Comprehensive Plan and Integrated Programmatic Environmental Impact Statement, Mississippi Coastal Improvements Program (MsCIP) Hancock, Harrison, and Jackson Counties, Mississippi

REPORT SUMMARY FOR CIVIL WORKS REVIEW BOARD

STUDY INFORMATION

Study Authority. The MsCIP was authorized by the Department of Defense Appropriations Act, 2006 (P.L. 109-148) 30 December 2005, which states:

> *"For an additional amount for "investigations" to expedite studies of flood and storm damage reduction related to the consequences of hurricanes in the Gulf of Mexico and Atlantic Ocean in 2005, $37,300,000 to remain available until expended: Provided, that using $10,000,000 of the funds provided, the Secretary shall conduct an analysis and design for comprehensive improvements or modifications to existing improvements in the coastal area of Mississippi in the interest of* ***hurricane and storm damage reduction, prevention of saltwater intrusion, preservation of fish and wildlife prevention of erosion, and other related water resource purposes*** *at full Federal expense; Provided further, that the Secretary shall recommend a cost-effective project, but shall not perform an incremental benefit-cost analysis to identify the recommended project, and shall not make project recommendations based upon maximizing net national economic development benefits; Provided further, that interim recommendations for near term improvements shall be provided within 6 months of enactment of this act with final recommendations within 24 months of this enactment."*

.

Study Sponsor. A Letter from the State of Mississippi indicating the intent to be the non-Federal cost-share sponsor of the MsCIP was received by the Mobile District on 28 August 2008. A copy of the letter is provided as an attachment to the main report.

Study Purpose and Scope. The purpose and scope of the MsCIP Comprehensive Plan is to identify solutions to the hurricane and storm damage, saltwater intrusion, fish and wildlife, erosion, and other related water resource problems of coastal Mississippi. The solutions recommended in this report are intended to render the region more resilient and less susceptible to damages resulting from future coastal storm events. Resiliency (i.e., ability to withstand / survive) to storm events equaling or exceeding the 2005 hurricanes was an evaluation criteria that was applied to the formulation of the recommended projects, which incorporates natural and manmade features in a comprehensive storm damage reduction plan. This report is a final response to provide final recommendations. These recommendations do require additional analysis to further the Comprehensive Plan.

Project Location/Congressional District. The MsCIP Comprehensive Plan study area (see Figure 1) consists of the three Mississippi coastal counties: Hancock, Harrison, and Jackson. Congressional District: MS-4, as represented by the Honorable Gene Taylor (D), Mississippi Senators are Senator Thad Cochran (R) and Senator Roger Wicker (R).

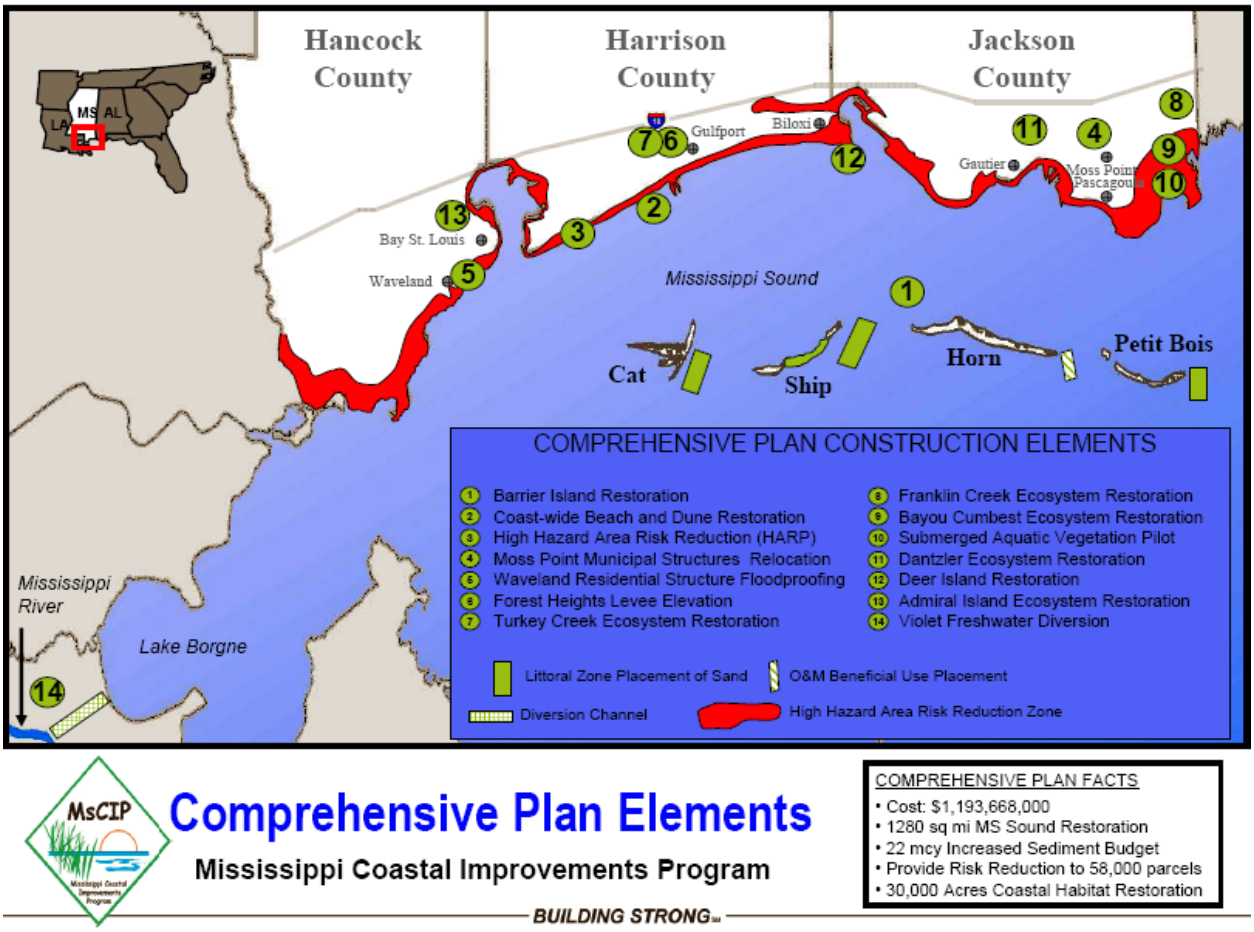

Figure 1: MsCIP Study Area

Prior Reports and Existing Water Projects.

a. Reports. There have been over 36 prior studies and reports of the flooding and environmental conditions along the Mississippi Coast. Those most recent report on the area is:

Mississippi Coastal Improvements Program Interim Report, 30 December, 2006. In response to the authorization's instruction "… *that interim recommendations for near term improvements shall be provided within 6 months of enactment of this act…*" the Chief of Engineers submitted this Interim Report. It recommended the implementation of 13 projects across the coast at a cost of $108 million.

b. Other Projects. The 15 MsCIP interim projects are currently being constructed and listed in the Table 1.

Table 1
Currently Authorized MsCIP Interim Projects

Projects	Purpose	County
Bayou Caddy	Ecosystem Restoration	Hancock
Hancock County Beaches	Ecosystem Restoration & Hurricane & Storm Damage Reduction	Hancock
Hancock County Streams	Flood Damage Reduction & Ecosystem Restoration	Hancock
Jackson Marsh	Ecosystem Restoration	Hancock
Clermont Harbor	Hurricane & Storm Damage Reduction	Hancock
Downtown Bay St. Louis	Hurricane & Storm Damage Reduction	Hancock
Cowand Point	Hurricane & Storm Damage Reduction	Hancock
Long Beach Canals	Flood Damage Reduction	Harrison
Harrison County Beaches	Ecosystem Restoration & Hurricane & Storm Damage Reduction	Harrison
Courthouse Road	Flood Damage Reduction & Ecosystem Restoration	Harrison
Shearwater Bridge	Hurricane & Storm Damage Reduction	Jackson
Gautier Coastal Streams	Flood Damage Reduction & Ecosystem Restoration	Jackson
Pascagoula Beach Boulevard	Hurricane & Storm Damage Reduction & Ecosystem Restoration	Jackson
Upper Bayou Casotte	Flood Damage Reduction	Jackson
Franklin Creek Floodway	Hurricane & Storm Damage Reduction	Jackson

In addition to the MsCIP projects, the USACE is responsible for the maintenance of the Federally authorized deep draft projects at Gulfport and Pascagoula, the Gulf Intracoastal Waterway, and other shallow draft navigation projects. There is one authorized shore protection project, Harrison County Beaches, in the project area that was authorized in the 1950's with maintenance the responsibility of the local sponsor.

Federal Interest. The Federal Interest in flood risk management in coastal Mississippi, was first established in the Flood Control Act of 1936, and expanded by the Flood Control of 1954, and is implicit in the current authorization for this study. Likewise, the Federal Interest for hurricane and storm damage reduction, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and other related water resource purposes also extends to the current Feasibility Study and the tentatively recommended Comprehensive Plan presented therein. The tentatively recommended plan includes cost effective solutions, and minimizes negative environmental effects.

STUDY OBJECTIVES

Problems and Opportunities. The problems identified by the study team, state, county, and city officials, residents, and agency staff, included:

- Hurricane-induced storm surge caused significant damage to structures and infrastructure within the three-county (Hancock, Harrison, and Jackson) MsCIP study area;
- Hurricane-induced storm surge caused significant damage to coastal ecosystems and fish and wildlife resources within the three-county study area;
- Hurricanes induced saltwater intrusion within the Mississippi Sound ecosystem and associated coastal environments; and
- Hurricanes induced erosion of coastal wetlands and coastal infrastructure within the three county MsCIP study area.

Comprehensive, ***system-wide opportunities*** were identified during the MsCIP planning process to guide the development and evaluation of solutions to the region's water resource problems. An overall theme of Comprehensive Plan opportunities is not merely to reverse the harm done by the hurricanes of 2005, but, as importantly, to promote the long-term future sustainability of physical, human, and environmental resources within the study area. The Comprehensive, system-wide opportunities include:

- Assist in sustainable redevelopment of hurricane damaged physical, environmental, and human resources within the MsCIP study area;
- Reduce the susceptibility of residential, commercial, and public structures and infrastructure to hurricane induced storm damages within the three-county (Hancock, Harrison, and Jackson) MsCIP study area;
- Assist in the recovery and long-term sustainability of coastal wetlands that support important fish and wildlife resources within the study area;
- Accelerate the recovery and assist in the long-term sustainability of maritime forest environments that suffered hurricane induced damages;
- Restore barrier island environments that suffered hurricane induced storm damages in a manner that promotes long-term sustainability of their fish and wildlife resources;
- Reduce saltwater intrusion within the Mississippi Sound coastal environment;
- Assist in the recovery of coastal ecosystems and infrastructure damaged by erosion during the hurricane events of 2005 and support programs that promote long-term erosion reduction and limit erosion potential during future hurricane events.

Planning Objectives. The system-wide objectives established for this study provide specific targets to measure progress toward achieving the comprehensive goals outlined above. Projects formulated as part of the Comprehensive Plan were evaluated based on their ability to contribute to achieving the targets established in these objectives. System-wide objectives include the following:

- Reduce loss of life caused by hurricane and storm surge by 100%;

- Reduce damages caused by hurricane and storm surge by $150M-$200M annually, per coordination with state and local interests based on knowledge of damages from previous hurricanes;
- Restore 10,000 acres of fish and wildlife habitat including coastal forests, coastal wetlands, wet pine savannah, submerged aquatic sea grasses, oyster reefs, and beaches and dunes by the year 2040;
- Manage seasonal salinities within the western Mississippi Sound such that optimal conditions for oyster growth (surrogate for other aquatic resources, 15 ppt during summer months) are achieved on an annual basis by 2015;
- Reduce erosion to barrier islands, mainland, and interior bay shorelines by 50%;
- Create opportunities for collaboration with local, state, and Federal agencies to facilitate implementation of programs and activities that maximize the use of resources in achieving the comprehensive goal.

Planning Constraints. There are a number of issues that constrain the development of certain potential measures that might be used to address the identified problem set. Planning constraints are limited to laws and regulations that constrain the planning process. Among these include:

- Measures developed must not negatively impact the resources within the NPS's Gulf Islands National Seashore, particularly with respect to the agency's 2006 Management Policies as well as from those constraints created by inclusion of Horn and Petit Bois Islands as Wilderness Areas;
- Measures developed must avoid, minimize, or mitigate any negative impacts to T&E species identified as residing within areas potentially impacted by study recommendations;
- Measures developed must comply, to the maximum extent practicable, with State of Mississippi Coastal Management Plan;
- Measures developed must meet the guidelines for maintenance of State Water Quality standards;
- Measures must comply with provisions of the Clean Water Act (CWA);
- Measures must comply with provisions of the National Historic Preservation Act (NHPA);
- Measures must comply with the Clean Air Act (CAA);
- Measures must comply with the Endangered Species Act (ESA);
- Measures must comply with the Coastal Barrier Resources Act (CBRA);
- Measures must comply with the Environmental Justice and Protection of Children Executive Order;
- Measures must be consistent with the Magnuson-Stevens Fishery Conservation and Management Act as amended by the Sustainable Fisheries Act of 1996.

ALTERNATIVES

Plan Formulation Rationale. A system-wide approach was used in formulating the Mississippi Coastal Improvements Program (MsCIP) Comprehensive Plan to ensure that both the MsCIP and the

Louisiana Coastal Protection and Restoration (LaCPR) efforts were fully coordinated and developed complementary plans for the restoration of the U.S. Gulf coastal region as an integrated system. In addition, the planning effort has taken a "top down" comprehensive planning approach, beginning with development of a Comprehensive Plan to address the overall water resources problems and opportunities of the region. Building off of the comprehensive identification of problems and opportunities, the planning effort then proceeded to develop site specific problems, opportunities and solutions that contribute to accomplishing the Comprehensive Vision for the restoration and protection of the Mississippi Gulf Coast. The results of this effort led to a comprehensive regional plan that addressee hurricane and storm damage reduction and environmental restoration needs, as well as recommending a variety of site specific projects for either for immediate implementation or for further investigation and subsequent implementation.

This draft Mississippi Coastal Improvements Program (MsCIP) Comprehensive Plan Report and Integrated Environmental Impact contains both a Comprehensive Plan and a variety of water resource development projects that were developed through the comprehensive planning process. The Report also describes components of the Comprehensive Plan which require additional investigations prior to identifying a specific recommendation for construction.

The planning process utilized in the MsCIP study was a highly iterative process. Multiple iterations of the Corps' six planning steps were required due to the fact that new problems or data were constantly being identified. Additionally, the development of large scale plans, such as "Lines of Defense" (LOD), brought new problems and opportunities to light, which needed to be included into the planning process. The following sections describe the specific measures considered and the results of the screening and evaluation process.

Management Measures and Alternative Plans

Examples of measures developed for storm damage reduction were supplied by the study team, agencies, and public, and included:

- Levees, seawalls, or embankments (barriers to surge);
- Gates, berms, and breakwaters (barriers to surge);
- Elevating structures (elevation above inundated area);
- Acquisition and removal from high-risk areas (removal from high-risk inundation zones);
- Zoning and Building Code modification (removal of the most damageable or critical infrastructure or services from highest risk areas);
- Floodplain Management (removal of the most damageable or critical infrastructure or services from highest risk areas);
- Moving back from the shoreline (removal of the most at-risk development, most damageable or critical infrastructure, or services from highest risk areas);

Examples of measures for erosion reduction, supplied by the study team and public, included:

- Placement of additional sand;
- Placement of harder erosion-control features, such as shell materials, construction debris, rubble, stone, geo-textiles;
- Supply of additional sand to littoral zone / island sediment budget;

- Reduction of sand-robbing activities in the near-shore or barrier island zones.

Examples of measures for ecosystem restoration and fish and wildlife preservation, supplied by the study team and public, included:

- Acquiring and restoring currently undeveloped lands;
- Restoring previously degraded wetlands;
- Removal of sediment and/or debris choking streams and estuaries;
- Re-grading to historic conditions and topography;
- Preserving habitats to reduce fragmentation;
- Removal of invasive species;
- Removal of dead vegetation, deadfalls, and other vegetation that interferes with natural functions;
- Planting of native species in areas in which those species were killed by the hurricanes; and
- Filling of drainage channels that interfere with natural functions.

Examples of measures for saltwater intrusion (seawater encroachment into a freshwater body) reduction, supplied by the study team and public, included:

- Reallocation of freshwater supply by re-regulation of reservoirs and
- Diversion of freshwater sources to direct more freshwater into areas of critical need.

Development of measures was also based on consideration of potential benefits and the potential negative outcomes it might cause (i.e., induced flooding). All of the structural measures were also developed in such a way that they could be laid out as either stand-alone concepts, or as components of a multi-featured plan for a given area (i.e., structural, nonstructural, or ecosystem restoration plan).

Final Alternatives

No Federal Action. No additional flood risk management, risk reduction, or ecosystem restoration would be provided under the "No Action" Alternative. Without modification to the existing flood risk management system, the study area would continue to be at greater risk from large flooding events and the affected community would be faced with continued economic concerns. The problem would worsen with time if no action is taken because flood-insurance rates could rise and the economic health of the City and region could decline significantly. Without addressing the need for ecosystem restoration, the influence of exotic species would continue to increase with decreasing resource values. In addition the influence of increase salinities would continue to be felt in the Mississippi Sound estuary without the consideration of barrier island restoration and/or freshwater diversion.

All of the development of measures and alternatives, evaluation, and screening conducted to this point in the plan formulation process resulted in a relatively small set of alternatives to be analyzed at the highest level of detail. The final refinement of alternatives consisted of incorporating comments from team members and stakeholders, as well as making adjustments based on the last set of evaluations. The final refinement was directed at identifying the most cost-effective options within the four key areas of study:

- Hurricane / storm damage reduction;
- Ecosystem restoration for preservation of fish, wildlife and habitat functions and values;
- Saltwater intrusion / encroachment reduction; and
- Coastline Erosion.

Saltwater intrusion/encroachment reduction and coastal erosion reduction purposes are encompassed under the discussions of hurricane / storm damage reduction and ecosystem restoration alternatives. Each alternative was refined to achieve more damage reduction, more ecosystem benefits, greater freshwater inflow, or better salinity reduction, particularly during the period of greatest importance in the life cycles of select organisms.

Comparison of Alternatives

Comparisons identify which of the final alternatives (plans) is the best and identify which of the final alternatives should be included as a recommended action of the comprehensive plan. The comprehensive plan is comprised of a number of mission, site, and resource specific features. Therefore, comparisons are made among alternatives directed at specific features. Comparisons are not made across features. For example, ecosystem restoration alternatives at a specific location are compared to each other, but ecosystem restoration alternatives are not compared to storm damage protection alternatives. Because no one plan is likely to be best in all categories of importance, we have to compare the effects of the various plans and make tradeoffs among the differences observed. In the previous section, the effects of each plan were examined individually. In this comparison step, we look at the important effects across all plans.

The comparison of final MsCIP alternatives started with presenting the future without-project conditions and future "with-project" conditions for each site or problem area, in both a descriptive presentation, and also in a "System of Accounts" comparison format. Data presented for comparison of final alternatives included:

- revised costs,
- benefits (monetary, or economic, environmental outputs, societal, etc.),
- potential impacts related to implementation,
- detailed design considerations,
- environmental outputs,
- damages prevented,
- geotechnical/site considerations,
- more detailed technical requirements,
- source material and source area considerations, and
- other technical, environmental, or economic issues.

The "System of Accounts" analysis presents information in four separate "accounts" or categories for comparison that include:

- "National Economic Development" (NED), which in this case only compares and contrasts the cost-effectiveness of each group of alternatives,
- "Regional Economic Development "(RED), which discusses the potential regional impacts of each group of alternatives,

- Environmental Quality (EQ), which discusses potential positive and negative environmental impacts of each group of alternatives and their environmental quality implications, and
- Other Social Effects (OSE) evaluations, which discusses and contrasts the potential social, and other effects of each group of alternatives.

The alternatives were also compared and contrasted according to their achievement of the additional criteria of a) effectiveness; b) completeness; c) acceptability, and d) efficiency (cost-effectiveness) according to applicable Corps guidelines.

In addition to these four traditional accounts, information on potential risks, uncertainties, and consequences, is also presented in System of Accounts format, for comparison at the same level of scrutiny of the information presented in other accounts.

The System of Accounts tables also include a "stakeholder risk score" which identifies stakeholder preferences for each of the final alternatives presented in the Systems of Accounts tables. The "stakeholder preference score" rates each alternative as a percentage of a theoretical "perfect plan" (in the eyes of the stakeholder groups). The higher the percentage, the more acceptable the alternative is to the stakeholder.

Key Assumptions

Some technical parameters, which may be important to the outcome of the technical analysis, are not estimated in a way that allows for the calculation of probabilities and confidence intervals. The uncertainty that these parameters bring to the analysis is typically addressed by using alternative parameter values in sensitivity or scenario analyses. In this study, this type of uncertainty was addressed by the evaluation of multiple storm tracks (paths), magnitudes (strength), and alignments, to ensure that the appropriate range of potential conditions was incorporated into the assumptions that went into defining future without-, and with-project conditions.

Scenario Analyses

Scenarios were developed to form a framework within which the effects and costs of various uncertain futures could be evaluated. With this, multiple future scenarios were used to gage the impact of future development and sea level rise.

Recommended Plan.

The comprehensive plan provides integrated systems-based solutions and tentatively selected plans that address: ***hurricane and storm damage reduction, ecosystem and restoration and fish and wildlife preservation, reduction of damaging saltwater intrusion, and reduction of coastal erosion.*** The tentatively selected plans also provide measures that aid in: regional economic redevelopment, positive societal effects, and long-term measures to reduce risk to the public and property.

The Comprehensive Plan has been developed in a progressive fashion with plan elements to be implemented in the short term (interim projects), near term (recommended for construction), following limited additional evaluation and documentation (AED), following more detailed evaluation and documentation of a specific plan element (contingent authorization) and those elements which required significant study, design, and documentation (feasibility study). Each plan feature has been developed to be a cost efficient feature with significant advancement toward the comprehensive goal of developing a resilient coastal zone, however the synergistic benefits which will accrue as more of the plan features are implemented. These synergistic benefits between plan features have not been estimated. Implementation of the comprehensive plan could ultimately result in the acquisition and/or floodproofing of over 58,000 parcels within the zone having a 1 percent

chance of annual inundation (100-year floodplain), reduction of risk to areas considered to have moderately high risk from storm surge effects, restoration and/ or enhancement of over 30,000 acres of coastal forest, wetland, estuarine, and beach and dune habitats and the continued sustainability of the Mississippi Sound ecosystem.

This report supports the recommendation of the following tentatively selected features to Congress for authority to implement the Mississippi Coastal Improvements Comprehensive Plan:

- Construct the list of projects seeking a construction ROD

○ Barrier Island Restoration
○ Turkey Creek Ecosystem Restoration
○ Bayou Cumbest Ecosystem Restoration
○ Dantzler Ecosystem Restoration
○ Admiral Island Ecosystem Restoration
○ Franklin Creek Ecosystem Restoration
○ High Hazard Area Risk Reduction Plan (HARP Phase 1)
○ Deer Island Ecosystem Restoration
○ Submerged Aquatic Vegetation Restoration;
○ Coast-wide Beach and Dune Restoration;
○ Moss Point Municipal Structures Relocation
○ Waveland Residential Structure Flood Proofing
○ Forrest (Forest) Heights Levee Elevation

- Conduct feasibility level investigations for
    - Investigations of Long-term High Hazard Area Risk Reduction Features
    - Investigations of Escatawpa River Freshwater Diversion
    - Investigations of Additional Environmental Restoration Features
    - Investigations of Additional Structural Hurricane and Storm Damage Risk Reduction Features

The Congressional authorization for this study mandated a comprehensive approach to solutions for water resource problems in coastal Mississippi. The comprehensive nature of the study team's approach included identifying solutions regardless of implementation authority or agency. Hence a number of tentatively selected plan features also include education and hurricane preparedness. These features include:

- Hurricane Risk Reduction Education
- Hurricane and Storm Warning Systems
- Hurricane Evacuation Planning Services Floodplain Management
- Building Codes
- Zoning Codes, and
- Relocation of Critical Infrastructure and Services (Line of Defense 5).

Feasibility level investigations concerning freshwater diversion at Violet, LA are authorized by Congress under WRDA 2007. Section 3083 authorized the design and implementation of a project for diversion of freshwater at or near Violet, Louisiana, for the purposes of reducing salinity in the western Mississippi Sound, enhancing oyster production, and promoting the sustainability of coastal wetlands. The MsCIP supports this action as a critical element to sustain the ecosystems of coastal Mississippi. This report supports a recommendation to Congress for funding this project in full coordinated with the States of Mississippi and Louisiana, the appropriate entities within the Corps of Engineers, and other interested stakeholders.

The following table identifies how the tentatively recommended components of the Comprehensive Plan address the Congressional concerns identified in the authorization. These comprehensive plan components are 'keystone' pieces of the comprehensive plan on which later recommendations would build. These plan elements have been determined to be engineeringly

feasible, environmentally acceptable and beneficial, and cost effective. Each of these tentatively recommended comprehensive plan components are designed to be implemented and function as stand alone units should additional time be required to design all plan components or additional plan components be determined to not be cost effective.

Table 2. Components of the Comprehensive Plan

	Areas of Concern			
Recommendation	**Storm Damage Reduction**	**Erosion Reduction**	**Salt Water Intrusion**	**Fish and Wildlife**
High Hazard Area Risk Reduction Plan	√			√
Additional Damage Reduction Alternatives	√			
Additional Ecosystem Restoration Alternatives	√	√		√
Barrier Island Restoration	√	√	√	√
Violet, LA Fresh Water Diversion	√	√	√	√
Escatawpa Fresh Water Diversion			√	√
Beach and Dune Restoration	√	√		√
SAV Restoration				√
Moss Point Municipal Structure Relocation	√			√
Waveland Floodproofing	√			
Forrest (Forest) Heights Levee	√			
Deer Island Restoration	√	√		√
Turkey Creek Restoration	√			√
Bayou Cumbest Restoration				√
Dantzler Restoration				√
Admiral Island Restoration	√			√
Franklin Creek Restoration	√			√

High Hazard Area Risk Reduction Plan (HARP)

This report supports the recommendation for authorization and immediate implementation of the Phase I HARP, and for planning of a Long-term HARP. The ultimate risk reduction goal would be to address all 58,000 plus parcels within the high hazard area (100-year floodzone). Of these 58,000 parcels, approximately 15,000 are located in the VE zone as designated by FEMA and as such the only appropriate risk reduction methodology is acquisition of the property to prevent future development. Another 18,000 parcels are located outside the VE zone but ground surface elevations are such that floodproofing is deemed impractical for single family residences. Approximately 25,000 parcels within the high hazard area would be suitable for floodproofing. The practicability of acquisition of 15,000 parcels was evaluated in terms of ability to implement within a relative short time frame (5 years) and the impact of significant land use changes on the local economy and the communities of the coast. In addition local stakeholders expressed significant concerns over government acquisition especially with the use of eminent domain.

With these issues in mind the Phase I HARP discussed below is based on the ability to acquire approximately 2000 parcels from willing sellers within 5 years of the initiation of the Project Partnership Agreement. The implementation of the project would include the right of eminent domain to be used in special circumstances, (e.g. clear up title or address remaining scattered properties located within a larger area) in coordination with the sponsor and local government. To

date we have received over 500 requests from individual property owners to be placed on a 'list' of interested sellers

Phase I HARP

The most effective alternative for reducing the risk from future hurricane surge events is to remove all structures and relocate population centers from the high risk zones. Formulation of alternatives included those which would provide for minimum level of risk reduction (approximate base flood elevation) up to those that would provide for risk reduction from increasing levels of inundation.

Hurricane Katrina destroyed an estimated 32,446 structures (i.e., damages of 51% to 100% of structure value), and caused significant damage to another 15,000 to 25,000 structures located within the inundation footprint of the three coastal counties in Mississippi. The rebuilding rate within the inundated area is much slower than might typically be expected following a hurricane. This is due in part to a significant increase in construction costs since Katrina, higher flood insurance rates and uncertainty resulting from the fact that FEMA has recently released draft Flood Insurance Rate Maps (FIRM) and requirements outlining at what elevation future first-floor construction must adhere to in order to qualify for flood insurance through the NFIP.

The sheer magnitude of the devastation, together with the number of persons displaced after Hurricane Katrina presented unprecedented challenges and opportunities. The HARP alternative is the most cost-effective option that provides a nonstructural alternative for reducing property damage resulting from hurricanes, storm surge and flooding, and by extension, reducing threats to lives in those areas, in the most hazardous areas along the Mississippi Coast. This report recommends that the Phase I HARP is specifically structured to capitalize on the current opportunity and encourage relocation outside the high-hazard surge-plain.

The advantages of such a program are numerous including:

- Reduces future property loss and potential loss of life;
- Eliminates costly structural alternatives and associated long term operation and maintenance costs;
- Provides a buffer and aids in reducing storm surge to adjoining properties; and
- Provides a potential opportunity to initiate alternative uses of the acquired land for fish and wildlife, ecosystem restoration and public recreation.

Phase I HARP Benefits

The tentatively recommended plan for immediate application for hurricane and storm damage reduction is a limited acquisition and relocation program, directed at approximately 2,000 of the most high-risk properties along the coastline. Benefits of the program include reduction of future damages and risks to lives within those areas, and incidental recreation and social effects benefits. Select areas within certain acquired areas would be available for ecosystem restoration, and could also produce additional restoration benefits. The average annual average damages avoided for the 2,000 structures were determined to $33,000,000. Regional economic benefits include an increase in sales volume of $1,171,260,000, a $246,056,800 increase in local income, and a net increase of 7,213 jobs.

Phase I HARP Costs

The estimated cost for implementation of Phase I is $397,000,000, but may be less depending on the ultimate number of parcels acquired and range of benefits provided under P.L. 91-646.

Long-term High Hazard Area Risk Reduction Plan Evaluation

Evaluation of long term HARP is warranted to address the continued relocation and/or floodproofing of structures from the high to moderately high risk areas of the Mississippi coast. A long-term HARP could involve the acquisition of large contiguous properties immediately following any large future hurricane events and be a joint effort between the USACE, FEMA, and the State of Mississippi.

Long Term HARP Benefits

The benefits of an ongoing acquisition and relocation program for coastal Mississippi could be tremendous taken into account the implications of sea level rise, continued propensity for development along the coast, and the frequency and magnitude of storms known to affect this area of the northern Gulf of Mexico. The additional study effort aimed at developing the framework and guidelines, detailed benefits, and costs would involve local and State interests as well as FEMA.

Long Term HARP Study Cost

Estimated study cost for development of a long-term HARP program is $5,000,000.

Moss Point Municipal Services Relocation

This report supports the recommendation for authorization to immediately implement the Moss Point Municipal Services Relocation component of the Comprehensive plan. The City of Moss Point is located north of the City of Pascagoula in Jackson County. All of the City's municipal services were disrupted by Hurricane Katrina, and their structures were either severely damaged or deemed uninhabitable. The MsCIP has formulated alternatives that would aid the city in providing basic community services in a more timely fashion after future storm events, and further demonstrate the effectiveness of relocations projects as a hurricane and storm damage reduction measure along the Mississippi coast. The best means of achieving these goals consists of relocating the city's municipal buildings to a lower risk site with regards to flooding within the incorporated limits. These buildings include the city hall, police station, fire station and community services building. Future use of the existing site of these buildings would be as open space that would provide a buffer between City and the Escatawpa River further reducing the damages from hurricane surge and flooding events.

Moss Point Benefits

The relocation of these facilities would greatly reduce future damages to the local infrastructure and provide a higher confidence in uninterrupted public service in future events. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs.

Moss Point Costs

First Costs: $10,800,000 Annual O&M: $0

Waveland Floodproofing

This report supports the recommendation for authorization to immediately implement the flood proofing at Waveland, MS. The city of Waveland is located in Hancock County and was directly in the path of Hurricane Katrina. Because of the low lying nature of the city, the only flood damage reduction measures available to a portion of Waveland are either acquisition or floodproofing of individual structures. FEMA has released a manual for "Recommended Residential Construction for the Gulf Coast" which is meant to aid residents in rebuilding on strong and safe foundations. The design manual (FEMA 550) provides recommended foundation design and guidance for rebuilding homes destroyed by hurricanes in the Gulf Coast. The Waveland floodproofing alternatives are

designed to evaluate the FEMA 550 guidelines with regards to current Corps' floodproofing practices. In addition to showing the application of existing elevation techniques and construction practices to reduce flood damages, this alternative would evaluate the use of possible innovative contracting techniques. These techniques would be designed to improve the Corps – contractor – homeowner relationship, focusing on using more timely and customer focused approaches. The 25 structures selected for floodproofing represent an adjacent group of structures that were not destroyed by Hurricane Katrina.

Waveland Benefits

In order to evaluate the different foundation and building types, 25 structures would be selected in the Waveland area that could be safely elevated out of the 1% chance storm event, and which could not be protected by any other structural measures evaluated as part of this study. Damages to these structures would be significantly reduced and the area would serve as an example of smart growth. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs.

Waveland Costs

First Costs: $4,425,000 Annual O&M: $0

Forrest (Forest) Heights Hurricane and Storm Damage Reduction Component

This report supports the recommendation for authorization to immediately implement levee improvements at Forrest (Forest) Heights in Harrison County Mississippi. The Forrest (Forest) Heights community is located within the city of Gulfport at the lower end of the Turkey Creek floodplain and in a part of the larger historic Turkey creek community. The Harrison County area was over topped and heavily damaged by the hurricanes of 2005. Particularly, the storm surge generated by Hurricane Katrina on August 29, 2005, caused structural damage to the existing levee that provides inland flood protection to this low lying residential community.

Storm surge inundation reached a depth of 2-8 ft over the entire community during Hurricane Katrina. In addition, prior to Hurricane Katrina, Forrest (Forest) Heights was frequently inundated by flood waters due to inland flooding along the lower reach of Turkey Creek that overtopped the existing levee. An economically justified improvement to the existing earthen levee for riverine flooding protection was evaluated in July 2005, prior to landfall of Hurricane Katrina. These evaluations included 100-year, 250-year and 500-year protection. This plan was put on hold following Katrina in order to evaluate suitable risk reduction to Forrest (Forest) Heights from hurricane storm surge flooding. The proposed levee was evaluated at elevations 17 ft and 21 ft above sea level.

All evaluated alternatives were also gauged against the intent of Executive Order 12898, "Federal actions to address environmental justice in minority and low-income populations". Since the establishment of the Turkey Creek Community by freed slaves and their descendants, federally funded construction programs including the Gulfport Regional Airport, US Highway 49 and Interstate Highway - 10 have impacted the Turkey Creek Watershed. In addition, numerous other constructions including hotels, shopping centers and housing developments have been federally permitted to fill wetlands and construct within the Turkey Creek watershed.

Through modeling results, a levee height of 21 feet above sea level was determined to be consistent with the levee certification guidelines with the basis measure being a storm surge elevation that has a 0.2% probability (500-year event) of occurrence in any given year. The levee is estimated to be 6,500 linear feet and require 93,000 cubic yards of fill. An existing park of 12 to 14 feet in elevation would serve as a water detention area for temporary containment of rainfall during storm events.

Forrest (Forest) Heights Benefits

Equivalent annual damages reduced by the 21-foot levee are estimated to be $331,508. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs. In addition to these damages reduced, the levee would provide a significant boost to the cohesiveness of the historically significant community, preserve the culture and heritage of it's predominantly minority residential population, and greatly improve their overall quality of life.

Forrest (Forest) Heights Costs

First Costs: $14,000,000 Annual O&M: $114,000

Potential Local Flood Risk Management Projects

This report supports a recommendation for future feasibility level analyses of local flood risk management components of the Comprehensive Plan. While large structural solutions such as surge gate barriers did not garner much local support, there were smaller scale structural solutions, such as smaller ring levees, local surge barriers, and levee alignments that have the potential to provide cost effective solutions. Possible ring levee alternatives identified as part of this study including ring levees at: Belle Fontaine, Gulf Park Estates, Pascagoula/Moss Point, Pearlington, Gautier, Ocean Springs, and Bay St. Louis.

Potential Local Flood Risk Management Project Benefits

A very preliminary estimate of annual without-project damages for these potential structural solutions totals well over $60 million. The implementation of ring levees and / or other structural components in these areas would reduce a significant portion of those damages and warrants further feasibility level consideration.

Potential Local Flood Risk Management Project Costs

Table 3 shows the estimated cost of these feasibility studies.

Table 3. Local Flood Risk Management Study Costs

Project	Feasibility Study Cost
Pearlington Ring Levee	$5,343,000
Bay St. Louis Ring Levee	$9,812,000
Ocean Springs Ring Levee	$8,861,000
Gulf Park Estates Ring Levee	$8,414,000
Belle Fontaine Ring Levee	$6,786,000
Gautier Ring Levee	$17,164,000
Pascagoula/Moss Point Ring Levee	$29,082,000

Site Specific Ecosystem Restoration Plan Components

This report recommends Congressional authorization to construct a number of site-specific ecosystem restoration components of the Comprehensive Plan. Attainment of three of the objectives

of the MsCIP study effort: fish and wildlife preservation, reduction of coastal erosion, and amelioration of the effects of saltwater intrusion, would significantly restore the ecosystem of coastal Mississippi to pre-hurricane conditions. The proposed restoration efforts would not only enhance the natural habitats of the area but would make the coastal area more resilient to the adverse impacts of future storms. Team members, including staff from the States of Mississippi and Louisiana, U.S. Fishand Wildlife Service, National Park Service, and non-governmental environmental organizations developed a number of options including coastal forest and wetland ecosystem restoration, barrier island / Mississippi Sound ecosystem restoration, and beach and dune ecosystem restoration to achieve these missions. From these options, nine comprehensive plan elements are recommended for construction, one is recommended for continued engineering and design, and several are recommended for additional feasibility level studies.

Turkey Creek Ecosystem Restoration

This project site is located in north Gulfport, Mississippi, adjacent to U.S. Highway 49, a major north-west thoroughfare, and within the impaired Turkey Creek watershed. The area is becoming increasingly urbanized and development pressures are resulting in increased wetland degradation and loss by direct filling with the incumbent decrease in flood storage capability. The Turkey Creek site is approximately 689 acres of predominately undeveloped land containing a number of dirt road/paths and several miles of drainage ditches. These drainage ditches were constructed in the past in an effort to drain the site and control the drainage across the site into specified areas in order to make the site more attractive for development. The site is primarily comprised of degraded wet pine savannah wetland habitat. The miles of drainage ditches and undeveloped roads fragments the wetland habitat and substantially alters the hydrology of the wetlands located to the south. Hurricane Katrina damaged and/or destroyed much of the remaining habitat (wind and salt damage to vegetation as well as salinity increases in the soils from the surge) such that the area has been determined to be incapable of unassisted recovery.

Wet (hydric) flats, which comprise as much as 20 – 30 percent of the coastal plain landscape from southeastern Virginia to south-eastern Texas, include wetlands on both organic and mineral soils and in the southeastern U.S. occur on the interfluvial marine terraces of the coastal plain. The hydric conditions contributing to the development of this habitat type include abundant rainfall and slow drainage associated with a landscape of low relief. Historically these habitats have been maintained in their open understory character by periodic fire. Pine savannah wetlands found in coastal Mississippi provide for diverse habitat for a number of plants and animals including many T&E species found only in these unique habitats. Pine savannah wetlands are commonly referred to as sponges that provide floodwater retention, groundwater recharge, and water purification. These habitats have been identified by the U.S. Fish and Wildlife Service as habitats of high value for evaluation species and relatively scarce or becoming scarce on a national basis or in the ecoregion section (Category 2) (Service Mitigation Policy, FR 46(15):7656-7663; dated 23 Jan 1981).

Several plans were evaluated in order to determine the most cost-effective plan for restoration. The Turkey Creek site had an HGM assessment performed in 2000, using the *Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Wet Pine Flats on Mineral Soils in the Atlantic and Gulf Coastal Plains* (Rheinhardt et al 2002).

The tentatively recommended plan requires the acquisition of 689 acres of predominately undeveloped land, filling the previously constructed draining ditches, excavating and removing existing roadbeds and any additional fill, and maintaining vegetation growth by burning the project area in the initial year of construction as well as maintaining it by mowing and burning every three years over the life of the project as needed. An essential component necessary when selecting the tentatively recommended plan at Turkey Creek was the need for burning. Burning allows the wet pine savannah environment to continue naturally as a functioning system without future intensive

maintenance to maintain the required vegetation species. Although mowing does effectively keep understory plants from over colonizing the area, it does not simulate the natural conditions (i.e. seed germination, heating the pine bark).

Turkey Creek Ecosystem Restoration Benefits

Higher areas within the site will be designated as wet pine savannah. These areas have depressional areas within them which will enable water to flow down into the depression thus, holding water. Following the initial burning there would be a natural re-growth of wet pine savannah habitat, including species such as *Pinus elliotti*, *Morella cerifera, Ilex glabra, Spartina patens, and Panicum virgatum*.

Many species of wildlife are indigenous to the wet pine savannah habitat and are expected to thrive in the restored area. Understory plant communities including wiregrass, sedges, orchids, American Chaffseed and rough-leaved loosestrife as well as the insectivorous plants (pitcher plants, bladderworts, venus flytrap, and sundews) would be expected. Rare and threatened and endangered birds that are expected to utilize the areas following burning and regrowth include Henslow's sparrow, Bachman's sparrow, red-cockaded woodpecker, and Mississippi Sandhill Crane. This ecosystem may also benefit the Mississippi Gopher frog and in drier areas along ridges, the black pine snake and the gopher tortoise.

Benefits are measured in terms of average annual functional units (AAFU). Results from this assessment were used to establish baseline (current) conditions and, ultimately, to measure the functional unit benefits resulting from different restoration plans. It is assumed that functional units will remain the same under existing conditions and the no action plan even though it is likely that under the no action plan the functional value of the habitat would degrade over time. For this reason the calculation of the environmental benefits of the proposed restoration are considered conservative in nature. The AAFU net benefit was calculated as the difference between the total functional units for the ecosystem restoration plan and the total functional units for the no action plan. The tentatively recommended plan would result in the acquisition of a significant contiguous acreage within the Turkey Creek watershed and a net benefit of over 1500 average annual functional habit units at a minimum of high value scarce habitat on an ecoregional or national basis.

Turk**ey Creek Ecosystem Restoration Costs**

First Costs: $6,800,000 Annual O&M: $47,000.

Dantzler Restoration Area

The 385-acre State-owned site is located in central Jackson County near the Pascagoula River. The site was planted in plantation pine during the 1960s and drainage ditches and stormwater lines were constructed in the early 1970s in anticipation of residential development of the site. The long-term exclusion of fire and the invasion of non-native species, such as Cogon grass and Chinese tallow tree, have also severely degraded the site. These exotic species out compete the native vegetation, which provides food sources to the many fish and wildlife important species, including T&E species. Without any native competing species, these exotic species eventually become the only species in the area and result in a continuing degradation of the functional value of the wetlands. The importance of the wet pine savannah has been previously been discussed in the Turkey Creek ecosystem restoration project above.

Winds from Hurricane Katrina destroyed most if not all of the plantation pine leaving massive amounts of tree litter on the ground. In addition, debris and sedimentation resulting from the storm surge added even more litter. The exotics that were present in the site prior to the storm thrive in this type environment and it is likely that without restoration of the site they will become the dominant species inhabiting the site. Six alternative plans were developed to address the ecosystem restoration of the area.

The tentatively recommended plan requires filling ditches, excavating and removing existing roadbeds and any additional fill, and maintaining vegetation growth by mowing and burning the project area in the initial year of construction as well as maintaining it by burning every three years over the life of the project as needed. As with the Turkey Creek ecosystem restoration, periodic burning of the site is a critical element to the success of the restoration.

Dantzler Restoration Benefits

Benefits are measured in terms of AAFU. The HGM approach was used to assess wetland function similar to Turkey Creek. A conservative increase of approximately 1250 AAFU in addition to the increased hydrologic capacity of the area would accrue from the implementation of this comprehensive plan element.

Dantzler Restoration Costs

First Costs: $2,200,000 Annual O&M: $26,000

Franklin Creek Ecosystem Restoration

The Franklin Creek ecosystem restoration area is located near the communities of Orange Grove and Pecan, Mississippi in eastern Jackson County, near the Mississippi - Alabama state line. This area has already been funded for acquisition and demolition of 30 structures as part of the MsCIP Interim Report (P.L. 110-28). The restoration area consists of 149 acres located north and south of U.S. Highway 90, a major thoroughfare through the community and the CSX railway alignment. This area routinely floods with only a slight rainfall; thus, this would also provide additional flood storage capacity by restoring the natural habitat. Pine savannah wetlands are commonly referred to as sponges that provide floodwater retention, groundwater recharge, and water purification. This habitat is becoming fragmented and with the increased development, fire maintenance is increasingly harder to perform.

The tentatively recommended plan requires filling ditches, excavating and removing existing roadbeds and any additional fill, installing culverts under the highway, and maintaining vegetation growth by burning and mowing the project area in the initial year of construction as well as maintaining it by burning every three years over the life of the project as needed.

Franklin Creek Restoration Benefits

Benefits are measured in terms of AAFU. The HGM approach was used to assess wetland function similar to Turkey Creek discussed above. A conservative net gain of 516 AAFU in addition to the improvement in the hydrologic capacity of the area would accrue with implementation of this plan.

Franklin Creek Restoration Costs

First Costs: $1,850,000 Annual O&M:$11,000

Bayou Cumbest Ecosystem Restoration

This area is located in the extreme southeastern portion of Jackson County adjacent to Bayou Cumbest and the Mississippi Sound. The Bayou Cumbest restoration area contains approximately 148 acres to be restored to emergent tidal marsh and scrub shrub habitat. The area currently consists of a degraded tidal marsh, as well as filled and developed areas. Due to the severity of Hurricane Katrina, most of the residential development was severely damaged or destroyed. The area contains low elevations and since most residential structures have been destroyed, the opportunity exists to reduce the risk of future hurricane and storm damage and to restore the once existent tidal marsh. Of the total 148-acre restoration site, approximately 110 acres would be restored to tidal marsh and while the remaining 38 acres would remain scrub/shrub wetland habitat. The area presently consists of previously filled marsh areas that were developed into a residential community. The proposed project requires the acquisition of approximately 144 acres of developed and undeveloped properties

in addition to the use of 4 acres of land being acquired via the County / FEMA process. Portions of approximately 7 parcels of previously developed land fall within the restoration area (20 acres) with the remaining being undeveloped.

Wetlands, marshes, and nearshore marine and estuarine habitat are the nursery grounds for the entire marine food chain in the Gulf of Mexico. These habitats have been identified by the U.S. Fish and Wildlife Service as habitats of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section (Category 1 - Service Mitigation Policy, FR 46(15):7656-7663; dated 23 Jan 1981). Pollution, development, and other factors are destroying such habitat throughout the Gulf region. As this habitat is destroyed, it further depletes the species that form the base of the food chain throughout the Gulf of Mexico. Numerous species of marine flora and fauna begin their life cycles in marshes and wetlands. Ultimately, the entire Gulf of Mexico ecosystem is threatened by the accelerated destruction of this habitat. Failure to address the loss of this habitat in the Gulf of Mexico region threatens the long-term health of the entire ecosystem and human culture, with the attendant loss of billions of dollars of marine-related resources.

The tentatively recommended plan will restore 148 acres. The tentatively recommended plan consists of acquiring lands and restoring the natural ecosystem by excavating old fill material, removing exotic plant species from non-excavated areas, filling existing artificial ditches, and planting native vegetation, such as *Spartina alterniflora* (Smooth Cordgrass) at the seaward edge of marsh; *Juncus roemerianus* (Black Needle Rush) at a slightly higher elevation; and *Spartina patens* (Saltmeadow Cordgrass) at even higher elevations at a density of 1 meter (Plan 2).

Bayou Cumbest Restoration Benefits

The HGM approach was used to assess wetland function. A conservative estimate of the increase in habitat value of 637 AAFU has been determined. These benefits are strictly the direct benefits of excavating the previous fill and restoring the tidal wetland vegetation. We have not calculated the indirect benefits applicable to the Mississippi Sound estuary from the increase in tidal fringe wetland. In coastal Mississippi tidal fringe wetlands are primarily restricted to eastern Jackson and western Hancock counties and the margins of the inland bays.

Bayou Cumbest Restoration Costs

First Costs: $25,400,000 Annual O&M: $114,000.

Admiral Island Ecosystem Restoration

The 123 acre restoration area is located in Hancock County adjacent to Bayou La Croix and near Bay of St. Louis. The site contains of 62 acres of emergent tidal marsh and 61 acres of scrub shrub habitats. The property is owned by the State of Mississippi and consists of degraded wetland habitat as a result of debris and sediment deposited during the storm surge event of Hurricane Katrina.

The tidal marshes in this area were ditched during the 1960s causing changes in the natural hydrology and subsequent changes in the species composition. Hurricane Katrina left extensive debris fields and sedimentation throughout the area and destroyed many native trees and vegetation. Due to the loss of native species, this area is experiencing a severe infestation of the invasive Chinese tallow tree, which is invading the marshes and the adjacent flatwoods. These exotic species out-compete the native vegetation, which provides food sources to the many fish and wildlife important species, including T&E species. Without any native competing species, these exotic species eventually become the only species in the area and result in a much degraded function of the wetlands.

The tentatively recommended plan consists of restoring the study area by excavating old fill material, filling existing artificial ditches, removing exotic plant species from non-excavated areas, removal of

hurricane debris and planting native vegetation, *Spartina alterniflora, Juncus roemerianus, and S. patens*.

Admiral Island Restoration Benefits

Benefits are measured in terms of AAFU. A major benefit of this restoration is the return of the natural hydrology of the area which is not reflected in the estimated increase in habitat value of 108 AAFU.

Admiral island Restoration Costs

First Cost: $21,700,000 Annual O&M: $58,000

Deer Island Ecosystem Restoration

Deer Island, located within the boundaries of Harrison County, Mississippi near the mouth of Biloxi Bay and the City of Biloxi, has a history of tropical storm damage. Damages from these storms has varied based on varying degrees of storm surge, wave action and wind depending on the speed, intensity, direction of travel, and proximity of the given storm. A breach on the west end was significantly widened, coastal marshes were impacted by debris and sedimentation, and the maritime forest was killed by wind and salt spray. The island is considered a mainland remnant and is not part of the coastal barrier system of islands along the Mississippi Coast. The island contains a diversity of habitat areas including beach/dune areas, marsh area, and maritime forest areas. It's proximity to the City of Biloxi provides a certain amount of protection to the city from waves generated by approaching hurricanes. This protection comes at a cost to the island as that energy affects the seaward shoreline and the interior marshes. It has been estimated that the island has lost approximately 300 acres or about 34 percent of its area since 1850, due to eroding shoreline.

A second restoration effort is currently underway which will fill the western breach and provided selective restoration to critical areas on the southern shoreline. This project is authorized under Section 528 WRDA 2000 and will be complete in 2009. Funding for this effort, however, is inadequate to completely restore the island and to remediate for the additional damage to the island caused by Hurricane Katrina.

The tentatively selected restoration plan includes the full restoration of the southern shoreline, restoration and enlargement of the Section 204 wetland feature on the northern shore of the island, and new stone training dikes to prevent future erosion.

Deer Island Benefits

Implementation of the combination plan would significantly improve the sustainability of Deer Island and provide an additional 342 acres of highly productive estuarine tidal fringe wetlands, restore beach and dune habitat, create hard bottom habitat through the use of stone containment, reduce coastal erosion, and restore the coastal maritime forest, an ecosystem of regional importance and concern. The total increase in functional habitat units from this proposed feature is 2125 FHI. In addition to environmental benefits the restoration of Deer Island provides substantial incidental hurricane storm damage reduction benefits to the developed mainland Biloxi area.

Deer Island Costs

First Costs: $21,400,000 Annual O&M: $0

Submerged Aquatic Vegetation Pilot Project

Additional information is required to assess the complex environmental make-up impacting submerged aquatic vegetation (SAV) in Mississippi Sound due to the fact that previous planting efforts utilizing vegetation alone have not been entirely successful. Many questions remain to be answered (i.e. water quality, circulation, etc.) prior to coastwide SAV restoration implementation.

The comprehensive plan recommends implementation of a pilot project to evaluate the feasibility of SAV restoration on a large scale.

Bayou Cumbest Pilot Restoration

The pilot project would restore 5 acres of *Ruppia maritima* in the Grand Bay National Estuarine Research Reserve resulting in the recovery of an equal amount of SAV habitat to that lost during the 2005 hurricane season. Three restoration techniques will be evaluated to demonstrate their feasibility for larger restoration projects. Three transplanting methods for restoring *R. maritima* will be evaluated as follows:1) direct planting from the donor site, 2) harvesting plant sprigs with one or more meristems (growth regions) from the donor site with subsequent growth in a greenhouse setting prior to planting, and 3) spreading seeds or mature flowering shoots over the restoration site. All plants and seeds would be acquired from a common donor site within the same system. After transplanting, quarterly monitoring for two years would be conducted to determine plant establishment, photosynthesis, growth, and expansion.

SAV Restoration Benefits

Submerged aquatic vegetation is an essential primary producer forming the basis of the food web for many estuarine species. These grasses provide important habitat for many Aquatic Resources of National Importance. In addition, SAVs are sensitive indicators of estuarine condition because of their high light requirements and susceptibility to eutrophication-induced algal blooms and hypoxia. Furthermore, loss of SAV promotes the alteration of the sediment characteristics and nutrient cycling, causing long-term changes in habitat suitability for natural plant recolonization. These changes include loss of fine sediments through resuspension and transport, promoting a feedback loop that further inhibits natural recovery.

SAV Restoration Costs

First Costs: $900,000 for monitoring and producing a final restoration report.

Additional Ecosystem Restoration Studies

This report supports the recommendation for further investigations of additional ecosystem restoration components of the Comprehensive Plan in anticipation of potentially recommending the features for future authorization as part of the MsCIP Comprehensive Plan.

In addition to the specific restoration projects described above, an additional 38 sites have been recommended by the interagency team for further investigation. These sites have been divided into two categories: 1) those sites which would have significant risk reduction benefits in addition to ecosystem benefits and 2) those that would have ecosystem benefits. These sites have been identified utilizing a GIS based tool which allowed identification and prioritization of sites based on the capability to produce sustainable wetland function without extensive future maintenance or management. Due to the complexity of some of the restoration needs and the interrelationship between risk reduction and environmental restoration a need for additional study was identified. The recommendation for further investigations would allow ecosystem restoration to be implemented on a holistic, watershed, and regional approach. Establishment of this program would ensure commitment to restoration of the hurricane damaged and destroyed ecosystems in coastal Mississippi; thus, allowing attainment of the overall Comprehensive Plan objectives.

Implementation of any of these projects would be dependent upon the preparation of a decision document, such as Project Information Report, which would range from $100,000 to $350,000 depending upon the specific project complexness. This cost has been incorporated into the cost estimates that follow.

Table 4 presents those project features that are designed to restore the hydrology and natural landscape of the coastal counties with incidental risk reduction benefits. These areas are primarily

undeveloped and are owned by the State of Mississippi as part of the Coastal Preserves Program. Table 5 presents those project features that are designed to both reduce the risk to life and property from future hurricane storm surge events and secondly to provide for substantial environmental benefit. These areas are typically fully developed residential areas that are subject to repetitive damage from hurricane and other storm events. Acquisition of these properties could be facilitated through the future implementation of the Long-Term High Hazard Area Risk Reduction Program recommended above.

Table 4. Additional High Priority Ecosystem Restoration Sites (Incidental Risk Reduction Benefits)

Site	Restoration Acres	Environmental Setting	Estimated Project Cost
Wachovia, Hancock	1,200 acres total – 800 marsh, 200 forested, 200 savannah	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$2,830,000 ER $ 0 RE
Ansley, Hancock	900 acres – 800 marsh, 100 forested	Emergent aquatic vegetation Wet pine savannah	$2,420,000 ER $ 0 RE
LaFrancis Camp Trenaisse, Hancock	45 acres total – all open water	Open water	$8,770,000 ER $ 0 RE
DuPont, Harrison	650 acres – 170 marsh, 480 forested	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$TBD ER $ 0 RE
Dantzler Part 2, Jackson	900 acres – 500 marsh, 385 forested	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$6,597,000 ER $ 0 RE
Pascagoula River Marsh, Jackson	11,150 acres	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$2,230,000 ER $ 0 RE
ER = Construction Costs, RE = Acquisition Cost, TBD = Costs for these ecosystem restoration are being developed			**Estimated Project Costs** **$22,847,000**

Table 5. Additional High Priority Ecosystem Restoration Sites (Primarily Risk Reduction Benefits)

Site	Restoration Acres	Environmental Setting	Estimated Project Cost
Pearlington, Hancock	76 acres (State owns 2,200 acres in the Pearlington area)	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$15,300,000 ER $14,900,000 RE
Pearlington South, Hancock	11 acres	Emergent aquatic vegetation Bayhead Swamps trees Bayhead Swamps shrubs Riverine/levee forests	$2,300,000 ER $21,100,000 RE
Port /West, Hancock	49 acres	Emergent aquatic vegetation	$10,000,000 ER $9,800,000 RE
Ansley, Hancock	2,023 acres (State owns 6,000 acres west of Lakeshore Road)	Emergent aquatic vegetation Wet pine savannah	$399,100,000 ER $83,000,000 RE
Heron Bay, Hancock	594 acres	Emergent aquatic vegetation	$83,200,000 ER $80,000,000 RE
Lower Bay, Hancock	226 acres	Emergent aquatic vegetation	$31,700,000 ER $8,400,000 RE
Lakeshore, Hancock	275 acres	Emergent aquatic vegetation	$54,500,000 ER $14,700,000 RE
Bayou Caddy/Lakeshore, Hancock	362 acres	Emergent aquatic vegetation	$71,700,000 ER $41,700,000 RE
Clermont Harbor, Hancock	209 acres	Emergent aquatic vegetation	$41,600,000 ER $166,700,000 RE
Bayou La Croix, Hancock	259 acres	Emergent aquatic vegetation	$51,400,000 ER $155,700,000 RE
Shoreline Park, Hancock	889 acres	Emergent aquatic vegetation	$175,600,000 ER $1,083,600,000 RE
Chapman Road, Hancock	146 acres	Emergent aquatic vegetation	$29,200,000 ER $144,900,000 RE
Jourdan River – Interstate 10 Development, Hancock	638 acres	Emergent aquatic vegetation	$126,200,000 ER $29,700,000 RE
Diamondhead, Hancock	433 acres	Emergent aquatic vegetation	$85,800,000 ER $182,200,000 RE

Site	Restoration Acres	Environmental Setting	Estimated Project Cost
Delisle, Harrison	120 acres (State owns 1,000 acres)	Emergent aquatic vegetation Bayhead swamps trees Bayhead Swamps shrubs	$24,100,000 ER $17,800,000 RE
Ellis Property, Harrison	443 acres	Emergent aquatic vegetation Pine savannah - wet pine flatwoods.	$46,900,000 ER $13,400,000 RE
Pine Point East, Harrison	103 acres (State owns 40-50 tax forfeited lots)	Emergent aquatic vegetation Wet pine savannah habitat	$20,600,000 ER $26,900,000 RE
Pine Point West, Harrison	83 acres (State owns 40-50 tax forfeited lots)	Emergent aquatic vegetation Wet pine savannah habitat	$16,800,000 ER $19,900,000 RE
Pass Christian Beach Front, Harrison	21 acres	Emergent aquatic vegetation Bayhead swamps trees Bayhead Swamps shrubs	$4,300,000 ER $6,400,000 RE
Pass Christian Site – Bayou Portage, Harrison	43 acres	Emergent aquatic vegetation Bayhead swamps trees Bayhead Swamps shrubs	$8,700,000 ER $19,100,000 RE
Brickyard Bayou, Harrison	14 acres	Emergent aquatic vegetation Bayhead swamps trees Bayhead swamps shrubs	$2,900,000 ER $4,100,000 RE
Biloxi River – Shorecrest, Harrison	15 acres	Emergent aquatic vegetation Bayhead swamps trees Bayhead swamps shrubs Riverine/levee forests	$3,000,000 ER $9,500,000 RE
Biloxi River – Eagle Point, Harrison	17 acres	Emergent aquatic vegetation Bayhead swamps trees Bayhead swamps shrubs Riverine/levee forests	$3,200,000 ER $14,200,000 RE
Biloxi Front Beach - South of Highway 90, Harrison	40 acres	Dune System	$7,000,000 ER $53,500,000 RE
Keegan Bayou, Harrison	54 acres	Emergent aquatic vegetation Wet Pine Savannah habitat	$10,900,000 ER $20,600,000 RE
St. Martin, Jackson	467 acres	Emergent aquatic vegetation	$92,400,000 ER $55,100,000 RE
Fort Point, Jackson	83 acres	Emergent aquatic vegetation	$16,700,000 ER $12,700,000 RE
Pine Island, Jackson	237 acres	Emergent aquatic vegetation	$497,900,000 ER $20,700,000 RE

Site	Restoration Acres	Environmental Setting	Estimated Project Cost
Belle Fontaine, Jackson	1,516 acres	Dune System	$297,900,000 ER $75,800,000 RE
Griffin Point, Jackson	182 acres	Emergent aquatic vegetation	$36,000,000 ER $34,900,000 RE
Bayou Chico, Jackson	258 acres	Emergent aquatic vegetation	$51,200,000 ER $31,700,000 RE
Grand Bay/Bayou Cumbest, Jackson	2,666 acres	Emergent aquatic vegetation	$525,700,000 ER $95,700,000 RE
ER = Construction Costs, RE = Acquisition Cost, TBD = Costs for these ecosystem restoration are being developed			**Estimated Project Costs** **$5,458,200,000**

Once the restoration sites have been prioritized, a sequencing plan would be developed identifying the events necessary to accomplish restoration. This would ensure prioritized sites received immediate attention and further details developed for the required analysis.

As projects are being developed, specific details would be developed to ensure compliance with regulations, policies, and acts. This information would be complied in a PIR and would consist of certain NEPA documents, EA, Finding of No Significant Impact, and others as necessary, project designs and details, economic analysis including incremental cost analysis for use in selection of a best buy plan, and other necessary documentation for approvals. The level of detail contained in a PIR would be commensurate with the complexity and cost of the project while including the information necessary to meet requirements.

In addition Program Status Reports would be developed to include a system-wide reevaluation considers program and project-level information, and the level of success of overall met program goals and objectives. Project level formulation activities would address optimization of the overall program's contribution to the system-wide goals and objectives in general, and project goals and objectives would be more specific. The individual project monitoring reports may result in project modifications that impact or modify system output, however, these modifications would not address system-wide issues within the comprehensive plan. Status reports would provide updates on the overall success of environmental restoration throughout coastal Mississippi

Costs

A rough order of magnitude cost estimate has been prepared for each project based on existing conditions and restoration measures. This could serve as an upward limit of funding for the comprehensive environmental restoration program. Costs cover site acquisitions including associated relocation costs, removal and site demolition activities, and ecosystem restoration activities.

Violet Freshwater Diversion Project Engineering and Design

This report supports the studies required to accomplish the intent of Section 3083 of the Water Resources Development Act of 2007 to design a freshwater diversion project to be located in the vicinity of Violet, LA. The project would provide sufficient inflows to the western Mississippi Sound area to support oyster reef health and productivity.

Mississippi Department of Marine Resources (MDMR) has been working with the Mississippi congressional delegation in order to address impacts from saltwater intrusion and degradation of the oyster resources found within Mississippi Sound, specifically in the western portion of the state in Hancock County. Joint efforts between Mississippi and Louisiana congressional delegates resulted in the identification of potential freshwater diversion projects from the Mississippi River as a mechanism for reversing the historic increase in salinity in the Mississippi Sound/Biloxi marshes area in order to support fresher marshes and oyster reef health and productivity thus enhancing both their economic value and the ecological services they provide (WRDA 2007, Section 3083).

The results from a simulated diversion of 7,500 cfs of Mississippi River water near Violet, Louisiana, suggest that 180 days after initiation of the diversion, salinities were lowered in western Mississippi Sound sufficiently to warrant additional examination. However, at present, absolute salinity values predicted by the model poorly match calibration data. Further refinement of the models should correct this limitation to allow the usefulness of the model results for estimating potential beneficial or deleterious effects on oysters and other coastal resources.

Key attributes have been identified that need to be incorporated into the evaluation of freshwater diversion options. The first is that salinities average as closely as possible to the optimal range for oyster health and productivity. This is clearly of critical importance since the primary purpose for contemplating freshwater diversions is to improve habitat conditions for oysters. Second, a diversion should not result in extended periods of low salinity resulting in mortality or poor growth and reproduction. This consideration is particularly critical during times of high river flow or other extreme conditions. Third, a diversion should not unduly influence habitat conditions for other critical resources.

Diversions that result in favorable conditions for oyster health may not be conductive to other equally important resources. For instance, most sea grasses do poorly at salinities less than 20 ppt. A diversion that results in excellent conditions over the prime commercial beds but drives salinities below 20 ppt in the seagrass elsewhere would not be acceptable. Other important habitat requirements that should also be considered for seagrass health include light availability and nutrient concentrations. These environmental concerns associated with water diversions, in addition to potential impacts on important fisheries species of those areas, require monitoring and adaptive operations of the diversion structure to enhance the long-term sustainability of nearshore and estuarine resources.

The Violet diversion project will likely consist of a gravity diversion structures constructed on the east bank of the Mississippi River at Violet, Louisiana. The structure would be designed and operated to provide for an estimated target freshwater diversion of approximately 10-12,000 cfs released into Lake Borgne. The structure would be operated in such a matter as to allow for releases in the quantities and frequencies necessary to reach the target salinity rate. Early modeling suggests timing of the release as well as frequency is crucial to ensure success at reaching the target salinity rate for oysters, an indicator species as to the overall health of the ecosystem. Further modeling would refine target frequencies and timing of releases of the freshwater to meet oyster habitat goals.

A diversion at Violet is currently being evaluated as part of the comprehensive ecosystem restoration plan for Mississippi River Gulf Outlet as authorized under Section 7013 of WRDA 2007. This evaluation is being fully coordinated with the MsCIP Comprehensive Plan.

Escatawpa River Diversion – Grand Bay Marsh Ecosystem Restoration

This report supports the recommendation for authorization to conduct feasibility level analyses of freshwater diversion at the Escatawpa River in anticipation of potentially recommending this comprehensive plan element for future authorization as part of the MsCIP Comprehensive Plan.

Historically, the estuarine marsh within the Grand Bay NERR represented the former deltaic environments of the Pascagoula and Escatawpa Rivers in eastern Jackson County. The outlets of these rivers have shifted westward over time, severely limiting the inflow of freshwater, nutrients, and sediments into the Bayou Cumbest area of the reserve.

Currently, it is speculated that much of the freshwater entering the Grand Bay NERR estuary is from surface runoff through Bayou Cumbest and Bayou Heron, within the Bangs Lake Hydraulic Unit, measuring approximately 21,374 acres. Human disturbances to the area have also altered historic sheet flow and surface water flows into the area, as well as the natural migration of the Pascagoula and Escatawpa Rivers.

Due to the time constraints, the team was only able to qualitatively determine that freshwater input into the systems does change the overall environment. It is known that these systems have been altered and/or starved by lack of freshwater inflow. An integrated environmental web exists in these rivers and also in Mississippi Sound, which needs to be fully identified, in order, to completely understand various effects that could possibly occur.

Further studies would allow for development of a refined hydrodynamic model for the area, inputting biological, water quality, and physical data into the model to evaluate a variety of freshwater diversion scenarios. This work represents a critical first step in the final assessment of potential water diversion projects for this area. Additionally, community information needs to be solicited obtained through interviews and public workshops will be solicited and a public workshop will be held to share the results.

Escatawpa River Diversion Benefits

A freshwater diversion project in the area, if feasible, may serve to enhance the wildlife resources of the area. The need for freshwater diversion at the Grand Bay savannahs and marshes would help restore the predominant wet pine savannah habitat. Shoreline erosion along the Grand Bay area (i.e. loss of the Grand Batture Islands) has also contributed to the increased **salinity in the area.**

Escatawpa River Diversion Costs

An estimated $ 3,000,000 is required for the additional environmental and engineering study and design.

Coast-wide Beach and Dune Ecosystem Restoration

This report supports the recommendation for authorization to construct additional beach and dune restoration improvements on the manmade beaches along the Mississippi coast. Essentially all the beaches along Coastal Mississippi are man-made. Harrison County has the most beachfront with a 26-mile stretch extending from Biloxi Bay to St. Louis Bay that was constructed in the 1950s. This beach is the longest man-made beach in the U.S. Hancock County has several miles of beach while Jackson County only has a small beach located in the Cities of Pascagoula and Ocean Springs. In total, the beaches extend along less than half of the Mississippi coastline.

Most of the dunes that previously existed along these beaches were destroyed by Hurricane Katrina and much of the beach was damaged. Many Federal, state, and local entities raised environmental concerns regarding the various Mississippi beaches during initial discussions held to receive local citizenry input. In some areas, such as in the City of Pascagoula, the beach was completely gone. Reconstruction of the dunes, where beaches exist, will provide a reduction of damaging wave action from smaller storms (i.e. normal summer storms, tropical storms, and/or lower energy hurricanes).

A project to restore the beaches in Harrison County has been completed under the Flood Control and Coastal Emergencies (FCCE) authority. Other projects to construct limited dunes to a height of 5-foot in Harrison County and to 2-foot in Hancock and Jackson County were proposed as part of the

MsCIP Interim Report. That dune restoration project has since been funded and the Corps, Mobile District is underway preparing the plans and specifications.

The project comprehensive plan element would provide for additional beach and dune systems on those beach areas not being addressed in the MsCIP Interim projects as well as to provide additional dune habitat to those currently being addressed.

Beach and Dune Ecosystem Restoration Benefits

The storms of 2005 destroyed a large percentage of critical habitat for the piping plover, various shorebirds including the Least Tern, and numerous fish and wildlife species. Beach nourishment and dune restoration would benefit piping plover as well as providing lost habitats for other shorebirds, additional eco-tourism opportunities, and enhancement to the overall quality of life in Coastal Mississippi. Placement of the dunes directly against a raised seawall or roadway would also serve aesthetically to mask the appearance of a structural barrier. Thus, adding to the public acceptance and/or appeal of this proposal.

Dunes are consistent with public preference for a more natural appearing defense mechanism rather than a hardened structure. Construction of dunes will include planting vegetation, such as sea oats (*Uniola paniculata*), and sand fencing to help stabilize the dunes. Sand dunes are naturally occurring dynamic coastal features, which are formed by the accumulation of wind blown sand. Sand is naturally carried along the beach by the wind. Sand fences help facilitate the building of sand dunes by trapping and collecting this wind driven sand. Sand fences are usually made of wood or biodegradable material. Dune plants tolerate harsh beach conditions including wind, salt spray, storms, scarce nutrients, limited freshwater, and intense sunlight and heat. The plants and/or seedlings provide feeding sources to a variety of animals while also providing nesting and roosting habitat.

The tentatively recommended plan for this element of the Comprehensive Plan was determined by a combination of cost-effectiveness analysis and achievement of key restoration objectives. The most cost-effective and functionally complete alternative was determined to consist of creation of a dune field that would be constructed approximately 50 ft seaward of the existing seawall and about 2 feet above the existing berm with a width of approximately 60 ft. The most functionally-effective alternative included dune vegetation and sand fencing to enhance establishment and survival of the dune vegetation.

Beach and Dune Ecosystem Restoration Costs

First Costs: $23,200,000 Annual O&M: $0

Barrier Island Ecosystem Restoration Alternatives

This report supports the recommendation for authorization to construct ecosystem restoration improvements at Mississippi's barrier islands. The barrier islands have historically constituted a impediment to saltwater entering the estuary formed by the islands, maintaining a careful balance of saltwater and freshwater flows, which sustain the valuable marine resources of Mississippi Sound. The barrier islands also provide a barrier to onshore movement of waves, and to a lesser extent storm surge, by attenuation. Over recent decades, the level of wave and surge reduction they provide has been steadily reduced, but much more so during the hurricane events of Camille, and Katrina, in which Ship Island was first severed, then dramatically separated, and badly eroded. Based on current investigations, it has been determined that these barrier islands are incapable of rebuilding on their own due to frequent, intense storms, relative sea level rise, and anthropogenic activities that may have resulted in a reduction in sand supply to the Mississippi barrier islands.

The degree of decline in shellfish and other marine resources within Mississippi Sound attributable to the degradation of the barrier islands is currently impossible to precisely quantify; however, it is

known that declining oyster populations are directly attributable to the increasing salinity within Mississippi Sound. Oysters are sensitive to specific ranges of salinity. Under current conditions, the islands provide a natural boundary between the water's salinity [~33 parts per thousand (ppt)] of the open Gulf of Mexico and the brackish water found in Mississippi Sound. Salinity in the Sound during low flow periods range from 10 to 30 ppt.

The contribution of surge reduction provided by the barrier islands, in their historic, existing, and altered states, has been subject to sensitivity analyses that indicate that some surge reduction is realized on the eastern Mississippi coast by the islands being in a pre-Camille footprint. Additional benefits were also predicted by creating longer and higher islands that were not subject to erosion on storms. It has also been roughly estimated that as much as ten feet of wave height reduction is provided by the barrier islands in their present condition as compared to the islands being removed from the system.

The alternatives for barrier island renourishment and protection of Mississippi Sound are being formulated and evaluated by a multi-agency regional study team consisting of staff from the National Park Service, U.S. Geological Survey, and Corps of Engineers. In addition, barrier island restoration has been suggested and is supported, by numerous members of the public, other agencies, and the State of Mississippi.

Alternatives being evaluated include very limited restoration of Ship Island, only in the vicinity of the endangered cultural sites of Fort Massachusetts and French Warehouse, on (the post-Katrina condition) "West" and "East" Ship Islands, respectively up to 'massive' restoration of the historic island dimensions. Although the protection of the cultural resource sites appears to be a justified option, this alternative would neither represent a complete solution, nor a completely effective means of addressing the larger problem faced on that island and the others. On the other hand, a more massive plan for barrier island restoration, or more direct application of sand, was rejected by many on the team, as unmanageable and potentially damaging, due to the unknown effects that might be introduced by placing sand into an area that could not be maintained by littoral drift over the long-term. More massive measures did not appear to provide a significantly greater volume of functional increase, for a much larger outlay of funds.

The most promising alternative for barrier island renourishment and protection of Mississippi Sound would produce the greatest functional benefit per dollar expended, would be a complete solution, would represent an efficient use of Federal and local funds, would be effective in its treatment of the problem (particularly in comparison to less effective structural wave reduction measures), and would be acceptable in terms of existing laws, policies and priorities. This alternative includes the direct placement of sandy sediments to fill the breach in Ship Island and thereby reconnect West and East Ship Islands to their historic condition and to place sandy sediments within the littoral zones of the Mississippi barrier islands to ensure that the sediment budget of the islands is sufficient to maintain the islands in the future. This littoral zone placement would also benefit from the modification of dredging and disposal practices of the federally maintained Gulfport and Pascagoula Harbor navigation projects. These coupled efforts would begin the long-term process of barrier island repair and sustainability.

Barrier Island Ecosystem Restoration Benefits

Restoration of the Mississippi barrier island system would provide significant system-wide ecosystem benefits as well as economic benefits associated with damages and economic losses avoided and regional economic benefits.

Most notably the restoration of the islands would help maintain and sustain the fragile Mississippi Sound ecosystem with its economic, recreational, environmental, and aesthetic benefit and provide for additional nesting habitat for threatened and endangered sea turtles and over wintering critical habitat for the piping plover. A functional habitat index evaluation of just the direct placement of

sand in Camille Cut with the associated dune habit restoration would increase that habitat value of Ship Island to approximately 500 habitat units vs. the 96 units provided currently by Ship Island. With the continued erosion of this island, the habitat value will only decline in the future without intervention. No environmental benefits have been calculated relative to the maintenance of the Mississippi Sound but a rough estimate of the fishery losses avoided by restoration of the island is over $43 million in average annual benefits.

Barrier Island Ecosystem Restoration Costs

First Costs: $477,200,000 Annual O&M: $0

Systems / Watershed Context.

The hurricanes of 2005 affected the entire region of the northern Gulf of Mexico from the panhandle of Florida to the Texas coast. Although Congress authorized two separate studies (MsCIP and LaCPR) with slightly different objectives, the USACE has taken a systematic and regional approach in formulating solutions and in evaluating the impacts and benefits of those solutions. All potential impacts, both adverse and beneficial impacts, are being considered without regard to geographic boundaries. The joint study teams collaborated at a Northern Gulf of Mexico integrated systems scale. A regional salinity and water quality model has been developed covering an area from west of Lake Pontchartrain to east of Mobile Bay and south beyond the Chandeleur Islands in the Gulf. Regional storm surge modeling has been applied to examine regional-scale changes to storm surge levels associated with several of the proposed project alternatives. A multi-disciplinary risk assessment team was assembled by the Corps to characterize the probabilities of different hurricanes that can impact the northern Gulf of Mexico region. The risk assessment team supported both the MsCIP and LaCPR work and FEMA's remapping efforts, and developed a unified general coastal flooding methodology that is being applied by USACE and FEMA.

Actions for Change

Hurricane Katrina demonstrated the need to be prepared and ready to broadly integrate the Corps' many mission capabilities. The 'Actions for Change' (Reference CG Directive #1 – Supplemental Actions to the USACE Campaign Plan, Applying Lessons Learned resulting from Hurricanes Katrina and Rita, Dated Aug 24, 2006) provide a common organizational framework to help meet that objective.

The MsCIP has embraced these actions throughout the planning process. The study team used a systems-based approach to develop comprehensive plans that were integrated across Corps' mission areas, as well as other local, state, and Federal agency projects and programs. The MsCIP also reassessed and sought policy changes to accommodate the never before seen devastation along the Mississippi Gulf Coast, and used a very dynamic independent and external review process. Alternatives were developed using adaptive planning and engineering systems and focused on sustainability of the environment and communities along the coast.

The organization of the MsCIP team allowed for flexibility across the traditional Corps' hierarchy, as well as incorporating team members from other agencies. This cooperative atmosphere created an organizational behavior allowing team members to focus on innovative and effective solutions to the problems with which they were tasked.

The MsCIP also developed and employed risk-based concepts which engaged stakeholders and allowed for informed decision making. The MsCIP planning process made extensive use of public and agency involvement, which introduced ideas, provided feedback, and gave first-hand accounts of the damages suffered as a result of the disaster. In an effort to demonstrate reliable public service professionalism, the public, state and local government input received at public workshops was also used to identify the degree of importance placed on environmental issues and to help the PDT in determining its recommendations.

The comprehensive planning effort has required an investment of research into storm surge modeling and impact analysis, water quality impacts of freshwater diversions, and determining the value of natural landscapes in the reduction of storm surge risk to adjacent areas. This research will be nature be continued into the future with the implementation of the adaptive management plan as outlined in the MsCIP Comprehensive Report.

The technical expertise and professionalism of the MsCIP team has been crucial to the development of a plan which considered multiple objectives on a regional and system-wide scale.

Finally, the results of the planning process were used to:

- Identify cost-effective solutions,
- Provide the best choices based on an extensive set of criteria, and
- Identify the trade-offs made during the evaluation of alternatives.

The planning process documented the culmination of technical analyses, public input, and systematic evaluation. The recommended solutions stand out in their ability to fulfill the Congressional authorization and the needs of the nation.

Environmental Operating Principles. The Tentatively recommended plan supports each of the seven USACE Environmental Operating Principles. The tentatively recommended plan will strive to achieve environmental sustainability by restoring critical natural landscape features, formulating plans that require little future maintenance and including inspection and monitoring throughout the project life. The tentatively recommended plan considers environmental consequences by considering all plan features in a systemwide fashion utilizing dynamic habitat models and considering geomorphic evolution in light of changing natural conditions. The tentatively recommended plan also considers environmental consequences by avoiding construction in critical seasons and locations, and by mitigating for the small impacts that will result from construction. The tentatively recommended plan seeks balance and synergy among human development activities and natural systems by maximizing flood risk management benefits while avoiding and minimizing impacts to significant resources. By implementing the tentatively recommended plan, the Corps will accept responsibility and accountability under the law to ensure that the project complies with all applicable Federal Laws. The tentatively recommended plan seeks ways and means to assess and mitigate cumulative impacts to the environment by initially avoiding any impacts and mitigating for the small impacts that do occur. Through consultation, coordination, and outreach with other Federal and State agencies, local government, and the public, the tentatively recommended plan will continue to build and share an integrated scientific, economic, and social knowledge base. Since the inception of the study, the Project Delivery Team (PDT) has listened to, respected, and learned from the perspectives of individuals and groups interested in Corps activities by maintaining coordination with local government representatives and interested members of the public.

Agency Technical Review and External Peer Review.

The Comprehensive Plan and Integrated Programmatic Environmental Impact Statement report has undergone an Agency Technical Review (ATR) conducted by the Corps" National Center of Expertise for Hurricane and Storm Damage Reduction in North Atlantic Division (NAD). The ATR has been coordinated by the Philadelphia District and utilized resources of NAD, other Corps Divisions, and the Engineering Resource and Development Center (ERDC). Comments made by the ATR team and responses to those comments are documented in the ATR package, which is provided as an appendix. Certification of completion of ATR is also provided as part of that appendix. The final report products will also undergo ATR by NAD, coordinated by the Philadelphia District and utilize resources of NAD, other Corps Divisions, and ERDC.

Independent External Peer Review of the final report was coordinated by the Baltimore District of the Corps via a contract with Battelle, Inc, and conducted by appropriate outside resources familiar with the study area and its resources. Comments made by the IEPR team and responses to those comments, are documented in the IEPR package, and also provided in the ATR/IEPR appendix. Consideration of information generated by the Interagency Performance Evaluation Task Force was done at all times during the conduct of this study, and was included in the development of Comprehensive Plan alternatives. The HQUSACE Policy Review comments via the Policy Guidance Memorandum (PGM) were addressed, and responses were incorporated into the report.

EXPECTED PROJECT PERFORMANCE

Project Performance. The comprehensive plan provides integrated systems-based solutions and tentatively selected plans that address: *hurricane and storm damage reduction, ecosystem and restoration and fish and wildlife preservation, reduction of damaging saltwater intrusion, and reduction of coastal erosion.* The tentatively selected plans also provide measures that aid in: regional economic redevelopment, positive societal effects, and long-term measures to reduce risk to the public and property.

The benefits of the recommended Mississippi Coastal Improvements Comprehensive Plan are as follows:

Construction projects:

- Barrier Island Restoration
  - Maintain and sustain the fragile Mississippi Sound ecosystem with its economic, recreational, environmental, and aesthetic benefits, provide for additional nesting habitat for threatened and endangered sea turtles and over wintering critical habitat for the piping plover, fishery losses avoided by restoration of the island equate to $43 million in average annual benefits.
- Turkey Creek Ecosystem Restoration
  - 689 acres of wet pine savannah restoration
- Bayou Cumbest Ecosystem Restoration
  - 110 acres of tidal marsh and 38 acres of scrub shrub habitat restoration
- Dantzler Ecosystem Restoration
  - 385 acres of wet pine savannah restoration
- Admiral Island Ecosystem Restoration
  - 62 acres of tidal marsh and 61 acres of scrub shrub habitat restoration
- Franklin Creek Ecosystem Restoration
  - 149 acres of wet pine savannah restoration

- Submerged Aquatic Vegetation Restoration;
    - Additional study via an in situ pilot project which will inform future restoration efforts
- Coast-wide Beach and Dune Restoration;
    - Restore piping plover habitat and habitat for other shorebirds, provide eco-tourism opportunities, and enhance overall quality of life in coastal Mississippi, construction of elevated dunes, situated immediately seaward of developed areas, provides additional protection against smaller hurricanes.
- Moss Point Municipal Structures Relocation
    - The relocation of these facilities would greatly reduce future damages to the local infrastructure and provide a higher confidence in uninterrupted public service in future events. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs.
- Waveland Residential Structure Flood Proofing;
    - Twenty-five structures in the Waveland area that would be safely elevated out of the 1% chance storm event. Future damages to these structures would be significantly reduced and the area would serve as an example of smart growth. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs.
- Forrest (Forest) Heights Levee Improvements
    - Equivalent annual damages reduced by the 21-foot levee are estimated to be $331,508. Regional economic benefits include an increase in sales volume of $20,250,000, a $4,286,426 increase in local income, and a net increase of 129 jobs. In addition to these damages reduced, the levee would provide a significant boost to the cohesiveness of the historically significant community, preserve the culture and heritage of it's predominantly minority residential population, and greatly improve their overall quality of life.
- High Hazard Area Risk Reduction Plan (HARP Phase 1):
    - The average annual average damages avoided for the 2,000 highest risk properties along the coastline were determined to be $33,000,000. Regional economic benefits include an increase in sales volume of $1,171,260,000, a $246,056,800 increase in local income, and a net increase of 7,213 jobs.

Feasibility level investigations:

- Escatawpa River Diversion – Grand Bay Marsh Ecosystem Restoration
    - A freshwater diversion project in the area, if feasible, may serve to enhance the wildlife resources of the area. The need for freshwater diversion at the Grand Bay savannahs and marshes would help restore the predominant wet pine savannah habitat.
- Additional Damage Reduction Alternatives
    - A very preliminary estimate of annual without-project damages for these potential structural solutions totals well over $60 million. The implementation of ring levees and / or other structural components in these areas would reduce a significant portion of storm-related damages and warrants further feasibility level consideration.
- Additional Coastal Mississippi Ecosystem Restoration Alternatives

    - This analysis identified 38 additional potential restoration sites which would primarily restore the hydrology and natural landscape of the coastal counties with incidental risk reduction benefits, or which would primarily reduce the risk to life and property from future hurricane storm surge events and secondly provide for substantial environmental benefit. The total restoration potential for these 38 sites is 27,380 acres.

Feasibility analysis of the Long-term HARP:

- The benefits of an ongoing acquisition and relocation program for coastal Mississippi could be tremendous taken into account the implications of sea level rise, continued development along the coast, and the frequency and magnitude of storms known to affect this area of the northern Gulf of Mexico. The additional study effort aimed at developing the framework and guidelines, detailed benefits, and costs would involve local and State interests as well as FEMA.

Education and hurricane preparedness to be implemented by others:

- Hurricane Risk Reduction Education
    - Warn all those in coastal Mississippi as to the extreme hazard to all that reside in the area, from the dual hazards of wind and surge/waves
- Hurricane and Storm Warning Systems
    - Make all residents and visitors aware of the current hurricane threat
- Hurricane Evacuation Planning
    - An evacuation plan, with preservation of life as the single most important goal, is an essential component of a comprehensive plan for ensuring the safety of residents of and visitors to the coast of Mississippi.
- Floodplain Management
    - Data and information developed in this analysis provides local government tools to be used in the determination of how to manage development or location of inhabited development, infrastructure, businesses, hazardous waste facilities, sites that contain large, un-anchored structural components when developing Master Plans for their communities.
- Building Codes
    - Assure that the latest design and construction techniques are being used that apply to hurricane-resistant construction
- Zoning Codes
    - Counties and cities may make full use of the resources provided under this study to limit development in highest hazard areas to those uses that will incur lesser damage and risks to life and safety
- Relocation of Critical Infrastructure and Services (Line of Defense 5)
    - Relocation of critical infrastructure and services outside the Maximum Probable Intensity (MPI) boundary so that these facilities and structures are capable of surviving the event, so that they can function after recession of the surge, to provide services and protect lives and property.

Feasibility level investigations concerning freshwater diversion at Violet, LA (authorized by Congress under WRDA 2007):

- Achieve each state's goals of establishing and maintaining salinity regimes for oysters and introducing sediment into the eroding Biloxi marshes of Louisiana

Project Costs. Table 6 summarizes the selected plan costs, Table 7 presents annualized costs and benefits, and Table 8 presents Federal and Non-Federal cost shares. . Post-implementation monitoring of ecosystem restoration components of the Comprehensive Plan is projected to be conducted for no more than five years at a cost of less than 1% of the total first cost of the project's ecosystem restoration features. Adaptive management of ecosystem restoration features is expected to cost no more than 3% of ecosystem restoration feature first costs, and may in some cases be less than that figure. Monitoring and adaptive management costs have been accommodated in the cost estimates for each potential ecosystem restoration component as part of the contingency estimate. Information gained from post-implementation monitoring and adaptive management of tentatively selected ecosystem restoration plans will be used to provide "lessons learned" for the design and implementation of future ecosystem restoration projects.

Table 6. Cost Summary Mississippi Coastal Improvements Program
(August 2008 Price Levels, $1,000s)

Tentatively Selected Plan Element	Project Costs (FY-08)	Annual O&M Costs
Comprehensive Barrier Island Restoration Plan**	$516,000,000	$0
Mainland Beaches	$24,900,000	$0
Forrest Heights Levee	$14,500,000	$114,000
Admiral Island	$23,200,000	$58,000
Turkey Creek	$7,200,000	$47,000
Dantzler	$2,300,000	$26,000
Bayou Cumbest	$26,900,000	$114,000
Franklin Creek	$2,000,000	$11,000
Deer Island	$22,900,000	$0
Submerged Aquatic Vegetation (SAV) Pilot Project	$1,000,000	$0
High Hazard Area Risk Reduction Program	$187,500,000	$75,000
Waveland Floodproofing Pilot Project	$4,611,000	$0
Moss Point Municipal Facility Relocations	$11,424,000	$0

** The cost for the Comprehensive Barrier Island Restoration Plan includes a contingency based on a Cost Risk Analysis.

TABLE 7. Equivalent Annual Benefits and Costs Mississippi Coastal Improvements Program
(August 2008 Price Level, 50-year Period of Analysis, 4.625 % Discount Rate)

Tentatively Selected Plan Element	Project Costs* (FY-08)	Annual O&M Costs	Project Benefits
Comprehensive Barrier Island Restoration Plan**	$477,200,000	$0	$17,699,600 annual damages avoided
Mainland Beaches	$23,200,000	$0	More than 30 miles of beach and dune restoration
Forrest Heights Levee	$14,000,000	$114,000	$331,500 annual damages avoided
Admiral Island	$21,700,000	$58,000	123 acres of ecosystem restoration
Turkey Creek	$6,800,000	$47,000	689 acres of ecosystem restoration
Dantzler	$2,200,000	$26,000	385 acres of ecosystem restoration
Bayou Cumbest	$25,400,000	$114,000	148 acres of ecosystem restoration
Franklin Creek	$1,850,000	$11,000	149 acres of ecosystem restoration
Deer Island	$21,400,000	$0	342 acres of ecosystem restoration
Submerged Aquatic Vegetation (SAV) Pilot Project	$900,000	$0	Ecosystem restoration benefits to be determined
High Hazard Area Risk Reduction Program	$397,000,000	$75,000	$33,000,000
Waveland Floodproofing Pilot Project	$4,425,000	$0	Annual damages avoided to be determined
Moss Point Municipal Facility Relocations	$10,800,000	$0	Annual damages avoided to be determined

There are no known HTRW issues, but contingencies were adjusted to account for this eventuality.
See Cost Appendix, Part 2 for the Total Project Cost Summaries. * These costs have been rounded and do not include interest during construction. ** The cost for the Comprehensive Barrier Island Restoration Plan includes a contingency based on a Cost Risk Analysis.

TABLE 8. Mississippi Coastal Improvements Program - Cost Sharing
(August 2008 Price Level)

Tentative Selected Plan Feature (AUTHORIZATION 65/35 percent)	**Total Project Cost**	**Federal Cost ***	**Non Federal Cost ***
Hurricane Risk Reduction Education	**	**	**
Hurricane and Storm Warning	**	**	**
Hurricane Evacuation Planning	**	**	**
Floodplain Management	**	**	**
Building Code Update	**	**	**
Zoning Code Update	**	**	**
Long-term Critical Infrastructure and Services Relocation (LOD 5)	**	**	**
Phase I High Hazard Area Risk Reduction Plan	$187,500,000	$121,875,000	$65,625,000
Moss Point Municipal Services Relocation	$11,424,000	$7,425,600	$3,998,400
Waveland Floodproofing	$4,611,000	$2,997,150	$1,613,850
Forrest Heights Levee	$14,500,000	$9,425,000	$5,075,000
Turkey Creek Ecosystem Restoration	$7,200,000	$4,680,000	$2,520,000
Dantzler Ecosystem Restoration	$2,300,000	$1,495,000	$805,000
Franklin Creek Ecosystem Restoration	$2,000,000	$1,300,000	$700,000
Bayou Cumbest Ecosystem Restoration & Hurricane Storm Damage Reduction	$26,900,000	$17,485,000	$9,415,000
Admiral Island Ecosystem Restoration	$23,200,000	$15,080,000	$8,120,000
Deer Island Ecosystem Restoration	$22,900,000	$14,885,000	$8,015,000
Submerged Aquatic Vegetation Pilot Program	$1,000,000	$650,000	$350,000
Coast-wide Beach and Dune Ecosystem Restoration	$24,900,000	$16,185,000	$8,715,000
Comprehensive Barrier Island Restoration (100% Federal; NPS Property)	$516,000,000	$516,000,000	$0
Subtotal of Authorization Request	**$844,435,000**	**$729,782,750**	**$114,952,250**
Subtotal of AE&D Request	**$12,000,000**		

Additional Investigations. The U.S. Army Corps of Engineers has sufficient authority to initiate a number of investigations , in anticipation of potentially recommending the features for future authorization as part of the MsCIP program, that are recommended by the reporting officers to provide further detailed investgations of the remaining features of the comprehensive plan. Authority for these investigations is provided in P.L. 109-148. In accordance with the provisions of WRDA 1986, as amended, cost sharing of investigations would be 50-percent Federal and 50-percent non Federal. At October 2008 price levels, the estimated cost of these investigations is $108,040,000. These investigations include:

- Investigations of Long-term High Hazard Area Risk Reduction Features
- Investigations of Escatawpa River Freshwater Diversion
- Investigations of Additional Environmental Restoration Features
- Investigations of Additional Structural Hurricane and Storm Damage Risk Reduction Features

Project Implementation. A Letter of Intent from the State of Mississippi indicating the intent to be the non-Federal sponsor of the Comprehensive Plan was received by the Mobile District on 28 August 2008. The tentatively selected plans are subject to cost sharing, financing, and other

applicable requirements of Federal and State laws and policies, including WRDA 1986, as amended, and with the non-Federal sponsor agreeing to comply with applicable Federal law and policies.

NED Effects of the Tentatively Recommended Plan – Congressional authorization for this project specified that the Corps "*shall not perform an incremental benefit-cost analysis to identify the recommended project, and shall not make project recommendations based upon maximizing net national economic development benefits".* Although the tentatively recommended plan is a cost effective plan (as required by the authorization), the overall net NED contribution to the national economy has not been calculated. The total average annual equivalent benefits (damages reduced) of those project components assessed in economic detail are at least $50 million.

RED Effects of Tentatively Recommended Plan - Existing local jobs, income and tax base, and future economic growth will benefit from a reduction of discouraging factors in the business climate such, as the potential of ruinous storm damage and income losses from shutdowns. The RED benefits of the structural plan components are $1.2 billion in increased sales, $261 million in increased income, and 7,600 additional jobs. RED benefits will also accrue from the ecosystem restoration and feasibility level investigation components of the tentatively recommended plan.

Other Social Effects of the Tentatively Recommended Plan - The overall social effects of the tentatively recommended plan include the preservation of life and property. The plan will substantially reduce the local, regional, and system wide impacts of future storms on homes and businesses, industry, employment, regional economies, environmental resources, and life, health and safety. In addition, secondary storm impacts to the much broader region such as the subsequent migration of the displaced population, wholesale disruption of the region's economy, disruption of the region's infrastructure, and severe impacts on the human, physical and natural resources of the area will be greatly reduced by the tentatively recommended plan.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) - It is anticipated that the entities of the State of Mississippi or other appropriate coastal municipalities (e.g. City of Gulfport for the Forrest Heights Levee) will assume complete responsibility for the operation of, maintenance of, repair of, and rehabilitation of, programs and projects recommended for implementation. In addition, monitoring project performance, followed by adaptive changes to the project if necessary, will be conducted. [Discussion of monitoring and adaptive management appears out of place under this heading- looks like it should be part of project costs]

Key Social and Environmental Factors. Implementation of the HARP would remove property from the highest risk areas, reduce the risk to human health and safety, and provide opportunities for recreation or ecosystem restoration as alternate uses of the lands. Implementation of this measure could have a significant impact to current land use as properties would be purchased and existing residential or businesses activities would be relocated elsewhere outside of high hazard areas. Potentially adverse impacts associated with relocation, construction, and secondary development could result in fractured communities, relocation of central areas that hold public sentiment, etc. Further consideration is warranted in conjunction with development of this program, in order, to identify specific impacts to each small intricate part of larger communities.

The recommendations contained within this analysis establish the framework for the protection, restoration, enhancement and re-establishment of the natural buffering capacities of Mississippi's coastal habitats. Mississippi's coastal habitat system provides a comprehensive network of areas that

are critical both to the environment and to society. These coastal habitats serve as vital breeding areas, nursery grounds, and areas where much of the massive amounts of organic carbon needed to fuel aquatic food chains are produced. These areas capture sediments, nutrients and even contaminants eroded from the uplands before they enter the aquatic system. These areas also absorb wave, tide, and surge energy before impinging upon the upland. The tentatively recommended plan restores much of Mississippi's coastal habitat system with a focus on restoring the resiliency of the natural and man-made environment to future storm events.

Stakeholder Perspectives and Differences. The tentatively recommended plan is consistent with the Seven-Point Strategy for rebuilding coastal resources of the State developed by the Governor of the State of Mississippi. The tentatively recommended plan was developed in close coordination with the Mississippi Department of Marine Resources (MDMR). The MDMR operates the Coastal Preserves Programs which acquire, protect, and manage sensitive coastal wetland habitats along the Mississippi Gulf Coast. The State currently has title to approximately 30,000 acres of the designated 72,000 acres of crucial coastal wetland habitat within Mississippi's 20 coastal preserve sites. Many of the acres targeted for restoration by the tentatively recommended plan are held within the Coastal Preserves Program. Additionally, The Mississippi Emergency Management Agency is currently working with the residents of Bayou Cumbest to purchase property damaged by Hurricane Katrina from willing sellers. The Corps, Mobile District has been closely coordinating with Mississippi Emergency Management Agency to develop its environmental restoration project in conjunction with those purchased properties.

One difference, which developed during the plan formulation process, was that some stakeholders considered the screening and assessment of large structural alternatives, such as building of a large continuous barrier island across the sound or building a continuous 30-foot tall seawall, as a waste of time and money. Although these measures did not pass the preliminary screening process, they were included in the early stage of plan formulation to ensure that all potential solutions were given appropriate consideration.

Environmental Compliance - This report presents information in support of a Record of Decision for construction for a number of ecosystem restoration, storm damage reduction, and multi-purpose projects. Additionally, other projects are developed in this feasibility study which are not presented in support of a Record of Decision for construction, but are addressed as reasonably foreseeable actions for the consideration of cumulative effects. Supplemental NEPA information will be presented in the future as programmatic elements of the Comprehensive Plan are further developed. A Notice of Intent (NOI) was published in the Federal Register on August 9, 2006, to inform the public of the Corps' intent to prepare an EIS for the MsCIP Comprehensive Plan. The public was invited to attend a public scoping meeting, a public workshop, and a public hearing to obtain public input and ensure compliance with NEPA. Several initial scoping meetings were held between April and August 2006 in conjunction with development of the interim report. A scoping workshop was held in Biloxi, MS, December 19, 2006, to gather public input for the programmatic EIS.

Per the Council on Environmental Quality regulations on implementing the National Environmental Policy Act, the Corps, Mobile District requested that a number of State and Federal Agencies accept the status of Cooperating Agency on the Integrated Report and Programmatic Environmental Impact Statement. In response to this request, dated October 30, 2006, nine federal agencies, seven state agencies, and one regional planning commission are participating as cooperating agencies.

State and Agency Review. Copies of the draft report were sent to 13 Indian nation officials, four statewide elected officials, 10 federal agencies, seven state agencies, one regional agency, 18 local government entities, five representatives of other organizations and more than 140 individuals. Responses to comments from this review were incorporated into the report.

Certification of Agency Technical Review and Legal Review - Final Agency Technical Review (ATR) was certified on 04 December 2008 with all review comments being satisfactorily addressed. Final Legal Certification of the Feasibility Report and EIS was completed on 28 April 2009 by Mobile District Office of Council. The Planning Center of Expertise for Coastal Storm Damage Reduction (PCX-CSDR) Review was certified on 07 November 2008.

Policy Compliance Review - The Policy Compliance Review conducted to date is documented in the Policy Guidance Memorandum dated 30 April 2009, which contains District responses to all comments. All responses have been incorporated into the final report and appendices as appropriate.