TEXAS COASTAL MANAGEMENT PROGRAM

SECTION 309 ASSESSMENT AND STRATEGIES REPORT:

2016-2020

May 2015

Texas Coastal Management Program
Texas General Land Office

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List of Acronyms

ADA – Americans with Disabilities Act
BBAG – Beach and Bay Access Guide
BOEM - Bureau of Ocean Energy Management
BRD - Bycatch reduction devices
CELCP - Coastal and Estuarine Land Conservation Program
CEPRA - Coastal Erosion Planning and Response Act
CFR – Code of Federal Regulations
CMP - Texas Coastal Management Program
CNMI - Commonwealth of the Northern Mariana Islands
CREZ - Competitive Renewable Zones
CWA – Federal Clean Water Act
CZ – Coastal Zone
CZM – Coastal Zone Management
CZMA - Coastal Zone Management Act
ENOW - Economic: National Ocean Watch
ERCOT - Electric Reliability Council of Texas
FEMA – Federal Emergency Management Agency
FERC - Federal Energy Regulatory Commission
FSA - Farm Service Agency
GIS - Geographic Information Systems
GCPM - Gulf Coast Prairies and Marshes
GLO - Texas General Land Office
GOMA – Gulf of Mexico Alliance
HABs - harmful algal blooms
HRI - Harte Research Institute
LNG – Liquefied Natural Gas
LRGV - Lower Rio Grande Valley
MRRP – Texas Monofilament Recovery and Recycling Program
NMDMP - National Marine Debris Monitoring Program
NMFS - National Marine Fisheries Service
NOAA - National Oceanic and Atmospheric Administration
NPS - Non-point source pollution
NRDC – Natural Resources Defense Council
NRC – Nuclear Regulatory Commission
OCM - Office for Coastal Management
OPEC - Organization of Petroleum Exporting Countries On-
OSSF – On- Site Sewage Facilities
OTEC – Ocean Thermal Energy Corporation
PUC - Public Utility Commission of Texas
RSLR – Relative Sea Level Rise

SAMP - Special Area Management Plan
SECO – State Energy Conservation Office
SGCN - Species of Greatest Conservation Need
TAC - Technical Advisory Committee
TCELCP - Texas Coastal and Estuarine Land Conservation Program
TCEQ - Texas Commission on Environmental Quality
TPWD – Texas Parks and Wildlife Department
TSSWCB - Texas State Soil and Water Conservation Board
USACE – U.S. Army Corps of Engineers
USDA – U.S. Department of Agriculture
USEPA – U.S. Environmental Protection Agency
USGS – U.S. Geological Survey

Introduction

The Coastal Zone Management Act (CZMA) of 1972 established the National Coastal Zone Management (CZM) program to preserve, protect, restore and enhance the nation's coastal resources. The CZM program, administered by the National Oceanic and Atmospheric Administration (NOAA), is a voluntary federal-state partnership that provides the basis for protecting, restoring and responsibly managing the nation's diverse coastal resources. To address the need for a comprehensive approach to the management of coastal natural resources in Texas, the Texas Coastal Management Program (CMP) was developed. The Texas CMP was accepted into the national CZM program in 1997, after the Texas Legislature passed the Coastal Coordination Act in 1991. The Texas General Land Office (GLO) administers the CMP, which is a networked program of the state natural resource agencies. The mission of the CMP is to improve the management of the state's coastal natural resource areas and to ensure the long-term ecological and economic productivity of the coast.

Section 309 of the CZMA, as amended in 1990 and 1996, establishes a voluntary grants program to encourage states with federally approved coastal management programs, to conduct a self-assessment to identify, develop and implement strategies to strengthen and enhance their programs in nine areas. These enhancement areas include: 1) wetlands, 2) coastal hazards, 3) public access, 4) marine debris, 5) cumulative and secondary impacts, 6) special area management plans, 7) ocean resources, 8) energy and government facility siting, and 9) aquaculture. As a condition of receiving 309 CMP grant funding, the CMP must submit a Section 309 Assessment and Strategies Report to NOAA every five years. The report provides an assessment of the CMP in the nine enhancement areas, identifies program priorities, and proposes strategies that lead to tangible program enhancements for the identified high priority areas over the subsequent five years. The 309 Assessment & Strategies process provides an opportunity for the Texas CMP, with input from key stakeholders and the public, to determine where strategic opportunities exist for enhancing the CMP in identified high priority enhancement areas.

The GLO contracted with the Harte Research Institute (HRI) for Gulf of Mexico Studies to assist in the development of Texas' Section 309 Assessment & Strategies FY 2016-2020 report. Development of the Assessment and Strategies report follows the process outlined in NOAA's guidance document, *Coastal Zone Management Act, Section 309 Program Guidance, and 2016 to 2020 Enhancement Cycle*.

The Section 309 Assessment process is broken down into a high-level Phase I evaluation performed for all nine enhancement areas, and an in-depth Phase II assessment and strategy development performed for high priority areas identified through the Phase I process.

The Phase I (High-Level) Assessment of the CMP will evaluate the nine enhancement areas, using key stakeholder input and analysis of available data, to rank the enhancement areas as a high, medium, or low priority for Texas' program. The Phase I Assessment (1) determined the extent to which problems and opportunities for program enhancement exist within each of the enhancement area objectives; (2) determined the effectiveness of existing management efforts to address identified problems; and (3) identified high priority needs for program enhancement in coordination with the Office for Coastal Management (OCM), key stakeholders and the GLO. For assessment areas ranked medium or low, no further assessment is required. For enhancement areas ranked as high priority, a second Phase II (In-Depth) Assessment was completed, followed by strategy development for those

areas.

The Phase II (In-Depth) Assessment and Strategies development explores potential problems, opportunities for improvement, and specific needs of high priority enhancement areas; designed to lead to one or more program change that address high priority needs (as defined by 15 CFR 923.123a see "Eligible Activities" in Section 3). Stakeholders and the public were engaged to help inform the development of the Assessment and Strategies.

Executive Summary

The Phase I (High-Level) Assessment includes a characterization of the resource and changes since the 2011-2015 assessment; a management characterization of current and recent changes of statutes, regulations, polices or case law as well as relevant programs; and a prioritization of high, medium, or low with an explanation for the prioritization. The table below summarizes the prioritization for all enhancement areas. Enhancement areas ranked as "High Priority" were further assessed during the Phase II evaluation process. Following the Phase II assessment, strategies were developed to address high priority issues identified in the assessments.

Enhancement Area	**Prioritization**
Wetlands	High
Coastal Hazards	High
Public Access	High
Marine Debris	Medium
Cumulative & Secondary Impacts	High
Special Area Management Planning	N/A
Ocean Resources	Medium
Energy & Government Facilities	Medium
Aquaculture	Low

Wetlands

Wetlands are coastal areas that are inundated or saturated in sufficient duration such that they support vegetation and life adapted for saturated soil conditions. Wetlands serve as valuable habitat and storm surge buffers, enhance water quality, supply food, and provide recreation and cultural value. This valuable habitat, though, is disappearing at an increasing rate due to development, agriculture, barren land, and open water. Wetlands also are negatively impacted by reduced water quality and quantity, increased contamination due to runoff, development, subsidence resulting from water withdrawal, and hydrologic changes. In the Coastal Texas Initial Needs Assessment (Gibeaut et al., 2014), coastal experts evaluated and scored wetlands as either the first or second highest issue of concern in each of the four Texas coastal regions. Given these findings, wetlands are assessed as a high priority enhancement area for the Coastal Management Program; therefore, a Phase II assessment was conducted and strategies were developed to address identified priorities and needs.

Coastal Hazards

Texas is subject to significant coastal hazards that include flooding, coastal storms (and associated storm surge), shoreline erosion (including bluff and dune erosion), relative sea level rise, and drought. To a lesser extent, Texas is vulnerable to land subsidence, saltwater intrusion, tornadoes, and possible geological hazards (e.g., tsunamis, earthquakes). Coastal hazards are of particular concern due to a growing population that will be in harm's way, the importance of coastal economic activity, and the value of our natural coastal ecosystems. Coastal hazards are assessed as a high priority enhancement area for the coastal management program and warrant resiliency planning and coastal hazard mitigation to protect and preserve the vitality of the Texas coast. A Phase II assessment was conducted and strategies were developed to address identified priorities and needs.

Public Access

Public access takes into account increased opportunities for use of Texas beaches and shoreline, including recreational opportunities such as boat access sites, scenic area access, fishing access points, and coastal trails and boardwalks. While public access sites in Texas are on an increase, this is an enhancement area that is important to Texas citizens as identified by a statewide survey (Wade, 2014). Public access is assigned as a high priority enhancement area for the coastal management program due to the need to maintain the GIS record over time; include public input on planning; and restore, maintain, and improve public access sites. A Phase II assessment was conducted and strategies were developed to address identified priorities and needs.

Marine Debris

Marine debris on the Texas coast originates from land-based and ocean-based sources. Marine debris is a significant issue worldwide, as well as in Texas. The Ocean Conservancy continues its efforts at the federal level to address this challenge, these challenges and at the state level, successful marine debris removal programs include the GLO's Adopt-A-Beach Program and the Monofilament Recovery and Recycling Program, which is coordinated by Texas Sea Grant. While federal and state marine debris programs are effective, more education and outreach funding is needed to advance the discussion about the harmful and lasting effects of marine debris. Expanding this effort would greatly enhance the goals of these programs. The funding limitations prescribe a medium priority for this enhancement area, and a phase II assessment is not necessary.

Cumulative & Secondary Impacts

Cumulative and secondary impacts of coastal growth and development include the collective effect on various individual uses or activities on coastal resources, such as coastal wetlands and fishery resources. These impacts pose threats to ecosystem health and function, and the services they provide to human populations. Significant coastal population increases, with a similar rise in housing construction, have led to substantial land cover change, stressing already sensitive coastal environments. Planning for and addressing these changes is essential to ensure that communities can continue to flourish, making this enhancement area a high priority. If these efforts do not occur, local entities will not be prepared to adapt to the cumulative and secondary impacts. A Phase II assessment was conducted and strategies were developed to address identified priorities and needs.

Special Area Management Planning

The Texas Legislature amended the Coastal Coordination Act in 1995 to specifically prohibit the Coastal Management Program from developing or approving a special area management plan, including a plan for an area

designated under the national estuary program. No action to change that has been taken since. Thus, a priority assessment for this enhancement area is not applicable in Texas, and a phase II assessment is not necessary.

Ocean Resources

The Gulf Coast provides an abundance of resources and services, including fisheries, oysters, wildlife, crude oil, mineral s, commercial and recreational navigation, and tourism. Many issues that impact ocean resources within the scope of the CMP are addressed in other high priority assessment areas so this remains a medium priority area. Therefore, a phase II assessment is not necessary.

Energy & Government Facility Siting

Energy and government facility siting encompasses energy transport (pipelines, electrical grid, ports, etc.), energy facilities (for oil and gas, natural gas, coal, nuclear, and renewable energy technologies), and government facilities. These facilities are of tremendous economic importance to the state and the nation. Technological advances and newly discovered and tapped resources enable continued growth in the energy sector. A recent U.S. Navy facility closure is also being refurbished to serve the energy industry. Energy and government resources are identified as a medium priority enhancement area, as the energy industry is currently addressing issues in these areas. Therefore, a phase II assessment is not necessary.

Aquaculture

With future population increases and demand for sustainable sources of protein, aquaculture will continue to grow in importance. Current aquaculture of both marine and freshwater species is entirely land-based. An imminent concern is in regard to off-shore aquaculture and the ramifications this might have on ocean resources, making the enhancement area a medium priority. A phase II assessment is not necessary.

Proposed Strategies

The strategies to enhance the CMP and address the identified five high priority enhancement areas are:

- Assessment & Data Collection to Enhance Permitting, Leasing, and Monitoring for Coastal Activities
- Incorporation of Ecosystem Services into Grant Processes
- Shoreline Management and Dune Protection
- Data Collection, Technical Assistance and Planning to Mitigate Coastal Hazards Implementation of Coastal Nonpoint Source Management

Stakeholder and Public Comment

Input for Phase I review was requested through phone calls and emails to networked resource agencies, selected stakeholders, and coastal partners. The primary means of feedback on Phase II was conducted through a stakeholder meeting/teleconference held in Austin. The final draft document was made available for public comment on the GLO website and in the Texas Register, and in addition was sent to the Coastal Coordination Advisory Committee members, networked resource agencies and 23 coastal partners asking for review and comment.

Conclusion

This assessment and prioritization of enhancement areas, coupled with the proposed strategies, derived through collaboration and input of coastal stakeholders, will address the most critical issues identified along the Texas coastal zone and strengthen the Texas Coastal Management Program. Through the Section 309 funding, the GLO will

continue to further the commitment to protect, enhance and restore the state's coastal natural resource areas. The GLO also will coordinate with applicable networked agencies and coastal partners to procure and produce the proposed strategies in the most economical and efficient manner.

Summary of Completed Section 309 Projects

Program update for the cumulative and secondary impacts strategy carried out with the 2001 – 2005 309 funding:

The 2001 to 2005 Cumulative and Secondary Impacts strategy was to develop Total Maximum Daily Loads (TMDLs) within the Armand Bayou, Oso Bay, and Nueces Bay watersheds to improve water quality resulting from enhanced management of cumulative and secondary impacts. The Nueces Bay Zinc in Oyster Tissue TMDL was approved by the TCEQ and EPA in 2006. The Oso Bay TMDL was approved by the TCEQ and EPA in 2008.

In Armand Bayou high concentrations of bacteria have been observed. The presence of these bacteria poses risks for contact recreation under the Texas Surface Water Quality Standards. Under this strategy, a contractor collected water quality and biological data to characterize the dissolved oxygen regime and biota during hot weather and low flows, in the area of transition from nontidal to tidal conditions. Data and information provided by the study supported the assessment by the TCEQ on the current level of water quality impairment, and the evaluation of appropriateness of existing water quality standards or assessment criteria, to turn support the development of a TMDL or other appropriate management strategies for the Bayou. A final report summarizing the data collection results was submitted to the TCEQ.

Program change progress: the Armand Bayou Stakeholder Coordination Committee petitioned the regional Bacteria Implementation Group (BIG) to join its Implementation Plan, and was approved by the TCEQ in 2013 and the BIG in 2014. The Implementation Plan addresses bacteria impairments in many water bodies in the greater Houston area, and covers an area directly adjacent to the Armand Bayou watershed.

Program updates for strategies carried out with 2006 – 2010 309 funding:

Saving our Coastal Heritage - Texas Rural County Demonstration Project/ Chambers County Greenprint

Under this strategy, the GLO contracted with the Trust for Public Land for GIS mapping to identify high priority areas for public access, habitat conservation and restoration, and other community identified priorities for Chambers County. The results published as a “greenprint” concluded that preserving natural habitat, protecting water quality, and targeting restorable native habitats, protection and restoration of natural drainage and creation of more public access for recreation were the highest conservation priorities. The “greenprint” was intended to prioritize local actions and to enhance the potential for leveraging funds and for protecting contiguous or connected areas for greater habitat value for wildlife and for greater public access and enjoyment. The “greenprint” also provides a model for work in other rural coastal counties not engaged in community-based natural resource and public access planning.

The Chambers-Liberty Counties Navigation District (CLCND) and Chambers County purchased the Preserve in 2012 from a real estate development company and land use of the property was restricted to activities that are beneficial to wildlife and plant communities, while allowing for the development of low impact public access infrastructure to facilitate nature-based recreation and environmental education. The Galveston Bay Foundation (GBF) was made a project partner to assist with: planning, development, and implementation of habitat restoration and public access strategies, engagement of stakeholder groups, and development of a habitat and water quality management plan. In March 2015, the “Turtle Bayou Nature Preserve Natural Resources Management and Public Access and Education Plan” was published. This plan directs future management of natural resources, public access and nature-based

recreation, and maintenance of preserve infrastructure within the 514 acres of the Turtle Bayou Nature Preserve.

Geohazards Mapping of South Padre Island

Harte Research Institute was contracted to develop a geohazards map of South Padre Island delineating critical environments and features (e.g. wetlands, dunes, and washover channels) that protect against and/or are vulnerable to certain geological processes or geohazards, such as hurricanes and relative sea level rise. The map projects where these critical environments and features are likely to be in 60 years, as sea level rise and shoreline retreat continue. The goal of this project was to allow for more effective planning and increase public awareness of the natural processes.

The data from this project was used in the development of the "South Padre Island Plan 2010," which includes a preliminary analysis in a high hazard zone of current and future property-at-risk and recommends the implementation of a hazard mitigation and response plan. The rules for local Erosion Response Plans under Chapter 31 of the Texas Administrative Code, §15.17 require that Erosion Response Plans (ERP) address post- storm recovery plans. The city's ERP, adopted in 2012, includes a program for pre-storm monitoring.

Calhoun County Bay Access Master Plan

This project was intended to serve as a comprehensive extension of a bay access improvement plan developed by Westside Calhoun County Navigation District for the southern part of Calhoun County. The county contracted with Atkins to create the "Calhoun County Texas Shoreline Access Plan." An analysis was conducted on the current inventory of existing public or semi-public bay and estuary shoreline access points and their available infrastructure for recreational activities and recommendations for improvements to enhance recreational opportunities and use. The plan, published in 2012, identifies and catalogs current and potential bay access sites and proposes strategies and recommendations for improving existing access points and for increasing low-impact, low-cost bay access (for example, kayaking trails and fishing piers).

Brazoria County Erosion Response Plan

The purpose of this project was to develop a local Erosion Response Plan to amend the existing County Beach Access and Dune Protection Plan. Tasks associated with formulation of the plan include development of a Set-Back Line (SBL), identification of opportunities for mitigation, and public outreach. In May 2012, the GLO approved the Erosion Response Plans for Brazoria County, Village of Surfside Beach, Town of Quintana, and City of Freeport.

Program updates for strategies carried out with 2010-2015 309 funding:

Under the Texas Coastal Management Program's Section 309 Assessment and Strategies Report 2011 – 2015 the Texas CMP developed a framework for a long-term coastwide planning process utilizing coastal and marine spatial planning though identification of key resources and needs along the coast for protection and management to balance coastal economic growth with the protection of critical habitats and ecosystems.

This still underway initiative incorporates a more integrated and comprehensive approach to planning, managing and preventing conflict within the state's coastal and marine areas to enhance the various economic and ecologic activities, and bring stakeholders to the table to identify goals and objectives. The outcome of this effort is intended to guide state and local policy makers to achieve a sustainable balance among ecological, social, economic and governance objectives, create greater certainty and less risk for users, and streamline the permitting process.

To launch the planning initiative and to identify current regional issues of concern along the coast, the GLO worked with CB&I to conduct a comprehensive literature review of public comments, grants and project proposals. This data discovery resulted in a list of unfunded or partially-funded projects that could help address the challenges facing the coast. Next, the GLO collaborated with the Harte Research Institute (HRI) to establish an evaluation process that included an assessment of the project's expected benefit and feasibility, along with the likelihood of economic, community and environmental losses that would result if the project did not occur.

The GLO formed a Technical Advisory Committee (TAC) of coastal experts representing 40 different public, private and non-governmental sectors to evaluate the projects and identify the most pressing threats to each of the four regions of the Texas coast. During a series of regional meetings held throughout September 2012 in Corpus Christi, South Padre Island, Galveston, and Victoria, the TAC reviewed and evaluated the projects that had the potential to address to each region's issues of concerns.

HRI compiled the data and drafted an analysis report by region resulting in a list of featured projects. CB&I developed a project costing model, and verified and updated the information for each featured project to provide a detailed analysis and cost estimate.

The GLO teamed up with Marmillion + Company to synthesize information from the TAC evaluation o produce an overview report, The Texas Coast: Shoring Up Our Future, which highlights the ecologic and economic features along the Texas coast, and identifies the primary issues of concern threatening its sustainability. The report was presented to the 83rd Texas Legislature and the Texas members of Congress. The report is available at, www.Shoring UpTexas.org, which will be expanded to include specifics on the information gathered from meetings with local elected officials and stakeholders. This education and outreach effort brings attention to wetland and habitat loss, impacts to fish and wildlife, gulf beach, bay and dune erosion, water quality and quantity degradation, impacts to recreation and local economy, flooding and storm surge, public access and community resiliency.

In the summer of 2013, the GLO and Marmillion + Co., presented this information to local elected officials in the coastal regions and discussed the coastal issues that are relevant to their communities. The five Coastal Issues Forums were held in July and August 2013 in Beaumont, Galveston, Port Lavaca, Corpus Christi and Port Isabel. The forums provided the GLO an opportunity to meet with elected officials and discuss the critical coastal areas in their regions, the issues affecting them, and examine the economic benefits and social value of their coastal communities. There were 130 attendees at the local officials meetings

After hosting the local officials meeting, the GLO turned its attention to updating the Resource Management Codes (RMCs), which are assigned to state-owned tracts in Texas bays and Gulf waters, and promote best management practices for activities within the tracts to minimize adverse impacts to sensitive natural resource areas. HRI assisted GLO to establish a process to update, streamline and standardize the RMCs for inclusion on a newly-developed GIS viewer. Last fall, the team formed the Data Standards Committee (DSC), a workgroup made up of representatives from the CMP-networked resource agencies, federal agencies, GLO Energy Resources and GLO GIS Teams, who routinely met over the course of a year to examine and redefine each code, identify needed data sets and develop the data driven code-assigning criteria. Data sets were compiled and processed to construct the RMC GIS viewer to assist resource managers and coastal stakeholders in planning for the use and sustainability of the ecologic, economic and

social assets of the Texas coast. The viewer can be found on the GLO website at: http://www.glo.texas.gov/what-we-do/energy-and-minerals/resource-management-codes/index.html.

Building on the outreach and awareness strategies, the GLO convened a series of resiliency forums, which were facilitated by Marmillion + Co. on the topic of coastal resiliency. Held in three coastal locations during the week of Dec. 7, 2014, these forums furthered our efforts to engage coastal leaders and stakeholders to raise statewide awareness of the Texas coast's tremendous value, and its increasing economic and environmental vulnerabilities due to a number of factors, such as population growth, larger and longer-lasting storms, and shoreline erosion. The purpose of the forums was to introduce community leaders to a number of planning tools and technologies that would help them prepare for changing conditions along the coast and to discuss with them their top coastal concerns. Coastal experts were on hand to showcase the planning tools, which helped identify risks associated with those threats. The discussion also centered on the link between economic and environmental health, especially the management of critical coastal infrastructure and its reliance on healthy bays, wetlands and barrier islands.

Through the CMP Section 309 grant funding, the GLO will continue to support and engage coastal communities in their resiliency planning to better prepare for future storms and coastal vulnerabilities to ensure a strong economic and ecologic Texas coast for generations to come.

Phase I (High-Level) Assessment

Wetlands

SECTION 309 ENHANCEMENT OBJECTIVE: Protection, restoration, or enhancement of the existing coastal wetlands base, or creation of new coastal wetlands. §309(a) (1)

Note: For the purposes of the Wetlands Assessment, wetlands are "those areas that are inundated or saturated at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." [33 CFR 328.3(b)]. See also pg. 17 of the CZMA Performance Measurement Guidance[1] for a more in-depth discussion of what should be considered a wetland.

Resource Characterization:

1. *Using provided reports from NOAA's Land Cover Atlas[2] or high-resolution C-CAP data[3] (Pacific and Caribbean Islands only), please indicate the extent, status, and trends of wetlands in the state's coastal counties. You can provide additional or alternative information or use graphs or other visuals to help illustrate or replace the table entirely if better data are available.*

Coastal Wetlands Status and Trends[2]		
Current state of wetlands in 2011 (acres)		
Percent net change in total wetlands (% gained or lost)*	from 1996-2011 **-2.21**	from 2006-2011 **-1.11**
Percent net change in non-tidal (% gained or lost)*	from 1996-2011 **-2.45**	from 2006-2011 **-1.41**
Percent net change in tidal (estuarine) wetlands (% gained or lost)*	from 1996-2011 **+0.12**	from 2006-2011 **+0.06**

How Wetlands Are Changing*		
Land Cover Type	**Area of Wetlands Transformed to Another Type of Land Cover between 1996-2010 (Sq. Miles)**	**Area of Wetlands Transformed to Another Type of Land Cover between 2006-2010 (Sq. Miles)**
Development	-36.59	-14.19
Agriculture	-5.67	-0.52
Barren Land	-6.89	-4.85
Water	-3.56	-4.55

** Data from http://www.csc.noaa.gov/ccapatlas/.Note: Islands likely have data for another time period and may only have one time interval to report. If so, only report the change in wetlands for the time period for which high-resolution C-CAP data are available. Puerto Rico and CNMI do not report.*

[1] http://coastalmanagement.noaa.gov/backmatter/media/czmapmsguide11.pdf
[2] http://www.csc.noaa.gov/ccapatlas/. Summary reports compiling each state's coastal county data are provided on the ftp site.
[3] http://www.csc.noaa.gov/digitalcoast/data/ccaphighres

2. *If available, briefly list and summarize the results of any additional state- or territory-specific data or reports on the status and trends of coastal wetlands since the last assessment to augment the national data sets.*

NOAA C-CAP Wetland Change Assessment

This wetland change assessment is largely based on the NOAA Coastal Services Center County Landcover Change Reports for the time period of 1996-2010 & 2006-2010 (www.scs.noaa.gov/ccapatlas), as well as observations by HRI of the spatial pattern of wetland change from C-CAP change maps. NOAA C-CAP reports were obtained for each of the 18 coastal counties and summary data was tabulated (see Appendices A and B). In Texas, wetlands account for a significant portion of the land area within the 18 coastal counties – covering 2,580 square miles or 1,651,782 acres, in 2010. Wetlands serve as floral and faunal habitat, support biodiversity, provide ecosystem services (such as water quality enhancement, nursery and foraging resource, and storm surge buffers), function as recreational areas, and add cultural value to the coastal-living experience. In Texas, coastal counties, a total of 58.27 square miles of wetland have been lost from 1996-2010 (data from NOAA C-CAP) and 28.97 square miles were lost from 2006-2010. Observation of NOAA C-CAP wetland change data show that wetland loss varies by county and may be the result of loss to open water, which is most common in the southernmost counties, or loss to development, as is the case in the northeast Harris and Jefferson counties (see Appendices A and B).

The southern-most Texas counties include Cameron, Willacy, Kenedy, and Kleberg counties. This region boasts extensive tidal flats that serve as critical environment for the endangered piping plover population, as well as large amount of important estuarine habitat such as the Laguna Madre and Bahia Grande wetland basins. All of these counties have experienced minimal wetland losses, except for Cameron County. Cameron County has lost a total of 10.21 sq. mi from 1996-2010, corresponding to unconsolidated shore converted to open water, associated with shoreline erosion. This is due primarily to re-flooding and hydrologic restoration of the Bahia Grande in 2005. Although changes from a wetland class to open water are generally considered a loss of wetland in the C-CAP classification, this area in particular was restored to its previous hydrologic state.

The Central Texas region, counties of Nueces, San Patricio, Refugio, Aransas, Calhoun, Victoria and Jackson, contain numerous bays, including Corpus Christi, Aransas, and Copano bays, as well as barrier islands of North Padre Island and Mustang Island. Wetland environments in the region support diverse fish and wildlife, fishing, hunting, birding, and other recreational activities. The region also experienced minimal wetland losses (less than 2 sq. mi from 1996-2010). Refugio, Aransas, and Calhoun counties gained wetland area. In Nueces County, 2.03 sq. mi of wetlands were lost from 1996-2010. A significant loss occurred near the mouth of the Nueces River mostly to unconsolidated shore and on portions of Mustang Island due to development. In Calhoun County, the most significant losses and gains seem to occur in the prairie pothole wetland area of the Ingleside strand plain and beach shoreline erosion on Matagorda Peninsula. In Victoria Country, most of the wetland losses are associated with wetland conversion to open water in the area of Rupley Lake. Lastly, in Jackson County, 0.15 sq. mi were lost from 1996-2010. Most of the wetland losses were associated with palustrine forest (-0.58 sq. mi) and are attributed to conversion to open water (-0.14 sq. mi) near the northern portion of Lake Texana. The wetlands in the Central Texas counties are critical to the economy as they are home to numerous wildlife management areas and migratory and recreational birds.

The region of the upper Texas coast, including the counties of Matagorda, Brazoria, Galveston, Harris, Chambers, Jefferson, and Orange, collectively have experienced some of the largest wetland losses in the state. Erosion, subsidence, and relative sea level rise combined with insufficient freshwater inflows, heavy shipping traffic, and other industrial uses are causing rapid wetland loss in the region. One notable difference in the upper Texas coast is that much of the wetland changes are due to development. In Galveston County, wetland losses to development

accounted for -5.08 sq. mi of wetland area, observed mostly within Galveston Island and Bolivar Peninsula, as well as in the vicinity of League City. In Harris County, wetland losses from 1996-2010 amounted to -19.86 sq. mi; the largest cumulative wetland loss of all Texas coastal counties. Most losses are in the category of Palustrine Forested (-17.07 sq. mi) and are attributed to development (-18.25 sq. mi). In Chambers County, 1.10 sq. mi of wetlands were lost from 1996-2010. Although significant wetland losses due to development (-1.79 sq.mi) and agriculture (-2.6 sq. mi) occurred, the area gained unconsolidated shore due to the expansion of Trinity River Delta. In Jefferson County, 13.80 sq. mi of wetlands were lost, primarily to development (-3.89 sq. mi) on the northeastern part of the county, and to open water (-3.58 sq. mi) in the vicinity of Sea Rim State Park. The Gulf shoreline of Texas Point National Wildlife Refuge experiences some of the highest Gulf-shoreline retreat rates in Texas and continues to lose wetland area to marine processes. Also, from 1996-2010, some of the lakes experienced wetland loss to open water, in particular Blind Lake and Eagle Lake. In Orange County, 7.78 sq. miles of shoreline were lost from 1996-2010 and 4.14 sq. mi were lost from 2006-2010. Some significant losses occurred from the conversion of wetlands to open water (-0.43 sq. mi) in the Lower Neches Wildlife Management area on the northeast part of Sabine Lake, as well as losses to development. Matagorda County is an exception where wetland area increased from 1996-2010 which is mostly attributed to a gain in unconsolidated shore due to the conversion of open water to wetland and the expansion of the Colorado River Delta.

Other Wetland Assessment Reports:

The NOAA C-CAP data is a great resource for assessing wetland loss due to conversion to open water, development, or agriculture. Many of the changes in wetlands are due to their conversion to another wetland type, or even gained through restoration and mitigation practices. Although, wetlands gained as a result of restoration cannot be readily quantified with C-CAP, further analysis of C-CAP data can provide information of wetland-to-wetland change. For example, it is of high priority and concern that some shrub-scrub areas in Cameron County be restored to the historical ecosystem of high marsh grasses (personal communication, Lower Rio Grande Valley National Wildlife Refuge, 2013). Similarly, low marsh environments in the Central coast are changing from predominantly Spartina grasses to increasingly greater densities of mangroves (Montagna et al., 2007).

A more recent report from USGS and EPA, “Emergent Wetlands Status and Trends in the North Gulf of Mexico,” summarized available literature since the 1970s. From the report, Texas has 112,758 hectares (435.4 sq. mi.) of estuarine emergent wetlands and 222,212 hectares (857.97 sq. mi.) of palustrine emergent wetlands in coastal Texas. The report also indicates that Texas experienced an average annual net loss of 2,185 hectares (8.4 sq. mi.) of all vegetated coastal wetlands from the mid-1950s to the early 1990s, and projected sea level rise places an additional 314,554 hectares (1,214.5 sq. mi.) of coastal wetlands at risk. The loss of estuarine emergent wetlands in Texas has been caused by loss or conversion to estuarine subtidal bays, palustrine emergent wetlands, lacustrine reservoirs, and other forms of land development. These changes have occurred as a result of submergence, erosion, and subsidence caused by underground water, oil and gas extraction, and the creation of dredge spoil sites, roads, levees, and other man-made developments along the coast. The loss of palustrine emergent wetlands results from loss or conversion to agricultural land, urban and rural development; palustrine farmed land, lacustrine reservoir construction, and natural succession to scrub-shrub and forested land. Some emergent wetland change was caused by the invasion of the non-native species.

In the performance measures from 2010-2012, it was calculated that the 1,406.83 acres of wetland were lost and a total of 1,131.57 acres of wetlands were gained due to activities subject to CZM regulatory programs. Wetland protection by acquisition or easements, with assistance from CZM funding, totaled 1,253.5 acres from 2010-2012, and wetland restoration with assistance from CZM funding or staff serviced 4,167.58 acres of wetland (not including beaches and dunes).

The GLO reported in 2010 the number of acres of permit-estimated loss and of required gain or mitigation of other habitat types due to activities subject to CZM regulatory programs to be 16.89 acres and 44.55 acres, respectively. The number of acres of tidal wetlands protected by acquisition or easement with assistance from CZM funding or staff is 2.2 acres. Lastly, the number of acres of other types of habitat protected by acquisition or easement with assistance from CZM funding or staff is 364.8 acres.

Management Characterization:

1. *Indicate if there have been any significant changes at the state or territory level (positive or negative) that could impact the future protection, restoration, enhancement, or creation of coastal wetlands since the last assessment.*

Management Category	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these.	Y
Wetlands programs (e.g., regulatory, mitigation, restoration, acquisition)	Y

2. *For any management categories with significant change, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
    a. *Describe the significance of the changes;*
    b. *Specify if they were 309 or other CZM-driven changes; and*
    c. *Characterize the outcomes or likely future outcomes of the changes.*

In 2001, the U.S. Supreme Court decision in Solid Waste Agency of Northern Cook County (SWANCC) v. the Army Corps of Engineers eliminated Clean Water Act (CWA) jurisdiction over isolated waters that are intrastate and non-navigable, where the sole basis for asserting CWA jurisdiction is the actual or potential uses of the waters by migratory birds that cross state lines. The 2001, and subsequent Supreme Court rulings, left isolated wetlands with limited protection. Recently, the U.S. Environmental Protection Agency and U.S. Army Corps of Engineers jointly released a proposed rule to clarify the scope of "Waters of the Unites States" with the aim to increase jurisdictional protection under the Clean Water Act for streams and wetlands. The proposed change aims to clarify the jurisdiction of the CWA and have a positive impact on the management and protection of wetlands. These are not CZM-related changes, but are significant for the protection of isolated wetlands as would be addressed through the federal consistency process and issuance of USACE permits.

The Gulf Coast Prairies and Marshes (GCPM) Handbook and The South Texas Plains Handbook are two in a series of Texas Conservation Action Plans available from the Texas Parks and Wildlife Department (TPWD). These handbooks

provide insight into specific GCPM resources and conservation issues, including a list of Species of Greatest Conservation Need (SGCN), rare communities, and important habitats that support these unique features. The GCPM handbook also presents a compiled list of issues and proposed solutions or actions. Although these are not CZM driven changes, the TPWD is a GLO partner agency. These action plans provide guidance and information necessary for prioritization of habitats, including wetlands, and can be used as a reference and input for CMP. The Texas Parks and Wildlife Department 2013 Salt Bayou Watershed Restoration Plan focuses on the protection and restoration of wetlands within the Salt Bayou watershed of Jefferson County. This is not a CZM driven program, but this restoration plan provides guidance and information necessary for prioritization of habitats including wetlands and can be used as a reference and input for CMP. This restoration plan is of significance, as the Chenier Plain is a highly productive wetland complex.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

High	_X___
Medium	_____
Low	_____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

In 2012, The GLO formed a Technical Advisory Committee, a group of coastal experts representing the public, private and non-governmental sectors, to participate in an initial needs assessment of the Texas coast. Regional workshops were hosted by the GLO with the staff assistance from the Harte Research Institute for Gulf of Mexico Studies (HRI).

During each meeting, the Technical Advisory Committee provided information on issues of concern (IOC) for each of the regions. Potential issues of concern (see Figure 1) were evaluated on a 5-level scale from “not concerned (0)” to “extremely concerned (4).” An average level of concern was derived using all the acquired responses for each of the IOCs. The IOC scores were normalized, to compare and visualize IOCs across all four coastal regions. By using a standardized score, the level of concern for these issues was expressed in a common and comparable scale across regions. After review of the TAC input, wetland and habitat loss was an issue of concern that emerged as a top priority for all regions of the Texas coast since they improve water quality, provide critical habitat for birds, wildlife, fish, crabs and other shellfish, control flooding and erosion, and recharge groundwater supplies. Many wetlands, in particular coastal marshes, provide wave attenuation, shoreline stabilization and storm surge attenuation (Barbier et al. 2013, Shepard et al. 2011). Characteristics associated with marsh health – vegetation density, biomass production and size of marsh – determine the ability of the marsh to protect inland areas. It is found that healthy marshes have higher shoot density and biomass and are able to attenuate more wave energy than marshes in degraded condition (Brission et al. 2014). Hence, protection and conservation of current healthy wetland environments is imperative, as well as restoration in areas of marsh loss, to increase ecosystem and community resilience to the impacts of storms and sea level rise.

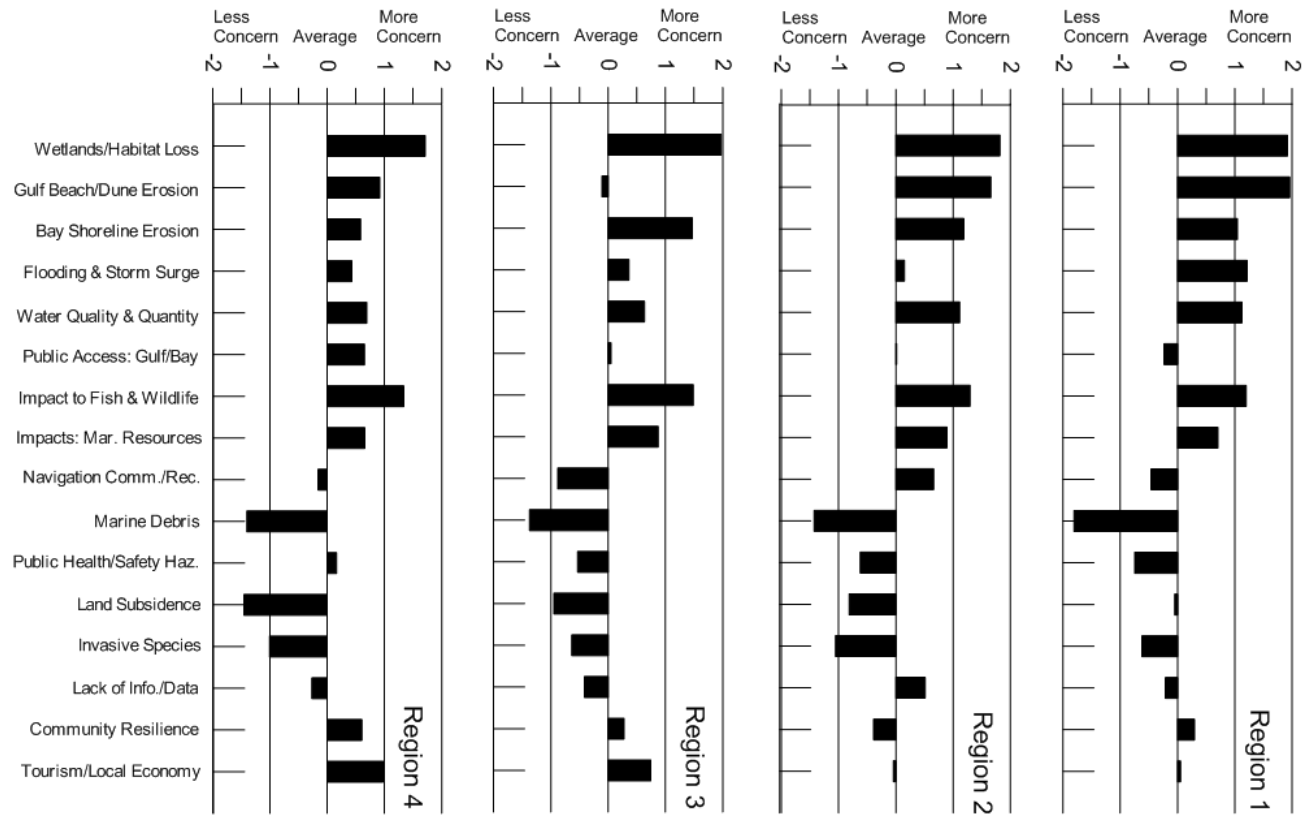

Figure 1. Cumulative scores for Issues of Concern for each of the four Texas regions. Wetland and habitat loss are a top concern for coastal communities across the entire Texas coast.

A factor affecting wetland loss is population growth. Approximately one quarter of the state's population currently lives in the 18 coastal counties. The projected population for the coastal region is expected to increase 50 percent by 2050, resulting in increased pressure on coastal systems, including wetlands (GLO, 2013). With an increase in population comes a rise in development, which has contributed to subsidence resulting from fluid withdrawal and hydrologic changes leading to increased erosion. When coupled with relative sea level rise, the benefits wetlands can provide to coastal communities are diminished. The current trend, though, can be reversed or at the very least slowed, if action is taken to protect, restore and enhance the existing wetlands using methods like living shorelines and if education and outreach efforts are increased.

Coastal Hazards

SECTION 309 ENHANCEMENT OBJECTIVE: Prevent or significantly reduce threats to life and property by reducing development and redevelopment in high-hazard areas, managing development in other hazard areas, and anticipating and managing the effects of potential sea level rise. §309(a) (2)

Note: For purposes of the Hazards Assessment, coastal hazards include the following traditional hazards and those identified in the CZMA: flooding; coastal storms (including associated storm surge); geological hazards (e.g., tsunamis, earthquakes); shoreline erosion (including bluff and dune erosion); sea level rise; Great Lake level change; land subsidence; and saltwater intrusion.

Resource Characterization:

1. ***Flooding:*** *Using data from NOAA's State of the Coast "Population in the Floodplain" viewer[4] and summarized by coastal county through NOAA's Coastal County Snapshots for Flood Exposure,[5] indicate how many people were located within the state's coastal floodplain as of 2010 and how that has changed since 2000. You may to use other information or graphs or other visuals to help illustrate.*

Population in the Coastal Floodplain			
	2000	**2010**	**Percent Change from 2000-2010**
No. of people in coastal floodplain[6]	929,315	1,079,909	16.20%
No. of people in coastal counties[7]	6,849,874	8,287,623	20.99%
Percentage of people in coastal counties in coastal floodplain	13.56%	13.03%	----------

2. ***Shoreline Erosion****: Using data from NOAA's State of the Coast "Coastal Vulnerability Index,"[8] indicate the vulnerability of the state's shoreline to erosion.*

Vulnerability to Shoreline Erosion		
Vulnerability Ranking	**Miles of Shoreline Vulnerable to Erosion[8]**	**Percent of Coastline[8]**
Very low (>2.0m/yr.) accretion	6	2%
Low (1.0-2.0 m/yrs.) accretion)	82	6%
Moderate (-1.0 to 1.0 m/yr) stable	664	53%
High (-1.1 to -2.0 m/yr) erosion	316	25%
Very high (<-2.0 m/yr) erosion	176	14%

[4] http://stateofthecoast.noaa.gov/pop100yr/welcome.html. Note FEMA is in the process of updating the floodplain data. This viewer reflects floodplains as of 2010. If you know the floodplain for your state has been revised since 2010, you can either use data for your new boundary, if available, or include a short narrative acknowledging the floodplain has changed and generally characterizing how it has changed.
[5] www.csc.noaa.gov/digitalcoast/tools/snapshots
[6] To obtain exact population numbers for the coastal floodplain, download the Excel data file on the State of the Coast "Population in the Floodplain" viewer: http://stateofthecoast.noaa.gov/pop100yr/welcome.html. Summary population data for each coastal state is available on the ftp site.
[7] To obtain population numbers for coastal counties, see spreadsheet of coastal population and critical facilities data provided or download directly from http://www.csc.noaa.gov/digitalcoast/data/stics. Summary population data for each coastal state is available on the ftp site.
[8] http://stateofthecoast.noaa.gov/vulnerability/welcome.html (see specifically "Erosion Rate" drop-down on map). The State of the Coast visually displays the data from USGS's Coastal Vulnerability Index.

3. ***Sea Level Rise**: Using data from NOAA's State of the Coast "Coastal Vulnerability Index"[9] indicate the vulnerability of the state's shoreline to sea level rise. You may provide other information or use graphs or other visuals to help illustrate or replace table entirely if better data is available.*

Coastal Vulnerability to Historic Sea Level Rise		
Vulnerability Ranking	**Miles of Shoreline**	**Percent of Coastline**
Very low	0	0%
Low	0	0%
Moderate	0	0%
High	0	0%
Very high	1244	100%

According to NOAA's State of the Coast Coastal Vulnerability Index, there are 1,244 miles of Texas coast, which have a "very high" vulnerability ranking to sea level rise relative to shorelines of various morphologies across the country. Compared to the global mean of 1.1 -3.1 mm/yr, Texas experiences high rates of sea level rise ranging from 1.93 to 6.30 mm/yr according to the NOAA tide gauges records. Figure 2 shows the historical shoreline change rates along with NOAA's tide gauge sea level rise trends to identify areas along the Texas coast with the highest vulnerability to sea level rise, in relation to Texas shorelines alone. Areas in red reflect higher loss of shoreline, whereas areas in green are areas of shoreline accretion.

From the NOAA tide gauge data (see Figure 2), sea level rise trends are most accelerated in the upper Texas coast as measured from the Galveston Pier 21 tide gauge (6.39 mm/yr). Historical shoreline change rates for Galveston County ranges from -3.5 to +3.5 m/yr (see Figure 2), placing Galveston County in high to very high vulnerability. The shoreline of Jefferson County has the second highest rate of sea level rise (5.42 mm/yr, from Figure 2) in conjunction with some of the highest shoreline retreat rates of the state (erosion greater than 4.5 m/yr from Figure 2), making this area the most vulnerable in Texas. Also categorized as "very high" vulnerability are Brazoria, Matagorda, Willacy and Cameron counties. Parts of these counties have experienced shoreline retreat greater than 3 m/yr and are experiencing sea level rise greater than 1.93 mm/yr (see Figure 2). Although the entire Texas coast is exposed to the effects of sea level rise, the central Texas coast, including Kenedy, Kleberg, Aransas, Nueces and Calhoun counties, have comparatively less shoreline retreat (under 2m/yr) indicating a moderate vulnerability ranking within the state.

[6] http://stateofthecoast.noaa.gov/vulnerability/welcome.html (see "Vulnerability Index Rating" drop-down on map). The State of the Coast visually displays the data from USGS's Coastal Vulnerability Index.

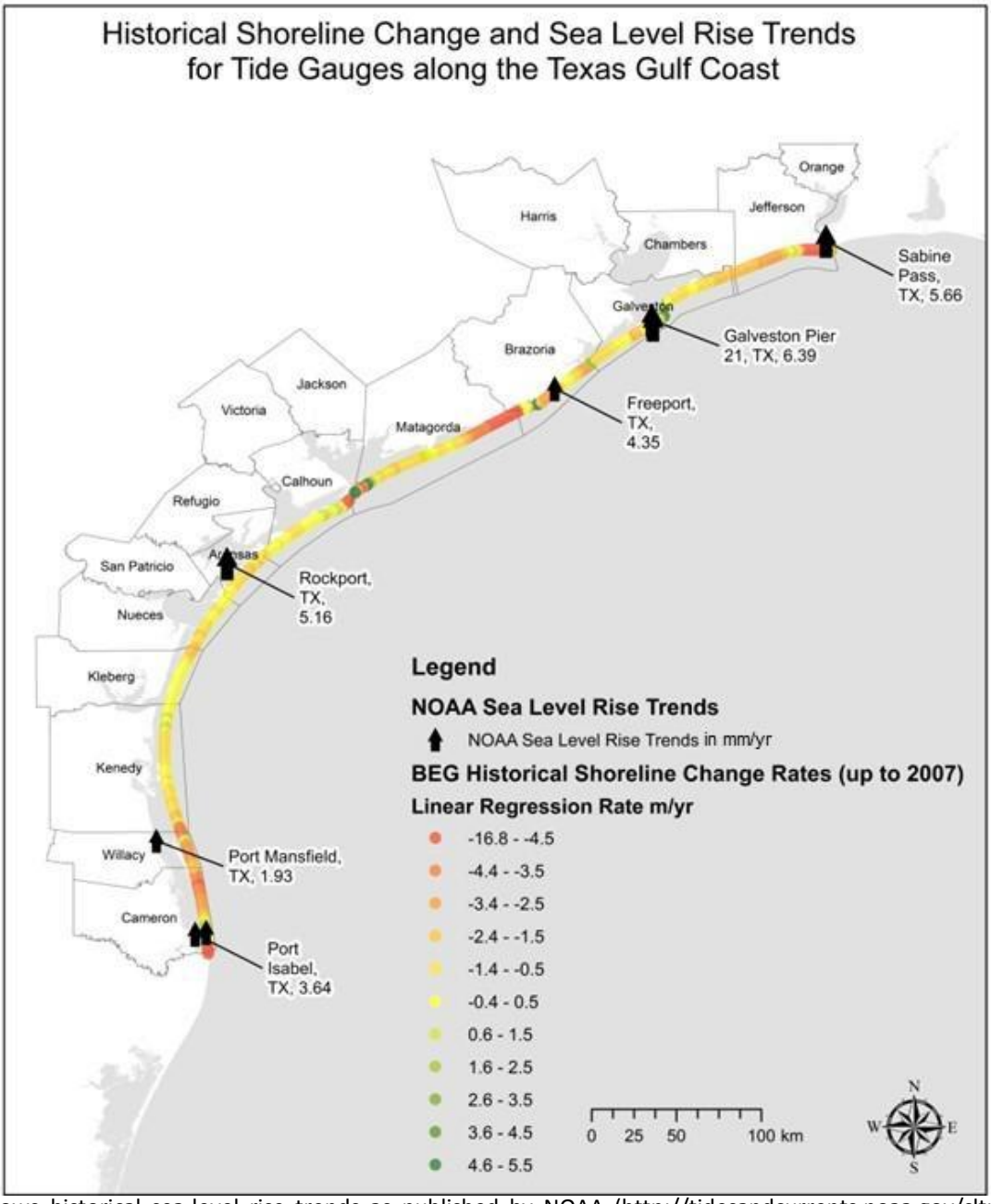

Figure 2. This map shows historical sea-level rise trends as published by NOAA (http://tidesandcurrents.noaa.gov/sltrends/) and historical shoreline change rates as calculated by the BEG (http://www.beg.utexas.edu/coastal/morphodynamics.php). Larger arrows signify negative or landward movement of the shoreline.

4. *Other Coastal Hazards: In the table below, indicate the general level of risk in the coastal zone for each of the coastal hazards. The state's multi-hazard mitigation plan is a good additional resource to support these responses. Risk is defined as "the estimated impact that a hazard would have on people, services, facilities and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."*

Type of Hazard	General Level of Risk[10] (H, M, L)
Flooding (riverine, storm water) Coastal storms (including storm surge)[11]	H H
Geological hazards (e.g., tsunamis, earthquakes) Shoreline erosion[12] Sea level rise[13,14,15] Great Lake level change[14]	L H H N/A
Land subsidence	L
Saltwater intrusion	M
Other – Tornado	L-M
Other – Drought	M-H

5. *If available, briefly list and summarize the results of any additional data or reports on the level of risk and vulnerability to coastal hazards within your state since the last assessment. The state's multi-hazard mitigation plan or climate change risk assessment or plan may be a good resource to help respond to this question.*

The Coastal Hazard assessment is primarily based on the State of Texas Hazard Mitigation Plan (2013 Update). Other regional hazard mitigation plans were also referenced including: The South East Texas Regional Planning Commission Regional Hazard Action Plan (2004), Houston-Galveston Area Council Regional Hazard Mitigation Plan (2011), Texas Colorado River Floodplain Coalition Mitigation Plan (2011), Guadalupe-Blanco River Authority Hazard Mitigation Plan (2011), Coastal Bend Mitigation Action Plan (2011) and the Hazard Mitigation Action Plan for the Rio Grande Border (2011). The regional coverage for each of the hazard mitigation plans is shown in Figure 3.

The following sections provide a review of the major hazards associated with Texas coastal counties. The FEMA Disaster Declarations Summary categorizes the federally declared disasters in the coastal zone from 1953-2014 (see Table 1). Hurricane and tropical storms account for the greatest number of declared disasters, followed by floods, fire and wildfire hazard, tornados, and freezes. Other hazards reviewed in the various hazard mitigation plans and relevant to this discussion include geologic hazards, shoreline erosion, relative sea level rise, land subsidence, saltwater intrusion, and drought.

[10] Risk is defined as "the estimated impact that a hazard would have on people, services, facilities and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage." *Understanding Your Risks: Identifying Hazards and Estimating Losses. FEMA 386-2. August 2001*

[11] In addition to any state- or territory-specific information that may help respond to this question, the U.S. Global Change Research Program has an interactive website that provides key findings from the 2014 National Climate Assessment for each region of the country, including regions for the coasts and oceans, and various sectors. The report includes findings related to coastal storms and sea level rise that may be helpful in determining the general level of risk. See http://nca2014.globalchange.gov/.http://nca2014.globalchange.gov/.

[12] See NOAA State of the Coastal Vulnerability to Sea Level Rise Tool (select "Erosion Rate" from drop-down box) http://stateofthecoast.noaa.gov/vulnerability/welcome.html. The State of the Coast visually displays the data from USGS's Coastal Vulnerability Index.

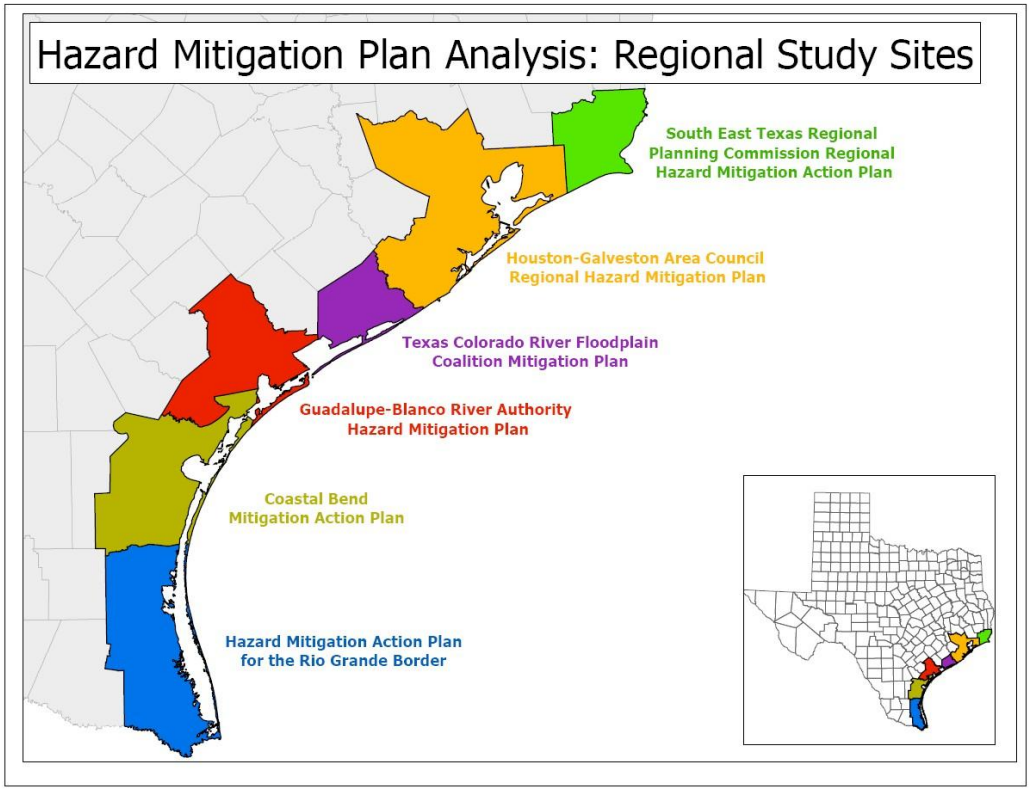

Figure 3. Coastal hazard mitigation plans by region (from Peacock et al. (2009)). As of June 20, 2014, all plans, except the Hazard Mitigation Action Plan for the Rio Grande Border, are in approved status by FEMA (http://www.fema.gov/multi-hazard-mitigation-plan-status).

Table 1. Summary of Disaster Declaration for Texas Coastal Counties 1953-2014. Data from FEMA13.

Summary of FEMA Disaster Declarations for the Texas Coastal Counties				
Tropical storms and hurricanes	Fire and Wildfire hazard	Floods	Freezes	Tornado
213	41	69	4	27

Flooding

Floods are defined as the accumulation of water within a water body and the overflow of excess water into the adjacent floodplain lands. Historically, floods, including flooding due to hurricanes/tropical storms, are one of the most frequent, destructive, and costly natural hazards affecting Texas, constituting 90 percent of the disaster damage experienced in the state (Texas Hazard Mitigation Plan, 2013). The State's Hazard Mitigation Plan reports riverine flooding as the costliest hazard, an estimated $5.5 million in state and $2 million in localized annualized physical losses. Figure 4 presents the number of flooding occurrences in each of the Texas counties. Counties inthe upper coastal region have had relatively frequent flooding occurrences since 1960 (over 40 from 1960-2012), particularly Harris, Galveston, Brazoria, Jefferson, and Orange counties.

The risk of flood for coastal Texas counties is high because they are likely to occur at least once every three years, the warning time for floods is generally short 3-6 hours, and when a flood does occur the impact is high because there is a greater potential for loss of human life and destruction and damage to infrastructure (Texas Hazards Mitigation Plan, 2013).

[13] FEMA Disaster Declarations Summary – Open Government Dataset available at https://www.fema.gov/media-library/assets/documents/28318

Flood events can last a few hours to several days or even months if certain weather conditions combine to allow precipitation to continue. This can cause shutdown of critical public safety, transportation, and utility facilities for up to 30 days or more.

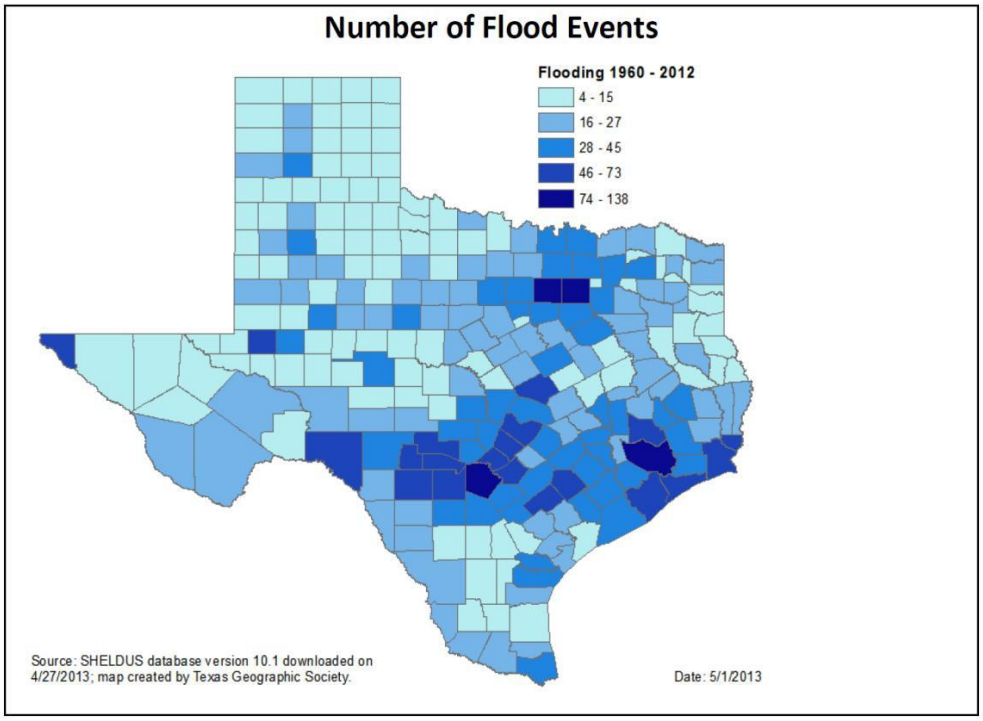

Figure 4. The map was obtained from the Texas Hazard Mitigation plan (2013) and features the number of flood events per county from 1960-2008 as reported by FEMA through SHELDUS.

Coastal Storms

Coastal storms including hurricanes and tropical storms are one of the most devastating natural hazards in the Texas coastal zone; exposing large areas of the coast, people, and infrastructure to the effects of flooding and wind damage (see Figure 5). A tropical storm is defined as a low pressure area of closed circulation winds that originates over tropical waters. Coastal storms in Texas have been designated as a high risk factor because they may result in major injuries or deaths, complete shutdown of critical facilities for days or even weeks, and they may cause major or complete destruction of property. Further, as of 2010, approximately 1 million people in Texas coastal counties live in the floodplain and may be exposed to the flood damage and property loss (NOAA, 2014c). Sixty percent of the federal disaster declarations in Texas coastal counties have been due to hurricanes or tropical storms (see Table 1) and the probability of occurrence is likely every 3 years. Although storm warning systems have improved, allowing more than 12 hours of warning, evacuation of all residents is a challenge. The State Hazards Mitigation Plan 2013 update classifies the frequency of occurrence highly likely for flooding and local erosion in the next year and likely for hurricanes and tropical storm events occurring in the next 3 years.

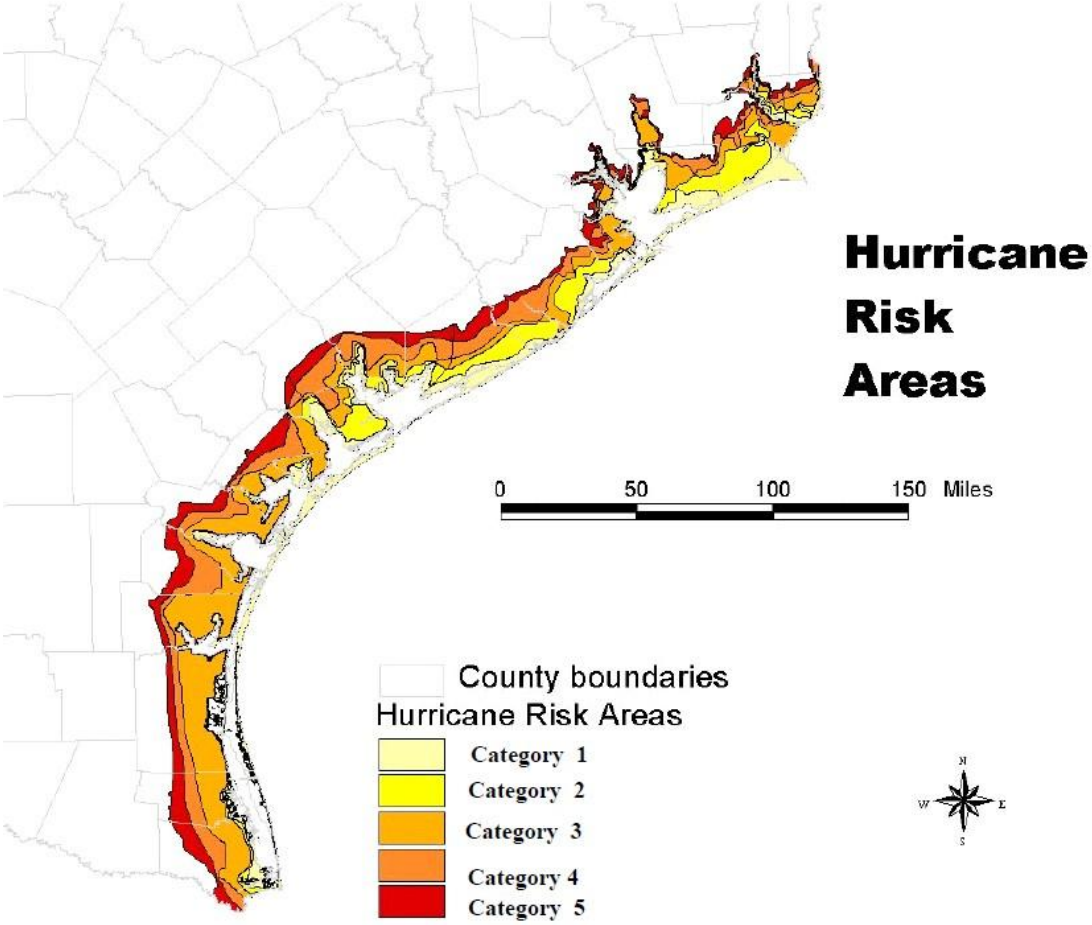

Figure 5. Hurricane Risk Areas for Texas Coastal Counties (Texas Hazard Mitigation Plan 2010-2013).

Geologic Hazards

Overall, Texas is at low risk of geologic hazards such as earthquake or tsunamis. Texas coastal counties have minimal risk of earthquakes or tsunamis (see Figure 6), which can occur as a result of submarine landslides (USGS, 2009).

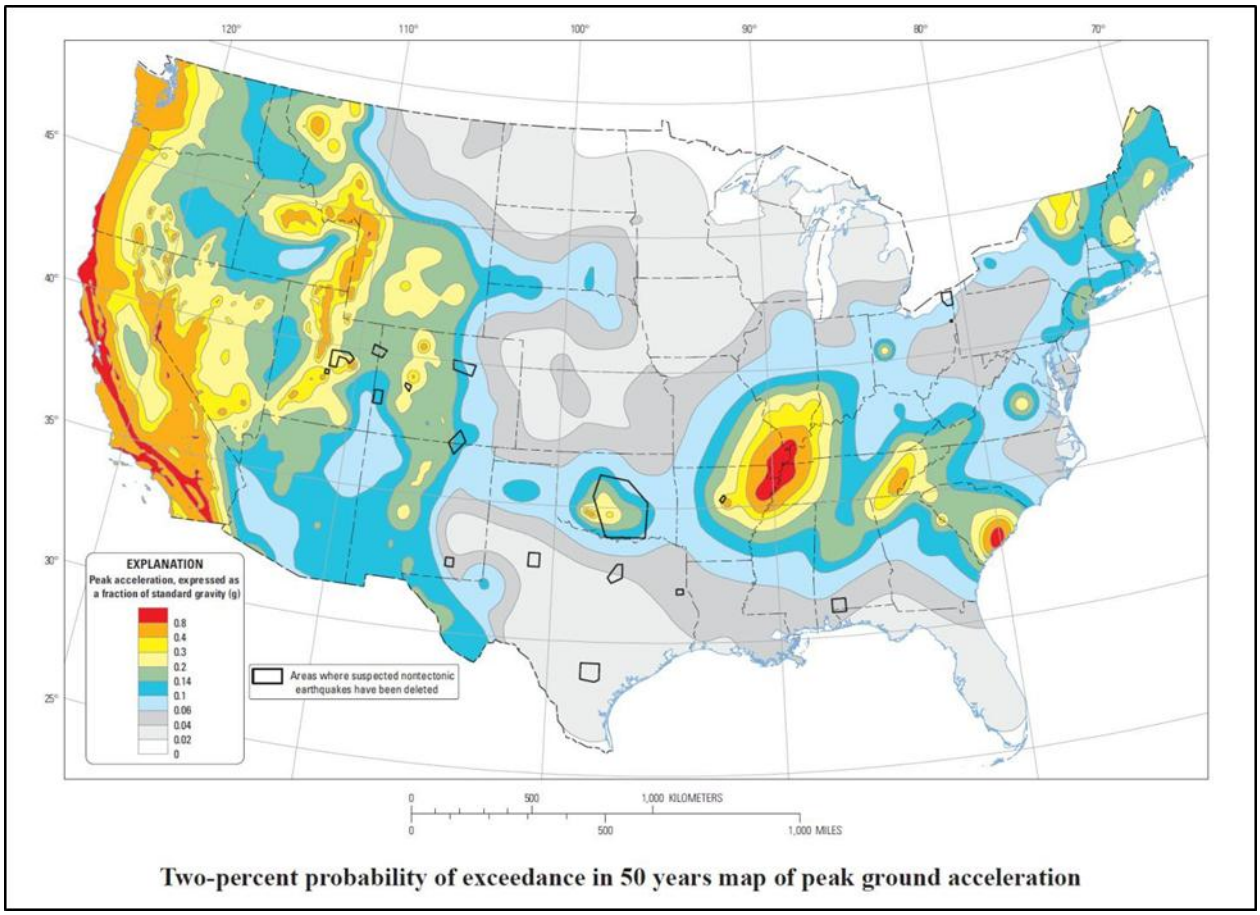

Figure 6. 2014 United States National Seismic Hazard Map (Image from USGS).

Shoreline Erosion

Coastal erosion is a hydrologic hazard defined as the wearing away of land and loss of beach, shoreline, or dune material, as a result of elevated sea level natural or manmade influences. Erosion can occur as a slow continuous process or may occur as a response to waves and currents that accompany tropical storms and hurricanes exposing property and infrastructure to storm surge. Texas has the sixth longest coastline in America coupled with some of the highest rates of coastal erosion. Approximately 64 percent of the Gulf shoreline is considered critically eroding, losing an area of 235 acres of shoreline each year (GLO, 2009). Shoreline change analysis after Hurricane Ike in 2008 revealed that many areas of the Texas upper coast experienced over 20 m of shoreline retreat, with a few areas such as the Sea Rim State Park experiencing retreat of 50 to 100 m (Gibeaut et al, 2012). Storm surge induced erosion and inundation on Bolivar Peninsula and sections of Galveston Island destroyed many homes and caused large-scale destruction of roads and other infrastructure and facilities (see Figure 7).
Erosion is ranked as high hazard because of the potential damage to infrastructure and facilities along the Gulf and Bay shorelines resulting from highly probable and frequent tropical storm activity or storm occurrence.

Whether the erosion is caused by the lack of sediments to balance the long-term losses within the coastal compartments, or the episodic erosion brought on by storms or human activities, planning and implementation of erosion response and sediment management practices is essential to the sustainability of the shoreline and public beaches. In particular, the upper Texas coast from Sabine Pass to Rollover Pass, the Brazos-Colorado headland from Quintana to Sargent Beach, and sections of South Padre Island have the greatest erosion rates along the Texas

Gulf shoreline (see Figure 2). In many of these locations, sufficient sand for nourishment is not available and other erosion mitigation methods may be needed.

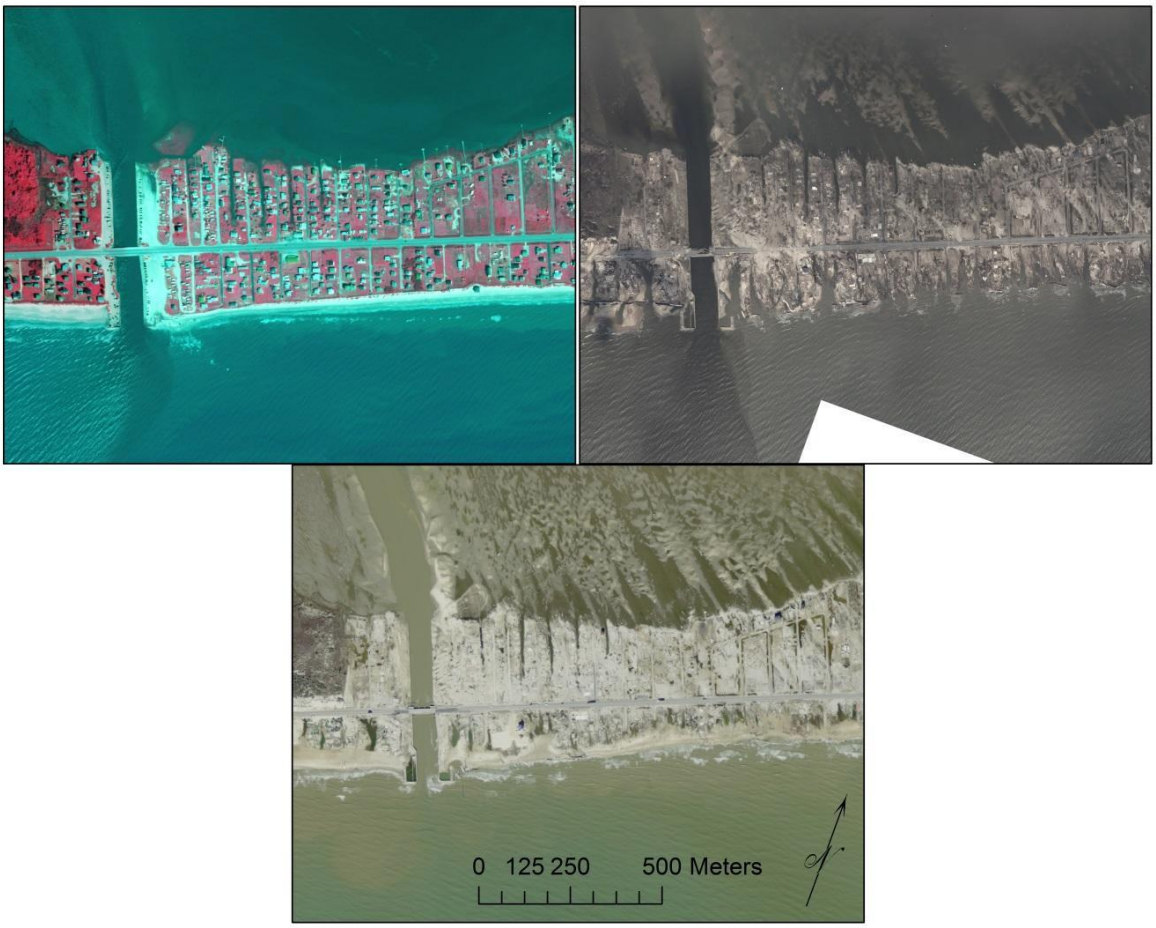

Figure 7. Imagery of Rollover Pass in Bolivar Peninsula Pre-Ike 2008 (top left), post Ike 2008 (top right), and the recovering shoreline in 2009. Images obtained from Texas Natural Resource Information System.

From the Initial Needs Assessment for the Texas coast, it was found that coastal erosion is as one of the top three issues of concern and priorities for all regions of the Texas coast (Gibeaut et al., 2014).

Relative sea level rise

Sea level rise is occurring through the entire Texas coast (see Figure 2) and exacerbates coastal erosion, inundates shallow estuarine depositional environments, and exposes infrastructure and critical facilities to wave energy or inundation. The vulnerability of the Texas coast to sea level rise as reported in the USGS Coastal Vulnerability Index (CVI) is very high (USGS, 2014). The CVI defines vulnerability as the relative risk that physical changes will occur as sea-level rises based on tidal range, wave height, coastal slope, shoreline change, geomorphology, and historical rate of relative sea-level rise. Although sea level rise is a slow process that does not immediately threaten human life, the potential ecosystem and economic costs and impacts are expected to be significant therefore, sea level rise is assigned as a medium hazard risk.

Land Subsidence

Land subsidence is defined as the loss of surface elevation due to the removal of subsurface support. Subsidence can take place from regional lowering of the land to localized collapsing. The occurrence of land subsidence is particularly high in the coastal counties relative to the rest of the state due to compaction of the underlying sediments, comprised of alluvial, estuarine, coastal and deeper marine sediments. This stack of sediment may be 10-15 km thick and compacting at a rate of 0.05 mm/yr (Montagna et al., 2007). Additional land subsidence may be caused by groundwater withdrawal and oil and gas extraction. Review of the regional hazard mitigation plans for the Texas Gulf coast reveals that subsidence is of low hazard concern; three out of five hazard plans acknowledge the hazard, but state the occurrence of significant subsidence in their plan-area is low. Because subsidence rates are minimal (0.05 mm/yr) and localized, the relative threat of land subsidence is classified as low, although it has the potential to augment the impacts of the sea level rise. Currently, subsidence alone has limited potential for injury or damage to critical facilities or infrastructure.

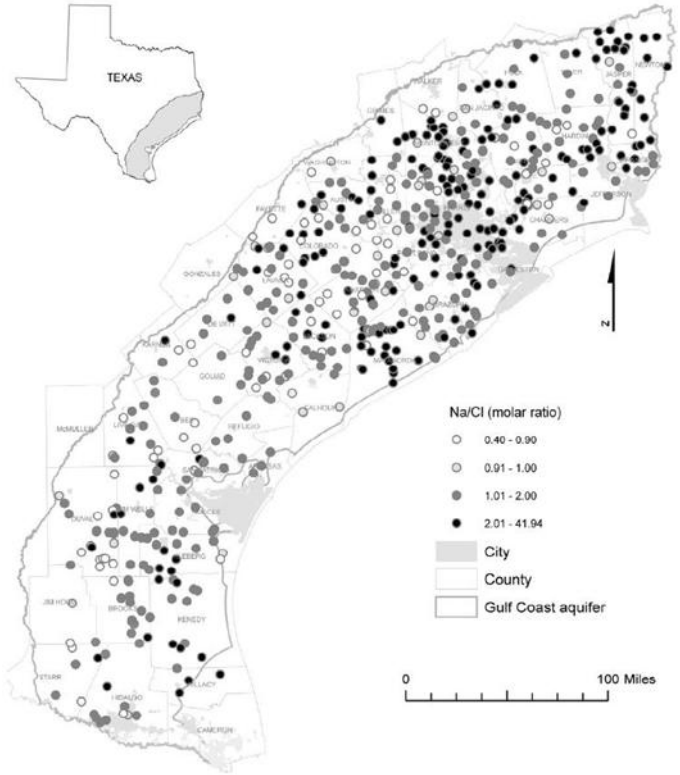

Figure 8. Distribution of Na/Cl molar ratio in the Gulf Coast aquifer of Texas (Chrowdhury et al., 2006). Na/Cl ratios of saltwater intrusion are usually lower than the marine values (~0.86 molar ratio) and high molar ratios (>1) typically characterize anthropogenic sources (Baer, 1999). Saltwater intrusion is documented for the Texas coast but, its occurrence is not likely to cause significant injury or loss to facilities or infrastructure and is found to be a medium risk hazard.

Saltwater Intrusion

Intrusion of saltwater into groundwater and other freshwater systems, particularly in estuaries, is a concern along coastal communities as it threatens municipal water supplies and affects freshwater environments, including plants and other living organisms. Saltwater intrusion into an aquifer can occur if water from the aquifer is extracted faster than it is replenished. Saltwater intrusion can also result from elevated storm surge from tropical storms and hurricanes (Steyer et al., 2007). Although its occurrence is not likely to cause significant injury or loss to facilities or infrastructure, it may have significant impact on communities and natural ecosystems. Saltwater intrusion has been

documented along parts of the Texas Gulf Coast and found to result from aquifer pumping and subsequent lowering of the water table, particularly in Kleberg, Matagorda and Brazoria counties (Chowdhury et al., 2006) (see Figure 8). The threat of saltwater intrusion is currently a medium risk.

Tornados

A tornado is defined as a rapidly rotating vortex or funnel of air extending groundward from a cumulonimbus cloud. Tornadoes occur most frequently in the northern part of Texas and are associated with cool frontal systems moving to the east (see Figure 9); however, tornadoes may also result from tropical storms in coastal counties. The severity of the impact of a large tornado is high because of the number of injuries and destruction that may take place with minimal warning time. According to FEMA Disaster Declarations database (see Table 1), the Texas coastal zone had 27 emergency declarations due to tornadoes from 1953 to 2014, a much lower number when compared to coastal storms or floods. Thus, the relative risk of a tornado in Texas coastal counties is low-medium.

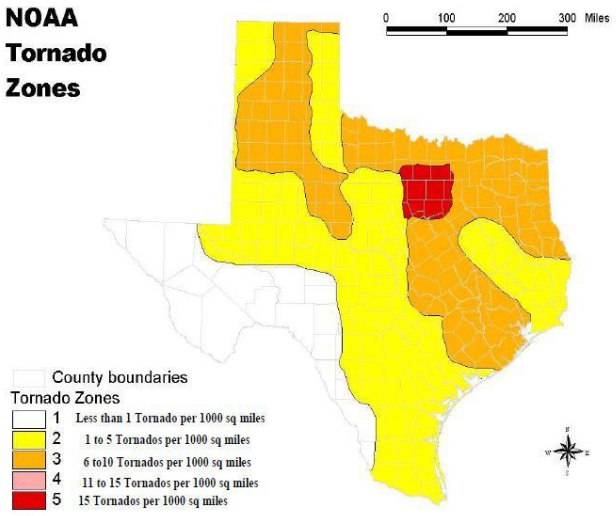

Figure 9. The map was obtained from the Texas Hazard Mitigation Plan (2010) and features tornado zones for Texas. Most of the Texas coastal counties lie within the low to low-medium range of tornado activity.

Drought

Drought is defined as the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Due to the geographic location of the state, as much as two-thirds of the state's counties, including coastal counties, lie within an arid or semi-arid climatic zone and are highly vulnerable to drought. During the past 15 years, Texas received more than 2,921 declarations for multi-county or regional drought; the Gulf Basin experiencing varying degrees of drought at least once every 5 years. According to the FEMA Disaster Declarations database, coastal counties do not have a federal declaration of drought, but many of the coastal counties have had Secretarial Drought Designation (see Figure 10) in the last 3 years. The U.S. Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to agricultural producers suffering losses in those counties.

Drought is prevalent in the coastal region and a cause of agricultural losses; yet, it has a low probability of causing death or injuries and has more minor impacts in the coastal region relative to other threats. Perhaps the biggest impact of drought to the coastal region is its impact to freshwater inflows into the bay systems. Drought within counties in or adjacent to a coastal watershed may lead to decreased input of freshwater to estuarine systems, causing increased salinities stressing environments and coastal resources like wetlands, oysters, and marine fauna. Therefore, drought is ranked as a medium to high risk hazard.

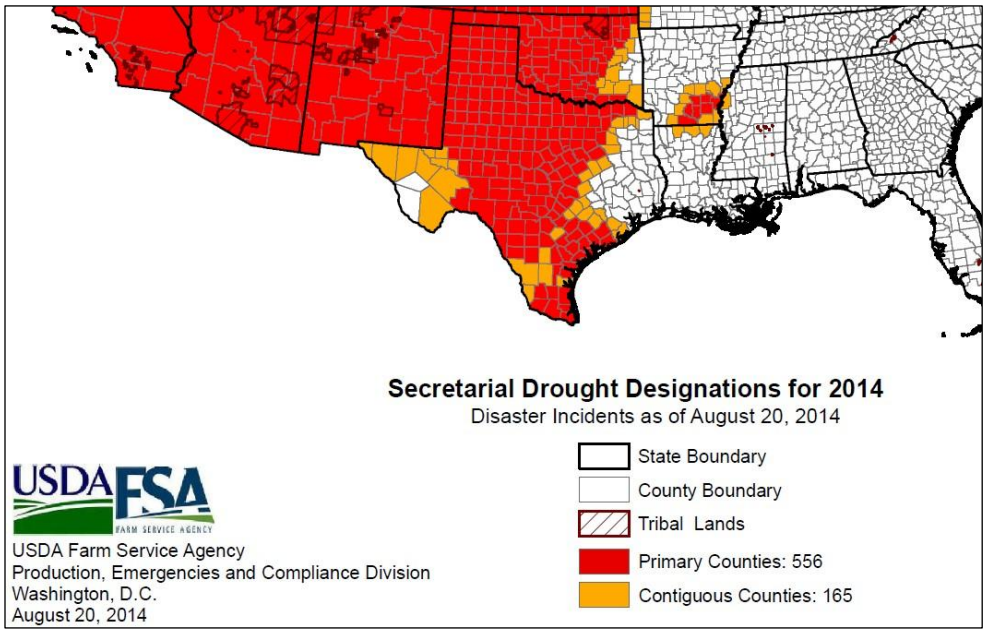

Figure 10. Secretarial Drought Designation Map.

Management Characterization:

1. *Indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred that could impact the CMP's ability to prevent or significantly reduce coastal hazards risk since the last assessment.*

Management Category	Employed by State (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these that address:			
Elimination of development/redevelopment in high-hazard areas[1]	N	Y	Y
Management of development/redevelopment in other hazard areas	N	Y	N
Climate change impacts, including sea relative sea level rise	N	Y	N
Hazards planning programs or initiatives that address:			
Hazard mitigation	Y	Y	N
Climate change impacts, including relative sea level rise	N	Y	N
Hazards mapping or modeling programs or initiatives for:			
Relative sea level rise	Y	Y	N
Other hazards	Y	N	N

2. *Briefly state how "high-hazard areas" are defined in your coastal zone.*

Special hazard areas

The Texas Natural Resources Code, §33.203, Management of Public Land, describes a special hazard area as a coastal natural resource area "[…] designated under 42 U.S.C. Section 4001 et seq. as having special flood, mudslide or mudflow, or flood-related erosion hazards and shown on a flood hazard boundary map or flood insurance rate map as Zone A, AO, A1-30, AE, A99, AH, VO, V1-30, VE, V, M, or E."

3. *For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
   a. *Describe the significance of the changes;*
   b. *Specify if they were 309 or other CZM-driven changes; and*
   c. *Characterize the outcomes or likely future outcomes of the changes.*

Development/Redevelopment in High Hazard Areas

Erosion Response Plans:

The 76th Texas Legislature enacted the Coastal Erosion Planning and Response Act (CEPRA) in 1999 as a funding mechanism to manage and mitigate damages caused by coastal erosion. The development of the ERP is a significant change, where local communities can establish or reinforce previously established setbacks for management of development in high hazard areas and mitigation of relative sea level rise. Administered by the GLO, the program has been successful in using state funding to leverage federal, state, local and private resources. The CEPRA

[1] Use state's definition of high-hazard areas.

[14] Use state's definition of high-hazard areas.

program contributes up to 75 percent of the funding for beach nourishment and dune restoration projects, and 60 percent for wetland and habitat restoration projects, shoreline protection projects, and erosion studies.

Recent changes from the 81st legislature, H.B. 2073 (2009), require local governments to adopt an Erosion Response Plan (ERP) to reduce public expenditures for erosion and storm damage losses of public and private property. Adoption of an ERP is a consideration for CEPRA funds (Texas General Land Office, 2011). In addition, some ERPs discuss development standards and opportunities for mitigation and restorations. Most ERPs were developed with the assistance of the CMP through grants to local governments.

Communities with Erosion Response Plans include:

- South Padre Island (2012) - Established a building setback line based on the "Historical Building Line" or HBL previously established in 1981 by the city and provided a minimum of 200 ft. of open beach above mean low tide. The city recognized that for it to maintain the HBL as its designated Setback Line for the ERP, the City was obligated to manage the position of the shoreline (Ravella et al., 2012).

- Nueces County and Corpus Christi (2012)-This plan provided setback lines and construction guidelines for new construction. The building setback line was set 350 ft. landward of the line of vegetation along the gulf beach. The building setback line prevents certain types of new construction within the foredune ridge area.

- Port Aransas (2012)- Setback lines established for the City of Port Aransas were developed in anticipation of coastal erosion and are located 200 ft. landward of the line of vegetation or a distance 60 times the historical annual erosion rate (as published by the Bureau of Economic Geology), whichever is greater.
    - The city also adopted an alternative rule: if dunes are destroyed by a meteorological event or do not exist, the setback line will be defined at 320 ft. landward of the Mean High Water or 70 times the annual erosion rate, whichever is greater.

- Brazoria County (2012)- The Brazoria County ERP established a building setback line of 1,000 ft. from mean high tide for all unincorporated areas of Brazoria County, and the municipalities of the Village of Surfside Beach, the Town of Quintana, and the City of Freeport, to reduce public expenditures from future storm damage to public and private properties. It established construction requirements for properties and structures located seaward of the building setback line and defined exemptions from those requirements. A setback line was not delineated along San Bernard National Wildlife Refuge or the shoreline adjacent to the Justin Hurst Management Area.

- Matagorda County (2012) – Established a building setback line that coincides with their existing Dune Protection Line and Beachfront Construction Line. The ERP identified requirements for properties located seaward of the building setback line and also defined exemptions from those requirements. The Matagorda County ERP further identified goals and procedures to enhance and protect the dune system and identified criteria for inventorying public access amenities and sites.

- City of Galveston (2012) - This document reviewed construction prohibitions, exemptions, and standards for

construction activities within and seaward of the Dune Conservation Area and within the Enhanced Construction Zone.

- The Dune Conservations Area included areas along Galveston's Gulf coast where naturally occurring beachfront dunes and restored (man-made) dunes were located. The Dune Conservation Area also included lands within 25 ft. of the north toe of existing or restored (man-made) dunes. The City prohibited construction within or seaward of the Dune Conservation Area. Exemptions may be provided for new construction and renovations of existing structures.
- The Enhanced Construction Zone was defined as an area immediately landward of the Dune Conservation Area with potential to be affected by the long-term effects of erosion. The Enhanced Constructed Zone was established for areas with Aggregate Shoreline Change Rates between -2 and -8 ft. /yr. Construction activities in the Enhanced Construction Zone were required to meet higher standards than activities in areas further inland.

- Galveston County (2012) - The historical Building Limit Line is 50 ft. landward of the Line of Vegetation. In this document, Galveston County defined its building setback line as the Dune Protection Line, which is located 200 ft. landward of the Line of Vegetation. The Galveston County ERP provided construction requirements and exemptions for properties and structures located seaward of the building setback line.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

   High X
   Medium _____
   Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

The Coastal Hazards Enhancement area is of high priority due to increasing population and development in a coastal zone that is eroding, subsiding, subject to relative sea level rise, and prone to storm impacts. Resiliency planning was the central theme at the three forums GLO hosted along the coast in 2014, drawing nearly 100 attendees. Participants included local elected officials, representatives from state legislative offices, a diverse group of city and county officials, including commissioners, planners, emergency readiness and response coordinators, real estate developers, and other community representatives and local citizens. The top coastal hazards identified by participants included: coastal storms; flooding; shoreline erosion; land subsidence; population growth; pollution; and sea level rise. The top identified impacts related to these hazards included: navigation and infrastructure vulnerability; wetlands and habitat loss; deteriorating water quality and quantity; tourism, recreation and other local economic vulnerabilities; and fish, wildlife, and other marine resource vulnerabilities.

In developing strategies to manage these natural resources, it is important to focus on coastal resilience so that we can continue to enjoy and benefit from all the resources and services provided the coast. To achieve this, it is important to increase our understanding of ecosystem services, and to both quantify and value ecosystem services to better understand how they are provided, what represents a threat to such provisions, and what

needs to be done to ensure their long-term sustainability. By monetarily valuing ecosystem services, we make relevant their importance in a common currency understood by everyone and that allows comparison to other monetarily defined competing uses.

Developing resiliency along the Texas coast will help communities recover from hazardous events and protect economic and natural assets. Coastal leaders and planners see great value in many of the new and existing resiliency planning tools and actively participate in planning efforts. However, there are also instances where planners understand resiliency, but sometimes lack the support of elected officials to implement the type of policies that lead to more sustainable long-term economies and infrastructure due to development pressures. Community officials along the coast are beginning to work together to address these challenges, but they believe the GLO is in the best position to give voice to the importance of the Texas coast – and to take the lead on major issues that have become critical to the nation's future.

Public Access

Section 309 Enhancement Objective: Attain increased opportunities for public access, taking into account current and future public access needs, to coastal areas of recreational, historical, aesthetic, ecological, or cultural value. §309(a) (3)

PHASE I (HIGH-LEVEL) ASSESSMENT:

Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *Use the table below to provide data on public access availability within the coastal zone.*

Public Access Status and Trends			
Type of Access	**Approximate Number**	**Changes or Trends Since Last Assessment** (↑, ↓, –, unknown)	**Data Source**
Beach access sites	260	↑212	Wade, 2014
Shoreline (other than beach) access sites	447	↑113	Wade, 2014
Recreational boat (power or non-motorized) access sites	673	↑424	Wade, 2014
Number of designated scenic vistas or overlook points	575 (observed) 83 (potential)	↑343	Wade, 2014 TPWD, 2014
Number of fishing access points (i.e. piers, jetties)	676	↑36	Wade, 2014
Coastal trails/ boardwalks	No. of Trails/ boardwalks 74 Miles of Trails/boardwalks 67	↑24	Wade, 2014 TPWD, 2014
Number of acres parkland/open	Total sites 208	unknown	TPWD, 2014 Wade, 2014

Public Access Status and Trends			
Type of Access	**Approximate Number**	**Changes or Trends Since Last Assessment** (↑, ↓, –, unknown)	**Data Source**
Space	Sites per miles of shoreline 504 sites/358 total miles of shorelines = 1.408 sites/mile of shoreline		
Other: Beach Watch	167 stations, 67 beaches	unknown	GLO, 2014
Other: ADA Compliant Sites	~ 87 (ADA Compliant) 189 (Mobility-Impaired Friendly)[2]	unknown	Wade, 2014
Other: Maintained ROW	50	unknown[3]	Wade, 2014

[1] Dramatic changes in public access sites is due to long-range update in information, not the creation of multiple access sites over 5 years. Inventory update project began in 2013 and concludes in 2015.

2. Briefly characterize the demand for coastal public access and the process for periodically assessing demand. Include a statement on the projected population increase for your coastal counties. There are several additional sources of statewide information that may help inform this response, such as the Statewide Comprehensive Outdoor Recreation Plan,[17] the National Survey on Fishing, Hunting, and Wildlife Associated Recreation,[18] and your state's tourism office.

There has been an 82 percent increase in the number of coastal public access sites in Texas (since 2002), but it is attributed to better data collection efforts and not an increase in the actual number of sites. Texas Sea Grant assessed the need and demand for coastal public access during its strategic planning process which takes place every four years. In Texas Sea Grant's Strategic Planning Survey for 2014-2017 (Texas Sea Grant, 2012), beach and coastal access ranked as the top concern of Texas citizens. The population within the state's coastal shoreline counties is projected to increase by 16 percent between 2010 and 2020. In 2010, the Texas coastal population was 6.1 million people and is projected to increase to 9.3 million by 2050 (NOAA, 2013). While the population along the coast increases, there will be increased pressure on our coastal resources. Additionally, there is a need for achieving ADA goals, providing enhanced resources for those who qualify under ADA.

[2] Includes beach and bay access sites

[3] Data could not be found for specific data since last assessment

[17] Most states routinely develop "Statewide Comprehensive Outdoor Recreation Plans", or SCROPs, that include an assessment of demand for public recreational opportunities. Although not focused on coastal public access, SCORPs could be useful to get some sense of public outdoor recreation preferences and demand. Download state SCROPs at www.recpro.org/scorps.

[18] The National Survey on Fishing, Hunting, and Wildlife Associated Recreation produces state-specific reports on fishing, hunting, and wildlife associated recreational use for each state. While not focused on coastal areas, the reports do include information on saltwater and Great Lakes fishing, and some coastal wildlife viewing that may be informative and compares 2011 data to 2006 and 2001 information to understand how usage has changed. See www.census.gov/prod/www/fishing.html.

Texas Sea Grant's Coastal Planning Program received 309 funding to update and enhance the Texas Coast Public Access Inventory. The goal of this project is to update the Texas Public Access Inventory and provide the information online through the TxCoasts.com website. This project addresses the needs of Texas Sea Grant's strategic planning efforts to bring awareness to public access and access planning, while also addressing the needs of GLO's 309 Project Enhancement Strategy for Public Access. In the 309 Enhancement Strategy for Public Access section, GLO states the need for "conducting a comprehensive inventory of coastal public access in Texas to support access planning." Further, the main effort to do this in Texas has been by GLO; conducted in 1989-1999, and updated in 2003. Since significant time has passed, it is of utmost importance to update the Public Access Inventory, as there have been changes seen along Texas beaches and bays (the creation of new access sites, the loss of once existing sites, population growth, and increases in tourism).

1. *If available, briefly list and summarize the results of any additional data or reports on the status or trends for coastal public access since the last assessment.*

No status and trends reports have been conducted since the last assessment. However, an assessment of all the beach and bay access points is being conducted by Texas Sea Grant's Coastal Planning Program and has been made available online. See discussion above in resource characterization.

Management Characterization:

1. *Indicate if the approach is employed by the state or territory and if there have been any significant state- or territory-level management changes (positive or negative) that could impact the future provision of public access to coastal areas of recreational, historical, aesthetic, ecological, or cultural value.*

Management Category	**Employed by State or Territory** (Y or N)	**CMP Provides Assistance to Locals that Employ** (Y or N)	**Significant Changes Since Last Assessment** (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	Y	Y
Operation/maintenance of existing facilities	Y	Y	Y
Acquisition/enhancement programs	Y	Y	Y

Cities and counties along the coast are required to adopt laws to protect the public's beach access rights. Usually, these local laws are adopted as a dune protection and beach access plan. The state reviews local beach access plans and certifies that they meet the minimum state standards set forth in the GLO Beach/Dune Rules.

To enhance ADA access, the Beach and Dune Program worked with the Coastal Management Program to purchase Mobi-mats for 16 coastal communities to allow persons with disabilities easier access to public beaches.

2. *For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
   a. *Describe the significance of the changes;*

b. Specify if they were 309 or other CZM-driven changes; and
c. Characterize the outcomes or likely future outcomes of the changes.

There have been two significant changes related to statutes, regulations, policies, and case law. The Severance v. Patterson case (Severance v. Patterson, 54 Tex. Sup. J. 172 (Tex. 2010)) and House Bill 3459 (Relating to access to and protection of certain coastal areas, June 14, 2013) have had, and may continue to have, significant impacts on public access and land development along the Texas coast. In Texas, public access to Gulf Coast beaches is not just the law, it is a constitutional right. The Texas Land Commissioner, by law, protects this public right for all Texans by enforcing the Texas Open Beaches Act. Under the Texas Open Beaches Act the public has the free and unrestricted right to access and use the State's beaches, which are located on what is commonly referred to as the "*wet beach,*" from the water to the line of mean high tide; the dry sandy area that extends from the "*wet beach*" to the natural line of vegetation can be privately owned, and may be subject to a public beach easement.

The recent Texas Supreme Court opinion in Severance v. Patterson has complicated the State's ability to use the traditional method for identifying the public beach easement on the west end of Galveston. The Texas Supreme Court opinion says erosion that suddenly changes the location of the dry beach, such as erosion caused by storms or hurricanes, does not move the established public easement from its original location. However, that public easement may "move according to gradual and imperceptible changes" that are part of a dynamic coast. The opinion of the Texas Supreme Court creates an uncertain future by rejecting how Texas traditionally determined the extent of the public beach easement. This uncertainty may prompt further litigation and delay coastal cleanup after the next big storm as administrators sort out what is public and what is private.

The Dune Protection Act (DPA) in Texas Natural Resources Code, Chapter 63, and the Beach/Dune rules in 31 Tex. Admin. Code Part 15, plays a key role in protecting coastal habitat under the CMP. When necessary, agency action to enforce the DPA has been defended and upheld in court, such as in the recent case of *State of Texas v. Larry Mark Polsky*, D-1-GV-13-000067, Travis County 126th District Court. In *Polsky*, the GLO prevailed in obtaining a jury verdict against a landowner who damaged dunes in Cameron County. The landowner was found to be in violation of his December 2010 dune protection permit and the DPA because he damaged, destroyed or removed dunes and constructed or started to construct in whole or part an unauthorized structure on his coastal property. The jury awarded penalties for the violation.

Texas House Bill 3459 addresses this distinction by granting new authority to the Commissioner of the GLO to suspend the determination of the line of vegetation after it is destroyed by a "meteorological event" and to then determine the location of the new line of vegetation. The new law defines "meteorological event" to include both atmospheric conditions that cause a sudden loss of land (avulsive events) as well as those caused by accretion and erosion. The new law codifies the distinction between avulsive events and slower-acting accretion and erosion processes. It gives authority to the Commissioner to determine the new line of vegetation or suspend the determination for up to three years when the line of vegetation is destroyed.

3. *Indicate if your state or territory has a publically available public access guide. How current is the publication and how frequently it is updated?*[19]

Public Access Guide	Printed	Online	Mobile App
State or territory has? (Y or N)	Y	Y	IN PROGRESS
Web address (if applicable)	http://www.glo.texas.gov/what-we-do/caring-for-the-coast/_publications/TexasBeachBayAccessGuide.pdf	http://www.glo.texas.gov/what-we-do/caring-for-the-coast/_publications/TexasBeachBayAccessGuide.pdf	IN PROGRESS
Date of last update	Printed in 2002[20]	Currently being updated	IN PROGRESS
Frequency of update	Currently every 10 years[21]	Previous update in 2002, Current update began in 2013, plans for update schedule TBD	IN PROGRESS

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

High **X**
Medium _____
Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

Coastal access is important both economically and ecologically as these areas contribute to ecosystem health as well as coastal tourism and recreation. With a large coast, maintenance and provision of public access is an ongoing high priority need. Due to the magnitude of number of sites, recent case law and legislative changes, and

its importance to Texas citizens as identified in a statewide survey (Texas Sea Grant, 2012), it is essential to continue projects that inventory public access to help the public, private property owners, and local governments understand evolving policies that affect public access. Part of the ongoing issue to maintain public access is dependent on changing technology and employing best management practices. The rules are currently under review under Section 2001.036 of the Government Code during which the Commissioner will confirm the ongoing need for the rules and amend the rules to provide for the suspension of LOV determinations following a meteorological event, and the closure of a public beach or access point during space flight activities.

[19] Note some states may have regional or local guides in addition to state public access guides. Unless you want to list all local guides as well, there is no need to list additional guides beyond the state access guide. However, you may choose to note that the local guides do exist and may provide additional information that expands upon the state guides.
[20] Transitioning to digital format only with printing options
[21] Transitioning to digital format only with printing options; new update frequency currently being decided on

Stakeholder feedback on public access took place in two main ways: through the Texas Sea Grant 2012 Strategic Planning Survey, a statewide survey to assess what the citizens and visitors of Texas deem most important for the Texas Coast; and two stakeholder meetings in Rockport and Port Lavaca communities, that came out of the GLO-funded Texas Public Access Inventory Project (Texas Sea Grant, 2012; Wade, 2014).

While public access is a public priority, it also has far reaching impacts. It directly affects stressors such as coastal development and population growth, as it relates to the health of the coastal ecosystem and essential habitats (wetlands, for example). Coastal storm events also affect public access, along with coastal degradation. Providing public access and defining what access means to a diverse public, remains a critical topic in coastal planning, and how this may relate to resiliency issues. The coastal zone continues to rebound from pressure from population growth and infrastructure, but the monitoring and sustainable practices moving forward will better ensure continued resilience as we look to the future of the Texas coast and the ecosystem services it provides. Public access is the beginning of education and essentially outreach, so that coastal communities – and those that visit them – can share in the beauty that this region provides. This is the beginning of establishing a future where care of the environment is top priority.

Marine Debris

Section 309 Enhancement Objective: Reducing marine debris entering the Nation's coastal and ocean environment by managing uses and activities that contribute to the entry of such debris. §309 (a) (4)

Phase I (High-Level) Assessment:
Purpose: To quickly determine whether or not marine debris is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource characterization:

1. *In the table below, characterize the existing status and trends of marine debris in the state's coastal zone based on the best available data.*

Source of Marine Debris	Existing Status and Trends of Marine Debris in Coastal Zone		
	Significance of Source (H, M, L, unknown)	Type of Impact (You can select more than one, if applicable) (aesthetic, resource damage, user conflicts, other)	Change Since Last Assessment (↑, ↓, -,
Land-based			
Beach/shore litter	H	aesthetic, resource damage, tourism, economic conditions, human health	-
Dumping	unknown	unknown	-
Storm drains and runoff	H	aesthetic, resource damage,	↑
Fishing (e.g., fishing line, gear)	H (Figures 12, 13: data not specific to land-based/ocean-based)	aesthetic, resource damage	↑
Other (please specify) (See Question 2 Table, this section)	unknown	aesthetic	↑
Ocean-based			
Fishing (e.g., derelict fishing gear)	H (Figures 12, 13: data not specific to land-based/ocean-based)	aesthetic, resource damage	↑
Derelict vessels	H	aesthetic, resource damage	Unknown
Vessel-based (e.g., cruise ship, cargo ship, general vessel)	unknown	aesthetic, resource damage	Unknown
Hurricane/storm	H	all impacts	-
Tsunami	unknown	unknown	-
Other (please specify)	N/A	N/A	N/A

(Note: information for questions 1 and 2 of Resource Characterization was obtained through personal communication with the Texas General Land Office Adopt-A-Beach Program; the Beach Access and Dune Protection Program, Coastal Resources Division; Marine Debris Reimbursement Program; Oil Spill Prevention and Response Division and Professional Services, and Construction Services throughout the months of June, July and August, 2014.)

2. *If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the status and trends or potential impacts from marine debris in the coastal zone since the last assessment.*

Source of Marine Debris	Summary of results since last assessment:
Land-based	
Beach/shore litter	NOAA created a marine debris blog: (http://marinedebrisblog.wordpress.com/) to highlight marine debris cleanup efforts, programs and partnerships across the country. The GLO's Adopt-A-Beach Program provided information on the number of miles cleaned, volunteers and tons collected. Debris details such as cigarette butts and bottle caps are also provided (see Tables 2 and 4). 2013 was the first year to incorporate plastic pieces and foam pieces, and to separate out plastic lids and plastic bottle caps. This data collection adjustment allows for the Adopt-A-Beach Program to adapt to Texas's changing coastal and marine environment. The Ocean Conservancy's 2014 International Coastal Cleanup Report includes Texas marine debris data (see Table 3).
Dumping	Dumping data is not available.
Storm drains and runoff	Determined by local jurisdiction (local initiatives). General trend is upwards (personal communication, GLO, 9/4/14) and must be mitigated through local jurisdictions. GLO records information and status for coastal wastewater permits (relevant documentation available from GLO).
Fishing (e.g., fishing line, gear)	Texas Sea Grant coordinates a program to collect monofilament via bins along the Texas coast. The Texas Monofilament Recovery and Recycling Program (MRRP) reduces discarded monofilament in the environment. In addition to collecting the fishing line with bins at popular fishing locations and boating ramps, a statewide campaign also heightens awareness about the negative impacts of monofilament line debris and encourages recycling. A total of 31,237 ounces have been collected and recorded from 2002 to 2014 (see Figure 11). Texas Parks and Wildlife Department administers the Crab Trap Removal Program, which held its 15th Annual coastwide event from February 21 to March 2, 2015. Since 2002, 31,237 derelict crab traps have been hauled from Texas bays (Texas Parks and Wildlife Department) (see Table 5).

Source of Marine Debris	Summary of results since last assessment:
Other (please specify)	The Texas Sea Grant Program coordinates the Clean Texas Marina Program, which has a marine debris component. There are 92 marinas now certified and 40 are now pledged, up from 19 and 12 respectively, from the last assessment. The GLO administers the Beach Maintenance Reimbursement Program, which provides state reimbursement to qualified city and county governments for certain expenses incurred while maintaining clean and safe public beaches. The 2010-2011 Progress Report on the Implementation of the Marine Debris Research, Prevention, and Reduction Act was released in October 2012. This report provides an update on the activities federal agencies have undertaken between January 2010 and December 2011 to address marine debris. (This is the second progress report following a report that was released in 2008-2009.) The National Marine Debris Monitoring Program (NMDMP), conducted by Ocean Conservancy and funded by EPA, is a Final Program Report (September 2007). Covering nine regions, Region 5 is dedicated to Dauphin Island, Alabama to the U.S. / Mexico border. Region 5 covers the following areas within Texas: South Padre Island, Padre Island National Seashore, Padre Island, Mustang Island, San Jose Island, Matagorda Beach, Surfside, Galveston Island State Park, San Luis Pass, Galveston Island, High Island, and Sea Rim State Park. Data collection tables (including total debris collected) are available within this report, but Region 5 has been combined with Region 4, which includes the northern jetty of Port Everglades, Florida, Puerto Rico, and the U.S. Virgin Islands to Gulf Shores, Alabama.
Ocean-based	
Fishing (e.g., derelict fishing gear)	See Fishing (e.g. fishing line, gear) section above.
Derelict vessels	Since 2005, a total of 956 derelict vessels have been documented coastwide. With funding from a Coastal Impact Assessment Program grant, a total of 739 vessels have been removed, with approximately 217 remaining. Funding for this project ends December 2016. There is not a dedicated funding stream for this effort. (Personal communication, GLO, Oil Spill Prevention and Response Division, April 2015, see Figure 12 below).
Vessel-based (e.g., cruise ship, cargo ship, general vessel)	See discussion in “Derelict Vessels” section above and Figure 12 below.
Hurricane/storm	No major hurricanes have occurred since the previous assessment. Hurricanes Rita (2005) and Ike (2008) are the most recent storm events.
Tsunami	No data available.

Table 2. Texas Adopt-A-Beach Program beach clean-up results, Spring 2010 – Spring 2014.

All Texas Counties: Date of Results	Miles Cleaned	Volunteers	Tons Collected
Spring 2010	188.4	6,790	131.85
Fall 2010	167.9	8,815	172.71
Winter 2011	24.5	266	6.09
Fall 2011	179.95	9,133	136.29
Winter 2011	19	346	6.53
Spring 2011	150.85	7,019	123.06
Fall 2012	186.4	9,316	153.52
Winter 2012	21.4	354	6.7
Spring 2012	152.8	7,369	136.92
Fall 2013	175.6	11,649	206.63
Winter 2013	30.1	603	9.75
Spring 2013	147	5,985	87
Winter 2014	23.9	442	6.44
Spring 2014	160.85	7,334	121.2
TOTALS:	**1,628.65**	**75,421**	**1,304.69**

Table 3. Ocean Conservancy International Coastal Cleanup results, Texas, 2013.

State:	People:	Pounds Collected:	Miles:	Total Items Collected:	Total Items Per Person:
Texas	12,412	205,953	150.2	368,003	29.6

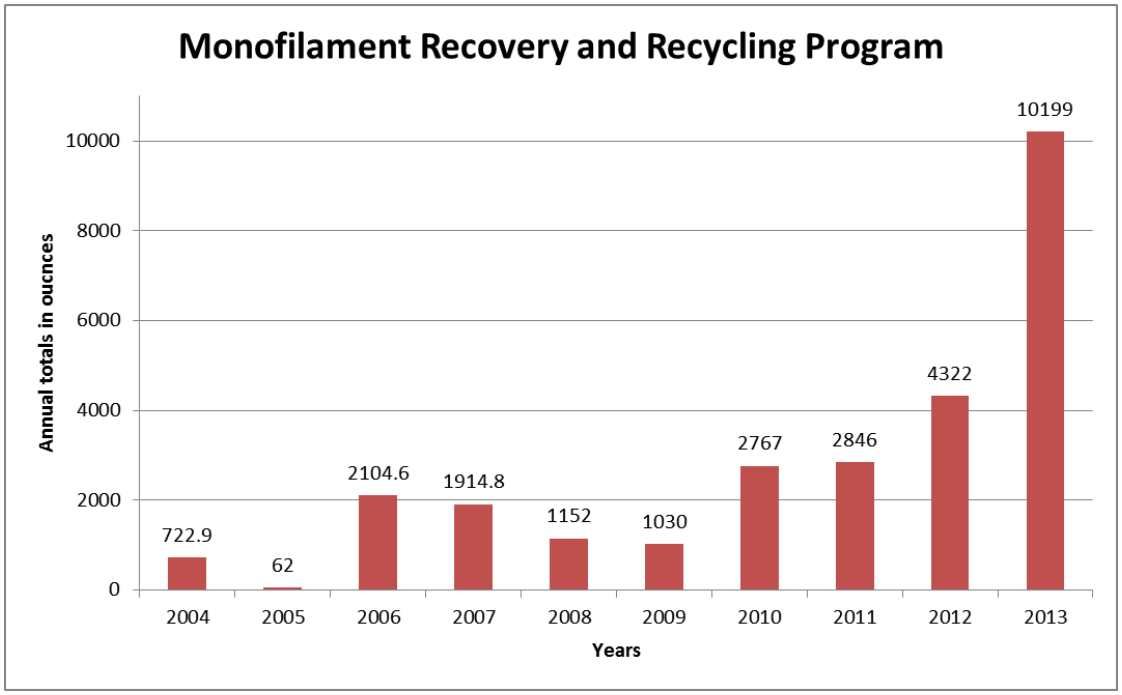

Figure 11. Monofilament Recovery and Recycling Program - annual totals (in ounces).

Table 4. Texas Adopt-A-Beach Program trash data, 2010 – 2013.

Year:	Item:	Total Items:	Percentage:
Fall 2010	Caps, Lids	33,650	78.86%
	Bags (plastic)	21,236	11.27%
	Cigarette Butts	18,818	9.99%
	Beverage Bottles (plastic)	17.937	9.52%
	Beverage Cans	12,782	6.79%
	Food Wrappers/Containers	12,159	6.46%
	Cups, Plates, Forks, Knives, Spoons	10,745	5.70%
	Beverage Bottles (glass)	8,339	4.43%
	Rope	7,782	4.13%
	Straws, Stirrers	6,668	3.54%
	Top Ten Total	**150,116**	**79.69%**
Fall 2011	Cigarettes/Cigarette Filters	35,790	18.08%
	Caps, Lids	30,998	15.66%
	Beverage Bottles (plastic) 2 liters or less	17,578	8.88%
	Bags (plastic)	16,368	8.27%
	Food Wrappers/Containers	12,672	6.40%
	Beverage Cans	10,166	5.14%
	Cups, Plates, Forks, Knives, Spoons	9,631	4.87%
	Straws/Stirrers	8,253	4.17%
	Glass Beverage Bottles	6,861	3.47%
	Rope	6,214	3.14%
	Top Ten Total	**154,531**	**78.06%**
Fall 2012	Cigarettes/Cigarette Filters	37,362	20.19%
	Caps/Lids	31,037	16.77%
	Beverage Bottles (plastic) 2 liters or less	16,419	8.87%
	Bags (plastic)	13,844	7.48%
	Food Wrappers/Containers	12,712	6.87%
	Cups, Plates, Forks, Knives, Spoons	9,031	4.88%
	Straws/Stirrers	8,334	4.50%
	Beverage Cans	7,638	4.13%
	Rope	6,133	3.31%
	Cigar Tips	5,823	3.15
	Top Ten Total	**148,333**	**80.16%**
Fall 2013	Bottle Caps (plastic)	62,641	17.02%
	Plastic Pieces	50,085	13.61%
	Cigarette Butts	34,235	9.30
	Beverage Bottles (plastic)	26,020	7.07%
	Foam Pieces	21,029	5.71%
	Food Wrappers (candy, chips, etc.)	15,458	4.20%
	Fishing Line (1 yard/meter = 1 piece)	13,191	3.58%
	Lids (plastic)	12,389	3.37%
	Straws/Stirrers	11,107	3.02%
	Beverage Cans	9,497	2.58%
	Top Ten Total	**255,652**	**69.47%**

Table 5. Annual Crab Trap Removal Program results: 2002 – 2014. The numbers in red indicate combined numbers for Aransas and Corpus Christi Bay, using Conn Brown Harbor as a trap drop off site. The traps came from both directions

Crab Traps Removed:	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sabine Lake	438	266	128	140	23	31	61	16	81	101	82	75	73
Galveston Bay	3214	1091	1264	1193	1113	1748	476	446	363	568	171	408	342
Matagorda Bay	526	522	452	117	109	202	50	179	7	64	41	45	8
San Antonio Bay	2131	1558	1537	629	206	363	561	1048	666	554	138	274	277
Aransas Bay	(1392)	(407)	114	255	384	308	(126)	189	349	116	35	61	30
Corpus Christi Bay	*	*	72	47	33	163	*	22	121	34	25	18	18
Up Laguna Madre	283	4	3	55	4	1	1	27	1	3	0	3	0
Low Laguna Madre	86	10	1	73	50	0	26	0	0	51	7	13	40
Totals:	**8070**	**3858**	**3571**	**2509**	**1922**	**2816**	**1301**	**1927**	**1588**	**1491**	**499**	**897**	**788**

*** These are blank because the numbers have been combined with Aransas Bay (row above).**

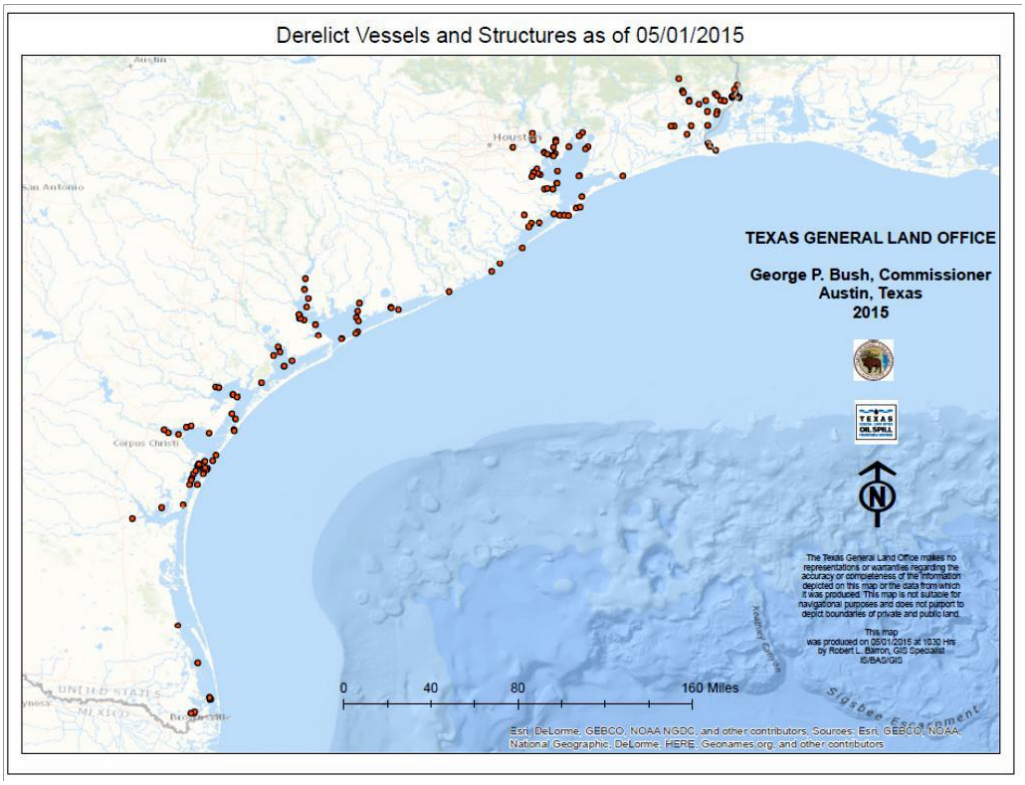

Figure 12. This map shows the locations of the remaining 217 derelict vessels in the coastal environment that have been documented by the GLO, Oil Spill Prevention and Response Division.

Management Characterization:

1. *Indicate if the approach is employed by the state if there have been any significant state level management changes (positive or negative) for how marine debris is managed in the coastal zone.*

Management Category	**Employed by State** (Y or N)	**CMP Provides Assistance to Locals that Employ** (Y or N)	**Significant Changes Since Last Assessment** (Y or N)
Marine debris statutes, regulations, policies, or case law interpreting these	Y	Y	N*
Marine debris removal programs	Y	Y	N

* Please note that there are no new marine debris statutes, regulations, policies or programs that will impact the Texas Adopt-A-Beach Program (more information found in Resource Characterization, Part 2.)

2. *For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
   a. *Describe the significance of the change;*

      Not applicable.

   b. *Specify if it was a 309 or other CZM-driven change; and*

      Not applicable.

   c. *Characterize the outcomes and/or likely future outcomes of the changes(s).*

      Not applicable.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*
   High _____
   Medium__X___
   Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

Marine debris is not only a worldwide issue; it is also a significant concern in Texas. Collectively, both federal and state marine debris programs are robust, but are still in need of more education and outreach efforts. Further financial support to help spread the messages about the negative impacts marine debris has on our Texas shores could help reduce the amount of trash found in Texas as a whole.

Marine debris was a significant issue in the aftermath of Hurricane Ike. The GLO served as the primary Federal Emergency Management Agency (FEMA) contact for marine debris and coordinated environmental requirements, addressed contractor issues, worked with city, county, and federal governments, and worked with the public on issues associated with marine debris removal. In the year following the storm more than 28,000 cubic yards of debris and 131 vessels were removed from state-owned submerged lands. At the time of Hurricane Ike, there was some confusion over who had primary authority for clean-up. The GLO worked with the state legislature to address this issue and GLO was designated as the responsible agency. This designation enables the GLO and TX CMP to pre-position workers and equipment before a storm. This change will help address marine debris response necessary in the wake of future storms.

Incentives should be considered for coastal communities who actively participate in regulation and enforcement of anti-littering laws in an effort to reduce marine debris on Texas shores. Texas Adopt-a-Beach, tracks data collection at beach cleanup sites, which is reported in an online system that is used by various entities. This data can be used to produce educational materials for region specific areas that can be distributed throughout the Texas coastal zone for Texans of all ages.

Cumulative and Secondary Impacts

Section 309 Enhancement Objective: Development and adoption of procedures to assess, consider, and control cumulative and secondary impacts of coastal growth and development, including the collective effect on various individual uses or activities on coastal resources, such as coastal wetlands and fishery resources.§309(a)(5)

Phase I (High-level) Assessment:
Purpose: To quickly determine whether or not cumulative and secondary impacts is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *Using National Ocean Economics Program Data on population and housing, please indicate the change in population and housing units in the state's coastal counties between 2012 and 2007. You may wish to add additional trend comparisons to look at longer time horizons as well (data available back to 1970) but, at a minimum, please show change over the most recent five year period (2012-2007) to approximate current assessment period.*

Trends in Coastal Population and Housing Units				
Year	**Population**		**Housing**	
	Total (# of people)	% Change (compared to 2007)	Total (# of housing units)	% Change (compared to 2007)
2007	5,885,491	7.49%	2,357,256	4.67%
2012	6,326,058		2,467,309	

The chart above shows an increase in the state's coastal population by almost half a million over a five year span (2007-2012), with an increase of over 100,000 in total number of housing units over the same five year period. This information is highlighted in the housing density maps (see Figures 13), from 1970 to a projected 2030. Reviewing the following map of Texas Priority Conservation Areas, Environmentally Sensitive Shoreline, and Ecologically Unique Rivers map (see Figure 14; showing what is potentially threatened by projected increases in population and housing density in core urban areas), combined with the potential continued growth in population, it should be noted that the increasing areas in population and housing development will impact these vital natural resources (see Figures 13-15).

In addition to the potential threat to ecologically sensitive areas, the increase in population and housing units will increase the need for infrastructure and energy, which could increase the density of wind turbines (see Figure 16, March 2012) and the need for space for waste via landfills (see Figure 17, April 2007).

The Texas coastal zone lies in a floodplain (see Figure 18) which will be susceptible to sea level rise in the future (see 309 Assessment Coastal Hazards Section, Figure 2). Finally, as discussed in the Wetlands section, wetland habitat is a vital component of the Texas coastal region. The U.S. Army Corps of Engineers has jurisdiction over wetland delineation permits, and as seen in Figures 19 and 20, these permits are extensive. Wetlands along this region are critical to storm buffering, in addition to serving as floral and fauna habitat, supporting biodiversity, providing ecosystem services, functioning as recreational areas and adding cultural value to the coastal-living

experience (citing 309 Phase I Assessment Wetlands Section, Resource Characterization 2). Coastal Hazards, including flooding, coastal storms and shoreline erosion, have been identified as a high priority by the Texas CMP, and these are all directly affected by the survival of the regional wetlands and their environmental support as a buffer zone.

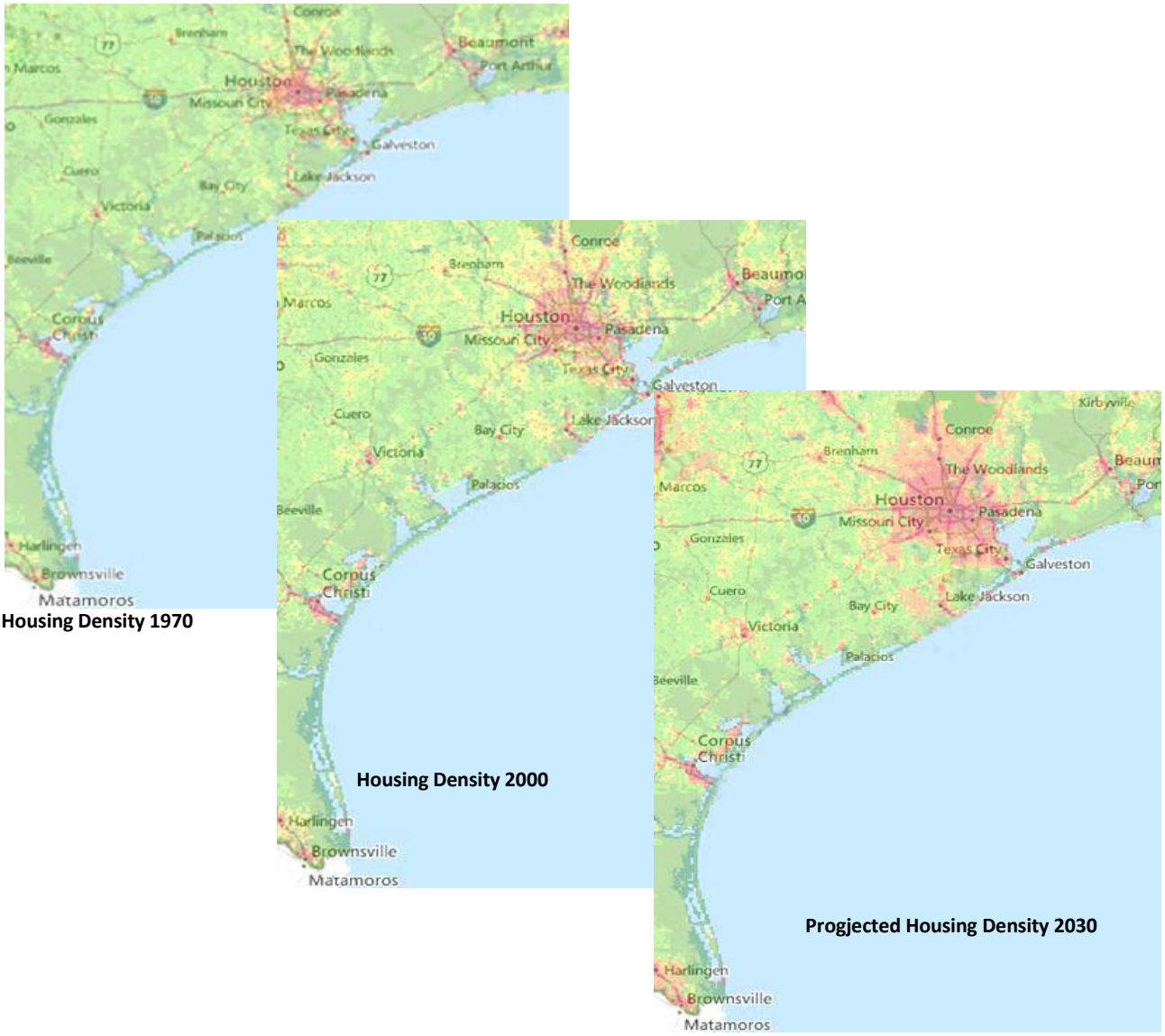

Figure 13. Housing density maps, showing a visual increase in population density from the years 1970, 2000, and 2030. Source: Landscope America Atlas, 2014 (NatureServe).

The maps present a clear picture of how coastal development threatens the coastal system. Specifically, the maps show hot spots of high housing density in red, with low density in green. From 1970 to 2000, housing density increased dramatically in the three core coastal urban areas (Houston-Galveston, Corpus Christi and Brownsville-South Padre). The projections for 2030 show an even more significant increase in housing density in these core areas. These areas, while home to core coastal urban centers, are also home to many essential habitats in which coastal species thrive (see Figure 14). In addition, these increases in housing density also describe the increased population that will appear along the coast in the future. This dynamic has direct impacts on coastal hazards as a result of the number of people and built infrastructure that are put in harm's way.

Figure 14. Texas Priority Conservation Areas, Environmentally Sensitive Shoreline, and Ecologically Unique Rivers. Source: Landscope America Atlas, 2014 (NatureServe), defined by The Nature Conservancy.

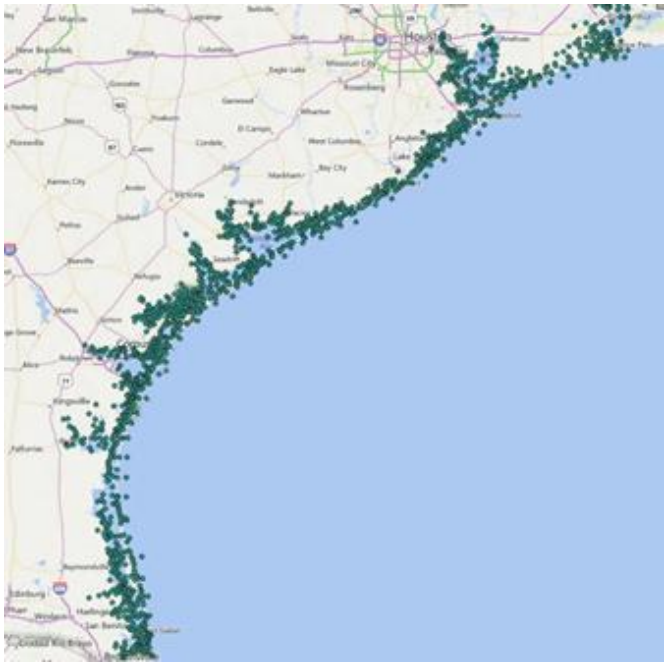

Figure 15. Texas Species Critical Habitat along the Texas coastal shore. Source: Landscope America Atlas, 2014 (NatureServe). Texas General Land Office created the Texas Gulf Coast Species / Habitat layer in 1995.

This map describes an inventory of specific places of coastal habitat and the species that use them. When comparing this map to housing density projections, there is concern as to the consequences in these special habitats.

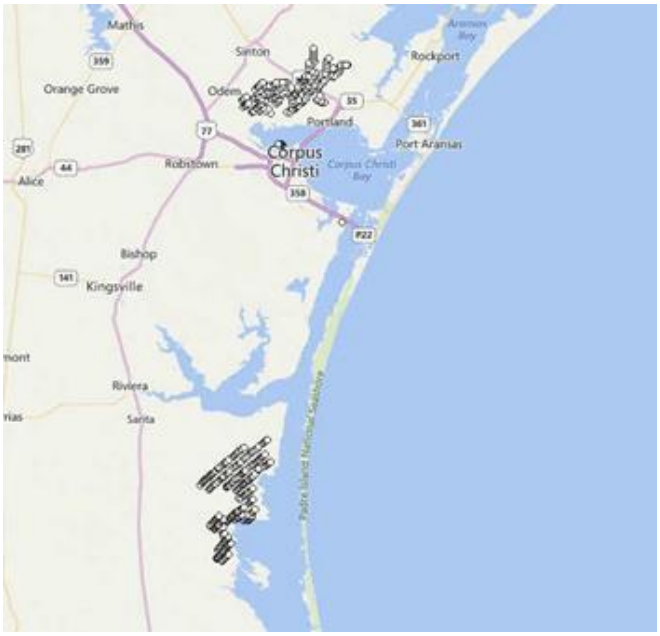

Figure 16. Texas Wind Turbines (FAA). Source: Landscope America Atlas, 2014 (NatureServe). The Federal Aviation Administration (FAA) created the Texas Windmills layer, Updated March 2012.

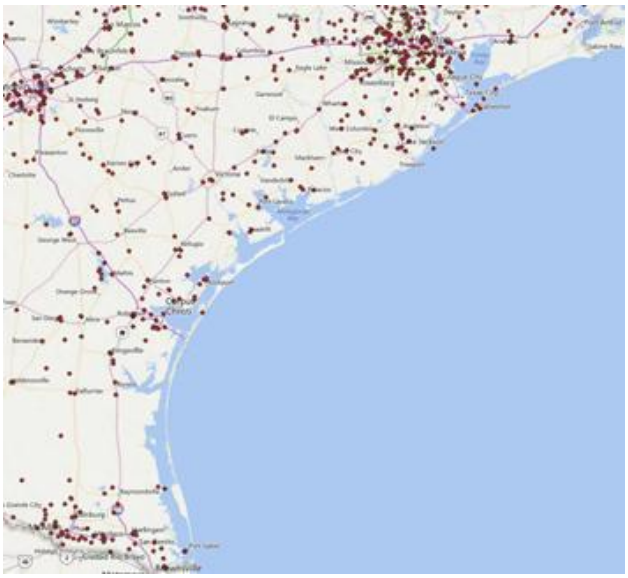

Figure 17. Texas Municipal Solid Waste Sites and Landfills. Landscope America Atlas, 2014 (NatureServe). The Texas Commission on Environmental Quality (TCEQ) created the Municipal Solid Waste Sites and Landfills Layer in April 2007.

Waste and landfills are located throughout the entire state, but are also concentrated in our core coastal urban areas. In addition, some are located very close to species habitats as seen in the species habitat map. As housing density and population continue to rise, more waste will increase landfill needs, further threatening the coastal environment by taking up valuable space better suited to other activities and causing potential pollution through landfill gas, leachate, or runoff.

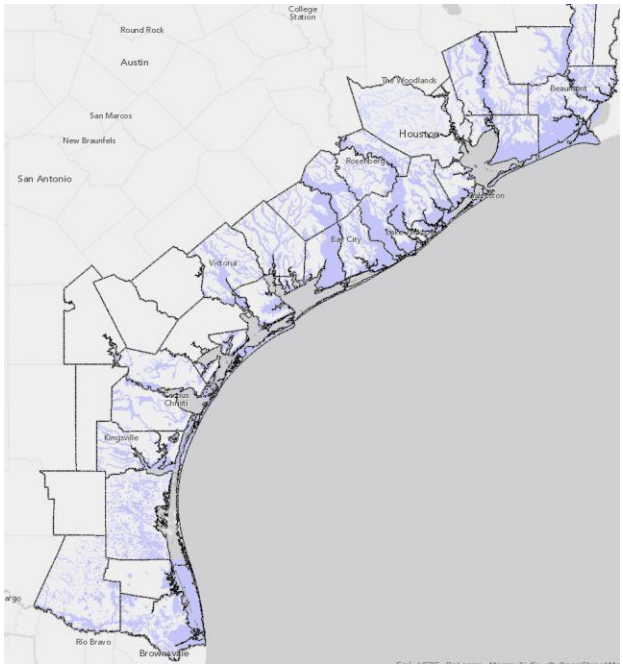

Figure 18. 100 year floodplain. Source: Texas Coastal Community Planning Atlas, 2014.

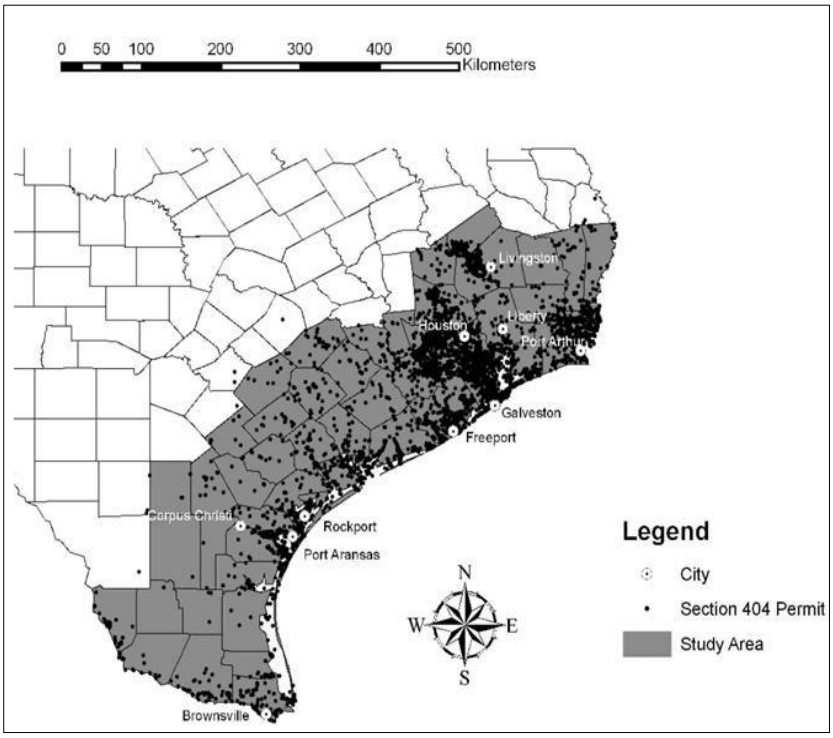

Figure 19. Location of Section 404 wetland permits, designated by the U.S. Army Corps of Engineers jurisdiction, indicating permits for development in the Texas Coastal Zone, 1991-2002 (Brody 2008).

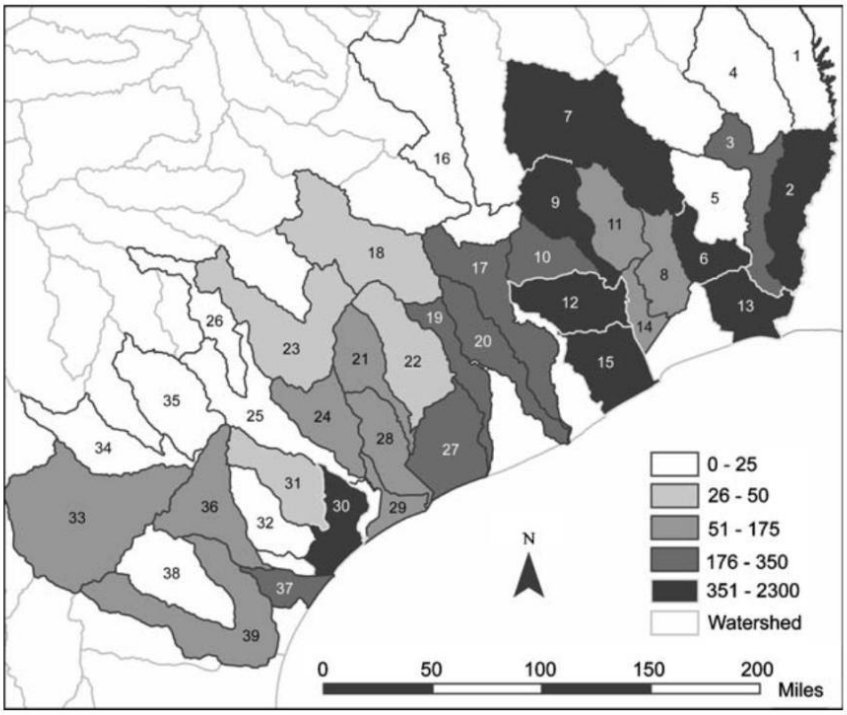

Figure 20. Wetland permit counts by watershed, Texas Coastal Zone, 1991–2002 (Brody 2007).

2. *Using provided reports from NOAA's Land Cover Atlas or high-resolution C-CAP data please indicate the status and trends for various land uses in the state's coastal counties between 2006 and 2011 (2010)*. You may use other information and include graphs and figures, as appropriate, to help illustrate the information.*

Distribution of Land Cover Types in Coastal Counties (Texas between 2006 and 2010) *		
Land Cover Type	**Land Area Coverage in 2010 (Acres)**	**Gain/Loss Since 2006 (Acres)**
Developed, High Intensity	190,649.6	Gain: 12,595.2 Loss: 691.2
Developed, Low Intensity	211,859.2	Gain: 6,649.6 Loss: 1472
Developed, Open Space	147,968	Gain: 7,129.6 Loss: 2912
Grassland	843,622.4	Gain: 21,811.2 Loss: 98,195.2
Scrub/Shrub	970,841.6	Gain: 96,448 Loss: 26,752
Barren Land	411,257.6	Gain: 24,883.2 Loss: 14,521.6
Open Water	2,281,137.6	Gain: 9,184 Loss: 5,779.2
Agriculture	2,883,136	Gain: 9,382.4 Loss: 24,876.8
Forested	353,753.6	Gain: 2,246.4 Loss: 7,385.6
Woody Wetland	503,769.6	Gain: 6,182.4 Loss: 8,640
Emergent Wetland	965,132.8	Gain: 12,044.8 Loss: 15,360

The highlighted areas in the chart above describe the loss in land cover types of grassland, agriculture, forested and woody and emergent wetland in a four year time span (2006-2010). Gains and losses occur in different localities such that change is best observed in case specific examples. Overall, there is a gain of slightly more than 21,000 acres of developed land cover and almost 6,000 acres of wetland loss within four years (Woody and Emergent Wetland combined).

3. *Using provided reports from NOAA's Land Cover Atlas or high-resolution C-CAP data, please indicate the status and trends for developed areas in the state's coastal counties between 2006 and 2011 (2010)* in the two tables below. You may use other information and include graphs and figures, as appropriate, to help illustrate the information.*

Development Status and Trends for Coastal Counties (Texas) [1, 2, 3]			
	2006	**2010**	**Percent Net Change**
Percent land area developed	8.30	8.67	3.18
Percent impervious surface area	3.25	3.41	3.86

How Land Use is Changing in Coastal Counties (Texas)[2]	
Land Cover Type	**Areas Lost to Development Between 2006-2010**[1, 2, 3] (Acres)
Barren Land	5,331.2
Emergent Wetland	2,432
Woody Wetland	6,540.8
Open Water	409.6

Agriculture	18,796.8
Scrub/Shrub	4,844.8
Grassland	7,193.6
Forested	12,992

[1] Data was only available from 2010, not 2011.
[2] Numbers calculated by taking the average of all coastal counties. See Appendix D.
[3] Reference: http://www.csc.noaa.gov/ccapatlas/#.

4. *Using data from NOAA's State of the Coast "Shoreline Type" viewer, indicate the percent of shoreline that falls into each shoreline type. You may provide other information and/or use graphs or other visuals to help illustrate.*

Shoreline Types[1]	
Surveyed Shoreline Type	**Percent of Shoreline**
Armored	15
Beaches	15
Flats	8
Rocky	18
Vegetated	44

[1] http://stateofthecoast.noaa.gov/shoreline/welcome.html

5. *If available, briefly list and summarize the results of any additional state-specific data or reports on the cumulative and secondary impacts of coastal growth and development, such as water quality and habitat fragmentation, since the last assessment to augment the national datasets.*

Additional datasets showing development:

- The Texas Sustainable Coastal Initiative Coastal Communities Planning Atlas is a visualization tool to identify data related to environmental degradation, natural hazard risks and changes in land use patterns. Users can create maps based on various development scenarios. http://coastalatlas1.arch.tamu.edu/fv/CoastalAtlas_1/

- The LandScope America project includes state-specific information regarding a conservation overview, priorities, partners, plants and animals, protected areas, recreation and exploration, and threats and issues, with an interactive map option feature. www.landscope.org

Management Characterization:

1. *Indicate if the approach is employed by the state and if there have been any significant state-level changes (positive or negative) in the development and adoption of procedures to assess, consider, and control cumulative and secondary impacts of coastal growth and development, including the collective effect on various individual uses or activities on coastal resources, such as coastal wetlands and fishery resources, since the last assessment?*

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	Y	N
Guidance Documents	Y	Y	N
Management Plans (including SAMPs)	N[1]	Y	N

[1] Communities implementing approved Public Access and Erosion Response Plans are eligible to receive state funds.

Cities and counties Beach Access and Dune Management Plans and Erosion Response Plans address development and access in coastal areas. (See the Wetlands Enhancement section for more information .) The state reviews local beach access plans and certifies that they meet the minimum state standards set forth in the General Land Office Beach/Dune Rules. These plans can address land use, development, and impervious surfaces, but are under the authority of local municipalities and counties. Changes taking place at the local level do not constitute state-level changes.

2. *For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
    a. *Describe the significance of the change;*
    b. *Specify if it was a 309 or other CZM-driven change; and*
    c. *Characterize the outcomes and/or likely future outcomes of the changes(s).*

As stated in the chart above, there have been no significant changes since the last assessment.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

    High __X__
    Medium_____
    Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

The coastal population in Texas is increasing and this trend is predicted to continue in the future leading to increased demand for and use of coastal resources. This leads to expanded cumulative and secondary impacts to coastal communities and the local environments on which they depend.

The cumulative and secondary impacts enhancement area is deemed high priority because significant changes to

the coastal environment pose threats to ecosystem health and function, the services they provide to human populations, and the overall resilience of coastal and marine systems. Impacts to natural resources are projected to remain chronically high due to increasing development in the coastal zone, coupled with projected regional relative sea level rise effects.

As population and infrastructure demands continue to increase, resulting in the expansion of impervious surface area, the risk of negatively impacting wetlands, coastal habitat and water resources will rise. To help mitigate these effects, freshwater inflow research is continuing along the Texas coast and will remain relevant in the future (Montagna et al 2002). Senate Bill 3 provides protection of freshwater inflows and must be taken under consideration both inland and at the coast (Puig-Williams 2013). Coastal development exacerbates the impacts coastal hazards have on coastal communities and the natural environment.

Special Area Management Planning

Section 309 Enhancement Objective: Preparing and implementing special area management plans for important coastal areas. §309(a)(6)

The Coastal Zone Management Act defines a Special Area Management Plan (SAMP) as "a comprehensive plan providing for natural resource protection and reasonable coastal-dependent economic growth containing a detailed and comprehensive statement of policies; standards and criteria to guide public and private uses of lands and waters; and mechanisms for timely implementation in specific geographic areas within the coastal zone. In addition, SAMPs provide for increased specificity in protecting natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, including those areas likely to be affected by land subsidence, sea level rise, and improved predictability in governmental decision making."

PHASE I (HIGH-LEVEL) ASSESSMENT:
Purpose: To quickly determine whether the enhancement area is a high priority enhancement objective for the CMP that warrants a more in-depth assessment. The more in-depth assessments of Phase II will help the CMP understand key problems and opportunities that exist for program enhancement and determine the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *In the table below, identify geographic areas in the coastal zone subject to use conflicts that may be able to be addressed through a special area management plan (SAMP). This can include areas that are already covered by a SAMP but where new issues or conflicts have emerged that are not addressed through the current SAMP.*

Geographic Area	**Opportunities for New or Updated Special Area Management Plans** Major conflicts/issues
Coastal Zone	Opportunities exist for development of SAMPs, but SAMPs are not currently authorized in Texas*

Note: The Texas Legislature amended the Coastal Coordination Act in 1995 to prohibit development of a special area management plan, including a plan for an area designated under the national estuary program. No action to change that has been taken since.

2. *If available, briefly list and summarize the results of any additional state- or territory-specific data or reports on the status and trends of SAMPs since the last assessment.*

This is not applicable in Texas.

Management Characterization:

1. *Indicate if the approach is employed by the state or territory and if there have been any significant state- or territory-level management changes (positive or negative) that could help prepare and implement SAMPs in the coastal zone.*

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
SAMP policies, or case law interpreting these	N	N	N
SAMP plans	N	N	N

This section is not applicable, as development and approval of SAMPs is prohibited.

2. *For any management categories with significant changes, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
    a. *Describe the significance of the changes;*
    b. *Specify if they were 309 or other CZM-driven changes; and*
    c. *Characterize the outcomes or likely future outcomes of the changes.*

None.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

(no priority given, as SAMPs are prohibited by the Texas Legislature.)

High _____
Medium _____
Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

This section is not applicable, as development and approval of SAMPs by the CMP is prohibited.

Ocean Resources

Section 309 Enhancement Objective: Planning for the use of ocean resources.§309(a)(7)

Phase I (High-level) Assessment:

Purpose: To quickly determine whether or not ocean resources is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *Understanding the ocean economy can help improve management of the resources it depends on. Using the Economic: National Ocean Watch (ENOW)[30] indicates the status of the ocean economy as of 2010 as well as the change since 2005 in the tables below. Include graphs and figures, as appropriate, to help illustrate the information.*

Status of Ocean Economy for Coastal Counties (2010)[30]				
	Establishments (# of Establishments)	**Employment** (# of Jobs)	**Wages** (Dollars)	**GDP** (Dollars)
Living Resources*	234	2,120	$58.0 Million	$196.9 Million
Marine Construction	175	6,948	$417.4 Million	$858.4 Million
Marine Transportation	721	29,714	$1.8 Billion	$4.5 Billion
Offshore Mineral Extraction	2,259	88,123	$13.3 Billion	$79.5 Billion
Tourism & Recreation	2,124	39,663	$616.9 Million	$1.3 Billion
All Ocean Sectors[1]	5,513	166,568	$16.2 Billion	$86.7 Billion

[1]Ship and boat building is included in the "All Ocean Sectors" row even though it is not one of the table rows. Ship and boat building represents the 2.2 percent of establishments, 2.8 percent of the employment, 1.4 percent of theWages, and 0.4 percent of the GDP for all ocean sectors.

Change in Ocean Economy for Coastal Counties (2005-2010)[30]				
	Establishments (% change)	**Employment** (% change)	**Wages** (% change)	**GDP** (% change)
Living Resources*	-7.87%	-5.48%	22.56%	23.59%
Marine Construction	3.55%	15.8%	47.9%	29.32%
Marine Transportation	7.61%	8.93%	34.64%	49.98%
Offshore Mineral Extraction	20.87%	14.07%	36.22%	10.25%
Tourism & Recreation	13.95%	5.39%	20.5%	18.98%
All Ocean Sectors**	14.06%	10.44%	35.5%	12.61%

*Living resources sector includes the fishing industry, aquaculture, and seafood processing and markets.

** This average reflects categories not included in this table.

[30] National Ocean Watch: http://www.coast.noaa.gov/enowexplorer/

2. *In the table below, characterize how the threats to and use conflicts over ocean resources in the state or territory's coastal zone have changed since the last assessment.*

Significant Changes to Ocean Resources and Uses	
Resource/Use	**Change in the Threat to the Resource or Use Conflict Since Last Assessment** (↑, ↓, –, unknown)
Resource	
Benthic Habitat (including coral reefs)	↑
Living marine resources (fish, shellfish, marine mammals, birds, etc)	↑
Sand/gravel	↑
Cultural/historic	↑
Other (please specify)	
Use	
Transportation/navigation	↑
Offshore development[31]	↑
Energy Production	↑
Fishing (Commercial and Recreational)	↑
Recreation/Tourism	↑
Sand/gravel extraction	↑
Dredge disposal	–
Aquaculture	–
Other (please specify)	

[31] "Offshore development' includes energy support infrastructure like underwater cables and pipelines, and infrastructure associated with energy production, is captured under the "energy production" category.

3. *For the ocean resources and uses in question 2 Table (above) that had an increase in threat to the resource or increased use conflict in the state's coastal zone since the last assessment, characterize the major contributors to that increase.*

Major Contributors to an Increase in Threat or Use Conflict to Ocean Resources												
Resource	**Major Reasons Contributing to Increased Resource Threat or Use Conflict** (Note All that Apply with "X")											
	Land-based development	Offshore development	Polluted runoff	Invasive species	Fishing (Comm & Rec)	Aquaculture	Recreation	Marine Transportation	Dredging	Sand/Mineral Extraction	Ocean Acidification	Other (Specify)
Benthic Habitat		X	X					X	X			
Living marine resources	X	X	X	X	X		X	X			X	
Cultural/historic	X		X						X			
Offshore Development[31]		X	X									
Energy Production		X	X									
Fishing (Commercial and Recreational)			X	X	X						X	
Recreation and Tourism			X								X	

4. *If available, briefly list and summarize the results of any additional state-specific data or reports on the status and trends of ocean resources and/or threats to those resources since the last assessment to augment the national datasets.*

Commercial fishery landings have declined since 2009 (NOAA, 2014a). The traditional threats to fisheries have been overfishing, bycatch, harmful algal blooms (HABs), hypoxia/water quality, agrarian pesticides, and habitat degradation. Additional threats include decrease in freshwater inflows, loss of nursery habitat, and non-point source discharges. Oyster landings in Texas, on the other hand, increased significantly in 2010, and reached its peak in 2013 with the highest tons landed since 2003 (NOAA, 2014a). This could be a consequence of the Deepwater Horizon Oil spill and the resulting decrease in landings in Louisiana, adding pressure to the oyster populations in Texas to supply the demand. Threats to oysters also include water quality and lack of shell replenishment, decrease in freshwater inflow and habitat loss. Looking at other commercially important species, landings for red snapper increased since 2009, while landings for brown shrimp and black drum remained the same (NOAA, 2014a).

Continuous threats to maintaining viable populations of all oceanic species include erosion and relative sea level rise, marine habitat loss, bycatch, harmful algal blooms (HABs), invasive species, non-point source pollution, hypoxia, decreased freshwater inflows, and ocean acidification which are described below.

Erosion and Relative Sea Level Rise (RSLR) are stressors to ocean resources as they change environmental conditions and lead to habitat loss. Ocean resources provide a suite of ecosystem services including the provision of habitat, protection against storms and flooding, erosion control, food, recreational opportunities, and water purification (waste and nutrient regulation). Erosion and RSLR are direct threats to these services, along with other factors such as decreased river discharges, alteration of water flows, development and damage from commercial and recreational use, non-point source pollution, invasive species, and climate change.

Habitat loss can have significant impacts on marine species populations and may result from erosion and RSLR, decrease in river discharges, alteration of water flows, and damage from commercial and recreational use among other things. The removal of oil platforms can also contribute to loss of marine habitat. An alternative to their complete removal is to convert these platforms into artificial reefs. The Department of Interior's Bureau of Safety and Environmental Enforcement developed a "Rigs-to-Reefs" national policy that allows non-producing oil platforms to be converted into artificial reefs, creating marine habitat. The program has been popular among fishermen, the oil industry, and regulators around the Gulf of Mexico. Texas has an Artificial Reef Plan and Program that allows the TPWD to enhance, promote, maintain and monitor the artificial reefs off the Texas coast. There are currently 66 artificial reef sites in Texas representing a total of 3,440 acres of important habitat supporting activities such as commercial and recreational fishing and diving (Texas Parks and Wildlife Department, 2014a).

Bycatch from commercial trawl and other fisheries threatens non-target species in all life history stages, such as juvenile finfish and endangered and threatened species such as marine mammals and sea turtles. As a response to this threat, in 1998 the National Marine Fisheries Service (NMFS) implemented the use of bycatch reduction devices (BRD) by Gulf shrimp trawlers in their nets. This implementation followed the Gulf of Mexico Fishery Management Council recommendations and is estimated to save millions of juvenile red snapper and other finfish from being caught in shrimp trawls (Fletcher, 2014). To reduce regulatory conflict between state and federal mandates and to ensure shrimp vessels can fish in both state and federal waters, Texas Parks and Wildlife mandates shrimp trawlers be equipped with BRDs and it classifies as "*approved devices*" only those previously approved by NMFS (Riechers, 2010).

Harmful algal blooms (HABs) continue to be a threat to oceanic and estuarine resources along the Texas coast and although some are thought to be caused by naturally occurring conditions, some may be linked to invasive species, pollution, ocean acidification, and overfeeding (when nutrients such as nitrogen, phosphorus, and carbon flow downriver to the ocean at a fast rate that "overfeeds" the algae that exists naturally in the ecosystem), (NOAA, 2014b; Errera et al., 2014). In the winter and summer of 2012, TPWD reported multiple occurrences of HABs in Matagorda, Aransas/Copano Bay, Bolivar peninsula, Galveston, and Surfside that led to over 1 million fish killed and posed health hazards to coastal inhabitants. TPWD provides regular reports on HAB tests and occurrences (Texas Parks and Wildlife Department, 2014b). In the U.S., HABs usually cost about $82 million every year in economic losses to the restaurant, seafood, and tourism industry (NOAA, 2014b). In Texas, there is no information concerning annual economic losses, but one of the biggest impacts is to the closure of commercial oyster industry (Texas A&M Sea Grant, 1986; Evans & Jones, 2001). Tourism is also hurt by HABs, as tourists avoid the coast when beaches are contaminated by these events. A report in 2000 indicated that a HAB event in Galveston County had a direct negative economic impact of approximately $10.7 million (Texas A&M Sea Grant, 1986; Evans & Jones, 2001).

Invasive species are known to pose a threat to indigenous habitats, food webs, and marine species. Although some invasive species arrive as a result of warming temperatures, most invasive species are transported by commercial vessels ballast water, ship hulls, or by accidental or intentional release from marine aquaria and aquaculture facilities. The Texas Invasive Species Coordinating Committee was established in 2009 to coordinate state agencies efforts and prevent and manage invasive species in Texas (Texas Parks and Wildlife Department, 2014c; Texas Invasives, 2014).

Water quality and quantity, which are crucial for healthy ocean resources and coastal populations, are continuously affected by development, non-point source pollution and decreased freshwater inflows. Non-point source pollution (NPS) is all water-related pollution that does not originate from regulated point sources such as waste water treatment facilities, concentrating animal feeding, and municipal storm water systems. NPS water pollution originates when rainfall flows off roads, buildings, land, and other landscape features carrying pollutants into lakes, rivers, aquifers, drainage ditches, wetlands, and bays.

As population increases and land-use and impervious surfaces intensify, so do the impacts of NPS. The infamous "dead zone" in the Gulf of Mexico (off the coast of Louisiana and part of Texas) illustrates the environmental impact NPS can have (Clemons, 2005). Dead zones occur when fertilizer runoff congests waterways with nutrients, such as nitrogen and phosphorous, leading to an explosion of microbes that consume oxygen and deplete the water of oxygen, killing fish and other marine life (The Associated Press, 2014). The Federal Clean Water Act (CWA) requires the states to develop a program to protect water resources from NPS pollution. In Texas, the NPS Management Program is cooperatively administered by the Texas State Soil and Water Conservation Board (TSSWCB) and the Texas Commission on Environmental Quality (TCEQ) and involves partnerships among different organizations and across political boundaries to prevent and reduce NPS pollution (TSSWCB, 2014).

The Texas Parks and Wildlife Department's Kills and Spills Team (KAST) investigate fish and wildlife kills consequent of pollution and natural events. KAST assesses the impacts to fish and wildlife, and investigates the causes of the incidents, which are divided in two broad categories: natural causes and human activities. In Texas, the most common natural cause of fish kills is low dissolved oxygen, i.e. hypoxia, since if there is not enough oxygen in the water, fish cannot breathe. Concerning human activities, the most common causes of fish kills include toxic releases of chemicals, fertilizers, crude oil, used oil, sewage, and pesticides.

Freshwater inflows determine water quality by transporting nutrients and diluting salinities in estuaries, and balancing erosion rates by delivering sediments. These fresh water, nutrients, and sediments are all necessary to sustain estuarine and marine life (The Texas Water Development Board, 2010). However, a growing population has led to the diversion of water from rivers and streams and to reduced freshwater inflows to the coast; currently, there are six times more water in reservoirs than in the natural environment worldwide, leading to altered landscapes, seascapes, and aquatic habitats (HRI, 2014a). A decrease in freshwater inflows can also cause loss of habitat, productivity, and biodiversity. Thus, as the upstream demand for freshwater continues, the ability to effectively manage freshwater inflows becomes increasingly critical[22] (FIT, 2015).

Ocean acidification occurs due to changes in the ocean's chemistry as seawater absorbs much of the carbon dioxide that is in the atmosphere and as carbon enters the water from land-based sources. As a result, there is an increase in CO_2 concentration, a decrease in pH, and a change in the inorganic carbon chemistry of seawater. This increase in acidity (decrease in pH) alters conditions required for oysters, clams, corals, and other animals that build shells and skeletons and is thought to promote shifts in community structure, specifically in marine phytoplankton (Errera et al., 2014; Ocean Conservancy, 2014). In 2009, Congress approved the Federal Ocean Acidification Research and Monitoring Act to oversee and gain a better understanding of how acidification affects important national fisheries. Without relevant information, industries that depend on fish and shellfish populations won't know how to protect their businesses. If acidification harms fisheries that are important to the Gulf of Mexico's food web, this could have significant impacts in the state of Texas' seafood industry, which is important not only locally, but nationally (NRDC, 2014).

In addition to these chronic threats, two oil spills occurred since the previous assessment that threatened not only living marine resources and benthic habitats, but also recreation and tourism, offshore development, energy production, and recreational and commercial fishing. The Deepwater Horizon oil spill off the coast of Louisiana discharged a total of 4.9 million barrels during 87 days. Given the amount of oil discharged, the large quantity that still remains unaccounted for, the unprecedented use of oil dispersants, and the fact that even a small amount of oil can have significant biological effects, the scope of damages of this spill will likely unfold for years or decades to come.

In economic terms, the oil spill had negative impacts on fishing, tourism, and offshore drilling. Soon after the spill, the U.S. Department of the Interior enforced a six-month offshore drilling moratorium which suspended work on 33 rigs in the Gulf of Mexico (National Wildlife Federation, 2014; Wikipedia, 2014). A report by Dr. J. Mason (2010), an economist and Louisiana State University endowed chair of banking, estimated that the offshore drilling moratorium cost the State of Texas approximately $153 million in earnings and $22.8 million in state and local taxes. Fortunately for Texas, the direct impacts of the oil spill were not as significant as in other Gulf States. Oil arrived in small amounts to the Jefferson County coastline and did harm some bird and turtle species.

[22] Especially since 44 percent of Texas is in moderate to exceptional drought (as of 12/30/2014) and the state's population increases approximately 1,000 people a day (The Texas Water Development Board, 2015).

This included brown pelicans, which are one of the endangered species found in Texas coastal counties, who regularly use Texas beaches, and endangered sea turtle species that swim in Texas coastal waters and nest on islands like South Padre Island in the spring (Galbraith, 2012). In fact, for two decades the Kemp's ridley sea turtle had been recovering from extinction and its nests were increasing amid continuous efforts to save the species. Then, just as the turtle's nesting season was underway, the oil spill occurred and there has been a downward trend in nesting ever since. Although the spill's damaging effects are not yet fully understood, there is a consensus among many scientists that the spill played a critical role in the turtle's downward trend (Rice, 2014).

In March of 2014, 165,000 gallons of fuel oil were released into Galveston Bay after a barge collided with a ship in the Houston Ship Channel. The Port of Houston shut down for four days following the spill, closing the bay's multi-billion dollar fishing industry and costing $1.2 billion in lost commerce (Kirkpatrick, 2014). Galveston Bay is an ecologically sensitive area, so ecological damages were expected. The oil drifted into the Gulf and washed ashore further down the coast, including Matagorda Island (Harman, 2014). Approximately 325 birds and 21 dolphins were recovered dead and several turtles and shorebirds remain at risk; fortunately, barrier islands have been very important in protecting the bays where many species of birds nest (Harman, 2014). Careful ecosystem monitoring, mitigation, and restoration efforts are critically important to ensure healthy marine resources, especially after energy industry accidents (Quiao Chen, 2014).). In fact, experts say that the efficiency of the state and federal emergency response efforts could have been improved if an ocean observing system device, such as high frequency radar, had been strategically placed in Galveston Bay (Kirkpatrick, 2014).

Looking at future threats, the increase in offshore oil development planned for the Western Gulf of Mexico offshore from Texas will increase threats to living marine resources in the Coastal Zone (Faucon, 2013). The Department of Interior's Bureau of Ocean Energy Management (BOEM) held three lease sales in Western Gulf of Mexico (November 2012, August 2013, and August 2014) covering a total of 62.3 million acres for oil and gas development on the U.S. Outer Continental Shelf offshore from Texas. There are two more Western Gulf of Mexico sales scheduled prior to 2017. Increased offshore drilling will increase the risks of oil spills and associated environmental damage, so this poses an increasing threat to marine resources in the coming years (WorkBoat, 2014; BOEM, 2014; Deloitte, 2014).

There are currently several threatened and endangered species in the Coastal Zone, including eight species of amphibians, 37 species of birds, 10 species of fish, 14 species of insects, 17 species of mammals, 18 species of mollusks, 37 species of plants, and 22 species of reptiles. The Texas Natural Diversity Database from Texas Parks and Wildlife provides a list of current endangered species including marine mammals, coastal fisheries, crustaceans, waterbirds, and shorebirds (Texas Parks and Wildlife Department, 2012a, 2014d).

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if any significant state or territory- level changes (positive or negative) in the management of ocean resources have occurred since the last assessment?

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	N	N
Regional Comprehensive Ocean Management Plans	Y	Y	Y
State Comprehensive Ocean Management Plans	N	N	N
Single-sector Management Plans	Y	Y	Y

2. For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:

a. Describe the significance of the change;

Regional Comprehensive Management Plan

Information concerning the Texas Conservation Action Plan in 2012 can be found in the Wetlands Phase I Management Characterization section (page 15).

Single-Sector Management Plan

Texas Parks and Wildlife Department extended the five-fish daily bag limit of speckled trout (in effect September 1 , 2014), which was in effect for the Lower Laguna Madre since 2007, but now includes all marine waters from East Matagorda Bay to the Texas-Mexico border at the mouth of Rio Grande (Tompkins, 2014). This stricter rule addresses an observed decline in trout, attributed to an increase in fishing pressure, and an overall concern about the fisheries' ability to sustain healthy populations. In addition to increasing fishing pressure, environmental stressors such as decreased freshwater inflow and loss of estuarine habitat have led to this concern. Lastly, higher salinity levels driven by the drought have also negatively impacted trout spawning (Holmes, 2014; Sasser, 2014; Tompkins, 2014).

b. Specify if it was a 309 or other CZM-driven change; Non-CZM efforts.

These referenced management plans were non-CZM efforts, but were driven by the need to continue to protect and enhance coastal habitat, particularly those in decline or that are threatened.

c. Characterize the outcomes and/or likely future outcomes of the changes(s).

The outcomes of the management plans and awareness documents are the identification of important coastal and estuarine areas for conservation and the prioritization of coastal habitats.

TPWD daily bag limit:

The goal for this regulation is to stabilize and improve trout populations in the bays along the middle and lower Texas coast. This reduced bag limit is intended to increase the number and size of trout in the bay and improve

the chances for spawning success. The model used by TPWD predicts that this rule will decrease the number of trout kept by anglers by approximately 14 percent and increase the spawning stock biomass (total weight of all sexually mature female trout) by approximately 16.5 percent (Tompkins, 2014). Since the rule took effect on September 1, 2014, it is still too early to measure results. Benefits of this rule change should manifest in three to five years and show up in fisheries samplings and angler creel surveys (Tompkins, 2014).

3. *Indicate if your state or territory has a comprehensive ocean Management Plan.*

Comprehensive Ocean Management Plan	**State Plan**	**Regional Plan**
Completed plan (Y/N) (If yes, specify year completed)	N*	N
Under development (Y/N)	Y**	Y**
Web address (if available)	N/A	N/A
Area covered by plan	Texas	Gulf of Mexico Region

*For Aquatic Nuisance Species Only (invasive): Texas State Comprehensive Management Plan for Aquatic Nuisance Species.

** The GLO is developing a Long-Term Planning Initiative for the state of Texas. For the Gulf of Mexico region, the Gulf of Mexico Alliance (GOMA) Governor's Action Plan II for healthy and resilient coasts covered the period of 2009-2014 and focused on five priority areas: water quality, habitat conservation and restoration, ecosystems integration and assessment, nutrient and nutrient impacts, coastal community resilience, and environmental education. Plans for GOMA's Action Plan III are unknown

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

High _____
Medium X
Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

Ocean resources, including fish and wildlife, commercial and recreational fishing, oil and gas exploration, shipping, and tourism have a high economic value and human demand; the livelihood of coastal populations depends on these resources.

Ocean resources are designated as a medium priority enhancement area for the Texas Coastal Management Program as most ocean resource issues are addressed though other enhancement areas in this report. Stressors to ocean resources are addressed through efforts that focus on wetland degradation, catastrophic coastal hazards, impacts of public use, and marine debris. Given the interconnectedness of estuarine, coastal, and offshore environments, changes in one environment will influence the others therefore these issues can be address through strategies developed for other enhancement areas.

Energy and Government Facility Siting

Section 309 Enhancement Objective: Adoption of procedures and enforceable policies to help facilitate the siting of energy facilities and Government facilities and energy-related activities and Government activities which may be of greater than local significance. §309(a)(8)[32]

Phase I (High-level) Assessment:
Purpose: To quickly determine whether or not energy and Government facilities is a priority enhancement objective for the CMP that warrants a more in-depth assessment. The in-depth assessment would enable CMPs to understand key problems and opportunities that exist for program enhancement as well as the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *In the table below, characterize the status and trends of different types of energy facilities and activities in the state or territory's coastal zone based on best available data. If available, identify the approximate number of facilities by type. The MarineCadastre.gov may be helpful in locating many types of energy facilities in the coastal zone.*

Type of Energy Facility/Activity	Exists in CZ		Proposed in CZ	
	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unknown)
Energy Transport				
Pipelines[33]	Y	↑	Y	↑
Electrical grid (transmission cables)	Y	↑	Y	↑
Ports	Y	Same	N	-
LNG[34]	Y	↑	Y (10)	↑
Propane and crude export facility	NA	NA	NA	↑
Energy Facilities				
Oil and gas	Y (30)	↑	Y	↑
Natural Gas Power Plants	Y (54)	↑	Y (7)	↑
Coal	N	-	N	↓
Nuclear[35]	Y (1)	-	N	↑
Wind	Y (10)	↑	Y (8)	↑
Wave[36]	N	-	N	↓
Tidal[49]	N	-	N	-

32 CZMA § 309(a)(8) is derived from program approval requirements in CZMA § 306(d)(8), which states: "The management program provides for adequate consideration of the national interest involved in planning for, and managing the coastal zone, including the siting of facilities such as energy facilities which are of greater than local significance. In the case of energy facilities, the Secretary shall find that the State has given consideration to any applicable national or interstate energy plan or program." NOAA regulations at 15 C.F.R. § 923.52 further describe what states need to do regarding national interest and consideration of interests that are greater than local interests.

33 For approved pipelines (1997-present): http://www.ferc.gov/industries/gas/indus-act/pipelines/approved-projects.asp

34 For approved FERC jurisdictional LNG import/export terminals: http://www.ferc.gov/industries/gas/indus-act/lng/exist-term.asp

35 The Nuclear Regulatory Commission provides a coarse national map of where nuclear power reactors are located as well as a list that reflects there general locations: http://www.nrc.gov/reactors/operating/map-power-reactors.html

36 For FERC hydrokinetic projects: http://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics.asp

Status and Trends in Energy Facilities and Activities in the Coastal Zone				
Type of Energy Facility/Activity	Exists in CZ		Proposed in CZ	
	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unkwn)	(# or Y/N)	Change Since Last Assessment (↑, ↓, –, unkwn)
Current (ocean, lake, river)[49]	N	-	N	-
Hydropower	N	-	N	-
OTEC	N	-	N	-
Solar	N	-	N	-
Biomass	Y (6)	-	N	-
Geothermal	N	-	N	-

Energy Transport

Pipelines

There are two pipelines being constructed to supply crude from Western Texas to the Gulf Coast markets and to relieve congestion of crude oil production in the Permian Basin (Magellan Midstream Partners, L.P., 2014; Sunoco Logistics, 2014):

- Magellan Midstream Partners L.P.'s BridgeTex Pipeline System with 400 miles of pipe
- Sunoco Logistics Partners L.P.'s Permian Express II Pipeline System with 334 miles of pipe

There is also the Keystone pipeline that runs from Canada to refineries in the Texas coast. In its Gulf Coast Extension, completed in January, 2014, the pipeline connected Cushing, Oklahoma to Port Arthur, Texas. Currently, another expansion is underway, to be completed by mid-2015, that is going to transport crude oil from Liberty County to refineries and terminal in the Houston area (TransCanada, 2012, 2013, 2014).

In addition, since the previous assessment there are two proposed/pending major gas pipeline projects (FERC, 2014a):

- CP14-73 Lavaca Bay Pipeline System with 29.5 miles of pipe.
- CP12-508 Cheniere Corpus Christi Pipeline with 23 miles of pipe

Electric Grid Major changes/improvements since last report

The Electric Reliability Council of Texas (ERCOT) acts as the independent organization under the Public Utility Regulatory Act and is responsible for coordinating market transactions, system-wide transmission planning and network reliability, and ensuring the reliability and suitability of the regional electric network. Every year, ERCOT assesses the transmission system by addressing issues of reliability of transmission lines, economic transmission needs, and recommendations for future improvements. One thing ERCOT and the Transmission Service Providers have been trying to address is the increase in electricity demand consequent of oil and gas exploration and production in Texas. In 2013, most problems experienced in the Texas grid system occurred in locations of oil and natural gas development; especially in South Texas, where the exploration of the Eagle Ford shale caused the need for transmission system improvements. In total, approximately $330.8 million in transmission system improvements in the Eagle Ford shale area were approved since 2012 and are expected to be in service between 2014 and 2017; part of Victoria County is included in this area (ERCOT, 2013).

Load increase in the Houston area has also been the cause of congestion in transmission lines; costing approximately $38.5 million in congestion rent[23] from January to October of 2013. Research has identified the need for an increase in the transmission system import capacity to meet the needs of a growing load in the Houston area

and ERCOT and the Regional Planning Group are looking at ways to accomplish this (ERCOT, 2013).

To address the increase in electricity demand, there are two improvement projects taking place in the Lower Rio Grande Valley (LRGV).

1) The Valley Import project, which is expected to increase the total import capacity into the area and be completed by 2016, includes reconductoring two existing 345 kV import lines and constructing a new 345 kV import line (Figure 21) (ERCOT, 2013).

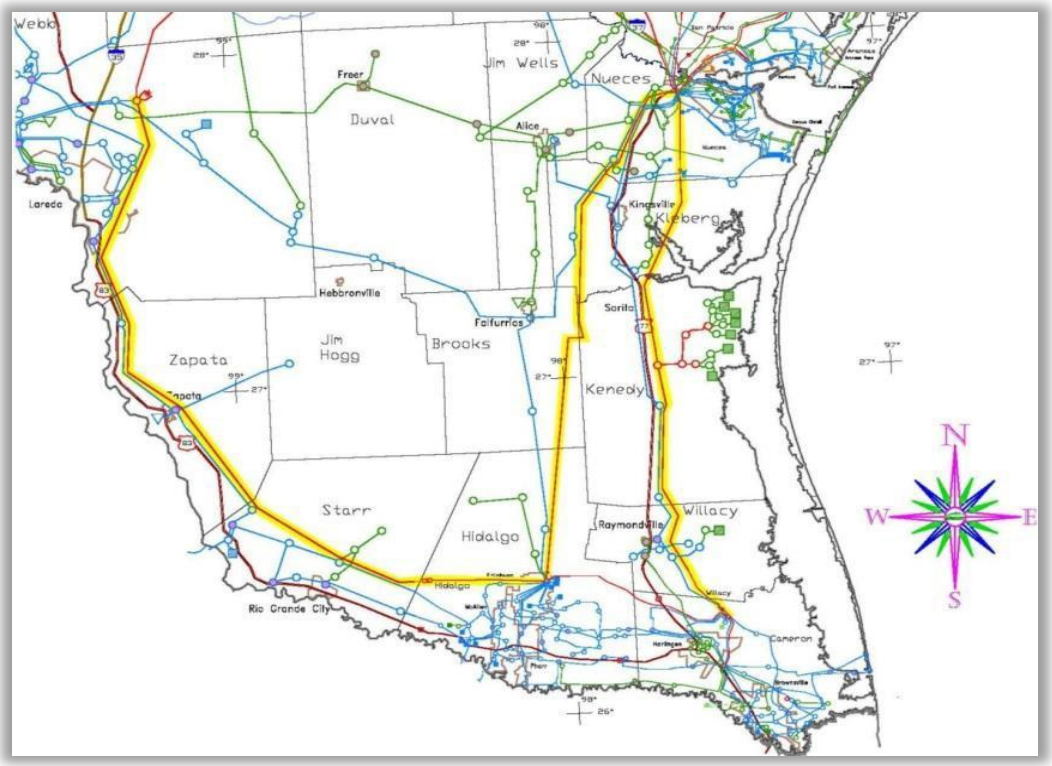

Figure 21. Improvements in import capacity from the Valley Import Project. Source: ERCOT, 2013.

2) The Cross Valley project is another grid improvement that includes the construction of a new 345 kV line that runs across the LRGV area, from west to east (Figure 21). It is expected to be in service before the summer of 2016 to meet reliability needs in and around Brownsville area. Both these projects together are estimated to cost approximately $800 million (ERCOT, 2013).

Looking at future needs, in April 2010 ERCOT received funding from the Department of Energy as part of the 2009 American Recovery and Reinvestment Act to conduct interconnection-wide long- range transmission planning for the ERCOT Region. The findings of the report indicate that the Houston area will need at least one additional import path in the next ten years (ERCOT, 2013).

[23] Congestion occurs when transmission limitations do not allow for the most efficient transmission of energy to meet a given demand [1].

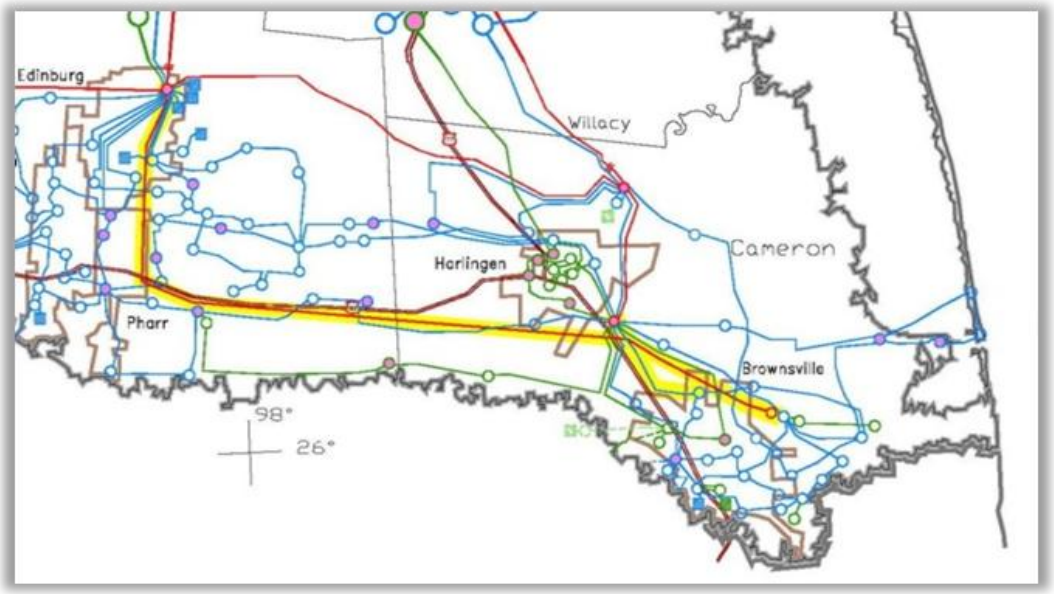

Figure 22. Grid Improvements from the Cross Valley Project. Source: ERCOT, 2013.

Ports

Texas ports (marine terminals where marine cargo and cruise activity occurs) play a crucial role in the State's transportation system and are a critical part of the State's economy. According to Texas Ports Association, Texas ports generate a total of 1.4 million jobs, $278 billion in economic activity, and $6.5 billion in state and local taxes (Texas Department of Transportation, 2014). They handle over 550 million tons of foreign and domestic cargo yearly, which is 20 per cent of the country's port tonnage (Texas Department of Transportation, 2014; Martin Associates, 2012). According to the U.S. Department of Transportation, seven of the Texas ports are among the top 50 U.S. ports in terms of annual tonnage, including Houston (2^{nd}), Beaumont (6^{th}), Corpus Christi (7^{th}), and Texas City (11^{th}). The vacation cruise market is also present in the Gulf with the Port of Galveston placed as the fourth-largest U.S. cruise market based on embarkation in 2012. Forecasts indicate that the use of Texas waterways will continue to increase, spurred by growing population, increasing worldwide waterborne trade, and the scheduled expansion of the Panama Canal which will double the capacity of the canal and allow some of the world's largest ships to pass through (Texas Department of Transportation, 2014; Ackerman, 2013). Texas Ports have not seen any major change since the previous assessment, but to accommodate larger ships as a result of the Panama Canal expansion, some ports may need to invest in new cranes, dredging, bigger freight yards, and improved connections to railheads (Banker, 2013).

Figure 23. Texas Sea Ports. Source: Texaswideopenforbusiness.com

Liquefied Natural Gas (LNG)

The Federal Energy Regulatory Commission (FERC) is the authorizing agency for the siting and construction of onshore and near-shore LNG import and export facilities under Section 3 of the Natural Gas Act. As part of the requirements set by the National Environmental Policy Act, FERC prepares environmental assessments or impact statements for proposed LNG facilities under its jurisdiction. Once the projects are approved and built, they are overseen by FERC for as long as they are in operation. Currently, FERC regulates twenty-four LNG facilities (FERC, 2014b).

The Coastal Zone has the following LNG terminals (FERC, 2014b):

Existing

Two LNG import/export terminals

Approved

Expansion of Freeport Terminal approved, but not yet under construction

Proposed Terminals

One Proposed Import terminal

Four Proposed Export terminals

Potential Export Terminals

There are six potential sites identified by project sponsors for Export Terminals

Propane and crude export facility

Occidental Petroleum (Oxy) Ingleside Energy Center, LLC (Naval Today, 2012) is building a propane and crude export

facility to begin operation in January, 2015 (Sebastian, 2013). The company has signed a long-term agreement with NuStar Energy L.P to ship natural gas liquids on NuStar's currently idled 200-mile pipeline between Mont Belvieu and Corpus Christi (Business Wire, 2014).

Energy Facilities

Oil and Gas

By the end of 2014, Texas' oil production could surpass the production of every OPEC country (Organization of Petroleum Exporting Countries), except for Saudi Arabia. Texas' production, mainly driven by Eagle Ford Shale in South Texas, the Permian Basin in West Texas, and Barnett Shale in North Texas, will reach approximately 3.4 million barrels a day, surpassing production in Iraq and Iran. Among non-OPEC countries, Texas is the world's sixth largest oil and gas producer (Hiller, 2014).

As of January 2013, Texas leads the nation in crude oil refining capacity with 27 petroleum refineries (the same as in the previous assessment) with a capacity of over 5.1 million barrels of crude oil per day (4.8 million in the previous assessment), accounting for approximately 29 percent of total U.S. refining capacity (25 percent in the previous assessment. Texas also leads the nation in natural gas production accounting for approximately 29 percent of the U.S. marketed natural gas production in 2013 (U.S. Energy Information Administration, 2014a). In the Texas coastal zone, there are a total of 18 petroleum refineries and 12 natural gas processing plants (U.S. Energy Information Administration, 2014a; 2014b).

No new refinery has been built in the U.S. since 1976, primarily due to environmental concerns. However, with an increase in oil extraction from Texas, Oklahoma, and North Dakota, companies are planning to expand existing plants and to build small processors around the country. Valero Energy Corp., Marathon Petroleum Corp., and other refiners are finding ways to expand the fuel- making capacity at their existing plants without the cost of building new ones to take advantage of the increase in crude flowing from U.S. wells (Lefebvre, 2014).

There are plans for plants capable of processing the ultra light oil extracted from Eagle Ford shale formation in South Texas. These facilities are cheaper to build and are not classified as refineries since they cannot handle multiple crude oil types or produce a combination of fuels. Some companies which were not traditionally involved in refining are now interested in the refining business. For example Kinder Morgan Energy Partners LP, a pipeline company, is building an ultra light plant near the Houston Ship Channel that will generate up to 100,000 barrels a day of fuels for export; and Magellan Midstream Partners LP is considering a similar project in Corpus Christi, Texas. There is increased interest in expanding or creating new refineries in the coastal zone because of increased in oil extraction in the State (Lefebvre, 2014).

Lastly, the Bureau of Economic Geology proposed a new project to capture CO_2 produced from the W.A. Parish power plant (a coal-burning facility), which may be used to enhance production at mature oil fields in the Gulf Coast region (Bureau of Economic Geology, 2014; NRG, 2014). This joint venture between NRG and JX Nippon Oil and Gas Exploration proposes to use the new Petra Nova Carbon Capture System and is projected to be fully operational by mid-2015. Once captured, the CO_2 will be injected via an enhanced oil recovery operation into Hilcorp's West Ranch Oilfield located in Jackson County (Bureau of Economic Geology, 2014). An estimated 1.6 million tons of CO_2 per year will be used for EOR at West Ranch and oil production there is expected to increase from approximately 500-15,000 barrels per day (Bureau of Economic Geology, 2014; NRG, 2014). The role of the Bureau will be to monitor the first three years of geologic storage of the anthropogenic CO2 injected into West Ranch.

Natural Gas Power Plants

Since the last assessment, there are approximately 21 additional natural gas power plants. Thus in addition to processing plants and refineries, the coastal zone has 54 natural gas power plants, and 7 proposed natural gas power plants planned for 2014, 2015, and 2016 (Platts, McGraw Hill Financial, 2013).

Coal

Texas is the fifth largest coal producer in the country and number one lignite producer. Currently, Texas only produces lignite, the lowest grade of coal, with the majority of lignite reserves found in the Texas Gulf Coast region. Texas is also the leading State in coal consumption with its emissions of carbon dioxide and sulfur dioxide the highest among the nation (Texas Department of Transportation; 2014; U.S. Energy Information Administration, 2013).

At the moment there are no coal power plants in the coastal zone, but two are very close to the region: (1) WA Parish Power Plant located outside Houston in Fort Bend County and (2) Coleto Creek Power Plant located in Fannin, Goliad County (U.S. Energy Information Administration, 2013). Of the eight coal plants proposed for the coastal zone at the time of the previous assessment, none has been approved. In Texas, there are a total of 18 coal power plants, but the development of new ones may prove challenging given the availability and lower price of natural gas, coal emissions of atmospheric pollutants and greenhouse gases, and the federal regulatory requirements for lower emissions (Wright, 2013).

Nuclear

Texas has two nuclear power plants, one of which is in the coastal zone, the South Texas project nuclear power plant located in Matagorda County. The South Texas project plant has two reactors and two additional ones are proposed, but not yet accepted or built (U.S. Energy Information Administration, 2014b; U.S. Nuclear Regulatory Commission, 2013a, 2013b). At the time of the previous assessment there was one other proposed plant, the Victoria County Station with two reactors, but that license application has been suspended (U.S. Nuclear Regulatory Commission, 2013a).

In 2012, Nuclear energy provided about 9 percent of the state's electricity, behind natural gas and coal and ahead of wind energy (U.S. Energy Information Administration, 2014a; Sierra Club, 2014; CASEnergy Coalition, 2010).

Wind

Texas is the leading state in wind energy generation, with more installed capacity, more jobs, and wind turbines than any other State (American Wind Energy Association, 2014b). The percentage of Texas' electricity provided by wind has been increasing reaching 9.9 percent in 2013; the equivalent of powering 3.3 million average American homes (American Wind Energy Association, 2014).

Currently in the coastal zone there are:

- 10 wind farms with a total net summer capacity[24] of 1829.1 MW (U.S. Energy Information Administration, 2014c); as compared to three wind farms at the time of the previous assessment with a combined capacity of 663MW
- 2 proposed onshore wind farms (Platts McGraw Hill Financial, 2013)
- 6 offshore wind projects proposed

Compared to onshore wind, offshore wind has the advantage that it peaks during the day, when demand for power is highest. In an effort to support this kind of energy and diversify Texas' energy portfolio, GLO signed two lease agreements to allow research and construction of two offshore wind farms: Galveston and GOWind (Rhame, 2007). Meanwhile in May of 2014, the developing company Baryonyx withdrew its permit application to build its GOWind project and this project was canceled (4COffshore, 2014); plans to build the Galveston Offshore Wind remain active.

In addition, since the previous assessment, three other proposed offshore wind farms were cancelled: Jefferson Offshore and Brazoria Offshore were both cancelled due to unknown reasons and Mustang Island Offshore Wind Farm was canceled due to its proximity to the Naval Air Station in Corpus Christi, since the turbines could interfere with the low-level pilot training maneuvers inshore of the proposed wind farm location (Open Energy Information, 2014; Parker, 2012).

Wave

According to the Texas Comptroller of Public Accounts, although lengthy, the Texas coastline and Gulf of Mexico offshore conditions are neither suitable nor cost-effective to ocean and wave power technologies due to shallow waters and the semi-enclosed nature of the basin (Window on State Government, 2014a). At the time of the previous assessment the GLO had granted the first offshore lease to Texas-based Renew Blue Inc. to use ocean water and waves to produce bottled desalinated water in Freeport (with the Seadog Pump technology). Traditionally, desalination processes require significant amounts of electricity (around 40 to 50 percent of the

operating costs are associated with electric use). In this case, the Seadog Pump technology would harness wave-power to generate electricity, which means it would operate solely on wave power to desalinate water and consequently significantly reduce desalination costs. At the time of this assessment the plant has not been built. Nonetheless, given the high demand for freshwater in the State and the lower cost this technology would have in powering a desalination plant, there might be an opportunity for wave energy in the Texas coastal zone. As some have argued, desalination is an attractive opportunity to address the Texas water supply problem (Abraham, 2013).

Tidal, Current, Hydropower, and Ocean thermal energy conversion (OTEC)

The Texas coast in currently unsuitable for tidal, current, hydropower, and OTEC energy (Moreno, Sallent, Espi, Bao,

& Teillet, 2008; Office of Energy Efficiency & Renewable Energy, 2014; Open Energy Information, 2012; SECO, 2014a; U.S. Energy Information Administration, 2014a; Window on State Government, 2014a, 2014b).

Solar

Texas has the largest potential for solar energy in the country due to size and abundant sunshine; however, other states lead in the solar energy generation mainly due to favorable state policies and incentives that encourage solar system installation: California, New Jersey, Arizona, Colorado, and New York (Window on State Government, 2014c).

[24] Net summer capacity is the maximum output, commonly expressed in megawatts (MW), that generating equipment can supply to system load at the time of summer peak demand (period of June 1 through September 30) (Glossary- U.S. Energy Information Administration (EIA)).

At the time of the last assessment in the coastal zone, there was one solar showcase project installed to power the City of San Benito's wastewater treatment plant and a solar energy plant proposed for the city of Houston. The solar power system installed in San Benito, Cameron County to power the city's wastewater treatment plant produces 75,000 kWh of electricity per year and provides 10 percent to 20 percent of the power required to treat the water in the plant (Severn Trent Services, 2014). Also in San Benito, the Angela G. Leal Elementary School, built in 2011, includes a $27,000 solar energy project that is estimated to save the district $59,000 during the next 30 years (Del Valle, 2013); solar panels installed on the roof of the building will heat water used to cook in the school cafeteria and light two of the science labs (Del Valle, 2011).

A proposed project at the time of the previous assessment was a solar energy plant to be built by NRG Energy, Inc. in the city of Houston. In September of 2009, the city had agreed to buy all solar power from this $40 million-plant over a 25-year time period. If built, this plant would have been the largest solar power plant in the State. Surprisingly, city officials backed out of the agreement and the plans to build the plant have been cancelled (Vo, 2009). Currently, there are no existing solar power plants in the coastal zone and none are proposed despite the state's tremendous solar energy potential. Few state wide incentives might be one reason for low investment in this energy source (State Impact Texas, 2014).

Biomass

Biomass is any animal or plant matter used to produce energy. The most common resource is wood, but other sources include grasses, food crops, agriculture residues, manure, and methane from landfills. As an agricultural state, Texas has a great potential as producer of this kind of energy (Window on State Government, 2014d). There are currently six biomass power plants in the coastal zone and no proposed plant (U.S. Energy Information Administration, 2014b).

Geothermal

Geothermal energy is obtained by using high temperatures underground to produce electricity from heated water or other direct uses (e.g. hot springs spas or aquaculture) (Window on State Government, 2014e). Traditionally, geothermal energy generation has been restricted to Western states; however, with the rise in electric and oil prices and improvements in technology, more attention has turned to the State's potential for geothermal energy (SECO, 2014b). Drilling for geothermal resources (drilling for water) is similar to drilling for oil and gas, which means Texas can use its decades of experience with oil and gas extraction. The state also has an advantage in access to detailed heat data resources, reservoirs, and deep water due to oil and gas drilling practices (SECO, 2014b; Geothermal Energy Association, 2014). A study by Southern Methodist University's Geothermal Laboratory estimates that within ten years, the State could have between 2,000 to 10,000 MW in geothermal energy generating capacity accessed through oil and gas wells (SECO, 2014b).

Currently there are no geothermal power plants in the coastal zone; however, this area is one of five major regions with the strongest potential for geothermal electric power generation in the state (SECO, 2014b).

2. *If available, briefly list and summarize the results of any additional state or territory-specific information, data, or reports on the status and trends for energy facilities and activities of greater than local significance in the coastal zone since the last assessment.*

Energy Facilities

Natural Gas Power Plants

Since the last assessment, there are approximately 21 additional natural gas power plants.

Oil and Gas

The Bureau of Economic Geology proposed a new project to capture CO_2 produced from the W.A. Parish power plant (a coal-burning facility), which may be used to enhance production at mature oil fields in the Gulf Coast region (Bureau of Economic Geology, 2014; NRG, 2014). This joint venture between NRG and JX Nippon Oil and Gas Exploration proposes to use the new Petra Nova Carbon Capture System and it is projected to be fully operational by mid-2015. Once captured, the CO_2 will be injected via an enhanced oil recovery operation into Hilcorp's West Ranch Oilfield located in Jackson County (Bureau of Economic Geology, 2014). An estimated 1.6 million tons of CO_2 per year will be used for EOR at West Ranch and oil production there is expected to increase from approximately 500-15,000 barrels per day (Bureau of Economic Geology, 2014; NRG, 2014). The role of the Bureau will be to monitor the first three years of geologic storage of the anthropogenic CO2 injected into West Ranch.

Wind

There were some significant changes in wind energy generation in the coastal zone since the last assessment. At the time of the previous assessment there were three wind farms in the coastal zone with a combined capacity of 663 MW and currently there are ten wind farms with a combined capacity of 1829 MW (176 percent increase) (U.S. Energy Information Administration, 2014c). There are also two proposed onshore wind farms (Platts McGraw Hill Financial, 2013) and seven proposed offshore wind projects (Open Energy Information, 2014).

3. *Briefly characterize the existing status and trends for Government facilities and activities of greater than local significance[37] in the state's coastal zone since the last assessment.*

At the time of the previous assessment, the U.S. Naval Station in Ingleside in San Patricio County had been designated for closure under the Base Realignment and Closure Act of 2005. This remains the major change in Government facilities in the coastal zone since the previous assessment. The ownership of the base reverted to the Port of Corpus Christi and in 2012 the port sold its larger portion to Occidental Petroleum (Oxy) Ingleside Energy Center, LLC (Naval Today, 2012) who plans to construct a propane and crude export facility to begin operation in January, 2015 (Sebastian, 2013). The company has signed a long-term agreement with NuStar Energy L.P to ship natural gas liquids e on NuStar's currently idled 200-mile pipeline between Mont Belvieu and Corpus Christi (Business Wire, 2014).

Management Characterization:

1. *Indicate if the approach is employed by the state or territory and if significant state or territory-level changes (positive or negative) that could facilitate or impede energy and Government facility siting and activities have occurred since the last assessment.*

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Statutes, regulations, policies, or case law interpreting these	Y	Y	N
State Comprehensive Siting Plans/Procedures*	N	N	N

*In regards to siting of energy facilities, different agencies can address siting through public hearings (PUC, TCEQ, Texas RRC. ERCOT), but the ability of the Coastal Coordination Council (CCC) or any agency to deny a project based on siting is in question. In Texas, specifically for renewable energy projects, the issue of siting is of concern for onshore and offshore projects, the latter being of lesser concern. Clear siting authority for both onshore and offshore facilities would be beneficial.

2. *For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*

   a. Describe the significance of the change;

Although there are no significant changes in the management categories listed in the table above, a few changes have occurred since the last assessment concerning proposed rules, State investment, and offshore exploration leases; these changes have the potential to influence energy development in the coastal zone in the near future.

Changes since the Last Assessment

Electric Utilities Siting

At the time of the last assessment, there was a proposed State rule §25.55 concerning location of electric utilities in floodplains and emergency power for electric utility facilities. This rule, if adopted, would apply to all electric utilities and all transmission and distribution utilities and ensure that electrically energized portion(s) of all substation equipment shall be not less than one foot above the 100-year floodplain, as identified by the floodplain maps from the Federal Emergency Management Agency (FEMA) (PUC, 2010a). Since then, the State of Texas Commissioner decided at an open meeting to take no action, and the rule expired by operation of law (personal communication with the Public Utility Commission's Rules Coordinator, Docket Management Division, June 17, 2014).

State Investment in Transmission Lines

The utilities code 39.904 in conjunction with Senate Bill 20 (2005) established Texas' Renewable Energy Program and directed the Public Utility Commission of Texas (PUC) to identify Competitive Renewable Zones (CREZ) (PUC, 2010b). CREZ are designated areas within Texas where natural resources, land areas, and renewable energy sources can generate energy that will be added to traditional energy sources. The CREZ program is the PUC's response to a public mandate to increase renewable energy in the State and to alleviate grid congestion that limits the deliverability of energy (PUC, 2010b; Oncor Electric Delivery Company LLC., 2014).

The State invested large amounts of money in high voltage transmission lines to carry energy produced by wind

farms in remote areas to urban areas in the center of the State. A report that analyzed wind energy siting after this investment concluded that the siting of wind turbines after CREZ shifted from the coastal south to the Panhandle region (Robinson, 2012). This suggests that wind development might shift towards the Panhandle due to improved transmission lines and an increase in State investment.

Offshore Oil Exploration Leases

From 2012 to 2014, the Department of Interior's Bureau of Ocean Energy Management (BOEM) held three lease sales for the Western Gulf of Mexico covering a total of 62.3 million acres for oil and gas development in the U.S. Outer Continental Shelf (OCS) offshore Texas. In addition, two more Western Gulf of Mexico sales are scheduled before 2017 (BOEM, 2014). With these leases being sold, there is a likely chance for an increase in offshore drilling and oil and gas production in the Texas coastal zone.

b. Specify if it was a 309 or other CZM-driven change; and Non-CZM

The efforts are not driven by CZM.

c. Characterize the outcomes and/or likely future outcomes of the changes(s).

Concerning CREZ and the investment of the State of Texas in transmission lines to carry energy from remote areas to urban areas in the center of the State, the likely outcome according to the report mentioned above, is a shift of wind turbines siting from the coastal south to the Panhandle region (Robinson, 2012), suggesting that wind development might shift towards the Panhandle due to improved transmission lines and an increase in State investment.

Concerning the sale of Western Gulf of Mexico Offshore Oil Exploration Leases, the likely outcome will be an increase in offshore drilling and oil and gas production in the Texas coastal zone.

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

High _____
Medium__X__
Low _____

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

Energy production is vitally important in the coastal zone, the state, the nation, and world-wide. By the end of 2014, Texas' oil production could surpass the production of every OPEC country, except for Saudi Arabia, and it will reach approximately 3.4 million barrels a day, making Texas surpass Iraq and Iran in production. Among the non-OPEC countries, the State is the world's sixth largest producer of oil (Hiller, 2014). As of January 2013, Texas leads the nation in crude oil refining capacity with 27 petroleum refineries accounting for approximately 29 percent of total U.S. refining capacity (U.S. Energy Information Administration, 2014a). In addition, with the three Western Gulf of Mexico lease sales and two more planned by 2017 for oil and gas development, these numbers

are likely to increase, bringing more money and jobs to the economy. Texas is the leading state in wind energy generation, with more installed capacity, more jobs, and wind turbines than any other state (American Wind Energy Association, 2014).

We prioritize this enhancement area as a medium priority as the energy industry is currently addressing issues in the area. We identify a concern that increasing industry demand for upstream water resources may impact coastal populations and natural resources in a future cycle but we find no regulatory issues that require attention during this cycle. Freshwater inflows to estuarine habitats are critical not only to estuarine and marine species, but to coastal populations as well, as they already deal with limited water resources. Thus, alterations to these natural water flows need to be carefully monitored and regulated. Texas Senate Bill 3's (SB3) goal is to sustain healthy estuaries and watersheds by identifying environmental and water allocation needs and flow standards (Texas Commission on Environmental Quality, 2013). Future standards and regulations must address coastal consequences of industrial water use.

Aquaculture

Section 309 Enhancement Objective: Adoption of procedures and policies to evaluate and facilitate the siting of public and private aquaculture facilities in the coastal zone, which will enable states to formulate, administer, and implement strategic plans for marine aquaculture. §309(a)(9)

Phase I (High-level) Assessment:
Purpose: To quickly determine whether or not aquaculture is a priority enhancement objective for the CMP that warrants a more in-depth assessment to understand key problems and opportunities that exist for program enhancement and the effectiveness of existing management efforts to address those problems.

Resource Characterization:

1. *In the table below, characterize the existing status and trends of aquaculture facilities in the state's coastal zone based on the best available data. Your state Sea Grant Program may have information to help with this assessment.(38)*

Type of Facility/Activity	**Status and Trends of Aquaculture Facilities and Activities**		
	# of Facilities(39)	Approximate Economic Value	Change Since Last Assessment (↑, ↓, –, unknown)
Catfish	26 Producers / 2,200 ac.	18.7 Million lbs. – estimated value $19,635,000. (per Peter Woods March 2014.)	↑
Red Drum	5 farms 710 total ac. (600 ac. grow out) / 2,350,000 lbs.	$9,000,000	↓
Hybrid Striped Bass	4 farms / 1,800 ac. / 3,500,000 lbs	$9,400,000	↑
Water Gardens	Operators	Production Retail sales: $7,000,000 +	unknown
Marine Shrimp	7 farms / 853 ac. / 2,476,187 lbs.	$6,933,324 (from Dr. Ya-Sheng Juan, TPWD, Jan. 2014)	↓
Sport fish (not red drum)	44 farms / 576 ac. / 13,275,000 fish sold	$4,182,000 (Treece, 2014 citing USDA)	↑
Trout	3 farms / ? acres / value ? (per USDA)	Unknown.	Unknown
Crawfish	20 / 1,500 acres / 800,000 lbs.	$1,000,000 (also included under Crustaceans and information from Treece, 2014 citing USDA)	--
Tilapia (food fish)	2 operators / 150,000 lbs.	$277,500 (Ya-Sheng Juan & Rob Schmidt, TPWD)	↓

Type of Facility/Activity	Status and Trends of Aquaculture Facilities and Activities		
	# of Facilities(39)	Approximate Economic Value	Change Since Last Assessment (↑, ↓, –, unkwn)
Tilapia (recreational stocking)	13 operators / ac. ? / lbs. ?	$ value unknown.	Unknown (same number of operators)
Ornamentals	27 operators / 40 ac. / lbs. ?	$892,000 (USDA)	--
Baitfish	25 operators / 20 ac. / 81,000 lbs.	$398,000 (USDA)	--
Alligators	12 operators / ac. ? / lbs. ? /	$100,000 (USDA)	--
Aquatic nurseries	5 / ac. ?	$ Value unknown.	Unknown
Other food fish	20 farms / 6,916,000 lbs.	$14,692,000 (USDA)	Unknown
Other aquatic products	16 farms / only 5 farms responded to USDA survey	Unknown.	Unknown

2. *If available, briefly list and summarize the results of any additional state or territory-specific data or reports on the status and trends or potential impacts from aquaculture activities in the coastal zone since the last assessment.*

The Texas Aquaculture Association was cited in the last assessment (Treece 2009), and there have been two reports since then: (The Texas Aquaculture Industry – 2012 (Treece) and The Texas Aquaculture Industry – 2014 (Treece). The data cited in the table above was acquired from the most recent 2014 report. (The 2012 Report contains broad information about suitable aquaculture areas and informative maps.)

Table 6. Aquaculture updates since last assessment (Treece, 2009, 2014)

Information cited in last report (from Treece 2009):	Updated information from Treece Report, 2014:
Texas Aquaculture industry annually produces close to 40 million pounds of aquaculture products. (Increased by 10 million pounds in recent years and in large part is due to the increase in catfish production.)	Historical average: Texas aquaculture production: 180 operations; approx. 30 million pounds.
The industry has a net worth of approx. $57 million (includes the sale of water garden plants, ornamentals, filters, stocker tilapia fingerlings, etc.) (These items are not included in annual production weight.)	Approx. $60 million total value.

Information cited in last report (from Treece 2009):	Updated information from Treece Report, 2014:
The aquaculture industry is estimated to contribute over $171 million to the Texas economy.	Estimated $360 million / year total economic impact on state's economy when jobs, feed, and other economic benefits are included.
Channel catfish is the largest aquaculture crop in Texas in 2008 with an estimated production of 28 million pounds worth an estimated $22.4 million.	Channel catfish has remained the largest aquaculture crop in Texas since 2008.
Previously, the Pacific white shrimp industry was the second most valuable crop, but it peaked in 2003 and has been declining, with only 3.73 million pounds produced in 2008.	2009: 3.2 million lbs.; 2010: approx. 2.5 million lbs. 2011: approx. 2.2 million lbs.; 2012: approx. 2.9 million lbs.; and 2013: approx. 2.5 million lbs.
Although the Texas marine shrimp aquaculture sector has historically been one of the highest contributors of the aquaculture industry, the farm gate price has been low since 2004.	From 2004 to 2007 marine shrimp production declined; but went up in 2008 and back down in 2009 and down even more in 2010.
The increase in redfish production has increased the farm gate price from $2.78/lb. in 2009.	Sales slowed in 2010 and 2011 due to the BP oil blowout affecting the tourist trade in the Gulf.

Texas Aquaculture Association Availability List 2014

Summary: A list of Texas aquaculture businesses, what fish they stock, food size, aquaponics, ornamentals / tropicals, and whether they carry aquaculture supplies.

Texas Aquaculture - A Regulatory Guide, produced by the Texas GLO

Summary: A trifold brochure including a summary of the Texas Department of Agriculture, the Texas Commission on Environmental Quality, the Texas Parks and Wildlife Department and the GLO.

Texas Aquaculture Cooperative, from the Agricultural Marketing Resource Center

Summary: A brief article from Markham, Texas, October 2008, describing the Texas Aquaculture Cooperative (created in 2002 by catfish farmers scattered throughout Texas, includes 35 producers and a frozen catfish processing plant.) In 2008, the plant is turning out as much as 30,000 pounds of finished product weekly.

Specific information about Texas Shrimp Farm Production, 2006 – 2013 (Texas Aquaculture Association)

Summary: 2007 – 2013 Texas shrimp farm production (compiled by Granvil Treece using sources: acres, pounds, PLs, harvest.)

A list of Texas aquaculture facilities (Texas Aquaculture Association)

Summary: Client legal name, DBA, Physical Address, City, State, Zip

The Census of Aquaculture (USDA) has extensive detailed information about aquaculture in Texas via tables.)

Summary: Values of Aquaculture products by type with details on water sources, aquaculture methods, product sales, distribution, and employment and payroll (2005 and 1998).

Management Characterization:

1. Indicate if the approach is employed by the state or territory and if there have been any state or territory-level changes (positive or negative) that could facilitate or impede the siting of public or private aquaculture facilities in the coastal zone.

Management Category	**Employed by State or Territory** (Y or N)	**CMP Provides Assistance to Locals that Employ** (Y or N)	**Significant Changes Since Last Assessment** (Y or N)
Aquaculture comprehensive siting plans or procedures	Y (The Texas Department of Agriculture coordinates the licensing of aquaculture facilities and vehicles transporting (live) cultured species, in partnership with Texas Parks & Wildlife Department and the Texas Commission on Environmental Quality.) (Texas Agriculture Code § 12 et seq.)	Y	N
Other aquaculture statutes, regulations, policies, or case law interpreting these	Y	Y	N

2. *For any management categories with significant changes briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information:*
   Describe the significance of the change;
   b. Specify if it was a 309 or other CZM-driven change; and
   c.
   d. Characterize the outcomes and/or likely future outcomes of the changes(s).

Note about Aquaculture Management Characterization:

Texas Parks and Wildlife Department established rules for offshore aquaculture, available in the State Register and on their website (TPWD Aquaculture regulations can be found in Texas Administrative Code, Title 31, Chapter 57, Subchapter C (Treece 2014)). Texas GLO is involved in aquaculture by making leases, while they are not involved in the regulation of aquaculture producers (which is managed by TPWD). The Gulf of Mexico

Fisheries Management Council (Council) has approved an offshore aquaculture amendment to allow commercial offshore aquaculture in Gulf of Mexico Federal waters (EEZ, from state boundary out 200 miles). However, the Council has only been able to allow research projects to conduct offshore aquaculture under an exemption to the Act. Currently, no commercial operation can be allowed in the Gulf under this Act, without an amendment passed to the Act allowing it. This process was completed by the Council and the full fisheries amendment adopted as a stand-alone fisheries management plan, including aquaculture (see FINAL Fishery Management Plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico (January 2009); Treece 2014).

The Council approved the Offshore Aquaculture Fisheries Management Plan and Amendment in January 2009, and passed the recommendation to implement the fisheries management plan to the U.S. Department of Commerce, NOAA/NMFS (Treece 2014).

According to Treece (2014), this process has met with opposition from environmental groups. In 2004, the Mississippi-Alabama Sea Grant Consortium published "Efforts to Develop a Responsible Offshore Aquaculture Industry in the Gulf of Mexico: A Compendium of Offshore Aquaculture Consortium Research", which includes Chapter 6: "Environmental Issues Associated with Offshore Aquaculture & Modeling Potential Impact", highlighting issues associated with offshore aquaculture, such as benthic carbon loading, water column nitrification, stimulation of harmful algal blooms, and escapement and implications to wild populations. They state that these issues "must be considered prior to expansion to open ocean locations" (p. 97, Riedel & Bridger 2004).

In regard to Texas, as of August 26, 2014: "The General Land Office is the state agency responsible for authorizing the use of state owned land, including state owned submerged land out to the 3 marine league line. Any structure or activity on state owned submerged land is required to have a lease or easement. *[Currently,] [t]here are no active leases or easements for aquaculture in the Gulf of Mexico.*" (Personal Communication, GLO, August 26, 2014 emphasis added.)

Enhancement Area Prioritization:

1. *What level of priority is the enhancement area for the coastal management program?*

   High _____
   Medium_____
   Low ___X___

2. *Briefly explain the reason for this level of priority. Include input from stakeholder engagement, including the types of stakeholders engaged.*

The level of priority is suggested as low for this enhancement area, with emphasis placed on careful monitoring of offshore aquaculture initiatives. Given the data available in the Texas coastal region, it seems there is valid pressure to move aquaculture services offshore; however, the current regulatory framework does not adequately address concerns posed by the opposition, presenting a potential barrier to development of a safe and viable offshore aquaculture industry.

Phase II In-Depth Assessment

Wetlands

In-Depth Resource Characterization:

Purpose: To determine key problems and opportunities to improve the CMP's ability to protect, restore, and enhance wetlands.

1. *What are the three most significant existing or emerging physical stressors or threats to wetlands within the coastal zone? Indicate the geographic scope of the stressor, i.e., is it prevalent throughout the coastal zone or specific areas that are most threatened? Stressors can be development/fill; hydrological alteration/channelization; erosion; pollution; invasive species; freshwater input; sea level rise; or other (please specify). When selecting significant stressors, also consider how climate change may exacerbate each stressor.*

	Stressor/Threat	**Geographic Scope** (throughout coastal zone or specific areas most threatened)
Stressor 1	Commercial and residential development	In particular near current urban areas throughout the state (Galveston, Brazoria, Aransas, Nueces and Cameron counties)
Stressor 2	Relative Sea level rise and Erosion	State wide, most prevalent in central and upper coast
Stressor 3	Drought/Climate Change	State wide, most extreme in South Texas

2. *Briefly explain why these are currently the most significant stressors or threats to wetlands within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.*

Separate from the NOAA C-CAP data (used for the Phase 1 Assessment), the *Wetland Status and Trends reports* (Tremblay and Calnan 2009; Tremblay and Calnan 2010; Tremblay, Vincent, and Calnan 2008; White et al. 2002; White et al. 2004; White et al. 2006; White et al. 2007; White et al. 2005) offer information regarding wetland change for most of the coastal regions within the Coastal Management Zone (CMZ) in Texas. The Wetland Status and Trends projects mapped wetland from color-infrared photographs taken from 2001-2008 and compared them to historical wetland maps from 1979 and the 1950's. The report provides the number of acres of wetland change and also highlights causes of change. A review of most of these reports were included in the last 309 assessment report (Harte Research Institute 2011) and will not be covered in depth in this section, but a list of the most prevalent causes of wetland change by region is presented in Table 2 below.

From these reports, historical major wetland loss and wetland change has been caused by change in climatic patterns, change in sediment supply, land subsidence, relative sea level rise, and land use changes (agriculture, development, building of channels and canals). Expected increases in coastal population are likely to exacerbate current wetland stressors in Texas including development, relative sea level rise (RSLR) and erosion, and climatic change.

Table 7. Historical causes of wetland change from Status and Trends reports*

Location	Report Date	Historical causes of wetland change (Since 1950's)
Upper Coast Strandplain	2007	Climatic change, Relative Sea Level Rise (RSLR), subsidence (active faults), erosion (Gulf side) and construction of levees and dikes.
Beaumont-Port Arthur	2009	RSLR (including subsidence), channelization and subsequent reduction in sediment supply, clearing for agriculture, industry and urban development.
Bolivar Peninsula	2004	Active surface faults, subsidence, and local development.
Galveston Island	2004	Subsidence, development, and cattle trails.
Follets Island	2004	RSLR and subsidence on active faults.
Freeport Area	2005	Sediment supply changes (Brazos River diversion), Gulf Intracoastal Waterway dredging and dredge material disposal, erosion, and development.
Matagorda Bay area	2010	Historical climate change (extreme drought 1956- subsequent vegetation recovery), localized subsidence from subsurface fluid withdrawal and RSLR (localized).
Matagorda Island/Peninsula	2002	RSLR, morphological change cause by Hurricane Carla, surface faults (subsidence), and change in sediment supply from river diversion (delta development).
Corpus Christi	2008	Climatic change (vegetation recovery from drought and expansion of mangroves), development, RSRL, excavation of quarries.
Barriers of Coastal Bend	2006	RSLR, climatic change, and agricultural practices.
Padre Island National Seashore	2007	Climatic change (recovery of vegetation on flats) and dune migration over flats.
South Padre Island	2005	Climatic change (mangrove expansion and lower estuarine water level) and development.
Brownsville-Harlingen	2011	Climatic Change (lower estuarine water level less marsh in deflation troughs), clearing for agriculture/grazing, dredging and dredge material disposal.

**Source: (Tremblay and Calnan 2009; Tremblay and Calnan 2010; Tremblay, Vincent, and Calnan 2008; White et al. 2002; White et al. 2004; White et al. 2006; White et al. 2007; White et al. 2005*

Relative Sea Level Rise and Erosion

Relative sea level rise (RSLR) including subsidence is one of the highest reported causes of wetland loss (White and Tremblay. 1995; Ravens et al. 2009; Cline et al. 2011) in Texas and it is expected to continue into the future. Wetlands provide a suite of ecosystem services, including the provision of habitat, water purification, recreational opportunities, and protection against storms and flooding. All these important benefits are at risk with the threat posed by RLSR. In addition, climatic change may exacerbate the magnitude of RSLR rates which in turn may cause wetland loss through erosion or inundation (Brunn 1962; Leatherman et al. 2000).

In order for wetlands to remain in their current extent or expand, marsh sedimentation rates have to be equal to or surpass those of RSLR (Brinson, Christian, and Blum 1995). It is unlikely that sedimentation rates along Texas estuarine wetlands can keep up with RSLR as the construction of upstream dams and reservoirs has reduced the

quantity of sediments reaching the coast (White et al. 2002). Table 8 shows a comparison of marsh sedimentation rates of 3 fluvial-deltaic system in the upper Texas coast (White et al. 2002) and current RSLR rates from NOAA. As seen in Table 8, wetland sedimentation is less than observed rates of RSLR. In the case that wetlands do not accrete at a rate to compete with RSLR, migration inland and upslope may occur. Landward migration of wetlands is possible if areas that are undeveloped and gently sloping are available.
Currently the Texas coast is mostly unarmored (87 percent), providing opportunities for mitigation of wetlands due to RSLR.

Table 8. Sedimentation rate of Texas Fluvial-Deltaic Systems and RSLR rates.

Watershed	Sedimentation Rate (mm/yr)*	Closest Tide Gauge	Relative sea level rise Rate (mm/yr)**
Trinity	5.1	Galveston	6.6
Lavaca-Navidad	3.3	Freeport	4.4
Nueces	2.6	Rockport	5.5

*Source White et al (2002)
** Source NOAA Sea Level Trends http://tidesandcurrents.noaa.gov/sltrends/sltrends.html. Accessed 12/15/2014

In Texas, erosion, combined with RSLR, is one of the major causes of wetland loss. Erosion of gulf-facing shoreline has been previously discussed in the Phase 1 Hazards section; this section will focus on bay shorelines. Currently, average bay shoreline erosion for various Texas bays (Table 9) is generally under 2 m/yr. The highest average rate is in Galveston bay. Although the average rate of change seems minimal, erosion occurs in localized areas and some areas experience more change than others (see Appendix F maps for Bay Shoreline Erosion rates). Furthermore, bay shoreline erosion impacts important habitats such as rookery islands and wetlands which support fisheries and provide shoreline protection.

Another area of high erosion is along the Gulf Intracoastal Waterway (GIWW), where erosion rates average up to 1.2 m/yr and can be as high as 3 m/yr (Ducks Unlimited, 2013). The GIWW has introduced changes to wetland hydrology and has exposed wetlands to wind and vessel induced wave erosion. Ducks Unlimited has developed a web-based prioritization tool which shows areas where breakwaters may be needed to protect areas most critical for protecting wetlands for waterfowl and coastal wildlife (Ducks Unlimited, 2013).

Table 9. Shoreline change rates for select Texas bay systems.

	Shoreline Change m/yr			
Bay	Min	Max	Mean	Std Dev
Galveston Bay	-6.7	13.0	-0.6	1.2
San Antonio Bay	-3.3	6.6	-0.3.	1.1
Copano-Aransas Bay	-19.7	10.5	-0.2	1.7
Corpus Christi Bay	-4.0	23.5	0.7	3.2
Baffin Bay	-3.8	8.3	-0.1	0.6

Development and Increasing Population

The state of Texas is the second most populated state in the nation and had the most growth between 2000 and 2010, increasing from 20.8 million to 25.1 million residents (Water for Texas 2012 State Water Plan 2012). Population projections show that by the year 2060 (Figure 24) many of the Texas coastal counties will have

grown by 50 to 100 percent. This is one of the fastest growing coastal regions in the country and increased tourism, recreation, commercial and industrial projects will accelerate wetland alteration (Brody 2008). Accompanying concerns include the increase in water demand, increased non-point source pollution, increased impervious surface and habitat fragmentation, increased impervious cover, and impacts resulting from increased energy development.

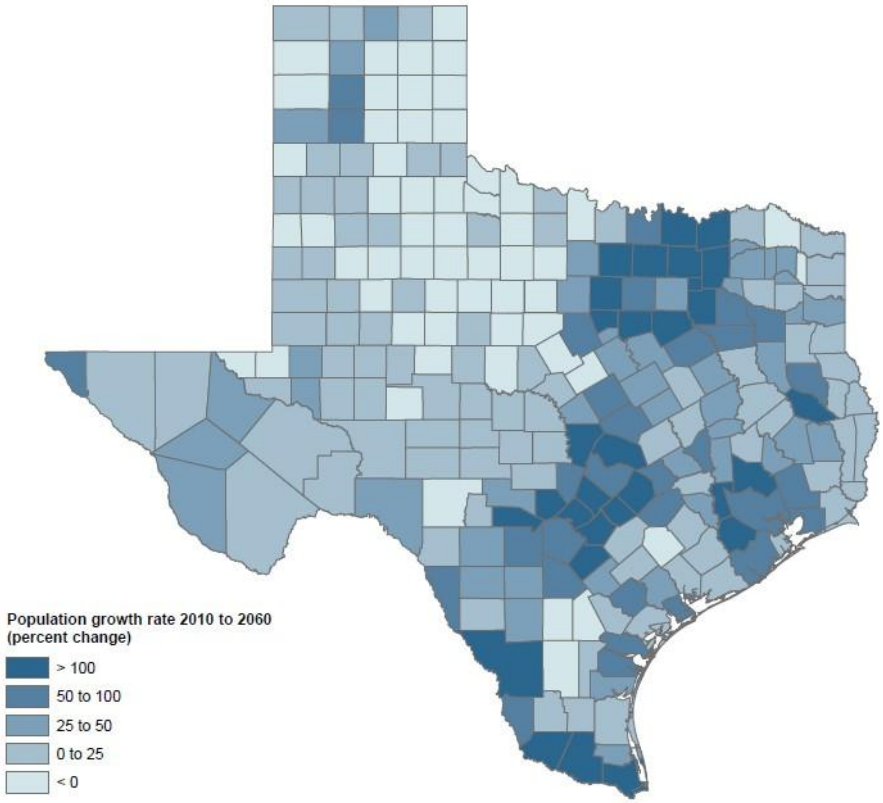

Figure 24. Projected population growth in Texas Counties. Image from Water for Texas 2012 State Water Plan,

Development also leads to a loss of wetland habitat. In Harris County alone, 30 percent of freshwater marshes and swamps have been lost since 1992 (30), primarily to development and many of these freshwater habitats lying outside the 100-year floodplain are unprotected by the federal regulatory system (Geotechnology Research Institute, 2014). Rising population density is also associated with an increase in impervious surfaces; the alteration of natural wetlands leads to loss of habitat and natural water retention within the watershed unit. Brody et al. (2007) analyzed wetland permit data from 1991-2002 (Figure 25) as well as watershed flooding occurrences for the same time period, and found that an increase of impervious surfaces within a watershed corresponds with a significant increase in the degree of flooding. Also, increased development leads to other issues such as changes in hydrology, habitat fragmentation, and spread of invasive species. While population growth and development may not be curtailed, planning and conservation of priority wetlands may help improve community resilience.

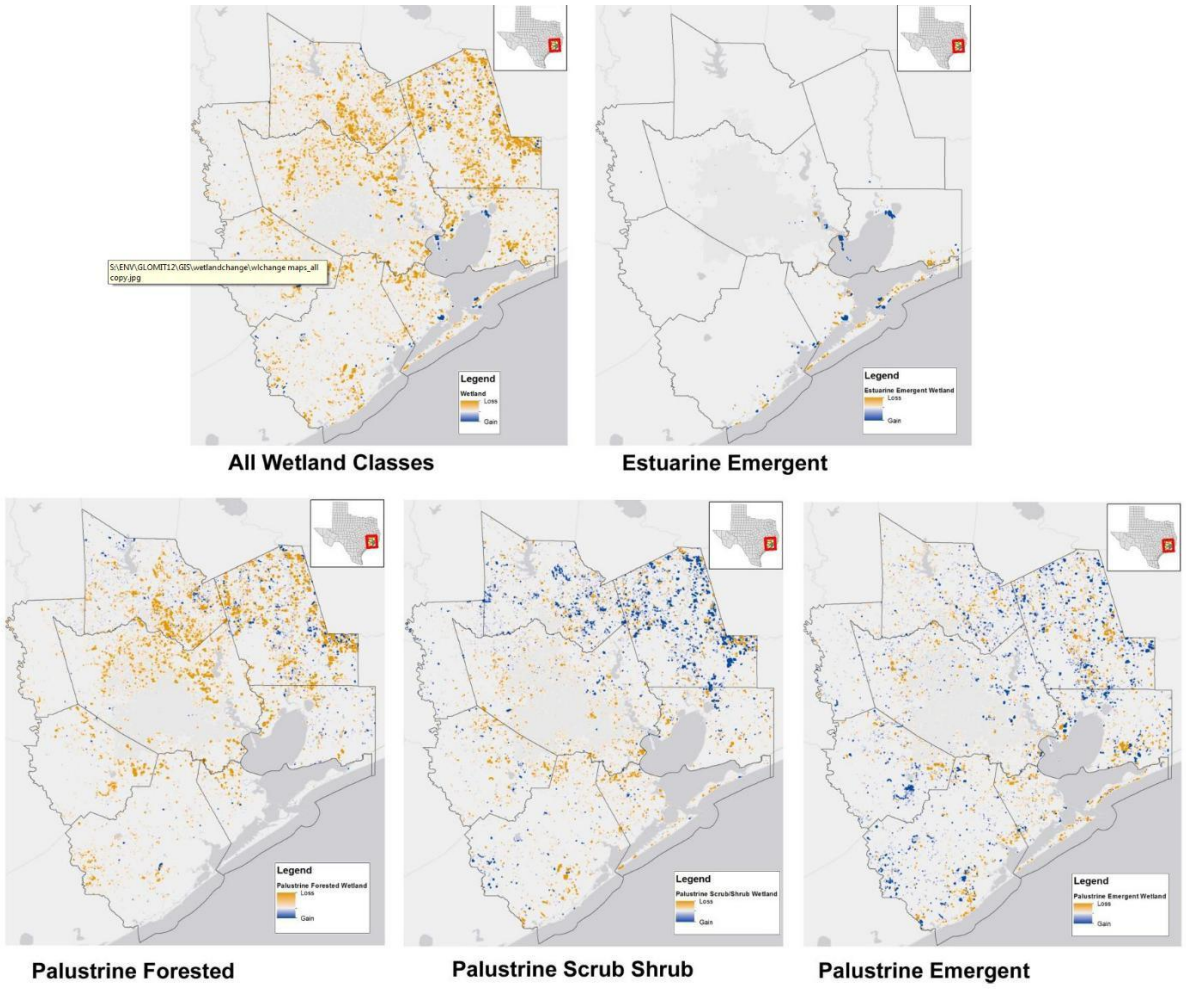

Figure 25. Heat map showing net loss (orange) and gain (blue) of various wetland classes between 1996-2010 in the upper Texas coast including coastal counties of Brazoria, Harris, Galveston, and Chambers. Image from (Geotechnology Research Institute, 2014).

With increased development there is an accompanying increase in water demand which may lead to decreased flow into estuarine environments having profound effects on these ecosystems. The projected increase of water demand is associated with increasing consumption as well as growing sectors like mining (including the exploration, development and extraction of oil, gas coal and other materials) steam-electric power generators, agricultural irrigation, and livestock water needs (Water for Texas 2012 State Water Plan 2012).

Drought and Climate Change

Drought has historically affected the distribution of wetlands as it impacts soil moisture and estuarine water levels. Although drought may be a temporary and periodic event (Figure 26) for many areas, it is an ongoing issue in South Texas where more frequent drought spells prevent the necessary amount of fresh water for reaching freshwater wetlands in the coastal area. This is a challenging situation for land and local wildlife refuge managers who may not have the ability to acquire, move, or store fresh water for wetlands in time of drought (personal communication, Laguna Atascosa National Wildlife Refuge). The availability of fresh water is important for wildlife, wading birds, and waterfowl; as well as to maintain healthy estuarine water quality.
Additionally, the drying of wetlands promotes encroachment of invasive plant species, presenting additional management challenges.

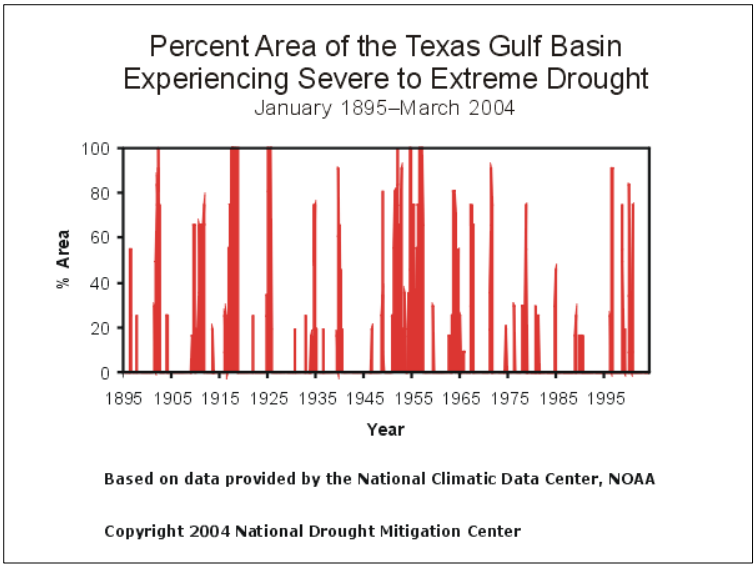

Figure 26. Image from the National Drought Mitigation Center at University of Nebraska Lincoln available online at http://drought.unl.edu/Planning/Monitoring/HistoricalPDSIMaps/HistoricalPDSIGraphs.aspx.

3. *Are there emerging issues of concern but which lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.*

Emerging Issue	Information Needed
Energy Development	Information is needed on potential impacts to wetlands and other critical habitats that result from mining, processing, and transportation of energy products including injection wells, pipeline and facility construction, and plan operations.
Freshwater Inflows	Evaluate the potential impacts and benefits of established flow standards on fresh water inflows to estuarine habitats and organisms.
Restoration and Mitigation Tracking and Environmental Data	Development of a comprehensive database for monitoring and tracking mitigation and restoration and identify areas for restoration. Develop comprehensive habitat database. Conduct climate change vulnerability assessments.

Fresh Water Inflow Standards

In the previous assessment a short introduction of Senate Bill 3 was presented. Senate Bill 3 (2007) implemented a stakeholder led process to determine environmental flow standards for river basins and bay systems that are adequate to support a sound ecological environment, to the maximum extent reasonable considering other public interests (TCEQ 2014). Through this process, stakeholder committees, scientific teams, and state resource agencies are tasked with developing a set of recommendations which are submitted to the Texas Commission on Environmental Quality (TCEQ) for consideration of formal standards for each of the 11 bay/basin areas (seven of which are on the Texas Coast). To date, four of seven coastal basins have made recommendations. Environmental flow standards adopted by the TCEQ consist of a seasonal schedule of flow quantities that address subsistence flow, base flow, and one level of high flow pulses. One issue that has emerged from this process is the need for increased

monitoring and data collection in coastal areas. Recommendations have been impacted especially by lack of data, or out-of-date data on water circulation, important estuarine species, and hydrogeologic change. This includes transdisciplinary research that integrates biological, hydrological, land use, and policy analysis.

Flow standards:

- "subsistence flows"—Very low flows seen only during times of drought
- "pulse flows"—Short-term events brought on by heavy rainfall producing a surge of water in the river and/or into the bay system
- "base flows"—Flow volumes that fall between subsistence flows and pulse flows and that occur most of the time; generally there are several different levels of base flows

Restoration and Mitigation Tracking and Environmental Data

Restoration activities are occurring across the Texas coastal zone, and additional and improved data and information is essential for tracking the long-term impacts of these projects. As much restoration occurs on state-owned submerged lands, monitoring and enforcement through site visits are an important means to ensure restoration and mitigation success and compliance. As development and use of the coast continues to increase, there is not sufficient capacity or data to track these sites at the desired frequency. There is a need to move to real-time and data-driven GIS tracking of these areas so that permit documentation, drawings, past site photos and impacts to the area can be viewed and modified digitally as compared to keeping paper files. Information regarding estuarine circulation patterns, biological, ecological, ecosystem services and updated bathymetric and topographic data is needed to help staff identify areas in need of restoration, track the status and vitality of required mitigation areas, or areas that may serve as mitigation banks, and to help inform decisions on the probability of restoration or mitigation success during the permitting process. The development of an online or mobile data viewing and collection platform with underlying environmental datasets would help improve the efficiency of management and mitigation compliance, and data collection and distribution for coastal-related activities, enforcement, and decision-making.

In-Depth Management Characterization:

Purpose: To determine the effectiveness of management efforts to address identified problems related to the wetlands enhancement objective.

1. *For each additional wetland management category below that was not already discussed as part of the Phase I assessment, indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred since the last assessment.*

Management Category	Employed By State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Wetland assessment methodologies	N	Y	N
Wetland mapping and GIS	Y	Y	Y

Watershed or special area management plans addressing wetlands	Y	Y	Y
Wetland technical assistance, education, and outreach	Y	Y	N
Other: Permitting-	Y	Y	Y
Other: Wetland Protection and Restoration	Y	Y	Y

2. *For management categories with significant changes since the last assessment, briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information.*
    a. *Describe significant changes since the last assessment;*
    b. *Specify if they were 309 or other CZM-driven changes; and*
    c. *Characterize the outcomes or likely future outcomes of the changes*.

Wetland Assessment and Mapping

Wetland mapping and change analysis in the Texas Coastal Zone has been an ongoing effort (Please see Question 2 in this section). During the last assessment period a new map was published for the Brownsville- Harlingen region (Tremblay, 2011). These maps are supported through CMP and are considered CZM-driven changes. These maps are essential for estimating wetland change (as reported in the last assessment). A current ongoing effort is the *Baseline Mapping for Mangroves Monitoring in the Coastal Bend, Texas Gulf Coast.* This CMP funded project will obtain valuable baseline information for monitoring the expansion and migration of mangroves in the Texas Coastal Bend, establish methods and procedures for hyperspectral imagery mapping, and expand upon previous wetland status and trend studies in the Coastal Bend.

Watershed or Special Area Management

Some changes have occurred in regard to freshwater inflow standards (please see Question 3 in this section). These are not CZM-driven changes, but may have an impact on wetland health and other estuarine environments.

The TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB) support the development and implementation of watershed protection plans (WPPs) that have the potential to prevent or manage nonpoint source pollution. Several WPPs have been developed with local stakeholder groups, usually with funding and technical assistance from the TCEQ and/or the TSSWCB, along with the U.S. EPA. These plans are highly localized and could be expanded and coordinated for comprehensive coastal protection and targeted watershed areas under the coastal non-point source pollution program. Watershed Protection Plans along the Texas Coastal Zone include:

- Double Bayou
- Cedar Bayou
- Armand Bayou
- Dickinson Bayou
- Moses-Karankawa Bayous
- San Bernard
- Lower Nueces River
- Arroyo Colorado

Permitting

In 2014, the GLO updated the Resource Management Codes (RMC) with the assistance of state and permitting agencies and published them on a GIS platform. The codes are designed to provide development guidelines on state owned tracts, that will help protect sensitive environments, including wetlands, during oil and gas development. The data-derived codes will provide up-to-date information to inform the oil and gas leasing and permitting process and development decisions. New RMCs are available online at: http://www.glo.texas.gov/what-we-do/energy- and-minerals/resource-management-codes/index.html. This is a CZM 309-driven change.

Wetland Technical Assistance, Education, and Outreach

The Texas Parks and Wildlife Department provides assistance to landowners who are interested in developing and managing wetland habitats on their property through programs like the Texas Prairie Wetlands Project, the Coastal Program, and the Landowner Incentive Program. Depending on eligibility, some programs offer cost-share assistance to build and manage wetlands, technical guidance from local biologists and other guidance information. This is not a CZM-driven effort.

CMP is funding many education and outreach programs such as Coastal Bend Bays Foundation volunteer marsh planting and restoration, Upper Oso Watershed habitat education project, and The Texas Coastal Monitoring program, all of which provide a hands-on learning experience to participating members of the community. These programs educate individuals on coastal environments, monitoring techniques and practices and help foster appreciation and understanding of the services provided by wetlands and other coastal habitats. These are other CMZ-driven efforts.

Wetland Protection and Restoration

In early 2013, the GLO held a series of Technical Advisory Committee meetings along the coast to develop a list of key coastal issues and to obtain feedback on potential priority projects. Feedback provided indicated that wetlands and habitat loss is the top issue of concern and a priority across all regions (Gibeaut et al., 2014).
Proposed projects directly benefiting emergent wetlands in the coastal region that were reviewed included conservation easements, shoreline protection and restoration through the beneficial use of dredged material (BUDM) placement, and living shoreline marsh restoration efforts (Gibeaut et al., 2014). Through this CMP funded effort, a priority list of potential projects was developed as a resource when conservation and restoration funding becomes available. This is a CMZ 309-driven effort.

In 2014, 14 wetland enhancement and protection projects were funded through the Gulf Environmental Benefit Fund from the National Fish and Wildlife Foundation (NFWF). The projects address high priority conservation needs (some identified in the Texas Coastal and Estuarine Land Conservation Program Plan and from TAC feedback) and represent important efforts to protect and enhance natural and living resource along the Texas coast. Funded projects include a combination of land/marsh acquisition and estuarine and shoreline restoration and enhancement. More Gulf Environmental Benefit Fund projects are expected in the 2015 funding cycle and the NFWF will continue to engage the Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, Texas General Land Office, US Fish and Wildlife Service, and NOAA to identify priority conservation projects for consideration. This is not a CZM-driven effort.

In addition, five other coastal land acquisition and restoration projects have been submitted for evaluation under Gulf Restoration, Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf

Coast States Act or RESTORE Act, funding. Through funding opportunities that resulted from the Deep Water Horizon oil spill, Gulf States have a unique opportunity to address some priority protection and restoration of valuable wetlands and other coastal resources. This is not a CZM-driven change.

Other GLO funding to protect, restore, and study wetlands include the Coastal Impact Assistance Program (CIAP) and the Coastal Erosion Planning and Response Act program (CEPRA). The CEPRA is a state-sponsored program that funds studies to reduce the effects of coastal erosion as well as infrastructure and shoreline development to mitigate erosion impacts. The CIAP is funded by the royalties from offshore oil and gas leases

in federal waters and supports projects related to conservation, protection, or restoration of coastal areas including wetlands and natural resources, and implementation of federally approved marine, coastal, or comprehensive conservation management plans. Through these non-CZM programs, the state of Texas funds projects which aid in management and enhancement of wetlands.

Some CMP funded Wetland Enhancement Projects include locations in Nueces Bay, Oso Bay, Dickinson and Armand Bayou, and Magnolia beach. In addition a projects like "*Science based monitoring of created wetlands and restored habitat within the Galveston Bay system"* and "*Maximizing the ecological value of coastal wetland restoration: comparison among restoration techniques"* advance the scientific knowledge of wetland restoration for the Texas coast. These are CZM-driven changes aimed at enhancing coastal wetlands and providing information for future wetland management.

3. *Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's or territory's management efforts in protecting, restoring, and enhancing coastal wetlands since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state's or territory's management efforts?*

The State has established successful programs for the protection, restoration, and enhancement of coastal environments including wetlands. State programs previously mention - CEPRA, CIAP and CMP- work in tangent to fund various research and wetland enhancement efforts The CEPRA program has invested over $94 million since its inception in 1999 for mitigation of coastal erosion (GLO, 2011). CEPRA funded 91 bay and gulf erosion- mitigation projects from 2008-2011. Similarly, the Texas CMP program awarded over $3 million during the 2013-2014 funding, part of which was invested in the research, restoration and enhancement of wetlands.

Identification of Priorities:

1. *Considering changes in wetlands and wetland management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve its ability to more effectively respond to significant wetlands stressors.*

MANAGEMENT PRIORITY 1:
Continued and enhanced monitoring of wetlands including status, ecological function, and ecosystem services.

Description: Continued wetland mapping and monitoring is essential for assessment of wetland trends, health, and needs and also for bay shoreline change analysis. Conduct outreach to expand knowledge of the ecosystem services

provided by wetlands to enhance wetland mitigation and restoration inspections, enforcement, monitoring and tracking. A first step to accomplish this is to incorporate ecosystem services into Texas Coastal Zone Management policies and tools to facilitate adaptive and sustainable policies.

MANAGEMENT PRIORITY 2:
Enhance management processes to provide for wetland resilience through policies, restoration, and outreach.

Description: Faced with various coastal issues such as climate change, relative sea level rise, erosion, and population growth, there is a need to mitigate impacts as well as prevent future wetland degradation. Often engineering solutions are sought to mitigate some of these issues. More recently, resilient coastal solutions have been employed to address wetland and shoreline erosion. Texas has a special opportunity in that a large percentage of its shoreline is undeveloped, so future construction can adopt coastal resiliency principles, like living shorelines, that not only mitigate for hazards, but maintain their ecological function and ecosystem-services provided by coastal wetlands. Outreach is essential in building a support for healthy and resilient communities. Education and outreach can be provided to private land owners on the benefits of living shorelines for shoreline protection instead of bulkheads and other engineered hard structures. Other considerations for management enhancements include expansion of wetland restoration BMPs and state- federal coordination to increase BUDM for wetland restoration projects.

MANAGEMENT PRIORITY 3:
Develop vulnerability assessments of wetland habitat, incorporating projected environmental and anthropogenic changes.

Description: Climate change vulnerability assessments of natural systems will identify which species or ecosystems are likely to be most affected by projected climate change and relative sea level rise and help us understand why these resources are likely to be vulnerable (Glick, Stein, and Edelson 2011). Stakeholder engagement is integral to identify community areas highly vulnerable to environmental and human impacts. Through this process, stakeholder identified environmental priorities may be assessed using available data and models to arrive at various management approaches. One method of improving sustainable resource management could also include the development of a stakeholder-driven comprehensive watershed-based planning program to protect vulnerable areas, reduce erosion and to protect natural drainage features and vegetation.

2. *Identify and briefly explain priority needs and information gaps the CMP has to help it address the management priorities identified above. The needs and gaps identified here do not need to be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.*

Priority Needs	Need? (Y or N)	Brief Explanation of Need/Gap
Research	Y	More research in wetland processes such as sedimentation, ecology, ecosystem services, and hydrodynamic processes
Mapping/GIS	Y	Maintain and update bathymetry and topography
Data and information management	Y	Improved database on coastal related activities including restoration and mitigation monitoring and tracking
Training/capacity building	Y	Training professionals in living shorelines. Staff training on mitigation and restoration tracking and evaluation.

Decision-support tools	Y	Comprehensive management – consolidate multiple plans; increase policy acceptance through greater stakeholder coordination and involvement.
Communication and outreach	Y	Education and outreach wetland functions and ecosystem services.
Other (Specify)		

Enhancement Area Strategy Development:

1. *Will the CMP develop one or more strategies for this enhancement area?*

Yes X
No _____

2. Briefly explain why a strategy will or will not be developed for this enhancement area.

Coastal wetlands are considered high priority because they are integral to support healthy coastal ecosystems and resources and provide hazard mitigation. Wetlands are at great risk of deteriorating due to climate change, drought, relative sea level rise, erosion, and increasing coastal development. Research, mapping, and monitoring will help us gain a better understating of wetland processes which will help to adaptively manage wetlands through restoration, inspections, permitting, mitigation tracking and enforcement. Development of an agency-wide data management platform for wetland mitigation inspections and assessments will help inform permitting assistance and enforcement. Information regarding wetland function and ecosystem services is needed to gain a better understanding of wetland use and importance to help aid in management decisions. Development of a 309 strategy to address the wetlands enhancement area will aid in the State's wetland management.

Coastal Hazards

In-Depth Resource Characterization:

Purpose: To determine key problems and opportunities to improve the CMP's ability to prevent or significantly reduce coastal hazard risks by encouraging sustainable and resilient development and redevelopment in high-hazard areas and managing the effects of relative sea level rise.

1a. ***Flooding In-depth**: Using data from NOAA's State of the Coast "Population in the Floodplain" viewer[25] and summarized by coastal county through NOAA's Coastal County Snapshots for Flood Exposure,[26] indicate how many people at potentially elevated risk were located within the state's coastal floodplain as of 2010. These data only reflect two types of vulnerable populations. You can provide additional or alternative information or use graphs or other visuals to help illustrate or replace the table entirely if better data are available.*

2011 Populations in Texas Coastal Counties at Potentially Elevated Risk to Coastal Flooding[27]				
	Under 5 and Over 65 years old		In Poverty	
	# of people	% Under 5/Over 65*	# of people	% in Poverty*
Inside Floodplain	184,639	3.06%	188,037	3.12%
Outside Floodplain	863,115	14.30%	889,994	14.75%

*percent of total population

According to the 2010 census the counties with the greatest population in the floodplain include Harris , Brazoria , Galveston , and Cameron .

1b. ***Flooding In-depth** (for all states besides territories): Using summary data provided for critical facilities, derived from FEMA's HAZUS[28] and displayed by coastal county through NOAA's Coastal County Snapshots for Flood Exposure,[29] indicate how many different establishments (businesses or employers) and critical facilities are located in the FEMA floodplain. You can provide more information or use graphs or other visuals to help illustrate or replace the table entirely if better information is available.*

Texas Coastal Counties: Critical Facilities in the FEMA Floodplain[44]						
	Schools	Police Stations	Fire Stations	Emergency Centers	Medical Facilities	Communication Towers
Inside Floodplain	249	37	40	1	14	25
Coastal Counties	2152	225	181	15	117	159

A total of 326 critical facilities exist within the FEMA flood plain Texas counties within the CZM area (see Appendix E). The greatest amount of facilities in the flood plain occurs in Harris County (193) followed by Galveston County (35). Analysis of NOAA Land Cover Data show that development within the flood plain of these counties continues. A total of 34,921 acres of land were developed from 2001 to 2006; 12.6 percent of that was within the FEMA floodplain (see Appendix F). The counties with highest acres of development within

[25] http://stateofthecoast.noaa.gov/pop100yr/welcome.html
[26] http://www.csc.noaa.gov/digitalcoast/tools/snapshots
[27] Data Source: American Community Survey 5-year estimates available at http://coast.noaa.gov/digitalcoast/dataregistry/#/acs.
[28] http://www.fema.gov/hazus; can also download data from NOAA STICS http://www.csc.noaa.gov/digitalcoast/data/stics. Summary data on critical facilities for each coastal state is available on the ftp site.
[29] http://www.csc.noaa.gov/digitalcoast/tools/snapshots

the floodplain are Harris, Brazoria, and Galveston. Further analysis shows that most development (70 percent) is constructed over natural areas, which include wetlands and forested areas.

2. *Based on the characterization of coastal hazard risk, what are the three most significant coastal hazards[30] within the coastal zone? Also indicate the geographic scope of the hazard, i.e., is it prevalent throughout the coastal zone or are specific areas most at risk?*

	Type of Hazard	**Geographic Scope** (Throughout coastal zone or specific areas most threatened)
Hazard 1	Coastal Storms	Coast-wide
Hazard 2	Flooding/Storm Surge	Coast-wide
Hazard 3	Erosion and RSLR	Coast-wide – Gulf shoreline and bay front communities

3. *Briefly explain why these are currently the most significant coastal hazards within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.*

Coastal Storms

FEMA Disaster Declarations from 1953-2014 occurred in 11 of the 18 coastal counties. Coastal storms present an imminent threat to people and property living near the coast, and many of the impacts to communities, natural environments, and the economy are long lasting (see Phase 1 Coastal Hazards for summary of coastal storms). Hurricane return periods are shown in Figure 27 and return periods for major hurricanes in Figure 35. Counties of the Texas coast, on average, experience a hurricane once every 9-13 years and a major hurricane (≥Category 3) once every 25-40 years (Blake and Landsea 2011). Because hurricanes may occur any year, it is essential for communities to mitigate for impacts yearly and prior to hurricane season. Many of the large communities on the Texas coast have not experienced a major hurricane in 30+ years. With the exception of the upper coast which was devastated by Hurricane Ike in 2008, Nueces County experienced its last major hurricane in 1970 (Celia) and Cameron County's last major hurricane was Hurricane Allen in 1980 (Landsea and Blake, 2011). Coastal residents who are younger or who recently moved to a coastal area might not have experienced such an event and therefore don't know how to prepare or respond. For this reason, hurricane preparedness and post storm planning and outreach are essential.

Flooding

Flooding has historically been a major hazard in Texas and is the most frequent and costliest hazard for the state of Texas (see Phase 1 assessment). Most Texas coastal counties have experienced over 16 floods from 1960-2012; and Harris, Galveston, and Chambers Counties experienced over 74 floods for the same time period (see Figure 4 in Phase 1). Harris and Galveston Counties, in particular, have the highest amount of land development within the FEMA floodplain (Appendix F). This information is supported by the study of Brody et al. (2007), who found the highest number of federal wetland permits (between 1991-2002) occurred in watersheds encompassing major urban areas of the Houston-Galveston area. In addition, their study shows that the larger number of wetland permits issued within a watershed and an increase in the area of impervious surface correlates with a significantly higher increase in the degree of flooding, runoff volumes and pollutant loadings.

[30] See list of coastal hazards at the beginning of this assessment template.

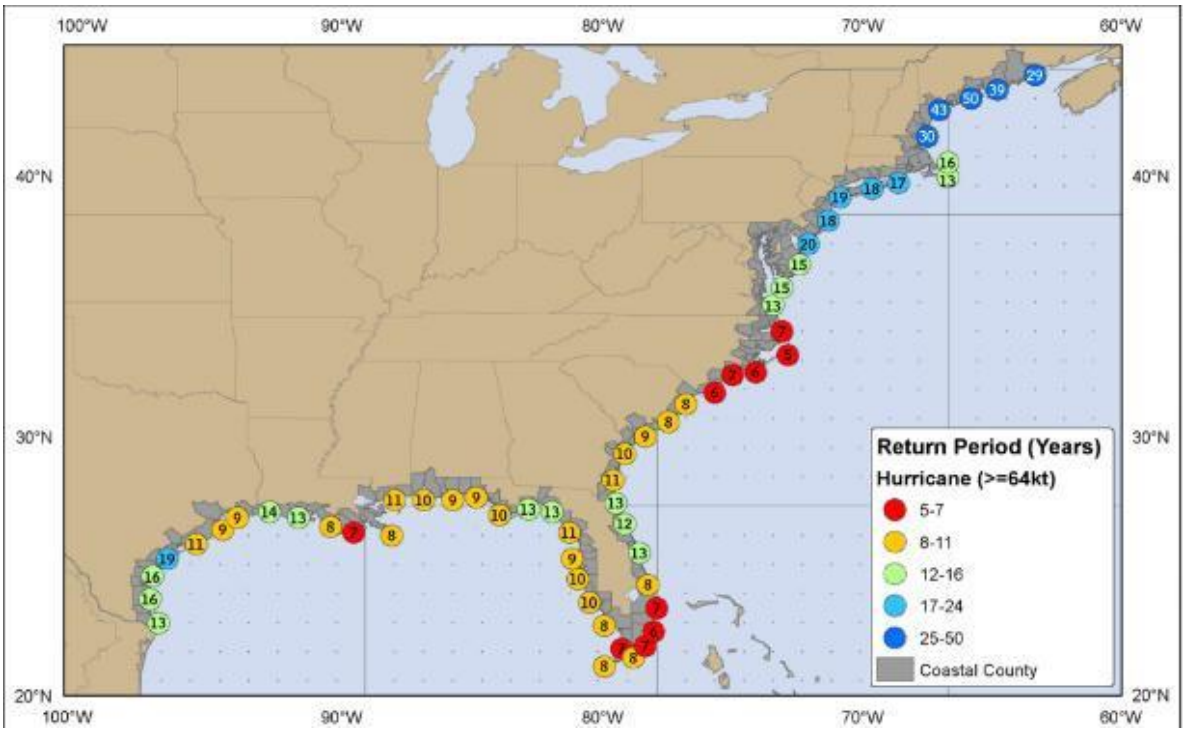

Figure 27. Estimated return period in years for hurricanes passing within 30 nautical miles of various locations on the U.S. coast. Image from Blake and Landsea (2011).

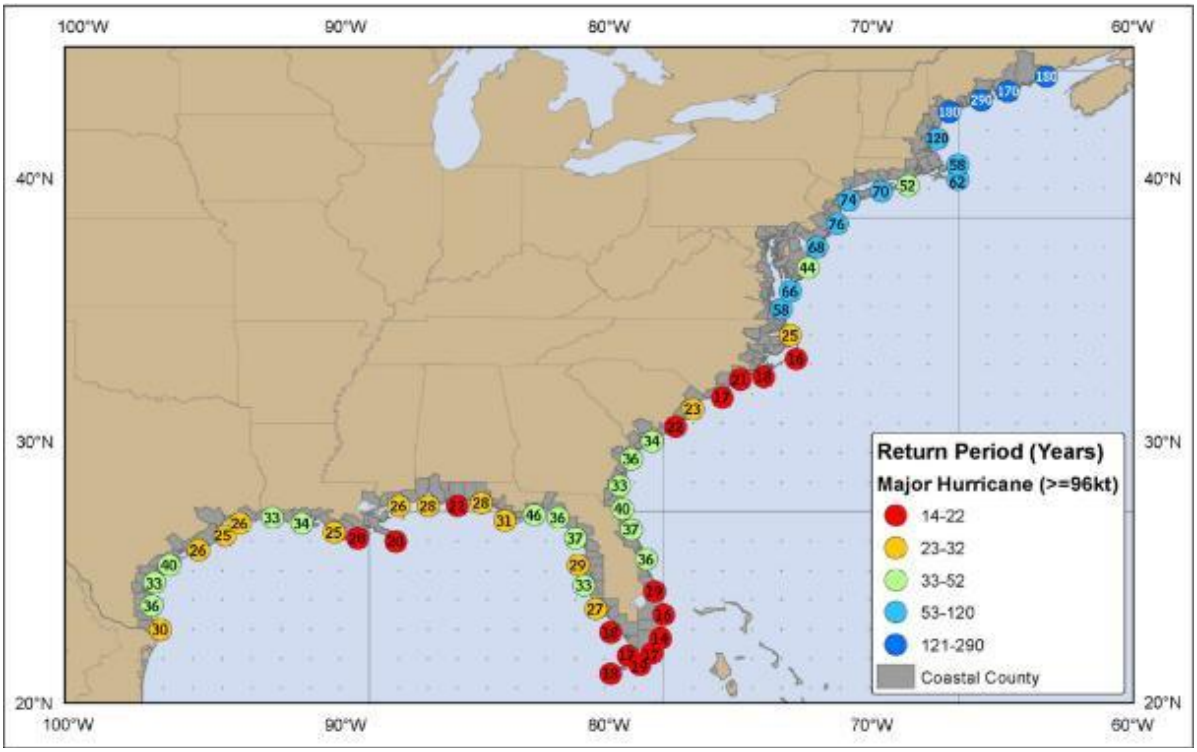

Figure 28. Estimated return period in years for major hurricanes passing within 50 nautical miles of various locations on the U.S. Coast. Image from Blake and Landsea (2011).

Similar to coastal storms, increased population and development will increase the amount of impervious surfaces, through habitat destruction, altering the physical, chemical, and biological characteristics of the

watershed and thereby increasing the vulnerability of communities to flooding, and surface water pollution.

Erosion and Relative sea level rise

Long-term, continuous shoreline erosion and episodic shoreline change is a serious hazard on the Texas coast threatening homes, infrastructure, commercial establishments, and coastal habitats (see Phase 1 assessments for maps and descriptions). It is currently considered a significant hazard for coastal areas (Texas Hazard Mitigation Plan, 2013), such that setback requirements for community erosion response plans, require the erosion rate to be considered in the setback rules for communities facing the Gulf. The GLO monitors shoreline change rates, a project continuously updated by the Bureau of Economic Geology at the University of Texas at Austin. The bay shoreline data set is currently being updated.

Causes of erosion are attributed to processes like wave and current removal of unconsolidated sediment along shorelines, as well as ship wakes, storms, and relative sea level rise. Erosion is compounded due to the natural lack of sufficient sediment supply to the coast, coastal development activities along the edges of shorelines, and navigation structures. Erosion threatens beach use and access, habitat loss, roadways and infrastructure, like evacuation routes, and natural storm protection from dunes and barrier islands.

4. *Are there emerging issues of concern, but which lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.*

Emerging Issue	Information Needed
Change in hazard exposure and impact on coastal communities resulting from changing coastal ecosystems and land-use patterns.	Data to assess and model ecosystem and land-use changes for use in vulnerability assessments. This information will be incorporated into the Beach and Dune Rules within Chapters 15 and 25 of the Texas Administrative Code for coastal communities to reference and include in their local Erosion Response Plans and ordinances.

In-Depth Management Characterization:

Purpose: To determine the effectiveness of management efforts to address identified problems related to the coastal hazards enhancement objective.

1. *For each coastal hazard management category below, indicate if the approach is employed by the state or territory and if there has been a significant change since the last assessment.*

Management Category	Employed by State/Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Change Since the Last Assessment (Y or N)
Statutes, Regulations, and Policies:			
Shorefront setbacks/no build areas	Y	Y	Y
Easements	Y	N	Y
Repair/rebuilding restrictions	Y	Y	N

Hard shoreline protection structure restrictions	Y-beach/dune	Y	N
Promotion of alternative shoreline stabilization methodologies (i.e., living shorelines/green infrastructure)	N	Y	N
Repair/replacement of shore protection structure restrictions	Y		
Inlet management	Y	Y	N
Protection of important natural resources for hazard mitigation benefits (e.g., dunes, wetlands, barrier islands, coral reefs) (other than setbacks/no build areas)	Y	Y	N
Repetitive flood loss policies (e.g., relocation, buyouts)	Y	Y	N
Freeboard requirements	N	Y	N
Real estate sales disclosure requirements	Y	Y	N
Restrictions on publicly funded infrastructure	Y	Y	N
Infrastructure protection (e.g., considering hazards in siting and design)	Y	Y	N
Other (please specify)			
Management Planning Programs or Initiatives:			
Hazard mitigation plans	Y	Y	Y
Sea level rise or climate change adaptation plans	N	Y	N
Statewide requirement for local post-disaster recovery planning	N	Y	N
Sediment management plans	Y	Y	N
Beach nourishment plans	Y	Y	N
Special Area Management Plans (that address hazards issues)	Y	Y	N
Managed retreat plans	N	Y	N
Other (please specify)			
Research, Mapping, and Education Programs or Initiatives:			
General hazards mapping or modeling	Y	Y	Y
Relative sea level rise mapping or modeling	Y	Y	Y
Hazards monitoring (e.g., erosion rate, shoreline change, high-water marks)	Y	Y	Y
Hazards education and outreach	Y	Y	Y
Other (please specify)	N/A	N/A	N/A

Statutes, Regulations, and Policies:

Most hazard mitigation in the State of Texas is the responsibility of city governments because the state and county levels of government have little control over land use and building standards (Peacock and Husein 2011). The State employs the Dune Protection Act, Open Beaches Act, Coastal Erosion Planning and Response Act and the Coastal Management Program to aid and fund many hazard management efforts.

Shorefront setbacks

Refer to Phase 1, Coastal Hazards, Management Characterization for more details.

Rolling easements

Refer to Phase I, Public Access, Management Characterization.

Management Planning Programs or Initiatives:

Hazard mitigation plans

Updates to the State's Hazard Mitigation Plan were completed by the Texas Division of Emergency Management in 2013 (Phase 1 assessment). In addition many Regional hazard mitigation plans were updated or developed during the last assessment period (see Hazard Phase 1 Assessment Q.5)

Research, Mapping, and Education Programs or Initiatives:

General hazards mapping or modeling

Through a multi-year CMP grant, Texas A&M University – Galveston Hazard Reduction & Recovery Center has developed the Texas Coastal Communities Planning Atlas. This site offers a mapping decision support tool for public use, hazard information for communities (mitigation, preparedness, response and recovery), and best-practices resources (including hazard-mitigation planning, building codes and land-use planning). The atlas (figure 29) features approximately 300 data layers including administrative boundaries, policy data, transportation, census information, social vulnerability analysis data, hazards, and environmental and landscape features. This tool offers professionals and members of the community access to data layers for exploring hazard risks.

Recently the USACE Galveston District conducted the reconnaissance phase of the *Coastal Texas Storm Damage Risk Management and Ecosystem Restoration Study.* The project aims to conduct feasibility studies to identify potential shoreline degradation, storm damage risk reduction, environmental restoration and protection projects as well as related improvements. A series of scoping presentations were delivered by the USACE in the summer of 2011 to coastal communities in various coastal regions to gather feedback to identify areas of potential mitigation. The feasibility phase should begin by summer 2015. The feasibility study would cover potential projects to mitigate impact of hazards such as flooding and coastal erosion.

Another mapping and web-mapping tool available is the Coastal Resilience Tool from The Nature Conservancy (TNC). The TNC tool offers information and data for sea level rise, inundation scenarios for select location, Sea Level Effect on Marshes model results and results of Exposure and Vulnerability Index.

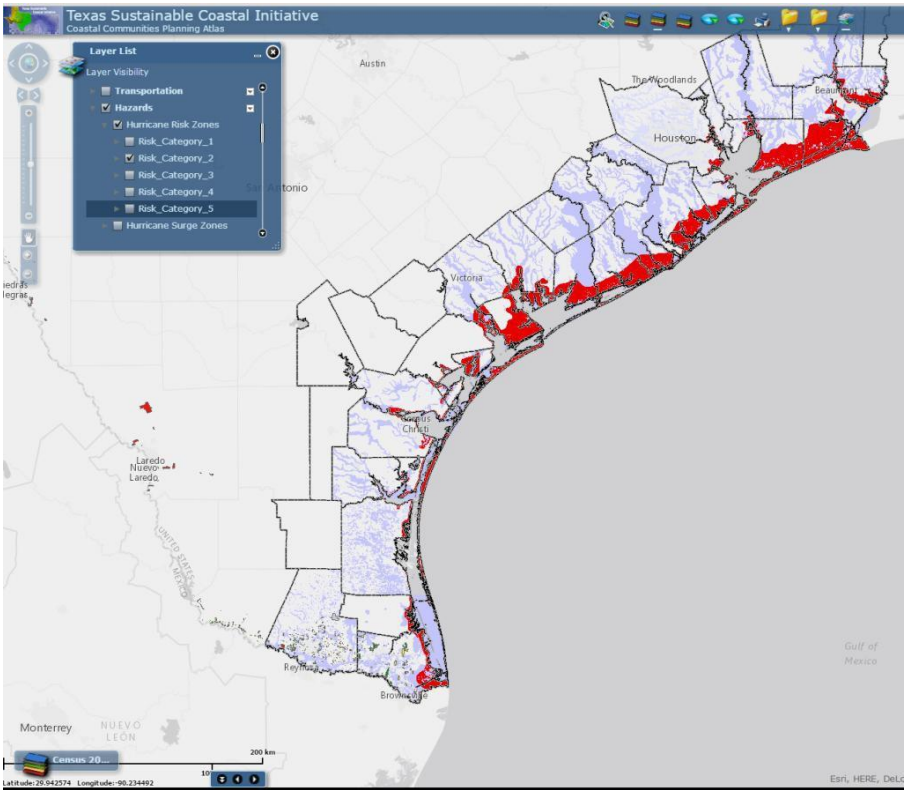

Figure 29. Screen view of the Coastal Communities Planning Atlas featuring FEMA 100 yr flood risk zones (purple) and hurricane risk zones (category 2).

Relative sea level rise mapping or modeling

The Harte Research Institute at Texas A&M University – Corpus Christi is currently working on a multi- disciplinary assessment of relative sea level rise on the Upper Texas Coast. The assessment involves projecting geographic changes expected from relative sea level rise, estimating economic impacts on the natural and built environments, and analyzing current policies and opportunities for coastal zone management with respect to relative sea level rise. Results will be disseminated through a data and information-rich website that will enable policy makers, managers, and the general public to evaluate the impacts or risks of private and public land use decisions with greater precision and accuracy. The Gulf Coast Community Protection and Recovery District offers a GIS web portal showing over 100 geospatial files from various regional, state, and federal databases, The maps area available online at http://www.gccprd.com/, These maps feature storm surge models, hurricane Ike observations, hydrology and environmental layers, population and landcover information.

Hazards monitoring

New monitoring stations have been added to the 29 existing Texas Coastal Ocean Observation Network (TCOON) stations. The installation of "Sentinels of the Coast" data collection stations began in 2014 with the installation of four structures. These are rated to withstand the forces of a Category 4 hurricane (18 foot storm surge, 10 foot high wave, and winds of 100 plus miles per hour). These stations are designed to acquire information on wave, sea level, and wind activity regularly and during storm events. Data will be publicly available online beginning in June 2016.

Hazards education and outreach

The *Texas Homeowners Handbook to Prepare for Coastal Natural Hazards* was developed as a project of the Gulf

of Mexico Alliance Coastal Community Resilience Team to provide guidelines for preparation, evacuation, insurance, and list of emergency contacts and websites. The manuals are available in print and online in English and in Spanish at: http://www.glo.texas.gov/what-we-do/caring-for-the-coast/hurricanes/index.html.

In December 2014, the GLO held a series of meetings for coastal communities to provide information on tools and resources for hazard planning and mitigation. The Coastal Resiliency Forums were held in Cameron, Nueces and Harris counties and targeted planners, city officials, and similar staff from the surrounding areas. The forum featured professionals who presented various tools to aid in hazard planning. Tools included the Geohazard maps for Texas Barrier Islands, the Nature Conservancy Coastal Resilience Mapping tool, Community Resilience Index, the Community Rating System, and the Surging Seas Risk Finder tool. Group discussion was encouraged to find where gaps in hazard mitigation might lie.

Research & Restoration

The State funds projects which mitigate coastal hazards through programs such as the Coastal Impact Assistance Program (CIAP), the Gulf of Mexico Energy Security Act (GOMESA), the Coastal Erosion Planning and Response Act (CEPRA), and the Disaster Recovery (DR) Program. Through these programs coastal communities can mitigate hazard impacts by employing projects related to beach nourishment, wetland and shoreline protection and restoration, planning, and outreach activities.

The CEPRA program funds projects to reduce the effects of coastal erosion as well as infrastructure and shoreline development to mitigate erosion impacts. CEPRA projects during the last funding period include beach nourishment, studies/monitoring, and shoreline mostly concentrated on the upper Texas coast that is still recovering from the erosion impacts from Hurricane Ike. The Coastal Bend and lower coast CEPRA projects focused on marsh/habitat restoration near Corpus Christi and beach nourishment along South Padre Island.

The GLO's DR program works with Texas coastal communities to recover from hurricane damage and construct resilient infrastructure features. Through the GLO DR program a "*Gulf Coast Conservation Protection and Restoration District"* study has been funded as is ongoing, as well as *Community Resilient* infrastructure inventory has been completed. Also funder through DR, the Gulf Coast Community Protection and Recovery District has completed Phase 1 of a study to find opportunities for storm surge and flooding related disaster mitigation, hazard warning, and other projects or programs to assist and protect persons, businesses, and properties along the upper Texas coast.

The CIAP program is funded by royalties from offshore oil and gas leases in federal waters and supports projects related to conservation, protection, or restoration of coastal areas including wetlands and natural resources, implementation of federally approved marine, coastal, or comprehensive conservation management plan.

CMP funded projects during the last assessment period which aid in mitigation of hazards include:
The Status and Trends of Coastal Vulnerability to Natural Hazards project is a multi-phased project designed to undertake a status and trends study of coastal vulnerability to natural hazards of counties in the CMP boundary.

The *Residential Storm Surge Damage Assessment for Galveston County* will create a decision support tool for spatial analysis of hazards and community related data sets - including storm surge hazard areas, ground elevations, and residential structure location and value. This model will cover Galveston County only and will aid

local elected and emergency management officials to manage disaster flood events in a proactive and predictive way. The tool allows users to choose between alternative response scenarios to minimize loss of life and property in the most cost effective manner.

The *Geologic Framework of Follets Island Brazoria County* study will gather geological information necessary to understand coastal processes and evolution.

The *South Padre Island Dune Restoration Volunteer Program,* the *Jamaica Beach Dune Restoration*, and various other wetland restorations projects (see Wetland Phase II report) were accomplished through CMP. Dune and wetland restoration help mitigate the impacts of relative sea level rise and coastal flooding while restoring the function and services of natural environments. In addition to restoring habitat for hazard mitigation, volunteer programs for dune and wetland restoration are efficient for community outreach.

2. *Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's management efforts in addressing coastal hazards since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state's management efforts?*

CMP funded study by Peacock and Husein (2011) surveyed various cities and municipalities in 41 coastal counties including those in the CMZ on the use of non-structural hazard mitigation policies and techniques. Of the 267 targeted jurisdictions, 124 provided feedback. Comparison of CZM jurisdiction and non-CZM jurisdictions show that CZM jurisdictions show more extensive use of shoreline regulations, make more extensive use of habitat protection and protected area regulation, have higher and more extensive building codes and standards, and more public hazard education and awareness programs.

Performance Measures

From the GLO's Texas Coastal Management Program annual reports through the last CZM program cycle (2010-2013), a total of 118 coordination events related to coastal hazards were offered and 1,351 stakeholder groups participated in the coordination events. A total of 211 communities completed a project to reduce future damage from hazards and 72 completed projects to increase public awareness of hazards with the assistance of CZM program. The program funded 317 education activities in which 23,961 individuals participated. Also, it provided funds for 130 training events related to coastal hazards, with 3,994 participants. Overall, $13.3 million was spent and $4,600,025.55 was leveraged by CZM funds for coastal hazards

Identification of Priorities:

1. *Considering changes in coastal hazard risk and coastal hazard management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve its ability to more effectively address the most significant hazard risks.*

MANAGEMENT PRIORITY 1:

Continue to promote outreach to coastal communities on coastal resiliency and preparedness and provide hazard planning assistance & tools.

Description: Continue to educate and promote BMPs and programs to enhance the preservation of natural shorelines for coastal hazard mitigation planning, like building living shorelines. Incorporate ecosystem services and community resiliency into public outreach programs. Provide technical assistance and planning tools to communities for vulnerability assessments and pre-storm planning. Pilot studies where ecosystem services are valued and including in project selection could also be beneficial.

MANAGEMENT PRIORITY 2:
Expand mapping and modeling efforts of hazards on the environment.

Description: Continue to support mapping and modeling efforts which help increase the understanding of the impacts and potential effects that flooding, coastal storms and climate change may have on the natural and built environment. This information is essential for planners and natural resource managers understanding of hazards and exposure for coastal communities. Identification of high risk environments, critical for community or natural resource protection, will aid in coastal management planning and decisions. This information should be made easily available for public consumption and referenced for inclusion in the Beach and Dune Rules of the Texas Administrative Code, when applicable.

MANAGEMENT PRIORITY 3:
Identify high-risk populations, evaluate exposure and vulnerabilities, and develop targeted programs to address hazard preparedness and post-disaster recovery.

Description: As part of social and economic resilience plans, it is important to identify the needs of high-risk populations in coastal areas. This may entail conducting community vulnerability assessments for hazard preparedness and development of decision support tools for identified highly vulnerable communities. This effort may include research related to health, social, and economic barriers on hazard mitigation and evacuation, community resources, and post-disaster recovery plans.

2. *Identify and briefly explain priority needs and information gaps the CMP has for addressing the management priorities identified above. The needs and gaps identified here should not be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.*

Priority Needs	Need? (Y or N)	Brief Explanation of Need/Gap
Research	Y	Analyze resilience: social, economic, ecological and infrastructure ; community barriers (i.e. colonias)
Mapping/GIS/modeling	Y	Update subsidence mapping and monitoring, improve topographic and bathymetry models. Develop and update infrastructure maps in GIS format for communities which still rely on paper records.
Data and information management	Y	Continue to populate GLO's coastal database and enhance data management platforms for on-site hazards response and assessments.

Training/Capacity building	Y	Green building/infrastructure for improved hydrology
Decision-support tools	Y	Community targeted decision-support tools
Communication and outreach	Y	Continue efforts to bring necessary data, tools, and professional assistance to local communities.
Other: Policy	Y	Leadership in coastal resilience – leverage existing efforts like Community Rating System

Enhancement Area Strategy Development:

1. *Will the CMP develop one or more strategies for this enhancement area?*

2. *Briefly explain why a strategy will or will not be developed for this enhancement area.*

Yes X
No

Coastal vulnerability will continue to increase as coastal populations continue to grow, land-use changes and natural disasters impact natural habitat defenses. To accommodate more people and development activity, while balancing demands on coastal resources, it is in our best interest to develop innovative policies, institutional capacity and management approaches to increase community resilience. Improving data management and in house capacity to conduct on-site assessments will enhance response and post-storm assessments. We can reduce community vulnerability through better land-use and water management, low impact development, and pre- storm preparedness planning utilizing the best data and modeling. This can be achieved through community-based planning efforts, GLO providing technical assistance to communities to assess and understand their risks and vulnerability, to improve emergency readiness and response, creating a more resilient coastal community. A data management platform will enhance outreach and data sharing capacity with local communities.

Public Access

In-Depth Resource Characterization:

Purpose: To determine key problems and opportunities to improve the CMP's ability to increase and enhance public access opportunities to coastal areas.

1. *Use the table below to provide additional data on public access availability within the coastal zone not reported in the Phase I assessment.*

Public Access Status and Trends			
Type of Access	**Current number**[31]	**Changes or Trends Since Last Assessment**[32] (↑, ↓, –, unknown)	**Cite data source**
Access sites with accessibility amenities[33]	No. of Sites 87 Percent of Sites 1%	↑	Wade, 2014

2. *What are the three most significant existing or emerging threats or stressors to creating or maintaining public access within the coastal zone? Indicate the geographic scope of the stressor, i.e., is it prevalent throughout the coastal zone or are specific areas most threatened? Stressors can be private development (including conversion of public facilities to private); non-water-dependent commercial or industrial uses of the waterfront; increased demand; erosion; sea level rise; natural disasters; national security; encroachment on public land; or other (please specify). When selecting significant stressors, also consider how climate change may exacerbate each stressor.*

	Stressor/Threat	**Geographic Scope** (throughout coastal zone or specific areas most threatened)
Stressor 1	Coastal Development	Coastal zone, barrier islands
Stressor 2	Coastal Hazards: Erosion, Relative Sea Level Rise, Flooding, Subsidence	Coastal zone, barrier islands, North Texas coast
Stressor 3	Demand and Human Use, Population Increases	Coastal zone

3. Briefly explain why these are currently the most significant stressors or threats to public access within the coastal zone. Cite stakeholder input and/or existing reports or studies to support this assessment.

The increasing coastal development in Texas is a significant stressor on public access. This can lead to unfavorable impacts on water access, water resources, and local environments in the coastal communities (Texas General Land Office, 2013).

[31] Be as specific as possible. For example, if you have data on many access sites but know it is not an exhaustive list, note "more than" before the number. If information is unknown, note that and use the narrative section below to provide a brief qualitative description based on the best information available.

[32] If you know specific numbers, please provide. However, if specific numbers are unknown but you know that the general trend was increasing or decreasing or relatively stable/unchanged since the last assessment, note that with a ↑(increased) , ↓ (decreased) , – (unchanged). If the trend is completely unknown, simply put "unkwn."

[33] For more information on ADA see www.ada.gov.

The county population along the state's coastal shoreline is projected to increase by 16 percent between 2010 and 2020. In 2010, the Texas coastal population was 6.1 million people and is projected to increase to 9.3 million by 2050 (NOAA, 2013). While the population along the coast increases, there will be increased pressure on the state's coastal resources, and specifically on public access to these resources. This growth will continue to put increasing pressure on recreational uses such as fishing, wind surfing, wildlife viewing, and other sources of recreation that require access to coastal waters.

The expansion of impervious surface area contributes to wetland loss and degradation of water quality and quantity. The encroachment on public access sites exacerbates the impacts coastal hazards have on coastal communities and the natural and intrinsic value. This includes the existence of hazardous public access sites subject to coastal storms, relative sea level rise, and flooding. Coastal hazards can also lead to a decrease in the numbers of coastal access sites available to the public over time. To effectively manage the impacts that coastal development has on coastal natural systems (e.g. water access and water resources), coastal public access must remain as a high priority for the state. Additional challenges to coastal habitat protection include violations to the Dune Protection Act brought on by illicit construction, filling, and removal of critical dunes and dune vegetation complexes seaward of a community's dune protection line. Cumulative impacts over a period of time caused by illicit construction create breaches in a community's continuous dune line, which weakens the integrity of critical dunes over time and results in a loss of protected natural resources.

Enhancing beach access for persons with disabilities also is a primary concern. The GLO's Texas Accessibility Guide was produced to assist local governments with American with Disabilities Act (ADA) compliance when constructing new walkovers and access ways. Since the document was created, new ADA guidelines and information from the U.S. Access Board was released to address new development that is occurring due to the increasing population trends.

As with anything new, the application of the Severance opinion and the changes in state statute and Beach and Dune Rules can create some uncertainty as interested parties work through the interpretation of law, evaluate the application of science, and re-evaluate policies and procedures for delineating the rights of parties along the coast after a storm.

When the new system for delineating the public beach is tested following a storm, there may be delays in the resolution of conflicts over the delineation of public beach easements and the implementation of future coastal projects. There may continue to be challenges associated with the implementation of coastal projects as interested parties continue to debate the scope and extent of the Severance opinion. The state expects there will be a continued risk for litigation over the interpretation and application of Severance and other applicable legislative and rule changes. This highlights the need to regularly update the Beach and Dune Rules in the Texas Administrative Code. (For background information, refer to Phase I Assessment for Public Access.)

Emerging Issues	Information Needed
Disputes arising from how a court case may/may not impact the public beach access and any changes in law and policy (Example: Severance v. Patterson)	Policy and process development.
Ecosystem Services Loss	Quantification of ecosystem services and how they impact public access. Adverse impacts on public access affects the health of the beach/dune system and informs maintenance practices and best management practices that should be implemented. This will help prioritize the state's management efforts and areas.
Changes in environmental conditions from disturbances to the beach and dune system from events such as storms, oil spills, large sargassum blooms, water quality impairments, etc. These disturbances can hinder public access or pose health and safety issues.	Specific GIS data and modeling of how these environmental changes affect the beach dune system and in turn hinder and reduce public access. This information can be incorporated into the Beach and Dune Rules in Chapters 15 and 25 of the Texas Administrative Code, which can be updated and certified to reflect the evolving conditions that affect the coastal communities.

In-Depth Management Characterization:

Purpose: To determine the effectiveness of management efforts to address identified problems related to the public access enhancement objective.

1. *For each additional public access management category below that was not already discussed as part of the Phase I assessment, indicate if the approach is employed by the state or territory and if significant changes (positive or negative) have occurred at the state- or territory-level since the last assessment.*

Management Category	Employed by State/Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Comprehensive access management planning	Y	Y	Y
GIS mapping/database of access sites	Y	Y	Y
Public access technical assistance, education, and outreach (including access point and interpretive signage, etc.)	Y	Y	Y
Other (please specify)			

2. *For management categories with significant changes since the last assessment briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information.*
    a. *Describe significant changes since the last assessment;*
    b. *Specify if they were 309 or other CZM-driven changes; and*

c. *Characterize the outcomes or likely future outcomes of the changes.*

Texas Sea Grant's Coastal Planning Program received 309-driven funding in 2013 and 2014 to update and enhance the Texas Coast Public Access Inventory. The goal of this project is to update the Texas Public Access Inventory and enhance the data layers in the new website, TxCoasts.com, formally known as the Beach and Bay Access Guide publication.

This project addresses the needs in the previous 309 Assessment and Strategies Report 2011-2015, with regard to strategic planning efforts to enhance public access education and outreach. The past report identified the need to conduct a comprehensive inventory of coastal public access to support access planning. The last comprehensive access point update was completed before Hurricane Ike. CMP is funding the access point data collection, which includes information on available activities and facilities for each identified access point.

3. *Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's management efforts in providing public access since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state's management efforts?*

The GLO continues to enforce the Open Beaches Act, Dune Protection Act and Beach and Dune Rules in the Texas Administrative Code. The Open Beaches Act allows local governments to create or enhance access sites through a proposal to amend local access management plans, which the state would then certify and adopt. Local government initiatives to create or enhance access must be in accordance with applicable natural resource management code and Texas Administrative Codes. Phase I and Phase II of the Texas Public Access Inventory Project provides insight into state management efforts in overseeing management of public access, and represents the first update since 2002 (Texas General Land Office, 2002). The first inventory was compiled in 1998 and updated in 2002. The most recent inventory update began in fall of 2013. The lag time between these updates negatively impacts the state's ability to fully oversee management of public access along the coast because there is a lack of up-to-date information, which precludes informed decisions on site maintenance, priorities, and other access planning considerations.

Quarterly inspections of public access locations are completed in Brazoria County, Matagorda County, City of Galveston, City of Corpus Christi, Nueces County, and Port Aransas Beach. These are completed by the field offices and data/photos are submitted to the agency's Coastal Resources Division for inclusion in the new TxCoasts.com website.

Identification of Priorities:

1. *Considering changes in public access and public access management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve the effectiveness of its management effort to better respond to the most significant public access stressors. (Approximately 1-3 sentences per management priority.)*

MANAGEMENT PRIORITY 1:

Improving Public Access through Information and Data Management

Description: Public access information includes: public easement information, site data, and aerial imagery showing public use. Aerial imagery data is currently not available in digital format that overlays with a GIS database and other information resources. . This information is vital to public access management and identification of post-storm impacts on public access. Priority should be placed on development and updating of a public access database that is publicly accessible and updated on a regular schedule. Priority should be given to maintaining the GIS record database over time, having a set schedule for updating the database, a user friendly system that makes updates more feasible, and allows for efficient information retrieval. Utilization of this database will enhance GLO capacity to inspect and maintain public access sites on one real-time information platform.

MANAGEMENT PRIORITY 2:
Comprehensive Public Access Planning

Description: Comprehensive public access planning and collaboration with coastal leaders will ensure continual restoration, maintenance, appropriate accessibility and improvements to public access sites, upkeep and prioritization of data for decision-making, and appropriate updates to the Beach and Dune Rules in the Texas Administrative Code and to local Erosion Response Plans. This will include increasing capacity and assistance to local governments for developing beach access and dune protection plans, public access improvements, maintenance and adoption of best management practices, and incorporation of new ADA and U.S. Access Board guidelines into the GLO's Texas Beach Accessibility Guide. Studies to inform decision-making would assess how coastal hazards and environmental changes impact public access and recreational uses to plan for future demands.

MANAGEMENT PRIORITY 3:
Public Engagement, Communication and Outreach

Description: Public engagement is critical to leverage support and facilitate decision-making to accommodate for diverse needs and uses. Receiving public input on planning for coastal public access is important because it improves understanding of identified community priorities. Fostering relationships and improving coordination and outreach to the public, local governments and local resource managers will enhance coastal access and beach management. Provide support and guidance to local governments when revising local zoning ordinances to reflect changes at the state and federal level. There is a need for updated management guidance documents and educational materials to be produced as part of the state's education and outreach efforts.

2. *Identify and briefly explain priority needs and information gaps the CMP has to help it address the management priorities identified above. The needs and gaps identified here do not need to be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.*

Priority Needs	Need? (Y or N)	Brief Explanation of Need/Gap
Research	Y	Research on hazard impacts on public access and conduct economic valuations.
Mapping/GIS	Y	Map and display public access inventory data in a web accessible GIS format.
Data and information management	Y	Compile a digital inventory of public access related data, along with environmental factors, human population and use and built infrastructure. Maintain and develop schedule to keep up-to-date.
Training/Capacity building	Y	Conduct trainings and continue to provide technical assistance to local government and the general public with regard to statute and rule changes, and best management and maintenance practices. Continue to enhance access for the mobility impaired.
Decision-support tools	Y	Assist in expanding the use of mapping and modeling tools by local resource managers for decision-making, particularly with regard to hazards vulnerability.
Communication and outreach	Y	Proactive communication with elected officials, local resource managers and the public, and technical assistance to coastal communities to preserve and enhance public access.

Enhancement Area Strategy Development:

1. *Will the CMP develop one or more strategies for this enhancement area?*

Yes X
No _____

2. *Briefly explain why a strategy will or will not be developed for this enhancement area.*

Coastal access is a public right for recreational use to enjoy low-impact beach access, including the enjoyment of coastal aesthetics. Shorelines are directly affected by stressors such as storm events, coastal development and population growth and environmental hazards (e.g. oil spills), which can impede public access and degrade the ecosystem. The GLO is the steward to prevent the destruction and erosion of public beaches and coastal public resources by encouraging best management practices for erosion response and beach maintenance through adaptive management. To preserve shoreline function and management to allow for public use, the GLO should continue to provide technical and planning assistance and tools to local governments. It is also important to educate the public about coastal issues such as dune protection, beach access, erosion and flood protection, and to provide opportunities for public participation in the restoration and maintenance of the beach/dune and bay systems. Adopting these sustainable practices will better ensure continued resilience for the coastal communities.

Cumulative and Secondary Impacts

In-Depth Resource Characterization:

Purpose: To determine key problems and opportunities to improve the CMP's ability to address cumulative and secondary impacts of coastal growth and development.

1. *What are the three most significant existing or emerging cumulative and secondary stressors or threats within the coastal zone? Indicate the geographic scope of the stressor, i.e., is it prevalent throughout the coastal zone or are there specific areas that are most threatened? Stressors can be coastal development and impervious surfaces; polluted runoff; agriculture activities; forestry activities; shoreline modification; or other (please specify). Coastal resources and uses can be habitat (wetland or shoreline, etc.); water quality; public access; or other (please specify). When selecting significant stressors, also consider how climate change may exacerbate each stressor.*

	Stressor/Threat	**Coastal Resource(s)/Use(s) Most Threatened**	**Geographic Scope** (throughout coastal zone or specific areas most threatened)
Stressor 1	Population increase and coastal development	• Habitat (wetland and shoreline) conversion and loss • Deteriorating water quality and quantity	throughout the coastal zone, particularly near metropolitan areas
Stressor 2	Environmental changes (erosion, relative sea level rise, flooding)	• Habitat (wetland and shoreline) erosion and loss • Vulnerability of protective features like dunes and wetlands • Public access	throughout the coastal zone
Stressor 3	Reduced freshwater Inflows and water quality impacts	• Habitat (wetland and shoreline) • Public access	throughout the coastal zone. Mainly near bay systems

Population increase and coastal development

Development along the Texas coast is increasing, with coastal habitat acreage lost to agriculture and development. Increasing population and use of coastal resources and associated infrastructure development changes land-use and expands impervious surface cover which impacts stormwater runoff and water quality in bay systems. These factors have cumulative effects on coastal resources and their ability to adapt and respond to changing conditions, threatening the health of ecosystems, protective properties, and other ecosystem services and the local economies based on these services.

The increase in population and housing development will impact vital natural resources (See Figures 13-18, Phase I, Cumulative and Secondary Impacts), Texas Priority Conservation Areas, Environmentally Sensitive Shoreline, and Ecologically Unique Rivers map (Figure 14, Phase I, Cumulative and Secondary Impacts; showing what is potentially threatened by projected increases in population and housing density in core urban areas).

In addition to the potential threat to ecologically sensitive areas, the increase in population and housing density in core urban areas will increase the need for infrastructure and energy, and landfills (Figure 17, Phase I, Cumulative and Secondary Impacts).

Environmental Changes (Erosion, Relative Sea Level Rise, Flooding)
Relative sea level rise threatens the entire Texas coastal zone, and will impact wetlands and coastal habitats. The Texas coastal zone lies in a floodplain (See Figure 18, Phase I, Cumulative and Secondary Impacts) which will be susceptible to sea level rise in the future (See 309 Assessment Coastal Hazards Section, Figure 2, Phase I) impacting coastal habitat, resources and vulnerability of local communities and infrastructure to storms and flooding events.

Freshwater inflows
As population and infrastructure demands increase, pressures on water resources also increase. A decrease of freshwater inflows from rivers to bays and estuaries significantly affects salinity levels and water quality. This will impact the survivability and diversity of coastal habitats and species, drinking and agriculture water supply.

1. *Are there emerging issues of concern, but which lack sufficient information to evaluate the level of the potential threat? If so, please list. Include additional lines if needed.*

Emerging Issue	Information Needed
Water quality degradation	Development of an inventory and mapping to monitor nonpoint source pollution and run-off. Identification of septic systems and impacts to watersheds water quality to prioritize management efforts and system inspections and replacements.
Non-jurisdictional wetlands	Inventory of wetlands not under jurisdiction; current conditions and reevaluate policies and procedures for wetland monitoring
Erosion response and management	Erosion studies, emerging technology and best management practices; and evaluation of current response plans for adaptive management

In-Depth Management Characterization:

Purpose: To determine the effectiveness of management efforts to address identified problems related to the cumulative and secondary impacts enhancement objective.

1. For each additional cumulative and secondary impact management category below that is not already discussed as part of the Phase I assessment, indicate if the approach is employed by the state or territory and if significant state- or territory-level changes (positive or negative) have occurred since the last assessment.

Management Category	Employed by State or Territory (Y or N)	CMP Provides Assistance to Locals that Employ (Y or N)	Significant Changes Since Last Assessment (Y or N)
Advancement methodologies for determining CSI*	N	Y	N
CSI* research, assessment, monitoring (including LIDAR and aerial photography)	N	Y	Y
CSI* GIS mapping/database	Y	Y	Y
CSI* technical assistance, education and outreach	N	Y	N
Other (please specify)			

*cumulative and secondary impacts

2. *For management categories with significant changes since the last assessment briefly provide the information below. If this information is provided under another enhancement area or section of the document, please provide a reference to the other section rather than duplicate the information.*
   a. *Describe significant changes since the last assessment;*
   b. *Specify if they were 309 or other CZM-driven changes; and*
   c. *Characterize the outcomes or likely future outcomes of the changes.*

Significant changes have been accomplished with regard to methodologies, like LIDAR and aerial photography, for determining cumulative and secondary impacts such as shoreline change studies to determine erosion and avulsion with regard to the loss of public beach, dune protection and enforcement, identifying hazards and potential areas for restoration. This information has been better integrated into a shared coastal database with associated GIS mapping for public and resource agency access. The data integration and mapping is a 309 driven change.

3. *Identify and describe the conclusions of any studies that have been done that illustrate the effectiveness of the state's or territory's management efforts in addressing cumulative and secondary impacts of development since the last assessment. If none, is there any information that you are lacking to assess the effectiveness of the state and territory's management efforts?*

In 2014, a 312 review of the CMP was conducted by NOAA and represents capacity and opportunities of the CMP to prioritize addressing issues under cumulative and secondary impacts. During this evaluation period, it was acknowledged; that the CMP has undergone legislative changes to its program such as with the erosion response program, beach dune planning and performance measures. The program has initiated a coast-wide planning effort, and continues to implement the Texas Open Beaches Act, Coastal Erosion Planning and Response Act, and Dune Protection Program. To increase efficiency and effectiveness, information sharing within the division and GLO is facilitated through meetings and biweekly division updates to staff and management. The CMP staff have increased internal coordination with programs within the GLO, other state agencies, and universities to address these priorities.

Since the previous assessment, a significant 309 driven change was a project focused on ocean and coastal

resources assessment, monitoring, and GIS mapping. The GLO contracted the Harte Research Institute to gather and assess data for developing a long-term plan for effective coastal resource management in Texas. Coastal and marine spatial planning (CMSP) is an integrative, adaptive ecosystem-based approach to planning that brings together all the relevant agencies and stakeholders to ensure a more sustainable use of our marine space and resources. This is an ongoing project and the major accomplishments thus far have been data inventory and acquisition, the development of a data catalog for CMSP, and the update of the resource management codes (RMC) system, which is mentioned previously in the wetlands section (HRI, 2014b).

The University of Texas - Bureau of Economic Geology collected and analyzed data to determine shoreline change rates and develop digital elevation models using aerial photography and LiDAR surveys to assess Hurricane Ike-induced shoreline change. The project collected erosion rate data, a vital component to the program's understanding of the erosion process along the coast and in the identification and prioritization of future restoration projects. This was a CZM, non 309, driven change.

The GLO completed an evaluation on the natural resource and economic benefits of GLO funded coastal erosion projects to provide to the Texas Legislature. This project quantified economic benefits associated with construction projects, including calculation of storm damage reduction benefits and provided an evaluation of natural resource improvements associated with habitat restoration and protection projects. This was a CZM, non 309, driven change.

In 2012, the GLO initiated coastwide erosion response plan updates. This project identified critical erosion areas and evaluated socio- and environmental economic issues. This data was used to revise rules as necessitated by the passage of HB 2073 and HB 2074 by the 81st Texas Legislature. As required by HB2073, the updated plan serves as a template for local governments in drafting their local erosion response plans.

Identification of Priorities:

1. *Considering changes in cumulative and secondary impact threats and management since the last assessment and stakeholder input, identify and briefly describe the top one to three management priorities where there is the greatest opportunity for the CMP to improve the effectiveness of its management effort to better assess, consider, and control the most significant threats from cumulative and secondary impacts of coastal growth and development. (Approximately 1-3 sentences per management priority.)*

MANAGEMENT PRIORITY 1:
Sustainable coastal planning

Description: Evaluate coastwide strategies regarding land use and development to recommend best management practices for shoreline development and maintenance, habitat preservation and restoration, provide for recreation and public access and water quality management. Conduct community resilience assessments, encourage local communities to plan for 'smart' development, synthesize and evaluate the most effective plans for increasing coastal resiliency, for both communities and natural resources.

MANAGEMENT PRIORITY 2:
Vulnerability assessments and comprehensive adaptive management for resiliency planning for coastal hazards

Description: Promote and expand the use of existing vulnerability tools such as the Coastal Resilience Index and the Nature Conservancy's Coastal Resilience 2.0 to help community and natural resource vulnerability evaluations for resiliency planning. Provide tools and technical assistance to local communities to encourage pre-storm planning and preparations to respond to coastal hazards.

MANAGEMENT PRIORITY 3:
Implementation of coastal nonpoint source management measures

Description: Implement strategies to address watershed management & water quality impairments of particular importance should be concerns about environmental flows and wastewater management. Provide technical assistance related to the control of NPS pollution from off-system roadways, urban development, and watershed planning in accordance with Section 6217 of the CZMA.

2. *Identify and briefly explain priority needs and information gaps the CMP has to help it address the management priorities identified above. The needs and gaps identified here do not need to be limited to those items that will be addressed through a Section 309 strategy but should include any items that will be part of a strategy.*

Priority Needs	Need? (Y or N)	Brief Explanation of Need/Gap
Assessment, management and planning tools	Y	• Conduct community resilience assessments for community hazards planning • Studies to assess population and land use changes and impacts to coastal resources and sustainability Sea level rise coastal hazards modeling
Nonpoint source data and planning tools to implement NPS program	Y	• GIS mapping to prioritize areas to target for NPS management • Support innovative projects that address increasing needs to manage non-point source pollution for water quality • Education and outreach and coordination with communities and water planning groups
Regional Sediment Management Planning	Y	• Develop regional sediment management plans, incorporating BUDM, to identify potential restoration sites in the vicinity of navigation projects. • Sediment supply studies and source identification mapping
Planning and monitoring to enhance restoration	Y	• Improve restoration and mitigation site monitoring and mapping • Assessments of mitigation banking and mitigation site identification and tracking

Enhancement Area Strategy Development:

1. *Will the CMP develop one or more strategies for this enhancement area?*

Yes X
No _____

2. *Briefly explain why a strategy will or will not be developed for this enhancement area.*

All activities that occur on the coast have cumulative and secondary impacts as the coastal ecosystem is diverse and complex along with the resources and uses it provides. A strategy will be developed because strategic and adaptive management is necessary to balance economic and environmental management decisions to ensure the sustainability of the coast. Therefore, data collection, studies, mapping and modeling is integral to understand how these activities interact with the dynamic coastal system to inform management decisions with regard to land use and development and sustainable use of coastal resources. Strategies for addressing this enhancement area might include: coastal development guidelines to address environmental protection and mitigation, sediment use, hazard and flood planning and measures to address urban development and nonpoint source impacts.

Proposed Strategies for CMP Enhancement

Assessment & Data Collection to Enhance Permitting, Leasing, and Monitoring for Coastal Activities

I. *Issue Areas*

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☒ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

The goal of this strategy is to develop a coastal mobile data collection platform and applications to streamline and improve the efficiency of data collection, management, and distribution for coastal-related activities and decision-making.

Under this strategy, evaluation and expansion of current mobile platform capabilities, existing data and database integration will be conducted to streamline and improve process efficiency, and improve data integration and distribution throughout GLO coastal divisions. Data collected targeted through this strategy would include but not be limited to uses for: coastal lease permitting, wetland mitigation monitoring, enforcement, derelict structures and vessel identification, beach & bay access point inspections, and Coastal Erosion Protection and Response Act construction activities.

For mitigation site monitoring on state lands, a mobile Rapid Assessment Method (RAM) would be implemented by our coastal field offices under this strategy. The RAM assesses mitigation success and site quality using the following 10 metrics: ecological buffer, eco-connectivity, man-made structures in the area, barriers to landward migration of marsh, tidal restrictions, surface water flow alterations, point

source pollution, percent vegetation coverage, habitat class richness, and wildlife abundance/diversity. By using the RAM before, during, and after mitigation, and entering the data into a GIS database, we hope to increase the overall success rate of all mitigation projects due to the increased amount of information collected and shared utilizing the mobile platform to inform decision-making.

C. Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)

This strategy would revise the field collection methods and overall management approach for issuing leases and permits for submerged land use activities; moving towards online interactive permitting with the future goal of issuing leases in the field. Centralizing this data along with tracking and maintaining a streamlined database will give us opportunities to more efficiently manage, monitor and inspect all permit/leasing sites, mitigation sites, coastal projects, beach and bay access points, and derelict structures. Findings from conducted mitigation assessments that are readily available in a GIS platform would help inform and demonstrate to stakeholders and permitting entities the level of success for similarly proposed mitigation projects. This information will be used by staff working with permit applicants to revise proposed mitigation based on the level of success of similar past projects. Final implementation of this initiative would result in revised procedures for data collection, availability, and distribution internally and externally to the public.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

This strategy will address the need for a consistent and efficient data management platform for all coastal related activities spanning multiple divisions within the GLO such as Coastal Resources, Asset Management, Oil Spill, Disaster Recovery, Energy, Survey, Communications, and Construction Services.

The following priority needs and information gaps identified in the assessment will be addressed through this work:
Restoration and mitigation project tracking and data management was identified as an emerging issue in the phase II wetlands assessment section, with the lack of a comprehensive database for monitoring and tracking restoration areas identified as an information gap. This strategy will directly address that gap as a standardized data collection process and database will be established for tracking and managing mitigation site assessments.

Coastal resources data collection efficiency and tracking improvements will enhance capacity for permitting and lease tracking and enforcement to assist with planning for public access, coastal development, and wetland mitigation.

Staff training on mitigation and restoration tracking and evaluation was cited as a need under the wetlands

assessment. After the development of a GIS tool for mitigation site mapping and adoption of a RAM method staff will be trained in the assessment, documenting and update process. The assessment and evaluation of mitigation banking and conservation easements will help address identified wetlands loss.
In addition, this strategy will provide enhanced staff capacity and efficiency to conduct coastal lease permitting, mitigation site monitoring and enforcement, and derelict vessel and structure identification by hiring graduate researchers and through the use of a mobile data collection platform.

This strategy is cross-cutting effort and will additionally address the following needs and gaps:
Continued efforts to bring necessary data, assessment tools, and professional assistance to local communities will help and, improve community resilience, a priority need identified in coastal hazards.
Systematic ecosystem data collection and monitoring through mitigation site assessment from past permitted projects will improve agency datasets on ecosystem and habitat response to development impacts; and

Updates regarding the status of derelict structures and vessels, as would be collected through the mobile data platform, would help assure proper cleanup and safety of nearshore areas, a concern in both the Coastal Hazards and Marine Debris enhancement areas;
Inspection and documentation of Public Access sites will aid in keeping a comprehensive inventory of public access up-to-date and provide useful information to the public.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

This strategy will carry out the development and implementation of a coastal mobile platform for efficient data collection, evaluation and processing for decision making and through increased efficiency of wetland restoration and mitigation assessment and monitoring. Specific benefits include:

- Achieve a faster cohesive collection, input, and data integration process (no paperwork and data entry);
Enhanced ability to identify, document, and enforce unauthorized construction and associated quantification of impacts as assessments and photo records can be accessed and updated on site;
Streamline the permitting process on state owned submerged lands;
- Increased efficiency in wetland restoration project assessment and monitoring*;
- Improved tracking and information sharing of locating derelict hazardous structures and vessels;
Progress our ability to manage residential piers, breakwaters, cabin leases, and recreational use structures, like boat ramps;
- Provide a mechanism to keep the public access point inventory up-to-date which is heavily utilized by the public for beach access; and
- Present information to stakeholders in a user friendly and up-to-date format to bolster communications and efficiency to provide customer assistance through website and GIS map formats.

*Information collected through the RAM would be used to streamline the assessment of mitigation, and identify reasons why mitigation may or may not be successful, thereby lowering the cost in time and resources for GLO in monitoring these sites long-term. The RAM would continue to provide standardize data long-term after reporting requirement by permittee/ leaseholder are no longer required. The information collected by the RAM can also contribute to our understanding of how wetlands function in response to stressors and change over time.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

This strategy has been identified by management as a means to create government efficiencies and cost savings by integrating coastal-related activities under one data management system. The impetus for information sharing and communication across specific job-related duties will increase collaboration and ideas and create efficiencies, saving staff time and effort, allowing for integrated coastal resource management of data rather than management through a sector by sector basis.

The GLO's Information Systems (IS) has been working on testing mobile application development for field use and this strategy would utilize their staff capacity and incorporate lessons learned from their testing. Additionally they would be responsible for application updates and maintenance. This would allow integration of the agency's coastal work onto one cross-cutting and supported platform. Coastal staff would work with IS to develop application specific to field needs and data collection per subject matter.
Information input and uploaded would be accessible almost immediately to others to view for processing permits, leases or enforcement or other decision-making. This application will then be available for other agency divisions to leverage.

The Coastal Field Operations team has laid the groundwork for implementing RAM of mitigation sites through part-time student conducted assessments, yet a RAM method for Texas has not been analyzed to select the best method for Texas, assessments have not conducted on a regular basis, and some of the assessments are paper documents while others are in the online database, proving tricky for comprehensive and integrated tracking. Tracking and assessment of mitigation sites is a requirement of state-owned submerged land leasing, therefore this strategy will be successful by providing an enhancement to the current process through the formalization of a rapid assessment method and integration of past assessments into one GIS searchable database.

Therefore, it is anticipated that we will be able to achieve adoption of policies and processes to facilitate permitting, leasing, and enforcement efficiencies, project and mitigation monitoring, and response to and management of coastal hazards such as derelict structures and vessels within the strategy timeframe.

VI. Strategy Work Plan

Strategy Task 1: Develop a Coastal Mobile Data Collection Platform and Applications for Decision-Making
Total Years: 1-5
Total Budget: $620,000

Year: 1

Description of activities:

GLO will conduct a technical assessment, and based upon recommendations from the assessment a data

management platform would be acquired to fit the needs identified through the assessment. System requirements will be identified and documented and an architecture and workflow diagram will be created. The workflow diagram will take into consideration short-term and longer-term solutions to transfer from current processes and technology to this new system. Configuration of the applications for field data collection would commence.

Major Milestones:

- Data management product solution selected and acquired to support and enhance coastal mobile data management needs
- Architecture diagram for data management
  System requirements document
- Workflow diagram to bridge current technology and data management

Budget: $200, 000

Year: 2

Description of activities:

A coastwide pilot project will be initiated through the coastal field offices/permit service centers located in La Porte in the Upper Coast and in Corpus Christi in the Lower Coast. Implementation will incorporate recommendations for the expansion of the mobile platform providing screenshots of the application on field assessments. This will provide us with the strengths and shortcomings of the mobile application platform on all field data collection and it will help determine if additional devices/services need to be purchased for faster integration.

Major Milestones:

- Implement a coastwide pilot application for mobile field data collection testing Document product use and evaluate for broader use
- Develop best practices and written procedures for workflow
- Agency report on recommended process changes, progress improvement, develop metrics for success and workflow

Budget: $120,000

Years: 3-4

Description of activities:

Implementation and testing of the pilot project will continue and be expanded to incorporate additional coastal and beach and dune related data such as mitigation site assessments and public access point inspections. Modifications will continue to the platform and applications based on coastal field staff user input.

Major Milestones:

- Continue implementation and development of mobile application field testing and modify for expanded use
- Continue software development and modifications for data collection and database and workflow

structure based on field testing

- Modify best practices, metrics, workflow, and written procedures for mobile collection and data integration

Budget: $200,000 ($100,000 per year)

Years: 4-5

Description of activities:

Conclude the pilot project and expand and incorporate use of the mobile platform to all other coastal-related divisions such as the Survey, Oil Spill and Appraisal divisions. Investigate expansion of the application for on-site lease issuance in the future.

Major Milestone(s):

- Fully implement coastal mobile strategy for all field data collection
- Continue software development and modifications for data collection and database and workflow structure
- Adopted into agency policy best practices, metrics, workflow, and written procedures for mobile collection and data integration

Budget: $100,000 for year 5

Strategy Task 2: Conduct Rapid Assessments of Mitigation Projects on State Owned Submerged Lands

Total Years: 1-5

Total Budget: $180,900

Year: 1

Description of activities:

Two students will be employed. A GIS student will create a GIS layer and associated metadata for all past mitigation assessments conducted. Some of this information is available in a GIS format however; most will need to be digitized from hardcopies. Another graduate student will conduct a review and evaluation of other RAMs in use for similar habitats and compare it to the existing RAM used by GLO to establish a methodology for use in Texas.

Major Milestones:

- Procure students and conduct orientation to RAM and information collection and storage by field staff GIS layer of mitigation assessment data, associated metadata and geodatabase received by GLO Methodology and recommendations for future inputs of data collection into geodatabase for GIS layer update
- Training of GLO staff on update process and data entry for geodatabase

Budget: $53,000

Year: 2

Description of activities:
A student will continue to conduct a review and evaluation of other RAMs and provide recommendations for improvements, including use of mobile application for data collection and procedures to routinely monitor existing sites every 5 years at minimum. This report would be then be reviewed by academic experts and would be the foundation for our draft RAM for eventual incorporation and adoption by GLO.

Major Milestones:

- Report on RAM methodologies and recommendations for improvements
- Technical review of RAM methodologies report
- Staff training on proposed RAM methodologies

Budget: $19,000

Years: 3-5

Description of activities:
Two students will be employed, one for the Upper Coast field office and one for the Lower Coast field office, to conduct mitigation assessments using RAM and update the database. Students will work 20 hours per week conducting mitigation assessments for designated project sites. RAM data collection will be input into GIS software. Exit interviews will be held with the students and analysis of student work will be conducted for assessment refinement comprising an outline of current mitigation techniques and practices, and recommended modifications to RAM procedure for evaluating coastal wetlands. This will give us firsthand knowledge of the RAM's strengths and shortcomings, and allow us to fine-tune it accordingly.

Major Milestones:

- Procure students
- Mitigation site assessments using RAM (report the number-to-date) Updated GIS layer of mitigation assessment data
- Agency documentation outlining updates to methodologies and implementation

Budget: $108, 900 ($36,300 per year)

Year: 5

Description of activities:
A final manual on the RAM and use of mobile application and database for data collection and monitoring schedule will be presented to Asset Inspection for approval and adoption for Agency use in mitigation assessments on state owned lands.

Major Milestones:

- Agency manual for RAM
- Adoption of the RAM as official GLO policy when performing mitigation activities.

Budget: **$0**

VII. Fiscal and Technical Needs

A. Fiscal Needs: *If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.*

Due to the nature of this work, and limitations of 309 funding, we will be seeking outside funding to supplement the cost to purchase the data management solution product and on-going modifications and customization needs identified through field testing to enhance application functionality throughout the development of this data collection and management system. If additional funding is necessary it will not come from CMP but through other state coastal related funding sources such as the Surface Damage account which is funded through the collection of royalties for the leasing of mineral rights on state owned lands administered by the GLO under the Texas Natural Resources Code and Relinquishment Act.

B. Technical Needs*: If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

When and if the resources necessary for successful planning and implementation of the project are not available within the agency, the agency will engage consultants, purchase equipment, or work within cooperative agreements with other state and/or federal entities to accomplish the tasks necessary for successful planning, implementation, and completion of projects. The agency is always conscious of using the most fiscally efficient delivery method to accomplish the tasks of agency projects.

Current IS staff have begun the development of internal mobile applications yet given other functions and the amount of time and staff capacity to develop a large-scale application it is in our best interest to seek outside expertise and advising on the latest technology and platforms to best suit our needs and functions. After application selection and implementation, IS staff will be able to modify, maintain, and oversee GLO use.

The GLO currently is conducting wetland mitigation assessments however more staff capacity is needed in addition to a standardized using a less time intensive method to assessment and monitor these sites long- term. An analysis is needed to evaluate RAM implement in other states to develop the best model for implementation in Texas. The mitigation tracking database currently used needs to be updated to incorporate a GIS component.

Strategy 5-Year Budget

Strategy Title	**Year 1 Funding**	**Year 2 Funding**	**Year 3 Funding**	**Year 4 Funding**	**Year 5 Funding**	**Total Funding**
Coastal Mobile Data Collection Platform and Applications	$200,000	$120,000	$100,000	$100,000	$100,000	$620,000
Rapid Assessment Method for Mitigation	$53,000	$19,000	$36,300	$36,300	$36,300	$180,900
Total Funding	$253,000	$139,000	$136,300	$136,300	$136,300	$800,900

Incorporation of Ecosystem Services into Grant Processes

I. Issue Areas

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☒ Marine Debris
- ☒ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

☐ A change to coastal zone boundaries;

☒ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;

☐ New or revised local coastal programs and implementing ordinances;

☐ New or revised coastal land acquisition, management, and restoration programs;

☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,

☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

To incorporate ecosystem services into the Coastal Management Program's (CMP) policies and procedures to ensure sustainable coastal management decisions.

C. Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)

The strategy will integrate ecosystem services into the Texas CMP project selection process, and if applicable the Coastal Erosion Planning and Response Act Program, to improve the management of Texas coastal resources. The strategy will examine existing frameworks that allow for the inclusion of ecosystem services in the decision-making process, will assess how the CMP can incorporate ecosystem services, and will provide the means to implement ecosystem services valuation to build flexibility in Texas coastal decision-making and management. Additionally, the strategy will develop an approach to increase stakeholders' ecosystem services literacy and awareness by creating key messages for outreach to local audiences.

Based on the strategy results, the GLO will make the following program changes to the Texas Coastal Management

program: 1.) include in the Coastal Management Program's application guidance document information on how to identify ecosystem services in proposed projects; 2.) modify the grants application form to incorporate any benefits or impacts to ecosystem services of the proposed project; and 3.) update the application review criteria to include a consideration of ecosystem services, and grant additional points for beneficial ecosystem services.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

Incorporation of ecosystem services into the Coastal Management Program's policies and procedures will address the following gaps and needs:

- Research on wetland ecosystem services, hazard impacts, and ecosystem services loss will provide the baseline for incorporating ecosystem services valuation tools;
- Quantification and valuation of ocean ecosystem services will assist in Texas CMP project selection and scoring criteria;
- Collection of data on ecosystem change indicators, stressors and thresholds will highlight the benefits of proposed projects ;
- Education and outreach of wetland functions and ecosystem services will allow applicants to understand how proposed projects enhance or restore ecosystem services;
- Stakeholder engagement will increase stakeholder ecosystem services literacy and awareness, and ensure support for sustainable management strategies. By understanding the link between ecosystem services and human well-being, stakeholders will be more likely to support and demand practices that will ensure the long-term sustainability of Texas natural resources.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

The Texas coast provides many valuable contributions to our daily lives, such as food, clean water, habitat for recreationally- and commercially-important species, protection against storms and flooding, and supportive services such as soil formation and nutrient cycling. These ecosystem services are critical components to a healthy coastal community, but are rarely included in coastal management decisions. Identifying, quantifying and valuing ecosystem services will allow coastal resource managers to more effectively communicate the economic and social value of these services and incorporate their benefits into coastal management determinations. This approach also will enhance wetland restoration evaluation, restoration and mitigation project tracking, and the understanding of the benefits of living shorelines.

This strategy will increase the state's ability to protect its natural resources and consequently increase community and economic resilience to natural coastal hazards. Incorporating the benefits of ecosystem services in project selection, restoration site monitoring, and funding allocation decisions will greatly benefit the Texas Coastal Management Program.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

Valuing ecosystem services is an emerging initiative for coastal programs and communities. The GLO has developed strong relationships with its networked agencies, local leaders and stakeholders, who are all essential contributors and stakeholders to the Coastal Management Program. The GLO will work with these coastal partners to integrate the ecosystem services component into the CMP's procedures, policies and project scoring criteria, and to communicate these enhancements to the coastal communities through workshops. The GLO will work with the grants coastal issue team under the Coastal Coordination Advisory Committee to integrate ecosystem services into the CMP guidance document and grants scoring criteria. The process of revising the guidance and grants scoring occurs annually. The networked coastal resource agencies are involved in this process and are supportive of the incorporation of ecosystem service evaluation which was a factor in developing this strategy. The evaluation of ecosystem services can also be expanded to other coastal grant funding like CEPRA and Beach Dune activities. Therefore, the integration of these factors into the project selection process has a high likelihood of success.

VI. Strategy Work Plan

Strategy Goal: To incorporate ecosystem services into the Coastal Management Program's (CMP) policies and procedures to ensure sustainable coastal management decisions.
Total Years: **1-3**
Total Budget: $130,000

Year 1:

Description of activities:

Establish the baseline of ecosystem services valuation and quantification in coastal management. Existing federal, state and local frameworks will be assessed to identify cases where ecosystem services valuation have been applied to natural resource management that might be applicable in the CMP. Using the assessment, CMP processes will be analyzed and recommendations made for implementing ecosystem services into the CMP processes. An agency report will be drafted with recommendations to address gaps and priorities and identify ways in which ecosystem services can be implemented in the CMP.

Major Milestones:

- Assessment of existing frameworks utilizing ecosystem service evaluation.
- Agency report identifying ecosystem services valuation gaps, priorities and implementation pathways for the CMP.

Budget: $70,000

Year 2:

Description of activities:

Based on implementation recommendations, pilot evaluation projects will be selected to test the application of ecosystem services into CMP project selection process. Refinements will be made comparing the current selection process and scoring. Ecosystem services criteria will then be phased into the Texas Coastal Management Program grant project funding selection process and application guidance document. The integration of the ecosystem criteria will be in consultation with the networked resources agencies and incorporate their feedback.

Major Milestones:

- Using the CMP grant evaluation process, evaluate pilot projects using the developed ecosystem services criteria.
- Ecosystem services valuation/quantification incorporated into CMP guidance document, application and scoring criteria.

Budget: $60,000

Year 3:

Description of activities:

To increase stakeholders' ecosystem services literacy and awareness the CMP will conduct outreach on the importance of ecosystem services and its inclusion in the Coastal Management Program to coastal partners through existing channels like its website and CMP grant workshops. The majority of outreach materials will be produced in house. After the first round of CMP grant project selection with the incorporated ecosystem services criteria, adjustments will be made to the process, application and guidance document.

Major Milestone:

- Develop outreach materials on ecosystem services for Coastal Management Program grant workshops.
- Updates to CMP project selection and scoring criteria.

Budget: $11,000

VII. Fiscal and Technical Needs

A. **Fiscal Needs:** *If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.*

Section 309 funding should be sufficient to carry out this strategy.

B. **Technical Needs**: *If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

The activities that require additional technical knowledge are the implementation of an ecosystem services case

study, which can include quantification and/or valuation, and the development of a communications strategy. Trained economists and social scientists are required, and biologists, geologists, and/or statisticians would be beneficial.

Strategy 5-Year Budget

Strategy Title	Year 1 Funding	Year 2 Funding	Year 3 Funding	Year 4 Funding	Year 5 Funding	Total Funding
Incorporate Ecosystem Services into the Coastal Management Program	$70,000	$60,000	$11,000	$0	$0	$141,000
Total Funding	**$70,000**	**$60,000**	**$11,000**	**$0**	**$0**	**$141,000**

Beach and Dune Protection

I. Issue Areas

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☐ Wetlands
- ☐ Marine Debris
- ☒ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

☐ A change to coastal zone boundaries;

☒ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;

☐ New or revised local coastal programs and implementing ordinances;

☐ New or revised coastal land acquisition, management, and restoration programs;

☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,

☒New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

To update beach and dune administrative rules and policies that affect the Gulf shoreline, which will assist local communities with coastal hazard mitigation and restoration.

The GLO's Beach Access and Dune Protection Program will update, clarify and certify Beach and Dune Rules in the Texas Administrative Code, which outline methods for coastal communities to protect natural resources and ensure accessibility for all Gulf beach users. Beach and Dune Program staff will provide technical assistance to local coastal leaders to implement the amendments that are appropriate for their community into their local Beach Access and Dune Protection Plans, guidance documents and programs.

C. *Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)*

To update the beach and dune administrative rules, the GLO's Beach Access and Dune Protection Program will work directly with local governments and coastal stakeholders to carry out the following blueprint over a five year period.

Renew the Texas Administrative Code Update Process – The Beach and Dune Rules can be found in Chapters 15 and 25 of the Texas Administrative Code. Currently, there are rules that require clarifications or revisions to make them more applicable to the changing management practices of coastal local governments. Rule changes can be triggered by changes to statute, changes in policy or management practices, or environmental impacts such as storms or inundation of sargassum.

These amendments will provide efficient mechanisms to approve or implement new management practices, and allow coastal governments to provide input on decision making and local management of the beach and dune system. If these rules are not updated, local governments will not have the flexibility to adapt to new beach and dune issues as they arise.

The GLO will initiate the update process by engaging with stakeholders and local governments to receive input on proposed amendments. Utilizing the feedback, the GLO will draft the amendments and file it in the Texas Register for a 30-day public comment period. Once the comment period is over, the GLO will address the comments and either adopt with no changes or implement the changes for further review. Once it is filed with the Texas Register again, it is effective into rule after 20 days. When the recommended changes are certified, the GLO will meet with local leaders to inform them on how they can incorporate the rule changes into their Erosion Response Plans, their Dune Protection and Beach Access Plans and other relevant programs or ordinances.

Coastal Partnerships – The Beach Access and Dune Protection Program will host meetings and workshops to guide coastal communities and partners through the Texas Administrative Code amendments and to provide technical assistance on how to incorporate any applicable amended rules into their local plans. The workshops and meetings will create an opportunity to share information and exchange ideas on beach access enhancements, ADA requirements, dune protection and re-vegetation projects, beach maintenance management strategies, erosion response measures, and changes to guidance documents, governing rules or statutes.

Hosting workshops to focus on best practices to maintain a healthy Gulf beach and dune system will be a new and much needed method of information delivery and exchange for the Beach Access and Dune Protection Program. This method will help shape and solidify the updates to the Beach and Dune Rules in the Texas Administrative Code and increase the likelihood of local governments incorporating the applicable changes into their Erosion Response Plans and their Dune Protection and Beach Access Plans. Convening local leaders will enhance the coastal dialogue and provide a mechanism to integrate new policies and procedures into local plans and ordinances.

Public Awareness – To improve the understanding of the beach and dune system and the importance of beach access, the GLO will integrate the approved Beach and Dune Rule amendments into the Dune Protection and Improvement Manual and the Texas Beach Accessibility Guide. Local governments use the Texas Beach Accessibility Guide to help ensure that Gulf beach access points and facilities are accessible to persons with disabilities and are compliant with federal and state guidelines. The Dune Protection and Improvement Manual is an educational publication that describes the functions and benefits of having a healthy dune system. The Manual provides local governments, stakeholders and the public information to help enhance dune protection along the Gulf coast through restoration methods and minimization of impacts. Guidelines for the appropriate construction of dune walkovers are utilized by coastal developers and communities alike. Private homeowners and developers also reference these publications to make the appropriate determinations when building along the coast.

To accommodate the changing demographics in the State of Texas, the Texas Beach Accessibility Guide will be translated into Spanish. The updated publications will continue to be available on the GLO website.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

This strategy addresses the many needs identified in the Assessment, including: updating the Texas Administrative Code and other outdated beach and dune publications to provide guidance to communities to improve public access as indicated as need in the Public Access and Coastal Hazard assessments. The strategy also will increase staff capacity to communicate and provide technical assistance and outreach to coastal communities on best management practices for beach and dune protection and will provide these practices through amendments to the Beach Access and Dune Protections Plans.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

Formulating an action plan to collect, update and educate the public on beach and dune administrative rules and policies will enable the GLO to monitor CMP project more effectively, increase enforcement and possibly minimize future impacts through increase community awareness.

Incorporating the beach and dune updates into the various documents and policies will strengthen coastal resiliency along the Texas coast and reduce the exposure local communities have to hazards due to storm surge and erosion. The updated guidelines also will help protect coastal habitat by restoring and enhancing critical beaches and dunes, and will increase direct access to the beach for all users, including persons with disabilities.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

The likelihood of success for this strategy is high. The current GLO administration and management fully supports the proposal to have the Beach Access and Dune Protection Program work more closely with local government officials and coastal partners to make the necessary updates to the Texas Administrative Code, the Erosion Response Plans, the Dune Protection and Beach Access Plans, the Dune Protection and Improvement Manual and the Texas Beach Accessibility Guide. This endorsement is an acknowledgment to the importance of this strategy and likelihood of its success in achieving the stated goals within this strategy timeline. The GLO Beach Access and Dune Protection

Program is the appropriate entity to carry out this endeavor as they have the working relationship with local entities and oversee local beach access and dune protection plan certification and public accessibility compliance.

The GLO also will coordinate with NOAA to offer the Planning and Facilitating Collaborative Meetings training to GLO coastal staff who will participate in the 309 strategies and in the various CMP coastal outreach efforts.

VI. Strategy Work Plan

Strategy Goal: To update beach and dune administrative rules and policies that affect the Gulf shoreline, which will assist local communities with coastal hazard mitigation and restoration.
Total Years: Five
Total Budget: $375,000 ($75,000 for one FTE over five years)

Strategy Task 1: Renew the Texas Administrative Code Update Process

Years: 2016 - 2020

Description of Activities:

The Beach Access and Dune Protection Program will collaborate with coastal communities to update the Beach and Dune Rules in the Chapters 15 and 25 of the Texas Administrative Code. Staff will develop a schedule of communities to meet with (prioritize for those out of compliance or with outstanding issues) and form internal workgroup with GLO Legal Team to develop timeline and process for TAC chapter 15 amendments.

Milestones:

- Hire one FTE to assist existing Beach and Dune Team.
- Host meetings and workshops on beach maintenance best practices.
- Amend Chapters 15 and 25 of the Texas Administrative Code.
- Continue to amend the Beach and Dune Rules in the Texas Administrative Code as environmental and governmental activities occur.

Strategy Task 2: Coastal Partnerships

Years: 2016 - 2020

Description of Activities:

The Beach Access and Dune Protection Program will provide technical assistance to coastal communities to guide them through the Beach and Dune Rule update and to incorporate applicable rules into their local coastal plans and programs.

Milestones:

- Host meetings and workshops to provide technical assistance to coastal local governments and coastal partners.
- Work with local governments to incorporate amended rules into local ordinances, Erosion Response Plans, Dune Protection and Beach Access Plans, and other relevant plans and programs.

Strategy Task 3: Public Awareness
Years: 2017 - 2020

Description of Activities:
Integrate the approved Beach and Dune Rule amendments into GLO Beach and Dune publications, materials and website.

Milestones:

- Update the Dune Protection and Improvement Manual. Update the Texas Beach Accessibility Guide.
- Translate the Dune Protection and Improvement Manual and the Texas Beach Accessibility Guide to Spanish.
- Update information on GLO website.

VII. Fiscal and Technical Needs

A. Fiscal Needs: *If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.*

It is anticipated that 309 funding will be sufficient to carry out this strategy.

B. Technical Needs: *If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

The state does possess the technical knowledge and skill to carry out the majority of the strategy; however, the GLO can't currently accomplish this with the existing number of staff. Upon the Governor's request, Texas state agencies are reducing their budgets; making the addition of one FTE even more critical for the Beach and Dune Team to adequately carry out the important function of addressing the Gulf shoreline management.

Certain local governments, however, do not have the technical knowledge on staff to incorporate extensive updates to their local coastal plans and may require financial assistance to carry out any local program change.

5-Year Budget Summary by Strategy

Strategy Title	**Year 1 Funding**	**Year 2 Funding**	**Year 3 Funding**	**Year 4 Funding**	**Year 5 Funding**	**Total Funding**
Beach and Dune Protection	$75,000	$75,000	$75,000	$75,000	$75,000	$375,000
Total Funding	$75,000	$75,000	$75,000	$75,000	$75,000	$375,000

Living Shoreline Protection

I. Issue Areas

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

B. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

To increase the use of living shorelines by local governments and private property owners along the bay to address erosion issues and to enhance and restore the habitat and water quality.

The GLO will contract to research the current use and future application of living shorelines in Texas bays. The GLO's Coastal Management Program staff and the GLO's Permit Service Center staff will use this information to advise local governments and private-property owners, through the permitting consultation process, of the benefits of utilizing natural shorelines in the Texas coastal zone. The GLO also will coordinate with its coastal partners, building on existing outreach efforts, to communicate the advantages of living shorelines and provide technical assistance for implementation.

C. *Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)*

There is an increasing need to incentivize to allow property owners along the bay shoreline to protect their real estate but also minimize the impacts on the natural environment and preservation of ecosystem services. This can

be achieved through the use of living shorelines. Currently, the Texas coast has 8,465 km of estuarine shoreline, of which approximately 13 percent has been protected using hard structures including bulkheads, riprap, walls or other barriers made of concrete, wood or metal. This strategy seeks to enhance resilient environments and communities by:

- Creating an inventory of current living shoreline projects in the state; Identifying challenges and opportunities for living shoreline use in Texas;
- Completing an assessment of estuarine shorelines methods;
- Developing a homeowner's guide for protecting and mitigating bay shoreline erosion; and
- Providing outreach to homeowners, local governments, permitting professionals and contractors.

The GLO will work with a contractor to review current work and literature regarding shoreline management and restoration along the Texas coast. A NOAA program liaison also will be contacted to provide guidance on NOAA living shoreline resources, and GLO staff will analyze similar projects completed by other Gulf states.

The assessment may include surveys of public opinions of shoreline management to help identify challenges in implementation of resilient shoreline measures. It also may include an update of the shoreline change assessments, which identifies critical erosion areas along the Gulf. Shoreline trends measured in recent years can be combined with data of location of private or public lands to identify areas where living shorelines may be applied. These data will be essential for coastal management, coastal planning, and for the public looking to purchase real estate or to identify bay shoreline trends in their current property.

Presently, a living shoreline (marsh creation, etc.) must have an approved Coastal Boundary Survey prior to construction. This is required based on Sec. 33.136 of the Texas Natural Resources Code.
With residential property owners, most bulkheads are placed on private land at the time of construction, so no authorization is needed from GLO and they typically qualify for a Nationwide Permit 13 with the USACE, making it a very simple permitting process to construct a bulkhead. In many cases, GLO Permit Service Center staff will meet with the residential property owner to assist in marking a line for the bulkhead above the state boundary to ensure no fill material is placed on state land.

Having data and materials that highlight the benefits of incorporating a living shoreline will assist the GLO's Permit Service Center staff in their work of informing permit applicants of all associated options.

Outreach is another component of this strategy, which may be targeted toward general public shoreline owners, regulatory agency leadership and permitting staff, landscape architects, marine contractors and suppliers, and local regulatory and natural resource management staff. The outreach information may be distributed through the GLO website, development of FAQ and BMP documents and videos.

Lastly, with coordination and work in partnership with other local governments and non-governmental organizations, such as Texas Sea Grant and various Bay Foundations, Gulf of Mexico Alliance, USACE Regional Offices, and other state and federal wildlife agencies seeking ecosystem approaches to species protection, this strategy can leverage shoreline mitigation work for a living shoreline demonstration on public lands. The strategy will serve as an example for the GLO's coastal programs, as well as provide volunteer opportunities that will expand the living shoreline concept and encourage ecosystem stewardship.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

This strategy addresses the many needs identified in the Assessment, including:

- Increasing staff capacity to develop and promote the use of living shorelines as a means of shoreline protection and wetland restoration. This strategy seeks to address data gaps on the applicability and feasibility of small-scale living shoreline implementation; and
- Providing policy guidance and technical assistance to communities and decision-makers to enhance shoreline management through improved understanding of the benefits of living shorelines, feasibility of living shoreline implementation, outreach and training on the benefits of a healthy dune system and policies and management practices that maintain the system.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

In addition to the erosion control and hazard mitigation benefits, living shorelines preserve habitat and ecosystem services provided by naturally vegetated environments. One such benefit is improved water quality. Shoreline erosion is frequently the greatest sources of fine sediment and turbidity in a watershed. Living shorelines and their associated vegetation help stabilize erosion and act as a sediment sink for particulates in the water column (Restore Americas Estuaries, 2014). In addition, use of natural shoreline protection structures such as oyster reefs further increases the filtration of estuarine waters.

Implementation of living shorelines improves the likelihood of ecosystem based management. This information will be made available online and incorporated into the GLO's Resource Management Code data portal. This project will directly benefit coastal zone management by providing managers, agency staff and the general public with the tools they need to select the most appropriate techniques to use for resilient shoreline protection and by providing an analysis of challenges in implementing these techniques. The results of the information gathered through this project will enhance interpretation of CZM policies and facilitate planning and management efforts. In addition, the tasks achieved and information obtained through this project will support other management efforts such as limiting cumulative and secondary impacts and identification of priority restoration areas or the identification of areas for land acquisition or preservation.

Currently in Texas, The Galveston Bay Foundation implements a "Living Shorelines" program as part of its conservation effort. In cooperation with different partners, the Galveston Bay Foundation offers assistance and guidance to private landowners with the design, permitting and identification of funding sources for living shoreline projects (Galveston Bay Foundation, 2014). Outside of this program, assistance to implement living shorelines in other Texas coastal communities is minimal.

This strategy seeks to gain better understanding of living shorelines; update and improve current estuarine shoreline change rate data (including shorelines of emergent wetlands, flats, as well as modified shorelines); develop a homeowner's shoreline protection guide and provide education and training to homeowners, coastal managers and coastal professionals; and to develop an implementation plan to lay foundation for a living shoreline program in Texas. This program may incorporate revisions to local coastal programs through the use of living shoreline incentives or other state coastal programs, it may create a procedure of restoration on state owned lands and it could find ways to facilitate permitting procedures for living shoreline projects.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

The likelihood of success for this strategy is high. The current GLO administration and management fully supports the proposal to research and increase the awareness of the benefits of living shorelines. The GLO's Permit Service Center, which handles many shoreline permitting questions, also is a proponent of having the appropriate living shoreline data and outreach materials to use when assisting the public. This will help provide local communities with an intricate overview of the options to control erosion, while at the same time, understanding the impacts on habitat and water quality.

The GLO and its partners have extensive knowledge of estuarine wetland ecosystems and regulatory experience as well as high capacity for research, information dissemination and the development of decision support tools. The GLO will work with partners, as necessary, to achieve project goals. The GLO will leverage the GLO-funded living shoreline work the Galveston Bay Foundation has conducted and will use their input for expansion to other areas of the coast

VI. Strategy Work Plan

Strategy Goal: To increase the use of living shorelines by private property owners along the bay through outreach and guidance materials to address erosion issues and to enhance and restore the habitat and water quality.
Total Years: Five
Total Budget: $276,000

Stretegy Task 1: Assessment of Living Shorelines

Years: 2016 - 2018

Description of Activities:

Analyze shoreline management and restoration programs and literature and identify living shorelines that would be applicable to the Texas bay shorelines.

Milestones:

- Identify successful programs in other states and identify what components may be suitable for Texas.

- Complete an inventory of living shoreline projects in Texas.
- Identify Living Shoreline Techniques suitable for Texas estuarine environments.
- Develop a findings report.

Task 1 Budget: $55,000

Strategy Task 2: Updates and Improvements to Estuarine Shoreline Assessment

Years: 2016 - 2017

Description of Activities:

Update existing shoreline change assessment and combine with date of location of private or public lands.

Milestones:

- Create an estuarine shoreline assessment database.
- Develop a findings report.

Task 2 Budget: $150,000

Strategy Task 3: Living Shoreline Recommendations for Texas

Years: 2019 - 2020

Description of Activities:

Evaluate data to identify recommendations to incorporate living shorelines into coastal management programs. Develop a Homeowners' Shoreline Management Guide to share with the coastal communities.

Milestones:

- Create Homeowner's Shoreline Management Guide.
- Assess potential for the creation of a living shoreline program for Texas.
- Provide recommendations for incorporating living shorelines in coastal management and goals.

Task 3 Budget: $51,000

Strategy Task 4: Living Shoreline Outreach and Education

Years: 2019 - 2020

Description of Activities:

Target living shoreline outreach toward general public bay shoreline owners, regulatory agency leadership and permitting staff, landscape architects, marine contractors and suppliers, and local regulatory and natural resource management staff.

Milestones:

- Conduct living shoreline workshops and training.
- Develop materials and tools for technical assistance.

Task 4 Budget: $20,000

VII. Fiscal and Technical Needs

A. Fiscal Needs: *If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.*

It is anticipated that 309 funding will be sufficient to carry out this strategy.

B. Technical Needs: *If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

The state does possess the knowledge and skill to carry out the majority of the strategy; however, the GLO does not currently have the capacity or implementation experience to accomplish this strategy. Therefore, the GLO will contract to carry out certain functions of this strategy. The GLO will work with coastal partners like the Galveston Bay Foundation, and permitting agencies to gain input on executing this strategy. For the data collection and living shoreline assessment, a contractor will be needed to conduct this work. There is a possibility a contractor will need to be hired for the outreach component for material development and workshops. The GLO will closely monitor and manage the contracts to make sure all deliverables are successfully accomplished in a manner that supports the goals of the Coastal Management Program.

5-Year Budget Summary by Strategy

Strategy Title	**Year 1 Funding**	**Year 2 Funding**	**Year 3 Funding**	**Year 4 Funding**	**Year 5 Funding**	**Total Funding**
Bay Shoreline Protection	$35,000	$80,000	$90,000	$43,000	$28,000	$276,000
Total Funding	$35,000	$80,000	$90,000	$43,000	$28,000	$276,000

Data Collection, Technical Assistance and Planning to Mitigate Coastal Hazards

I. Issue Areas

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☒ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☒ Wetlands
- ☒ Marine Debris
- ☒ Public Access

II. Strategy Description

A. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

☐ A change to coastal zone boundaries;

☐ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;

☐ New or revised local coastal programs and implementing ordinances;

☐ New or revised coastal land acquisition, management, and restoration programs;

☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,

☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

To help communities mitigate and adapt to coastal hazards by hosting community resiliency index training and providing technical assistance in the form of an online toolkit and guidance document for local community resilience planning.

C. *Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)*

The GLO will contract with a coastal partner skilled in conducting the Community Resiliency Index (CRI), which is a self-assessment to determine the level of disaster preparedness for a community. To establish a baseline, in Year 1, the GLO will select two local communities, one in the upper coast and one in the lower coast, that have been identified by the GLO as appropriate pilot CRI communities through prior local elected officials meetings and resiliency forums the GLO has hosted. The Community Health and Resource Management (CHARM) mapping application will be used at the CRI workshops to give participants the ability to map and analyze the disaster scenario. Specific local data will be added to the CHARM model for each assessment. The CRI workshops also will

provide a brief introduction to the Community Rating System and its benefits to the local communities. Based on CRI findings, technical assistance to address the vulnerabilities will be provided to the two communities through a Texas Sea Grant planning specialist. An online toolkit will be developed and made available for communities to use to find information on planning for community resiliency and data resources for modeling coastal hazards. A guidance document will be produced as a result of the CRI pilots for use by other Texas coastal communities for resiliency planning. The guidance will incorporate the CRI process, lessons learned, and data, modeling, and planning resources.

The GLO will conduct an inventory of coastal hazards data to identify data gaps applicable to this effort. Updated topography and bathymetry data has already been identified as a need and will be done through this strategy for inclusion in resiliency models, such at Climate Central's Surging Seas Risk Finder and the Nature Conservancy's Coastal Resilience Mapping Portal which local communities can then use for resiliency planning.

Supplemental CRI assessments focusing on different sectors in the community, i.e., tourism, ports, fishing industry, also will be conducted in later years to help the communities link the various sectors in an overall resiliency plan. The GLO and Texas Sea Grant will evaluate the overall assessment process and incorporate lessons learned before selecting two additional pilot communities to repeat the comprehensive CRI assessment and receive technical assistance.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

An assessment of community resilience was identified as a priority need in the Coastal Hazards and Cumulative and Secondary Impacts assessment sections, however this strategy would also provide enhancements to other priority areas such as wetlands and public access. This strategy will target the following identified needs and gaps:

- Leverage existing resiliency efforts, such as the Community Rating System, for the Coastal Resilience Index, for improved mitigation and planning for Coastal Hazard mitigation.
- Assessment of community resilience (social, economic, ecological and infrastructure) as well as community barriers towards achieving resilience.
- Implement and update GIS and mapping data: Update subsidence mapping and monitoring, improve topographic and bathymetry models, and provide infrastructure maps in GIS format for communities which still rely on paper records. Updating topographic and bathymetry models will help improve flooding and wetland migration models, as identified in the Wetlands and Coastal Hazards assessments.
- Provide assessment and management planning tools (Population increase and associated infrastructure; relative sea level rise) as indicated as a gap under the Cumulative and Secondary Impacts assessment.
- Develop community targeted decision-support tools (online toolkit and guidance document). This will continue efforts to bring necessary data, tools, and professional assistance to local communities.
- Provide leadership in coastal resilience – partner on existing resiliency efforts through SeaGrant to

establish GLO as a resource and leader for assistance and guidance for community planning.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

The Community Resiliency Index is a proven, inexpensive tool to help coastal communities address existing coastal hazards and planning vulnerabilities. Through the CRI process, local elected officials, planners, administrators, emergency teams, engineers and other pertinent local personnel can evaluate their disaster response processes and strategies, staffing levels, infrastructure, facilities, transportation, social systems, and business plans for the various sectors within their local government. The assessment will highlight areas that are adequately prepared as well as areas where more resources should be designate to become a more resilient community.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

Some communities that previously engaged in the CRI process had limited success in addressing identified vulnerabilities due to shortages in staff resources or funding to implement the identified processes and improvements into their local plans and ordinances. Providing technical assistance and data tools directly to the coastal communities after the CRI will increase the likelihood of success for this strategy, and will allow the local governments to incorporate the necessary adjustments into their disaster preparedness plans. SeaGrant as a project partner brings planning and data resources and expertise in conducting CRIs and planning assistance to communities. SeaGrant has experience engaging communities and sharing research to support planning efforts for resilient coastal communities.
SeaGrant's resources also include a network of extension agents, placed throughout the state, who can provide local planning assistance.

The GLO has previously supported local communities through guidance and financial support in the development of Erosion Response Plans by holding Coastal Resilience Forums along the coast to inform local leaders and community planners of potential planning tools and resources to mitigate risks from coastal hazards to reduce community vulnerability.

VI. Strategy Work Plan

Strategy Goal: To help communities mitigate and adapt to coastal hazards by hosting community resiliency index training and providing technical assistance to local governments.
Total Years: 1-5
Total Budget: $405,000

Year 1:

Description of activities:

The GLO will contract with Texas Sea Grant CRI trainers to conduct two pilot CRI assessments in selected communities in the Upper Coast and Lower Coast. The GLO will coordinate with Texas Sea Grant to include community-specific data layers into the CHARM mapping application, which will be used at the CRI workshops.

Major Milestones:

- The GLO will select two communities for the CRI assessment and coordinate the workshop setup.
- Texas Sea Grant will update the CHARM model with community-specific information.
- Texas Sea Grant CRI trainers will conduct the two CRI workshops.

Budget: $12,000

Year 2:

Description of activities:

The GLO will coordinate with the local entities to determine the relevant sectors (ports, tourism, and fisheries) in the two pilot communities that are prime candidates for supplemental CRI assessments. Workshops will be held to administer the CRI assessment, incorporating the CHARM model to analyze results in a spatial capacity. Following the workshops, Texas Sea Grant planning specialists will work with the two pilot communities to provide direct technical assistance to support resiliency planning improvements identified through the CRI to reduce vulnerability. A guidance document will begin to be developed to document the process of administering the CRI and lessons learned in Texas along with resources for technical assistance and information.

Major Milestones:

- Industry-specific CRI assessments will be conducted in the two pilot communities.
- Texas Sea Grant will update the CHARM model with industry-specific data.
- Texas Sea Grant planning specialists will begin working with communities to address the vulnerabilities identified in the CRI.
- Draft guidance document.

Budget: $51,000

Year 3:

Description of activities:

The Texas Sea Grant planning specialists will continue to provide technical assistance to the communities in regards to the overall assessment, as well as the individual industry assessments. Guidance document development will continue. The GLO will conduct an inventory of coastal hazards data, and will identify any gaps for data collection. The state topography and bathymetry datasets will be updated for inclusion in vulnerability models to support coastal planning.

Major Milestones:

- GLO will conduct a coastal hazards inventory.
- Topography and bathymetry datasets will be updated.
- The two pilot communities will continue to receive technical assistance.
- Guidance document developed.

Budget: $120,000

Year 4:

Description of activities:

Two new communities will undergo a CRI-CHARM assessment, while the technical assistance will continue for the first two pilot communities. Updates to the topography and bathymetry datasets will be completed. Updates to the guidance document will be incorporated based on lessons learned and information gathered from conducting CRI's in these two additional communities.

Major Milestones:

- Two new communities undergo a CRI assessment.
- The topography and bathymetry data updates will be completed.
- The two pilot communities will continue to receive technical assistance.

Budget: $131,000

Year 5:

Description of activities:

The two selected new coastal communities will participate in the industry-specific CRI assessments, and will receive technical assistance to implement the CRI results. Texas Sea Grant will continue to add data layers to the CHARM model to support community planning. Updates to the guidance document will be incorporated based on lessons learned and information gathered from conducting CRI's in these two additional communities.

Major Milestones:

- Industry-specific CRI assessments will be conducted in the two communities.
- These communities will receive technical assistance to update their resiliency plans or adopt guidelines or amend ordinances to address community resiliency.
- Target metric would be 2 out of the 4 communities would make/implement policy changes.
- The CHARM model will be updated to continue the community planning support.
- Update guidance document.

Budget: $91,000

VII. Fiscal and Technical Needs

A. Fiscal Needs: *If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.*

Section 309 funding should be sufficient to carry out this strategy.

B. Technical Needs: *If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

This strategy will require technical knowledge specific to CRI assessment instruction and its direct application to local community planning. Technical knowledge also is needed to incorporate the CHARM model, which allows local entities to map and analyze disaster scenarios during the CRI assessment, and to update the topography and bathymetry data.

Strategy 5-Year Budget

Strategy Title	Year 1 Funding	Year 2 Funding	Year 3 Funding	Year 4 Funding	Year 5 Funding	Total Funding
Data Collection, Technical Assistance and Planning to Mitigate Coastal Hazards	$12,000	$51,000	$120,000	$131,000	$91,000	$405,000
Total Funding	**$12,000**	**$51,000**	**$120,000**	**$131,000**	**$91,000**	**$405,000**

Implementation of Coastal Nonpoint Source Management

I. Issue Areas

The proposed strategy or implementation activities will support the following high-priority enhancement areas *(check all that apply)*:

- ☐ Aquaculture
- ☐ Energy & Government Facility Siting
- ☒ Coastal Hazards
- ☐ Ocean/Great Lakes Resources
- ☐ Special Area Management Planning
- ☒ Cumulative and Secondary Impacts
- ☐ Wetlands
- ☐ Marine Debris
- ☐ Public Access

II. Strategy Description

B. The proposed strategy will lead to, or implement, the following types of program changes *(check all that apply):*

- ☐ A change to coastal zone boundaries;
- ☒ New or revised authorities, including statutes, regulations, enforceable policies, administrative decisions, executive orders, and memoranda of agreement/understanding;
- ☐ New or revised local coastal programs and implementing ordinances;
- ☐ New or revised coastal land acquisition, management, and restoration programs;
- ☐ New or revised special area management plans (SAMP) or plans for areas of particular concern (APC) including enforceable policies and other necessary implementation mechanisms or criteria and procedures for designating and managing APCs; and,
- ☒ New or revised guidelines, procedures, and policy documents which are formally adopted by a state or territory and provide specific interpretations of enforceable CZM program policies to applicants, local government, and other agencies that will result in meaningful improvements in coastal resource management.

B. Strategy Goal:

To provide adequate programmatic support and staffing to address necessary actions needed to fully satisfy CZARA requirements and receive full approval of the coastal NPS program. Additionally, the strategy will provide technical assistance related to the control of NPS pollution from off-system roadways, urban development, and watershed planning in accordance with Section 6217 of the Coastal Zone Management Act.

Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) requires each state with an approved Coastal Zone Management Program to develop a federally approvable program to control coastal nonpoint source (NPS) pollution. In December 1998, Texas submitted their Coastal Nonpoint Source Program to NOAA and the EPA and in July 2003, this plan was conditionally approved with seven outstanding conditions. Since 2003, the outstanding noncompliance conditions have been reduced to four, which include: 1) new development, existing development and site development; 2) watershed protection;
3) new and operating onsite sewage disposal systems; and 4) roads, highways and bridges.

NOAA's 312 findings on March 23, 2015 recognized Texas' good faith effort to move forward with full approval of its conditionally approved program; however, the state must develop and submit a work plan with interim benchmarks and a timeline for meeting the goals and objectives identified as important to the coastal NPS pollution program.

The work plan and documentation indicating how Texas meets the outstanding conditions must be submitted no later than June 30, 2019.

C. *Describe the proposed strategy and how the strategy will lead to and/or implement the program changes selected above. If the strategy will only involve implementation activities, briefly describe the program change that has already been adopted, and how the proposed activities will further that program change. (Note that implementation strategies are not to exceed two years.)*

Development of a Coastal NPS Management Strategy will provide the framework for addressing and managing NPS pollution and resulting water quality issues that degrade the coastal environment. Following this strategy, major steps will be made toward achieving NOAA's target of full Coastal NPS Program approval and implementation by July 2019.

The actions under this strategy will help implement the off-system roadway and urban development best management practices (BMPs) needed to protect water quality and enhance natural ecosystem services. City, county, district, and other jurisdictional personnel will be responsible for implementing off-system roadway and land development programs.

This project will also coordinate with regional water quality planning staff, local real estate developers, and other land development professionals to implement measures to reduce runoff volumes and pollutant loadings from off-system roadways and urban development to help protect and restore water quality conditions.

III. Needs and Gaps Addressed

Identify what priority needs and gaps the strategy addresses and explain why the proposed program change or implementation activities are the most appropriate means to address the priority needs and gaps. This discussion should reference the key findings of the assessment and explain how the strategy addresses those findings.

NOAA's 2014 312 evaluation concluded that the CMP must develop a strategy with interim benchmarks and a timeline for meeting the goals and objectives of the Coastal NPS Program by September 30, 2015. This strategy would be informed by the goals and objectives developed to address high priority needs for addressing the four outstanding Coastal NPS conditions in an integrated way. Under CZARA, in order for a state to maintain full funding of their coastal management programs they must fully satisfy their coastal NPS program requirements. Therefore, this strategy to move to towards full approval of our coastal NPS program is of high priority to the Texas General Land Office, CMP and the TCEQ for 319 funding.

IV. Benefits to Coastal Management

Discuss the anticipated effect of the strategy, including the scope and value of the strategy, in advancing improvements in the CMP and coastal management, in general.

The causes and prevention of NPS pollution are complex, diffuse, and often difficult to quantify. NPS pollution is recognized as one of the most significant factor in water quality degradation. In urban and agricultural areas there are links between degraded water quality and land use activities. Coastal planning and smart development measures are essential to protecting coastal water quality, which is subject to increasing impacts from development and land

use change. To protect surface water and groundwater resources, enhanced local policy, employment of enhanced best management practices, and improved watershed management should be developed in order to minimize increases in stormwater runoff and maximize reductions of targeted pollutant loadings.

V. Likelihood of Success

Discuss the likelihood of attaining the strategy goal and program change (if not part of the strategy goal) during the five-year assessment cycle or at a later date. Address the nature and degree of support for pursuing the strategy and the proposed program change and the specific actions the state or territory will undertake to maintain or build future support for achieving and implementing the program change, including education and outreach activities.

The proposed effort provides a foundation and staffing resources to address important NPS pollution concerns affecting the Texas coastal zone, which includes GIS mapping to prioritize areas to target NPS management, supporting innovative projects that address increasing needs to manage NPS pollution, and education and outreach coordination with communities in regard to water quality and health. GLO is currently using non-CMP funding to work on the urban and onsite sewage disposal systems measures. This strategy will build upon the current work for these measures and allow expansion to begin to address the other outstanding measures.

GLO has been working with the other networked coastal natural resource agencies (TCEQ, Texas State Soil and Water Conservation Board, and Texas Department of Transportation) to address these measures. GLO and networked agencies recognize the importance of achieving full approval of the coastal NPS program and thus this work is a high priority for the CMP. The likelihood of success in developing a strategic effort that will result in program changes is good as there has been lots of forward momentum and management support. However, as a majority of the non-point source outstanding measures fall under the purview of the TCEQ, much cooperation and coordination will need to continue to occur. The other challenge is funding. GLO and TCEQ have to leverage funds to implement changes to address these measures across a very large coastal zone. Some of these measures may require statutory changes in order to implement which requires significant effort to achieve and are dependent on other political factors.

VI. Strategy Work Plan

Strategy Goal: Implementation and actions to address the outstanding Coastal NPS management measures to achieve full program approval.
Total Years: 1- 5
Total Budget: $602,100

Strategy Task 1: Administration

Years: 1-5

Description of activities: A program specialist will be hired to oversee and administer the coastal NPS program and all related tasks. The program administrator will be responsible for organizing and leading all contractual, scientific, and stakeholder related tasks of implementing the CMP coastal NPS program. This person will manage the interagency NPS workgroup and be responsible for drafting all formal program submissions to NOAA/EPA.

Major Milestones:

- Hire a program administrator

Budget: $75,000 per year

Strategy Task 2: Roads, Highways and Bridges and New and Existing Site Development

Years: 2-5

Description of activities: Provides outreach, education and technical assistance to assist coastal communities; uses developed stormwater BMP guidance and related materials to encourage municipalities to adopt ordinances and practices that comply with 6217 requirements for new and existing development. Provide outreach, education, and technical assistance to coastal jurisdictions to follow TxDOT guidance for roadway design, siting, operation, and maintenance so as to meet 6217 requirements. This will include Secoordination with networked state agencies to establish voluntary and incentive-based programs.

Major Milestones:

- Support and/or establish voluntary and incentive-based programs.
- Conduct outreach and provide planning assistance to target identified communities. Summary of outreach workshops/trainings/meetings held.
- Report on community land development and coastal roadways criteria updates.
- Formal NPS program submittal to NOAA and EPA for approval of this management measure.

Budget: Tasks 2-4 will be conducted concurrently and executed as timing, budget and priorities align.

Strategy Task 3: Septic Systems Regulatory Inspections (Point of Sale Real-Estate Inspections)

Years: 2-5

Description of activities: Work with the TCEQ and other partners to provide necessary outreach and education; utilize the state On-Site Sewage Facilities (OSSF) checklist to assist Authorized Agents, Designated Representatives, realtors, lenders, and other stakeholders to implement OSSF inspections to meet 6217 requirements. Local capacity building and outreach aims to enhance local rules concerning septic system installation and maintenance. Outreach activities provide training, technologies and best management practices designed to reduce the number of failing systems, accommodate growth and economic development, and increase the effectiveness of county health department inspection and enforcement programs. Under this task, development of a database may be necessary to manage data on outreach conducted and OSSF inspections.

Major Milestones:

- Track number of realtors/lenders trained to conduct comprehensive inspections utilizing the CZARA OSSF Checklist.
- Track number of Authorized Agents/Designated Representatives trained to conduct comprehensive inspections utilizing the CZARA OSSF Checklist.
- Agency report on accomplishments during the year and work plan for next year. Formal submittal to NOAA and EPA for approval of this management measure.

Budget: Tasks 2-4 will be conducted concurrently and executed as timing, budget and priorities align.

Strategy Task 4: Watershed Protection

Years: 2-5

Description of activities: Provide outreach, education and technical assistance services to assist coastal communities to address watershed and related water quality issues. Conduct an inventory to determine the existence and status of watershed planning efforts that currently exist in Texas coastal areas. We would produce and/or utilize existing best practices guides to aid areas that do not meet 6217 standards in developing future practices. Based upon these findings, engagement through planning processes with groups in sensitive watershed areas could occur. This effort could address water quality problems in a holistic way by engaging stakeholders and scientists to assess the causes and prioritize prevention and mitigation strategies to address identified problems. Use existing watershed programs developed for environmental flows through the SB3 process can provide an established base from which to proactively expand watershed planning.

Major Milestones:

- Develop or identify existing materials and distribute Erosion and Sediment Control Guidelines for Urban and Suburban Areas.
- Coordinate with regional water planning groups in sensitive watersheds that do not meet 6217 standards to implement and conduct outreach on best management practices.
- Establish a recognition program for local governments
- Agency report on accomplishments during the year and work plan for next year.
- Document outreach activities and technical and planning assistance provided.
- Formal submittal to NOAA and EPA for approval of this management measure.

Budget: Tasks 2-4 will be conducted concurrently and executed as timing, budget and priorities align.

VII. Fiscal and Technical Needs

A. Fiscal Needs: If 309 funding is not sufficient to carry out the proposed strategy, identify additional funding needs. Provide a brief description of what efforts the CMP has made, if any, to secure additional state funds from the legislature and/or from other sources to support this strategy.

Due to the complexity and scale required to achieve these management measures, this strategy will be supplemented with other funding sources, such as CWA 319 funds.

***A. Technical Needs**: If the state does not possess the technical knowledge, skills, or equipment to carry out all or part of the proposed strategy, identify these needs. Provide a brief description of what efforts the CMP has made, if any, to obtain the trained personnel or equipment needed (for example, through agreements with other state agencies).*

The CMP is relying on the other state networked agencies and partners/consultants to provide technical expertise as the outstanding management measures fall within the capacity and functional knowledge of these agencies. GIS and mapping is being conducted through contractors of OSSF systems and priority areas for

application of this strategy. This information will be utilized by networked agencies, so therefore, needs to be collected in a manner that will integrate into their existing databases and regulatory functions. Partners, such as Sea Grant and AgriLife extension agents, will be utilized to conduct local outreach and provide additional technical expertise for management measure implementation.

Strategy 5-Year Budget Summary

Tasks	Year 1 Funding	Year 2 Funding	Year 3 Funding	Year 4 Funding	Year 5 Funding	Total Task Funding
Task 1	$75,000	$75,000	$75,000	$75,000	$75,000	$375,000
Task 2-4	$0	$40,000	$12,700	$59,700	$114,700	$227,100
Total Strategy Funding	$75,000	$115,000	$87,700	$134,700	$189,700	**$602,100**

5-Year Budget Summary for All Strategies

Strategy	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	Total Funding
Assessment & Data Collection to Enhance Permitting, Leasing, and Monitoring for Coastal Activities	$253,000	$139,000	$136,300	$136,300	$136,300	***$800,900***
Incorporation of Ecosystem Services into Grant Processes	$70,000	$60,000	$11,000	$0	$0	***$141,000***
Bay Shoreline Protection	$35,000	$80,000	$90,000	$43,000	$28,000	***$276,000***
Beach and Dune Protection	$75,000	$75,000	$75,000	$75,000	$75,000	***$375,000***
Data Collection, Technical Assistance and Planning to Mitigate Coastal Hazards	$12,000	$51,000	$120,000	$131,000	$91,000	***$405,000***
Implementation of Coastal Nonpoint Source Management	$75,000	$115,000	$87,700	$134,700	$189,700	***$602,100***
TOTAL FUNDING	**$520,000**	**$520,000**	**$520,000**	**$520,000**	**$520,000**	**$2,600,000**

Stakeholder and Public Engagement

Stakeholder Feedback – Phase I

Input for Phase I was requested through phone calls and emails to selected stakeholders and coastal partners. These stakeholders and partners represented State agencies and local government including Texas Sea Grant, Texas Commission on Environmental Quality, Texas Parks & Wildlife Department, Texas Water Development Board, the General Land Office, Texas Railroad Commission, Texas Department of Transportation, Brazoria County, Galveston Bay Estuary Program, Cameron County Parks & Recreation, and Texas Coastal Ocean Observing Network.
Wetland protection, restoration, or enhancement is one of the high priorities identified by stakeholders for the coastal zone. Wetlands serve as habitat and nursery grounds for over 95 percent of the recreational and commercial fish species found in the Gulf of Mexico and provide other benefits to humans including retaining and removing water pollutants, protecting against storms and flooding by storing runoff during rainfall events and reducing damages from storm events, and providing recreational opportunities such as fishing and kayaking. Fragmentation in rural areas, population growth, urban development, dredging, subsidence, sediment diversion, saltwater intrusion, erosion, hydrologic change, and relative sea level rise are all major threats to coastal wetlands as identified by stakeholders. Educating the public on the importance of protecting and restoring wetlands and pursuing conservation of lands via conservation easement or fee-simple acquisition were identified as solutions to address this coastal zone priority.

Preventing or significantly reducing the threats to life and property brought by coastal hazards is a high priority as identified by stakeholders. Coastal Hazards and specifically shoreline erosion are directly related to coastal wetland loss and this is one more reason why restoring and protecting coastal wetlands is critical.

Preserving, enhancing, and increasing public access to Texas bays and beaches is another high priority identified by stakeholders. Stakeholders believe there is very limited access to recreational activities such as kayaking, fishing, and bird watching. Acquisition of property and enhancement of existing public property, such as dune walkovers, are solutions identified by stakeholders to respond to this priority. According to local stakeholders, dune walkovers will ensure safe public access that is compliant with the Americans with Disability Act (ADA), while at the same time preventing visitors from walking and disturbing the dunes and allowing its vegetation to grow for better dune stabilization. It was pointed out that increasing and enhancing public access to the Texas coast will increase tourism and local economies. Other measures include sand dune protection, enhancing ADA accessibility such as boardwalks for wheelchairs, reducing the impact of runoff from parking areas, installing filters for storm runoff from roads and parking areas, protecting natural resources from non-point source pollution, and improving building codes to protect the environment. Additionally, public access is a serious concern given Texas' eroding coastal shoreline. As public beaches are affected by erosion, they move onto private property and cease to exist. Stakeholders are concerned with the potential loss of public property and public access and the conflict that arises between private property rights and public beach access. As development occurs and erosion persists, the protection of public access from the State becomes critical. Policy guidance from state level and the Texas Coastal Management Program could be ways/tools to respond to this conflicting issue.

Energy and Government facility siting was identified as medium priority with one issue raising some discussion: that of wind (onshore and offshore) energy siting. Wind energy development is an emerging force in the Texas coast, but there is not a regulatory agency or strict environmental regulations for its siting; this represents a big hole in wind energy development according to stakeholders. The state should have a more active role in wind energy siting policies and regulations to minimize environmental impacts and ensure sustainable development.

Lastly, aquaculture could be very beneficial for Texas and be an important contributor to the school fund. However, there are no offshore facilities in the state. The reason why aquaculture has not moved to Texas, as identified by stakeholders, is due to regulatory uncertainty and siting issues. Offshore aquaculture should be permitted by the state and this could be done, for example, by starting lease sales that would give the buyer the right to operate.

Stakeholder Feedback – Phase II and Strategies Development

Input for Phase II and Strategies Development was requested through a stakeholder meeting held in Austin, Texas on March 10, 2015 from 2:00 – 4:00 pm. Invitations were sent to 29 selected stakeholders and coastal partners, and 27 attended either in person or remotely. We received 4 post-meeting written responses. The summary below describes the entirety of stakeholder feedback.

At the meeting, the HRI team went through each high priority enhancement area using the synthesis document (Appendix H). The team had prepared feedback sheets that could guide feedback for each enhancement area, as well as capturing oral feedback.

NOAA commented that the identification of CZM priorities through this process drives how priorities are established for the coming years.

During the discussion on wetlands, the topic of non-jurisdictional wetlands arose and the importance of assessing and tracking impacts to them from development. Currently, NGOs and other organizations monitor wetlands, also important when considering overall ecosystems services. This issue is tied to the new EPA/USACE proposed rules, and as such, could be an unresolved issue for many years due to clarification of the new rules as well as potential litigation. What can Texas do at this point and time to address? In post meeting comments, a reviewer pointed out that data on non-jurisdictional wetlands in relation to jurisdictional wetlands (location, function, and value) would streamline the CWA 404 permitting.

Another comment regarding wetlands pointed out that a habitat vulnerability assessment, specifically wetland function and value data along with erosion and surge data, would help the Coastal Erosion Planning and Response Act (CEPRA) program to prioritize projects. Proactive approaches in the CEPRA program would include community outreach and education. This would include training of CEPRA employees in wetland, ecosystem, coastal erosion, and construction processes; and project management tools and practices, community outreach and community education.

In the coastal hazards section, regarding the planning and outreach management priority, the use of Best Management Practices (BMPs) should be broadened beyond just living shorelines and should include all shoreline protection. As well, BMPs should have flexibility to address the variance seen among sites. This discussion topic carried over into written comments in which the comment was again made that a clear definition of living shorelines should be developed. In addition, there are related concerns about erosion control and ecological/fishery production.

It was also discussed, under coastal hazards, the need for pre-emptive action for disaster response. After disasters, roads and such infrastructure is often the priority, but building resilience into planning before disasters is imperative. Resilience studies and models looking at vulnerabilities in coastal communities and increased communication with specific stakeholders and the general public can help local entities better plan for coastal hazards.

In the public access discussion it was mentioned that ADA compliance issues should be emphasized. There is a lack of local enforcement of many coastal and disaster planning programs. The state could assist these local entities to increase their enforcement capability. This could be through education and outreach or other methods.
The idea of a wiki that would complement the public access inventory was discussed at length. This could allow continual updating by citizens – what is functional, well-maintained, star rating system, etc. It might also serve to incentivize maintenance as a potential source of community tourism dollars. Disaster Recovery (DR) has a wiki in place that they have found useful to answer the public's questions and provide technical guidance and videos for submitting the appropriate forms. Galveston Bay has an app that allows people to give feedback that might be a useful concept to incorporate. There was also mention that communities successful in getting grants and other funding might partner with less functional communities. The wiki could facilitate this; it could be a way for communities to share experiences and help each other. In the written comments, it was noted that DR developed a wiki website to organize and present information, and this website may serve as a stepping stone for developing a coastal wiki.

Another related issue concerns identification and prioritization of critical access points to ensure they are functional before and after a storm or disturbance. Perhaps supplemental funding opportunities to reestablish access points more quickly after disasters are a possibility.

It was identified under the cumulative and secondary impacts discussion, that the freshwater inflows stressor may be difficult to address when decisions are made upstream by river authorities, not necessarily by coastal communities that are affected. What can be done to help coastal communities advocate for adequate freshwater inflows to the coast? It was recommended that freshwater inflows be listed as an emerging issue in this section replacing erosion response plans, as erosion response plans are already in place, though they require frequent updates. It was noted that most erosion response plans are on track; although, some plans still need more attention.

In written comments, it was noted that coordination with local officials and stakeholders is key to reducing negative cumulative impacts, especially in addressing development. One particular concern mentioned in written comments concerned vulnerability assessment for population and infrastructure in smaller coastal communities, where wastewater infrastructure has the potential to negatively impact water quality.

The Texas Coastal and Ocean Observations Network (TCOON) offers opportunities to address oil spill response and harmful algal blooms (HABs) detection. One need is high frequency radar (HFR) capabilities, which offer faster observations and responses. This is happening in two stations on the upper coast, but more funding is needed. If the Coast Guard or Homeland Security saw benefits of adding HFR to the coast, then funding might be possible. Addition of water quality monitoring equipment would also be helpful for the HABs detection and tracking.
In the ocean resources discussion, stakeholders agreed that it is important to add identification and valuation of ecosystem services (ES) in decisions about natural resources. Currently, there are methods to value ES but no

models widely accepted that can be applied since ES valuation is site and context specific. The state of Texas, like the federal government, is anxious to employ feasible ES data and models and ES valuations into their coastal programs.

A final written suggestion was to have GLO coordinate communication among all coastal programs: all aspects of Coastal Resources from CMP, CIAP, CEPRA, Consistency, and Disaster Recovery.

Final Draft Review

The final draft document was made available for public comment on the GLO website on June 25, 2015. This was followed by a notice on July 7, 2015 to the Coastal Coordination Advisory Committee members, networked resource agencies and 23 coastal partners asking for review and comment.

On July 10, the final draft document was made available for public comment in the Texas Register, fully accessible online. The comment period was closed on July 28, 2015.

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Appendices

Appendix A: Coastal Wetlands Status and Trends

ndix A. Coastal Wetland Status and Trends

			Coastal Wetlands Status and Trends					
			Net change in total wetlands (square miles gained or lost)		Net change in freshwater (palustrine) wetlands (square miles gained or lost)*		Net change in saltwater (estuari wetlands (square miles gained or lo	
l County	Area of County (sq. mi)	Wetland Area 2010 (sq. mi)	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-20
on	949.70	173.51	-10.21	-10.7	-2.07	-1.68	-0.52	
y	604.60	89.78	1.76	0.37	-0.8	-0.25	-0.42	
y	1,432.40	250.24	-2.2	0.15	-2.25	-0.89	0.58	
g	881.90	101.07	-2.03	-0.09	-1.54	-0.5	0.29	
s	844.10	44.99	-2.03	-0.68	-0.7	-0.61	0.33	
tricio	704.80	70.76	-0.74	-1.4	-0.086	-0.94	-0.47	
o	777.00	87.10	0.35	0.3	-0.03	-0.14	-0.03	
as	263.70	76.29	0.55	0.73	-0.35	0.32	0.91	
un	544.80	96.43	1.86	0.96	0.25	-0.99	-0.44	
a	888.10	78.06	-0.96	-0.63	-2.16	-0.79	0.21	
n	851.30	54.48	-0.15	-0.09	-0.15	-0.12	-0.01	
orda	1,140.30	177.43	0.73	0.25	0.07	-0.42	0.26	
ia	1,441.10	445.44	-1.22	0.11	-5.12	-3.82	0.14	
ton	413.60	67.33	-1.44	1.74	-5.45	-2.54	3.8	
	1,777.30	141.83	-19.86	-9.63	-20.34	-9.92	0.11	
bers	630.70	159.63	-1.1	-0.32	-4.66	-3.88	0.52	
on	987.80	314.42	-13.8	-5.9	-12.01	-5.62	-1.77	
e	379.60	152.11	-7.78	-4.14	-7.47	-4.17	-0.32	
sq. mi)	**15,512.80**	**2,580.91**	**-58.27**	**-28.97**	**-64.87**	**-36.96**	**3.17**	
Acres	9,928,192.00							

<<<Percent change compared to wetland area in 1996

	Percent net change in total wetlands (% gained or lost)		Percent net change in freshwater (palustrine) wetlands (% gained or lost)		Percent net change in saltwater (est wetlands (% gained or lost)	
	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-20
	-2.21	-1.11	-2.45	-1.41	0.12	

um of palustrine forested, scrub/shrub and emergent wetlands

sum of estuarine forested, scrub/shrub and emergent wetlands

y wetland status and trends data was obtained from the NOAA C-CAP Land Cover and Landcover Change reports available at http://www.csc.noaa.gov/ccapatlas/

Appendix B: Coastal Wetland Change

ppendix B. Coastal Wetland Change

			How Are Wetlands Changing?							
			Area of land transformed to development		Area of land transformed to agriculture		Area of land transformed to barren Land		Area of land transformed water	
oastal County	Area of County (sq. mi)	Wetland Area 2010 (sq. mi)	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 20
ameron	949.70	173.51	-0.99	-0.55	0	0.01	0.77	0.3	-11.2	
'illacy	604.60	89.78	-0.01	-0.1	-0.17	0.01	0.1	0.1	1.15	
enedy	1,432.40	250.24	-0.02	-0.03	-0.4	-0.4	-1.13	-2.05	-1.17	
eberg	881.90	101.07	-0.3	0	-0.16	-0.07	0.32	-0.25	-0.5	
ueces	844.10	44.99	-0.35	-0.19	-0.23	-0.06	-0.9	-0.46	-0.6	
an Patricio	704.80	70.76	-0.1	-0.07	-0.06	0.02	-0.24	-0.27	-0.39	
efugio	777.00	87.10	-0.01	0	-0.3	0	-0.2	-0.04	0.27	
ransas	263.70	76.29	-0.17	-0.01	0.11	-0.01	0.22	0.06	0.21	
alhoun	544.80	96.43	-0.23	-0.21	-0.27	-0.02	-0.32	-0.1	1.55	
ictoria	888.10	78.06	-0.03	-0.01	0.06	0	-0.17	-0.17	-0.56	
ckson	851.30	54.48	-0.3	-0.03	-0.3	0	0	0	-0.014	
latagorda	1,140.30	177.43	-0.09	-0.03	0.21	0.03	-1.2	-0.04	1.7	
razoria	1,441.10	445.44	-3.18	-0.55	-0.36	0	-1	-0.07	3.5	
alveston	413.60	67.33	-5.08	-1.81	-0.17	0	-0.87	-0.05	4.5	
arris	1,777.30	141.83	-18.25	-6.82	-0.64	0	-1.3	-0.4	-1.2	
hambers	630.70	159.63	-1.79	-0.52	-2.6	0	-0.42	-0.18	3.2	
fferson	987.80	314.42	-3.89	-2.14	-0.9	-0.03	-0.158	-1.08	-3.58	
range	379.60	152.11	-1.8	-1.12	0.51	0	-0.39	-0.15	-0.43	
otal (sq. mi)	15,512.80	2,580.91	-36.59	-14.19	-5.67	-0.52	-6.89	-4.85	-3.56	
otal Acres	9,928,192.00									

*sum of palustrine forested, scrub/shrub and emergent wetlands

**sum of estuarine forested, scrub/shrub and emergent wetlands

Area of wetland transformed to Development (sq mi)		Area of wetland transformed to agriculture (sq mi)		Area of wetland transformed to barren land (sq mi)		Area of wetland transfor open water (sq mi	
from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 2006-2010	from 1996-2010	from 20
-36.59	-14.19	-5.67	-0.52	-6.89	-4.85	-3.56	

ounty wetland status and trends data was obtained from the NOAA C-CAP Land Cover and Landcover Change reports available at http://www.csc.noaa.gov/ccapatlas/

Appendix C: Paid Flood Insurance Claims in Texas

Statistics

In general, our statistical analysis shows us a spatial pattern of paid flood insurance claims in Texas. We see that paid claims take place mostly in Texas urban areas and along the coast. A large difference between the different statistical measures is not detected. Although, the maximum statistic does show us the most different visual of paid flood insurance claims. Total, average and median do not show very large differences. However, it should be noted that there is a slight difference between average paid flood insurance claims and median paid claims. The difference is most likely due to extreme events in our data. Detailed results for statistics can be found in the provided geodatabase.

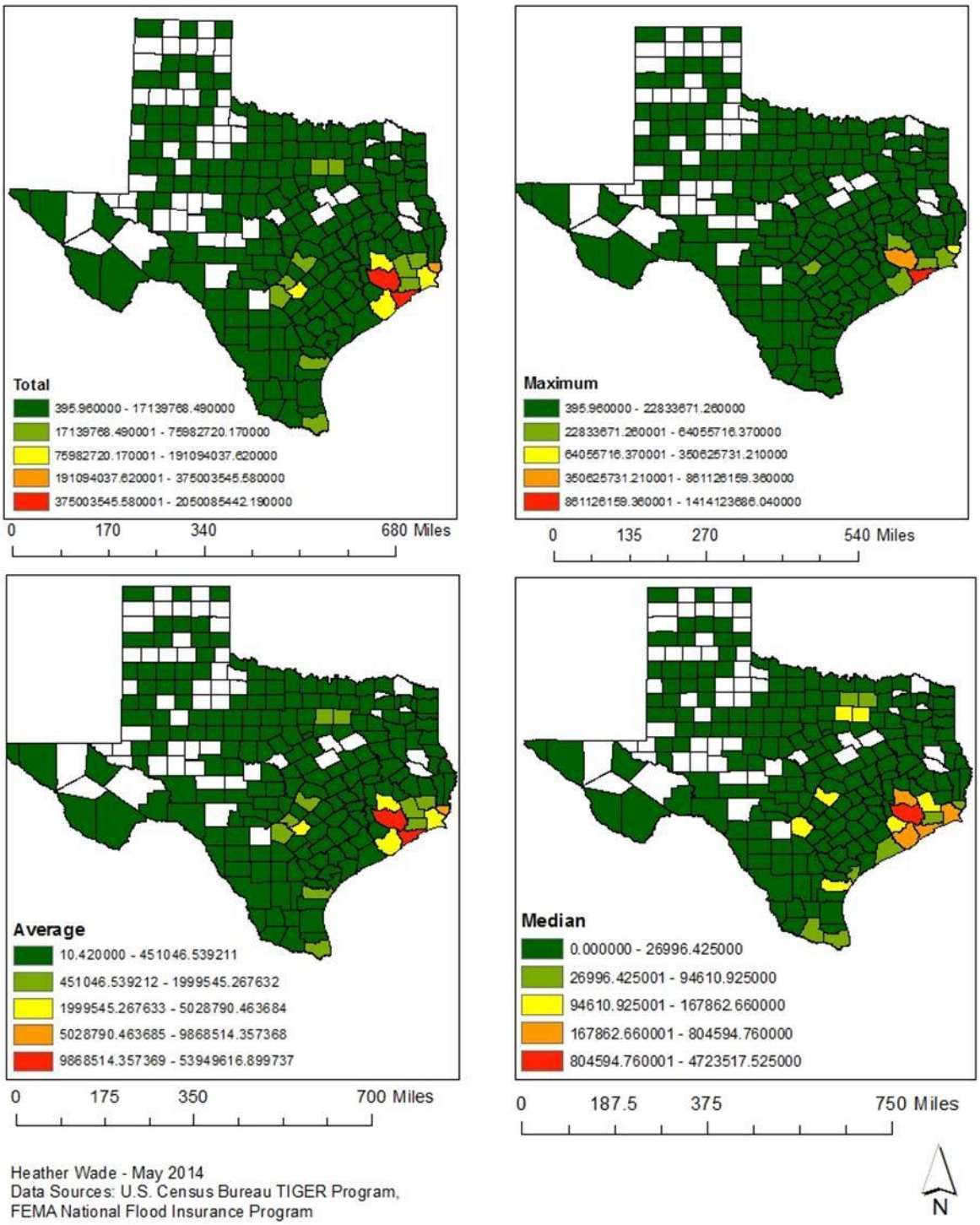
Cluster and Outlier Analysis

The cluster analysis indicates that there is a statistically significant cluster of high values in the Houston-Galveston region. More specifically, the high-value clustered region makes up six coastal counties. A positive value for I indicates that a feature has neighboring features with similarly high or low attribute values; this feature is part of a cluster. A negative value for I indicates that a feature has neighboring features with dissimilar values; this feature is an outlier. In either instance, the p-value for the feature must be small enough for the cluster or outlier to be considered statistically significant. Detailed results for the values calculated can be found in the provided geodatabase.

Hotspot Analysis

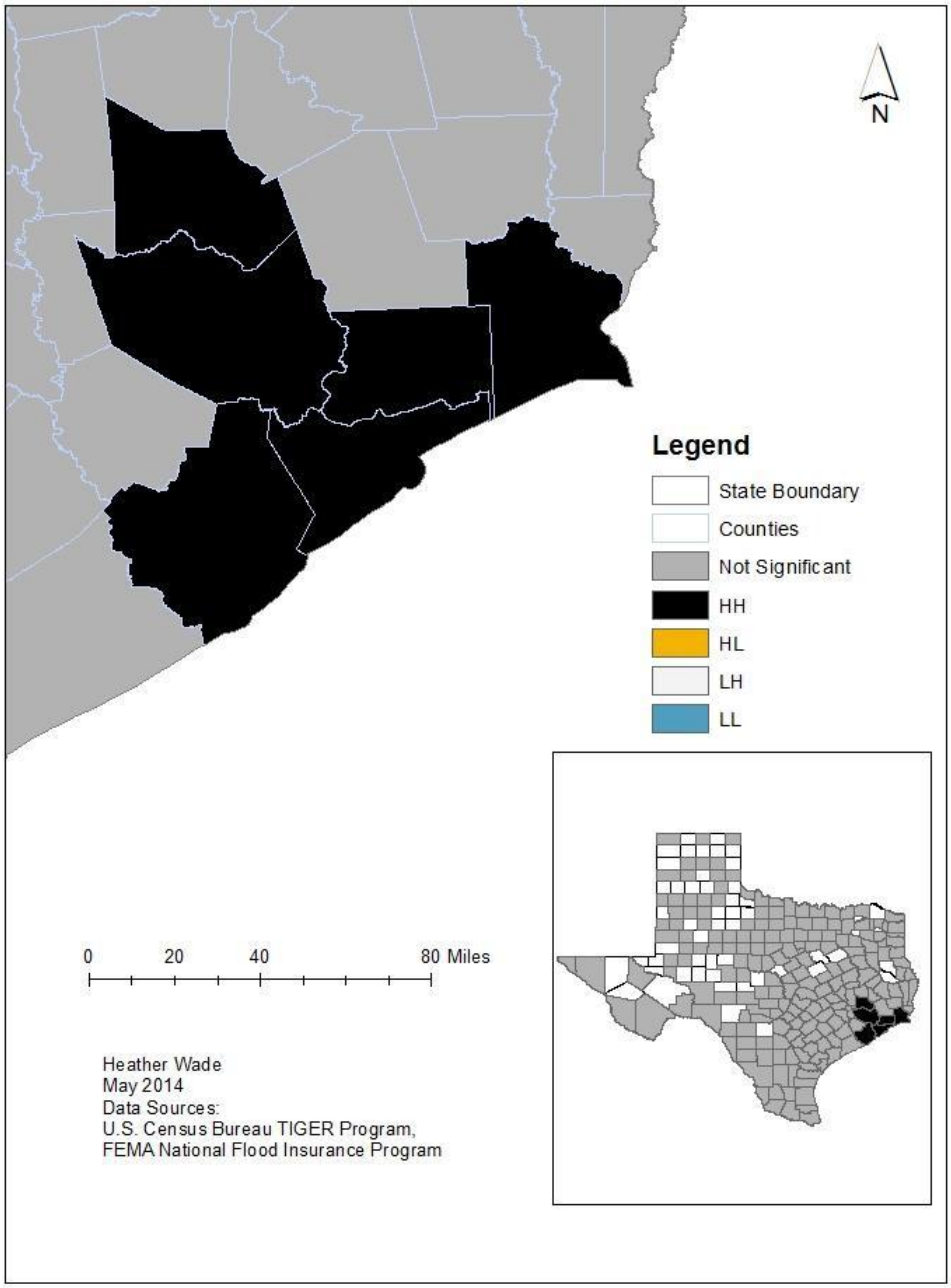
The hotspot analysis indicates that there is a hotspot cluster in the Houston-Galveston region, as well. This region in the hot spot analysis comprises of 17 counties. The hotspot analysis also identifies spatial clusters of high and low values, similar to the Cluster/Outlier analysis. The hotspot analysis does not identify spatial outliers. Detailed results for the hotspot analysis can be found in provided geodatabase.

Statistical Analysis of Paid Flood Insurance Claims in Texas

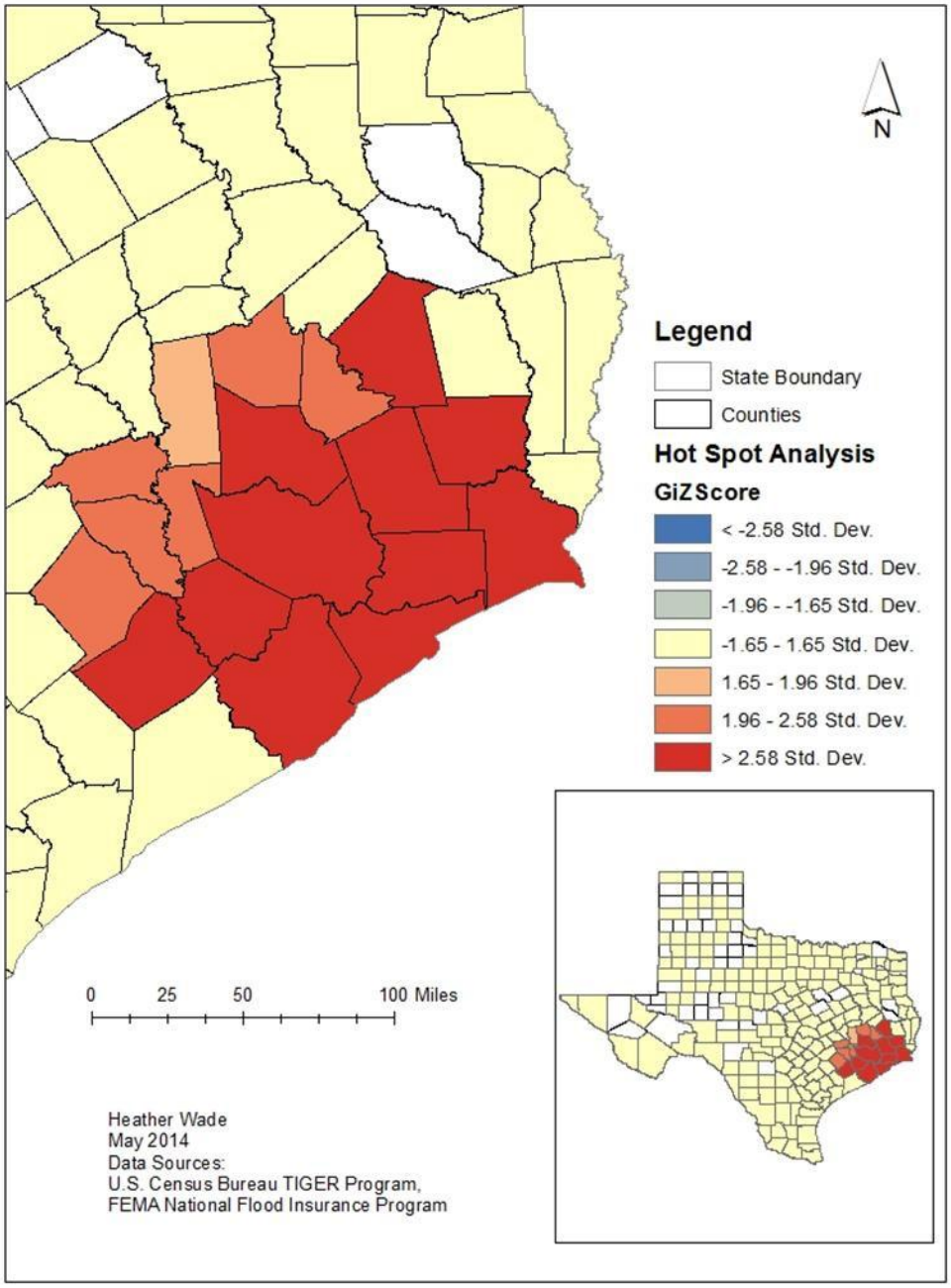


Heather Wade - May 2014
Data Sources: U.S. Census Bureau TIGER Program,
FEMA National Flood Insurance Program

Cluster and Outlier Analysis of Paid Flood Insurance Claims in Texas



Hot Spot Analysis of Paid Flood Insurance Claims in Texas



Appendix D: Development Status and Trends

Development Status and Trends for Coastal Counties						
	% Land Area Developed			% Impervious Surface		
Counties	2006	2010	% Net Change	2006	2010	% Net Change
Orange	14.05	14.81	5.35	4.47	4.79	7.19
Jefferson	13.09	13.4	2.37	5.08	5.22	2.91
Chambers	4.66	4.89	4.82	1.52	1.61	5.84
Galveston	14.91	15.59	4.53	5.19	5.45	5.07
Harris	53.23	56.18	5.54	24.68	25.84	4.68
Brazoria	7.99	8.36	4.73	2.61	2.75	5.32
Matagorda	1.57	1.6	1.61	0.44	0.45	1.69
Jackson	1.25	1.32	5.37	0.34	0.35	4.1
Victoria	4.01	4.1	2.27	1.3	1.34	2.41
Calhoun	1.88	1.95	3.99	0.61	0.64	4.19
Refugio	1.08	1.09	1.39	0.28	0.29	1.41
Aransas	2.9	2.95	1.58	0.95	0.98	3.09
San Patricio	4.75	5	5.31	1.7	1.83	7.8
Nueces	9.68	10.22	5.57	4.12	4.39	6.62
Kleberg	1.78	1.81	1.83	0.56	0.57	2.44
Kenedy	0.38	0.37	-3.5	0.11	0.1	-3.5
Willacy	1.62	1.64	1.42	0.52	0.54	3.1
Cameron	10.49	10.8	2.98	3.98	4.18	5.13

Areas Lost to Development Between 2006-2010 (sq. miles)								
Counties	Barren Land	Emergent Wetland	Woody Wetland	Open Water	Agriculture	Scrub/ Shrub	Grassland	Forested
Orange	0.05	0.21	0.9	0.04	0.58	0.22	0.33	0.74
Jefferson	0.07	0.95	1.18	0.09	1.04	0.08	0.24	0.19
Chambers	0.06	0.11	0.38	0.04	0.88	0.13	0.18	0.22
Galveston	0.2	0.82	0.96	0.04	2.02	0.53	0.6	0.87
Harris	6.5	1.09	5.67	0.35	13.85	3.58	5.69	16.77
Brazoria	0.12	0.17	0.67	0.03	3.3	0.52	0.57	0.78
Matagorda	0	0.01	0.02	0	0.23	0.04	0.08	0.05
Jackson	0	0	0.03	0	0.3	0.15	0.07	0.03
Victoria	0.02	0	0.01	0	0.47	0.17	0.08	0.08
Calhoun	0.01	0.2	0.01	0.01	0.09	0.05	0.38	0.04
Refugio	0.03	0	0	0	0.04	0.04	0.01	0.01
Aransas	0.01	0.01	0.01	0	0	0.03	0.11	0.16
San Patricio	0.11	0.01	0.01	0.01	0.93	0.42	0.38	0.09
Nueces	0.72	0.06	0.03	0	3.6	0.84	1.21	0.17
Kleberg	0.03	0	0	0	0.29	0.07	0.06	0.01
Kenedy	0.01	0.01	0	0	0.01	0.02	0.1	0
Willacy	0.02	0	0	0	0	0.03	0.05	0
Cameron	0.37	0.15	0.34	0.03	1.74	0.65	1.1	0.09
Total	8.33	3.8	10.22	0.64	29.37	7.57	11.24	20.3

Reference: http://www.csc.noaa.gov/ccapatlas/#

Appendix E: Critical facilities in the FEMA floodplain

Critical facilities in the FEMA Floodplain										
s in ain	Total schools	Schools in flood plain	Total police stations	Police stations in the flood plain	Total fire stations	Fire stations floodplain	Total emergency centers	Emergency centers in the floodplain	To med facil
17	156	10	18	1	9	0	1	0	
6	12	2	4	3	2	1	1	1	
1	1	0	1	1	0	0	0	0	
5	24	5	2	0	3	0	0	0	
19	145	15	8	3	8	3	1	0	
4	37	2	7	0	8	0	1	0	
2	7	2	4	0	3	0	0	0	
0	8	0	3	0	3	0	0	0	
1	12	0	4	0	9	2	0	0	
7	39	3	3	0	9	0	0	0	
0	9	0	4	0	4	0	0	0	
4	25	3	4	0	7	0	0	0	
14	99	11	19	1	22	15	1	0	
35	111	25	17	6	14	5	3	0	
193	1326	162	96	16	53	9	7	0	
1	12	0	3	1	8	3	0	0	
5	99	3	14	0	9	0	0	0	
12	30	6	14	5	10	2	0	0	
326	**2152**	**249**	**225**	**37**	**181**	**40**	**15**	**1**	

Appendix F: Land conversion in the coastal floodplain

Development in the Coastal Floodplain				
ount of land converted to development 2001-2006 (acres)			Type of land conver	
side FEMA floodplain	Outside FEMA floodplain	% Development inside FEMA floodplain	Agriculural	Na
360	1,491	19%	579	
12	3	80.0%	0	
0	0	0.0%	0	
0	148	0.0%	38	
438	772	36.2%	403	
89	539	14.2%	160	
0	12	0.0%	7	
70	294	19.2%	5	
5	68	6.8%	48	
7	104	6.3%	72	
0	0	0.0%	0	
13	63	17.1%	38	
714	3,077	18.8%	2,130	
757	2,287	24.9%	878	
1,923	20,734	8.5%	5,914	
0	720	0.0%	171	
21	184	10.2%	42	
4	12	25.0%	0	
4,413	30,508	12.6%	10,485	

Appendix G: Synthesis Document

Integrative Coastal Management: Living and Working on the Texas Coast

The Texas coast abounds with tremendous natural, cultural, and social resources. These resources are part of a large social-ecological system being shaped and re-shaped by an array of social and ecological intersections, but this complex system is under increasing stress (Figure 30).

The diagram below is based on in-depth assessment of high priority Coastal Zone Management (CZM) enhancement areas: wetlands, coastal hazards, public access, cumulative and secondary effects, and ocean resources. Detailed information on each high priority enhancement area is found in Phase II In- Depth of the Coastal Zone Management Act §309 Program Guidance - 2016-2020 year Cycle. This conception of the complex Texas coastal system is science driven, and reflects the primary stressors and issues in the coastal zone at this time. Some of these stressors lead to rapid change (e.g. storms and floods) and some lead to gradual change (e.g. subsidence), but all impact the quality and resiliency of the Texas coast. It would be impossible to capture all of the system complexity in a two-dimensional diagram, but the intent is to show that all of these components are inter-related and connected in the diagram, reminding us that management approaches addressing one component may have far reaching effects. Integrative coastal management is the flexible tool we use today that shapes our future resources.

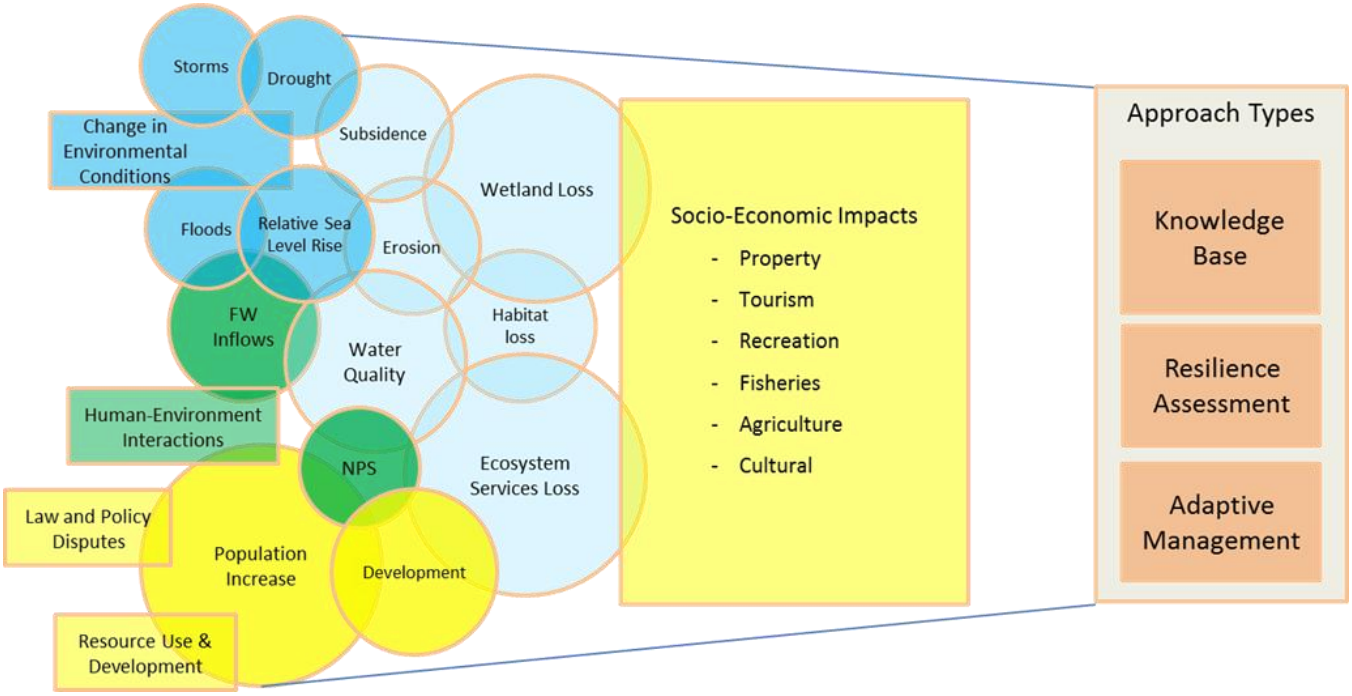


Figure 30. Circles (stressors) and rectangles (emerging issues) are identified drivers or impacts of concern for the five priority enhancement areas. Larger circles roughly correspond to components that were identified in more than one high priority enhancement area. Darker shapes reflect primary stressors while lighter shapes are secondary or indirect components. Yellow shapes indicate human derived components. Blue shapes indicate environmentally derived components. Green shapes indicate components that are both human and environmentally determined. Socio-Economic Impacts are listed in the large yellow box. Types of approaches that address this complex coastal system are shown in the orange boxes on the far right. These approaches provide the structure for addressing priority needs in an efficient manner.

Table 10. **Description of Figure 30 Components:**

Primary Environmental	Definition
Storms	Storms are one of the major coastal hazards impacting highly developed areas along the coast and affecting critical coastal habitats.
Drought	Drought is one of the major causes of change to wetlands distribution.
Floods	Flooding is one of the major coastal hazards; from 1976-2013, the State of Texas had over $5 billion in paid flood insurance claims.
Relative Sea Level Rise (RSLR)	RSLR combined with erosion and subsidence is one of the major causes of wetland loss in Texas. It threatens homes, infrastructure, and public access; it increases flooding occurrences and it has the potential to change boundaries of public easements and right-of-ways.
Change in Environmental Conditions	Change in environmental conditions such as storms, floods, RSLR, and drought change hazard exposure. Changes in environmental conditions include intensity, duration, and frequency of hazard exposure.
Primary Human-related	Definition
Population Increase	Population increase leads to higher water use, reduced freshwater inflows to the coast, energy development, non-point source pollution, and higher demand and use of public access resources. These factors impact the quality of coastal habitats (including wetlands) and the provision of coastal ecosystem services, critical to coastal communities' livelihoods. Growing populations drive development.
Development	Development (including land use/land cover change and increasing coastal population, housing units and infrastructure) affects water quality, wetland/habitat loss, hydrology, habitat fragmentation and spread of invasive species. It also leads to increased impervious surface and flooding potential; and drives higher demand and use for public access for recreation and other water-dependent uses.
Primary Human/Environment	Description
Freshwater (FW) Inflows	Reduced FW inflows to the coast, as a consequence of increasing population and upstream water use, is a serious threat to coastal habitats, water quality, wetlands (as they dry and become more vulnerable to invasive species), and estuarine water and salinity levels. FW inflows may affect recreational opportunities.
Non-point Source Pollution (NPS)	NPS directly affects water quality and puts at risk the provision of ecosystem services such as water purification, fisheries, aesthetics, provision of habitat, and recreation opportunities. NPS can have serious impacts on tourism and commercial and recreational fishing.

Socio-Economic	Description
Property loss/damage	Loss and damage to private and commercial property (as well as decrease in property value) given the loss or degradation of ecosystem services and wetlands.
Tourism	Decrease/loss of tourism revenue due to degraded environmental conditions and aesthetics.
Recreation	Decrease/loss of recreation revenue/expenditures associated with degraded environmental conditions (e.g. site closure and visitation decrease).
Fisheries	Impact to commercial fishing revenue and catch as total catch and quality of catch.
Agriculture	Impacts to agricultural production.
Cultural	Impact to cultural and aesthetic aspects of coastal communities such as a decrease in biodiversity and reduced access to coastal habitats.

Secondary Environmental	Description
Wetland Loss	Wetlands provide an important suite of ecosystem services and benefits to society. Important ecosystem services provided by wetlands include habitat, water purification (nutrient and waste regulation), flood and storm protection (disturbance regulation), erosion control, and recreation. Socio-economic impacts of wetland loss are likely to lead to a decrease in coastal and ecosystem resilience.
Ecosystem Services Loss	All anthropogenic and natural drivers pose a serious threat to ecosystem services. Important coastal ecosystem services at risk include: • Water purification (e.g. nutrient and waste regulation affected by NPS pollution, FW inflows, and development) • Flood and storm protection (disturbance regulation) • Erosion control (directly influence by RSLR and subsidence) • Food (commercial and subsistence fishing) • Water supply • Recreation and aesthetics (affected by NPS pollution and development) • Aesthetic and historic access (such as a decrease in iconic species due to degraded habitat) and science and education • Raw materials (such as fuel and energy) • Biodiversity/Biological regulation (species interaction), which is critical for ecosystem resilience and control of pests and diseases
Water Quality	Water quality is both a consequence and a driver of change and can be affected by NPS, development, decreased FW inflows, and population increase. Poor water quality leads to wetland and ecosystem services loss, with economic impacts on tourism, recreation activities, and fishing.
Subsidence	Subsidence directly impacts wetlands through submersion and historically was a major cause of wetland loss in the upper Texas coast. Subsidence compounds the effect of RSLR and increases the risk of flooding. For public access, subsidence translates to a loss of sites and change in boundaries.
Erosion	In Texas, erosion, combined with RSLR, is one of the major causes of wetland loss. Erosion threatens public infrastructure, homes, private property, and public access sites. High density areas close to the shoreline become more vulnerable to the impacts of flooding, storms, and RSLR. Erosion is mitigated by healthy wetlands, oyster reefs, and seagrass.
Habitat Loss	Habitat loss can have significant impacts on coastal and marine species populations. Decrease in river discharges, alteration of water flows, damage from commercial and recreational use, non-point source pollution, invasive species, and climate change are some of the causes for habitat loss.
Secondary Human-related	Description
Law and Policy Disputes	Law and policy disputes can be both a consequence and driver of change. Disputes may arise over increased development and population, water allocation and water rights, FW inflows, and loss of property and beach access caused by erosion, catastrophic events, and RSLR.
Resource Use & Development	Resource use and development includes both offshore and onshore energy development. Offshore development is likely to increase given the offshore oil lease sales from 2012-2014 and two more scheduled in 2017. Onshore natural gas and wind energy development including mining, processing, and transportation of various forms of energy products impact coastal and ocean resources.
Secondary Human/Environment	Description
Human-Environment Interactions	These are stressors that have natural and anthropogenic aspects. Their significance as a stressor is that they affect human livelihood and recreation. HABs are a toxic factor for oceanic and estuarine resources along the Texas coast and are likely to intensify with warming temperature, ocean acidification, and increasing populations. Recent sargassum blooms negatively impact tourism on the Texas coast.

Integrative Coastal Management: a Framework

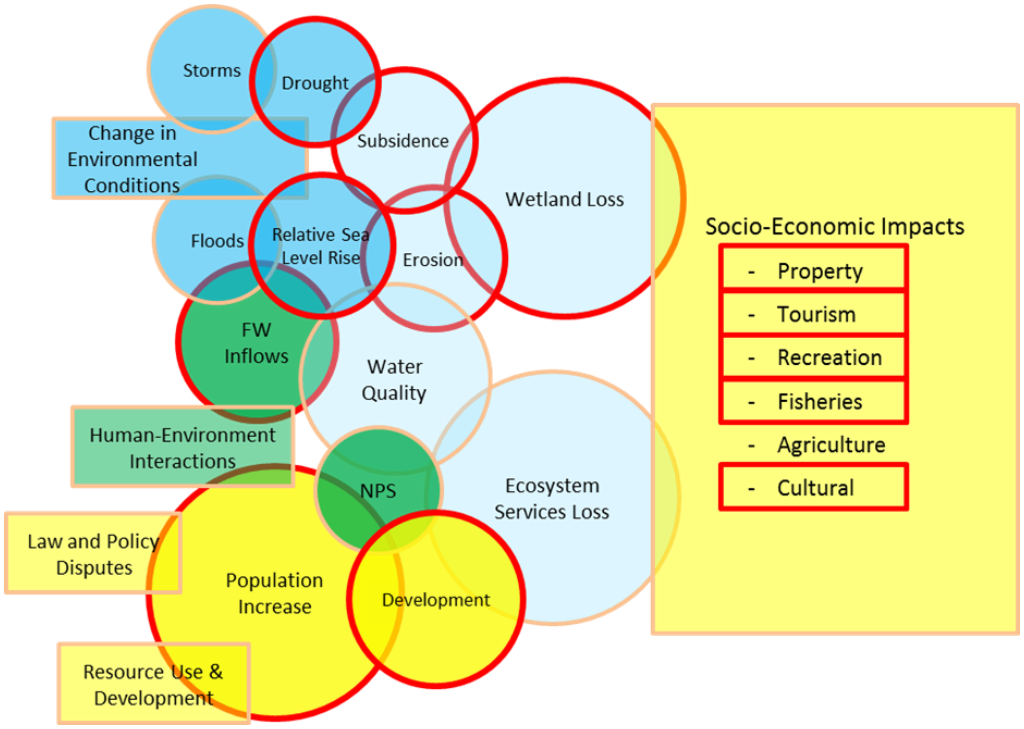
Integrative coastal management is a lasting and flexible framework for understanding the changing social-ecological system; an informed and documented assessment of resilience factors; and adaptive management practices that foster ecosystem based approaches, comprehensive planning and public engagement to facilitate acceptance. Approaches must be flexible and adaptable to new information and circumstances, with knowledge strategies that recognize the need to address research gaps, data management, monitoring, mapping and modeling. Integrating a knowledge approach with resilience assessment and adaptive management is not a departure from tools such coastal and marine spatial planning (CMSP), but a framework that continues the CMSP focus on assisting state and local resource management to support economic growth and smart development. With coastal growth, natural resource use and vulnerability are increasing along the coastal zone. It is important to continue the development of knowledge based tools and policies for smart growth that promote resilient coastal communities.

Types of Approaches to address management priorities:

Knowledge base - These approaches include activities which improve policies and management programs by providing supporting data, information, or models of environmental, ecological, social, or economic coastal resources. These address current conditions, historical trends, relationships and projections. A sound knowledge base decreases risk in management decisions. Resilience assessment – These approaches include activities which use data and information products to produce assessment of relative vulnerabilities, or prioritization and identification of needs related to natural resource areas, ecological systems, coastal communities, or coastal programs.

Adaptive Management – Adaptive management is a process that promotes flexibility in decision making that can be adjusted in the face of uncertainties as outcomes from management actions and constantly evolving complex coastal systems. It recognizes that diverse voices are important in iterative and inclusive approaches to management. This innovative management approach addresses challenges of human activities on coastal ecosystems and their ability to provide important benefits to society, such as healthy and abundant seafood, clean beaches, and protection from storms and flooding.

ENHANCEMENT AREA: WETLANDS



Stressors and Threats

Commercial and Residential Development

Increasing population is a top stressor for wetlands because of the associated increased development, water use, and energy development in coastal counties. Expanding development may directly impact wetlands through habitat loss and indirectly through changes in hydrology, habitat fragmentation and spread of invasive species. Increased water use may limit freshwater availability, which is important for the survival of freshwater and estuarine wetlands. Wetlands which dry out are more vulnerable to invasive species encroachment. In addition, low water inflow to estuaries may impact estuarine water levels and salinities.

Relative Sea Level Rise and Erosion

The combined effects of erosion and RSLR are, historically, one of the major causes of wetland loss in Texas. Subsidence, which is part of the RSLR rate observed in many of Texas' coastal regions, contributes to the direct impacts to wetlands through submersion. Erosion may also be caused by several factors including wave activity and currents, RSLR, amount of sediment available, and other natural or human activity which impacts shoreline processes.

Drought

The occurrence of drought has historically affected the distribution of wetlands causing vegetation to dry out and reducing estuarine water levels.

Emerging Issues

Freshwater Inflow

The full extent of potential and long-term impacts of decreased and available freshwater inflow to estuaries is not fully understood. Studies which improve the knowledge of hydrology, ecosystem health and future vulnerability are recommended.

Restoration and Mitigation

Increasing restoration and ongoing habitat mitigation efforts can be enhanced through improved data and information resources.

Resource Use and Development

More information and research is needed on impacts related to the production, processing, and transportation of various forms of energy products. Additional research and monitoring would be useful in assessing these impacts.

Priority Needs and Information Gaps

- Research on wetland processes such as sedimentation, ecology, ecosystem services, and hydrodynamic processes.
- Mapping and GIS: Maintain and update bathymetry and topography data where possible.
- Restoration and mitigation project tracking and data management
- Training professionals in living shorelines.
- Staff training on mitigation and restoration tracking and evaluation.
- Comprehensive management – consolidate multiple plans; increase policy acceptance through greater stakeholder involvement.
- Education and outreach of wetland functions and ecosystem services. Also public awareness of living shoreline concepts.

Management Priorities

Continued and enhanced monitoring of wetlands including status, ecological function, and ecosystem services.

Continued wetland mapping and monitoring is essential for assessment of wetland trends, health, and needs and also for bay shoreline change analysis. Expanded knowledge of wetland ecosystem services can improve upon wetland mitigation and restoration. There are many types of knowledge-based activities which can benefit wetland protection and management. Some examples include but are not limited to:

- Wetland and bay shorelines change mapping
- Hydrological modeling (current/wave)
- Enhance management process for conservation and restoration

Develop a vulnerability assessment of wetland habitat which incorporates projected environmental and anthropogenic changes.

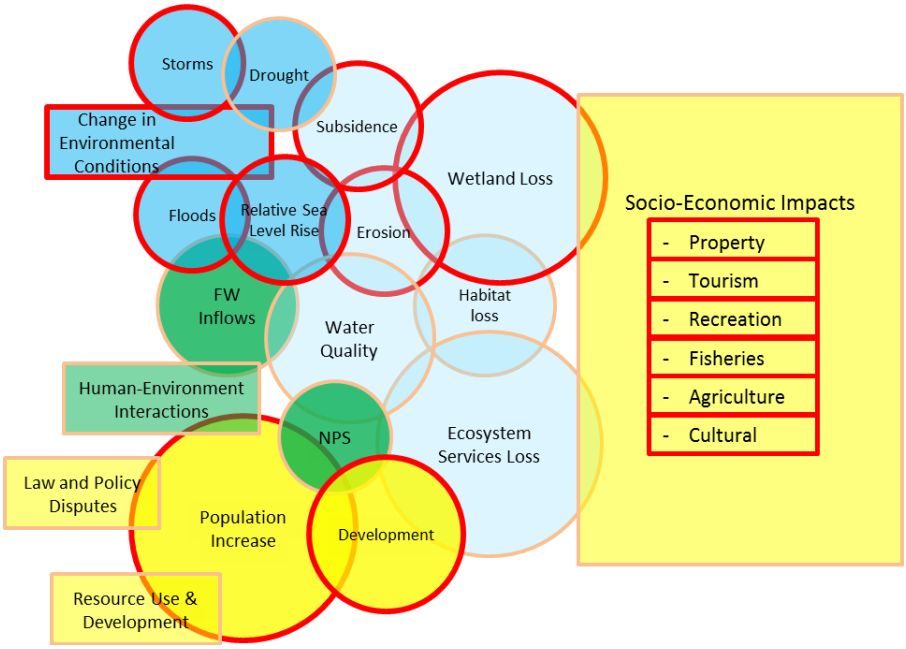
Develop a Habitat Vulnerability Assessment for Wetlands. Vulnerability assessments bridge the gap between knowledge and management. Climate change vulnerability assessments of natural systems identify which species or systems are likely to be most affected by projected change and help us understand why these resources are likely to be vulnerable. Through this process, stakeholder identified environmental priorities may be assessed using available data and models to arrive at various management approaches. The state may take advantage of current data available and engage stakeholders to achieve management and conservation priority maps and to identify areas of high risk by stressors and change. These models are flexible and can be adjusted to meet the needs of a management program.

Expand land-use planning and conservation to increase wetland resilience through wetland policies, restoration, and outreach.

Resilient coastal solutions can be employed to address wetland and shoreline erosion. Potential activities that increase coastal resilience include: restoration and mitigation (including employment of living shorelines), public outreach, workshops with state and local decision-makers, working with communities to increase economic incentives of wetland conservation, development of additional guidance documents and tools, and policy changes aimed at improving critical wetland protection.

- Incorporate relative sea level rise into planning decisions
- Programs to enhance wetland conservation and restoration
- Wetland restoration BMPs
- Methods to enhance mitigation tracking

ENHANCEMENT AREA: COASTAL HAZARDS



Stressors

Coastal Storms

Constituting 60 percent of the Coastal Counties FEMA Disaster Declarations from 1953-2014, coastal storms are some of the most destructive hazards in the Texas coastal zone. Coastal Storms present a major threat to people and property living near the coast, and many of the impacts to communities, the natural environment, and the economy are long lasting.

Flooding/Storm Surge

Flooding is the most frequent and costliest hazard for the state of Texas. Most Texas coastal counties have experienced over 16 floods from 1960-2012, and counties like Harris, Galveston, and Chambers experienced over 74 floods for the same time period. Coastal flooding impacts may be exacerbated by increased development in the floodplain and ongoing processes such as subsidence, relative sea level rise, and erosion.

Erosion and Relative Sea Level Rise

Shoreline erosion (long-term and episodic) and relative sea level rise are considered significant hazards to Texas coast. Erosion is attributed to natural processes like wave and current removal of unconsolidated sediment as well as sea level rise and subsidence. Approximately 64 percent of the Gulf shoreline is considered critically eroding, losing an area of 235 acres of shoreline each year. Shoreline change analysis after Hurricane Ike (2008) revealed that many areas of the Texas upper coast experienced over 20 m of shoreline retreat, with a few areas such as the Sea Rim State Park experiencing retreat of 50-100 m. Erosion is a threat to public health and safety, public beach use and access, general recreation, traffic use, public property and infrastructure, private commercial and residential property, fish and wildlife habitat and culturally significant areas.

Emerging Issues

Ecosystem and Land Use Change

Change in environmental conditions such as storms, floods, RSLR, and drought change hazard exposure. Changes in environmental conditions include intensity, duration, and frequency of hazard exposure.

Change in Hazard Exposure

Areas not previously prone to flooding might have increased risk now or may face increased risk in the future due to environmental and anthropogenic coastal change. Erosion, relative sea level rise, wetland loss, increased impervious surfaces and coastal populations may lead to landscape and environmental changes which may increase or decrease hazard exposure. Further understanding can be achieved through a combination of scientific projection and models of potential scenarios.

Priority Needs and Information Gaps

- *Assessment of community resilience (social, economic, ecological and infrastructure) as well as community barriers in achieving resilience for Texas coastal communities.*
- *Mapping and GIS: Update subsidence mapping and monitoring, improve topographic and bathymetry models. Implementing and updating infrastructure maps in GIS format for communities which still rely on paper records.*
- *Coastal Hazard and Environmental database*
- *Green building/infrastructure for improved hydrology*
- *Community targeted decision-support tools*
- *Continue efforts to bring necessary data, tools, and professional assistance to local communities*
- *Leadership in coastal resilience – leverage existing efforts like Community Rating System.*

Management Priorities

Mapping and Modeling impacts of hazards on environment.

Support mapping and modeling efforts which help increase the understanding of the impacts and potential effects that flooding, coastal storms and climate change may have on the natural and built environment in areas where these may be missing, outdated or have low resolution. Strategies to improve upon knowledge based products include:

- GIS assistance to local communities
- Develop inventory of hazard assessment, data tools, and products.

Identify high-risk populations, evaluate exposure and vulnerabilities, and develop targeted programs for hazard preparedness and post-disaster recovery.

As part of social and economic resilience plans, it is important to identify the needs of high-risk populations in coastal areas. This effort should include research related to health, social, and economic

barriers on hazard mitigation and evacuation, community resources, and post-disaster recovery plans.

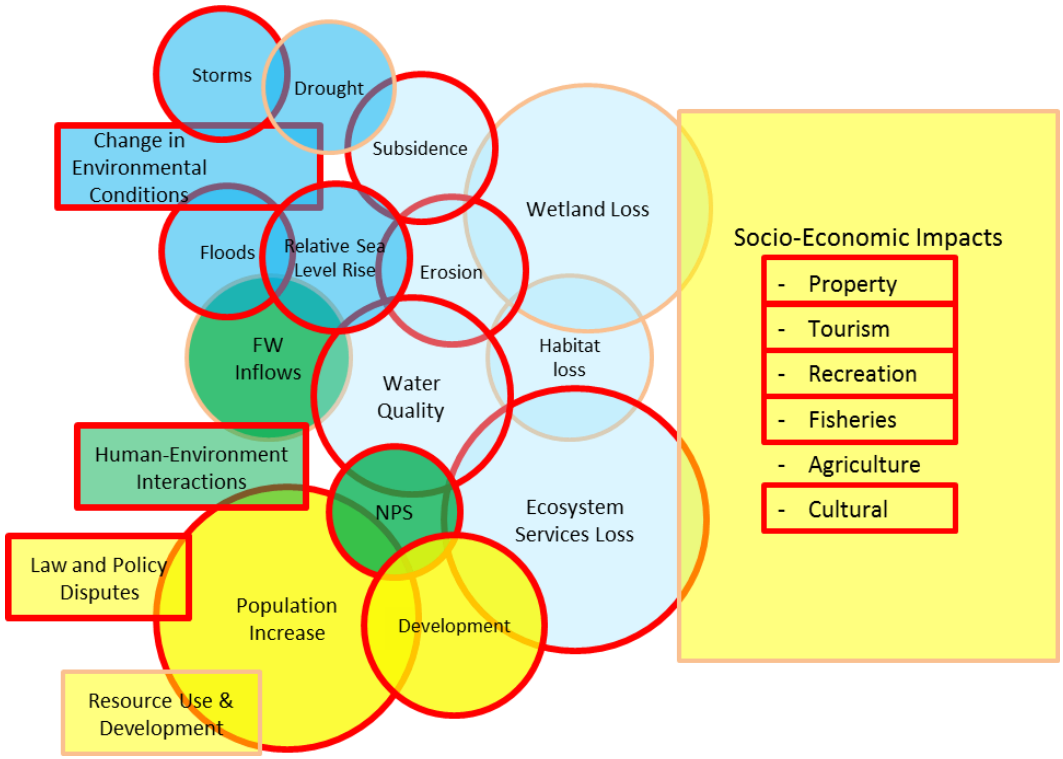
- Conduct assessment of community coastal hazard planning.
- Develop decision support tools for highly vulnerable communities.

Planning and Outreach.

Resilient coastal solutions can be employed to address coastal hazard mitigation. Potential strategies that increase coastal resilience include:

- Develop and promote best management practices for living shorelines. Support living shorelines for shoreline protection and hazard mitigation. The use of living shoreline, where appropriate, provides protective functions while also providing habitat and other ecosystem services functions.
- Provide hazard planning assistance and tools (i.e. Community Resilience Index) to local communities seeking to implement programs.
- Programs to enhance preservation of natural shorelines (i.e. conservation easements and land acquisition). These programs help limit construction in hazard prone areas.

ENHANCEMENT AREA: PUBLIC ACCESS



Major Public Access Stressors

Coastal Development

Development along the Texas coast is increasing, with acreage lost to grasslands, agriculture and wetlands, and increases in impervious surface area. All of these factors may encroach on public access sites, putting more pressure on their resources and taking away from their natural and intrinsic value. Development stresses water resources, and through increased use, requires more site maintenance and infrastructure.

Environmental Changes (Erosion, Relative Sea Level Rise, Flooding)

Changing environmental conditions and coastal hazards stress Public Access through mechanisms such as erosion, relative sea level rise, flooding, subsidence, and coastal storms.

Increasing Demand and Use

As the population along the coast increases, there will be increased pressure on our coastal resources, and specifically on public access to Texas coastal resources. This growth will continue to put increasing pressure on recreational uses such as fishing, wind surfing, wildlife viewing, and other sources of recreation that require access to coastal waters.

Emerging Issues

Law and Policy Issues

The application of the Severance opinion and the changes in statute and rules create uncertainty as interested parties work through the interpretation of law, evaluate the application of science, and reevaluate policies and procedures for delineating the rights of parties along the coast after a storm. There may continue to be challenges associated with the implementation of coastal projects as interested parties continue to debate the scope and extent of the Severance opinion.

Oil spills, Sargassum, and HABs

Changing environmental conditions include oil spills, Sargassum events, and red tide, to name a few. Oil spills can potentially shut down access to coastal waters, degrade water quality, and harm aquatic life. Sargassum events impact recreational opportunities for coastal communities and their visitors. Red tide can have many implications, including widespread fish kills and upper respiratory issues in humans.

Priority Needs and Information Gaps

- *Research on hazard impacts and ecosystem services loss*
- *Mapping/GIS; relating access to other resources and data information*
- *Implementation and evaluation of Public Access*
- *Increase capacity to communicate and provide outreach regarding public and private property rights, and how these are balanced by the CMP*

Management Priorities

Improving Public Access through Information Management

Develop and implement a public access information management program and method for keeping the public access inventory up to date. The program should emphasize the use of various sources of data to include: public easements, site data, and aerial imagery showing public use in digital format that overlay with a GIS database and other information resources. The publicly accessible inventory should be user friendly and updated on a regular schedule.

Public Access Assessments

Research objectives to be considered include coastal hazards and environmental change impacts on public access and human use.

- Determine impacts of hazards and environmental change impacts on public access
- Assess current and future demands Identify public access amenities

Comprehensive Public Access Planning and Public Engagement

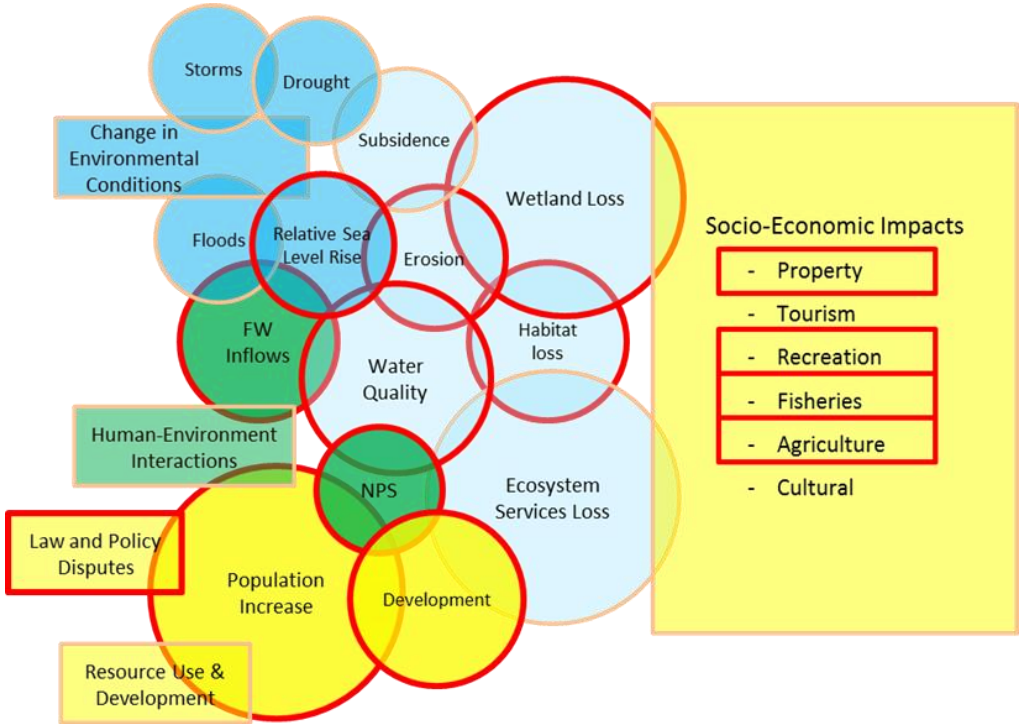
Comprehensive Public Access Plan (CPAP) will formalize the process for adequately planning and implementing a comprehensive and strategic public access program for the state of Texas. CPAP will ensure continuing restoration, maintenance, appropriate accessibility and improvements to public access sites; ensure that relevant data and research are used to make decisions regarding public access;

require public involvement in the process, and include a regular evaluation of the program. Communication and outreach on public access is essential to have fully functional and healthy sites. There is a need for updated guidance documents and educational materials to be produced as part of the state's education and outreach efforts.

Specific strategic actions to achieve these strategy objectives may include:

- Update or designate public access sites as areas of particular concern, areas for preservation or enhancement.
- Ensure that signage is provided for all public access sites.
- Ensure that all users of the coast, including handicapped individuals and all socio-economic classes, are afforded the same public access opportunities.
- Increase community support and cooperation through public education and involvement. Support local governments in revising local zoning ordinances to provide for additional public access.
- Develop a rights-of-way program to ensure established public rights-of-way are maintained and used as public access sites.
- Create a long-term funding mechanism to support public access creation, improvement, and maintenance projects.
- Develop or enhance programs to encourage landowners to dedicate property and easements for public access.

ENHANCEMENT AREA: CUMULATIVE AND SECONDARY IMPACTS



Major Cumulative and Secondary Impacts Stressors

Increasing Population, Demand and Use

The increase in population and housing development will impact vital natural resources. In addition to the potential threat to ecologically sensitive areas, growing population and associated housing units will expand the need for infrastructure and energy, with higher density of wind turbines and landfill space for waste. It has been determined that both land area and impervious surface area have increased over the four year time period, from 2006 – 2010, possibly from an increase in population and associated infrastructure.

Relative Sea Level Rise and Associated Changes in Land Cover Types

The Texas coastal zone lies in a floodplain susceptible to relative sea level rise in the future. Wetlands are a vital component of the Texas coastal region and will be negatively impacted by RSLR. In addition to an increase of over100,000 units in housing density from 2007-2012, the Texas coastal zone also faced an increase of almost 22,000 acres in high density, low density and developed open space between 2006 and 2010. This region suffered a loss in agriculture, forested area, and woody and emergent wetlands of over 100,000 acres during the same time period.

Freshwater Inflows

As population and infrastructure demands increase, pressures on water resources also increase. A decrease of freshwater inflows from rivers to bays and estuaries significantly affects salinity levels and water quality. This is important for the survivability and diversity of coastal habitats.

Emerging Issues

Water Quality: non-point source pollution; run-off; circulation

Water quality in some coastal areas has been degraded by pollution and run-off caused by rapid development and non-point source pollution. For example, urban runoff occurs because there is a lack of design and performance standards for new construction to reduce total suspended solids and mitigate the adverse impacts of storm water. Coastal water quality is also being degraded as a result of problems associated with On-Site Disposal Systems (OSDS) in smaller communities and rural areas and poor planning of transportation and other infrastructure. These issues are complicated by ocean circulation patterns along the shore in the Texas coastal zone.

Non-Jurisdictional Wetlands

Federal jurisdiction for wetland protection only covers those linked to navigable waters. The United States Environmental Protection Agency has recently proposed changes to the definition of wetlands that fall within federal jurisdiction. These new rules may impact coastal development and Texas must be ready to effectively respond to these changes.

Erosion Response Plans

Continual evaluation of erosion response plans to adapt to relative sea level rise.

Priority Needs and Information Gaps

- *Assessment, management planning tools (Population increase and associated infrastructure; relative sea level rise)*
- *Support innovative projects that address increasing needs to manage NPS for water quality including developing a watershed planning process (water quality: non-point source pollution, run-off, circulation)*
- *Develop regional sediment management plans to identify potential restoration sites in the vicinity of navigation projects to assist in monitoring of increased land area and impervious surface from development.*
- *Assessment and evaluation of mitigation banking and conservation easements to address wetlands loss.*

Management Priorities

Vulnerability assessment for population and infrastructure

The Texas CMP may establish criteria and procedures for the methods used in coastal management efforts. The program should coordinate with other state institutions performing forecasting work in order to use the best available science and methods for decision-making along the Texas coast.

- The program should consider using other existing vulnerability tools such as the Coastal Resilience Index and the Nature Conservancy's Coastal Resilience 2.0 to help further evaluate community and natural resource vulnerabilities and their associated resiliency to various stressors.
- Of particular importance should be concerns about environmental flows and wastewater management. Environmental flows significantly affect salinity levels and water quality, and are likely to be stressed by increased population and associated infrastructure. Environmental flows

are important for the survivability and diversity of coastal habitats.

Coordinate coastal planning

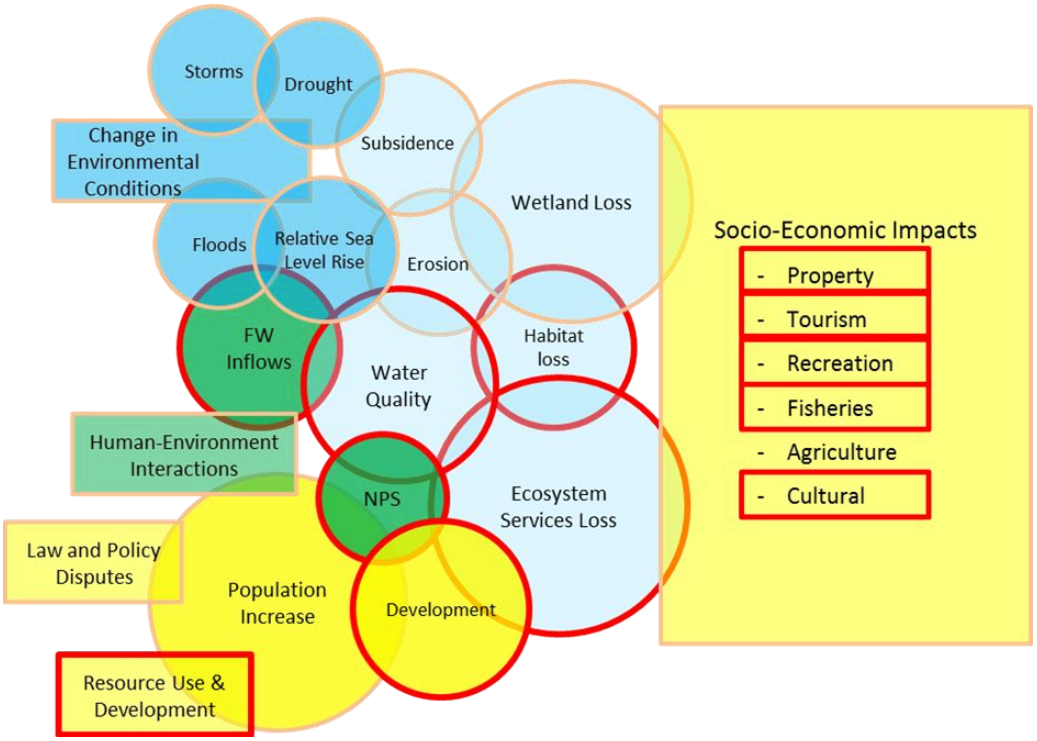
Conduct community resilience assessments, encourage local communities to plan for 'smart' development, synthesize and evaluate the most effective plans and regulations for increasing coastal resiliency, for both communities and natural resources. Current efforts include:

- Coastal planning and associated sea level rise Coastal Planning Atlas (Texas A&M University)
- The Houston Endowment and Meadows Foundation "Living with Sea Level Rise in Texas" project, a comprehensive sea level rise assessment led by Dr. James Gibeaut, Harte Research Institute for Gulf of Mexico Studies at Texas A&M University, Corpus Christi.

Address development in coastal areas

The Texas CMP should consider evaluating coast wide regulations regarding land use and development, with an aim at increasing resiliency of the Texas Coast. Methods for achieving this could include providing incentives for local jurisdictions to adopt stricter regulations in hazardous or environmentally sensitive areas or increasing the requirements of local jurisdictions in their planning and regulation efforts, and implementing strategies to address watershed management and water quality impairments. Watershed-based protection programs should be developed that provide general goals for local governments to use to guide future development and land use activities.

ENHANCEMENT AREA: OCEAN RESOURCES



Major Ocean Resources Stressors

Erosion and Relative Sea Level Rise

Erosion and Relative Sea Level Rise are stressors to ocean resources as they change environmental conditions and lead to habitat loss. The provision of habitat is essential for marine species as it provides them with a place to live and eat. Stressors that impact these species will have significant impacts in coastal communities and the economy.

Water quality and quantity

Water quality and quantity is affected by development, non-point source pollution (NPS) and decreased freshwater inflows and represent a major threat to the Gulf of Mexico nearshore environment. Contact recreation water quality impairments are of concern and pathogen prevalence can increase over time with continued coastal population growth and land use change. Freshwater inflows determine water quality by transporting nutrients and diluting salinities in estuaries and balance erosion rates by delivering sediments. Population increase has led to the diversion of water from rivers and streams and to reduced freshwater inflows to the coast, leading to altered landscapes, seascapes, and aquatic habitats. Thus, as the upstream demand for freshwater continues, the ability to effectively manage freshwater inflows becomes increasingly critical.

Development and resource use

Resource use and development stresses ocean resources via human activities pressure and alter the environment. The increase in offshore oil development planned for the Western Gulf of Mexico, for example, will increase threats to living marine resources in the Coastal Zone. The Department of Interior's Bureau of Ocean Energy Management held three lease sales for oil and gas development and has two more scheduled until 2017. Increased offshore drilling will increase the risks of oil spills and associated environmental damage, posing an increasing threat to ocean resources in the upcoming years.

Emerging Issues

Human-Environment Interactions (Oil spills, seaweed, and HABs)

Human and Environment Interactions are stressors that have both anthropogenic and natural elements, which consequently can be challenging to contain and control. Harmful Algal Blooms (HABs) represent one of those stressors whose cause has been linked to both natural and human factors, such as warming waters and nutrient enrichment. These toxic blooms continue to be a threat to oceanic and estuarine resources along the Texas coast and are likely to intensify with warming temperature, ocean acidification, and increasing populations. Additional emerging issues include oil spills and seaweed.

Socio-Economic Impacts

The major socio-economic impacts derived from stressors and environmental impacts are property, tourism, recreation, fisheries, and cultural. Degraded environmental conditions and loss of ecosystem services are likely to result in a decrease, damage, or loss of property, tourism revenue, recreational opportunities/expenditures, commercial fishing revenue and catch, and in cultural aspects of coastal communities such as a decrease in biodiversity and iconic species.

Priority Needs and Information Gaps

- Quantification of ocean ecosystem services (ES)
- Identification of ecosystem services and resilience indicators
- Research on ecosystem stressors and ecosystem responses to such stressors
- Advance systematic ecosystem data collection and monitoring
- Coastal ocean observing system capable of monitoring ecosystem state and stressors
- Active engagement of stakeholders to ensure support for sustainable management strategies
- Local and state management alignment

Management Priorities

Advance understanding of ecosystem functions and services

Healthy and resilient ocean resources are functioning ecosystems capable of providing ecosystem services, even if under pressure and changing conditions. To manage these resources, a better understanding of ecosystem services (quantification), ecosystem stressors, and of how ecosystems respond to stressors and change is needed. It is also important to identify ecosystem services indicators so that we can start monitoring ecosystems health, state, and change. A first step to accomplish this is to incorporate ecosystem services into Texas Coastal Zone Management policies and tools to facilitate adaptive and sustainable policies.

Coastal Ocean Observations

Maintaining healthy and resilient ocean resources requires a coastal and ocean observing system that systematically monitors marine ecosystem states and stressors and allows for fast responses and recovery in case of disturbances. It is important to monitor the provision of ecosystem services, the presence and intensity of ecosystem stressors, and how ecosystems respond to such threats. To do this, we need to support existing networks and systems in providing critical data and information and invest in improved collection and monitoring technologies. A first step is to support existing coastal ocean observing

capabilities (e.g. Texas Coastal Ocean Observation Network (TCOON)) in providing near real time oceanic, atmospheric, and meteorological conditions. These datasets are essential to all coastal and ocean-related mitigation, restoration, research, and planning activities. Once current capabilities are assured, future technology such as water quality instrumentation, high frequency radar, and other monitoring equipment can be used to augment the network capacities. High frequency radar locations along the Texas Coast have been identified and would be especially beneficial for response to oil spills such as the March 2014 spill at Galveston Bay.

Sustainable resource management

Ecosystem-based management is a holistic and interdisciplinary approach that accounts for the interconnectedness of the entire ocean ecosystem, including humans, to maintain ecosystem health, productivity, and resilience. For this to happen, it is important to align state and local management priorities such as development and water quality to avoid conflicting interests, and have active engagement of stakeholders to ensure a broader stewardship and support.