes, and many communities, have already developed a hazard mitigation plan (discussed in the next section), it may be helpful to leverage the risk assessment process conducted within an existing hazard mitigation plan. Rather than adding another layer of plan formulation to already stretched local governments, it may be more effective for communities to tie many of their ongoing planning efforts together through such a comprehensive risk and vulnerability assessment developed through the hazard mitigation planning process.

## 2.6 Planning Recommendations

CPRA recommends several measures to enhance comprehensive, multi-jurisdictional, land use, and recovery plans.

***State Legislature*:**

- Amend the Louisiana Revised Statutes to require parishes and municipalities to develop a comprehensive plan whether or not they have adopted a planning commission.

- Amend the Louisiana Revised Statutes to require that a comprehensive plan include elements that address land loss, flood risk, post-disaster recovery, and/or natural hazards. Statutory language should more closely reflect the APA's recommendations that a comprehensive plan include:

    - Land Use
    - Transportation
    - Critical Infrastructure and Community Facilities
    - Housing
    - Economic Development
    - Natural Hazards and Disaster Recovery
    - Environmental and Water Management
    - Coastal Management and Conservation
    - Program Implementation

***State Agencies*:**

- Recommend that future planning grants administered by state agencies such as GOHSEP and OCD require parishes and/or municipalities to have adopted a post-2005 land use plan. Such land use plans should contain a section specifically addressing flood risk reduction measures that are consistent with the 2017 Coastal Master Plan.

***MPOs/RPCs:***

- Incorporate future climate and landscape change in regional planning activities to guide infrastructure investment and development out of areas with high flood risk and areas where risk will increase in the future.
    - Consider future environmental conditions including sea level rise, subsidence, land loss, and flood risk, and their potential impacts on communities through economic damages or other costs.
    - Utilize the 2017 Coastal Master Plan as a guide to establish a systematic and comprehensive approach to future coast wide projections.

***Parish and Municipal Governments*:**

- Adopt or improve comprehensive plans that incorporate a holistic scope of elements based on recent APA guidance including land use, natural hazards, post-disaster recovery, and land loss and/or flood risk. Plans should be forward-thinking and address:
    - Transportation, critical infrastructure, community facilities, housing, economic development, environmental/water management, and coastal management/conservation goals.
    - Future environmental conditions, including sea level rise, subsidence land loss, and flood risk, and their potential impacts on communities through economic damages or other costs.

- Integrate or coordinate comprehensive plans with other local hazard mitigation plans and/or post-disaster recovery plans.

- Coordinate comprehensive plans with all parish budgetary and planning activities including land use plans, economic development plans, transportation plans, water management plans, and recreation plans, etc.

- Develop or revise existing land use plans to shift development out of areas with high flood risk and areas where risk will increase in the future. Parish and municipal land use plans should:
    - Guide public investment into already developed areas through infill, recovery, and new development which are supported by existing infrastructure and services.
    - Prohibit development in wetlands or other environmentally sensitive areas.

- Quantify the costs of unwise development.
    - Include information about projected future conditions, including sea level rise, subsidence, land loss, and flood risk when conducting cost benefit/cost-effectiveness analysis in all parish government activities. The 2017 Coastal Master Plan should serve as a guide for establishing a systematic and comprehensive approach for future coast wide projections.
    - Account for potential economic impacts of this coastal change in future cost/revenue analyses, including impacts on operation and maintenance costs, property tax revenues, or other costs.

- Develop post-disaster recovery plans as part of a comprehensive plan and/or hazard mitigation plan to set a course of action for where and how to rebuild after a disaster.

***Academic/NGO Groups*:**

- Create state wide standards and best practices for comprehensive plans that recommend all future development consider climate change impacts including projected rates of sea level rise, subsidence, land loss, and flood risk. The results of the 2017 Coastal Master Plan should serve as guidance for establishing a systematic and comprehensive approach to these future coast wide projections.

- Conduct a coast wide assessment of comprehensive plan implementation in order to better determine how planning efforts are making on the ground impacts and to understand implementation challenges.

- Conduct coast wide planning capacity assessments to better understand the available resources, including technical assistance and existing funding streams that can further municipal, parish, and regional planning efforts. Develop recommendations and/or proposals to fill capacity gaps at local or state levels.

# 3.0 Hazard Mitigation Plans

Hazard mitigation plans are multi-disciplinary risk reduction plans required by the Federal Emergency Management Agency (FEMA) for states and parishes to receive mitigation grants. These local mitigation plans form the foundation for communities' comprehensive and long-term strategies to reduce disaster losses. They also create a framework for risk-based decision making to protect health and safety, reduce damage to property, and minimize disruptions to the economy and governmental operations from future disasters.

## 3.1 State Hazard Mitigation Plan

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (1998, amended 2013) provides FEMA with the statutory authority over disaster response activities and mandates that state, local, and tribal governments develop hazard mitigation plans as a prerequisite to receive federal disaster assistance. State and local plans are required to describe the actions needed to mitigate the hazards identified and establish an implementation strategy. The Disaster Mitigation Act of 2000 (DMA) updated the Stafford Act to promote a more proactive and comprehensive process rather than the initial reactive, disaster-driven approach. DMA also set forth new requirements that emphasize coordination of hazard mitigation planning and implementation activities across state and local levels of government.

Various state and local hazard mitigation plans are currently in place throughout Louisiana. At the state level, GOHSEP produces the State Hazard Mitigation Plan (SHMP). SHMP analyzes a range of climatological, geological, and human-influenced hazards, and assesses the relative risk they pose at the parish level based on past events. Hazards incorporated in the SHMP include: coastal erosion, dam failure, drought, earthquake, extreme heat, flooding, levee failure, saltwater intrusion, sea level rise, sinkholes, storm surge, subsidence, thunderstorms (hail, high wind, and lighting), tornadoes, tropical cyclones, wildfires, and winter weather. These hazards are typically evaluated for their probability of occurrence, as well as their impact in terms of damage to property, injuries, fatalities, and loss of state assets. Future impacts of hazards are often considered through annualized loss estimates based on historic data.

An important update to the most current SHMP (2014) is the recognition of climate change and its incorporation into hazard descriptions and the risk assessment process. The plan states, "In determining future likelihood, recent trends in global climate change information must also be taken into account. Temperature and precipitation averages always fluctuate with time, but in recent years both have tended to increase…. This upward trend is expected to continue, and will have significant impacts on weather related hazards in Louisiana…. As such, climate change amplification is a new addition to this Plan Update, and it will be incorporated in the profiles and risk assessments" (GOHSEP, 2014, p. 2-16).

SHMP makes much progress in highlighting climate change and its impact on hurricane events. The document does not pursue additional analysis of how these future events could change based on a changing climate, and instead, future impacts are framed in terms of annualized loss information based on past events occurring from 1987-2012. Therefore, it still remains challenging for coastal parishes or local officials to infer how flood risk may change in the future due to increased hurricane and storm surge events. However, the discussion of climate change and future coastal conditions is more extensive in the land loss profile which includes projections of future land loss and economic damages in various coastal Louisiana parishes due to global sea level rise and subsidence over the next 10 years (2014-2024). The rates of sea level rise and subsidence utilized to determine GOHSEP's projections are aligned with those utilized in CPRA's 2012 Coastal Master Plan.

This demonstrates that while initial steps have been taken to better coordinate coastal change and climate science across Louisiana state agencies, there is more work to be done to encourage incorporation of climate change into long range planning. In addition to sea level rise and subsidence data, CPRA also uses current literature and data to estimate changes in future precipitation and evapotranspiration, which could also be included in the state hazard mitigation plan hazard assessment analysis. It should also be noted that recent updates to FEMA's requirements for state hazard mitigation plans now mandate consideration of climate change. The *State Mitigation Plan Review Guide* (released in March 2015 and effective as of March 2016) asks state plans to "provide an overview of the probabilities of future hazard events," and requires that the "[p]robability must include considerations of changing future conditions, including the effects of long-term changes in weather patterns and climate on the identified hazards" (FEMA, 2015c, p.14). Thus, the need for more coordination of climate change related data between state agencies, and the robust analysis of such data is of increasing importance. Such coordination and data sharing about potential future land loss and flood risk will provide a comprehensive and consistent hazard mitigation framework across state agencies.

In addition to assessing the potential impact of hazards on Louisiana parishes, SHMP also provides a framework for reducing risk. As part of the requirements set forth in the Code of Federal Regulations on Emergency Management and Assistance – Hazard Mitigation (44 CFR 201.4(c)(4)(iii)), state hazard mitigation plans ***should*** include prioritization criteria for communities to receive planning and/or project grants that consider:

- Highest risk
- Repetitive loss properties
- Most intense development pressures
- Maximization of project cost benefit analysis (for non-planning grants)

GOHSEP utilizes these funding prioritization recommendations to varying degrees. First, SHMP notes that the agency "does not have [a] formal system established to evaluate and prioritize potential mitigation projects on basis of risk, [but plans] to introduce such criteria to the process" (GOHSEP, 2014, p. 4-42). However, in general, communities are assessed at the parish level for

both risk and project effectiveness. Secondly, GOHSEP follows the Flood Mitigation Assistance (FMA) grant program requirements that funds are to be directed to repetitive loss properties, and, while there exists no such formal requirements for the Hazard Mitigation Grant Program (HMGP) or the Pre-Disaster Mitigation Competitive Grant Program, the state "presently considers the repetitive loss status of properties in determining which grants it will support" (GOHSEP, 2014, p. 4-42). Third, GOHSEP does not currently include future development pressure in its grant evaluation process but it does intend to consider this factor in the future. Lastly, a cost benefit analysis is a key factor in determining the allocation of funds; however, it is utilized in slightly different ways depending on the grant program involved.

These evolving funding prioritization methods suggest that ongoing dialogue and coordination between GOHSEP and CPRA is critical to enact a comprehensive coast wide nonstructural program. Ideally, funding resources can be pooled in a coordinated manner that promotes coast wide risk reduction priorities instead of piecemeal, project-by-project allocations. Such coordination will enhance large-scale nonstructural project implementation and assure that various funding sources are allocated in a strategic and efficient manner as to not duplicate efforts and to make the most progress towards comprehensive risk reduction goals.

## 3.2 Local Hazard Mitigation Plans

In addition to state level planning, hazard mitigation planning occurs and often has the most impact at the local level. Currently, all coastal Louisiana parishes have FEMA approved hazard mitigation plans, as well as plans for 14 communities, 9 universities, 5 special districts, and 1 Native American community. GOHSEP reviews and assesses local parishes' hazard mitigation plans to better coordinate state and local efforts. The most recent SHMP found that while certain types of hazards were consistently identified, there was great variation in hazard definitions, risk assessment data, risk assessment methodologies, and economic loss estimates (GOHSEP, 2014). For instance, all coastal parishes identified tropical cyclones; however, very few identified climate change as a local hazard. (See Table 3 below.)

**Table 3: Coastal Hazards Included in Parish Hazard Mitigation Plans.**

| Parish | Coastal Erosion | Flooding | Tropical Cyclones | Levee Failure | Saltwater Intrusion | Sea Level Rise | Storm Surge | Subsidence |
|---|---|---|---|---|---|---|---|---|
| Acadia | | X | X | | | | | X |
| Ascension | | X | X | X | | | X | |
| Assumption | | X | X | X | | X | X | X |
| Calcasieu | | X | X | | | | | |
| Cameron | X | X | X | | | | X | X |
| Iberia | X | X | X | X | | | X | |
| Iberville | | X | X | X | | | | |
| Jefferson | X | X | X | | | | X | X |
| Jefferson Davis | X | X | X | X | | | X | |
| Lafourche | X | | X | X | | | | X |
| Livingston | | X | X | | | | X | |

| Parish | Coastal Erosion | Flooding | Tropical Cyclones | Levee Failure | Saltwater Intrusion | Sea Level Rise | Storm Surge | Subsidence |
|---|---|---|---|---|---|---|---|---|
| Orleans | X | X | X | X | | X | X | X |
| Plaquemines | X | X | X | X | X | | X | |
| St. Bernard | | X | X | X | X | | X | X |
| St. Charles | X | X | X | X | X | | | X |
| St. James | | X | X | X | | | X | X |
| St. John the Baptist | | X | X | X | | | | X |
| St. Martin | | X | X | X | | | | |
| St. Mary | X | X | X | X | | | X | |
| St. Tammany | | X | X | X | | | | X |
| Tangipahoa | | X | X | | X | | | X |
| Terrebonne | | X | X | X | X | | X | X |
| Vermilion | X | X | X | X | | | X | |

Note: The table above is adapted from GOHSEP's 2014 State Hazard Mitigation Plan.

Local hazard mitigation plans are quite variable due to the wide range in capacity of local governments including available staff, funding, data, and other resources. GOHSEP notes that "some communities have a full range of implementation tools, while others have none" (GOHSEP, 2014, p. 4-36). SHMP also describes that due to this lack of capacity, "most" communities are not actively managing their plans and plans are not integrated into other ongoing community planning and administrative efforts.

To take steps to better coordinate the development of local parish hazard mitigation plans and to align these with SHMP, GOHSEP has committed to continuing to provide funding and technical assistance for parish plan updates. All 64 parish plans will be due for an update between 2014 and 2017, and the agency is preparing for a three year effort that "will produce updated plans in a framework that facilitates future updates and provides a degree of uniformity across jurisdictions" (GOHSEP, 2014, p. 4-41). This framework includes creating greater consistency between data sources, data processing steps, and other activities. As part of this effort, GOHSEP has the opportunity to encourage consideration of climate change in all local hazard mitigation plans, and to encourage the consistent adoption of CPRA's coast wide estimates of future land loss, sea level rise, flood risk, and other climate change projections determined through the 2017 Coastal Master Plan development process. This would allow for increased coordination and consistency between state and local hazard mitigation planning efforts.

Lastly, local hazard mitigation plans have been critiqued as being somewhat generic, standardized documents whose aim is limited to procuring federal disaster funding. Evaluations of local mitigation plans have found that they are "of mediocre quality in general" (Lyles et al., 2014). To enhance the value and usefulness of hazard mitigation planning, GOHSEP should consider incentivizing improved plan quality and provide further guidance and recommendations to enhance plan quality. Several best practices or "principles of plan quality"

as applied to the hazard mitigation process are outlined in *Evaluation of Local Hazard Mitigation Plan Quality* (2012), which serves as a helpful framework.

## 3.3 Integrating Hazard Mitigation Plans with Other Planning Efforts

In addition to the importance of addressing hazard mitigation, climate change, and nonstructural project implementation through the development of state and parish hazard mitigation plans, it is also crucial that the goals and objectives of these plans are developed in coordination with communities' broader vision and planning processes. As noted earlier, it is the comprehensive plan or land use plan rather than the hazard mitigation plan that sets the framework for guiding regulatory policies. In order to have a broader impact than just procuring FEMA grant funding, a hazard mitigation plan must be connected to or directly incorporated into the comprehensive plan, land use plan, or other related activities.

APA has developed model state requirements and best practices for incorporating a hazard mitigation element in a comprehensive plan in the *Growing Smart Legislative Guidebook* (Meck, 2002). This guidebook notes that in comparison to post-disaster recovery, "[s]triving to prevent unnecessary damage from natural disasters through proactive planning that characterizes the hazard, assesses the community's vulnerability, and designs appropriate land use policies and building code requirements is a more effective and fiscally sound approach to achieving public safety goals related to natural hazards" (Meck, 2002, p. 7-143). Integrating a comprehensive plan with a hazard mitigation plan is an important step towards furthering a community's risk reduction goals and objectives. More broadly, the hazard mitigation plan should be integrated with the emergency management plans, continuity of operations plans, transportation plans, CDBG action plans, local neighborhood plans, long-term recovery plans, and more. Doing so is complex and poses challenges as the process may entail modifying agency mandates or streamlining bureaucratic processes; however, integrating these functions greatly increases effective implementation of hazard mitigation activities. FEMA's *Integrating Hazard Mitigation into Local Planning* (2013) outlines a wider range of opportunities to align planning and hazard mitigation activities. In addition to comprehensive plans, these include zoning ordinances and municipal codes, building codes, subdivision regulations, capital improvement plans, functional plans, area plans, site review, economic development strategies, transfer of development rights, and other options (FEMA, 2013b).

Some Louisiana parishes have already taken steps towards integrating a natural hazards element in their local comprehensive plan. For example, New Orleans's *Plan for the 21st Century: New Orleans 2030* contains an entire chapter dedicated to "Resilience and Living with Water and Natural Hazards," which sets forth the goal of "a holistic community standard of resilience from flooding and other natural hazards" (City of New Orleans, 2010, p. 12.1). Likewise, *Vision 2030: Terrebonne's Plan for Its Future*, includes a chapter on "Environmental Issues and Hazard Mitigation," which notes that "…the Parish wants to make sure that sustainability and resiliency are introduced into the comprehensive planning process so that an integrated approach to hazard loss reduction considers all possible aspects of the issue" (Houma-Terrebonne Regional Planning Commission, 2013, p. 7-10). *The Vermilion Parish Comprehensive Resiliency Plan* recognizes that improving flood protection was the "most important resiliency consideration" identified through their community outreach process and thus the plan addresses coastal erosion, saltwater intrusion, and flooding (Vermilion Parish Police Jury, 2014). There are many opportunities, and a diverse array of approaches, for parishes and municipalities to integrate hazard mitigation into land use planning activities.

## 3.4 Hazard Mitigation Plans Recommendations

Below are CPRA's recommendations for enhancing mitigation plans to better advance risk reduction objectives and to prepare for future changes in flood risk:

***GOHSEP*:**

- Further the SHMP's efforts to incorporate the impacts of climate change by:
    - Address future hazards due to a changing climate and coastal landscape including sea level rise, subsidence, land loss, and flood risk when formulating hazard profiles.
    - Utilize, to the best extent possible, the projections of sea level rise, subsidence, land loss, and flood risk developed in support of the 2017 Coastal Master Plan to create a unified and state wide approach to hazard identification and mitigation.

- Enhance coordination of mitigation planning and nonstructural project implementation across state agencies including CPRA and OCD. Consider how best to coordinate various funding sources in a strategic and efficient manner as to not duplicate efforts and to make the most progress towards comprehensive risk reduction goals.

- Offer incentives to improve local hazard mitigation plan quality and utilize recommended best practices to evaluate hazard mitigation plan quality.

***Parish and Municipal Governments*:**

- Improve the quality and integration/linking of parish hazard mitigation plans with other state and parish level planning processes including the 2017 Coastal Master Plan, parish comprehensive plans, emergency management plans, transportation plans, CDBG action plans, land use plans, and zoning processes. Often hazard mitigation plans are not utilized or incorporated into general community planning and development processes except during disaster recovery efforts.
    - Integrate the hazard mitigation plan in the comprehensive plan by mapping out and clearly labeling hazard areas in a parish comprehensive plan.
    - Include an approved post-disaster recovery plan or set of prioritized actions in the comprehensive plan before a disaster event occurs.
- Participate in mutual aid emergency response programs, such as the Emergency Assistance Management Compact (EMAC)/ Intrastate Mutual Aid Compact (IMAC), to help communities and residents recover more quickly post-disaster.

***Academic/NGO Groups*:**

- Develop Louisiana specific best practices for better integration of hazard mitigation plans with other planning processes including the 2017 Coastal Master Plan, parish comprehensive plans, emergency management plans, transportation plans, CDBG action plans, land use plans, and zoning processes.

- Conduct an assessment of hazard mitigation plan quality and implementation effectiveness in order to better determine how hazard mitigation plans are making on the ground impacts and to understand implementation challenges.

# 4.0 Regulatory Tools: Local Ordinances, National Flood Insurance Program (NFIP), and Coastal Zone Management Program (CZMP)

Ordinances and regulations are tools used by local governments to codify actions in their jurisdictions and to create an orderly process for making and implementing important public policy decisions. As noted above, a comprehensive plan or land use plan provides a broad vision for a community's goals; however, such a document serves more as a guide rather than a set of specific laws. These plans must then be implemented through various ordinances and regulations which do carry the force of the law in order to catalyze meaningful action. There exist many types of regulatory strategies that aim to reduce flood risk and increase community resilience, a few of which are discussed below. First discussed are the regulatory tools that are used to implement comprehensive or land use plans that can assist in reducing flood risk; then, broader regulatory frameworks to reduce flood risk are outlined including the National Flood Insurance Program (NFIP) and the Coastal Zone Management Program (CZMP).

## 4.1 Parish and Municipal Ordinances and Regulations

Zoning, subdivision regulations, unified development codes, and other regulations are key tools that can help communities reduce their flood risk. These types of statutory rules are the conduits through which plans and policies are implemented and achieve on the ground results. The APA's *Hazard Mitigation: Integrating Best Practices into Planning* (Schwab, 2010, p. 48) notes that "integrating hazards into planning implementation tools has three primary goals:

- Keeping future development out of known hazard areas.
- Keeping hazards from affecting existing developed areas.
- Strengthening existing development to resist hazards."

**Zoning ordinances** are regulatory tools that shape community growth by specifying the type of development permitted or prohibited in spatially explicit districts. Zoning is a common method used to shape community development and such ordinances can be formulated to, for example, encourage development in low risk areas, mandate elevating homes in high risk areas, or implement stormwater management best practices.

Zoning to reduce flood risk can occur in a variety of ways including through floodplain management boundaries established by FEMA's Flood Insurance Rate Maps (FIRMs) and regulations associated with NFIP or Community Rating Systems (CRS), as well as the CZMP, both of which will be discussed in more detail below. In addition, flood zoning can incorporate use/nonconforming-use regulations, overlay districts, setbacks, transfer of development rights (TDR), and other strategies.

Many cities and towns in Louisiana are implementing creative zoning strategies to reduce flood risk in their local jurisdiction. A few examples are discussed below:

- **Lake Charles-** has employed floodplain management regulations that restrict uses dangerous to health and safety in times of flood; control filling, grading, dredging, and other development that may increase flood damage; regulate flood barriers that will unnaturally divert flood waters or that may increase flood hazards to other lands; and

require that structures must be elevated to the base flood elevation (BFE) (GOHSEP, 2014).

- **Terrebonne Parish-** currently has no land use regulations outside of urbanized areas; however, the parish recommends implementing broader flood protection measures in the parish's updated comprehensive plan. The plan states that it "should be possible to incorporate a floodplain overlay district applicable to those unregulated areas of the parish also falling in the 100-year floodplain" (Houma-Terrebonne Regional Planning Commission, 2013, p. 7-13). In addition, over the course of 2013-2014, the parish has taken steps towards introducing 10 new floodplain ordinances that include:
    - Requiring that sellers share the flood history of the property with buyers.
    - Prohibiting landfills and hazardous waste in the flood zone.
    - Requiring that new developments within floodplains provide storage for floodwaters.
    - Constructing new buildings higher than the BFE for lower insurance rates and to account for future changes to the coastline.
    - Prohibiting construction in the Special Flood Hazard Area (SFHA).
    - Requiring that new buildings be constructed to withstand 100-year storms.

  (The above proposals are described by the Terrebonne Parish Consolidated Government's flyer for public meetings posted on the TPCG's website on June 21, 2013.) Although introduced, none of the ordinances have yet been approved, which indicates the many challenges local governments face in trying to better protect their constituents from flood risk.

- **Mandeville-** created drainage overlay districts that require proposed buildings, structures, and parking areas are to be located outside of any areas that experience periodic flooding to the greatest extent possible. Natural drainage ways must be maintained and cannot be culverted (GOHSEP, 2014).

- **New Orleans-** released a draft Comprehensive Zoning Ordinance in September 2014 (City of New Orleans, 2015). The ordinances include development standards for several types of "Open Space" districts including "Neighborhood," "Greenway," and "Regional" open space districts, as well as "Natural Areas" and "General Planned Development" (formerly "Environmentally Sensitive") districts. These districts restrict residential density, require 60% of the site be used for active/passive recreation, encourage the cluster development of buildings, protect wildlife habitat, and outline stormwater "best management practices," among other things (GOHSEP, 2014).

More information on local zoning and ordinance case studies can be found at the Louisiana Resiliency Assistance Program website (resiliency.lsu.edu/planning/). In addition to these case studies, the *Coastal Land Use Toolkit* (2012) from the Center for Planning Excellence also provides locally adapted model development and recovery standards. The toolkit includes an Implementation Handbook, Zoning Code, Subdivision Code, and Additional Ordinances that can help communities establish regulatory frameworks that reduce flood risk and promote sustainable development (www.cpex.org/coastal-land-use-toolkit).

In addition to local regulatory activities, recent federal policy recommendations also encourage higher flood ordinances and standards. In January of 2015, President Obama issued Executive Order 13690 which proposed a new "Federal Flood Risk Management Standard." The goal of the policy is to lessen the impacts of climate change and to increase the resilience of communities. Federal agencies are afforded flexibility in determining how to implement the recommended standards which include:

- Utilizing data and methods informed by best available, actionable climate science that integrates current and future changes in flooding;
- Building two feet above the 100-year (1% annual chance) BFE for most standard projects and three feet above BFE for critical buildings such as hospitals and evacuation centers; or
- Building to the 500-year (0.2% annual chance) flood elevation.

Moreover, the executive order directs federal agencies to use, where possible, natural systems, ecosystem processes, and nature-based approaches when developing design alternatives for consideration. This executive order applies to all federal agencies and associated grants, and thus it is important to align state and local activities with OE 13690 in order to promote best practices and qualify for federal funding opportunities.

### 4.1.1 Parish and Municipal Ordinances and Regulations Recommendations

Local flood ordinances are critical to incorporating flood risk reduction in a parish's or municipality's development decisions. Below are CPRA's recommendations for incorporating flood risk reduction principles into local regulations, policies, and ordinances:

***Parish and Municipal Governments*:**

- Adopt higher freeboard requirements such as FEMA FIRM BFE +2 for standard projects and BFE +3 for critical infrastructure, or building to the 500-year flood elevation as recommended by federal policy. Elevation requirements may also be based on future flood depths and recommended elevations by the 2017 Coastal Master Plan.

- Implement more stringent zoning codes, subdivision ordinances, or other flood ordinances that include hazard mitigation or flood risk reduction elements, such as those found in the *Coastal Land Use Toolkit*, to promote higher risk reduction standards in areas subject to increased flood risk.

***Academic/NGO Groups:***

- Develop new or promote existing model coastal or hazard mitigation zoning codes, subdivision ordinances, or other flood ordinances that include hazard mitigation or flood risk reduction elements to protect current and future community development and recovery.

## 4.2 National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) was created in 1968 with the passage of the National Flood Insurance Act and aimed to reduce the impact of flood damages on communities through increased access to affordable flood insurance in exchange for community adoption of floodplain management standards and regulations. When a municipality or parish enrolls in NFIP, flood insurance becomes available to almost all residents and businesses, whether owner or renter, regardless of the location of their structure with respect to the floodplain. Flood insurance is required for homes and businesses with federally backed mortgages that are built in a FEMA defined SFHA. These requirements are not applicable to homes without a mortgage, homes without a federally backed mortgage, or homes built outside of the floodplain.

The intent of NFIP is to reduce the burden of disaster recovery on taxpayers by promoting responsible development in flood prone areas and, while there is ongoing debate about

whether it achieves this goal, the program has greatly influenced the expansion of city growth across Louisiana and the nation as a whole. This increased development of floodplains has led to increased flood risk and disaster recovery claims. Since 1978, NFIP has paid more than $51 billion in claims (as of June 30, 2015), which includes an average of $3.5 billion/year paid in flood insurance claims from 2005-2014 (FEMA, 2015a). Hurricane Katrina (2005) spurred the most significant payout in the program's history with $16.3 billion paid to 167,000 policy holders (FEMA, 2015e). Due to catastrophic events such as Katrina, the program also faces significant financial and management difficulties and has been listed as "high risk" by the U.S. Government Accountability Office since 2006 (GAO, 2011). As a result, through the Biggert-Waters Flood Insurance Reform Act of 2012, the program has undergone a process of reforms to improve its financial stability and organization management. The Biggert-Waters Act reforms are intended to allow flood insurance premiums to better reflect the actual risk of living in a floodplain, which has caused concern for many policyholders in coastal communities across Louisiana.

In order to provide communities with opportunities to reduce flood insurance costs in exchange for additional flood risk reduction actions and more stringent ordinances, NFIP also encourages participation in CRS. Communities that enroll in CRS receive additional reductions in flood insurance premiums for implementing activities supporting four main goals: 1) increasing access to information about flood risk and risk reduction options, 2) improving floodplain mapping and regulatory standards, 3) promoting flood damage reduction activities, and 4) promoting flood preparedness plans (FEMA, 2013d). Examples of actions that earn the largest reductions in premiums can be found in FEMA's *NFIP Community Rating System: A Local Official's Guide to Saving Lives, Preventing Property Damage, and Reducing the Cost of Flood Insurance* and include:

1) **Acquisition and relocation**- acquire and/or relocate flood prone buildings so that they are out of the floodplain.
2) **Flood protection**- protect existing floodplain development by floodproofing, elevation, or minor structural projects.
3) **Higher regulatory standards**- require freeboard, compensatory storage, or coastal construction standards in AE Zones; zone floodplain for one acre minimum sized lots; tailor regulations to protect areas subject to special flood hazards (such as subsidence or coastal erosion).
4) **Providing additional flood data**- develop new flood elevations, floodway delineations, wave heights, or other regulatory flood hazard data for an area not mapped in detail by the flood insurance study; have a more restrictive mapping standard.
5) **Levee safety**- maintain existing levees, not otherwise credited in the flood insurance rating system, that provide some flood protection.
6) **Open space preservation**- guarantee that currently vacant floodplain parcels will be kept free from development.

In Louisiana, the Department of Transportation and Development (DOTD) is the state agency responsible for coordinating the implementation of NFIP and CRS. Currently, all parishes in coastal Louisiana participate in NFIP, which translates into over 472,000 policies and almost $114 billion dollars of flood insurance in force for 2013 (FEMA, 2015d). In addition, many parishes and municipalities also participate in CRS. Jefferson and Terrebonne are the top ranked parishes in Louisiana and both have earned a CRS rating of six that results in a 20% flood insurance discount and has saved policy holders $15.2 million and $1.2 million, respectively, in 2013. New Orleans/Orleans Parish ranked slightly lower; however, CRS savings still amounted to $7.3 million in 2013, which demonstrates the significant cost benefits of the CRS program (GOHSEP, 2014). See Table 4 for more details.

**Table 4: Coastal Louisiana Participation in NFIP's CRS Program.**

| Coastal Community | CRS Score | % Discount (SFHA) | 2013 Savings (CRS Discount) |
|---|---|---|---|
| **Parish** | | | |
| Ascension Parish | 8 | 10% | $394,815 |
| Calcasieu Parish | 8 | 10% | $284,412 |
| Jefferson Parish | 6 | 20% | $15,219,849 |
| Lafourche Parish | 10 | 0% | $0 |
| Livingston Parish | 9 | 5% | $294,944 |
| Orleans Parish | 8 | 10% | $7,373,615 |
| St. Charles Parish | 8 | 10% | $586,047 |
| St. James Parish | 7 | 15% | $12,315 |
| St. John the Baptist Parish | 8 | 10% | $306,504 |
| St. Tammany Parish | 7 | 15% | $1,886,145 |
| Tangipahoa Parish | 9 | 5% | $67,740 |
| Terrebonne Parish | 6 | 20% | $1,201,325 |
| **Municipality** | | | |
| Covington | 10 | 0% | $0 |
| French Settlement | 9 | 5% | $4,723 |
| Gretna | 8 | 10% | $251,185 |
| Harahan | 8 | 10% | $82,866 |
| Houma | 7 | 15% | $194,277 |
| Kenner | 7 | 15% | $2,429,879 |
| Lake Charles | 8 | 10% | $185,275 |
| Lutcher | 9 | 5% | $125 |
| Mandeville | 7 | 15% | $256,196 |
| Morgan City | 8 | 10% | $118,707 |
| New Orleans | 8 | 10% | $7,373,615 |
| Port Vincent | 10 | 0% | $0 |
| Slidell | 7 | 15% | $976,259 |
| Sorrento | 9 | 5% | $8,120 |
| Westwego | 8 | 10% | $51,881 |

While flood damage prevention ordinances that meet or exceed the minimum standards of NFIP are currently in place in all coastal parishes, not all communities have updated Digital Flood Insurance Rate Maps (DFIRMs) with final effective BFEs. As parishes adopt the latest DFIRMs and BFEs, new work will be required periodically to assure that the latest land elevations, benchmarks, storm surge modeling, and other relevant information about Louisiana's dynamic coast are incorporated. One program that is working to do this is the FEMA Levee Analysis and

Mapping Procedures (LAMP). LAMP is a first attempt at an approach to address the risk reduction benefits of levees that do not meet the standards for protection against a 100-year flood. Accurate FIRMs are critical to proper floodplain management. CPRA will continue to monitor and participate in FEMA LAMP to ensure levees and coastal features are considered when evaluating the parish's risk.

### 4.2.1 NFIP Recommendations

Below are CPRA's recommendations for improving and expanding insurance coverage to better advance risk reduction objectives and to increase flood damage prevention:

***DOTD*:**

- Work to improve access to resources or other technical support to help facilitate local participation in CRS. Such technical support could include resource sharing, coordination of mapping/data collection efforts, etc. Collaborate with CPRA to determine joint initiatives that could promote access to data or other activities or resources that would assist communities in participating in CRS.

***Department of Insurance:***

- Consider expanding opportunities for insurance coverage beyond NFIP by including private or community-based insurance options.

***Parish and Municipal Governments*:**

- Join or expand NFIP CRS to lower flood risk and reduce the cost of flood insurance. Parishes should pursue additional activities and regulatory measures to improve their CRS score and further reduce flood insurance premiums. Communities should adopt higher regulatory standards such as increased freeboard, additional levels of protection for structures behind levees, or cumulative substantial damage tracking requirements.

***Academic/NGO Groups:***

- Continue to monitor the implementation of changes to NFIP including the 2012 Biggert-Waters Act and the Grimm-Waters-Richmond Act and continue to advocate for responsible implementation of program reforms and policy updates.

## 4.3 Coastal Zone Management Program (CZMP)

The Office of Coastal Management (OCM) within the Louisiana Department of Natural Resources (DNR) is charged with implementing the Louisiana Coastal Resources Program (CRP). The Coastal Zone Management Program (CZMP) was established under the authority of the Louisiana State and Local Coastal Resources Management Act of 1978, as amended (Act 361, La. R.S. 49:214.21 et seq). CZMP attempts to "balance conservation and resources, ... resolve user conflicts, encourage coastal zone recreational values, and determine the future course of coastal development and conservation" (DNR, 2015, p. II-2).

In order to achieve these goals, OCM manages resources and regulates development in the coastal zone though the Coastal Use Permit (CUP) Program to prevent damaging effects on coastal waters. A CUP is generally required for projects that include (but are not limited to): dredging and filling; levee siting, construction, operation and maintenance; hurricane and flood protection facilities; urban developments; energy development activities; mining activities; shoreline modification; recreational developments; and industrial developments. Activities that are generally exempt from a CUP include: agricultural, forestry, and aquaculture; activities in

areas that have consistently had these activities in the past; maintenance and repair of existing structures; construction of a residence or camp; and construction and modification of navigation aids. In addition, activities that are located on lands five feet or more above sea level or in "fastlands" (areas enclosed by levees) are also generally exempt from the regulations (DNR, 2015). Any public, private, or commercial projects within the coastal zone must apply for authorization prior to construction if that project is not exempt.

In addition to the state program, the Local Coastal Management Program (LCMP) provides parishes with an increased level of local control over activities and uses that would typically be regarded as uses of local concern, but that would fall to state oversight if there is no local coastal management program in place. DNR cannot require parishes to develop LCMPs; however, the agency provides technical assistance and reviews local plans' new regulations and ordinances. Currently there are 20 parishes which are either fully or partially within the Louisiana coastal zone boundary and half of these parishes (10) have approved LCMPs including: Calcasieu, Cameron, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. James, St. Tammany and Terrebonne Parishes. In addition, St. John the Baptist and St. Charles Parishes are working towards developing LCMPs.

In the aftermath of Hurricanes Katrina and Rita, there have been calls for increased review of projects built in the coastal zone through the DNR CUP process. For instance, the Louisiana Recovery Authority's (LRA) *Louisiana Speaks Regional Plan* recommendations include: "Use the existing CZMP of the DNR, along with additional or expanded programs as necessary, to thoroughly review and screen projects proposed in coastal areas. Such review would have the power to deny permits or require appropriate mitigation. State auditing of approved local CZMPs should be tightened to ensure consistency with regional and state objectives" (LRA, 2007, p. 61). The Center for Planning Excellence (CPEX) more recently notes that CRP should "assert [a] proactive regulatory role… [and seek] extension of [its] programmatic… and geographic purview" (CPEX, 2015, p. 59). For instance, CRP should be extended to "…cover uses of land at above five feet of elevation if [r]elative sea level rise is predicted to place that land below five feet within 50-years, or [t]hat land has direct impacts on properties falling within the coastal zone, in terms of drainage and/or storm protection" (CPEX, 2015, p. 59).

While CUPs typically pertain to projects that have "direct and significant impacts on coastal waters," the *Coastal User's Guide to the Louisiana Coastal Resources Program* also refers directly to minimizing the risk due to flood and storm hazards. The guide states, "Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines: …elevation, soil, and water conditions and *flood and storm hazard characteristics of site*…. It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable significant: …increases in the *potential for flood, hurricane and other storm damage, or increases in the likelihood that damage will occur from such hazards* [emphasis added]" (DNR, 2015, p. 7-8).

In terms of potential flood risk reduction activities, DNR regulates "uses of concern" including urban developments (such as the siting, construction, or operation of residential, commercial, industrial, governmental structures, and transportation facilities), recreational developments, and shoreline modifications (among other elements) in the coastal zone. Such activities could reasonably benefit from elevation requirements, flood hazard overlay zoning, or land use restrictions. However, as mentioned above, there are significant exemptions for uses occurring on lands five feet above mean sea level or on "fastlands." Depending on how these exempt areas are delineated, ongoing land loss and subsidence may put structures and infrastructure at

increased flood risk in the future. Statutory reforms – removing or modifying such exemptions – may be necessary to better utilize the CUP process to reduce communities' flood risk.

### 4.3.1 CZMP Recommendations

Below are CPRA's recommendations for enhancing CZMP/CUP to better advance risk reduction objectives and to prepare for future changes in flood risk:

***State Legislature*:**

- Modify or expand the statutes allowing DNR the sufficient authority through the CZMP/CUP process to ensure future development is properly sited and designed.
    - Enable the CUP review process to incorporate single-family homes.
    - Enable the CUP review process to consider including structures that may be defined as "fastlands" in the present day, but are predicted to be below five feet above sea level over the next 50 years.
        - Incorporate future 2017 Coastal Master Plan projections of land loss in the CUP evaluation process including subsidence and sea level rise.
    - The CUP review process should also include areas newly encircled by levee infrastructure.

***Louisiana Department of Natural Resources, Office of Coastal Management*:**

- Utilize existing regulatory tools and frameworks to enforce coastal zone management regulations.
    - The CUP review process should include all subdivisions, even if parcels are developed individually.
    - The CUP review process should utilize to the best extent possible the projections of sea level rise, subsidence, land loss, and flood risk developed in support of the 2017 Coastal Master Plan to create a unified and state wide approach to hazard identification and mitigation.

# 5.0 Infrastructure and Building Standards

The siting of critical infrastructure, which is a vital component of a parish or community's physical organizational structure and functioning, is a significant decision that can affect an area's future resilience. Because infrastructural systems weave communities together through both physical assets and services provided, they are especially critical components to consider in hazard mitigation and resilience planning. Protecting infrastructure from flooding and investing in new infrastructure in areas of lower risk are two important strategies to make communities more resilient to land loss and climate change. Similarly, building codes and standards are key tools that also shape the fabric of the built environment and provide opportunities for communities to become more resilient to flood risk. Building codes serve as a regulatory framework adopted by a parish or municipality that is then enacted at the individual structure scale. Ensuring that adopted building codes sufficiently support flood risk reduction goals and that they are consistently and uniformly enforced are important elements for successful implementation.

## 5.1 Resilient Infrastructure Investments

Investments in infrastructure are important tools that communities can use to promote growth and development while also minimizing the impact of flood risk and promoting community

resilience. Since Hurricane Katrina in 2005, there have been renewed calls to reduce coastal flood risk by consolidating development in less flood prone areas and to approach public infrastructure investments more strategically in order to avoid unnecessary expansion of facilities and support services. LRA's *Louisiana Speaks Regional Plan* set forth a regional investment strategy and recommends, "[A]dopting by legislative action or executive order, a requirement that all deliberate efforts be made to locate new state buildings and infrastructure investments within the urbanized area of existing cities and towns. Within already-developed areas, development sites in city and neighborhood centers and small-town downtowns should be given priority for public investments wherever possible and appropriate" (LRA, 2007, p. 40). More recently, FEMA's Hurricane Isaac Mitigation Assessment Team calls for siting infrastructure (e.g., electrical substations, pump stations, and cellular towers) outside of the 500-year floodplain where possible; where this is not possible, these facilities should be elevated above the 500-year elevation (FEMA, 2013a).

Many communities in Louisiana have pursued responsible public investment in infrastructure and have included this as a key element as part of a comprehensive plan.

- **Vermilion Parish-** As part of its land use strategies, the parish recommends that "[p]ublic investments within these [critical and sensitive areas such as floodplains] should only maintain or mitigate existing infrastructure (i.e., new public infrastructure should not be located within these areas) or be used to construct infrastructure intended to protect the human settlement areas. When possible and funding is available, public infrastructure should be removed from these areas when that can be done without risk to lives and property" (Vermilion Parish Police Jury, 2014, p. 115).

- **Terrebonne Parish-** The Terrebonne Parish Comprehensive Plan Update: Vision 2030 includes policy recommendations for decision makers and calls for "integrat[ing] land use and infrastructure investment policies to avoid expanding or extending new infrastructure when existing infrastructure could be more efficiently utilized" (Houma-Terrebonne Regional Planning Commission, 2013, p. 8-1).

- **Lafourche Parish-** The Lafourche Parish Comprehensive Resiliency Plan notes key development principles which include "Coordinating new development with water management infrastructure by… strategically investing in infrastructure that guides desired growth" (Lafourche Parish, 2014, p. 83).

- **New Orleans-** As part of its land use and zoning strategy, the parish recommends "avoid[ing] new development where it would require creation of new infrastructure" (City of New Orleans, 2010, p.14-6).

In addition to strategically investing in key infrastructural systems to promote prudent growth and development, increasing the resilience of existing infrastructural systems is also of critical importance. Improvements to infrastructure should not only include mitigating current flood risk, but also incorporate design standards that allow for greater resilience and adaptation to climate change and future flood risk.

## 5.2 Building Codes

Building codes are another critical strategy for reducing flood risk and improving community resilience to climate change. As the Insurance Institute for Business and Home Safety (IIBHS) notes, "the goal of resilience is to take actions today in order to reduce losses tomorrow. Because building codes set the baseline for structures that are intended to last for decades,

they are an important means of improving resilience" (IIBHS, 2015, p. 5). Strong building codes can have significant impacts. For example, a study conducted by the Louisiana State University Hurricane Center (2006) found that stronger building codes could have reduced storm damage from Hurricane Katrina in Mississippi by $3.1 billion, saving nearly 40,000 buildings from significant damage or destruction; in addition, these higher standards could have reduced wind damage by 80% and saved $8 billion (Build Strong America, 2015). Additionally, FEMA's Hurricane Katrina Mitigation Assessment Team further highlights the importance of building codes and elevation standards and found that the "elevation of a building was the most critical factor in its success at withstanding the storm surge" (FEMA, 2006, p. iii). Over the last several years, Louisiana has been working to update and improve its building codes and, importantly, the enforcement of building codes.

In 2005, the state of Louisiana enacted Act 12 of the First Extraordinary Session to create the Louisiana State Uniform Construction Code (LSUCC), which establishes minimum standards for new construction and reconstruction (La. R.S. 40:1720.21-1730.40). The Louisiana State Uniform Construction Code Council (LSUCCC) was created to determine if amendments to the state uniform code are justified, to review and adopt changes to the code as appropriate, and to provide training, education and certification to local code enforcement officers, inspectors, third party providers and building officials. LSUCCC updated the state's uniform construction code, which is based on the International Code Series (I-Codes), by adopting the most recent (2012) editions with certain deletions and amendments (see LSUCC "Codes and Standards" for most recent codes and amendments in effect). I-Codes include the International Building Code (IBC), International Existing Building Code, International Residential Code (IRC), International Mechanical Code, and International Fuel Gas Code. All local jurisdictions are required to enforce LSUCC, and local amendments are not permitted. LSUCC also provides that parishes and municipalities may adopt additional requirements to qualify for NFIP or establish higher standards in accordance with local floodplain management regulations.

According to IIBHS, Louisiana ranks 8th out of 18 states along the Gulf and Atlantic coasts for its strength of residential building code systems (IIBHS, 2015). However, IIBHS laments that "Louisiana took a step backward in 2013, with the approval of an Emergency Declaration by the State Code Council, which adopted the 2012 editions of the IRC design wind speed maps without the new trigger for following high-wind design requirements. By adopting the new design wind speed maps without the maps delineating high-wind design or windborne debris regions, the state created a deficiency in protecting residential dwellings in areas subject to high winds" (IIBHS, 2015, p. 11-12).

Momentum for higher standards promoting flood risk reduction continues to build and there has been an increased movement nationwide towards requiring the siting and design of infrastructure, buildings, and critical facilities to reduce risk. The 2015 Federal Executive Order 13960 recommends that federal buildings and federally funded projects locate buildings and critical facilities two and three feet, respectively, above the 100-year or 1% annual chance BFE or outside of the 500-year or 0.2% annual chance floodplain.

The latest edition of the American Society of Civil Engineer's *Flood-Resistant Design and Construction Standard* (ASCE 24-14) sets forth important standards to decrease buildings' vulnerability to flood risk. ASCE-24 provides minimum requirements for the siting, design, and construction of buildings in flood hazard areas subject to building code requirements. These standards apply to a wide range of building types including commercial, residential, industrial, educational, healthcare, critical facilities, and others. ASCE-24 is a referenced standard in the I-Codes, and buildings and structures within the scope of IBC and proposed to be located in any flood hazard area must be designed in accordance with it. Additionally, FEMA requires that

Hazard Mitigation Assistance (HMA) applicants and subapplicants design and construct all projects located in the flood hazard areas in conformance with ASCE/SEI 24-14, or latest edition, as a minimum standard, or the Applicant's equivalent minimum design standard. ASCE-24-14 flood standards are defined according to a structure's Flood Design Class which is based on building type, occupancy, and location in FIRM flood zone. For instance, single-family residential and small commercial structures are Class 2 and must be elevated to the BFE +1 foot or Local Design Flood Elevation (DFE) (whichever is higher); Class 4 structures such as hospitals, emergency shelters, critical facilities, etc. must be elevated to the BFE +2 feet, local DFE, or 500-year flood elevation (whichever is higher).

In addition to having robust building codes it is also important to enforce the codes with uniformity and regularity. After Hurricane Katrina, GOHSEP obtained $10.5 million in federal hazard mitigation grant funds to develop better local capacity to enforce building codes. The resulting program, administered by the Department of Public Safety and LSUCCC, offers training, education, technical support, and direct funding for regional code offices working in a number of parishes (FEMA, 2013a). Such activities are a model for other jurisdictions and state and local agencies need to continue to build capacity to enforce local building codes across the coast.

It is recommended that LSUCCC and local parishes continue to adopt updated standards and, based on the potential for increasing risk, consider new higher ordinances or regulations above the minimum requirements. The LSUCCC and local parishes must maintain minimum disaster related provisions of the adopted model code, including freeboard provisions for the most current versions of the International Building Code and International Residential Code when updating the building code. Adopting higher regulatory standards such as increased freeboard, additional levels of protection for structures behind levees, or cumulative substantial damage tracking requirements must be strongly considered.

### 5.2.1 Infrastructure and Building Standards Recommendations

Below are CPRA's recommendations to stakeholders for incorporating flood risk reduction principles into the enhancement of infrastructure and building standards:

***DOTD*:**

- Integrate transportation modeling and planning with parish land use planning to align state and local infrastructure investments.
    - Incorporate projected future environmental conditions and climate change including sea level rise, subsidence, land loss, flood risk, and their potential impacts on communities in DOTD's transportation modeling and planning process when evaluating the cost benefit of infrastructure projects.
    - Utilize, to the best extent possible, the projections of sea level rise, subsidence, land loss, and flood risk developed in support of the 2017 Coastal Master Plan to create a unified and state wide approach to hazard identification and mitigation.

***DOTD and Department of Public Service*:**

- Consider climate change impacts in the planning, design, and cost of infrastructure improvement projects (including roadways, water, wastewater, and utility systems).
    - Incorporate projected future environmental conditions and climate change including sea level rise, subsidence, land loss, and increasing flood risk when conducting cost benefit/cost-effectiveness analysis including impacts on operating and maintenance costs in all DOTD activities.

  - Consider measures to make infrastructure more resilient to flood risk including installing generators at all critical facilities and elevating roads with a history of flooding where possible.

***Uniform Construction Code Council*:**

- Increase resilience of building stock by updating building standards for high risk structures in the floodplain and continuing to provide resources for local implementation and enforcement of LSUCC standards.
  - Create a state wide standard process for building code enforcement.
  - Update building code standards to promote flood damage reduction by adopting ASCE-24-14 into the 2015 IRC.
  - Prevent the weakening of the code by deleting the statewide freeboard requirement.
  - Update building code standards to promote storm damage reduction including high-wind design requirements in the 2012 IRC.
  - Maintain minimum disaster related provisions of the adopted model code and adopt higher regulatory standards such as increased freeboard, additional levels of protection for structures behind levees, or cumulative substantial damage tracking requirements.

***Parish and Municipal Governments:***

- Increase resilience of building stock by strengthening building standards for high risk structures in the floodplain in accordance with ASCE-24-14, and increase enforcement of these standards.
- Require more stringent development standards for new construction that require a Flood Insurance Study for neighborhoods under 50 structures and five acres or less.
- Development, land use, and drainage projects should be considered on watershed basis verses parish or community boundaries.

***Residential and Commercial Development:***

- Encourage new construction that prioritizes disaster resilient design – focusing on flood protection height, wind resistance, and green infrastructure that will ensure the sustainability of the community and tax base.
- Avoid building slab-on-grade residential homes that require imported fill in flood prone areas. Instead use open, pier and beam foundations that will not adversely impact neighboring structures or communities downstream.
- Subdivisions in the Special Flood Hazard Area should discourage imported fill to meet the base flood elevation, as it could change the surrounding hydrology and adversely affect existing building stock.

# 6.0 Capital Improvement Plans and Incentives

Fiscal, budgetary, and spending devices are utilized to implement policy decisions and shape the growth of parishes and municipalities. Economic incentives are important tools that better position a jurisdiction to compete for new business investment while promoting and retaining existing businesses since these commercial enterprises form the economic foundation of a community or parish. A parish or city comprehensive plan must also be implemented through budgetary spending priorities that align with the community's overarching goals. Thus, a community's capital improvement plan (CIP) is a useful method to implement measures to reduce flood risk and coastal hazards.

Parish and municipal capital improvement plans are generally five- or six-year spending programs which allocate funding to local infrastructure projects and services including roadways, utilities, water and sewer systems, schools, police/fire stations, and/or open space acquisition. These expenditures make tangible financial commitments that support broader policy decisions through specific investments. As such, these financial tools are also opportunities to incorporate hazard mitigation measures and to strategically invest in infrastructure that promotes development in lower risk areas. APA notes in *Hazard Mitigation: Integrating Best Practices in to Planning* that there are "opportunities for intervention [and hazard mitigation integration] in all of the activities in which planners are routinely involved, including… [c]apital budgeting, and capital improvements programs, to ensure that public funds are invested in mitigation as needed" (Schwab, 2010, p. 6). Capital improvement plans can include both risk reduction expenditures and non-expenditures. Expenditures include allocating funding for flood risk or hazard mitigation activities such as funding open space acquisition or elevating a roadway. Non-expenditures prohibit funding for projects that increase the vulnerability of future development such as expanding roadways and sewer systems in high risk areas.

Thus, aligning capital improvement plans with a jurisdiction's comprehensive plan is an important step towards realizing flood risk reduction and hazard mitigation goals. Several parishes and municipalities in Louisiana have already taken steps towards aligning capital improvement plans with their comprehensive plan. Below are a few examples:

- **Vermilion Parish** recommends "future updates of the CIP should consider the recommendations of this [Vermilion Parish Comprehensive Resilience] Plan and aim for consistency to the extent that funding allows" (Vermilion Parish Police Jury, 2014, p. 23). In addition, CIP projects directly linked to improving community resilience should receive priority funding and implementation.

- **Terrebonne Parish's** Comprehensive Plan Update recommends that capital improvement projects be given priority that will complement drainage and levee projects in the capital budget to support sustainability and resiliency within the parish. The parish currently directs almost 75% of its capital budget towards levee/drainage and road/bridge projects and notes, "what is remarkable about the parish's existing Capital Budget is that more than half of it is dedicated to levees and drainage improvements, which, for Terrebonne Parish, are the *sine qua non* of sustainability and resiliency at this time" (Houma-Terrebonne Regional Planning Commission, 2013, p. 11-5).

- **New Orleans** has integrated its master plan with a comprehensive zoning ordinance, capital improvement plan, and capital budget stating that all "must be consistent with the goals and policies of the [Master] Plan" (City of New Orleans, 2010, p. 1.9).

Beyond traditional capital improvement plans, local governments may harness other spending tools or market-based tools through incentives and disincentives. Incentives can include tax incentives, TDR, or market-based incentives such as real estate disclosure.

Tax incentives work by promoting development outside of high risk areas through preferential assessment programs, tax abatements, or tax credits. For instance, parishes or municipalities could offer a one-time tax credit for elevation or retrofitting an existing home, or relocation to an area of lower flood risk. Similarly, tax incentives could be used to promote conservation of undeveloped properties with a high flood risk by taxing these properties at a lower rate based on its restricted value. Additional incentive and disincentive types include tax increment financing and impact fees.

TDR promote development in lower risk areas while restricting development in high risk areas. TDR provide a method of exchange of zoning or development privileges from high risk or environmentally/culturally sensitive areas (like open space, agricultural land, wildlife habitat, or historic landmarks) to areas where a community would like to grow (such as downtown areas or locations serviced by transportation networks, schools, jobs, or commerce). These transfers can allow for the preservation of open spaces in order to preserve their environmental value or natural functions while reducing risk to future buildings and infrastructure. TDR are more novel land use incentives implemented through negotiation with amenable developers to swap developable properties. Additionally, developers could be offered density bonuses that promote increasing housing opportunities in areas of low flood risk.

Real estate disclosure encourages potential buyers to become more informed about a property's flood risk. Such disclosure mandates could require sellers to state a property's flood risk or location in a FEMA mapped flood zone. Alternately, local governments or NGOs could provide buyers additional information about current or future flood risk.

## 6.1 Capital Improvement Plans and Incentives Recommendations

The following are CPRA's recommendations for incorporating risk reduction principles into future economic investments as well as into economic development policies and incentives:

***Parish and Municipal Governments*:**

- Develop a parish wide CIP and align CIP funding priorities with the flood risk reduction goals of their comprehensive plan.

- Include a reference to an existing plan or initiative for each project in the CIP to ensure continuity of planning processes.

- Consider tax incentives (such as preferential assessment programs, tax abatements, or tax credits), TDR, or market-based incentives such as real estate disclosure to promote development in lower risk areas.

# 7.0 References

American Society of Civil Engineers. (2014). Flood-Resistant Design and Construction Standard (ASCE 24-14). Retrieved September 2015, from http://www.asce.org/templates/publications-book-detail.aspx?id=6963.

Build Strong America. (2015). Key Facts: Building Codes Save Lives and Protect Property. Retrieved September 2015, from http://buildstrongamerica.com/issue/key-facts/.

Center for Planning Excellence. (2012). Best Practices Manual for Development in Coastal Louisiana. Retrieved April 2015, from http://www.cpex.org/best-practices-manual-coastal.

Center for Planning Excellence. (2012). Coastal Louisiana Land Use Toolkit. Retrieved September 2015, from http://www.cpex.org/coastal-land-use-toolkit.

Center for Planning Excellence. (2015). View from the Coast. Retrieved April 2015, from http://issuu.com/cpex/docs/draft_02202015/1.

City of New Orleans. (2010). "Plan for the 21st Century: New Orleans 2030." Adopted August 18, 2010. As amended through 2012. Ordinance No. 024079. Retrieved April 2015, from http://www.nola.gov/city-planning/master-plan/.

City of New Orleans. (2015). Comprehensive Zoning Ordinance. Retrieved October 2015, from http://www.nola.gov/city-planning/czo/ .

Disaster Mitigation Act of 2000. (2000). Public Law 106–390. October 30, 2000. Retrieved January 2015, from http://www.fema.gov/media-library-data/20130726-1524-20490-1790/dma2000.pdf

Eastern Research Group. (2013). What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure. National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center. Retrieved September 2015, from http://coast.noaa.gov/digitalcoast/sites/default/files/files/publications/12072013/What_Will_Adaptation_Cost_Report.pdf.

Emmer, R., Wilkins J., Schiavinato, L., Davis, M., and Wascom, M. (2007). "Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations for the Future." Louisiana Sea Grant College Program, Louisiana State University.

Ergen, Cemil E. (2006). Flood Mitigation Decision Tool for Target Repetitive Loss Properties in Jefferson Parish. Graduate Thesis. University of New Orleans. Retrieved September 2015, from http://scholarworks.uno.edu/cgi/viewcontent.cgi?article=1426&context=td.

Executive Order 13960. Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input. January 30, 2015. Retrieved September 2015, from https://www.whitehouse.gov/the-press-office/2015/01/30/executive-order-establishing-federal-flood-risk-management-standard-and-.

Federal Emergency Management Agency. (2006). Summary Report on Building Performance Hurricane Katrina 2005 (FEMA P-548/2006). Retrieved September 2015, from http://www.fema.gov/media-library-data/20130726-1446-20490-0294/548_SumRprt0329fnl.pdf.

Federal Emergency Management Agency. (2013a). Hurricane Isaac in Louisiana: Building Performance Observations, Recommendations, and Technical Guidance (FEMA P-938). Mitigation Assessment Team Report. Retrieved April 2015, from http://www.fema.gov/media-library-data/20130726-1908-25045-0581/fema_p_938_isaac_mat.pdf.

Federal Emergency Management Agency. (2013b). Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials. Retrieved September 2015, from http://www.fema.gov/media-library/assets/documents/31372.

Federal Emergency Management Agency. (2013c). Local Mitigation Planning Handbook. Retrieved January 2016, from http://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf.

Federal Emergency Management Agency. (2013d). National Flood Insurance Program Community Rating System Coordinator's Manual (FIA-15/2013). National Flood Insurance Program. Community Rating System. Retrieved September 2015, from http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf.

Federal Emergency Management Agency. (2015a). Resources: Flood Facts. Retrieved April 2015, from https://www.floodsmart.gov/floodsmart/pages/flood_facts.jsp.

Federal Emergency Management Agency. (2015b). National Flood Insurance Program-Community Rating System- A Local Official's Guide to Saving Lives, Preventing Property Damage, and Reducing the Cost of Flood Insurance. FEMA B-573. Retrieved April 2015, from http://www.fema.gov/media-library-data/20130726-1708-25045-7720/99032_nfip_small_brochure.pdf.

Federal Emergency Management Agency. (2015c). State Mitigation Plan Review Guide. Released March 2015, Effective March 2016. FP-302-094-2. Retrieved April 2015, from http://www.fema.gov/media-library-data/1425915308555-aba3a873bc5f1140f7320d1ebebd18c6/State_Mitigation_Plan_Review_Guide_2015.pdf.

Federal Emergency Management Agency. (2015d). Policy Statistics Country-Wide As Of 01/21/2015. Retrieved April 2015, from http://bsa.nfipstat.fema.gov/reports/1011.htm.

Federal Emergency Management Agency. (2015e). Significant Flood Events As of August 31, 015. Retrieved October 2015, from https://www.fema.gov/significant-flood-events.

Florida Department of Community Affairs and Florida Division of Emergency Management. (2010). Post-Disaster Redevelopment Planning: A Guide for Florida Communities. Florida Department of Community Affairs and Division of Community Planning and Division of Emergency Management. Retrieved April 2015, from http://www.floridadisaster.org/recovery/documents/Post%20Disaster%20Redevelopment%20Planning%20Guidebook%20Lo.pdf.

Florida Division of Emergency Management. (2014). Public Facilities Flood Hazard Mitigation Assessment Manual. Retrieved January 2016, from http://www.floridadisaster.org/mwg-internal/de5fs23hu73ds/progress?id=qizWsCYWrupB3WgRw8av7EhDvqWI6knst0sH4B2ASKc.

Grannis, Jessica. (2011). "Adaptation Tool Kit: Sea Level Rise and Coastal Land Use. How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise." Georgetown Climate Center, Georgetown Law. Washington, DC. Retrieved September 2015, from http://www.georgetownclimate.org/resources/adaptation-tool-kit-sea-level-rise-and-coastal-land-use.

Godschalk D. and Anderson W. (2012). "Sustaining Places: The Role of the Comprehensive Plan." (PAS Report 567) American Planning Association, Planning Advisory Service. Retrieved September 2015, from https://www.planning.org/store/product/?ProductCode=BOOK_P567.

Godschalk D. and Rouse D. (2015). Sustaining Places: Best Practices for Comprehensive Plans. (PAS Report 578) American Planning Association, Planning Advisory Service. Retrieved September 2015, from https://www.planning.org/store/books/pdf/pas578execsumm.pdf.

Governor's Office of Homeland Security. (2014). 2014 State Hazard Mitigation Plan. State of Louisiana. Retrieved April 2015, from http://www.getagameplan.org/mitigateplanupdate.htm.

Houma-Terrebonne Regional Planning Commission. (2013). Terrebonne Parish Comprehensive Plan Update: Vision 2030. Adopted by H-T Regional Planning Commission November 29, 2012. Accepted with amendment by Terrebonne Parish Council February 27, 2013. Retrieved April 2015, from http://www.tpcg.org/index.php?f=vision2030&p=plan2030.

Insurance Institute for Business and Home Safety. (2015). Rating the States 2015: An Assessment of Residential Building Code and Enforcement Systems for Life Safety and Property Protection in Hurricane-Prone Regions. Retrieved April 2015, from https://www.disastersafety.org/wp-content/uploads/IBHS-Rating-the-States-2015.pdf.

International Panel on Climate Change. (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. (Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley [eds.]). Cambridge University Press, Cambridge, UK, and New York, NY, USA. Retrieved September 2015, from http://ipcc-wg2.gov/SREX/report/full-report/.

Jacob, J. S. and Showalter, S. (2007). The Resilient Coast: Policy Frameworks for Adapting the Built Environment to Climate Change and Population Growth in Coastal Areas of the US Gulf of Mexico. Texas Sea Grant. Retrieved September 2015, from http://nsglc.olemiss.edu/TheBuiltEnvironment08-sm_000.pdf.

Lafourche Parish. (2014). The Lafourche Parish Comprehensive Resiliency Plan. Adopted by Lafourche Parish Council April 8, 2014. Retrieved April 2015, from http://38.106.5.169/government/departments/planning/comprehensive-resiliency-plan.

Louisiana Chapter of the American Planning Association. "Past Winners [of APA Awards]." Retrieved September 2015, from https://sites.google.com/a/louisianaplanning.com/home/business.

Louisiana Department of Natural Resources. (2015). A Coastal User's Guide to the Louisiana Coastal Resources Program. Office of Coastal Management. Revised January 2015. Retrieved April 2015, from http://data.dnr.louisiana.gov/LCP/LCPHANDBOOK/FinalUsersGuide.pdf.

Louisiana Recovery Authority. (2007). Louisiana Speaks Regional Plan: Vision and Strategies for Recovery and Growth in South Louisiana. Retrieved April 2015, from http://lra.louisiana.gov/index.cfm?md=subsite&tmp=home&ssid=1.

Louisiana Resiliency Assistance Program (LRAP). LSU Coastal Sustainability Studio and Office of Community Development- Disaster Recover Unit. Retrieved April 2015, from http://resiliency.lsu.edu/.

Louisiana Revised Statues, Title 33 Municipalities and Parishes, §106 General Powers and Duties. (La. R.S. 33:106). Retrieved April 2015, from https://www.legis.la.gov/Legis/Law.aspx?d=88652.

Louisiana Revised Statues, Title 33 Municipalities and Parishes, §107 Purposes in View. (La. R.S. 33:107). Retrieved April 2015, from https://www.legis.la.gov/Legis/Law.aspx?p=y&d=88655.

Louisiana Revised Statues, Title 33 Municipalities and Parishes, §109 Legal Status of Official Plan. (La. R.S. 33:109). Retrieved April 2015, from https://www.legis.la.gov/Legis/Law.aspx?d=88657.

Louisiana Sea Grant. (2013). Regulatory Best Practices to Make Louisiana Coastal Communities More Resistant to Natural Hazards. Louisiana Sea Grant Law and Policy Program. Retrieved September 2015, from http://data.dnr.louisiana.gov/ABP-GIS/ABPstatusreport/White_Paper_final.pdf

Louisiana State Uniform Construction Code Council. "Codes and Standards." Retrieved April 2015, from http://lsuccc.dps.louisiana.gov/codes.html.

Louisiana State Uniform Construction Code Council. "State Uniform Construction Code (La. R.S. 40:1720.21 through 1730.40)." Retrieved April 2015, from http://lsuccc.dps.louisiana.gov/pdf/LA%20State%20Uniform%20Construction%20Code%202011.pdf.

Lyles L., Berke P., and Smith G. (2012). Evaluation of Local Hazard Mitigation Plan Quality. Center for Sustainable Community Design and Coastal Hazards Center, University of North Carolina at Chapel Hill. Retrieved September 2015, from http://mitigationguide.org/wp-content/uploads/2013/01/Evaluation-of-Local-HMP-Quality-full.pdf.

Lyles L., Berke P., and Smith G. (2014). Do planners matter? Examining factors driving incorporation of land use approaches into hazard mitigation plans. Journal of Environmental Planning and Management. 57:5, 792-811, DOI: 10.1080/09640568.2013.768973 Retrieved September 2015, from http://dx.doi.org/10.1080/09640568.2013.768973.

Meck, Stuart, ed. (2002). Growing Smart Legislative Guidebook: Model Statutes for Planning and the Management of Change. American Planning Association. Retrieved April 2015, from www.planning.org/growingsmart/guidebook/print/.

National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center, National Sea Grant College Program, Office of Ocean and Coastal Resource Management, and U.S. Environmental Protection Agency's (EPA) Office of Sustainable Communities. (2011). Achieving Hazard-Resilient Coastal and Waterfront Smart Growth. Retrieved September 2015, from http://coastalsmartgrowth.noaa.gov/resilience.html.

Pace, N. (2013). Resilient Coastal Development Through Land Use Planning: Tools and Management Techniques in the Gulf of Mexico. Mississippi-Alabama Sea Grant Legal Program. University of Mississippi School of Law. Retrieved April 2015, from http://seagrant.noaa.gov/Portals/0/Documents/what_we_do/social_science/ss_tools_reports/resilient-planning_web.pdf.

RESTORE the Mississippi River Delta. (2014). Achieving Resilience in Coastal Communities: Resources and Recommendations. Retrieved September 2015, from http://online.nwf.org/site/DocServer/ac-proof-aug.2014.pdf?docID=15501.

Robert T. Stafford Disaster Relief and Emergency Assistance Act. (2013). United States Code, Title 42. The Public Health and Welfare, Chapter 68. Disaster Relief. Retrieved January 2015, from https://www.fema.gov/media-library-data/1383153669955-21f970b19e8eaa67087b7da9f4af706e/stafford_act_booklet_042213_508e.pdf

Schwab, J., Ed. (2010). Hazard Mitigation: Integrating Best Practices in to Planning. American Planning Association: Planning Advisory Service. Retrieved April 2015, from http://www.fema.gov/media-library-data/20130726-1739-25045-4373/pas_560_final.pdf.

Terrebonne Parish Consolidated Government. (2013). "Public Meetings Start for Flood Ordinance Changes." (Flyer for Public Meetings.) Posted June 21, 2013. Retrieved April 2015, from http://www.tpcg.org/files/planning/floodsafe/Terrebonne%20Protect%20Yourself_Protect%20Your%20Communityv4.pdf.

U. S. Army Corps of Engineers. (2009). Louisiana Coastal Protection and Restoration Final Technical Report: Nonstructural Plan Component Appendix. New Orleans District, Mississippi Valley Division, U. S. Army Corps of Engineers. Retrieved April 2015, from http://www.mvn.usace.army.mil/Portals/56/docs/environmental/LaCPR/NonstructuralPlanComponent.pdf

U.S. Government Accountability Office (GAO). (2011) Report to Congressional Committees: Action Needed to Improve Administration of the National Flood Insurance Program. GAO-11-297. Retrieved April 2015, from http://www.gao.gov/assets/320/319467.pdf.

U.S. Government Publishing Office. "Code of Federal Regulations." Title 44 Emergency Management and Assistance. Chapter 1 Federal Emergency Management Agency, Department of Homeland Security. Subchapter D Disaster Assistance. Part 201 Mitigation Planning. Section 201.4 Standard State Mitigation Plans. Retrieved April 2015, from http://www.gpo.gov/fdsys/pkg/CFR-2011-title44-vol1/pdf/CFR-2011-title44-vol1-sec201-4.pdf.

Vermilion Parish Police Jury. (2014). Vermilion Parish Comprehensive Resiliency Plan. Retrieved April 2015, from http://vermilionparishpolicejury.com/ABOUT_resilencyplan112011.html.

Wilkins, J., Emmer, R., Hwang, D., Kemp, G., Kennedy, B., Mashriqui, H., Sharky, B. (2008). Louisiana Coastal Hazard Mitigation Guidebook. Louisiana Sea Grant. Retrieved September 2015, from http://dnr.louisiana.gov/assets/docs/coastal/interagencyaff/LaCoastalHazMitGuidebook.pdf.

Wilkins, J. (2011). Is Sea Level Rise 'Foreseeable'? Does it Matter? Journal of Land Use & Environmental Law. Vol. 26, No. 2 (Spring 2011), pp. 437-501. Retrieved September 2015, from http://archive.law.fsu.edu/journals/landuse/vol26_2/wilkins.pdf.