# MISSISSIPPI COASTAL IMPROVEMENTS PROGRAM (MsCIP)
# INTERIM REPORT

# ECONOMIC APPENDIX

# CONTENTS

# ECONOMIC ANALYSIS FOR BAYOU CADDY ECOSYSTEM RESTORATION, HANCOCK COUNTY, MS

## Introduction

This section describes the economic analysis evaluation for shore protection and ecosystem restoration at Bayou Caddy, Hancock, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

Hancock County was heavily damaged by the hurricanes of 2005 particularly, the storm surge and winds generated by Hurricane Katrina on August 29, 2005. Bayou Caddy drains most of southwest Hancock County south of Interstate-10. It is a federally authorized navigation project used by both commercial and recreation craft. The Bayou Caddy watershed experienced the most severe erosion along the Mississippi Coast during the storms of 2005. This document provides information regarding erosion to the Bayou Caddy marsh and the potential loss of aquatic resources.

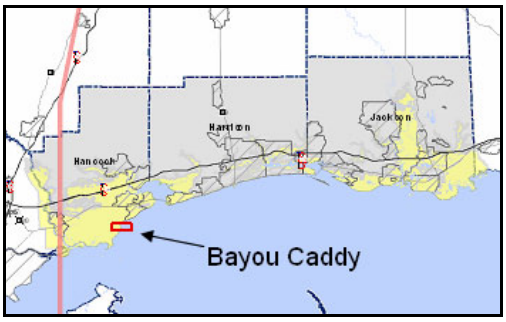



**Figure 1. Project Location**


**Figure 2. Bayou Caddy Marsh (Image from Google Earth)**

## *Opportunities*

The following opportunities were identified for this problem area:

a. Restoration of emergent tidal wetland habitat;

b. Prevention of future erosion;

c. Protection from future storm and hurricane wave energy; and

d. Creation of additional aquatic resource nursery habitat (i.e. – fishery, invertebrates, etc.)

## *Assumptions*

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in estimating average annual benefits and costs

b. Values shown in the report are stated in October 2006 dollars unless otherwise noted.

c. A 50-year period of analysis was used to calculate average annual costs.

d. Impacted area (Hancock County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

## *Existing Conditions*

Tidal marsh borders the estuarine and adjacent waters in Mississippi and provides natural protection from the wave and wind energy. Erosion from wave attack under average conditions, coupled with hurricanes and other storms in the area, have undermined and eroded the marsh habitat at the proposed project site. Concrete seawalls armor the shoreline further to the north and east, and a large section of the Mississippi mainland. Sediment budgets are supplemented in these areas by periodic replenishment projects. Extensive areas of coastal wetlands located in western Hancock County are experiencing land losses due to erosion. Average rates of erosion in the Hancock County marshes are on the order of 12 to 13 feet per year over the past 70 years.

The erosion and disappearance of marsh habitat in Mississippi has exposed shorelines along both the mainland of Mississippi and its barrier island system to increased wave energy and accelerated erosion. In addition, the natural migration of the barrier islands alters the sheltering of these areas from erosive forces. Commercial and recreational fishermen also frequently use Bayou Caddy. As a result of this high level of boat activity and other natural erosive forces, the mouth and western face of the bayou are eroding and losing marsh. With the erosion of the western shoreline at Bayou Caddy, the area has become more prone to disturbance from waves, resulting in marsh habitat degradation.

## *Alternatives*

Four alternative plans for shore protection and marsh restoration and creation were previously evaluated in the August, 2003 Preliminary Restoration Plan prepared by the Mobile District. Each plan involved the use of concrete bridge rubble available from Hancock County as a result of their local construction project. The rubble was to be used to construct a breakwater as the outer perimeter for a containment dike structure at the proposed project site. The concrete rubble breakwater would protect the site from wave action, but could not contain dredged material from the Bayou Caddy channel. Following that construction, material from the next maintenance and/or new work dredging operation would then be beneficially used to restore tidal marsh at the site. It was anticipated that approximately eight acres of wetlands would then be restored with vegetative plantings.

**Alternative 1—No Action Plan.** This plan involves no federal action.

**Alternative 2—Breakwaters.** This alternative consists of placing material offshore to reduce wave action, thereby diminishing the amount of erosion to the marsh. This plan involves the use of “clean” concrete bridge rubble from Hancock County as a result of a local construction project. It is estimated that approximately 50,000 cubic yards of material would be placed at an approximate cost of $133,500.

**Alternative 3—Earth dike containment structure.** This alternative would consist of an earth dike with an 8-foot crest width at elevation +6 feet MLLW and 1V:3H side slopes. The estimated fill volume includes template fill volume and additional fill likely to be needed to replace settled dike fill. Existing soil at the site is considered unsuitable for dike fill, based on limited available subsurface data as previously discussed.

**Alternative 4—Combination of Breakwaters and Earthen Dike with Marsh Creation.** This alternative consists of a combination of the Marsh Creation and breakwater alternatives. Bridge rubble would be placed by the Mississippi Department of Marine Resources to function as a protective breakwater for the inner containment structure. Using ruble form bridges damaged during Hurricane Katrina will not only reduce this project cost, but it will also help the State with disposal of

large quantities of concrete debris. The earthen dike would be constructed to contain dredged material that would be beneficially used from the federally authorized navigation channel.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Breakwater | Moderate | $2,010,000 | $0 |
| Alt 3 | Earthen Dike with Marsh Creation | Minimal | $4,140,000 | $134,600 |
| Alt 4 | Breakwater plus Earthen Dike with Marsh Creation | Moderate | $5,690,000 | $89,600 |

Numbers are rounded to the nearest hundredth.

## *Project Benefits*

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

### *1) Flood Damage Reduction*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Emergent tidal wetland habitat protects development with its natural buffer. The marsh area, such as Jackson Marsh and Bayou Caddy, absorbs high wave energy typically associated with tropical storms and hurricanes. In addition, emergent tidal wetlands also provide large areas of undeveloped (i.e. natural) land which absorbs large amounts of water from storms. Tidal marsh breaks down the wave energy of smaller storm before it reaches development.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *1) National Ecosystem Restoration (NER)*

Removal of the sediment would provide flushing of the system and improvement to tidal exchange resulting in less stagnant water. Removal of the obstructions would allow fish to migrate up the systems by the sub-adult and larvae for use as a forage area. The improved habitat would also improve foraging areas for shorebird use. Removal of the non-biodegradable foreign material and deposition of sediments would improve overall water quality by improving circulation and enhanced drainage in the area resulting in an overall reduction of flooding to nearby residences.

## *Incremental Cost Analysis*

The justification for the proposed project is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501, *Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

## *Assumptions*

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives (habitat unit, HU). HU is based on an assessment protocol, which provides a basic level of stream health evaluation that is based on physical conditions within the assessment area. The assessment is used to record the scores for up to 15 assessment elements (i.e., channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover [warm water fishery], manure presence, salinity, riffle embeddedness, and macroinvertebrates observed). However, all assessment elements were not applicable to the assessment area and were not included.

Four alternative plans for shore protection and marsh restoration and creation were previously evaluated in the August, 2003 Preliminary Restoration Plan prepared by the Mobile District. Each plan involved the use of concrete bridge rubble available from Hancock County as a result of their local construction project. The rubble was to be used to construct a breakwater as the outer perimeter for a containment dike structure at the proposed project site. The concrete rubble breakwater would protect the site from wave action, but could not contain dredged material from the Bayou Caddy channel. The preferred alternative in that report included an earthen dike as the containment structure. Following that construction, material from the next maintenance and/or new work dredging of the Bayou Caddy navigation channel would then be beneficially used to restore tidal marsh at the site. It was anticipated that approximately eight acres of wetlands would then be restored with vegetative plantings.

The first step in incremental analysis is to display the environmental outputs (effects on habitat expressed in habitat units, HU) and the cost estimates of the management measures increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average annual outputs and average annual costs were used for this analysis.

Table 2 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no work is undertaken to prevent erosion. Alternative 2 represents a concrete rubble breakwater with earthen dike structure with plantings and without plantings. Alternative 3 represents a concrete rubble breakwater with steel sheet pile containment structure with plantings and without plantings. Alternative 4 represents a concrete rubble breakwater with vinyl sheet pile containment structure

with plantings and without plantings. Project outputs for each alternative are displayed in terms of units of habitat that can be supported for each alternative considered.

**Table 2.**
**Outputs and Costs by Increments**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Breakwaters | $2,010,000 | $112,234 | $0 | $112,234 | 330 |
| 3 | Earth Dike with Marsh Creation | $4,140,000 | $231,169 | $134,600 | $365,769 | 300 |
| 4 | Breakwaters plus Earth Dike with Marsh Creation | $5,690,000 | $317,718 | $89,600 | $407,318 | 465 |

Numbers are rounded to the nearest hundredth.

Additional output is the output of each alternative above the baseline condition. Alternative 1 is the baseline condition. Using this as the baseline, the additional output for Alternative 1 will be zero. The additional output of the other four alternatives will be the difference between the average annual output of the baseline condition and the average annual output of the alternative.

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (HU) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their outputs. The result is a ranking of Alternative 1, 3, 2, and 4 as displayed in Table 3. Where two or more solutions produce the same output, the solutions are ranked in ascending order of their costs. At each level of output the least cost solution is determined. No solutions are eliminated in this step because they all produce different levels of outputs.

**Table 3.**
**Summary of Costs and Additional Outputs in Ascending Order**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 3 | Earth Dike with Marsh Creation | $4,140,000 | $231,169 | $134,600 | $365,769 | 300 |
| 2 | Breakwaters | $2,010,000 | $112,234 | $0 | $112,234 | 330 |
| 4 | Breakwaters plus Earth Dike with Marsh Creation | $5,690,000 | $317,718 | $89,600 | $407,318 | 465 |

The fifth step in incremental analysis is to eliminate economically ineffective solutions. The outputs and costs undergo a pair-wise comparison. The results of the comparison are analyzed to determine which solutions will produce less output at equal or greater cost than subsequently ranked solutions. Those solutions that will produce less output at equal or greater cost than subsequently ranked solutions are deleted. Alternative 3 (Earth Dike with Marsh Creation) produces less output than Alternative 2 (Breakwaters, but cost more to implement, thus alternative 3 is eliminated from further evaluation. Table 4 displays the results of the cost effectiveness analysis.

**Table 4.**
**Outputs and Costs of Cost-Effective Least Cost Solutions for Each Level of Output**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 3 | Earth Dike with Marsh Creation | $4,140,000 | $231,169 | $134,600 | $365,769 | 300 |
| 2 | Breakwaters | $2,010,000 | $112,234 | $0 | $112,234 | 330 |
| 4 | Breakwaters plus Earth Dike with Marsh Creation | $5,690,000 | $317,718 | $89,600 | $407,318 | 465 |

The sixth step is to calculate average costs for the set of solutions that emerged from the cost effectiveness analysis. Average costs are calculated by dividing each level of output's cost by its output. Alternatives with outputs less than the lowest average cost level are eliminated from further analysis. Alternative 1 (the no action plan) does not have an average cost per unit of output, since it does not cost anything or produce anything. Table 5 displays this information.

**Table 5.**
**Average Cost of Each Level of Output**

| Alt. | Alternative Description | Output (FHI) | Average Annual Cost ($) | Average Cost per FHI ($ / FHI) |
|---|---|---|---|---|
| 1 | No Action | 0 | $0 | $0 |
| 2 | Breakwaters | 330 | $112,234 | $340.10 |
| 4 | Breakwaters plus Earth Dike with Marsh Creation | 465 | $407,318 | $875.95 |

Shading over the lowest average cost.

The next step is to recalculate average costs for additional output. The average costs are calculated for additional output using the incremental levels of output. These calculations begin with the lowest average cost level of output, the "zero level" output. The average costs are calculated using the additional costs and additional outputs above those of the previously identified level of outputs with the lowest average cost. Levels of output less than the lowest average cost are eliminated from further analysis. This process is repeated until the final level of output is identified as the lowest average cost of output. This step was not necessary because of the number of alternatives.

Calculating the incremental costs is the eighth step. The difference in cost between two solutions divided by the difference in output between the same two solutions is the incremental cost. Table 6 shows the calculations.

**Table 6.**
**Incremental Costs**

| Output (FHI) | Average Annual Cost ($) | Additional Output (FHI) | Additional Cost ($) | Incremental Cost ($ per FHI) |
|---|---|---|---|---|
| 0 | $0 | 0 | $0 | $0 |
| 330 | $112,234 | 330 | $112,234 | $340.10 |
| 465 | $407,318 | 135 | $295,084 | $2,185,81 |

The final step is to compare successive outputs and incremental costs. The results from the incremental costs are compared and then used as a decision making tool by progressively proceeding through the available level of outputs and asking if the next level is "worth it." That is to say, "is the habitat value of the additional unit of environmental benefit in the next available level of output worth its additional monetary costs?"

### *2) Aesthetics*

Overall aesthetic quality would be improved, since the existing structure is crumbling in places. Implementation of the proposed action would reduce sediment movement and turbidity. Sheetpile will also serve as substrate for epifauna. Overall the project will restore and maintain storm drainage for the upland areas on the landward side of the road. Maintaining storm drainage will prevent flooding from extreme rain and storm events that could result in erosion of upland resources. Structure repairs will maintain the integrity of the road and channel structure reducing sediment movement and turbidity resulting from the failure of the drainage channel. The restored marsh will serve the important function of providing nursery areas for fishes, shellfish, and crustaceans as well as stabilizing sediments in the immediate area. Various shorebirds and migratory birds utilize areas along the Mississippi shoreline. Restoring the marsh will provide valuable shorebird habitat.

**Figure 3. Bayou Caddy Post Katrina**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Hancock County is located in the lower west corner of Mississippi. The County shares its borders with Harrison County, Mississippi to the east, St. Tammany Parish, Louisiana to the west and Pearl River County, Mississippi to the north. According to the 2000 Census, the county has a population of 42,967.

Table 7 shows the employment breakdown for Hancock County. There are no manufacturing and industrial jobs in Hancock County. The county is heavily dependent upon the retail and food service industry as is often the case in poorer areas.

**Table 7.**
**Employment Breakdown of Hancock County**

| Sector | Mississippi | Hancock County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 0 | 0% |
| Wholesale | 35,316 | 251 | 0.7% |
| Retail | 135,838 | 1,586 | 1% |
| Real Estate | 9,665 | 131 | 1% |
| Professional | 29,023 | 1,555 | 5% |
| Administration | 46,115 | 1,280 | 3% |
| Education | 1,678 | 0 | 0% |
| Health Care | 131,976 | 500 | 0.3% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 2,114 | 2% |
| Other Services | 22,180 | 176 | 0.7% |
| Total | 713,310 | 7,693 | 1% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Hancock County was $17,748 and the median household income was $35,202 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 8 displays the income breakdown for Hancock County.

**Table 8.**
**Income Breakdown for Hancock County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Hancock County | $17,748 | $35,202 | 2.56 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 9. The percentage of persons below the poverty level for the state of Mississippi and Hancock County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Hancock County. The unemployment rate for Hancock County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 9.**
**Poverty Level and Unemployment Rate for Hancock County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Hancock County | 14.1% | 6.3% | 12.6% | 22.3% |

Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $2,010,000 for the breakwaters, $4,140,000 for the Earth Dike alternative, and $5,690,000 for the combination breakwater and earth dike with marsh alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures for all three alternatives are estimated to be $0 for the breakwaters, $134,600 for the earth dike with marsh, which in present worth form amounts to $2,410,654, and $89,600 for the combination breakwaters with earth dike and marsh, which in present worth form amounts to $1,605,346 (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population. Tables 10 and 11 give a summary of the EIFS model inputs.

**Table 10.**
**Summary of Construction Inputs for Bayou Caddy by Project Alternative**

| Indicator Variable | Breakwater | Earth Dike w/ Marsh | Breakwater plus Earth Dike w/ Marsh |
|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $2,010,000 | $4,140,000 | $5,690,000 |

**Table 11.**
**Summary of O&M Inputs for Bayou Caddy by Project Alternative**

| Indicator Variable | O&M Breakwater | O&M Earth Dike w/ Marsh | O&M Breakwater plus Earth Dike w/ Marsh |
|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $0 | $2,410,654 | $1,605,346 |

## *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and

procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Breakwaters.*** If implemented, the total sales volume related to this alternative is projected to increase by $4,020,000 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $0 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Earth Dike alternative.

***Earth Dike****.* If implemented, the total sales volume related to this alternative is projected to increase by $13,101,308 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $4,821,308 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Steel Pile Dike.

***Breakwaters and Earth Dike****.* If implemented, the total sales volume related to this alternative is projected to increase by $14,590,692 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $3,210,692 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Vinyl Dike.

## *Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Breakwaters.*** If implemented, the total income related to this alternative is projected to increase by $969,363 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $0 (i.e. the total income increased because of O&M) was added to the total income of the Earth Dike alternative.

***Earth Dike.*** If implemented, the total income related to this alternative is projected to increase by $3,159,184 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,162,586 (i.e. the total income increased because of O&M) was added to the total income of the Steel Pile Dike alternative.

***Breakwaters and Earth Dike.*** If implemented, the total income related to this alternative is projected to increase by $3,518,327 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $774,210 (i.e. the total income increased because of O&M) was added to the total income of the Vinyl Dike alternative.

## *Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Breakwaters.*** If implemented, the total employment related to this alternative is projected to increase by 24 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 0 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Earth Dike alternative.

***Earth Dike.*** If implemented, total employment related to this alternative is projected to increase by 79 workers in Hancock County. Note, O&M is only accounted for if the project is implemented;

therefore, 29 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Steel Pile Dike alternative.

***Breakwaters and Earth Dike.*** If implemented, total employment related to this alternative is projected to increase by 89 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 20 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Vinyl Dike alternative.

## *Impact on Population*

If implemented, the population related to all three alternatives is projected to increase by 0. Tables 12 and 13 summarize the outputs of the EIFS model.

**Table 12.**
**EIFS Model Outputs for Bayou Caddy Proposed Project Alternatives**

| Indicator Variable | Projected Δ Breakwaters | Projected Δ Earth Dike w/ marsh | Projected Δ Breakwaters plus earth dike with marsh |
|---|---|---|---|
| Direct Sales Volume | $2,010,000 | $4,140,000 | $5,690,000 |
| Induced Sales Volume | $2,010,000 | $4,140,000 | $5,690,000 |
| Total Sales Volume | $4,020,000 | $8,280,000 | $11,380,000 |
| Direct Income | $484,681 | $998,299 | $1,372,058 |
| Induced Income | $484,681 | $998,299 | $1,372,058 |
| Total Income | $969,363 | $1,996,598 | $2,744,117 |
| Direct Employment | 12 | 25 | 34 |
| Induced Employment | 12 | 25 | 35 |
| Total Employment | 24 | 50 | 69 |
| Local Population | 0 | 0 | 0 |

**Table 13.**
**Summary of O&M Outputs for Bayou Caddy by Project Alternative**

| Indicator Variable | Projected Δ Breakwaters | Projected Δ Earth Dike w/ marsh | Projected Δ Breakwaters plus earth dike w/ marsh |
|---|---|---|---|
| Direct Sales Volume | $0 | $2,410,654 | $1,605,346 |
| Induced Sales Volume | $0 | $2,410,654 | $1,605,346 |
| Total Sales Volume | $0 | $4,821,308 | $3,210,692 |
| Direct Income | $0 | $581,293 | $387,105 |
| Induced Income | $0 | $581,293 | $387,105 |
| Total Income | $0 | $1,162,586 | $774,210 |
| Direct Employment | 0 | 15 | 10 |
| Induced Employment | 0 | 15 | 10 |
| Total Employment | 0 | 30 | 20 |
| Local Population | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, "Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others." This project addresses the following under the OSE account:

### *Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 14 shows the number selected housing statistics for census tract 304. There are 1,524 housing units in the tract. The average structure was built between 1976. Table 15 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 16 shows the value of the owner occupied structures in the two tract area.

**Table 14.**
**Selected Housing Statistics**

| Category | Tract 304 |
|---|---|
| Number of Structures | 1,524 |
| Median Year Built | 1976 |
| Occupancy Status | |
| Occupied | 1,077 |
| Vacant | 447 |
| Tenure | |
| Owner | 911 |
| Renter | 166 |

U.S. Census Bureau, 2000 Census

**Table 15.**
**Number of Units in Structure**

| Units in Structure | Tract 304 |
|---|---|
| 1, detached | 998 |
| 1, attached | 10 |
| 2 | 7 |
| 3 or 4 | 4 |
| 5 to 9 | 7 |
| 10 to 19 | 5 |
| 20 to 49 | 0 |
| 50 or more | 0 |
| Mobile Home | 473 |
| Boat, RV, van, etc. | 20 |
| **Total** | **1,524** |

U.S. Census Bureau, 2000 Census

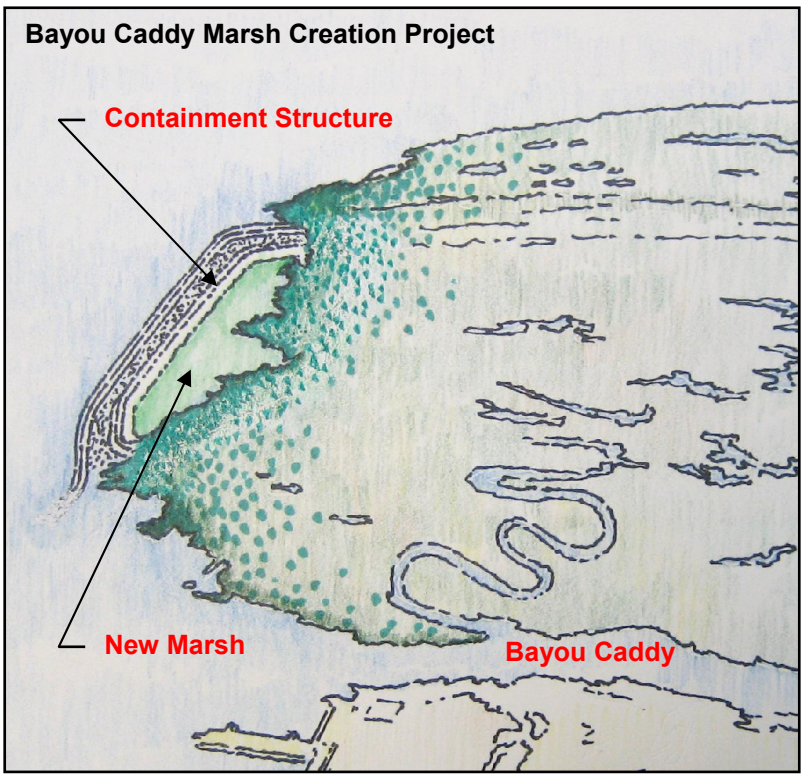
**Table 16.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 304 |
|---|---|
| Value | |
| Less than $10,000 | 36 |
| $10,000 to $14,999 | 38 |
| $15,000 to $19,999 | 32 |
| $20,000 to $24,999 | 73 |
| $25,000 to $29,999 | 62 |
| $30,000 to $34,999 | 31 |
| $35,000 to $39,999 | 35 |
| $40,000 to $49,999 | 101 |
| $50,000 to $59,999 | 96 |
| $60,000 to $69,999 | 67 |
| $70,000 to $79,999 | 104 |
| $80,000 to $89,999 | 38 |
| $90,000 to $99,999 | 16 |
| $100,000 to $124,999 | 104 |
| $125,000 to $149,999 | 37 |
| $150,000 to $174,999 | 34 |
| $175,000 to $199,999 | 0 |
| $200,000 to $249,999 | 0 |
| $250,000 to $299,999 | 0 |
| $300,000 to $399,999 | 0 |
| $400,000 to $499,999 | 0 |
| $500,000 to $749,999 | 0 |
| $750,000 to $999,999 | 7 |
| $1,000,000 or more | 0 |
| TOTAL | 911 |
| Median Value for Owner Occupied Housing | |
| Median Value for Mobile Homes | |

U.S. Census Bureau, 2000 Census

## *Recommended Plan*

The recommended plan for this problem area consists of the placement of a concrete rubble breakwaters and an earthen containment structure placed along a 3900 linear foot semi-circular alignment. The earth dike would have a crest that is 8 feet wide crest and would rise 6 feet above the lowest low water tide. The berm would slope upwards 1 foot for every 3 feet of horizontal width. Bridge rubble would be placed by the Mississippi Department of Marine Resources on an alignment just outside the earthen berm. This will function as a protective breakwater for the inner containment structure. Dredged material, beneficially used from the maintenance of the federally authorized navigation channel, will be pumped into the containment structure. After consolidation, this newly developed 8-acre site will be planted to create a saltwater marsh habitat that will also protect the existing marsh from further erosion.




## Cost

This solution is estimated to cost $5,690,000 (October 2006 Price Level).

# ECONOMIC ANALYSIS FOR HANCOCK COUNTY BEACHES, HANCOCK, MS

## Introduction

This section describes the economic analysis evaluation for damage to the drainage ways of the developments or areas near Shoreline Park, Bayou Phillip, Cowan Bayou, Heron Bay and Hancock County Marina. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

The beaches of Hancock County are approximately 9 miles in length, and host one of the Gulf Coast's largest populations of Least Tern, a Federally-listed endangered species, plus a significant number of Piping Plover. The beaches possessed a dune system (pre-Katrina) that was maintained by local interests, that was vegetated and supported a significant ecosystem, in addition to passive recreation usage outside the dune system. This dune system provided not only ecosystem benefits, but some measure of hurricane or storm damage reduction due to its ability to absorb some of the surge and wave energy during those types of events. During Hurricane Katrina, this dune system was almost entirely destroyed by surge and wave action. Almost all ecosystem functions and values were eliminated during this single event. Much of the sand removed is believed to be close off shore in the nearshore zone.

### *Opportunities*

The following opportunities were identified for this problem area:

- Hurricane storm damage reduction or remediation
- Prevention or remediation of Saltwater Intrusion
- Preservation of Fish & Wildlife and restoration of their habitats
- Prevention or remediation of erosion
- Other related water resource purposes, such as ecosystem restoration or barrier island restoration

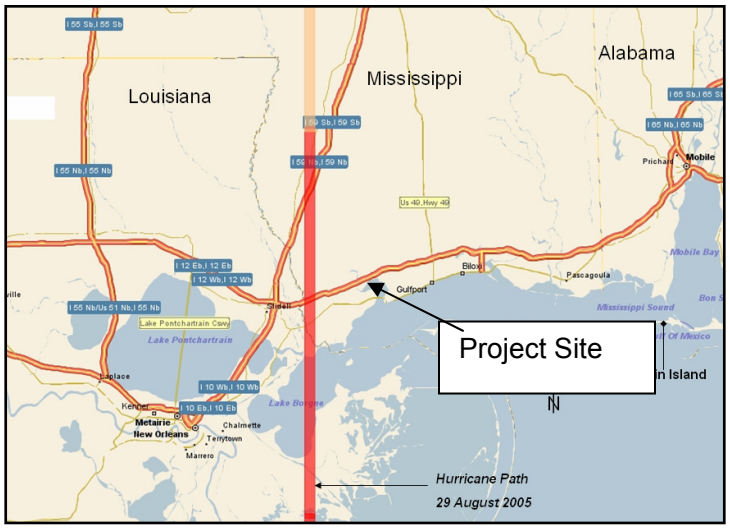



**Figure 1. Project Location**

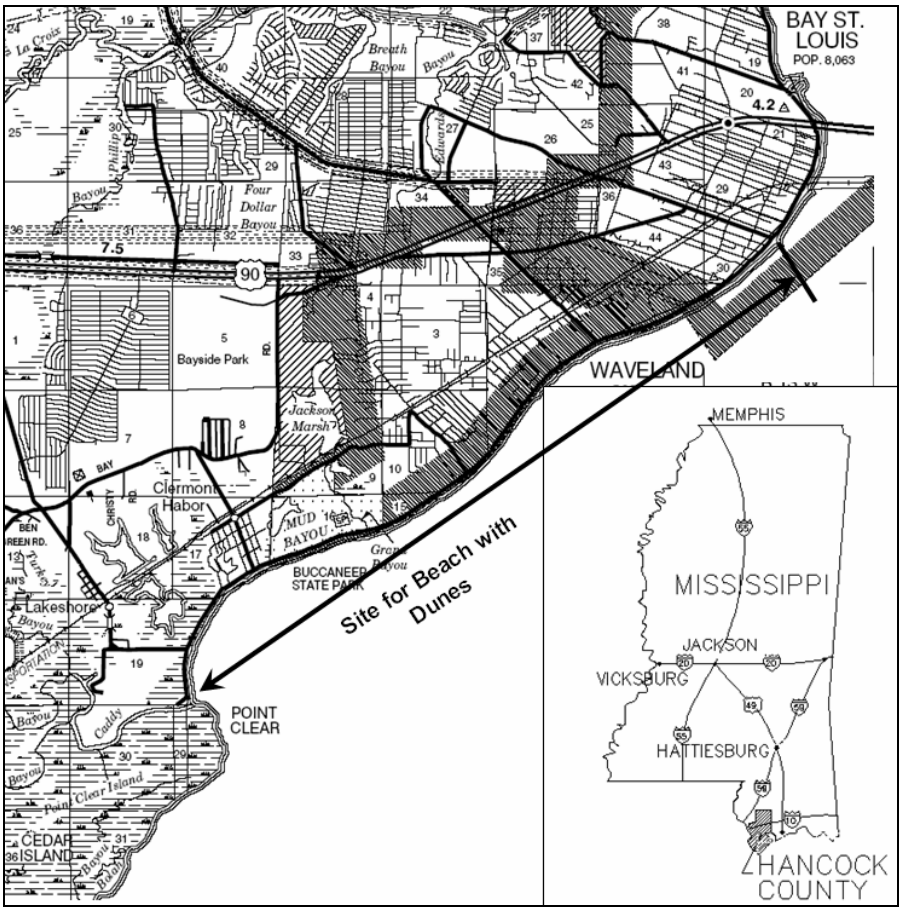



**Figure 2. Project Limits**

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in estimating average annual benefits and costs

b. Price levels are October, 2006 unless otherwise stated.

c. A 50-year period of analysis was used to calculate average annual benefits and costs.

d. Impacted area (Hancock County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Existing Conditions

The existing Mississippi Sound shoreline in the area is protected by a concrete stepped-face structure about 8 miles long. The seawall was constructed by local interests at various times between 1915 and 1928. Hydrographic and topographic survey data was obtained in the area by the Mobile District under contract in September, 2003. The top elevation of the seawall varies between +3.8 to +5.0 feet National Geodetic Vertical Datum (NGVD). A sand beach was pumped into place along about six miles of this seawall in early 1967 as part of the emergency repair and protection following Hurricane Betsy (September 1965). There is another beach extending for about a mile south of the U.S. Highway 90 Bridge crossing the mouth of St. Louis Bay that was placed by the Mississippi Highway Department during the bridge construction. An additional one-mile-long segment of beach with dunes was constructed in the summer of 2005 from Cadet Bayou eastward. Figure 3 shows the shoreline between Bayou Caddy (Cadet Bayou) and the Washington Street pier. Figures 6 and 7 show typical storm related damage at the beachfront.

South Beach Boulevard is the main thoroughfare along the entire length of the existing seawall. Historical as well as current wave attack against the shoreline of Hancock County has caused migration of soil through or under the seawall and scour of soil below the seawall in various locations, resulting in damages to South Beach Boulevard and other infrastructure. Sections of the highway have collapsed from time to time, disrupting and damaging utilities, and causing hazards and delays for residents and vehicular traffic. Hancock County has frequently repaired the seawall and road because of the loss of material from beneath the highway. Damaged utilities which have required repairs include water, sewer, natural gas, electric power, and electronic communications. The Mobile District has constructed a number of new seawall segments along various reaches of the existing seawall to alleviate this soil migration and scour problems in the study area under Sections 14 and 103 authorities. Seawall alternatives are addressed in the Clermont Harbor and Downtown Bay St. Louis plans.

The seawall is penetrated in a number of locations by sixteen open drainage channels. Typically, the components of these drainage channels at their crossings of South Beach Boulevard include concrete headwalls, concrete box culverts beneath the boulevard, and channel extension guide-walls extending out into Mississippi Sound. Many of these were severely damaged by hurricane Katrina. Typical damages included breaching of the extension guidewalls, failure of the guidewalls, and destruction of the outlet end of the box culverts.

Several tidal marshes exist on the landward side of the roadway on the southwestern end of Hancock County around the Waveland area. The existence of these expansive and contiguous tidal marshlands are maintained through tidal conduits (outfalls) built into the existing seawall at regular intervals. Many of the tidal conduits supporting these marsh areas are in a state of severe

deterioration. It is also believed that the much of the tidal flow between Mississippi Sound and the marshes have been critically restricted from sedimentation as a result of Hurricane Katrina. The existence of these valuable marshlands is dependent upon the continuation of the tidal exchange provided by the outfalls. The overall health of the marshes is likely constrained by the limited water exchange allowed by the tidal conduit system. Reconstruction and rehabilitation of these systems in a manner that would increase tidal flow and re-establish pre-storm interior drainage capacity is addressed in the Jackson Marsh plan.

# Alternatives

Two plans were evaluated for enhanced beach protection at the study site. All involved providing a dune atop the re-nourished beach. One alternative will be to place the dune material alone and the other alternative will be to place the dune material and add stabilizing fencing and dune vegetation. The finished stable dune will be 2 feet high to approximately Elevation 7.0 with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established upland borrow areas within 10 miles of the work area. The plantings will have a density of 1 plant per 4 square feet and the fence will include the entire linear length of the project. The dune alone project will require replacement within 10 years and the dune with plantings and fence will require replacement within 15 years.

**Alternative 1—No Action Plan.** This plan requires no federal action.

**Alternative 2—Dune placement only.** Place a dune 2 feet high to approximately Elevation 7.0 with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established upland borrow areas within 10 miles of the work area. See figure 3.

**Alternative 2—Dune placement with fencing and plantings.** Place a dune 2 feet high to approximately Elevation 7.0 with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established upland borrow areas within 10 miles of the work area. The plantings will have a density of 1 plant per 4 square feet and the fence will include the entire linear length of the project. See figure 3.

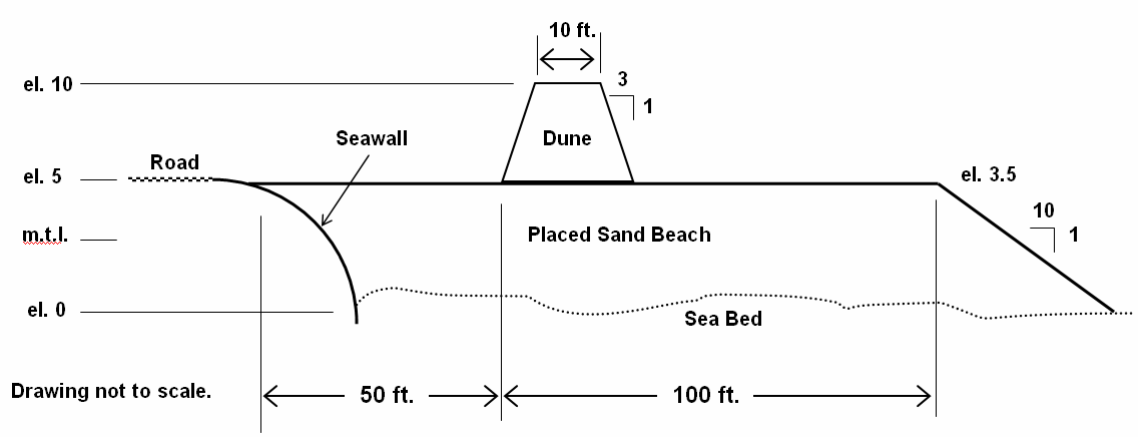



**Figure 3.**

The project delivery team evaluated the alternatives at each site based on their prospective impact. The projects were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Dune Placement | Minimal | $1,270,000 | $40,000 |
| Alt 3 | Dune Placement with fencing and planting | Moderate | $1,770,000 | $40,000 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefits for a hurricane and storm damage reduction study fall under the following categories: protection of residential and commercial structures from erosion and flooding, protection of public roads and bridges from erosion, protection of public utilities from erosion, and recreation benefits associated with the parking. It is anticipated that the add beach alternative and the add beach with dune alternative will provide some level of protection across these categories, however, for this analysis only recreation benefits will be quantifiable.

### *Recreation Benefit Analysis*

The purpose of this document is to provide an analysis of recreation benefits associated with a proposed project for shoreline and erosion protection of areas damaged by Hurricane Katrina in Hancock County, Mississippi. The project consists of environmental restoration measures, interior drainage infrastructure and storm damage reduction for areas damaged by Hurricane Katrina near Bayou Caddy and the Bay St. Louis and Waveland communities of Hancock County, Mississippi. Two of the alternatives being considered feature beach sand placement, with the primary purpose of the placement being the enhancement of the environmental value of the shoreline. Recreation will provide some National Economic Development (NED) benefits, but those benefits are incidental to the primary purpose of shoreline protection and environmental enhancement.

### *Existing (Pre-Katrina) Condition*

The seawall and Beach Blvd have seen numerous incidences of failure and undermining of both the seawall and the road itself. Storms in 1947 caused massive failures at numerous points along the seawall and road. Hurricanes Camille in 1969, Frederic in 1979, Elena in 1985 and Georges in 1998 also resulted in damage. Winter storm events in both 1994 and 1995 caused significant damage and complete failures of both seawall and roadway. Both events led to Section 14 projects being constructed in Hancock County. Since 1986, at least seven different studies have been conducted under Continuing Authorities programs. However, each has been limited in scope to a portion of the seawall and/or roadway that had failed or was believed to be in imminent danger of failure. Over the years, incessant wind and wave action, flooding, inadequate drainage, protective beach erosion, and occasional hurricanes have caused millions of dollars in damage. However, the storm events

themselves are not the damage vector per se. Rather, engineering investigations have revealed that the toe of the seawall has deteriorated, resulting in the loss of fine fill material through the toe. This has created voids behind the wall and underneath the road. In places where there is little or no beach, the loss of fine materials results in failure of the road, the seawall, or both.

Prior to Hurricane Katrina, the area was protected by a concrete seawall. The seawall was constructed by local authorities in the early 1900's. At various times since its construction, beach sand replacements have created flat, somewhat narrow beaches extending from a pedestrian walkway and parking area at the seawall face outwards to the water's edge. These beach areas have proven to be popular recreation resources among local residents. These beaches offered slack-water beach recreation opportunities, similar to the activities occurring in Harrison and Jackson counties to the east.

No visitation data were available for Hancock County beaches. However, the resource is a popular destination for the residents of Hancock County in general. Approximately 43,000 people were counted in the 2000 Census of Hancock County. By 2004, the county's population was believed to have grown to about 45,150. This is a change of nearly 2,200 people and represents an annual growth rate of about 5%. Hancock County, along with Mississippi's two other coastal counties (Harrison and Jackson) are among the fastest growing in the state and the southeastern region. Table 2 displays the 2000-2004 population data.

**Table 2.**
**Hancock County Population**
**2000-2004**

| Year | Population |
|---|---|
| 2000 | 42,967 |
| 2001 | 43,280 |
| 2002 | 43,981 |
| 2003 | 44,637 |
| 2004 | 45,145 |

Source: Bureau of the Census

***Market Area Determination***

Based on the limited visitation information for the beaches and local officials' knowledge, a single county market area was chosen for this analysis. Residents of other counties nearby either have their own waterfront or beachfront recreation areas, or have access to beaches that are closer to them than Park Beach. According to Census estimates, the market area population had grown to about 45,145 just before Hurricane Katrina.

***Determination of Visitation***

There are no detailed visitation data available for the affected resource. However, the Corps of Engineers operates Okatibbee Lake north of Meridian, Mississippi. Several of the sites on that lake offer slack-water sandy beaches, with similar sand quality, similar water depths, and a similar climate. The area's population is similar to Coastal Mississippi's in family size and income. Visitation rates, activity participation and other key recreation statistics were developed in the Okatibbee Recreation Master Plan in 1998. The data are developed and explained in great detail in Chapter 6 of that document (on file at the District office). With no reliable data sources available for Hancock County beaches, per capita use and participation rates from Okatibbee were used as a proxy for those figures in this analysis.

The per capita use rate at Lake Okatibbee was estimated at 3.55 using historical visitation records. This rate describes the counted visitors divided by the market area population. Since there are no visitation data for Hancock, we use 3.55 times the population to arrive at the data in the table below.

**Table 3.**
**Projected Visitation**

| Year | Market Area Population | Projected Visitation |
|---|---|---|
| 2006 | 45,145 | 160,265 |

***Determination of Participation by Activity***

Four general recreation activities will be provided by the type of beach conditions found in the project area. These are fishing, picnicking, sightseeing and swimming. Participation rates, turnover rates and group sizes are displayed in the following table. Again, all data are from the Okatibbee Master Plan report and represent recorded figures.

**Table 4.**
**Participation by Recreation Activity**

| | Participation Rate | Turnover Rate | Group Size |
|---|---|---|---|
| Fishing | 0.26 | 1.8 | 2 |
| Picnicking | 0.28 | 1.8 | 4.6 |
| Sightseeing | 0.34 | 4 | 2.7 |
| Swimming | 0.24 | 2.2 | 2.7 |
| Totals[1] | 1.12 | | |

[1] Participation is greater than 1.0 because many visitors participate in more than one activity.

***Determination of Recreation Demand***

With the above calculations, we can now estimate total recreation demand in visitor days and from there, estimate willingness to pay. To determine recreation demand, the following formula is used:

*Visitation x Participation Rate*

This formula can also be used to calculate design loads for recreation facilities by calculating it for each activity and incorporating group size and turnover. However, since design loads are not necessary to determine demand and willingness to pay, those figures are not presented here.

The result of the overall demand calculation is presented below:

**Table 5.**
**Recreation Demand**

| Year | Projected Visitation | Recreation Demand |
|---|---|---|
| 2006 | 160,265 | 179,497 |

*Future Without Project Condition*

The seawall, utilities, beach road were all severely damaged by the storm. If no federal action is taken to repair the seawall and create a beach environment, conditions will continue to deteriorate. Drainage outfalls will clog with debris and sand. Beach area will continue to erode. Fine material will continue to escape through the deteriorated seawall toe. Environmental degradation will continue to occur, the road will become unusable and recreation opportunities will be lost. In the Bay St. Louis recreation analysis, recreation visitation was believed to have been reduced by about 22% from pre-Katrina levels. This figure seems reasonable and an accurate portrayal of reduced visitation at the remainder of Hancock County's beachfront. Accordingly, the future without project condition recreation demand is placed at 140,007.

***Determination of Willingness to Pay***

The procedures described in ER-1105-2-100 address three evaluation methods. They are the travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method. The criteria described in ER-1105-2-100 were followed to determine the appropriate methodology for this analysis. The Unit Day Value (UDV) method was selected to evaluate recreation benefits because a regional model was not available and specialized recreation activities from a national perspective were not affected. Estimated annual visits affected did not exceed 750,000, which would indicate that a more rigorous empirical analysis is called for. Further, since a more detailed analysis of this resource would prove costly and time consuming, the UDV approach seems to be most prudent use of study resources. It is unlikely that any formulation of plan alternatives or plan selection will significantly change expected recreation benefits.

The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Hancock County beaches.

ER 1105-2-100 provides guidelines for assigning points and their conversion to dollar value for evaluating recreation.

The guidelines for assigning points to general recreation include five criteria:

(1) the quality of the recreation experience as affected by congestion;
(2) availability of substitute areas in terms of travel time;
(3) carrying capacity determined by level of facility development;
(4) accessibility as affected by road and parking conditions; and
(5) environmental quality based on aesthetics.

A resource is rated on a 100-point scale. The total possible points that can be assigned to each criterion are as follows:

(1) Recreation Experience – 30;
(2) Availability of Opportunity – 18;
(3) Carrying Capacity – 14;
(4) Accessibility – 18; and
(5) Environmental – 20.

The conversion of points to dollar value for general recreation is expressed in two activity categories:

(1) general recreation and
(2) general fishing and hunting.

Hence, points are estimated and expressed in the same manner. Based on analyst knowledge of the general area and the recreation opportunities provided by the asset and bolstered by several field

trips to the area before and after Katrina, recreation in Hancock County was scored and valued in accordance with the procedures described in ER 1105-2-100 and outlined in the tables below. These tables represent the estimation of recreation value without a project in the study area.

**Table 6.**
**Description of Recreation Points**

**Table 5: Guidelines for Assigning Points for General Recreation**

| **Criteria** | **Judgment Factors** | | | | |
|---|---|---|---|---|---|
| **Recreation experience**[1] | Two general activities[2] | Several general activities | Several general activities; one high quality value activity[3] | Several general activities; more than one high quality value activity | Numerous high quality value activities; some general activities |
| Total Points: 30 | | | | | |
| Point Value: | 0-4 | 5-10 | 11-16 | 17-23 | 24-30 |
| **Availability of opportunity**[4] | Several within 1 hr. travel time; a few within 30 min. travel time | Several within 1 hr. travel time; none within 30 min. travel time | One or two within 1 hr. travel time; none within 45 min. travel time | None within 1 hr. travel time | None within 2 hr. travel time |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Carrying Capacity**[5] | Minimum facility for development for public health and safety | Basic facility to conduct activity(ies) | Adequate facilities to conduct without deterioration of the resource or activity experience | Optimum facilities to conduct activity at site potential | Ultimate facilities to achieve intent of selected alternative |
| Total Points: 14 | | | | | |
| Point Value: | 0-2 | 3-5 | 6-8 | 9-11 | 12-14 |
| **Accessibility** | Limited access by any means to site or within site | Fair access, poor quality roads to site; limited access within site | Fair access, fair road to site; fair access, good roads within site | Good access, good roads to site; fair access, good roads within site | Good access, high standard road to site; good access within site |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Environmental** | Low esthetic factors[6] that significantly lower quality[7] | Average esthetic quality; factors exist that lower quality to minor degree | Above average esthetic quality; any limiting factors can be reasonably rectified | High esthetic quality; no factors exist that lower quality | Outstanding esthetic quality; no factors exist that lower quality |
| Total Points: 20 | | | | | |
| Point Value: | 0-2 | 3-6 | 7-10 | 11-15 | 16-20 |

Table 7 illustrates a reasonable assessment of the overall quality of recreation experience should no federal action be taken to repair the seawall and place beach sand.

**Table 7.**
**Recreation Score with No Federal Action**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1] Pts. Possible: 30 | 7 | Four activities are provided by the existing beach, all of which are of average quality. |
| **Availability of opportunity**[4] Pts Possible: 18 | 5 | There are beach facilities in Harrison, Jackson, and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| **Carrying Capacity**[5] Pts Possible: 14 | 4 | Undamaged stretches of beach are snapped up quickly by even moderate usage periods. |
| **Accessibility** Pts Possible: 18 | 8 | Accessibility is generally good; however damage-induced parking problems hamper accessibility. |
| **Environmental** Pts Possible: 20 | 1 | The existing beach still suffers from damage and debris removal is a continual effort. The debris represents both a health and safety hazard to the public. |
| TOTAL SCORE | 25 | |

Table 8 below (from Economic Guidance Memorandum (EGM) 06-03) provides a means of converting the resource's UDV score into FY 2006 dollars. With the score of 25 taken from table above, we estimate the future without project condition value of Hancock County beaches to be $4.49 by interpolating between the values given at 20 and 30. That is, an average recreational visitor to the park would place a willingness to pay value of approximately $4.49 on their recreation day. With recreation demand of 140,007 visitor days at $4.49, the total without project condition value is $628,633.

**Table 8.**
**Conversion to Recreation Values**

| Point Values | General Recreation Values |
|---|---|
| 0 | 3.19 |
| 10 | 3.79 |
| 20 | 4.19 |
| 30 | 4.79 |
| 40 | 5.98 |
| 50 | 6.78 |
| 60 | 7.38 |
| 70 | 7.78 |
| 80 | 8.57 |
| 90 | 9.17 |
| 100 | 9.57 |

*Future With Project Condition*

Two of the alternatives being considered for seawall repair include beach sand placement. Both call for placement of approximately 31,000 cubic yards of beach sand, shaped and formed into a dune

on the existing beach area. One alternative calls for a bare dune, the other calls for adding fencing and plantings to anchor the dune and further enhance the environmental quality. For the purposes of this analysis, there is little difference between the two in terms of recreation value. An argument could be made that the fence-and-planting alternative would provide a greater aesthetic value. However, the increase in value would likely be marginal, difficult to quantify, and would not likely have much of an effect on willingness to pay. Hence, the two alternatives are considered equal.

**Table 9.**
**Recreation Score for the With Project Condition**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1] Pts. Possible: 30 | 13 | Four activities are provided by the existing beach, all of which would be of very good, but not excellent quality. |
| **Availability of opportunity**[4] Pts Possible: 18 | 5 | There are beach facilities in Harrison, Hancock, and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| **Carrying Capacity**[5] Pts Possible: 14 | 8 | Peak season usage is still likely to cause some congestion. However, additional access points and more beach space will improve both parking conditions and beach space. The Corps "standard" of 150 square feet per visitor is not likely to be reached. |
| **Accessibility** Pts Possible: 18 | 12 | Accessibility is generally good; however the aforementioned parking problems hamper accessibility somewhat. |
| **Environmental** Pts Possible: 20 | 9 | No significant environmental issues are present. Occasional heavy rainfall results in swimming advisories (common among the southern U.S. coast). |
| TOTAL SCORE | 47 | |

Again referring to the conversion table, we find that a score of 47 equates to a willingness to pay of $7.93. With repair and replacement of the seawall and utility conduits and additional beach placement, the full pre-Katrina recreation demand is expected to occur, resulting in demand for 179,497 visitor days a year. Thus at $7.93 per visitor day, the total value of with project recreation is $1,423,407.

This represents a net increase of $794,775, and that figure represents the total NED benefit of the repair and beach placement alternatives.

## *Environmental Quality (EQ)*

### *1) National Ecosystem Restoration (NER)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

#### *Incremental Cost Analysis*

The justification for the proposed section is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501,

*Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

***Assumptions***

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives (habitat unit, HU). HU is based on an assessment protocol, which provides a basic level of stream health evaluation that is based on physical conditions within the assessment area. The assessment is used to record the scores for up to 15 assessment elements (i.e., channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover [warm water fishery], manure presence, salinity, riffle embeddedness, and macroinvertebrates observed). However, all assessment elements were not applicable to the assessment area and were not included.

The first step in incremental analysis is to display the environmental outputs (effects on habitat expressed in Functional Habitat Index, FHI) and the cost estimates of the management measure increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average annual outputs and average annual costs were used for this analysis.

Table 10 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no work is undertaken to prevent erosion. Alternative 2 represents the placement of a dune on the beach. Alternative 3 represents dune placement with fencing and plantings. Project outputs for each alternative are displayed in terms of functional habitat index (FHI) that can be supported for each alternative considered.

**Table 10.**
**Outputs and Costs by Increments**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Dune only | $1,270,000 | $70,914 | $40,000 | $136,614 | 260 |
| 3 | Dune with plantings | $1,770,000 | $98,833 | $40,000 | $174,433 | 405 |

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (HU) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their outputs. The result is a ranking of Alternative 1, 2, and 3 as displayed in the previous. Where two or more solutions produce the same output, the solutions are ranked in ascending order of their costs. At each level of output the least cost solution is determined. No alternatives were eliminated in this step because they all produce different levels of output.

The fifth step in incremental analysis is to eliminate economically ineffective solutions. The outputs and costs undergo a pair-wise comparison. The results of the comparison are analyzed to determine which solutions will produce less output at equal or greater cost than subsequently ranked solutions. Those solutions that will produce less output at equal or greater cost than subsequently ranked solutions are deleted. No alternatives were eliminated in this step because they all produce different levels of output.

The sixth step is to calculate average costs for the set of solutions that emerged from the cost effectiveness analysis. Average costs are calculated by dividing each level of output's cost by its output. Alternatives with outputs less than the lowest average cost level are eliminated from further analysis. Alternative 1 (the no action plan) does not have an average cost per unit of output, since it does not cost anything or produce anything. Table 11 displays this information.

**Table 11.**
**Average Cost of Each Level of Output**

| Output (FHI) | Average Annual Cost | Average Cost ($) per FHI |
|---|---|---|
| 0 | 0 | N/A |
| 260 | $136,614 | $525.44 |
| 405 | $174,433 | $430.70 |

The next step is to recalculate average costs for additional output. The average costs are calculated for additional output using the incremental levels of output. These calculations begin with the lowest average cost level of output, the "zero level" output. The average costs are calculated using the additional costs and additional outputs above those of the previously identified level of outputs with the lowest average cost. Levels of output less than the lowest average cost are eliminated from further analysis. This process is repeated until the final level of output is identified as the lowest average cost of output. Since no alternative was eliminated in the previous step, this step was not necessary.

Calculating the incremental costs is the eighth step. The difference in cost between two solutions divided by the difference in output between the same two solutions is the incremental cost. Table 12 shows the calculations.

**Table 12.**
**Incremental Costs**

| Output (FHI) | Average Annual Cost ($) | Additional Output (FHI) | Additional Cost ($) | Incremental Cost ($ per FHI) |
|---|---|---|---|---|
| 0 | $0 | 0 | $0 | $0 |
| 260 | $136,614 | 260 | $136,614 | $525.44 |
| 405 | $174,433 | 145 | $37,819 | $260.82 |

The final step is to compare successive outputs and incremental costs. The results from the incremental costs are compared and then used as a decision making tool by progressively proceeding through the available level of outputs and asking if the next level is "worth it." That is to say, "is the habitat value of the additional unit of environmental benefit in the next available level of output worth its additional monetary costs?"

*2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. Figures 4 and 5 show the existing state of the beach. No federal actions would mean a continued degradation to the aesthetic value of the natural resource. Adding the dune would have a minimal impact on the aesthetic value where adding the dune with plantings and fencing would have a moderate impact.

**Figure 4.**

**Figure 5.**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Hancock County is located in the lower west corner of Mississippi. The County shares its borders with Harrison County, Mississippi to the east, St. Tammany Parish, Louisiana to the west and Pearl River County, Mississippi to the north. According to the 2000 Census, the county has a population of 42,967.

Table 13 shows the employment breakdown for Hancock County. There are no manufacturing and industrial jobs in Hancock County. The county is heavily dependent upon the retail and food service industry as is often the case in poorer areas.

**Table 13.**
**Employment Breakdown of Hancock County**

| Sector | Mississippi | Hancock County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 0 | 0% |
| Wholesale | 35,316 | 251 | 0.7% |
| Retail | 135,838 | 1,586 | 1% |
| Real Estate | 9,665 | 131 | 1% |
| Professional | 29,023 | 1,555 | 5% |
| Administration | 46,115 | 1,280 | 3% |
| Education | 1,678 | 0 | 0% |
| Health Care | 131,976 | 500 | 0.3% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 2,114 | 2% |
| Other Services | 22,180 | 176 | 0.7% |
| Total | 713,310 | 7,693 | 1% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Hancock County was $17,748 and the median household income was $35,202 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 14 displays the income breakdown for Hancock County.

**Table 14.**
**Income Breakdown for Hancock County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Hancock County | $17,748 | $35,202 | 2.56 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 15. The percentage of persons below the poverty level for the state of Mississippi and Hancock County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Hancock County. The unemployment rate for Hancock County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 15.**
**Poverty Level and Unemployment Rate for Hancock County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Hancock County | 14.1% | 6.3% | 12.6% | 22.3% |

Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $1,270,000 for the add dune alternative and $1,770,000 for the add dune with plantings alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $40,000 for both alternatives, which in present worth form amounts to $716,357 (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population. Table 16 shows the EIFS model inputs.

**Table 16.**
**Summary of Inputs by Project Alternative**

| Indicator Variable | Add Dune | Add Dune w/ Plantings | Add Dune O&M | Add Dune w/ plantings O&M |
|---|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $1,270,000 | $1,770,000 | $716,357 | $716,357 |

*Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Add Dune.*** If implemented, the total sales volume related to this alternative is projected to increase by $3,972,714 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,432,714 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 2ft Removal alternative.

***Add Dune with plantings***. If implemented, the total sales volume related to this alternative is projected to increase by $4,972,714 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,432,714 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 1ft Removal alternative.

*Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Add Dune.*** If implemented, the total income related to this alternative is projected to increase by $957,961 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $345,478 (i.e. the total income increased because of O&M) was added to the total income of the 2ft Removal alternative.

***Add Dune with plantings.*** If implemented, the total income related to this alternative is projected to increase by $1,199,096 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $345,478 (i.e. the total income increased because of O&M) was added to the total income of the 1ft Removal alternative.

*Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Add Dune.*** If implemented, the total employment related to this alternative is projected to increase by 24 workers in Hancock County. Note, O&M is only accounted for if the project is implemented;

therefore, 9 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 2ft Removal alternative.

***Add Dune with plantings.*** If implemented, total employment related to this alternative is projected to increase by 30 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 9 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 1ft Removal alternative.

*Population*

If implemented, the population related to both alternatives is projected to increase by 0. Table 17 shows the EIFS model outputs.

**Table 17.**
**Summary of Outputs by Project Alternative**

| Indicator Variable | Projected Δ Add Dune | Projected Δ Add Dune w/ plantings | Projected Δ Add Dune O&M | Projected Δ Add Dune w/ plantings O&M |
|---|---|---|---|---|
| Direct Sales Volume | $1,270,000 | $1,770,000 | $716,357 | $716,357 |
| Induced Sales Volume | $1,270,000 | $1,770,000 | $716,357 | $716,357 |
| Total Sales Volume | $2,540,000 | $3,540,000 | $1,432,714 | $1,432,714 |
| Direct Income | $306,242 | $426,809 | $172,739 | $172,739 |
| Induced Income | $306,242 | $426,809 | $172,739 | $172,739 |
| Total Income | $612,483 | $853,618 | $345,478 | $345,478 |
| Direct Employment | 8 | 11 | 4 | 4 |
| Induced Employment | 7 | 10 | 5 | 5 |
| Total Employment | 15 | 21 | 9 | 9 |
| Local Population | 0 | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

*1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 18 shows the number selected housing statistics for census tracts 301and 302. There are 6,775 housing units in the two tract area. The average structure was built between 1946 and 1973. Of the structures, eight-one-percent are occupied and nineteen- percent are vacant. Of those occupied, sixty-seven percent are owner occupied and thirty-three percent are renter occupied. Table 19 shows the number of units per structure. The number of units depicts the type of structure;

single family corresponds to one unit, duplex corresponds to two units, and so on. Table 20 shows the value of the owner occupied structures in the two tract area.

**Table 18.**
**Selected Housing Statistics**

| Category | Tract 301 | Tract 302 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 2,690 | 4,085 | 6,775 | |
| Median Year Built | 1946 | 1973 | | N/A |
| Occupancy Status | | | | |
| Occupied | 2,318 | 3,157 | 5,475 | 81% |
| Vacant | 372 | 928 | 1,300 | 19% |
| Tenure | | | | |
| Owner | 1,404 | 2,288 | 3,692 | 67% |
| Renter | 914 | 869 | 1,783 | 33% |

U.S. Census Bureau, 2000 Census

**Table 19.**
**Number of Units in Structure**

| Units in Structure | Tract 301 | Tract 302 | Total |
|---|---|---|---|
| 1, detached | 1,955 | 3,251 | 5,206 |
| 1, attached | 31 | 20 | 51 |
| 2 | 149 | 112 | 261 |
| 3 or 4 | 120 | 164 | 284 |
| 5 to 9 | 94 | 99 | 193 |
| 10 to 19 | 24 | 36 | 60 |
| 20 to 49 | 35 | 97 | 132 |
| 50 or more | 174 | 34 | 208 |
| Mobile Home | 108 | 254 | 362 |
| Boat, RV, van, etc. | 0 | 18 | 18 |
| Total | 2,690 | 4,085 | 6,775 |

U.S. Census Bureau, 2000 Census

**Table 20.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 301 | Tract 302 |
|---|---|---|
| Value | | |
| Less than $10,000 | 20 | 31 |
| $10,000 to $14,999 | 19 | 22 |
| $15,000 to $19,999 | 15 | 13 |
| $20,000 to $24,999 | 18 | 31 |
| $25,000 to $29,999 | 8 | 35 |
| $30,000 to $34,999 | 9 | 43 |
| $35,000 to $39,999 | 7 | 60 |
| $40,000 to $49,999 | 78 | 149 |
| $50,000 to $59,999 | 156 | 191 |
| $60,000 to $69,999 | 185 | 199 |
| $70,000 to $79,999 | 132 | 253 |
| $80,000 to $89,999 | 140 | 192 |
| $90,000 to $99,999 | 151 | 231 |
| $100,000 to $124,999 | 202 | 254 |
| $125,000 to $149,999 | 121 | 293 |

**Table 20.**
**Owner Occupied Values by Census Tracts (continued)**

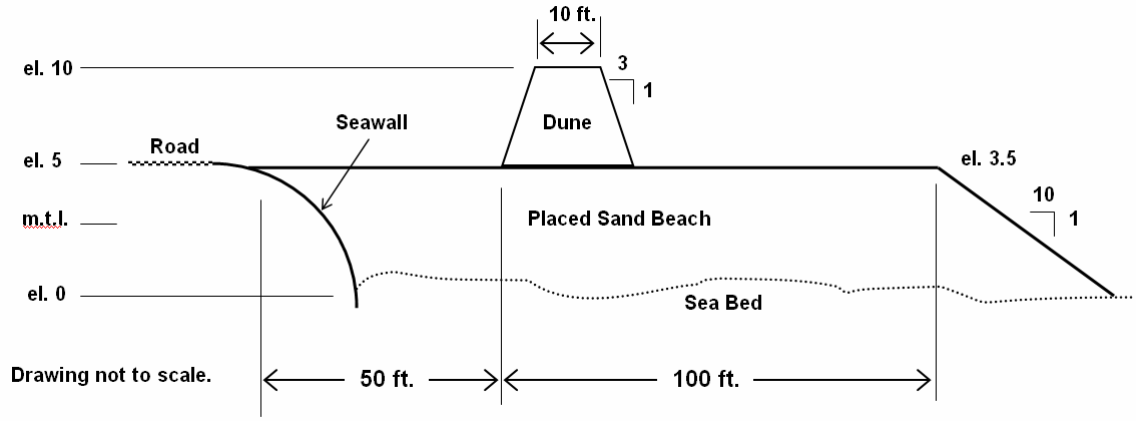
| Category | Tract 301 | Tract 302 |
|---|---|---|
| Value | | |
| $150,000 to $174,999 | 31 | 118 |
| $175,000 to $199,999 | 18 | 75 |
| $200,000 to $249,999 | 40 | 21 |
| $250,000 to $299,999 | 24 | 28 |
| $300,000 to $399,999 | 0 | 32 |
| $400,000 to $499,999 | 30 | 17 |
| $500,000 to $749,999 | 0 | 0 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 0 | 0 |
| TOTAL | 1,404 | 2,288 |
| Median Value for Owner Occupied Housing | $83,900 | $86,100 |
| Median Value for Mobile Homes | $60,300 | $37,400 |

U.S. Census Bureau, 2000 Census

# Recommended Plan

The recommended plan involves providing a dune atop the existing beach and adding a stabilizing fence and dune vegetation. The finished stable dune will be 2 feet high with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from an established upland borrow area. The plantings will have a density of 1 plant per 4 square feet and the fence will include the entire linear length of the project. The dune alone project will require replacement within 10 years and the dune with plantings and fence will require replacement within 15 years.

The recommended plan has been determined to be suited for near-term implementation. The key elements of the plan for this problem area could be implemented in approximately one year, including development of plans and specifications.




# Cost

This solution is estimated to cost $1,770,000 (October 2006 Price Level).

# ECONOMIC ANALYSIS FOR HANCOCK COUNTY STREAMS FLOOD DAMAGE REDUCTION AND ECOSYSTEM RESTORATION MOSS POINT, MS

## Introduction

This section describes the economic analysis evaluation for damage to the drainage ways of Hancock County. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

Hancock County was heavily damaged by the hurricanes of 2005 particularly, the storm surge and winds generated by Hurricane Katrina on August 29, 2005. Hurricane Katrina had an adverse affect on canals and drainage ways due to the deposition of sediment from the storm surge and windblown trees, and other debris. This document provides information regarding damage to the natural and man made drainage way systems of Hancock County, Mississippi and the potential for increased flooding in the surrounding area.

### *Opportunities*

**Opportunities identified** for this problem area were required to be linked to one or more of the following:

a. Hurricane storm damage reduction or remediation

b. Prevention or remediation of Saltwater Intrusion

c. Preservation of Fish & Wildlife and restoration of their habitats

d. Prevention or remediation of erosion

e. Other related water resource purposes, such as ecosystem restoration or barrier island restoration

They include:

- Reduction of future damages created by flooding from rains associated with hurricanes and major thunderstorms;
- Repair of damages to public facilities caused by 2005 storm events;

- Repair of damages to natural resources (primarily erosion of the natural drainage ways at this site) created by 2005 storm events.
- Restoration of commercial boat traffic blocked by sediment deposition;

**Location**. A general location map of the study areas is shown below

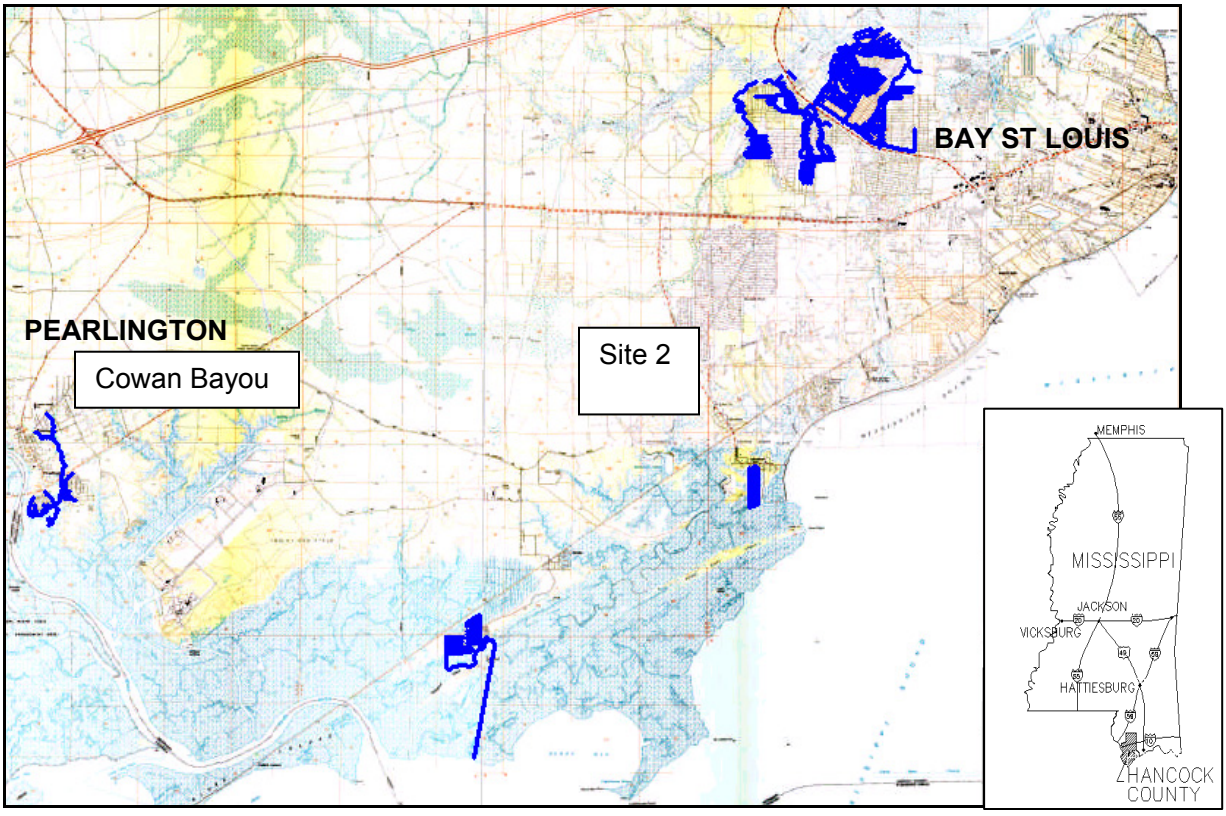



**Figure 1. Study Areas for Hancock County Streams**

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in estimating average annual benefits and costs

b. Price levels are October, 2006 unless otherwise stated.

c. A 50-year period of analysis was used since that is the remaining physical life of the rehabilitated seawall.

d. Impacted area (Hancock County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

The short-term alternatives identified for the Hancock County Streams project are five different sites. Each site is a drainage area that experienced sediment deposition as a result of storm surge from Hurricane Katrina. Each site has three alternatives.

## *Cowan Bayou*

**Hancock County Streams - Cowan Bayou – Alternative 1. No Action.** This alternative involves no federal action.

**Hancock County Streams - Cowan Bayou – Alternative 2. Sediment Removal (1ft)**. This alternative is a short term alternative that would consist of removing approximately 1 ft of sediment over an average width of 45 ft and length of 4.7 miles, see figure 6. There appears to be a minor amount of debris in the canals which would also have to be removed to facilitate removal of the sediment.

**Hancock County Streams - Cowan Bayou – Alternative 3. Sediment Removal (2ft)**. This alternative is a short term alternative that would consist of removing approximately 2 ft of sediment over an average width of 45 ft and length of 4.7 miles, see figure 6. There appears to be a minor amount of debris in the canals which would also have to be removed to facilitate removal of the sediment.

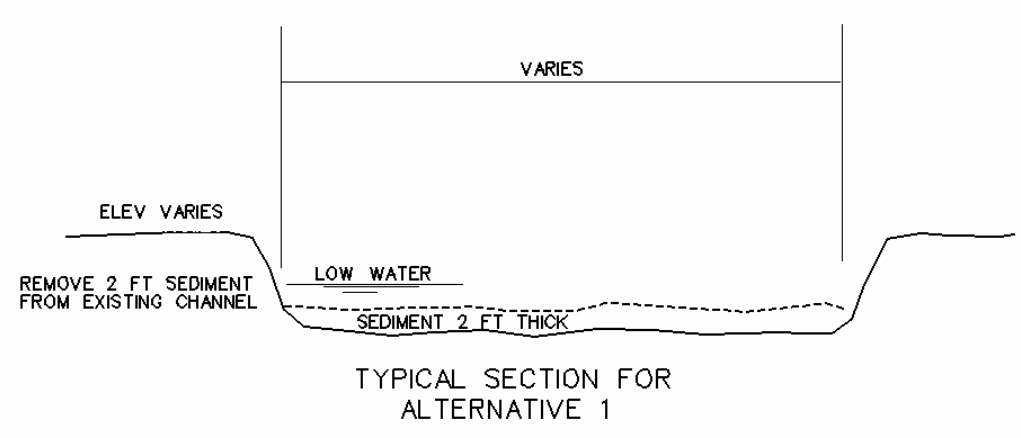



**Figure 6. Typical Cross Section for Cowan Bayou**

## *Site 2*

**Hancock County Streams – Site 2 – Alternative 1. No Action.** This alternative involves no federal action.

**Hancock County Streams – Site 2 – Alternative 2. Sediment Removal (1ft).** This alternative is a short term alternative that would consist of removing approximately 1 ft of sediment over an average width of 100 ft and length of 1.9 miles, see figure 8. There appears to be a minor amount of debris in the canals which would also have to be removed to facilitate removal of the sediment.

**Hancock County Streams – Site 2 – Alternative 3. Sediment Removal (2ft).** This alternative is a short term alternative that would consist of removing approximately 2 ft of sediment over an average

width of 100 ft and length of 1.9 miles, see figure 8. There appears to be a minor amount of debris in the canals which would also have to be removed to facilitate removal of the sediment.

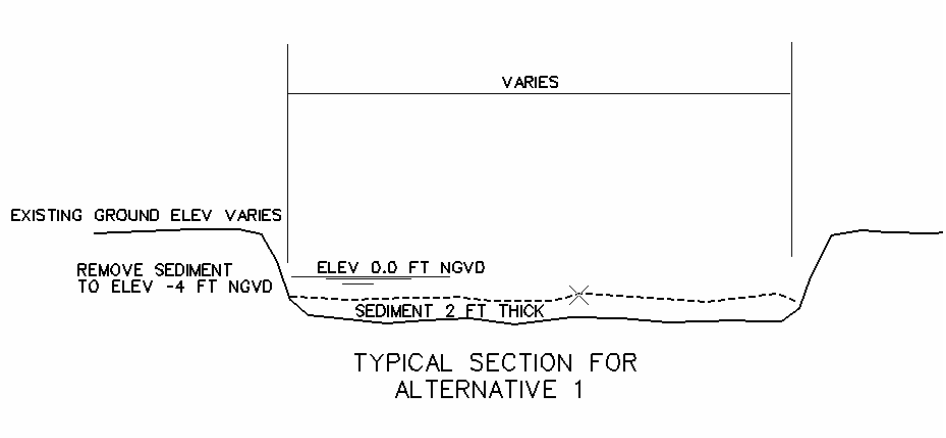



**Figure 8. Typical Cross Section for Site 2**

The sites were combined to form 3 alternatives, The no action plan, 1-foot sediment removal, and 2-foot sediment removal. The project delivery team evaluated the alternatives based on their prospective impact. The alternatives were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Total 1ft alternative | | | $4,070,000 | $64,900 |
| Total 2ft Alternative | | | $6,820,000 | $123,000 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

### *1) Flood Damage Reduction*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. This evaluation is slightly above sea level and would provide some flood damage reduction benefits.

## *2) Recreation*

This analysis provides rough order of magnitude estimates of recreational benefits associated with removing sediment and debris deposited into these systems by Hurricane Katrina, restoring both their pre-storm depths and restoring tidal flow. Such restoration would also likely improve water quality, reduce mosquitoes by eliminating stagnation and allowing game fish (such as red and spotted sea trout) access to shallow, brackish backwater spawning areas.

Each of the areas listed above are populated. They are nearly fully developed, with the typical home being a single-family residence of one to two stories. Few, if any are built slab-on-grade, as virtually all are located within the 100-year flood plain. Virtually all structures observed during field trips were constructed on piling foundations, with water front setbacks ranging from near zero to 30 feet. There is no evidence that restoring the pre-storm depths would result in flood damage reduction benefits.

### *Existing (Pre-Storm) Condition Fleet Characteristics*

In 1999, Hancock County had 7,249 recreational watercraft registered with Mississippi Wildlife, Fisheries and Parks. In Census 2000, the county counted 42,967 residents, meaning about one boat for every 5.93 persons (42,967 divided by 7,249 equals about 5.93). By 2004, there were an estimated 45,145. If boat registration and population are correlated, then there were likely 7,612 boats registered in the county by the start of the 2005 hurricane season (45,145 divided by 5.93 equals about 7,612). According to the breakdown of boat drafts in the boater registration data, approximately 94% of the registered boats had lengths less than 40 feet. Typically, boats longer than 40 feet have drafts of at least 3 feet and these boats would have great difficulty safely navigating the channels, even at high tide. Not only would they likely run aground, their width would be too great to allow for two-way traffic and their turning radius would be too wide to permit safe negotiation of the channels' often 90-degree turns. Hence, it is reasonable to believe that of the 7,612 boats in the county, approximately 7,156 of them could be in the affected fleet (7,612 times 94% equals about 7,156).

Of the 7,156 vessels in the affected fleet, only about 60% of them are located in the residential areas served by the drainage canals. The 60% figure was estimated using zip code boundaries, census tract income and household size data, and analyst judgment. The other 40% are believed to be either moored at area marinas or were trailered to and from a local boat ramp before Hurricane Katrina. So, for the purposes of this analysis, 60% of 7,156, or 4,294 will constitute the affected fleet. There is no available method of determining exactly how many of the affected fleet is located in the areas where dredging actions are proposed. Also, allocating vessels by canal-mile of the affected drainage system would place all but about one-fourth of the vessels at Shoreline Park and Bayou Phillip, which appears to be unreasonable. Having the vessel registration data by zip code would also be ineffective, as the entire study area is covered by only two zip codes. Lastly, boat registration data by census tract is unavailable. Hence, the only other method of allocating the fleet is to do it equally. That is, any proposed work for any of the four project areas will affect one-quarter of the affected fleet.

### *Sailing Frequency and Unit Day Value*

Interviews were conducted with several local residents in each of the four affected areas. On average, each vessel would make approximately one trip a week, regardless of the time of year. The climate of the study area is quite mild, with average daily temperatures staying well above freezing, even in winter. There is rarely a week in the calendar when conditions do not favor boating. Naturally, sailings are more frequent during summer months and less frequent during winter months, but no data exists to describe a seasonal pattern, so an average of one trip per week was used.

The typical trip is made on a weekend day. However, residents pointed out that quite a few of their neighbors are retired. These are likely to make two or more trips a week, and traverse the channels whenever the fishing and the weather is good. Peak demand occurs on the weekends, but with considerable traffic each day of the week. Without detailed knowledge from boater surveys, it is reasonable to believe that there are no lost opportunities associated with congestion.

Each trip normally consists of either two or three persons aboard, so the midpoint, or 2.5 persons, was chosen for this analysis.

With 4,293 vessels sailing 52 times a year with 2.5 persons aboard, the total annual visitor days comes to 558,090 (4,293 x 52 x 2.5 = 588,090).

The procedures described in ER-1105-2-100 address three evaluation methods. They are the travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method. The criteria described in ER-1105-2-100 were followed to determine the appropriate methodology for this analysis. The Unit Day Value (UDV) method was selected to evaluate recreation benefits because a regional model was not available and specialized recreation activities from a national perspective were not affected. Estimated annual visits affected did not exceed 750,000, which would indicate that a more rigorous empirical analysis is called for. Further, since a more detailed analysis of this resource would prove costly and time consuming, the UDV approach seems to be most prudent use of study resources. It is unlikely that any formulation of plan alternatives or plan selection will significantly change expected recreation benefits.

The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Buccaneer.

ER 1105-2-100 provides guidelines for assigning points and their conversion to dollar value for evaluating recreation.

The guidelines for assigning points to general recreation include five criteria:

(1) the quality of the recreation experience as affected by congestion;
(2) availability of substitute areas in terms of travel time;
(3) carrying capacity determined by level of facility development;
(4) accessibility as affected by road and parking conditions; and
(5) environmental quality based on aesthetics.

A resource is rated on a 100-point scale. The total possible points that can be assigned to each criterion are as follows:

(1) Recreation Experience – 30;
(2) Availability of Opportunity – 18;
(3) Carrying Capacity – 14;
(4) Accessibility – 18; and
(5) Environmental – 20.

The conversion of points to dollar value for general recreation is expressed in two activity categories:

(1) general recreation and
(2) general fishing and hunting.

Hence, points are estimated and expressed in the same manner. General recreation includes boating, skiing, camping, sightseeing, sunbathing, swimming and picnicking. General hunting and fishing includes fishing from the beach and pier. Hunting was once allowed in the park and adjacent

Mud Bayou during its early days prior to the construction of the water park, but has since been prohibited.

Based on analyst knowledge of the general area and the recreation opportunities provided by the asset and bolstered by several field trips to the area before and after Katrina, Buccaneer was scored and valued in accordance with the procedures described in ER 1105-2-100 and outlined in the tables below. These tables represent the estimation of recreation value without a project to repair South Beach Blvd and the adjacent seawall. Table 2 gives a description of general recreation points.

**Table 2.**
**Description of General Hunting and Fishing Points**

| **Guidelines for Assigning Points for General Hunting & Fishing** | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Judgment Factors** | | | | |
| **Recreation experience**[1] | Two general activities[2] | Several general activities | Several general activities; one high quality value activity[3] | Several general activities; more than one high quality value activity | Numerous high quality value activities; some general activities |
| Total Points: 30 | | | | | |
| Point Value: | 0-4 | 5-10 | 11-16 | 17-23 | 24-30 |
| **Availability of opportunity**[4] | Several within 1 hr. travel time; a few within 30 min. travel time | Several within 1 hr. travel time; none within 30 min. travel time | One or two within 1 hr. travel time; none within 45 min. travel time | None within 1 hr. travel time | None within 2 hr. travel time |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Carrying Capacity**[5] | Minimum facility for development for public health and safety | Basic facility to conduct activity(ies) | Adequate facilities to conduct without deterioration of the resource or activity experience | Optimum facilities to conduct activity at site potential | Ultimate facilities to achieve intent of selected alternative |
| Total Points: 14 | | | | | |
| Point Value: | 0-2 | 3-5 | 6-8 | 9-11 | 12-14 |
| **Accessibility** | Limited access by any means to site or within site | Fair access, poor quality roads to site; limited access within site | Fair access, fair road to site; fair access, good roads within site | Good access, good roads to site; fair access, good roads within site | Good access, high standard road to site; good access within site |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Environmental** | Low esthetic factors[6] that significantly lower quality[7] | Average esthetic quality; factors exist that lower quality to minor degree | Above average esthetic quality; any limiting factors can be reasonably rectified | High esthetic quality; no factors exist that lower quality | Outstanding esthetic quality; no factors exist that lower quality |
| Total Points: 20 | | | | | |
| Point Value: | 0-2 | 3-6 | 7-10 | 11-15 | 16-20 |

Table 3 illustrates a reasonable assessment of the overall quality of recreation experience should no federal action be taken to repair the seawall and roadway. Limited access, poor to-site road conditions and congestion along the to-site road would lower both the quality of the recreation experience itself, and lead to future decreases in quality as park revenues suffer. Availability and the relatively unique combination of activities would still garner fairly high marks, as would the overall recreation experience.

**Table 3.**
**Summary of Without Project Points**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1]<br><br>Pts. Possible: 30 | 12 | The community canals provided ready access to traditionally productive fishing grounds. Other activities include pleasure boating, water skiing, diving, snorkeling, spearfishing and sightseeing. |
| **Availability of opportunity**[4]<br><br>Pts Possible: 18 | 12 | While the fishing is good in the Sound and Bay, there are numerous other resources in the region, including Mobile and Grand Bay to the east and the Louisiana bayous to the west. All are about 1 to 1.5 hours away. However, *none of these* offer such a neighborhood setting and ready access to water in such an intense development. |
| **Carrying Capacity**[5]<br><br>Pts Possible: 14 | 8 | The areas are fully developed, and none of those interviewed reported congestion problems. However, transient and/or visiting sightseers could affect carrying capacity on extreme high peak weekends, such as warm weather holidays. |
| **Accessibility**<br><br>Pts Possible: 18 | 12 | All roads into and out of these areas are primarily residential. They are not congested and they're in generally good shape. Interior roads are residential as well, and suffer no serious problems. |
| **Environmental**<br><br>Pts Possible: 20 | 9 | No significant environmental issues were present before the storm. Occasional shoaling and debris deposition would occur, but the problems were neither overly frequent nor serious. |
| TOTAL SCORE | 51 | |

Table 4 (from Economic Guidance Memorandum (EGM) 06-03) provides a means of converting the resource's UDV score into FY 2006 dollars. With the score of 51 taken from table above, we estimate the future without project condition value of Hancock County Community channels to be $6.84 by interpolating between the values given at 50 and 60. That is, an average boater using the channels would place a willingness to pay value of approximately $6.84 on their recreation day. With 588,090 visitor days annually, the annual willingness to pay comes to $3.82 million.

**Table 4.**
**Conversion of Points to Dollar Values**

| Point Values | General Recreation Values |
|---|---|
| 0 | 4.59 |
| 10 | 5.18 |
| 20 | 5.58 |
| 30 | 6.18 |
| 40 | 6.78 |
| 50 | 7.38 |
| 60 | 8.17 |
| 70 | 8.57 |
| 80 | 9.17 |
| 90 | 9.37 |
| 100 | 9.57 |

## *Future Without Project Condition*

If one to two feet of sediment is not removed from the channels, shoaling will continue in numerous hotspots, which at this writing have unknown locations. These shoals are likely to create conditions that are virtually non-navigable by any vessel, regardless of size or draft. Table 5 below describes how the community channels are scored in the future without federal action.

**Table 5.**
**Future Without Recreation Points**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1]<br><br>Pts. Possible: 30 | 1 | The community canals are virtually inaccessible now and this will likely worsen in the future. Groundings are a near certainty and damage from obstructions and debris are a hazard to navigation. |
| **Availability of opportunity**[4]<br><br>Pts Possible: 18 | 12 | While the fishing is good in the Sound and Bay, there are numerous other resources in the region, including Mobile and Grand Bay to the east and the Louisiana bayous to the west. All are about 1 to 1.5 hours away. However, *none of these* offer such a neighborhood setting and ready access to water in such an intense development. |
| **Carrying Capacity**[5]<br><br>Pts Possible: 14 | 1 | With the channels shoaling in, the resource's capacity is essentially maxed out. It may be possible for a very small craft to safely navigate at high tide, but the craft would have to wait for the next high tide to return. |
| **Accessibility**<br><br>Pts Possible: 18 | 12 | The future without project condition will not affect accessibility. |
| **Environmental**<br><br>Pts Possible: 20 | 1 | With so many shallows, shoaled areas and oxygen depletion being caused by decaying debris, the value of these canals as spawning grounds is virtually zero. Exacerbating the degradation is the likelihood of mosquitoes using isolated pooled areas for breeding. |
| Total Score | 27 | |

With a score of 27, we again interpolate between from the values in the conversion table, this time arriving at a value of $6.00. However, because of the severity of the damage to the channels, sailings will be so rare that the total value of the channels as a resource is essentially zero.

### *With Project Condition*

Under the with project condition, the channels will be dredged and debris will be removed from the bottom. Two alternatives were considered in the Engineering Appendix—removing one foot of sediment, or removing two feet (the amount believed to have been deposited by Katrina). Since incremental plan formulation is not called for in this project, no incremental analysis appears here. This analysis assumes that two feet of sediment will be removed.

### *Average Annual Benefits*

Accordingly, the with-project condition will restore the channels to their pre-storm conditions. All sailings that would have occurred had Katrina not destroyed their capacity will occur in the future. Since the areas are fully developed, no increase in population or use is anticipated. Hence, the $3,820,000 in existing condition willingness to pay becomes the with projection condition average annual benefits.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *1) National Ecosystem Restoration*

Table 6 shows the environmental outputs and costs of the alternatives.

**Table 6.**
**Outputs and Costs**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Removal of 1ft of sediment at each site | $4,070,000 | $227,261 | $64,900 | $292,161 | 195 |
| 3 | Removal of 2ft of sediment at each site | $6,820,000 | $380,815 | $123,000 | $503,815 | 195 |

Numbers are rounded to the nearest thousand.

### *2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The waterways, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape. See Figures 1 and 2.

**Figure 1.**

**Figure 2.**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, “Display changes in the distribution of regional economic activity.” Hancock County is located in the lower west corner of Mississippi. The County shares its borders with Harrison County, Mississippi to the east, St. Tammany Parish, Louisiana to the west and Pearl River County, Mississippi to the north. According to the 2000 Census, the county has a population of 42,967.

Table 7 shows the employment breakdown for Hancock County. There are no manufacturing and industrial jobs in Hancock County. The county is heavily dependent upon the retail and food service industry as is often the case in poorer areas.

**Table 7.**
**Employment Breakdown of Hancock County**

| Sector | Mississippi | Hancock County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 0 | 0% |
| Wholesale | 35,316 | 251 | 0.7% |
| Retail | 135,838 | 1,586 | 1% |
| Real Estate | 9,665 | 131 | 1% |
| Professional | 29,023 | 1,555 | 5% |
| Administration | 46,115 | 1,280 | 3% |
| Education | 1,678 | 0 | 0% |
| Health Care | 131,976 | 500 | 0.3% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 2,114 | 2% |
| Other Services | 22,180 | 176 | 0.7% |
| Total | 713,310 | 7,693 | 1% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Hancock County was $17,748 and the median household income was $35,202 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 8 displays the income breakdown for Hancock County.

**Table 8.**
**Income Breakdown for Hancock County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Hancock County | $17,748 | $35,202 | 2.56 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 9. The percentage of persons below the poverty level for the state of Mississippi and Hancock County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Hancock County. The unemployment rate for Hancock County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 9.**
**Poverty Level and Unemployment Rate for Hancock County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Hancock County | 14.1% | 6.3% | 12.6% | 22.3% |

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $6,820,000 for the 2-ft removal alternative and $25,310,000 for the 1-ft removal alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $1,158,082 for the 2-ft removal alternative and $608,546 1-ft removal alternative (both alternative's O&M are estimated to occur every 25 years), which in present worth form amounts to $46,753,841 and $23,952,160 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent). Table 10 shows the model inputs.

**Table 10.**
**Summary of EIFS Inputs by Project Alternatives**

| Indicator Variable | 2ft Removal | 1ft Removal | 2ft Removal O&M | 1ft Removal O&M |
|---|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $6,820,000 | $4,070,000 | $1,158,082 | $608,546 |

### *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***2ft Removal.*** If implemented, the total sales volume related to this alternative is projected to increase by $16,096,164 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $2,316,164 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 2ft Removal alternative.

***1ft Removal.*** If implemented, the total sales volume related to this alternative is projected to increase by $9,457,092 in the local area of Hancock County. Note, O&M is only accounted for if the

project is implemented; therefore, $1,217,092 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 1ft Removal alternative.

### *Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***2ft Removal.*** If implemented, the total income related to this alternative is projected to increase by $3,881,349 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $558,508 (i.e. the total income increased because of O&M) was added to the total income of the 2ft Removal alternative.

***1ft Removal.*** If implemented, the total income related to this alternative is projected to increase by $2,280,437 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $293,484 (i.e. the total income increased because of O&M) was added to the total income of the 1ft Removal alternative.

### *Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***2ft Removal.*** If implemented, the total employment related to this alternative is projected to increase by 98 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 14 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 2ft Removal alternative.

***1ft Removal.*** If implemented, total employment related to this alternative is projected to increase by 58 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 8 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 1ft Removal alternative.

### *Impact on Population*

If implemented, the population related to both alternatives is not projected to increase. Table 11 summarizes model outputs.

**Table 11.**
**Summary of EIFS Outputs by Project Alternatives**

| Indicator Variable | Projected Δ 2ft Removal | Projected Δ 1ft Removal | Projected Δ 2ft Removal O&M | Projected Δ 1ft Removal O&M |
|---|---|---|---|---|
| Direct Sales Volume | $6,890,000 | $4,120,000 | $1,158,082 | $608,546 |
| Induced Sales Volume | $6,890,000 | $4,120,000 | $1,158,082 | $608,546 |
| Total Sales Volume | $13,780,000 | $8,240,000 | $2,316,164 | $1,217,092 |
| Direct Income | $1,661,420 | $993,476 | $279,254 | $146,742 |
| Induced Income | $1,661,420 | $993,476 | $279,254 | $146,746 |
| Total Income | $3,322,841 | $1,986,953 | $558,508 | $293,484 |
| Direct Employment | 42 | 25 | 7 | 4 |
| Induced Employment | 42 | 25 | 7 | 4 |
| Total Employment | 84 | 50 | 14 | 8 |
| Local Population | 0 | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

### *1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 12 shows the number selected housing statistics for census tracts 302 and 303. There are 9,133 housing units in the two tract area. The average structure was built between 1973 and 1980. Of the structures, 76-percent are occupied and twenty-four percent are vacant. Of those occupied, seventy-seven percent are owner occupied and twenty-three percent are renter occupied. Table 13 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 14 shows the value of the owner occupied structures in the two tract area.

**Table 12.**
**Selected Housing Statistics**

| Category | Tract 302 | Tract 303 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 4,085 | 5,048 | 9,133 | |
| Median Year Built | 1,973 | 1,980 | N/A | N/A |
| Occupancy Status | | | | |
| Occupied | 3,157 | 3,815 | 6,972 | 76% |
| Vacant | 928 | 1,233 | 2,161 | 24% |
| Tenure Status | | | | |
| Owner | 2,288 | 3,057 | 5,345 | 77% |
| Renter | 869 | 758 | 1,627 | 23% |

U.S. Census Bureau, 2000 Census

**Table 13.**
**Number of Units in Structure**

| Units in Structure | Tract 302 | Tract 303 | Total |
|---|---|---|---|
| 1, detached | 3,251 | 3,535 | 6,786 |
| 1, attached | 20 | 55 | 75 |
| 2 | 112 | 70 | 182 |
| 3 or 4 | 164 | 85 | 249 |
| 5 to 9 | 99 | 41 | 140 |
| 10 to 19 | 36 | 8 | 44 |
| 20 to 49 | 97 | 8 | 105 |
| 50 or more | 34 | 0 | 34 |
| Mobile Home | 254 | 1,097 | 1,351 |
| Boat, RV, van, etc. | 18 | 149 | 167 |
| **Total** | 4,085 | 5,048 | 9,133 |

U.S. Census Bureau, 2000 Census

**Table 14.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 302 | Tract 303 |
|---|---|---|
| **Value** | | |
| Less than $10,000 | 31 | 135 |
| $10,000 to $14,999 | 22 | 66 |
| $15,000 to $19,999 | 13 | 101 |
| $20,000 to $24,999 | 31 | 146 |
| $25,000 to $29,999 | 35 | 120 |
| $30,000 to $34,999 | 43 | 97 |
| $35,000 to $39,999 | 60 | 149 |
| $40,000 to $49,999 | 149 | 206 |
| $50,000 to $59,999 | 191 | 297 |
| $60,000 to $69,999 | 199 | 191 |
| $70,000 to $79,999 | 253 | 287 |
| $80,000 to $89,999 | 192 | 252 |
| $90,000 to $99,999 | 231 | 221 |
| $100,000 to $124,999 | 254 | 278 |
| $125,000 to $149,999 | 293 | 210 |
| $150,000 to $174,999 | 118 | 119 |
| $175,000 to $199,999 | 75 | 54 |
| $200,000 to $249,999 | 21 | 86 |

**Table 14. (continued)**
**Owner Occupied Values by Census Tracts**

| Category | Tract 302 | Tract 303 |
|---|---|---|
| **Value** | | |
| $250,000 to $299,999 | 28 | 0 |
| $300,000 to $399,999 | 32 | 33 |
| $400,000 to $499,999 | 17 | 0 |
| $500,000 to $749,999 | 0 | 9 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 0 | 0 |
| TOTAL | 2,288 | 3,057 |
| Median Value for Owner Occupied Housing | $86,100 | $70,700 |
| Median Value for Mobile Homes | $37,400 | $24,600 |

U.S. Census Bureau, 2000 Census

### *2) Health and Safety*

Since the 2005 hurricane season, standing or slow draining water has been a major health concern. Standing water, accompanied with the warm climate, creates a number of issues for local residents. One issue of the standing water is mold and the stale smell that it produces. This mold can cause a number of allergic reactions and has been associated with what has become what locals refer to as the 'Katrina Cough'. Although the 'Katrina Cough' has yet to be medically documented, the frequency and occurrence of people showing the cold like symptoms since the storm has dramatically increased compared to the typical number of cases in regular years.

A second issue of concern is the infestation of knats and rodents that thrive on these conditions. Knats are very tiny flies that enjoy the damp warm air and, through nuisance biting, can make it impossible for someone to walk outside at certain times throughout the day. Rodents, notorious carriers of disease, exponentially multiply in warm moist areas like the drainage ways. Slow moving water and debris to hide their movement makes these areas prime breeding ground.

Another significant health and safety issue is the intrusion of native wildlife into the urbanized areas. Snakes and alligators are coming closer to human dwellings due to their displacement from the storm. Sightings have significantly increased and the threat to small children and pets are the greatest. Removal of the sediment would alleviate these health risks and improve the quality of life to the local residents.

### *3) Attractive Nuisance*

An attractive nuisance is anything that may attract children onto property. Hurricane Katrina's storm surge left sediment and debris deposited all along the Mississippi Gulf Coast. Culverts and drainage ways are blocked and filled with this debris, creating an attractive nuisance that can be hazard to young children. Examples of attractive nuisances are vegetative debris (trees and shrubs), house hold goods (refrigerators, washers and dryers) and construction/other debris (concrete, rebar, house pylons, automobiles, and boats.

These attractive nuisances have the potential to cause minor to fatal accidents among young children. The removal of this debris will significantly lower the occurrence of these accidents. In addition to health and safety benefits, reduction of attractive nuisances will also decrease expensive health care related costs that will mostly be borne by insurance providers. The increased health care costs will be transferred to the public through higher insurance premiums, and thus represent a savings to the nation.

# Recommended Plan

An interim solution would include the removal of sediment and debris at the Cowan Bayou sites and the Hancock Marina site. The average widths of the channels are approximately 50 feet with an average sediment depth of approximately 3 feet. Table 15 shows the recommended plan at each project site.

**Table 15.**
**Recommended Plan by Project Site**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) |
|---|---|---|---|
| **Cowan** | | | |
| Alt 3 | Removal of 2-feet of sediment | Moderate | $3,750,000 |
| **Hancock Marina** | | | |
| Alt 3 | Removal of 2-feet of sediment | Moderate | $3,140,000 |
| **TOTAL** | | | $6,890,000 |

# ECONOMIC ANALYSIS FOR JACKSON MARSH ECOSYSTEM RESTORATION HANCOCK COUNTY, MS

## Introduction

This section describes the economic analysis evaluation for ecosystem restoration at Jackson Marsh, Hancock, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

Hancock County was heavily damaged by the hurricanes of 2005, particularly from the storm surge and winds generated by Hurricane Katrina on August 29, 2005. Hancock County shoreline runs between Bayou Caddy and Waveland and is fronted by Beach Boulevard, which is protected by a concrete seawall and existing beach. The seawall is penetrated in a number of locations by open drainage channels. At the outfall of the drainage channels, concrete box culverts run beneath Beach Boulevard, with guide walls extending out into the Mississippi Sound.

Many of these structures were severely damaged by Hurricane Katrina. Typical damages included breaching or complete failure of the extension guide walls and destruction of the box culverts. There are several tidal marshes on the southwestern end of Hancock County as shown in the figure above. These expansive and contiguous tidal marshlands are maintained through an exchange of tidal flow through conduits (outfalls) that connect via the drainage canals. The tidal flow between Mississippi Sound and the marshes has been critically restricted from sedimentation as a result of Hurricane Katrina as shown in the figure below. The existence of these valuable marshlands is dependent upon the continuation of the tidal exchange provided by the outfalls. This document provides information regarding loss of tidal exchange to Jackson Marsh and solutions to prevent the loss of these aquatic resources.


**Figure 1. Project Location**

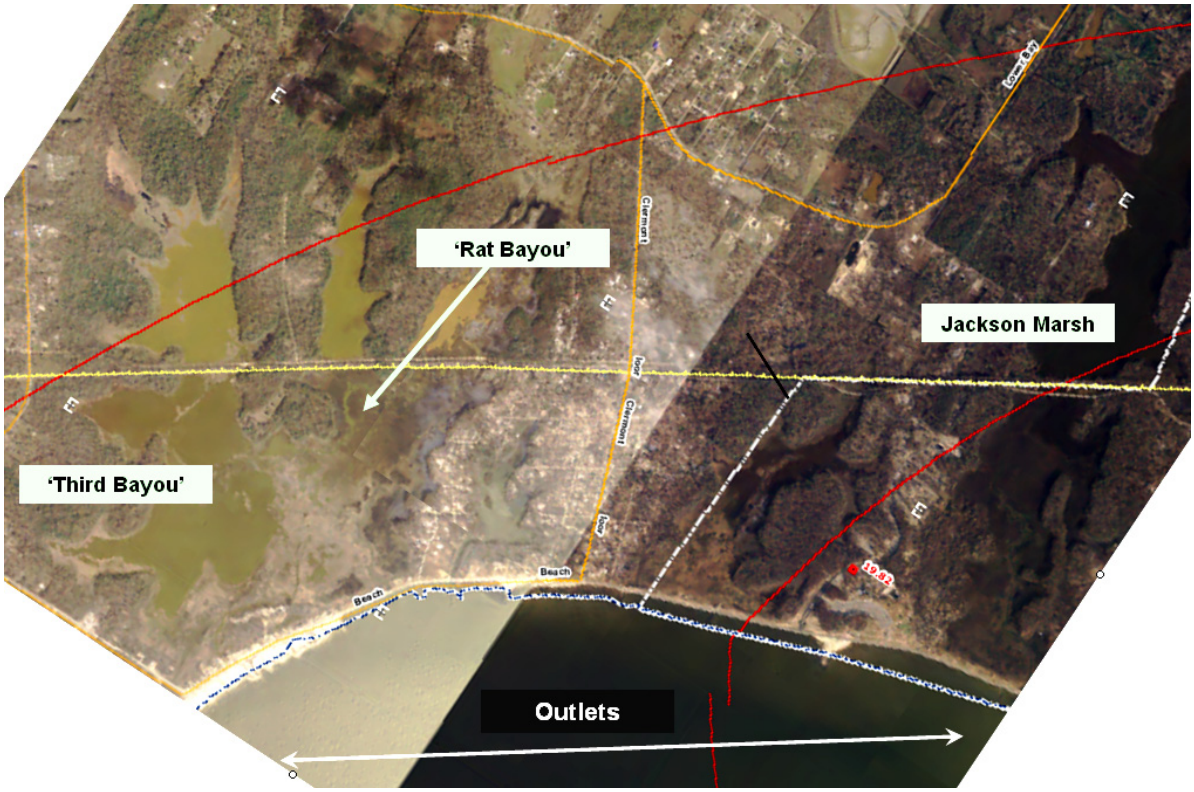



**Figure 2. Bayou Caddy Marsh (Image from Google Earth)**

# Opportunities

Opportunities identified for this problem area include:

a. Reduction of future hurricane-caused damage created by storm surge;

b. Reduction of future damage caused by waves created during hurricanes and other storms;

c. Repair of damages to natural resources created by 2005 storm events (primarily destruction wetlands at this site).

d. Restoration of environmental resources damaged by 2005 storm events.

e. Enhancement of water quality; and

f. Creation of additional aquatic resource nursery habitat (i.e. – fishery, invertebrates, etc.)

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent will be used in estimating average annual benefits and costs

b. Values shown in the report are stated in October 2006 dollars unless otherwise noted.

c. A 50-year period of analysis was used to calculate average annual costs.

d. Impacted area (Hancock County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Existing Conditions

The existing Mississippi Sound shoreline in the area is protected by a concrete stepped-face structure about 8 miles long. The seawall was constructed by local interests at various times between 1915 and 1928. Hydrographic and topographic survey data was obtained by the Mobile District under contract in September, 2003. The top elevation of the seawall varies between +3.8 to +5.0 feet National Geodetic Vertical Datum (NGVD). A sand beach was pumped into place on the along about six miles of this seawall in early 1967 as part of the emergency repair and protection following Hurricane Betsy (September 1965). There is another beach extending for about a mile south of the U.S. Highway 90 Bridge crossing the mouth of St. Louis Bay that was placed by the Mississippi Highway Department during the bridge construction. An additional one-mile-long segment of beach was constructed in the summer of 2005 from Cadet Bayou eastward.

South Beach Boulevard is the main thoroughfare along the entire length of the existing seawall. Historical as well as current wave attack against the shoreline of Hancock County has caused migration of soil through or under the seawall and scour of soil below the seawall in various locations, resulting in damages to South Beach Boulevard and other infrastructure. Sections of the highway have collapsed from time to time, disrupting and damaging utilities, and causing hazards and delays for residents and vehicular traffic. Hancock County has frequently repaired the seawall and road because of the loss of material from beneath the highway. Damaged utilities which have required repairs include water, sewer, natural gas, electric power, and electronic communications. The Mobile District has constructed a number of new seawall segments along various reaches of the existing seawall to alleviate this soil migration and scour problems in the study area under Sections 14 and 103 authorities.

The seawall is penetrated in a number of locations by open drainage channels. Typically, the components of these drainage channels at their crossings of South Beach Boulevard include concrete headwalls, concrete box culverts beneath the boulevard, and channel extension guide-walls extending out into Mississippi Sound. Many of these were severely damaged by hurricane Katrina. Typical damages included breaching of the extension guidewalls, failure of the guidewalls, and destruction of the outlet end of the box culverts.

There are 16 outlets along Beach Blvd with 12 identified outlets that the guide walls require replacement. That means that there are 24 walls, each 155 feet in length and having a pile length of 15 feet. This should give a total of 55, 800 square feet of piling in place. The pile section should be of sufficient stiffness to no require tiebacks. There will be an average of 5 feet in unsupported length and 10 feet of embedment.

Several tidal marshes exist on the landward side of the roadway on the southwestern end of Hancock County around the Waveland area. The existence of these expansive and contiguous tidal marshlands are maintained through tidal conduits (outfalls) built into the existing seawall at regular intervals. Many of the tidal conduits supporting these marsh areas are in a state of severe deterioration. It is also believed that the much of the tidal flow between Mississippi Sound and the marshes have been critically restricted from sedimentation as a result of Hurricane Katrina. The existence of these valuable marshlands is dependent upon the continuation of the tidal exchange provided by the outfalls. Without the tidal exchange, the marshes would drastically deteriorate and cease to function as a tidal salt marsh. In the short term, clearing and/or reconstruction of tidal outfalls would maintain a minimum tidal flow necessary to sustain salt marshes providing vital

stabilization. The overall health of the marshes is likely constrained by the limited water exchange allowed by the tidal conduit system. Reconstruction in a manner that would increase tidal flow may also result in the expansion and restoration of marsh areas that may have been restricted due to the present tidal exchange allowed by the old seawall and tidal conduits. Restoring a greater tidal flow will provide for the restoration, protection, stabilization, and continued existence of the present ecological resources.

# Alternatives

The immediate need is to replace those retaining walls that are in a high state of deterioration and in danger of failing. Those walls that have been recently replaced are basically sound and will only require channel excavations to clear the channel and restore tidal flow. Any reconditioning of the marshes themselves will be studied under the long term analysis.

**Alternative 1—No Action Plan.** This plan involves no federal action.

**Alternative 2—Repair drainage culverts (12) with aluminum sheet piles.** Replace existing training walls at 12 outlet structures with new aluminum sheet pile walls. The total wall length is 155 feet, pile length of 15 feet, pile embedded 10 feet. Pile to have a moment capacity of 10,000 ft-#/ft of wall or greater. Further investigation is needed to find the best product for corrosion and abrasion resistance. Excavate 1,000 CY of sand materials from within the channel and deposit it behind the new walls.

**Alternative 3—Repair drainage culverts (12) with vinyl sheet pils.** Install 155 LF of 55,800 square feet of new sheetpile walls using vinyl sheets at 12 locations. Excavate 1,000 CY of sand materials from within the channel and deposit it behind the new walls.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Aluminum Piles | Moderate | $4,520,000 | $234,700 |
| Alt 3 | Vinyl Piles | Moderate | $3,030,000 | $217,100 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

### *1) Flood Damage Reduction*

According to the P&G, “The national economic development account displays changes in the economic value of the national output of goods and services. Emergent tidal wetland habitat protects development with its natural buffer. The marsh area, such as Jackson Marsh, absorbs high wave energy typically associated with tropical storms and hurricanes. In addition, emergent tidal wetlands

also provide large areas of undeveloped (i.e. natural) land which absorbs large amounts of water from storms. Tidal marsh breaks down the wave energy of smaller storms before it reaches development.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *1) National Ecosystem Restoration (NER)*

Removal of the sediment would provide flushing of the system and improvement to tidal exchange resulting in less stagnant water. Removal of the obstructions would allow fish to migrate up the systems by the sub-adult and larvae for use as a forage area. The improved habitat would also improve foraging areas for shorebird use. Removal of the non-biodegradable foreign material and deposition of sediments would improve overall water quality by improving circulation and enhanced drainage in the area resulting in an overall reduction of flooding to nearby residences.

#### *Incremental Cost Analysis*

The justification for the proposed project is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501, *Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

#### *Assumptions*

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives (habitat unit, HU). HU is based on an assessment protocol, which provides a basic level of stream health evaluation that is based on physical conditions within the assessment area. The assessment is used to record the scores for up to 15 assessment elements (i.e., channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover [warm water fishery], manure presence, salinity, riffle embeddedness, and macroinvertebrates observed). However, all assessment elements were not applicable to the assessment area and were not included.

The first step in incremental analysis is to display the environmental outputs (effects on habitat expressed in habitat units, HU) and the cost estimates of the management measures increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average annual outputs and average annual costs were used for this analysis.

Table 2 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no work is undertaken to prevent erosion. Alternative 2 represents replacing 12 culverts with aluminum piles and the excavation of 1000 CY of sand. Alternative 3 represents the same as alternative 2 buth with vinyl piles. Alternative 4 represents the same as alternative 2 but with composite piles. Project outputs for each alternative are displayed in terms of units of habitat that can be supported for each alternative considered.

**Table 2.**
**Outputs and Costs by Increments**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 80 |
| 2 | Replace (12) culverts with aluminum pile | $4,520,000 | $252,388 | $235,000 | $742,388 | 525 |
| 3 | Replace (12) culverts with vinyl pile | $3,030,000 | $169,189 | $217,000 | $386,189 | 525 |

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (HU) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their costs. The result is a ranking of Alternative 1, 2, and 3 as displayed in Table 3. At each level of output the least cost solution is determined. This step eliminates alternative 2 because it yields the same level of output as alternative 3 but costs more to construct. No further steps are needed in this analysis.

**Table 3.**
**Summary of Costs and Additional Outputs in Ascending Order**

| Alt | Alternative Description | First Cost ($) | Annualized first cost ($) | O&M ($) | Average Annual Cost ($) | Outputs (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 80 |
| 2 | Replace (12) culverts with aluminum pile | $4,520,000 | $252,388 | $235,000 | $742,388 | 525 |
| 3 | Replace (12) culverts with vinyl pile | $3,030,000 | $169,189 | $217,000 | $386,189 | 525 |

*2) Aesthetics*

Overall aesthetic quality would be improved, since the existing structure is crumbling in places. Implementation of the proposed action would reduce sediment movement and turbidity. Sheetpile will also serve as substrate for epifauna. Overall the project will restore and maintain storm drainage for the upland areas on the landward side of the road. Maintaining storm drainage will prevent flooding from extreme rain and storm events that could result in erosion of upland resources. Structure repairs will maintain the integrity of the road and channel structure reducing sediment movement and turbidity resulting from the failure of the drainage channel. The restored marsh will serve the important function of providing nursery areas for fishes, shellfish, and crustaceans as well as stabilizing sediments in the immediate area. Various shorebirds and migratory birds utilize areas along the Mississippi shoreline. Restoring the marsh will provide valuable shorebird habitat.

**Figure 3. Looking Upstream from Culvert Entrance**

**Figure 4. Damaged pathway, drainage outlet, and outlet bridge near Waveland, MS**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Hancock County is located in the lower west corner of Mississippi. The County shares its borders with Harrison County, Mississippi to the east, St. Tammany Parish, Louisiana to the west and Pearl River County, Mississippi to the north. According to the 2000 Census, the county has a population of 42,967.

Table 4 shows the employment breakdown for Hancock County. There are no manufacturing and industrial jobs in Hancock County. The county is heavily dependent upon the retail and food service industry as is often the case in poorer areas.

**Table 4.**
**Employment Breakdown of Hancock County**

| Sector | Mississippi | Hancock County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 0 | 0% |
| Wholesale | 35,316 | 251 | 0.7% |
| Retail | 135,838 | 1,586 | 1% |
| Real Estate | 9,665 | 131 | 1% |
| Professional | 29,023 | 1,555 | 5% |
| Administration | 46,115 | 1,280 | 3% |
| Education | 1,678 | 0 | 0% |
| Health Care | 131,976 | 500 | 0.3% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 2,114 | 2% |
| Other Services | 22,180 | 176 | 0.7% |
| Total | 713,310 | 7,693 | 1% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Hancock County was $17,748 and the median household income was $35,202 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 5 displays the income breakdown for Hancock County.

**Table 5.**
**Income Breakdown for Hancock County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Hancock County | $17,748 | $35,202 | 2.56 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 6. The percentage of persons below the poverty level for the state of Mississippi and Hancock County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Hancock County. The unemployment rate for Hancock County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 6.**
**Poverty Level and Unemployment Rate for Hancock County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Hancock County | 14.1% | 6.3% | 12.6% | 22.3% |

Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $4,520,000 for the aluminum pile alternative, $3,030,000 for the vinyl pile and $3,060,000 for the composite pile alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $40,000 each year for sediment removal and full replacement of the aluminum pile every 15 years for $4,400,000. Annual O&M for the vinyl pile for the Dune alternative are estimated to be $40,000 each year for sediment removal and full replacement of the vinyl pile every 12 years for $2,900,000. Annual O&M for the composite pile for the Dune alternative are estimated to be $40,000 each year for sediment removal and full replacement of the composite pile every 12 years for $2,900,000. In present worth form O&M expenditures are $4,203,885, $3,887,177 and $3,887,177 for the aluminum, vinyl and composite piles respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four

indicators of a local economy: business volume, employment, personal income, and population. Table 7 shows the EIFS model inputs.

**Table 7.**
**EIFS Model Inputs for the Jackson Marsh Proposed Project Alternatives**

| Indicator Variable | Aluminum Pile | Vinyl Pile | Composite Pile | O&M Aluminum Pile | O&M Vinyl Pile | O&M Composite Pile |
|---|---|---|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $4,520,000 | $3,030,000 | $3,060,000 | $4,203,885 | $3,887,177 | $3,887,177 |

### *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

**Aluminum.** If implemented, the total sales volume related to this alternative is projected to increase by $17,547,770 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $8,407,770 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the aluminum alternative.

**Vinyl Pile**. If implemented, the total sales volume related to this alternative is projected to increase by $13,894,354 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $7,774,354 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the vinyl pile alternative.

**Composite Pile**. If implemented, the total sales volume related to this alternative is projected to increase by $13,894,354 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $7,774,354 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the composite pile alternative.

### *Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

**Aluminum**. If implemented, the total income related to this alternative is projected to increase by $3,557,312 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $2,027,408 (i.e. the total income increased because of O&M) was added to the total income of the aluminum alternative.

**Vinyl Pile**. If implemented, the total income related to this alternative is projected to increase by $1,475,747 or Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $1,874,669 (i.e. the total income increased because of O&M) was added to the total income of the vinyl pile alternative.

**Composite Pile**. If implemented, the total income related to this alternative is projected to increase by $1,475,747 for Jackson County. Note, O&M is only accounted for if the project is implemented;

therefore, $1,874,669 (i.e. the total income increased because of O&M) was added to the total income of the composite pile alternative.

### *Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

**Aluminum**. If implemented, the total employment related to this alternative is projected to increase by 107 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 51 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the aluminum alternative.

**Vinyl Pile**. If implemented, total employment related to this alternative is projected to increase by 86 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 48 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the vinyl pile alternative.

**Composite Pile**. If implemented, total employment related to this alternative is projected to increase by 86 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 48 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the composite and plants alternative.

### *Impact on Population*

If implemented, the population related to all three alternatives is not projected to increase. Table 10 shows the EIFS model outputs.

**Table 8.**
**EIFS Model Outputs for the Jackson County Beach Proposed Project Alternatives**

| Indicator Variable | Aluminum Pile | Vinyl Pile | Composite Pile | O&M Aluminum Pile | O&M Vinyl Pile | O&M Composite Pile |
|---|---|---|---|---|---|---|
| Direct Sales Volume | $4,570,000 | $3,060,000 | $3,060,000 | $4,203,885 | $3,887,177 | $3,887,177 |
| Induced Sales Volume | $4,570,000 | $3,060,000 | $3,060,000 | $4,203,885 | $3,887,177 | $3,887,177 |
| Total Sales Volume | $9,140,000 | $6,120,000 | $6,120,000 | $8,407,770 | $7,774,354 | $7,774,354 |
| Direct Income | $1,101,987 | $737,873 | $737,873 | $1,013,704 | $937,335 | $937,335 |
| Induced Income | $1,101,987 | $737,873 | $737,873 | $1,013,704 | $937,335 | $937,335 |
| Total Income | $2,202,974 | $1,475,747 | $1,475,747 | $2,027,408 | $1,874,669 | $1,874,669 |
| Direct Employment | 28 | 19 | 19 | 25 | 24 | 24 |
| Induced Employment | 28 | 19 | 19 | 26 | 24 | 24 |
| Total Employment | 56 | 38 | 38 | 51 | 48 | 48 |
| Local Population | 0 | 0 | 0 | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

### *Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 9 shows the number selected housing statistics for census tract 304. There are 1,524 housing units in the tract. The average structure was built between 1976. Table 10 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 11 shows the value of the owner occupied structures in the two tract area.

**Table 9.**
**Selected Housing Statistics**

| Category | Tract 304 |
|---|---|
| Number of Structures | 1,524 |
| Median Year Built | 1976 |
| Occupancy Status | |
| Occupied | 1,077 |
| Vacant | 447 |
| Tenure | |
| Owner | 911 |
| Renter | 166 |

U.S. Census Bureau, 2000 Census

**Table 10.**
**Number of Units in Structure**

| Units in Structure | Tract 304 |
|---|---|
| 1, detached | 998 |
| 1, attached | 10 |
| 2 | 7 |
| 3 or 4 | 4 |
| 5 to 9 | 7 |
| 10 to 19 | 5 |
| 20 to 49 | 0 |
| 50 or more | 0 |
| Mobile Home | 473 |
| Boat, RV, van, etc. | 20 |
| **Total** | **1,524** |

U.S. Census Bureau, 2000 Census

**Table 11.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 304 |
|---|---|
| Value | |
| Less than $10,000 | 36 |
| $10,000 to $14,999 | 38 |
| $15,000 to $19,999 | 32 |
| $20,000 to $24,999 | 73 |
| $25,000 to $29,999 | 62 |
| $30,000 to $34,999 | 31 |
| $35,000 to $39,999 | 35 |
| $40,000 to $49,999 | 101 |
| $50,000 to $59,999 | 96 |
| $60,000 to $69,999 | 67 |
| $70,000 to $79,999 | 104 |
| $80,000 to $89,999 | 38 |
| $90,000 to $99,999 | 16 |
| $100,000 to $124,999 | 104 |
| $125,000 to $149,999 | 37 |
| $150,000 to $174,999 | 34 |
| $175,000 to $199,999 | 0 |
| $200,000 to $249,999 | 0 |
| $250,000 to $299,999 | 0 |
| $300,000 to $399,999 | 0 |
| $400,000 to $499,999 | 0 |
| $500,000 to $749,999 | 0 |
| $750,000 to $999,999 | 7 |
| $1,000,000 or more | 0 |
| TOTAL | 911 |
| Median Value for Owner Occupied Housing | |
| Median Value for Mobile Homes | |

U.S. Census Bureau, 2000 Census

# Recommended Plan

The results of the alternative development, comparison, modification, screening, and selection process indicated that the recommended plan presented the most cost-effective solution, and was clearly the best-balanced plan where all factors were taken into consideration.

The recommended plan for this problem area consists of:

- Replacing existing outlet walls at 12 outlet structures with new vinyl sheet pile walls. The total wall length is 155 feet long with a pile length of 15 feet, each embedded 10 feet deep.
- Excavating 1,000 cubic yards of sand materials from within the drainage channel and depositing behind the new walls.

# Cost

This solution is estimated to cost $3,030,000 (October 2006 Price Level).

# CLERMONT HARBOR HURRICANE AND STORM DAMAGE REDUCTION, HANCOCK COUNTY, MS

## Introduction

### *Purpose*

The purpose of this analysis is to determine the National Economic Development (NED) benefits associated with several proposed alternative solutions to protect a 2,000 foot seawall segment on the Mississippi Sound.

### *Problem Statement*

Wave attack along the eastern shore of Hancock County has caused shoreline erosion and threatens to cause the failure of the seawall in the study area. Continued storm erosion is severely undermining the seawall that protects South Beach Boulevard, one of the main thoroughfares of the City of Waveland. Because of this erosion, the structural integrity of the highway is threatened.

### *Location*

The Clermont Seawall project is located in the extreme southern end of the City of Waveland and consists of one reach. The site is approximately seven miles south of the Bay St. Louis Bridge on South Beach Boulevard (see Figure 1). The reach extends about 2000 feet south of Buccaneer State Park along South Beach Boulevard. Intersecting streets in the vicinity are Clermont Boulevard and Pointset Avenue.

Waveland is located in Southeast Hancock County overlooking St. Louis Bay in southwestern Mississippi. The city is the second incorporated community within the county. In 2000, the 6,674 residents constituted approximately sixteen percent of the county's population.

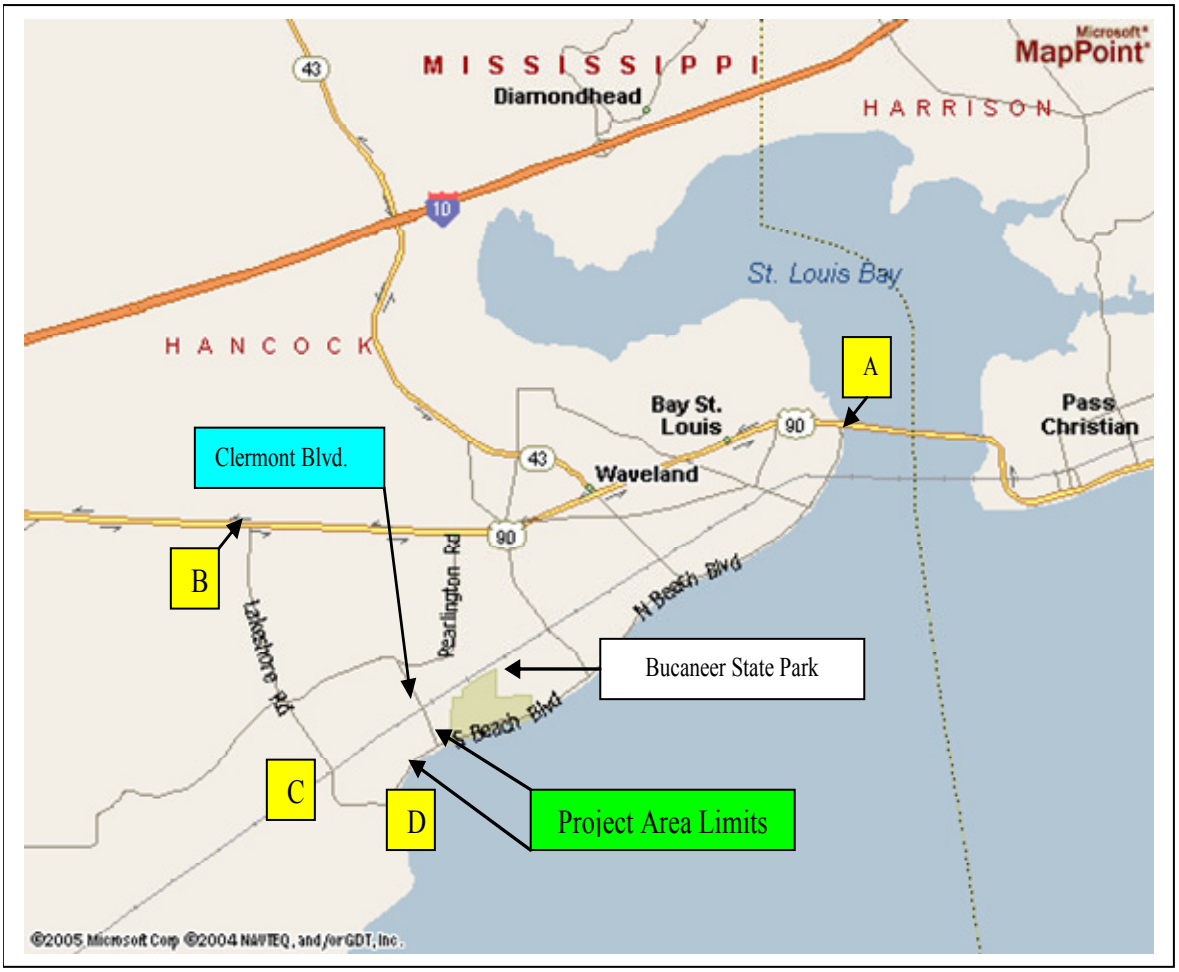



**Figure 1. Clermont Seawall Project Area Map**

# Socioeconomic Overview—Hancock County

## *Population and Land Use*

Waveland had an estimated population of 6,674[1] people in 2000, an increase of just over 24 percent from the 1990 population total of 5,369.[2] This compares to a 35% increase in Hancock County growth for the same period. The Hancock County population in 2000 totaled 42,967[3] and 31,760[4] in 1990.

The City of Waveland has largely developed as a resort community due to its shore front location. Land uses within the city are primarily residential. Commercial land use occurs in the downtown area and along US Highway 90.

The low-lying elevation of much of the land within Waveland means that the city is subject to flooding during storm conditions. These coastal areas are particularly vulnerable to storm surge damage and erosion due to tropical storms and especially to hurricanes like Katrina.

### *Income*

In 1990, the per capita income in Hancock County was about 5% lower than the per capita income for the Biloxi-Gulfport Metropolitan Statistical Area.[5] By 2000 this had changed to about 10% lower. The U.S Census Bureau estimated that the 1990 per capita income for Hancock County was $10,202.[4] In 2000, the average per capita income of Hancock County residents had risen to $17,748 that is an increase of 74 percent. During the same period the median family income increased from $24,727 to $40,307 which reflects a 63 percent change. The following table summarizes these parameters.

**Table 1.**
**Clermont Seawall Study Population and Income for Hancock County By Selected Years**

| Item | 1990 Census | 2000 Census |
|---|---|---|
| Hancock Co. Population | 31,760 | 42,967 |
| Per Capita Income | $10,202 | $17,748 |
| Median Family Income | $24,727 | $40,307 |

### *Employment*

The number of employed Hancock County residents increased by almost 39% between 1990 and 2000 which was 4 percent more than the population increase. Hancock County employment for 1990 was 24,134[4] compared to 33,333 in 2000.[6]

### *Transportation*

Figure 1 illustrates major roads serving the project site. The only connector streets able to hold the additional traffic from Beach Boulevard are U.S. Highway 90 and Lakeshore Road.

### *Tourist and Recreation Facilities*

Shoreline and beach areas clearly represent one of the city's most important recreational assets for both residents and tourists. Limited fishing occurs south of the project site and beach activities occur north of the site along Beach Boulevard. Other recreational activities are located along Beach Boulevard. The Buccaneer State Park offers camping and other activities.

## Methodology

There are three categories of economic losses in this study. These categories are variable vehicular costs, opportunity cost of time, and maintenance costs deferred. This analysis is based on ER 1105-2-100, paragraph E-50d3a on page E-183, (1) the variable vehicular costs using the travel cost method, paragraph D-4f, page D-18 (2) the opportunity cost of time. The values used to calculate the opportunity cost of time were obtained from table D-4 in ER 1105-2-100, Appendix D, page D-20. The procedure to calculate the value of time was from IWR 91-R-12. The cost to maintain the road is 100% storm damage and this maintenance cost will not be incurred with a project in place.

## Existing Condition

Under the existing condition, the traffic presently traveling on U.S. Highway 90 between Lakeshore Road and points south use Beach Boulevard. The existing condition route along South Beach

Boulevard is illustrated on figure 1. Points DA indicate the northbound route and points AD indicate the southbound route. The distance between the two points is 8.2 miles.

# Without-Project Condition

The without-project future condition is a “no action” plan. Under this condition, shoreline erosion from storms will continue so that the economic losses in the study area can be identified for National Economic Development (NED) benefits. As the erosion continues, the undermined portion of South Beach Boulevard at the Clermont Seawall site will fail. As highway failure occurs, local officials will close the compromised road and divert traffic to another route. It is estimated that the traffic will be diverted 20 days each year to repair the road.

The losses in this analysis are the incremental variable operating costs of the vehicles that will be diverted and the opportunity costs of time for the delayed motorists in the diverted vehicles. NED benefits can be claimed for elimination of some or all of these costs. The 25-year time period of the without project condition is the same as the with project condition, 2006 through 2030.

Information for this section was obtained from discussions and data provided by officials from the Hancock County Maintenance Office in a February 2001 field trip. Mobile District Corps of Engineers personnel during the field trip determined distances and speeds. Based on the information provided by knowledgeable officials, it is assumed that failure of the 2,000-foot seawall segment protecting South Beach Boulevard will occur within two years from a 2-year storm or less.

## *Traffic Diversion Route*

Highway failure of the seawall segments is imminent. When highway failure occurs, local officials will close the road and will designate an alternate route. The alternate route is 12.7 miles in length. The northerly beginning point of the alternate route is the junction of US Highway 90 and Beach Boulevard. The southerly ending point of the route is the junction of Lakeshore Drive and Beach Boulevard.

The designated alternate route of 12.7 miles is illustrated on Figure 1 using points D, C, B, & A as the northbound traffic route and points A, B, C, & D as the southbound traffic route. A detailed description of the routes follows:

a. Road closure will require vehicles using the northbound route (point “D” on the map) Beach Boulevard and Lakeshore Drive to turn left on Lakeshore Drive and proceed 2.2 miles in a northerly direction. The vehicles will veer to the right continuing on Lakeshore Drive (point “C”) another 2.4 miles until intersecting US Highway 90 (point “B”). Upon turning right on US Highway 90; the vehicles will proceed 8.1 miles until once again intersecting South Beach Boulevard (Point “A”).

b. Road closure will require vehicles using the southbound route at US Highway 90 and Beach Boulevard (“A”) to go west on US Highway 90, 8.1 miles to Lakeshore Drive (“B”). The vehicles will turn left on Lakeshore Road and travel 2.4 miles. The vehicles will veer left and continue on Lakeshore Drive (“C”) 2.2 additional miles until reaching South Beach Boulevard (“D”).

The daily traffic count for the traffic on Beach Boulevard was obtained from the 2004 Mississippi Department of Transportation Traffic Volume Maps for the Gulf Coast Area at the following site: http://www.gomdot.com/maps/coast_aadt/coast02.pdf. Traffic estimates near Clermont Boulevard showed 1,400 vehicles using Beach Boulevard daily.

To estimate annual traffic growth over the life of the project, the county population growth rate was used as a proxy for future growth in the traffic in the years 2005 and beyond. The county population

in 1990 was 31,760 and 42,967 for the year 2000 which reflects a 35.3 percent increase (42,967/31,760). This equates to an annual increase of 3.53% for each year in the ten-year period.

The annual growth rate of 1.0353 was multiplied by the 2004 average daily traffic estimate of 1,400 to determine the daily traffic count for the years 2005 and beyond. Due to the difficulties inherent in developing long-term projections of any economic activity, the level of the calculated daily traffic was held constant between the periods shown in Table 2. Table 2 illustrates the total projected daily traffic figures for north and southbound vehicles that would transit South Beach Boulevard for selected years during the 25-year project life.

**Table 2.**
**Clermont Seawall Study Projected Average Daily Traffic Count**

| Year | Daily Vehicles |
|---|---|
| 2006 | 1,501 |
| 2015 | 2,050 |
| 2030 | 2,050 |

## *Time Delays*

The increased mileage of an alternate route will increase the variable vehicle operating costs and will cause additional travel time to vehicle occupants who are diverted. An alternate traffic route represents longer travel time and a loss of that time diverted for other activities to those travelers.

The total alternate route distance for north and south bound vehicles equals 12.7 miles. Based on field information, the average alternate route speed limit is 25 miles per hour on the combined 4.6 mile Lakeshore Drive segment. A range of 25 to 45 miles per hour or an average of 35 miles per hour was determined as applicable for the 8.1 mile US Highway 90 segment.

The time for a vehicle to travel the designated alternate 12.7-mile route is 24.93 minutes. This was calculated using: Time = Distance/Speed. Using the two previously defined alternate route segments, the Lakeshore Road distance segment of 4.6 miles is divided by a speed of 25 mph to equal 18.4 percent of 1 hour, or 11.04 minutes. The US Highway 90 distance segment of 8.1 miles is divided by a speed of 35mph to equal 23.14 percent of an hour or 13.89 minutes. The total time of the alternate route is .42 of an hour or 24.93 minutes.

## *Traffic Diversion Benefits*

The calculation of the transportation savings for selected years over the life of the project is shown on Table 3. Travel costs for the traffic diversion were determined by multiplying the additional or incremental miles of the alternate route by the variable vehicle cost per mile[8] and multiplying that product by the number of days per year. Costs were then discounted to present value and a 5 1/8 percent interest rate was applied over the 25-year project life to the transportation costs shown on Table 3.

The calculation is as follows: the annual number of vehicles over the project life is multiplied by the variable operating cost per mile of a vehicle (14.1 cents per mile). That product is multiplied by the 4.5 incremental miles traveled of the alternate route (without-project route mileage of 12.7 miles minus with-project route mileage of 8.2 miles). The travel cost for the year 2006 follows: (1,501 vehicles x 20 days = 30,020 vehicles per year x $0.141 per mile x 4.5 miles = $19,048).

Table 3 illustrates total projected daily traffic figures for north and southbound vehicles transiting South Beach Boulevard for selected years of the project life.

**Table 3.**
**Clermont Seawall Study Variable Vehicle Operating Costs**

| Year | Daily Vehicles | Annual Vehicles | Total Annual Travel Cost |
|---|---|---|---|
| 2006 | 1,501 | 30,020 | $19,048 |
| 2015 | 2,050 | 41,000 | $26,015 |
| 2030 | 2,050 | 41,000 | $26,015 |

1/ $0.141 based on 2005 AAA Variable Vehicle Operating Costs @ 100 miles

Table 4 displays the without-project variable vehicle costs by year, present worthed and annualized. Transportation costs were held level between the selected years shown on Table 3. The average annual equivalent variable vehicle cost savings for traffic using both north and south bound alternate routes equals $22,477 or $22,500.

**Table 4.**
**Clermont Seawall Study Total Average Annual Variable Vehicle Costs**

| Number | Year | Present Worth Factor | Interest & Amortization | Travel Costs | Present Worth |
|---|---|---|---|---|---|
| 0 | 2005 | 1.0000 | 1.0000 | | |
| 1 | 2006 | 0.9512 | 1.0513 | $19,048 | $18,119 |
| 2 | 2007 | 0.9049 | 0.5388 | $19,048 | $17,236 |
| 3 | 2008 | 0.8608 | 0.3681 | $19,048 | $16,395 |
| 4 | 2009 | 0.8188 | 0.2828 | $19,048 | $15,596 |
| 5 | 2010 | 0.7789 | 0.2318 | $19,048 | $14,836 |
| 6 | 2011 | 0.7409 | 0.1978 | $19,048 | $14,113 |
| 7 | 2012 | 0.7048 | 0.1736 | $19,048 | $13,425 |
| 8 | 2013 | 0.6704 | 0.1555 | $19,048 | $12,770 |
| 9 | 2014 | 0.6377 | 0.1415 | $19,048 | $12,148 |
| 10 | 2015 | 0.6067 | 0.1303 | $26,015 | $15,782 |
| 11 | 2016 | 0.5771 | 0.1212 | $26,015 | $15,012 |
| 12 | 2017 | 0.5489 | 0.1136 | $26,015 | $14,280 |
| 13 | 2018 | 0.5222 | 0.1073 | $26,015 | $13,584 |
| 14 | 2019 | 0.4967 | 0.1018 | $26,015 | $12,922 |
| 15 | 2020 | 0.4725 | 0.0972 | $26,015 | $12,292 |
| 16 | 2021 | 0.4495 | 0.0931 | $26,015 | $11,693 |
| 17 | 2022 | 0.4276 | 0.0895 | $26,015 | $11,123 |
| 18 | 2023 | 0.4067 | 0.0864 | $26,015 | $10,581 |
| 19 | 2024 | 0.3869 | 0.0836 | $26,015 | $10,065 |
| 20 | 2025 | 0.3680 | 0.0811 | $26,015 | $9,574 |
| 21 | 2026 | 0.3501 | 0.0789 | $26,015 | $9,107 |
| 22 | 2027 | 0.3330 | 0.0768 | $26,015 | $8,663 |
| 23 | 2028 | 0.3168 | 0.0750 | $26,015 | $8,241 |
| 24 | 2029 | 0.3013 | 0.0734 | $26,015 | $7,839 |
| 25 | 2030 | 0.2866 | 0.0718 | $26,015 | $7,457 |
| Total | | | | | $312,853 |
| Average Annual | | | | | $22,477 |

Numbers may vary due to rounding.

## *Time Delay Benefits*

The calculation of travel time in any given year is the value of the incremental travel time per vehicle per trip multiplied by the number of people per vehicle and that product multiplied by the number of days per year of 20.

Travel time is determined by dividing the distance of each route by the typical speed of a vehicle. The difference in the without and with project route travel times is the time savings. The with project route on Beach Boulevard for both north and southbound travelers is 8.2 miles in distance, with a speed limit of 30 miles per hour. This equals a travel time of 16.40 minutes or .2733 of an hour. Based on the without-project rerouting time of 24.93 minutes, each vehicle would incur a saving in travel of 8.53 minutes (24.93 - 16.40) using the with project route.

For purposes of this report, it is estimated that there is one person per work vehicle trip and 2.22 persons per recreational vehicle trip. The number of persons per vehicle in this report is based on information published by the US Department of Transportation for State Motor-Vehicle Registrations-1998 for the category: “Automobiles per capita” (0.45 cars per person) in the State of Mississippi[9].

The county median income, the hourly wage, and the dollar value of the hourly and incremental value of the travel time were used to determine the dollar costs of the delay. Table D-4 on page D-20 of ER 1105-2-100 was used to identify the incremental value of time for Work trips, Social/Recreational trips, and “Other” trips (Low, Medium, and High time savings) in this rerouting analysis. Work trips are by a per person basis; Social/Recreational trips and “Other” trips are by a per vehicle basis. The additional timesaving of 8.5 minutes of travel time per trip, using the table, is a medium timesaving.

The value of time in the table for medium time savings (6-15 minutes) for work trips is 32.2 percent of the hourly wage. The value of time for Recreation and Other is 23.1 and 14.5 percent of the hourly wage, respectively.

The hourly wage used in this analysis is based on Hancock County average family income from the Bureau of Census.[6] The median family income for 2000 in Hancock County totals $40,307 annually.

To calculate the hourly wage, the average household income ($40,307) was divided by the average number of annual work hours (2080). This result equals an average family hourly wage rate of $19.38.

Table 5 displays the value of time used in this analysis. Rows 4 through 6 identify the hourly value of time by activity ($19.38 x .6 x .322= $3.74 for work trips and $19.38 x .6 x .231= $2.69 for “Social/Recreation” trips) Rows 7 through 9 of the table identify the actual delay cost of a trip. This is the percent of an hour delayed 8.5 minutes/60 minutes multiplied by the hourly value of time displayed in rows 4 through 6.

**Table 5.**
**Clermont Seawall Study Value of Time**

| Factor | Dollar Value |
|---|---|
| 2000 County Median Family Income | $40,307 |
| Hourly Wage (2080 hrs) For Family | $19.38 |
| EC 1105-2-Draft dated 31 March 1992 Per Person Hourly | $11.63 |
| Value of Hour (Time per person) Work 6-15 minutes 32.2% | $3.74 |
| Value of Hour (Time) Social/Recr Trips 6-15 minutes 23.1% | $2.69 |
| Value of Hour (Time) Other Trips 6-15 minutes 2.24% | $0.26 |
| Value of Delay (8.5 Minutes): Work | $0.53 |
| Value of Delay (8.5 Minutes): Social/Recreation | $0.38 |
| Value of Delay (8.5 Minutes): Other | $0.04 |

It is estimated that 5 percent of the vehicular trips are for work, 95 percent of the trips are for recreation, and 0 percent of the trips are for other. Corps of Engineers personnel obtained this estimate in a February, 2000 field trip from knowledgeable local officials.

Table 6 illustrates the value of Work, Recreational, and Other time saved for the persons transiting South Beach Boulevard with a project in place for selected years. The table also displays the total value for the time saved.

Work delay calculations shown in rows 1 through 4 of Table 6 are described below. Row 1 of Table 6, the value of the incremental time of a trip ($.53) is from row 7 of Table 5. Row 2 of Table 6 is the calculated number of persons delayed in 2006 in work related vehicles. The number of persons delayed in work related vehicles is calculated by multiplying the total number of vehicle trips: (1,501 in Table 2) by the percentage of work trips (.05) and multiplying that product by the number of persons per vehicle (1.00) to calculate the persons delayed (75). Row 3 of the table uses the number of days in a year (20) to convert the average daily counts to annual counts. Row 4 of the table is the total cost of a category of time. The calculation of the total cost is discussed in the next paragraph.

The cost of work delays is $795 in the year 2006. This cost is calculated by multiplying the value of one trip delayed in row 1 ($0.53 in Table 5) multiplied by the number of persons per day delayed in row 2 (1,501 vehicles per day in Table 3 x .05 percent which is the percentage of the vehicles that are used for work x 1 person per vehicle = 75 persons) and multiplying that product by the number of days per year in row 3 ($0.53 x 75 x 20).

Recreational delay calculations, in rows 5 through 8 of Table 6, are the same as work delay calculations, except for calculating the number of persons delayed. ER 1105-2-100 states that the number of persons delayed in recreational vehicles in row 6 is based on a per vehicle basis. The annual cost of 3,166 persons in 1,501 vehicles (1,501 vehicles x 0.95 of the vehicles x 2.22 persons per vehicle = 3,165.609) who are delayed is $24,062 ($0.38 in Table 5 x 3,166 people x 20 days = $24,601.60 or $24,602).

**Table 6.**
**Clermont Seawall Study Value of Time Delays/Opportunity Costs: Rerouting**

| Factor | 2006 | 2015 | 2030 |
|---|---|---|---|
| Work Delay Cost:(24.93-16.4)=8.53 minutes | 0.53 | 0.53 | $0.53 |
| Number of Persons in ADT Vehicles, Rounded | 75 | 103 | 103 |
| Number of Days | 20.00 | 20 | 20 |
| **Total Work Cost** | $795 | $1,092 | $1,092 |
| Recreational Delay Cost:(24.93-16.40)=8.53 minutes | $0.38 | $0.38 | $0.38 |
| Number of Persons in ADT Vehicles, Rounded | 3,166 | 4,323 | 4,323 |
| Number of Days | 20 | 20 | 20 |
| **Total Recreation Cost** | $24,062 | $32,855 | $32,855 |
| Other Delay Cost:(24.93-16.40)=8.53 minutes | $0.04 | $0.04 | $0.04 |
| Number of Persons in ADT Vehicles, Rounded | 0 | 0 | 0 |
| Number of Days | 20 | 20 | 20 |
| **Total Other Delay Cost** | $0 | $0 | $0 |
| Grand Total Delay Cost:=8.53 minutes | $0.38 | $0.38 | $0.38 |
| Number of Persons in ADT Vehicles, Rounded | 3241 | 4426 | 4426 |
| Number of Days | 20 | 20 | 20 |
| **Grand Total Cost** | $24,857 | $33,947 | $33,947 |

Table 7 displays the total value of time saved by year, present worthed and annualized. Savings were held level between the selected years shown on Table 6. The average annual equivalent variable vehicle cost savings for traffic using both north and southbound alternate route equals $29,330 or $29,300 when rounded to the nearest hundred dollars.

**Table 7.**
**Clermont Seawall Study Average Annual Time Saving**

| Number | Year | Present Worth | Interest & Amortization | Time Costs $$$ | Time P Worth $$$ |
|---|---|---|---|---|---|
| 0 | 2005 | 1.0000 | 1.0000 | $24,857 | $23,645 |
| 1 | 2006 | 0.9512 | 1.0513 | $24,857 | $22,492 |
| 2 | 2007 | 0.9049 | 0.5388 | $24,857 | $21,396 |
| 3 | 2008 | 0.8608 | 0.3681 | $24,857 | $20,352 |
| 4 | 2009 | 0.8188 | 0.2828 | $24,857 | $19,360 |
| 5 | 2010 | 0.7789 | 0.2318 | $24,857 | $18,416 |
| 6 | 2011 | 0.7409 | 0.1978 | $24,857 | $17,519 |
| 7 | 2012 | 0.7048 | 0.1736 | $24,857 | $16,665 |
| 8 | 2013 | 0.6704 | 0.1555 | $24,857 | $15,852 |
| 9 | 2014 | 0.6377 | 0.1415 | $33,947 | $20,594 |
| 10 | 2015 | 0.6067 | 0.1303 | $33,947 | $19,590 |
| 11 | 2016 | 0.5771 | 0.1212 | $33,947 | $18,635 |
| 12 | 2017 | 0.5489 | 0.1136 | $33,947 | $17,726 |
| 13 | 2018 | 0.5222 | 0.1073 | $33,947 | $16,862 |
| 14 | 2019 | 0.4967 | 0.1018 | $33,947 | $16,040 |
| 15 | 2020 | 0.4725 | 0.0972 | $33,947 | $15,258 |
| 16 | 2021 | 0.4495 | 0.0931 | $33,947 | $14,514 |
| 17 | 2022 | 0.4276 | 0.0895 | $33,947 | $13,807 |

**Table 7. (continued)**

| Number | Year | Present Worth | Interest & Amortization | Time Costs $$$ | Time P Worth $$$ |
|---|---|---|---|---|---|
| 18 | 2023 | 0.4067 | 0.0864 | $33,947 | $13,134 |
| 19 | 2024 | 0.3869 | 0.0836 | $33,947 | $12,493 |
| 20 | 2025 | 0.3680 | 0.0811 | $33,947 | $11,884 |
| 21 | 2026 | 0.3501 | 0.0789 | $33,947 | $11,305 |
| 22 | 2027 | 0.3330 | 0.0768 | $33,947 | $10,754 |
| 23 | 2028 | 0.3168 | 0.0750 | $33,947 | $10,229 |
| 24 | 2029 | 0.3013 | 0.0734 | $33,947 | $9,731 |
| 25 | 2030 | 0.2866 | 0.0718 | $24,857 | $23,645 |
| Sum | | | | | $408,253 |
| Average Annual | | | | | $29,330 |

# Maintenance Costs

Historical information from 1998 to 2003 of county expenditures to repair and maintain Beach Boulevard was provided by the Hancock County. A total of $10,099,053 or an average of $1,683,175 was spent in the six year period. The expenditures were to repair the North and South Beach Boulevard road storm erosion damage. The estimated time to complete the repairs on South Beach Boulevard is 20 days. Based on information provided by the County, County expenditures for North Beach Boulevard were 30% of the $1,683,175 ($504,952) and expenditures for South Beach Boulevard were 70% ($1,178,222). Table 8 displays the expenditures by selected year for South Beach Boulevard.

**Table 8.**
**Clermont Seawall Study Annual Maintenance Costs**

| Factor | 2006 | 2014 | 2022 | 2030 | Average Annual |
|---|---|---|---|---|---|
| Annual Maintenance Costs | $1,178,222 | $1,178,222 | $1,178,222 | $1,178,222 | $1,178,222 |

## *Total Benefits*

Table 9 displays the total savings with a plan in place for time delays/opportunity costs, variable vehicle operating costs, and maintenance costs for selected years.

**Table 9.**
**Clermont Seawall Study Value of Time Delays and Vehicle Variable Operating Costs**

| Factor | 2006 | 2015 | 2030 |
|---|---|---|---|
| Total Time Delays/Opportunity Costs | $24,857 | $33,947 | $33,947 |
| Total Variable Vehicle Operating Costs | $19,048 | $26,015 | $26,015 |
| Annual Maintenance Costs | $1,178,222 | $1,178,222 | $1,178,222 |
| Grand Total | $1,222,127 | $1,238,183 | $1,238,183 |

Table 10 displays the value of Delays and Vehicle Operating costs, present worthed and annualized that would be saved with a plan in place. The savings were held level between the selected years as shown on Table 9. The average annual equivalent variable vehicle cost savings for traffic using both

north and southbound alternate route plus savings from maintenance fees equals $1,230,029 or $1,230,000 rounded to the nearest hundred dollars.

**Table 10.**
**Clermont Seawall Study**
**Average Annual Value of Delays and Vehicle Operating Costs**

| Number | Year | Present Worth | Interest & Amortization | Total Costs $$$ | Total P Worth $$$ |
|---|---|---|---|---|---|
| 0 | 2005 | 1.0000 | 1.0000 | | |
| 1 | 2006 | 0.9512 | 1.0513 | $1,222,127 | $1,162,546 |
| 2 | 2007 | 0.9049 | 0.5388 | $1,222,127 | $1,105,870 |
| 3 | 2008 | 0.8608 | 0.3681 | $1,222,127 | $1,051,958 |
| 4 | 2009 | 0.8188 | 0.2828 | $1,222,127 | $1,000,673 |
| 5 | 2010 | 0.7789 | 0.2318 | $1,222,127 | $951,889 |
| 6 | 2011 | 0.7409 | 0.1978 | $1,222,127 | $905,483 |
| 7 | 2012 | 0.7048 | 0.1736 | $1,222,127 | $861,339 |
| 8 | 2013 | 0.6704 | 0.1555 | $1,222,127 | $819,348 |
| 9 | 2014 | 0.6377 | 0.1415 | $1,222,127 | $779,403 |
| 10 | 2015 | 0.6067 | 0.1303 | $1,238,183 | $751,147 |
| 11 | 2016 | 0.5771 | 0.1212 | $1,238,183 | $714,527 |
| 12 | 2017 | 0.5489 | 0.1136 | $1,238,183 | $679,693 |
| 13 | 2018 | 0.5222 | 0.1073 | $1,238,183 | $646,557 |
| 14 | 2019 | 0.4967 | 0.1018 | $1,238,183 | $615,036 |
| 15 | 2020 | 0.4725 | 0.0972 | $1,238,183 | $585,053 |
| 16 | 2021 | 0.4495 | 0.0931 | $1,238,183 | $556,530 |
| 17 | 2022 | 0.4276 | 0.0895 | $1,238,183 | $529,399 |
| 18 | 2023 | 0.4067 | 0.0864 | $1,238,183 | $503,590 |
| 19 | 2024 | 0.3869 | 0.0836 | $1,238,183 | $479,039 |
| 20 | 2025 | 0.3680 | 0.0811 | $1,238,183 | $455,685 |
| 21 | 2026 | 0.3501 | 0.0789 | $1,238,183 | $433,470 |
| 22 | 2027 | 0.3330 | 0.0768 | $1,238,183 | $412,337 |
| 23 | 2028 | 0.3168 | 0.0750 | $1,238,183 | $392,235 |
| 24 | 2029 | 0.3013 | 0.0734 | $1,238,183 | $373,113 |
| 25 | 2030 | 0.2866 | 0.0718 | $1,238,183 | $354,924 |
| Total | | | | | $17,120,844 |
| Average Annual | | | | | $1,230,029 |

The level of protection for each of the projects was determined by the Mobile District Corps of Engineers Hydraulics section. Each project is estimated to protect the seawall up to a 50 year storm, or a 2 percent chance of a storm occurring in any given year. The benefits to the project are the losses prevented from vehicle varying operating costs and time delays from those in the vehicles from the frequencies of the storms that are above the 50 year event. Table 11 displays the average annual costs integrated with the frequency of storm events. The average annual savings is $1,205,670 and rounded to $1,205,700.

**Table 11.**
**Clermont Seawall Study Frequency Analysis of With-Plan Benefits,**

| Frequency | 1/Freq | Incr. Prob. | Benefits By Freq | Benefits Average | AAD Dollars |
|---|---|---|---|---|---|
| 500.00 | 0.0020 | 0.002 | $0 | $0 | $0 |
| 51.00 | 0.0196 | 0.018 | $0 | $0 | $0 |
| 50.00 | 0.0200 | 0.000 | $1,230,029 | $615,015 | $241 |
| 5.00 | 0.2000 | 0.180 | $1,230,029 | $1,230,029 | $221,405 |
| 3.00 | 0.3333 | 0.133 | $1,230,029 | $1,230,029 | $164,004 |
| 2.00 | 0.5000 | 0.167 | $1,230,029 | $1,230,029 | $205,005 |
| | | 0.500 | | $1,230,029 | $615,015 |
| Sum | | 1.000 | | | $1,205,670 |

# With-Project Condition

This section describes the with-project condition securing the structural integrity of the highway and seawall along the project site on South Beach Boulevard. Under the with project condition, highway failure will not occur and the vehicles will continue either north or south bound on South Beach Boulevard unhampered by added variable vehicle cost or time delays.

## *Costs of Implementation*

Three plans were considered in the with-project condition analysis. These include (1) No-Action (2) a steel sheetpile seawall and (3) a vinyl sheetpile seawall that will protect the reach along Beach Boulevard and the traffic using the study area. The following table displays the total first cost of each plan provided by the Mobile District Corps of Engineer Cost Engineering.

As seen in the following table, the first cost of the various possible construction projects include construction placement; LERRDS (lands, easements, rights of way, and disposal sites), Planning, Engineering, and Design (PED); construction management; and contingencies. The cost for the steel sheetpile seawall is $1,650,000 and $1,320,000 for the vinyl sheetpile seawall at October 2006 prices.

For each plan, the first cost of the project was amortized over a 50-year project life using a discount rate of 5 1/8 percent which has an average annual equivalent factor of .055838. The average annual first cost is $92,133 and $73,706 for the steel and vinyl sheetpile walls respectively. Based on information from Engineering, the annual operations and maintenance is estimated to total $70,000 yearly for all alternatives which would entail repair to concrete and piles five times per year. The average annual cost for each plan is shown in the following table. Average annual costs range from $$162,133 ($92,133 + $70,000) for the steel sheetpile to $143,706 ($73,706 +$70,000) for the vinyl sheetpile construction. Average annual benefits for each alternative are $1,205,700 per year.

# Recommendations

Table 12 displays the average annual benefits, the average annual cost, average annual net benefits and the benefit to cost ratio of the plans considered. The values in this report are Oct 06 dollars.

**Table 12.**
**Clermont Blvd Seawall Study With-Plan Benefits, Costs, and Benefit-to-Cost Ratio**

| Plan | Average Annual Benefits | Average Annual Costs | Net Benefits | Benefit-to-Cost Ratio |
|---|---|---|---|---|
| No Action | $0 | $0 | $0 | $0 |
| Steel Sheetpile | $1,205,700 | $162,133 | $1,043,567 | 7.44 |
| Vinyl Sheetpile | $1,205,700 | $143,706 | $1,061,994 | 8.39 |

All plans are economically feasible; however, the alternative provides the maximum average annual net benefits of $1,061,994.

## *Socioeconomic Impacts using the Economic Impact Forecast System*

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $610,000 for the Riprap alternative and $1,410,000 for the Vinyl Sheetpile alternative, and $1,740,000 for the Steel Sheetpile alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures for all three alternatives are estimated to be $70,000, which in present worth form amounts to $1,253,625 (assuming a 50-year period of analysis and an interest rate of 5.125 percent).

### *Methodology*

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that, given the inputs for a particular project proposal, will assess potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system—models, tools, and database—is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

### *Assumptions*

EIFS assumes that the infrastructure pre-Katrina is intact, in-place, and functioning as a wholesome economic unit in the region of influence. The fact is that under existing conditions many of the established economic infrastructure is not present but transient. In some cases, rebuilt economic units have moved into fill that deficit to provide the goods and services. The assumption of this analysis assumes that the last or destroyed infrastructure will be rebuilt or replace in the near-term and will not significantly reduce the impacts and outputs forecasted in this investigation.

*Summary Explanation of the EIFS Model Output*

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**EIFS Model Inputs for Clearmont Harbor Proposed Project Alternatives**

| Indicator Variable | Vinyl Sheetpile | Steel Sheetpile | O&M |
|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $1,350,000 | $1,680,000 | $1,253,625 |

Based on the given inputs, the outputs are as followed:

**EIFS Model Outputs for Clearmont Harbor Proposed Project Alternatives**

| Indicator Variable | Projected Δ Vinyl Sheetpile | Projected Δ Steel Sheetpile | Projected Δ O&M |
|---|---|---|---|
| Direct Sales Volume | $1,350,000 | $1,680,000 | $1,253,625 |
| Induced Sales Volume | $1,350,000 | $1,680,000 | $1,253,625 |
| Total Sales Volume | $2,700,000 | $3,360,000 | $2,507,250 |
| Direct Income | $325,532 | $405,107 | $302,293 |
| Induced Income | $325,532 | $405,107 | $302,293 |
| Total Income | $651,065 | $810,214 | $604,586 |
| Direct Employment | 8 | 10 | 8 |
| Induced Employment | 8 | 10 | 8 |
| Total Employment | 16 | 20 | 15 |
| Local Population | 0 | 0 | 0 |

***Sales Volume***

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

**Vinyl Sheetpile**

If implemented, the total sales volume related to this alternative is projected to increase by $5,207,250 in the local area of Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, $2,507,250 (i.e., the total sales volume increased because of O&M) was added to the total sales volume of the Vinyl Sheetpile.

**Steel Sheetpile**

If implemented, the total sales volume related to this alternative is projected to increase by $5,867,250 in the local area of Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, $2,507,250 (i.e., the total sales volume increased because of O&M) was added to the total sales volume of the Steel Sheetpile.

### *Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

#### Vinyl Sheetpile

If implemented, the total income related to this alternative is projected to increase by $1,255,651 for Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, $604,586 (i.e., the total income increased because of O&M) was added to the total income of the Vinyl Sheetpile alternative.

#### Steel Sheetpile

If implemented, the total income related to this alternative is projected to increase by $1,414,800 for Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, $604,586 (i.e., the total income increased because of O&M) was added to the total income of the Steel Sheetpile alternative.

### *Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

#### Vinyl Sheetpile

If implemented, total employment related to this alternative is projected to increase by 31 workers in Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, 15 workers (i.e., the number of workers increase because of O&M) was added to the total employment of the Vinyl Sheetpile alternative.

#### Steel Sheetpile

If implemented, total employment related to this alternative is projected to increase by 35 workers in Hancock County. Note that O&M is only accounted for if the project is implemented; therefore, 15 workers (i.e., the number of workers increase because of O&M) was added to the total employment of the Steel Sheetpile alternative.

### *Population*

If implemented, the population related to all three alternatives is not projected to increase.

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# DOWNTOWN BAY ST. LOUIS HURRICANE AND STORM DAMAGE REDUCTION, HANCOCK COUNTY, MS

## Purpose

The purpose of this analysis is to determine the National Economic Development (NED) benefits associated with several proposed alternative solutions to protect a 6,500 foot segment of highway on the Mississippi Sound.

## Problem Statement

Storm erosion continues to undermine the shoreline that protects South Beach Boulevard, one of the main thoroughfares of the cities of Bay St. Louis and Waveland. Because of this erosion, the structural integrity of South Beach Boulevard is threatened.

## Location

The Downtown Bay St. Louis hurricane and storm damage reduction project is located along South Beach Boulevard between US Highway 90 and Washington Street in the City of Bay St. Louis. The project consists of one reach (see Appendix A, Figures 1-5).

## Socio-Economic Overview – Hancock County

### *Population and Land Use*

Bay St. Louis had an estimated population of 8,209 in 2000, as compared to an estimated population of 8,063 in 1990. The Hancock County population in 2000 totaled 42,967 and 31, 760 in 1990.

The City of Bay St. Louis has largely developed as a resort community due to its shore front location. Land uses within the city are primarily residential. Commercial land use occurs in the downtown area and along US Highway 90.

The low-lying elevation of much of the land within Bay St. Louis means that the city is subject to flooding during storm conditions. These coastal areas are particularly vulnerable to storm surge damage and erosion due to tropical storms and especially to hurricanes like Katrina.

### *Income*

In 1990, the per capita income for Hancock County was $10,202. In 2000, the average per capita income of Hancock County had risen to $17,748, which is an increase of 57%. During the same period, the median family income increased from $24,727 to $40,307 which is a 61% increase. The following table summarizes these parameters.

**Table 1.**
**Downtown Bay St. Louis Hurricane and Storm Damage Reduction**
**Population and Income for Hancock County by Selected Years**

| Item | 1990 Census | 2000 Census |
|---|---|---|
| Hancock Co Population | 31,760 | 42,967 |
| Per Capita Income | 10,202 | 17,748 |
| Median Family Income | 24,727 | 40,307 |

## *Employment*

Between 1990 and 2000, the number of employed Hancock County residents increased from 13,096 to 19,562. The change in number of residents employed reflects a 67% increase over the stated time period, which was four percent more than the county population increase.

## *Transportation*

Appendix A, figures 1 through 5 illustrates major roads serving the project site. US Highway 90, Dunbar Street/Old Spanish Trail and Nicholson Avenue are the alternate connector streets able to hold the additional traffic from South Beach Boulevard.

## *Tourist and Recreation Facilities*

The most important recreational assets for both residents and tourists in Bay St. Louis are the shoreline and beach areas. Limited fishing and beach activities occur south of the project site along Beach Boulevard. Buccaneer State Park offers camping and other activities and is also located along Beach Boulevard.

## *Methodology*

There are six categories of economic losses in the economic analysis. These categories are land, structures, utilities and parking areas, South Beach Boulevard and traffic rerouting. The values of these categories are 2006 cost less depreciated dollar values.

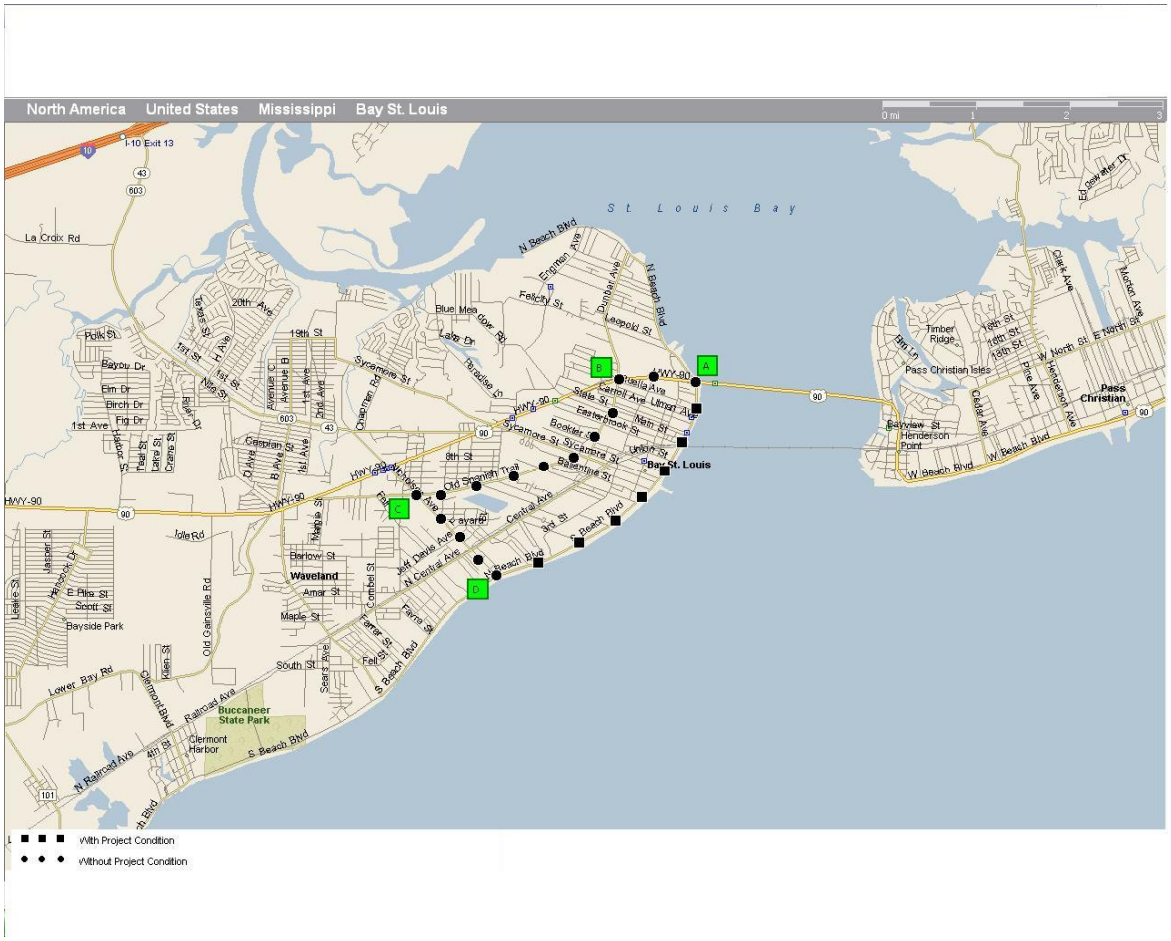
In 2005, Hurricane Katrina destroyed South Beach Boulevard, structures, utilities, the sidewalk and parking areas along the coast of Bay St. Louis, especially near downtown. Benefits are determined based on the assumption that all these entities will be redeveloped similar to conditions before Hurricane Katrina.

The value of the road is based on the amount vehicular users are willing to pay to use an alternate route. The categories used for analysis are variable vehicular costs, and the opportunity cost of time. The analysis is based on ER 1105-2-100, paragraph E-50d3a on page E-183, (1) the variable vehicular costs using the travel cost method, paragraph D-4f page D-18, (2) the opportunity cost of time. The values used to calculate the opportunity cost of time were obtained from table D-4 in ER 1105-2-100, Appendix D, page D-20. The procedure to calculate the value of time was obtained from IWR 91-R-12.

## *Existing Condition*

Under pre-Hurricane Katrina existing condition, South Beach Boulevard ran the length of the study area, along with a sidewalk. Many commercial structures were present and open for business along with their accompanying parking areas and utilities.

Due to Hurricane Katrina, under the existing condition, the water-side land is lost, all water-side structures and many land-side structures are destroyed, utilities are not usable, parking along South Beach Boulevard no longer exists and South Beach Boulevard is impassable. Under pre-Katrina circumstances, traffic would travel South Beach Boulevard between US Highway 90 and Nicholson Avenue, illustrated in Figure 1 between points A and D. Traffic must currently use the alternate route of traveling west of US Highway 90 to Dunbar Road then south on Dunbar that merges into Old Spanish Trail to Nicholson Avenue, illustrated in Figure 1 point A, B, C and D.




Note: 5/8 inch equals 1 mile

**Figure 1. Downtown Bay St. Louis Hurricane and Storm Damage Reduction Project Area Map**

## *Without Project Condition*

It is assumed that South Beach Boulevard, structures, utilities, sidewalk and parking areas will be restored to pre- Hurricane Katrina conditions. The without-project future condition is a “no action” plan. Under this condition, shoreline erosion from storms will continue so that the economic losses

can be identified for National Economic Development (NED) benefits. As the erosion continues, the undermined portion of South Beach Boulevard where a seawall could be located will fail.

In 2006 and 2007, it is assumed based on information provided by local officials and the County engineer that approximately 80 feet in depth of land will be reclaimed in front of a 1,000 foot section of South Beach Boulevard in downtown Bay St. Louis. In the first 56 feet, a sidewalk and 21 structures will be constructed. In the next 24 feet, a paved parking area and underground utilities will be constructed. The location of the structures on the land-ward side of South Beach Boulevard will not change, but the buildings will be refurbished and open for business. The sidewalk, utilities and road will be constructed along the entire length of the study area. Four additional parking areas will also be constructed. The structures, sidewalk, utilities, parking, and South Beach Boulevard will be constructed in 2006 and 2007 and available for use by January 2008.

It is assumed at the base of the land where a seawall will be constructed, a Federal project condition is where mean low tide occurs and erosion first occurs. Using a five foot annual erosion rate, the specific year of the loss of each entity, excluding the utilities, was calculated through perpendicular measurements by Corps personnel in Planning and Environmental Division on a drawing provided by the local sponsor and Engineering Division. The calculations were made by measuring the distance in feet from the potential seawall to each entity. The distances of the utilities were provided by the Non-Federal sponsor.

As highway failure occurs, local officials will close the compromised road and divert traffic to another route. The losses in this analysis are the incremental variable operating costs of the vehicles that will be diverted and the opportunity costs of time for the delayed motorists in the diverted vehicles. NED benefits can be claimed for elimination of some or all of these costs.

Information for “without project condition” was obtained from discussions and data provided by officials from Hancock County in a February 2006 field trip. Mobile District Corps of Engineers personnel determined the erosion rate based on drawings. With a five foot annual erosion rate, it is assumed that failure of South Beach Boulevard will occur within ten years and the road no longer usable due to lost land that protects the road.

*Lost Land, Sidewalk, Structures, Utilities, Parking and Road*

It is assumed that over 50 years, a rectangle including 6,500 feet of shoreline and 250 feet of land inland between US Highway 90 and Washington Ave will incur damages amounting to $24,375,000. A sidewalk will be built at a value of $900,000, utilities (water, sewer, electric, telephone, gas and cable) will have a value of $8,650,000, parking areas will have a value of $790,000, 21 potential new structures built in a 1,000 foot length in the study area located between the railroad and Demontluzin Avenue on the shore side of South Beach Boulevard has a value of $10,975,952, and 56 existing structures on the landward side of South Beach Boulevard between US 90 and Washington Avenue have a value of $28,975,658. The total value for structures lost is $39,753,610. South Beach Boulevard will be rebuilt after being destroyed in Katrina and have a value of $15,000,000. The information above was estimated by local officials for purposes of this report.

***Lost Land***

Local officials estimate the value of near-shore land to be $15.00 per square foot in 2006 and 2008. Based on an erosion rate of five feet per year and a study area length of 6, 500 feet, a total of 32,500 square feet will be lost annually at a value of $162,500. Table 1 in Appendix A shows the average annual loss to total $487,500 per year.

### *Sidewalk*

An eight foot sidewalk will be constructed along the length of the study area abutting the seawall. Some sections of the sidewalk will also be in front and along side of the development seaward of South Beach Blvd. and will vary in distance from the seawall. For purposes of this study, the sidewalk is lost when the erosion first impacts the seawall in 2008. Table 2 in Appendix A shows the value of the sidewalk, the present worth and the average annual loss.

### *Structures*

A total of 77 structures will be impacted by erosion in the study area. Table 3 in Appendix A displays the year the structures will be lost to erosion and Table 4 in Appendix A displays the value and present worth of the losses by year and the average annual loss.

### *Utilities*

Six utility lines will be rebuilt between South Beach Boulevard and the seawall. Table 2 displays the type of utility, the shortest distance to the seawall, the value of each utility and the year each utility will be lost to erosion without protection. Table 5 in Appendix A displays the losses by year and average annual loss of all utilities combined.

**Table 2.**
**Downtown Bay St. Louis Utilities**

| Utility | Distance from Seawall (ft) | Value | Year Impacted |
|---|---|---|---|
| Sewer | 70.7 | $1,500,000 | 15 |
| Gas | 72.4 | $950,000 | 15 |
| Phone | 74.1 | $1,700,000 | 15 |
| Electric | 75.8 | $1,500,000 | 16 |
| Water | 77.6 | $1,100,000 | 16 |
| Storm Drainage | 79.3 | $1,900,000 | 16 |

### *Parking*

Five parking areas will be constructed in the study area. Table 3 shows the shortest distance in feet between the parking areas and the seawall, and the value of each parking area. Table 6 in Appendix A shows the year, values, present worth of the value by area, and the average annual cost. The average annual cost is $20,259.

**Table 3.**
**Downtown Bay St. Louis Parking Areas**

| Parking Areas | Distance from Seawall (ft) | Value | Year Impacted |
|---|---|---|---|
| 1 | 80 | $25,000 | 16 |
| 2 | 3 | $250,000 | 1 |
| 3 | 190 | $250,000 | 38 |
| 4 | 120 | $220,000 | 24 |
| 5 | 150 | $45,000 | 30 |

### *South Beach Boulevard*

The shortest distance from South Beach Boulevard and the seawall is 47 feet, meaning that it will be impacted by erosion in approximately year 10. Table 7 in Appendix A displays the year, value, present worth of the cost by area and the average annual cost of the road.

### *Traffic Diversion Route*

Under pre-Katrina conditions, traffic uses South Beach Boulevard to travel between US Highway 90 and Nicholson Ave. The distance between the two points was determined to be 3.2 miles.

When failure of South Beach Boulevard occurs, local officials will close the road and designate an alternate route. The northerly beginning point of the alternate route is the junction of US Highway 90 and South Beach Blvd and the southerly ending point of the route is the junction of Nicholson Ave and Beach Boulevard. The alternate route is 4.6 miles in length.

The designated alternate route is illustrated on Figure 1 using points D, C, B & A as the northbound traffic route and points A, B, C & D as the southbound traffic route. A detailed description of the routes follows:

a) Under the northbound alternate route, traffic starts at the intersection of Nicholson Avenue and South Beach Boulevard, point D, and goes northerly on Nicholson Avenue to the intersection of Old Spanish Trail or Dunbar Road and Nicholson Avenue a distance of 1.2 miles in 2 minutes time to point C. The posted speed limit is 25 miles per hour. The traffic turns east on Old Spanish Trail which becomes Dunbar Road and travels northeasterly on Dunbar Road to the intersection of Dunbar Road and US Highway 90, a distance of 2.7 miles in 5 minutes time from point B to point C. The posted speed limit is 25 miles per hour. The traffic turns easterly from point B, Dunbar and US Highway 90 and travels on US Highway 90 to the intersection of South Beach Boulevard and US Highway 90, a distance of 0.8 miles in 2 minutes time to point A. The posted speed limit is 45 miles per hour. At that point, the traffic continues to point east. The distances and times were actual driving times using a watch and an odometer in February, 2006.

b) Under the southbound alternate route, traffic starts at the intersection of US Highway 90 and South Beach Boulevard, point A, and goes westerly on US Highway 90 to the intersection of Dunbar Road and US Highway 90 a distance of 0.8 miles in 2 minutes time to point B. The posted speed limit is 45 miles per hour. The traffic turns south on Dunbar Road which becomes Old Spanish Trail and travels southwesterly on Dunbar Road to the intersection of Old Spanish Trail and Nicholson Ave, a distance of 2.7 miles in 5 minutes time from point B to point C. The posted speed limit is 25 miles per hour. The traffic turns southerly on Nicholson Avenue and travels on Nicholson Avenue to the intersection of South Beach Boulevard and Nicholson Avenue, a distance of 1.2 miles in 2 minutes time to point D. The posted speed limit is 25 miles per hour. At that point, the traffic continues to points south. The distances and times were actual driving times using a watch and an odometer in February, 2006.

The daily traffic count for the traffic on South Beach Boulevard was obtained from the 2004 Mississippi Department of Transportation Traffic Volume Maps for the Gulf Coast Area at the following site: http://www.gomdot.com/maps/coast_aadt/coast02.pdf. Traffic estimates near Main Street and South Beach Boulevard showed 4,300 vehicles using Beach Boulevard daily.

To estimate annual traffic growth over the life of the project, the county population growth rate was used as a proxy for future growth of the traffic in the years 2005 and beyond. The county population in 1990 was 31,760 and 42,967 for the year 2000 which reflects a 35% increase. This equates to an annual increase of 3.53% for each year in the ten year period.

The annual growth rate of 1.0353 was multiplied by the 2004 average daily traffic estimate of 4,300 to determine the daily traffic count for the years 2005 and beyond. Due to the difficulties inherent in developing long-term projections of any economic activity, the level of the calculated daily traffic was held constant beginning with year 2014. Table 4 illustrates the total projected daily traffic figures for north and south bound vehicles that would transit South Beach Boulevard for selected years during the 50 year project life.

**Table 4.**
**Downtown Bay Saint Louis Hurricane and Storm Damage Reduction Projected Average Daily Traffic Count**

| Year | Daily Vehicles |
|---|---|
| 2008 | 4907 |
| 2013 | 5666 |
| 2014 | 5817 |
| 2057 | 5817 |

## *Time Delays*

The increased mileage of an alternate route will increase the variable vehicle operating costs and will cause additional travel time to vehicle occupants who are diverted. An alternate traffic route represents longer travel time and a loss of time diverted for other activities to those travelers.

The total alternate route distance for north and south bound vehicles equals 4.6 miles. Based on field information, the average alternate route speed limit is 25 miles per hour on the combined 3.9 mile segment of Nicholson Avenue and Dunbar/Old Spanish Trail. The .8 mile US Highway 90 segment has a speed limit of 45mph.

The time for a vehicle to travel the designated alternate 4.6-mile route is 10.38 minutes. This was calculated using: Time = Distance/Speed. Using the previously defined alternate route segments, the Nicholson Avenue and Dunbar Road/ Old Spanish Trail segment of 3.9 miles is divided by a speed of 25 mph to equal 15.6 % of 1 hour, or 9.36 minutes. The US Highway 90 distance segment of .8 miles is divided by a speed of 45mph to equal 1.7 % of an hour or 1.02 minutes. The total time of the alternate route is .17 of an hour or 10.38 minutes.

## *Traffic Diversion Benefits*

The calculation of the transportation savings for selected years over the life of the project is shown in Table 5. Travel costs for the traffic diversion were determined by multiplying the additional or incremental miles of the alternate route by the variable vehicle cost per mile and multiplying that product by the number of days per year. Costs were then discounted to present value and a 5 1/8 percent interest rate was applied over the 50-year project life to the transportation costs shown on Table 5.

The calculation is as follows: the annual number of vehicles over the project life is multiplied by the variable operating cost per mile of a vehicle (14.1 cents per mile). That product is multiplied by the 1.5 incremental miles traveled of the alternate route (without-project route mileage of 4.6 miles minus with-project route mileage of 3.2 miles). The travel cost for the year 2008 follows: (4,907 vehicles x 365 days = 1,791,029 vehicles per year x $0.141 per mile x 1.5 miles = $378,803).

Table 5 illustrates total projected daily traffic figures for north and south bound vehicles transiting South Beach Boulevard for selected years of the project life.

**Table 5.**
**Downtown Bay St. Louis Hurricane and Storm Damage Reduction**
**Variable Vehicle Operating Costs**

| Year | Daily Vehicles | Annual Vehicles | Total Annual Travel Cost |
|---|---|---|---|
| 2008 | 4,907 | 1,791,029 | $378,803 |
| 2013 | 5,666 | 2,067,940 | $437,369 |
| 2014 | 5,817 | 2,123,322 | $449,083 |
| 2057 | 5,817 | 2,123,322 | $449,083 |

1/ $0.141 based on 2005 AAA Variable Vehicle Operating Costs @ 1.5 miles

Table 8 in Appendix A displays the without-project variable vehicle costs by year, present worth and annualized. Transportation costs were held level between the selected years. The average annual equivalent variable vehicle cost savings for traffic using both north and south bound alternate routes equals $434,214 or $434,200**.**

***Time Delay Benefits***

The calculation of travel time in any given year is the value of the incremental travel time per vehicle per trip multiplied by the number of people per vehicle and that product multiplied by the number of days per year.

Travel time is determined by dividing the distance of each route by the typical speed of a vehicle. The difference in the without and with project route travel times is the time savings. The with project route on South Beach Boulevard for both north and south bound travelers is 3.2 miles in distance, with a speed limit of 25 miles per hour. This equals a travel time of 7.68 minutes or .128 of an hour. Based on the without-project rerouting time of 10.38 minutes, each vehicle would incur a saving in travel of 2.7 minutes (10.38 – 7.68) using the with project route.

For purposes of this report, it is estimated that there is one person per work vehicle trip and 2.22 persons per recreational vehicle trip. The number of persons per vehicle in this report is based on information published by the US Department of Transportation for State Motor-Vehicle Registrations-1998 for the category: “Automobiles per capita” (0.45 cars per person) in the State of Mississippi[9].

The county median income, the hourly wage, and the dollar value of the hourly and incremental value of the travel time were used to determine the costs of the delay. Table D-4 on page D-20 of ER 1105-2-100 was used to identify the incremental value of time for Work trips, Social/Recreational trips, and “Other” trips (Low, Medium, and High time savings) in this rerouting analysis. Work trips are by a per person basis; Social/Recreational trips and “Other” trips are by a per vehicle basis. The additional timesaving of 2.7 minutes of travel time per trip, using the table, is a low timesaving.

The value of time in the table for low time savings (0-5 minutes) for work trips is 6.4 percent of the hourly wage. The value of time for Recreation and Other is 1.3 and 0.1 percent of the hourly wage, respectively.

The hourly wage used in this analysis is based on Hancock County average family income from the Bureau of Census. The median family income for 2000 in Hancock County totals $40,307 annually.

To calculate the hourly wage, the average household income ($40,307) was divided by the average number of annual work hours (2080). This result equals an average family hourly wage rate of $19.38.

Table 6 displays the value of time used in this analysis. Rows 4 through 6 identify the hourly value of time by activity ($19.38 x .6 x .064= $0.74 for work trips and $19.38 x .6 x .013= $0.15 for “Social/Recreation” trips) Rows 7 through 9 of the table identify the actual delay cost of a trip. This is

the percent of an hour delayed 2.7 minutes/60 minutes multiplied by the hourly value of time displayed in rows 4 through 6.

**Table 6.**
**Downtown Bay St. Louis Hurricane and Storm Damage Reduction**
**Value of Time**

| Factor | Dollar Value |
|---|---|
| 2000 County Median Family Income | $40,307 |
| Hourly Wage (2080 hrs) For Family | $19.38 |
| EC 1105-2-Draft dated 31 March 1992 Per Person Hourly | $11.63 |
| Value of Hour (Time per person) Work 0-5 minutes 6.4% | $0.74 |
| Value of Hour (Time) Social/Recr Trips 0-5 minutes 1.3% | $0.15 |
| Value of Hour (Time) Other Trips 0-5 minutes 00.1% | $0.01 |
| Value of Delay(2.6 Minutes): Work | $0.032 |
| Value of Delay(2.6 Minutes): Social/Recreation | $0.007 |
| Value of Delay(2.6 Minutes): Other | $0.001 |

It is estimated that 10 percent of the vehicular trips are for work, 90 percent of the trips are for recreation, and 0 percent of the trips are for other. Corps of Engineers personnel obtained this estimate in a February 2006 field trip from knowledgeable local officials.

Table 7 illustrates the value of work, recreational, and other time saved for the persons transiting South Beach Boulevard with a project in place for selected years. The table also displays the total value for the time saved.

Work delay calculations shown in rows 1 through 4 of Table 7 are described below. Row 1 of Table 7, the value of the incremental time of a trip ($.03) is from row 7 of Table 6. Row 2 of Table 7 is the calculated number of persons delayed in 2008 in work related vehicles. The number of persons delayed in work related vehicles is calculated by multiplying the total number of daily vehicle trips by the percentage of work trips (.10) and multiplying that product by the number of persons per vehicle (1.00) to calculate the persons delayed (491). Row 3 of the table uses the number of days in a year to convert the average daily counts to annual counts. Row 4 of the table is the total cost of a category of time. The calculation of the total cost is discussed in the next paragraph. The cost of work delays is $5,376 in the year 2008. This cost is calculated by multiplying the value of one trip delayed in row 1 ($0.03 in Table 7) multiplied by the number of persons per day delayed in row 2 (4,907 vehicles per day in Table 7 x .10 percent which is the percentage of the vehicles that are used for work x 1 person per vehicle = 491 persons) and multiplying that product of 491 by delay cost per trip times the number of days per year in row 3 ($0.03 x 365 x 491= 5,376.45 or 5,376).

Recreational delay calculations, in rows 5 through 8 of Table 7, are the same as work delay calculations, except for calculating the number of persons delayed. ER 1105-2-100 states that the number of persons delayed in recreational vehicles in row 6 is based on a per vehicle basis. The annual cost of 9,804 persons in 4,907 vehicles (4,907 vehicles x 0.90 of the vehicles x 2.22 persons per vehicle = 9,804.186) who are delayed is $24,062 ($0.03 in Table 12 x 9,804 people x 365 days = $35,784.6 or $35,785).

**Table 7.**
**Downtown Bay St. Louis Hurricane and Storm Damage Reduction**
**Value of Time Delays/Opportunity Costs: Rerouting**

| Factor | 2008 | 2013 | 2014 | 2057 |
|---|---|---|---|---|
| Work Delay Cost:(9.00-6.4)=2.60 minutes | 0.03 | 0.03 | 0.03 | 0.03 |
| Number of Persons in ADT Vehicles, Rounded | 491 | 567 | 582 | 582 |
| Number of Days | 365 | 365 | 365 | 365 |
| **Total Work Cost** | $5,376 | $6,209 | $6,373 | $6,373 |
| Recr Delay Cost:(9.00-6.4)=2.60 minutes | 0 | 0 | 0 | 0 |
| Number of Persons in ADT Vehicles, Rounded | 9804 | 11320 | 11623 | 11623 |
| Number of Days | 365 | 365 | 365 | 365 |
| **Total Recreation Cost** | $35,785 | $41,318 | $42,424 | $42,424 |
| Other Delay Cost:(9.00-6.4)=2.60 minutes | 0 | 0 | 0 | 0 |
| Number of Persons in ADT Vehicles, Rounded | 0 | 0 | 0 | 0 |
| Number of Days | 365 | 365 | 365 | 365 |
| **Total Other Delay Cost** | $0 | $0 | $0 | $0 |
| Grand total Delay Cost:(9.00-6.4)=2.60 minutes | 0 | 0 | 0 | 0 |
| Number of Persons in ADT Vehicles, Rounded | 10295 | 11887 | 12205 | 12205 |
| Number of Days | 365 | 365 | 365 | 365 |
| **Grand Total Cost** | $41,161 | $47,527 | $48,797 | $48,797 |

Table 9 in Appendix A displays the total value of time saved by year, present worth and annualized. Savings were held level between the selected years shown on Table 7. The average annual equivalent variable vehicle cost savings for traffic using both north and southbound alternate route equals $47,182 or $47,200 when rounded to the nearest hundred dollars.

***Total Traffic Benefits***

Table 8 displays the total savings with a plan in place for time delays/opportunity costs, variable vehicle operating costs, and maintenance costs for selected years.

**Table 8.**
**Downtown Bay St. Louis Hurricane and Storm Damage Reduction**
**Value of Time Delays and Vehicle Variable Operating Costs**

| Factor | 2008 | 2013 | 2014 | 2057 |
|---|---|---|---|---|
| Total Time Delays/Opportunity Costs | $41,161 | $47,527 | $48,797 | $48,797 |
| Total Variable Vehicle Operating Costs | $378,803 | $437,369 | $449,083 | $449,083 |
| Grand Total | $419,964 | $484,896 | $497,879 | $497,879 |

Table 10 in Appendix A displays the value of Delays and Vehicle Operating costs, present worth and annualized that would be saved with a plan in place. The savings were held level between the selected years as shown on Table 8. The average annual equivalent variable vehicle cost savings for traffic using both north and south bound alternate route plus savings from maintenance fees equals $481,395 or $481,400 rounded to the nearest hundred dollars.

# Hurricane and Storm Damage Reduction (HSDR)

The level of protection for each of the projects was determined by the Mobile District Corps of Engineers Hydraulics section. The seawall is estimated to protect the structures, entities and road up to a 50 year storm (2 percent chance of a storm occurring in any given year). The benefits to the project are the losses prevented from vehicle varying operating costs and time delays from those in the vehicles from the frequencies of the storms that are above the 50 year event. Table 9 displays the average annual costs integrated with the frequency of storm events. The average annual HSDR savings is $1,785,459 and rounded to $1,785,500.

**Table 9.**
**Downtown Bay St. Louis Seawall Frequency Analysis of With-Plan Benefits**

| Frequency | 1/Freq | Prob | Without Project Damages | Without Project Average Damages | With Project Damages | With Project Average Damages | Damages Reduced |
|---|---|---|---|---|---|---|---|
| | | 0.0020 | | $ 3,642 | | $ 3,642 | $ - |
| 500 | 0.0020 | | $ 1,821,168 | | $ 1,821,168 | | |
| | | 0.0176 | | $ 32,067 | | $ 32,067 | $ - |
| 51 | 0.0196 | | $ 1,821,168 | | $ 1,821,168 | | |
| | | 0.0004 | | $ 714 | | $ - | $ 714 |
| 50 | 0.0200 | | $ 1,821,168 | | $ - | | |
| | | 0.1800 | | $ 327,810 | | $ - | $ 327,810 |
| 5 | 0.2000 | | $ 1,821,168 | | $ - | | |
| | | 0.1333 | | $ 242,822 | | $ - | $ 242,822 |
| 3 | 0.3333 | | $ 1,821,168 | | $ - | | |
| | | 0.1667 | | $ 303,528 | | $ - | $ 303,528 |
| 2 | 0.5000 | | $ 1,821,168 | | $ - | | |
| | | 0.5000 | | $ 910,584 | | $ - | $ 910,584 |
| 1 | 1.0000 | | $ 1,821,168 | | $ - | | |
| Totals | | | | $ 1,821,168 | | $ 35,709 | $1,785,459 |

## *With-Project Condition*

This section describes the with-project condition of securing the structural integrity of the highway and seawall along the project site on South Beach Boulevard. Under the with project condition, highway failure will not occur and the vehicles will continue either north or south bound on South Beach Boulevard unhampered by added variable vehicle cost or time delays.

## *Recommendations*

Table 10 displays the average annual benefits or savings that the seawall provides. The values in this report are 2006 dollars.

**Table 10.**
**With-Plan Benefits or Savings Downtown Bay Saint Louis Seawall**

| Plan | Average Annual HSDR Benefits | Average Annual Benefits | Total Average Annual Benefits |
|---|---|---|---|
| Concrete T-Wall | $1,785,500 | $481,400 | $2,266,900 |
| Concrete Gravity Wall | $1,785,500 | $481,400 | $2,266,900 |

# Economic Costs

First costs, composed of construction costs, planning engineering and design and construction management total $29,400,000 and 29,140,000, for the recommended concrete gravity wall and concrete T wall respectively. Interest during construction (IDC) accounts for the cost of obligating capital used for construction. The construction of a water resources project often takes several years, during which time costs are incurred without producing benefits. The Corps has accounted for this cost through the calculation of IDC. IDC costs are added to project first costs to determine NED project costs. IDC is calculated by adding compound interest at the applicable project discount rate from the date of expenditures are made to the beginning of the period of analysis. IDC costs are $746,493 and $753,325.

Operation and maintenance (O&M) will be performed every 10-years for both alternatives. O&M for the gravity wall would amount to $140,000 and $590,000 for the T wall. This equates to $198,177 and $835,178 present worth or an average annual value of $11,066 and $46,635 respectfully.

[1] U.S. Bureau of Census for 2000. City of Bay St. Louis
http://censtats.census.gov/data/MS/1602803980.pdf

[2] U.S. Bureau of Census for 1990.City of Bay St. Louis

[3] U.S. Bureau of Census for 2000. Hancock County Population USA MapStats
http://quickfacts.census.gov/qfd/states/28/28045.html

[4] U.S. Bureau of Census for 1990. Hancock County, Census of Population—Social and Economic Characteristics
http://www.fedstats.gov/qf/states/28/28045.html

[5] Bureau of Economic Analysis Regional Economic Accounts
http://www.bea.doc.gov/bea/regional/bearfacts/action.cfm

[6] U.S. Census Bureau, Census 2000, American FactFinder-- Population, Per Capita Income, Median Family Income

[7] U.S. Census Bureau, Census 2000, Hancock County Population USA MapStats
http://www.fedstats.gov/qf/states/28/28045.html

[8] Your Driving Costs 2005 American Automobile Association.

[9] U.S. Department of Transportation 1998 Motor Vehicle Registrations.

[10] http://www.fhwa.dot.gov/ohim/hs98/tables/mv1.pdf

# DOWNTOWN BAY ST. LOUIS HURRICANE AND STORM DAMAGE REDUCTION

## Recreation Benefit Analysis

### *Existing Condition*

Buccaneer State Park is located on Mississippi Sound, near Waveland, MS, approximately 4.8 miles to the southwest of the project area. The park offered visitors a range of recreation activities, including a wave pool, water slide, pavilion, primitive and developed camping, fishing, picnicking, and nature trails. The park was the busiest in the Mississippi State Park System, attracting an estimated 100,000 visitors annually. Approximately two-thirds of the visitors are from out of state. The park is the only one of its kind in the area, and it offered a nearly unique combination of recreation activities.

At various times during recent years, loss of fine fill material beneath South Beach Blvd. caused voids in the roadway and roadway failure. When failures occur or major maintenance operations are underway, traffic to and from the park has been disrupted. Visitation drops considerably due to the congestion and difficulty of accessing the park.

This is precisely what occurred during Hurricane Katrina on August 29, 2005. South Beach Boulevard--the main thoroughfare along the entire length of the project area—was destroyed by wave attack energy from the surge elevation of the storm. South Beach Boulevard was essentially lost as a thoroughfare along the coastline, and large numbers of the commercial and residential structures on both sides of the road were completely obliterated.

Buccaneer State Park, which itself suffered severe damage during the storm, is no longer accessible to the vast majority of its nearly 100,000 patrons. Estimates of damage to the park and its facilities were placed at $16.0 million by state park officials following the storm. Most of the damage was covered by insurance, and the state plans to cover any deductibles and uninsured losses. Though it is accessible at two locations, the primary access location was on South Beach Blvd. Damage and congestion at the secondary access point on Railroad Ave makes accessing the park difficult. With the loss of South Beach Blvd. as a thoroughfare, Railroad Ave. has seen increasing congestion and traffic delays. The road itself was damaged in several locations, as was the L&N Railroad to the north. Though the photo below does not show the roadway damage, it illustrates the damage caused by the storm surge several yards inland of Railroad Ave.

*L&N Railroad near Waveland, MS. From Railroad Ave looking generally northwest. David N. Luckie, US Army Corps of Engineers, 21 Sep 2005.*

Nearly all of the visitors to the park gained access to it by traveling from US 90 along South Beach Blvd for approximately 6 miles. The trip was relatively short and took only minutes to make, and users could park only a few hundred feet from the entrance. Without the South Beach Blvd route, users of the park must travel through the interior residential areas of Bay St. Louis and Waveland. These routes were already somewhat congested before the storm. Many of the roadways sustained considerable damage and the loss of South Beach Blvd has intensified and significantly worsened the congestion problem. Users who are not intimately familiar with the two cities' streets and traffic patterns wound up backtracking and circling until essentially stumbling upon a route accidentally. Those accessing the park from the Railroad Ave. location must now drive along a winding roadway through the site before locating the parking area closest to South Beach.

Immediately after the storm, the park was used as a temporary "trailer town," housing both displaced area residents and aid workers. A significant number of those temporary residents have since left the park, and state tourism and park officials expect the remainder to have left within a year. Only emergency repairs were made to the park's facilities, with accommodating the influx of the temporary residents as the goal of those repairs. Officials placed the price tag of those repairs at approximately $2.0 million, with approximately $1.0 million spent on wastewater collection and transport, and another $1.0 million spent on assorted other infrastructure repairs. No detailed cost data were available at this writing. However, the $2.0 million figure was widely reported in local news outlets (See The Sun Herald, April 12, 2006).

Buccaneer is currently closed to the public for recreation. Ready and convenient access is nonexistent and the facilities are still in need of repair. However, state park and tourism officials have repeatedly stated that the park will reopen as soon as its attractions can be repaired and the last of the aid workers have left. Officials are unsure about the exact time or season that the park would reopen, but believe that it could reopen sometime in 2007 or 2008. They are currently planning no broad scale upgrades to the park's facilities and there are no long term plans for such upgrades. Their current plans are to restore the park to its former self and restart the economic engine it was prior to Hurricane Katrina.

## *Future Without Project Condition*

If South Beach Blvd. is not repaired and the affected section of the seawall is not replaced, recreational users of Buccaneer State Park will have no thoroughfare by which to access the park's facilities and unique combination of recreational opportunities. Park visitors seeking a similar recreational experience will have to choose between traveling to other water parks in southern Alabama, enduring the congestion, delays and inconveniences of using the circuitous routes through Waveland and Bay St. Louis, or foregoing the recreation experience altogether. It is unlikely that all of those seeking the recreation opportunity will completely forgo the opportunity. It is also unlikely that they will choose to make an approximately 100-mile journey to an alternative water park in Southern Alabama that offers a similar, but not identical experience. It is much more likely that a significant reduction in visitation can be expected to occur at Buccaneer State Park. It is further likely that those who do visit the park will enjoy a significantly reduced recreation experience, owing to the lack of ready access to the park's facilities, time spent navigating the alternate routes and the reduced time spent enjoying the park's amenities.

## *Assumptions*

The following assumptions and restrictions will be used to estimate the with and without project conditions expected to occur in the 50-year planning period:

- The Unit Day Value method is suitable for estimating recreation value
- The park's facilities will be repaired and maintained to pre-Katrina conditions
- The park will reopen to public recreation use by FY 2008
- The federal discount rate of 5-1/8% will be used to discount future cash flows
- Average annual demand for recreation at the park will remain at or near the historical 100,000 average

## *Recreation Demand*

Mississippi Wildlife, Fisheries and Parks officials provided estimated visitation data for Buccaneer State Park in 2004, when the Mobile District was conducting a feasibility study of the entire Hancock County Seawall. Detailed, month by month visitation data were unavailable then as they are now. However, park visitation averaged 100,000 visitor days over a period of 5 years beginning in 1993. Visitation ranged from 78,000 in 1999 to 104,000 in 2003. Except for the 1999 figure, visitation was tightly clustered about the mean of just over 100,000. The 1999 figure was almost certain to have been so low due to the effects of Hurricane Georges, which struck the area in fall 1998. That storm caused considerable damage to the area and the park, and provides some insight into how reduced access and expected recreation quality would affect future park visitation.

If demand for recreation at Buccaneer remains at 100,000 annually for the 50-year planning period, and expected recreation experience declines by an amount equal to the figure indicated by 1999 visitation, it is reasonable to conclude that a similar decline in visitor days will occur if no federal action occurs. Accordingly, this benefit estimation will use an expected future without project condition visitation of 78,000 visitor days.

## *Unit Day Value Method*

The procedures described in ER-1105-2-100 address three evaluation methods. They are the travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method. The criteria described in ER-1105-2-100 were followed to determine the appropriate methodology for this analysis. The Unit Day Value (UDV) method was selected to evaluate recreation benefits because a regional model was not available and specialized recreation activities from a national perspective were not affected. Estimated annual visits affected did not exceed 750,000, which would indicate that a more rigorous empirical analysis is called for. Further, since a more detailed analysis of this resource would prove costly and time consuming, the UDV approach seems to be most prudent use of study resources. It is unlikely that any formulation of plan alternatives or plan selection will significantly change expected recreation benefits.

The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Buccaneer.

ER 1105-2-100 provides guidelines for assigning points and their conversion to dollar value for evaluating recreation.

The guidelines for assigning points to general recreation include five criteria:

(1) the quality of the recreation experience as affected by congestion;
(2) availability of substitute areas in terms of travel time;
(3) carrying capacity determined by level of facility development;
(4) accessibility as affected by road and parking conditions; and
(5) environmental quality based on aesthetics.

A resource is rated on a 100-point scale. The total possible points that can be assigned to each criterion are as follows:

(1) Recreation Experience – 30;
(2) Availability of Opportunity – 18;
(3) Carrying Capacity – 14;
(4) Accessibility – 18; and
(5) Environmental – 20.

The conversion of points to dollar value for general recreation is expressed in two activity categories:

(1) general recreation and
(2) general fishing and hunting.

Hence, points are estimated and expressed in the same manner. General recreation includes boating, skiing, camping, sightseeing, sunbathing, swimming and picnicking. General hunting and fishing includes fishing from the beach and pier. Hunting was once allowed in the park and adjacent Mud Bayou during its early days prior to the construction of the water park, but has since been prohibited.

Based on analyst knowledge of the general area and the recreation opportunities provided by the asset and bolstered by several field trips to the area before and after Katrina, Buccaneer was scored and valued in accordance with the procedures described in ER 1105-2-100 and outlined in the tables below. These tables represent the estimation of recreation value without a project to repair South Beach Blvd and the adjacent seawall.

**Guidelines for Assigning Points for General Recreation**

| **Criteria** | **Judgment Factors** | | | | |
|---|---|---|---|---|---|
| **Recreation experience**[1] | Two general activities[2] | Several general activities | Several general activities; one high quality value activity[3] | Several general activities; more than one high quality value activity | Numerous high quality value activities; some general activities |
| Total Points: 30 | | | | | |
| Point Value: | 0-4 | 5-10 | 11-16 | 17-23 | 24-30 |
| **Availability of opportunity**[4] | Several within 1 hr. travel time; a few within 30 min. travel time | Several within 1 hr. travel time; none within 30 min. travel time | One or two within 1 hr. travel time; none within 45 min. travel time | None within 1 hr. travel time | None within 2 hr. travel time |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Carrying Capacity**[5] | Minimum facility for development for public health and safety | Basic facility to conduct activity(ies) | Adequate facilities to conduct without deterioration of the resource or activity experience | Optimum facilities to conduct activity at site potential | Ultimate facilities to achieve intent of selected alternative |
| Total Points: 14 | | | | | |
| Point Value: | 0-2 | 3-5 | 6-8 | 9-11 | 12-14 |
| **Accessibility** | Limited access by any means to site or within site | Fair access, poor quality roads to site; limited access within site | Fair access, fair road to site; fair access, good roads within site | Good access, good roads to site; fair access, good roads within site | Good access, high standard road to site; good access within site |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Environmental** | Low esthetic factors[6] that significantly lower quality[7] | Average esthetic quality; factors exist that lower quality to minor degree | Above average esthetic quality; any limiting factors can be reasonably rectified | High esthetic quality; no factors exist that lower quality | Outstanding esthetic quality; no factors exist that lower quality |
| Total Points: 20 | | | | | |
| Point Value: | 0-2 | 3-6 | 7-10 | 11-15 | 16-20 |

The table below illustrates a reasonable assessment of the overall quality of recreation experience should no federal action be taken to repair the seawall and roadway. Limited access, poor to-site road conditions and congestion along the to-site road would lower both the quality of the recreation experience itself, and lead to future decreases in quality as park revenues suffer. Availability and the relatively unique combination of activities would still garner fairly high marks, as would the overall recreation experience.

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1]<br>Pts. Possible: 30 | 12 | The parks activities are likely to be hampered by access. Park facilities and maintenance costs are funded in part by fees, charges and the cost of food and sundries at the park. Without a stable flow of visitors, park facilities and the recreation experience will suffer. |
| **Availability of opportunity**[4]<br>Pts Possible: 18 | 18 | The closest water park with anything approaching Buccaneer's resources is Waterville USA, located in Gulf Shores, Ala. Gulf Shores is a drive of approximately 130 miles east. A similar water park was located near New Orleans, but that facility's future is very uncertain, given the priorities of rebuilding that city. |
| **Carrying Capacity**[5]<br>Pts Possible: 14 | 8 | The park site itself covers nearly three square miles, with miles of trail, hundreds of yards of gulf and lake front beach, acres of forest and dozens of picnic tables and BBQ grills. Lines at the pool and slide are long only during high peak usage. The park could easily handle additional demand above 100,000 (annual average). Carrying capacity is likely to suffer significantly if the South Beach access is not running at pre-Katrina levels. |
| **Accessibility**<br>Pts Possible: 18 | 5 | Railroad Ave is congested and suffered damage itself. The water-related activities are located nearer the southeastern side of the park; Railroad Ave is near the northwest side. |
| **Environmental**<br>Pts Possible: 20 | 9 | No significant environmental issues are present. However, lack of steady use could result in reduced maintenance, which would in turn lead to some environmental degradation (trash pickup, storm debris collection, erosion, etc). |
| TOTAL SCORE | 52 | |

The table below (from Economic Guidance Memorandum (EGM) 06-03) provides a means of converting the resource's UDV score into FY 2006 dollars. With the score of 52 taken from table above, we estimate the future without project condition value of Buccaneer State Park to be $6.90 by interpolating between the values given at 50 and 60. That is, an average recreational visitor to the park would place a willingness to pay value of approximately $6.90 on their recreation day.

| Point Values | General Recreation Values |
|---|---|
| 0 | 3.19 |
| 10 | 3.79 |
| 20 | 4.19 |
| 30 | 4.79 |
| 40 | 5.98 |
| 50 | 6.78 |
| 60 | 7.38 |
| 70 | 7.78 |
| 80 | 8.57 |
| 90 | 9.17 |
| 100 | 9.57 |

With 78,000 annual visitors and $6.90 per visitor day in the value of willingness to pay, the expected annual NED value of recreation at the park comes to $528,840.

## *With Project Condition*

The table below illustrates the effects of restoring thoroughfare and access to the park with a federal project in Bay St. Louis. Recreation experience, carrying capacity and accessibility all increase as normal patterns of activity are restored.

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1] Pts. Possible: 30 | 20 | The park provided a wide array of activities, including a wave pool, water slide, a beach for sunbathing, relatively calm and shallow water for swimming and wading, nature trails, camping, fishing and picnicking. While none are unique, the array of choices is broad and high quality. |
| **Availability of opportunity**[4] Pts Possible: 18 | 18 | The closest water park with anything approaching Buccaneer's resources is Waterville USA, located in Gulf Shores, Ala. Gulf Shores is a drive of approximately 130 miles east. A similar water park was located near New Orleans, but that facility's future is very uncertain, given the priorities of rebuilding that city. |
| **Carrying Capacity**[5] Pts Possible: 14 | 10 | The park site itself covers nearly three square miles, with miles of trail, hundreds of yards of gulf and lake front beach, acres of forest and dozens of picnic tables and BBQ grills. Lines at the pool and slide are long only during high peak usage. The park could easily handle additional demand above 100,000 (annual average). |
| **Accessibility** Pts Possible: 18 | 17 | The two access points were more than adequate before Katrina. Camping access was good at Railroad Ave.; most other activities had excellent access at South Beach Blvd. |
| **Environmental** Pts Possible: 20 | 15 | The scenery of the park was quite good, with lake, beach, forest and pier views. Water quality is also good at both the lake and in Mississippi Sound. There were no signs of serious erosion pre-Katrina, and the overall unique quality of the park and its surrounds lend to a high score. |
| TOTAL SCORE | 80 | |

With a score of 80, recreation willingness to pay is expected to increase to $8.57. Further, restoration of access and resumption of normal traffic to and from the park is expected to restore visitation to its pre-Katrina levels of 100,000 per annum. Accordingly, the NED value of recreation under with project conditions comes to $857,000. This represents a difference of $318,800 in expected annual NED recreation benefits attributable to a federal project. The without project condition had a value of $528,840, and the with project condition increases the value of the resource to $857,000. The difference of $318,000 is the annual benefit attributable to the proposed action. Since the benefits accrue at a fixed rare throughout the life of the project, no discounting is performed on future benefits unless those benefits are expressed in net present value terms. In net present value terms, this benefit stream equals $5.71 million in 2006 dollars.

# REGIONAL ECONOMIC DEVELOPMENT BENEFIT ANALYSIS

## Socioeconomic Impacts using the Economic Impact Forecast System

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $29,140,000 for the Concrete Gravity Wall alternative and $29,400,000 for the Concrete T Wall alternative. The Annual Operation and Maintenance (O&M) expenditures every 10 years is $140,000 for the gravity wall and $590,000 for the T-wall. In present worth form $198,177 and $835,178 for the gravity wall and T wall respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

## Summary Explanation of the EIFS Model Output

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**EIFS Model Inputs for Bay Saint Louis Proposed Project Alternatives**

| Indicator Variable | Concrete Gravity Wall | Concrete T Wall | O&M Gravity Wall | O&M T - Wall |
|---|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $29,140,000 | $29,400,000 | $140,000* | $590,000* |

*O&M expenditure every 10-years

Based of the given inputs the outputs are as followed:

**EIFS Model Outputs for Bay Saint Louis Proposed Project Alternatives**

| Indicator Variable | Projected Δ Concrete Gravity Wall | Projected Δ Concrete T Wall | Projected Δ O&M Gravity Wall | Projected Δ O&M T Wall |
|---|---|---|---|---|
| Direct Sales Volume | $29,500,000 | $29,770,000 | $198,177 | $835,178 |
| Induced Sales Volume | $29,500,000 | $29,770,000 | $198,177 | $835,178 |
| Total Sales Volume | $59,000,000 | $59,540,000 | $396,354 | $1,670,356 |
| | | | | |
| Direct Income | $7,113,484 | $7,178,591 | $47,787 | $201,391 |
| Induced Income | $7,113,484 | $7,178,591 | $47,787 | $201,391 |
| Total Income | $14,226,968 | $14,357,182 | $95,574 | $402,781 |
| | | | | |
| Direct Employment | 178 | 180 | 1 | 5 |
| Induced Employment | 178 | 180 | 1 | 5 |
| Total Employment | 356 | 360 | 2 | 10 |
| | | | | |
| Local Population | | | | |

## *Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Concrete Gravity Wall.*** If implemented, the total sales volume related to this alternative is projected to increase by $59,396,354 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $396,354 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Concrete Gravity Wall alternative.

***Concrete T Wall.*** If implemented, the total sales volume related to this alternative is projected to increase by $61,210,356 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,670,356 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Concrete T Wall.

## *Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Concrete Gravity Wall.*** If implemented, the total income related to this alternative is projected to increase by $14,322,543 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $95,575 (i.e. the total income increased because of O&M) was added to the total income of the Concrete Gravity Wall alternative.

***Concrete T Wall.*** If implemented, the total income related to this alternative is projected to increase by $14,357,182 for Hancock County. Note, O&M is only accounted for if the project is implemented;

therefore, $402,781 (i.e. the total income increased because of O&M) was added to the total income of the Concrete T Wall alternative.

## *Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Concrete Gravity Wall.*** If implemented, the total employment related to this alternative is projected to increase by 358 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 2 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Concrete Gravity Wall alternative.

***Concrete T Wall.*** If implemented, the total employment related to this alternative is projected to increase by 370 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 10 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Concrete T Wall alternative.

## *Population*

If implemented, the population related to both alternatives is not projected to increase.

# COWAND POINT HURRICANE AND STORM DAMAGE REDUCTION, HANCOCK COUNTY, MS

## Introduction

## Purpose

The purpose of this analysis is to determine the National Economic Development (NED) benefits associated with proposed alternative solutions to repair two segments of seawall adjacent to North Beach Boulevard in the city of Bay St. Louis, located in Hancock County, Mississippi. See Figure 1 for the exact project locations.

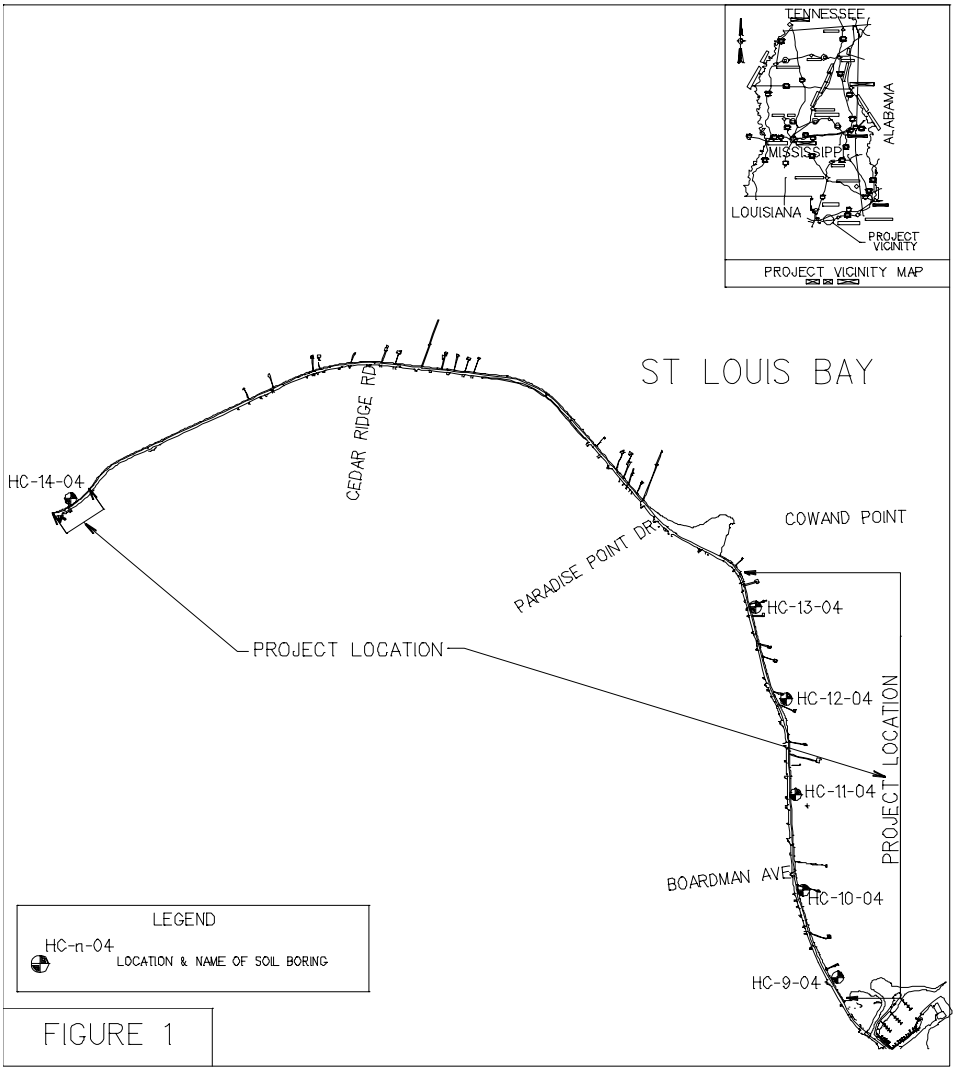



**Figure 1.**

# Problem Statement

Wave action along the western shore line of Bay St. Louis has caused severe beach erosion to North Beach Boulevard. The erosion under the seawall is threatening to undermine two (505' & 4,653') segments of North Beach Boulevard behind the seawall. Because of this, the structural integrity of North Beach Boulevard is in jeopardy and public access to a popular boat launch is in danger of being lost. This condition of this boulevard could lead to possible vehicular accidents, increased variable vehicle costs, and increases in annual maintenance expenditures to local residents as well as to the city and county. Attempts by Hancock County and the City of Bay St. Louis to provide interim protection along North Beach Boulevard have met with only marginal success.

Under future without-project conditions, erosion will continue and the undermined portion of North Beach Boulevard at the site will fail. As highway failure occurs, county officials would likely close the compromised road section and divert traffic to another boat launch. This will result in increased travel costs for vehicles and boats. The costs which have been estimated in this analysis are the incremental variable operating costs of the vehicles which would be diverted and the opportunity costs of time delays which motorists in their vehicles experience. National Economic Development (NED) benefits can be claimed for the elimination of some or all of these costs.

## *Socioeconomic Overview—Hancock County*

**Hancock County**[1] is a Gulf of Mexico county located in the State of Mississippi . As of 2000, the population is 42,967. The county seat is Bay St. Louis. The area is home to the John C. Stennis Space Center, NASA's largest rocket engine test facility.

**Geography**[2]According to the 2000 U.S. Census Bureau, the county has a total area of 1,431 km² (553 mi²). 1,235 km² (477 mi²) of it is land and 196 km² (76 mi²) of it is water. The total area is 13.69% water. In 2005, the county was the scene of the final landfall of the eye of Hurricane Katrina, and its communities and infrastructure suffered some of the most intense damage inflicted by that storm.

**Demographics**[3] As of the 2000 U.S. census of Population, there are 42,967 people, 16,897 households, and 11,827 families residing in Hancock County. The population density of the County is 35/km² (90/mi²). There are 21,072 housing units at an average density of 17/km² (44/mi²). The racial makeup of the county is 90.19% White, 6.83% Black or African American, 0.60% Native American, 0.88% Asian, 0.04% Pacific Islander, 0.33% from other races, and 1.14% from two or more races. A total of 1.80% of the population is Hispanic or Latino of any race. In 1990 U.S. Census, there were 31,760 people living in the County. See Table 1 for population data.

In the 2000 Census, there are 16,897 households out of which 31.50% have children under the age of 18 living with them, 53.90% are married couples living together, 11.30% have a female householder with no husband present, and 30.00% are non-families. A total of 24.70% of all 2000 households are made up of individuals and 9.20% have someone living alone who is 65 years of age or older. The average household size in 2000 was 2.52 and the average family size was 2.99.

In the county the 2000 population is spread out with 25.10% under the age of 18, 7.30% from 18 to 24, 28.00% from 25 to 44, 25.60% from 45 to 64, and 14.00% who are 65 years of age or older. The

[1] http://en.wikipedia.org/wiki/Hancock_County%2C_Mississippi
[2] http://en.wikipedia.org/wiki/Hancock_County%2C_Mississippi
[3] http://en.wikipedia.org/wiki/Hancock_County%2C_Mississippi

median age of the 2000 population is 38 years and for every 100 females there are 98.30 males. For every 100 females age 18 and over, there are 95.50 males.

The median income for a household in Hancock County in 2000 is $35,202, and the median income for a family is $40,307. Males had a median income of $32,229 in 2000 versus $22,066 for females. The per capita income for the county is $17,748, 14.40% of the population and 11.20% of families are below the poverty line. Out of the total population, 17.90% of those under the age of 18 and 10.30% of those 65 and older are living below the poverty line. In 1990, the US Census per capita income for the County was $10,202. See Table 1.

**Table 1.**
**Cownad Point Study Hancock County Demographics** [4]

| Item | 1990 Census | 2000 Census |
|---|---|---|
| Hancock Co Population | 31,760 | 42,967 |
| Per Capita Income | $10,202 | $17,748 |
| Median Family Income | $24,727 | $40,307 |

## *Land Use*

The city of Bay St. Louis is the county seat of Hancock County. The city has largely developed as a resort community due to its shore front location. Land uses within the city are primarily residential with commercial use confined to the downtown area, U. S. Highway 90 and portions of the bay and gulf shorelines.

The low lying elevation of much of the land within Bay St. Louis means that the city is subject to flooding during storm conditions. Coastal areas are particularly vulnerable to storm surge damage and erosion due to tropical storms. Hurricane Katrina devastated a large portion of Hancock County. It is assumed that any flooding losses along North Beach Boulevard will be put back to pre Katrina conditions by the year 2006.

## *Transportation*

Figure 2 is a map produced by the Mississippi State Highway Department showing average daily traffic[5]. The map illustrates major roads and streets serving the city of Bay St. Louis. The network of collector streets includes North and South Beach Boulevard, Second Street, and Dunbar Avenue. Important east-west routes include Felicity Street, Ulman Avenue, and Main Street.

Studies conducted by the Mississippi State Highway Department show that the most heavily traveled streets in the city are Main Street, Dunbar Avenue and Beach Boulevard between Washington Street and U. S. Highway 90. These streets experience occasional congestion at rush hours and during summer weekends. With the introduction of a gambling casino in the northern half of the city, traffic also is increasing along the lower portion of North Beach Boulevard and both Felicity Street and Dunbar Avenue with direct access to the casino.

[4] 1990 and 2000 U.S. Census of Population
[5] http://gomdot.com/maps/coast_aadt/coast09.pdf

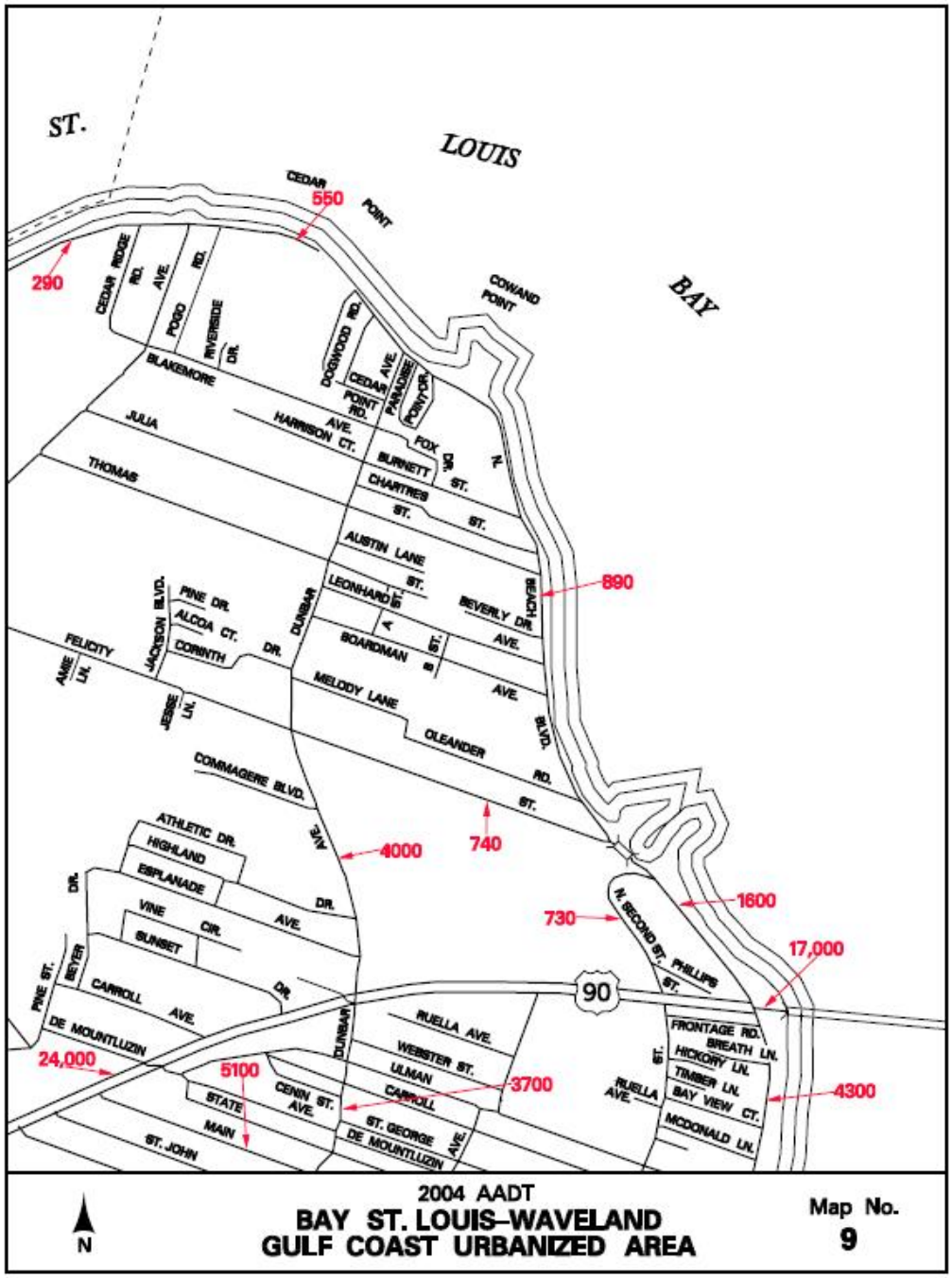



**Figure 2. North Beach Boulevard traffic count and Vicinity Map**

## *Tourist and Recreation Facilities*

In today's economic climate, the shoreline and beach areas represent the city's most important assets for both residents and tourists. Private ownership and generally poor condition of the shoreline and seawall structures limit public access.

Public boat launches in the area are at Bayou Caddy, Garfield Ladner Pier, Washington Street at South Beach Boulevard, Cedar Point, and Bayou Talla. Cedar Point and Bayou Talla are used

almost exclusively by freshwater and inshore saltwater anglers. The other three are used primarily by salt and brackish water anglers.

# Methodology

The methodology used in this analysis is from Engineering Regulation 1105-2-100, Appendix F, Section II.

This report identifies the losses under the without project future condition and the with project condition. The without project losses will be subtracted from the remaining losses under one or more plans, in order to identify the benefits attributable to each plan. The interest rate used in this analysis is 5 1/8%, the 2006 federal discount rate for project formulation and evaluation.

There are two categories of economic losses in this study. These categories are variable vehicular costs, opportunity cost of time, land loss. This analysis is based on ER 1105-2-100, paragraph E-50d3a on page E-183, (1) the variable vehicular costs using the travel cost method, paragraph D-4f, page D-18 (2) the opportunity cost of time. The values used to calculate the opportunity cost of time were obtained from table D-4 in ER 1105-2-100, Appendix D, page D-20. The procedure to calculate the value of time was from IWR 91-R-12.

## *Existing Condition*

Under the existing condition, the traffic presently traveling on North Beach Boulevard between US Highway 90 and points south to A Boat ramp use North Beach Boulevard. See Figure 3.

## *Without Project Condition*

This section of the report describes the future without-project condition of a 4,653-foot seawall section and a 505-foot section of seawall over a 25 year time period when a federal project could be in place. The two lengths of the study area were provided by Engineering Division. The 4,653 length of the study area begins at the N& E coordinates 3000478.1 and 827880.3. This beginning point is located between Leopold Street and Felicity Street near the Bay Waveland Yacht Club. The ending point is located at the N& E coordinates 304940.0 and 826794.4, near Cowand Point. The 505 foot length of the study begins at the N& E coordinates 305818.1 and 820107.1. The second section of the project ends at the N& E coordinates 305535.9 and 819700.5.

There is a seawall adjacent to North Beach Boulevard, approximately 3 miles north of the Bay St. Louis Bridge. The seawall protects the road: North Beach Boulevard. Two sections of this seawall (4,653-foot seawall section and a 505-foot section) incur storm damage annually. Most information for this section below was obtained from discussions and data provided by officials and staff from the Hancock County Commission Office and the Gulf Regional Planning Commission in an earlier Section 14 report: Cedar Point Seawall, dated 5 May 1998.

Constant wave attack against the shore line has eroded away the beach front. Proceeding along the highway to the North Beach Boulevard site, severe beach erosion has caused the water's edge to rest against the sea wall structure. Fill material is used for the construction, maintenance and repair of North Beach Boulevard. The seawall segment has been undermined intermittently along the entire length. Backwash has eroded the fill material from beneath the roadway. This condition could lead to possible vehicular accidents and increased operating costs.

When highway failure occurs, local county officials would likely close the road and divert traffic to the boat launch at Bayou Talla while maintenance is preformed. It is estimated that the number of days that North Beach Boulevard is closed for maintenance is 20 days per year. Traffic diversion will

increase expenditures for vehicle variable operating costs (fuel) and opportunity costs of the motorists in the vehicle. This analysis is limited the traffic which trailer boats to the Cedar Point boat launch that is located at the end of North Beach Boulevard. The typical boat launched at the site is a 16 foot fiberglass boat with a 50 horsepower motor. The speed a vehicle can pull a boat on a trailer to the launch is 30 miles per hour. The typical boat speed on the water is 30 miles per hour.

## *Traffic Diversion*

Highway failure is imminent. When failure occurs, local officials will close the road and boaters who currently use the Cedar Point launch will travel to the Bayou Talla boat launch, since that is the closest launch that provides access to inshore and freshwater fishing. Cedar Point users generally originate in Bay St. Louis, gain access to US Highway 90 at the Kiln Road intersection, travel east on 90, 3.4 miles then north and west on North Beach Boulevard to Cedar Point, 2.9 miles. The one-way distance of the route is 6.3 miles.

In order to use Bayou Talla, users will travel northwest on Kiln Road from the U. S. Highway 90 intersection to MS Highway 43, then travel west and north on MS 43 to an access road leading to the Bayou Talla launch. The one-way distance of this route is 9.1 miles, for an incremental difference of (9.1-6.3) 2.8 miles and a round trip difference of 5.6 miles.

The typical speed a vehicle can trailer a boat is 30 mph. Having arrived at Bayou Talla, boaters will travel by boat, at 30 mph, 2 miles east on Bayou Talla by boat to reach their original fishing destination. The distance of the route is 2 miles for an incremental difference of 2 miles and a round trip difference of 4 miles.

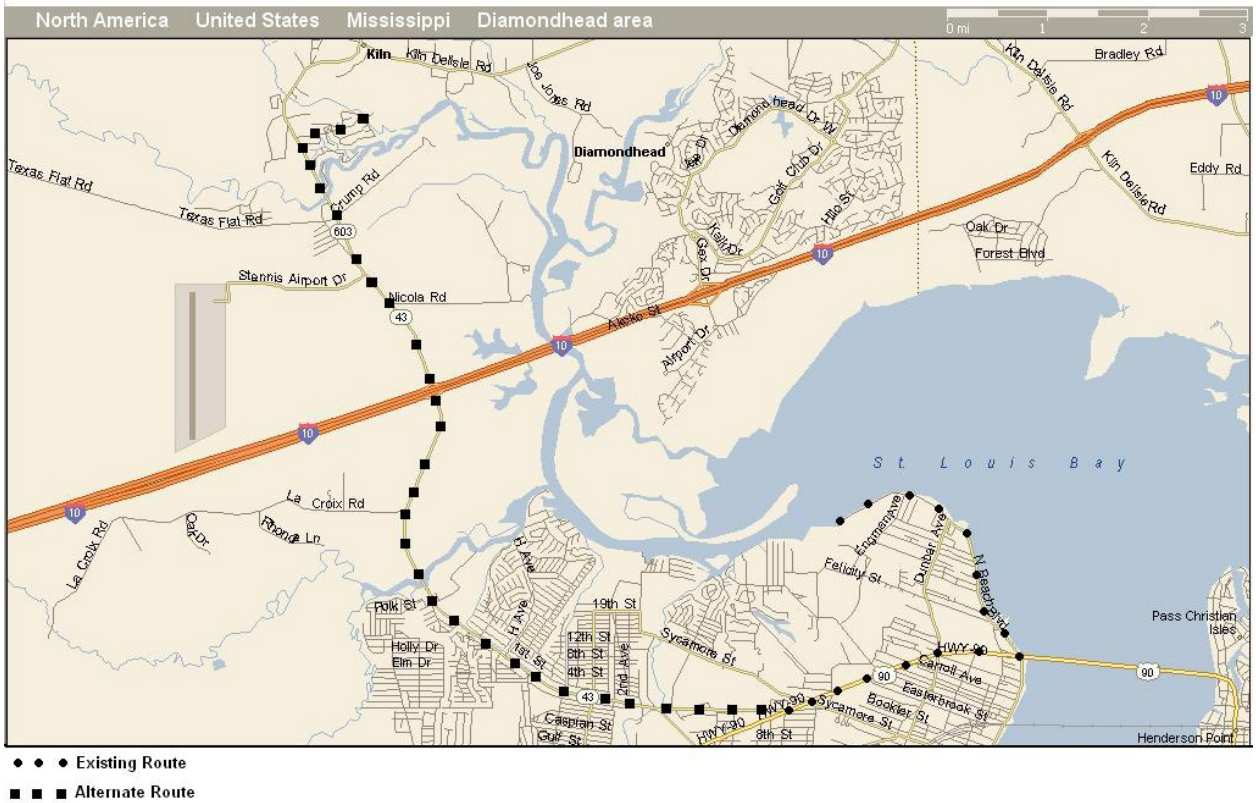



**Figure 3. MAP of Existing Trailering Route and Without Project Route**

Variable vehicle operating costs per mile for automobiles equal 14.1 cents per mile and are based on the American Automobile Association's (AAA) calculations in 2005. Variable vehicle costs for boats are 24.0 cents per mile based on a telephone survey of three local marinas by Mobile District personnel in December 2005. The above costs are the most current available and are assumed to be reasonable for October 2005 values. The methodology used in calculating the additional costs of the vehicles is the alternate route of incremental miles traveled times the annual number of vehicles times the variable vehicle cost per mile.

The average annual number of vehicles utilizing North Beach Boulevard's boat launch daily in table 2 for the years: 2006 through 2030 was computed by multiplying daily traffic figures, provided by the Gulf Regional Planning Commission, by 1.035286. Hancock County's compound population growth rate, from 1990 to the year 2000, was calculated by dividing the population for the year 2000 by the population of the year 1990. These population figures are shown in table 1 (42,976/31,760 =.352865/10 years =.035386).

In 2004, an average of 1600 vehicles travels the affected area daily. Officials estimate that approximately one percent of these vehicles are going to the launch during the week and some three percent use the launch on the week-end days. To account for seasonal variations, this analysis assumes that an average of 2.5% of the total daily traffic uses the Cedar Point Public Boat Launch on any given day. Due to the difficulties inherent in developing long-term projections of any economic activity, the level of calculated daily traffic was held constant beyond the year 2013 to the end of the project life. Table 2 below shows the traffic projections starting with 1996 for selected years.

**Table 2.**
**Cownad Point Study Traffic Diversion**

| Item | 2004 | 2006 | 2008 | 2013 | 2030 |
|---|---|---|---|---|---|
| Traffic Count | 1,600 | 1,715 | 1,838 | 2,186 | 2,186 |
| Traffic using Cedar Point Launch (2.5% in 2004 and 3.5% for without future condition) | 40 | 43 | 46 | 55 | 55 |

[1] based on an Annual Compound County Population Growth of .0353

Values were then multiplied by the alternate route mileage, variable vehicle cost per mile and days per year, as shown in Table 3 to calculate the additional variable operating costs. A sample calculation of annual variable vehicle operating costs for the year 2006 is as follows: affected daily number of vehicles x miles x variable vehicle operating cost x days per year. (2006**:** 42.87 vehicles x 5.6 miles x $0.141 operating cost x 365 days per year= $12,356.1 trailer + 42.87 x 4.0miles x $0.24 x 365= $15,022.6 boat).

**Table 3.**
**Cownad Point Study Variable Operating Costs 2006-2030**

| Year | Vehicles | Trailering Cost | Boating Cost | Total |
|---|---|---|---|---|
| 2006 | 43 | $677 | $823 | $1,500 |
| 2008 | 46 | $726 | $882 | $1,608 |
| 2013 | 55 | $863 | $1,049 | $1,912 |
| 2030 | 55 | $863 | $1,049 | $1,912 |

[1] $0.141 based on 2005 AAA Variable Vehicle Operating Costs $0.24 based on a marina survey of a 50 horsepower motor and a 16 foot fiberglass boat.

## Time Delays

Seawall and highway failure ultimately leads to road closure. Road closure in this case predicates boaters traveling to an alternate boat launch. An alternate route will not only increase variable vehicle operating costs per mile but also will pose an inconvenience to vehicle occupants who are diverted. Alternate traffic routes represent a loss of time and an increase in opportunity cost to those travelers diverted.

For the purpose of this analysis only one category of traveler is considered, recreational boaters. Tables 4 and 5 provide a complete catalog of information used to calculate without project opportunity costs of time for recreational travelers. The incremental round trip distance of the alternate route for automobiles to trailer a boat and the average speed traveled over the route, as identified in the traffic diversion section of this report, is 5.6 miles at 30 mph. The time to travel the route equals 11.2 minutes where Time = Distance/Speed (5.6 mi. /30mph = 18.7% of 1 hour or 11.2 minutes). The incremental distance of the boat detour is 4.0 miles and the average speed traveled is 3Omph. The time to travel the route equals 8.0 minutes or 4.Omi./30mph = 13% of 1 hour, 8.0 minutes. The total vehicle and boat delay from the alternate route is 19.2 minutes.

Based on information in Table 1, median household income for 2000 in Hancock County is $40,307 annually. Median household income divided by the average number of annual work hours (2080) equals an average family hourly wage rate of $19.38. The group size of a boating trip in the coastal area represents an estimate based on the group sizes of similar recreation trips on the Tennessee Tombigbee Waterway. There is no reliable estimate of the group size of local boat outings. The value of time saved per person or vehicle is adjusted and reflected as an hourly percentage of the average hourly family income per hour (US Army Corps of Engineer Publication ER 1105-2-100, Civil Works Planning). See Figure 4. The hourly percentage value of time saved for high time savings (15 min or more) equals 60.0 percent for leisure trips. This percentage was multiplied by the average family hourly rate of $19.38 to determine the hourly value of time of $11.63.

ER 1105-2-100
Appendix D, Amendment #1
30 Jun 2004

Table D- 4: Value of Time Saved by Trip Length and Purpose

| | VALUE OF TIME SAVED ADJUSTED TO HOURLY BASIS ($/HOUR) | VALUE OF TIME SAVED ADJUSTED TO HOURLY BASIS (% OF HOURLY FAMILY INCOME OF DRIVER ) |
|---|---|---|
| LOW TIME SAVINGS (O-5 MINUTES) | | |
| WORK TRIPS | $0.99 | 6.4% |
| SOCIAL / RECREATION TRIPS | 0.20 | 1.3% |
| OTHER TRIPS | 0.01 | 0.1% |
| | | |
| MEDIUM TIME SAVINGS (6-15 MINUTES) | | |
| WORK TRIPS | 4.99 | 32.2% |
| SOCIAL / RECREATION TRIPS | 3.58 | 23.1% |
| OTHER TRIPS | 2.24 | 14.5% |
| | | |
| HIGH TIME SAVINGS (OVER 15 MINUTES) | | |
| WORK TRIPS | 8.33 | 53.8% |
| SOCIAL / RECREATION TRIPS | 9.29 | 60.0% |
| OTHER TRIPS | 9.98 | 64.5% |
| | | |
| VACATION | | |
| ALL TIME SAVINGS | 11.63 | 75.1% |

Note: Work trip is on per person basis while all other trip purposes are on a per vehicle basis.

g. Publication of Planning Data, Information and Guidance. Various data used in planning are circulated by Economic Guidance Memorandum. These data include:

D-20

**Figure 4. Value of time**

Table 4 displays the lost opportunity of time for the persons in vehicles trailering boats as trip costs for selected years. The opportunity cost was calculated by multiplying the fractional hourly time: 0.1867 hours (11.2 minutes/60 minutes) delayed by the hourly value of time of $11.63 to determine the delay cost per trip of $2.17. The trip delay cost is multiplied by the number vehicles per day and that product is multiplied by the days per year to determine the additional cost in each of the selected years of the drivers trailering boats.

**Table 4.**
**Cownad Point Study**
**Value of time Delays/Opportunity Costs: Persons trailering boats**

| Factor | 2006 | 2008 | 2013 | 2030 |
|---|---|---|---|---|
| Delay Cost:5.6 miles@30mph=11.2 minutes | $2.17 | $2.17 | $2.17 | $2.17 |
| Number of Vehicles (one person per vehicle) | 43 | 46 | 55 | 55 |
| Number of Days | 20 | 20 | 20 | 20 |
| Total Cost | $1,861 | $1,995 | $2,372 | $2,372 |

Table 5 displays the value of lost time due to delays in using an alternative ramp to boat to a fishing site for selected years. It is expected that each boat trip will be diverted an extra 4.0 miles round trip and each of the boaters will spend a total of an extra 8.0 minutes (4 miles/30mph=0.1333 hours x 60 minutes) leaving from and returning to the alternate ramp site. The resulting additional boating trip

time was then multiplied by the method used in the value of time equation (0.1333 hours x $11.63= $1.55) and the method used to calculate the additional cost for each of selected years that is in Table 4.

**Table 5.**
**Cownad Point Study Value of Time Delays/Opportunity Costs: Boating**

| Factor | 1999 | 2000 | 2010 | 2023 |
|---|---|---|---|---|
| Delay Cost:4 miles @30mph= 8minutes | $1.55 | $1.55 | $1.55 | $1.55 |
| Number of Vehicles | 43 | 46 | 55 | 55 |
| Number of Days | 20 | 20 | 20 | 20 |
| Total Cost | $1,329 | $1,425 | $1,695 | $1,695 |

Table 6 displays the total lost time & opportunities in Table 4 and 5.

**Table 6.**
**Cownad Point Study Value of Time Delays/ Opportunity Costs**

| Factor | 2006 | 2008 | 2013 | 2030 |
|---|---|---|---|---|
| Total Value of Time | $3,190 | $3,419 | $4,067 | $4,067 |

### *Maintenance Costs*

Historical information from 1998 to 2003 of county expenditures to repair and maintain Beach Boulevard was provided by the Hancock County. A total of $10,099,053 or an average of $1,683,175 was spent in the six year period. The expenditures were to repair the North and South Beach Boulevard road storm erosion damage. The estimated time to complete the repairs on North Beach Boulevard is 20 days. Based on information provided by the County, County expenditures for North Beach Boulevard were 30% of the $1,683,175 ($504,952) and expenditures for South Beach Boulevard were 70%. Table 7 displays the expenditures by selected year for North Beach Boulevard.

**Table 7.**
**Cownad Point 14 Study Annual Maintenance Costs**

| Factor | 2006 | 2014 | 2022 | 2030 | Average Annual |
|---|---|---|---|---|---|
| Annual Maintenance Costs | $504,952 | $504,952 | $504,952 | $504,952 | $504,952 |

### *Total without Project Condition Costs*

The total average annual equivalent without project costs for alternate route variable vehicle operating costs and recreational opportunity costs total $3,768. The average annual cost over the life of the project to the existing traffic's alternate route variable vehicle operating costs and recreational opportunity costs is $1,772. The average annual cost of maintenance is $504,952. The total cost of the three categories is $510,493.

Table 8 shows the total annual costs using calculations in Tables 3, 6 and 7 applying the 2005 federal discount interest rate for project formulation and evaluation water resource projects of 5 1/8%. The costs were amortized over a twenty-five year period.

**Table 8.**
**Cownad Point 14 Study Total Without Project Condition Costs**

| Factor | 2006 | 2008 | 2013 | 2030 | Average Annual |
|---|---|---|---|---|---|
| Total Variable Vehicle Operating Costs | $1,500 | $1,608 | $1,912 | $1,912 | $1,772.02 |
| Total Time Delays/Opportunity Costs | $3,190 | $3,419 | $4,067 | $4,067 | $3,768.33 |
| Annual Maintenance Costs | $504,952 | $504,952 | $504,952 | $504,952 | $504,952 |
| Grand Total | $509,643 | $509,980 | $510,932 | $510,932 | $510,493 |

## *With Project Condition*

### *Benefit Analysis*

This section provides a quantitative analysis of the benefits under the with project condition. Three alternatives were considered in this analysis: Rip Rap Seawall, Vinyl Sheet pile Seawall, and a Steel Sheet pile Seawall. The benefits to each the three projects is the protection of the road from storms or the elimination of the variable vehicle costs, time delay costs, and maintenance costs that are displayed in Table 8 and are the costs remaining in the without project condition ($510,493).

The level of protection for each of the projects was determined by the Mobile District Corps of Engineers Hydraulics section. Each project is estimated to protect the road up to a 50 year storm, or a 2 percent chance of a storm occurring in any given year. The benefits to the project are the losses prevented from the variable vehicle costs, time delay costs, and maintenance costs using the frequencies of the storms that are between the 50 percent and 2 percent events.

Table 9 displays the calculation of the average annual costs remaining for the with plan condition. The cost of the variable vehicle costs, time delay costs, and maintenance costs is the same as in the without project condition, with the variable being the change in the level of protection of the 50-year storm. The average annual damage remaining or benefits to the project are $500,383 for all three with plan conditions.

**Table 9.**
**Cownad Point Study With Project Condition Average Annual Costs Remaining**

| Freq Event | Frequency Probability | Incremental Probability | Cost by Frequency | Cost Average $ | AAD (Dollars) |
|---|---|---|---|---|---|
| | | 0.002 | | $0 | $0 |
| 500.00 | 0.0020 | | $0 | | |
| | | 0.018 | | $0 | $0 |
| 51.00 | 0.0196 | | $0 | | |
| | | 0.000 | | $255,246 | $100 |
| 50.00 | 0.0200 | | $510,493 | | |
| | | 0.313 | | $510,493 | $159,954 |
| 3.00 | 0.3333 | | $510,493 | | |
| | | 0.167 | | $510,493 | $85,082 |
| 2.00 | 0.5000 | | $510,493 | | |
| | | 0.500 | | $510,493 | $255,246 |
| **Sum** | | 1.000 | | | $500,383 |

Construction of the three projects (Rip Rap Seawall, Vinyl Sheet pile Seawall, and a Steel Sheet pile Seawall) will begin in July, 2005 and will be completed at the end of December, 2006. Each project will have a 25 year life, and it will be in place from January 2006 through December 2030. The first

cost, in October 2006 dollars. The first cost and the annual maintenance of each alternative (O&M) was provided by personnel in Engineering Division.

The first cost of the rip-rap seawall is $1,991,000. Annual maintenance is $79,640. This maintenance is based on storms shifting the rip-rap and the cost to move the rip-rap back in place. The average annual cost of the project, using the current 2006 federal discount rate of 5 1/8% to present worth and amortize, is $215,708 ($1,991,000 x .9512=$1,893,936 x .0718 = $138,068 + $79,640= $215,708).

The first cost of the vinyl sheet pile seawall is $2,795,000. Annual maintenance is $200. The average annual cost of the project, using the same federal discount rate to present worth and amortize, is $191,214.

The first cost of the Steel Sheet Pile alternative is $4,769,000. Annual maintenance is $400. The average annual cost of the project, using the same federal discount rate to present worth and amortize, is $326,320.

Table 10 shows the average annual benefits and the costs of the three alternatives. The National Economic Development (NED) plan is the plan with the greatest net benefits to the nation. Based on information in Table 11, the Vinyl Sheet Pile Alternative is the NED plan with net benefits of $309,169.

**Table 10**
**Cowand Point Study Benefit to Cost Ratio**

| | Average Annual | | |
|---|---|---|---|
| **Plan** | **Benefits** | **Costs** | **Net Benefits** |
| Vinyl sheet pile | $500,383 | $191,214 | $309,169 |
| Steel sheet pile | $500,383 | $326,320 | $174,063 |

## *Socioeconomic Impacts using the Economic Impact Forecast System*

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Hancock County, Mississippi. The expenditures for the alternatives are estimated to be $3,860,000 for the Vinyl Sheet Pile alternative, and $4,900,000 for the Steel Sheet Pile alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures for all three alternatives are estimated to be $130,000, which in present worth form amounts to $2,328,161 (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

### *Methodology*

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

### *Assumptions*

EIFS assumes that the infrastructure pre-Katrina is intact, in-place, and functioning as a wholesome economic unit in the region of influence. The fact is that under existing conditions many of the established economic infrastructure is not present but transient. In some cases, rebuilt economic units have moved into fill that deficit to provide the goods and services. The assumption of this analysis assumes that the last or destroyed infrastructure will be rebuilt or replace in the near-term and will not significantly reduce the impacts and outputs forecasted in this investigation.

## *Summary Explanation of the EIFS Model Output*

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**EIFS Model Inputs for Cowand Point Seawall**
**Proposed Project Alternatives**

| Indicator Variable | Vinyl Sheet Pile | Steel Sheet Pile | O&M |
|---|---|---|---|
| Region of Influence (ROI) | Hancock County | Hancock County | Hancock County |
| Change in Local Expenditures | $3,860,000 | $4,900,000 | $2,328,161 |

Based of the given inputs the outputs are as followed:

**EIFS Model Outputs for Cowand Point Seawall**
**Proposed Project Alternatives**

| Indicator Variable | Projected Δ Vinyl Steel Pile | Projected Δ Steel Sheet Pile | Projected Δ O&M |
|---|---|---|---|
| Direct Sales Volume | $4,000,000 | $5,050,000 | $2,328,161 |
| Induced Sales Volume | $4,000,000 | $5,050,000 | $2,328,161 |
| Total Sales Volume | $8,000,000 | $10,100,000 | $4,656,322 |
| | | | |
| Direct Income | $964,540 | $1,217,732 | $561,401 |
| Induced Income | $964,540 | $1,217,732 | $561,401 |
| Total Income | $1,929,080 | $2,435,464 | $1,122,802 |
| | | | |
| Direct Employment | 24 | 31 | 14 |
| Induced Employment | 24 | 31 | 14 |
| Total Employment | 48 | 61 | 28 |
| | | | |
| Local Population | 0 | 0 | 0 |

### *Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Vinyl Sheet Pile.*** If implemented, the total sales volume related to this alternative is projected to increase by $12,656,322 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $4,656,322 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Vinyl Sheet Pile.

***Steel Sheet Pile.*** If implemented, the total sales volume related to this alternative is projected to increase by $14,756,322 in the local area of Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $4,656,322 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Steel Sheet Pile.

### *Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Vinyl Sheet Pile.*** If implemented, the total income related to this alternative is projected to increase by $3,051,882 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,112,802 (i.e. the total income increased because of O&M) was added to the total income of the Vinyl Sheet Pile alternative.

***Steel Sheet Pile.*** If implemented, the total income related to this alternative is projected to increase by $3,558,266 for Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, $1,112,802 (i.e. the total income increased because of O&M) was added to the total income of the Steel Sheet Pile alternative.

### *Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Vinyl Sheet Pile.*** If implemented, total employment related to this alternative is projected to increase by 76 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 28 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Vinyl Sheet Pile alternative.

***Steel Sheet Pile.*** If implemented, total employment related to this alternative is projected to increase by 89 workers in Hancock County. Note, O&M is only accounted for if the project is implemented; therefore, 28 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Steel Sheet Pile alternative.

### *Population*

If implemented, the population related to all three alternatives is not projected to increase.

# References

American Automobile Association. 2005. Your Driving Costs. Heathrow, Florida.

U. S. Army Corps of Engineers. 2000. Planning Guidance Notebook Regulation No. 1105-2-100, April 22, Washington, DC: CECW-P.

1990 and 2000 U.S. Census <http://en.wikipedia.org/wiki/Hancock_County%2C_Mississippi>

# ECONOMIC ANALYSIS FOR LONG BEACH CANALS FLOOD DAMAGE REDUCTION, HARRISON COUNTY, MS

## Introduction

This section describes the economic analysis evaluation for damage to several drainage ways flowing into upper portion of Bayou Portage and the potential for increased flooding in the surrounding area in Long Beach, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background and Problem Statement

Harrison County was heavily damaged by the hurricanes of 2005 particularly, the storm surge and winds generated by Hurricane Katrina on August 29, 2005. Hurricane Katrina had an adverse affect on canals and drainage ways due to the deposition of sediment from the storm surge and windblown trees, and other debris. This document provides information regarding damage to the drainage ways flowing into the upper portion of Bayou Portage and the potential for increased flooding in the surrounding area.

## Opportunities

The following opportunities were identified for this problem area:

- Reduction of future damages created by flooding from rains associated with hurricanes and major thunderstorms;
- Repair of damages to public facilities caused by 2005 storm events;
- Repair of damages to natural resources caused by 2005 storm events.

Figure 1 is a vicinity map of Turkey Creek and Canals 1 and 2.

Shown Below is sediment and debris in Canal 2 at Long Beach.

**Figure 1. 100-year Water Surface Elevation, Long Beach, Mississippi**

Shown below are residences flooded from storms and overflow of Canals 2&3.

**Figure 2. Flooded Residences in Long Beach, Mississippi.**

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in estimating average annual benefits and costs

b. Price levels are October, 2005 unless otherwise stated.

c. A 50-year period of analysis was used to calculate average annual benefits.

d. Impacted area (Harrison County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

Four alternative solutions were initially identified as addressing the conditions following the 2005 Hurricane season.

**Raising 28th Street**. This plan would be raise 28th Street by approximately 3 feet and the construction of culverts presented in Alternative 1.

**Construct a Culvert System beginning at 28th Street.** This plan consists of increasing the size of the culverts under 28th St to carry the flow presently going over the road and constructing new culverts to convey the flow to the Mississippi Sound.

**28th Street Bridge Modification and Modifications to Canal 2/3**. This plan consists of increasing the Canal 2 bridge opening at 28th Street and Klondike Road, and modifying the geometry of Canal 2. It would also involve a high flow diversion at the upstream end of Canal 2 to capture flows from flooding the Turkey Creek.

**Levee at 28th Street.** This plan consists of a levee just north of 28th Street crossing the upstream ends of Canal 1 and Canal 2. The levee would be approximately 4 feet high. Because of the flow patterns in Canal 1, a pump station would be required on the inside of the levee at the Canal Road area. A culvert through the levee would be required at this site. The culvert would have a flap gate on the Turkey Creek side to prevent high water in the creek from coming through the levee. This alternative was found to increase the flooding on the lower main stem of Turkey Creek by preventing the existing outflow of water to Canal 1 and Canal 2. Therefore, this alternative was no longer considered.

In addition, the “No-Action” Plan was also developed as a means of comparison to the other alternatives, and as a potentially viable alternative in and of itself.

The following alternatives, then, were developed and carried forward for further analysis:

1. The No-Action Plan
2. Construct a Culvert System beginning at 28th Street
3. 28th Street Bridge Modification and Modifications to Canals 2 & 3

The project delivery team evaluated the remaining alternatives at each site based on their prospective impact. The projects were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| **Culvert Enlargement at 28th Street and modification of Canals 2&3.** | | | | |
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Construct Culvert System beginning @ 28th Street Bridge | Minimal | $104,040,000 | $30,153 |
| Alt 3 | 28th Street Bridge Modification and Modifications to Canals 2&3 | Moderate | $23,480,000 | $112,793 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

# National Economic Development (NED)

## *Flood Damage Reduction*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. Although the work could reduce the rainfall flooding to some degree, it is not clear that the work will reduce flooding significantly.

## *Recreation*

This analysis provides rough order of magnitude estimates of recreational benefits associated with removing sediment and debris deposited into these systems by Hurricane Katrina, restoring both their pre-storm depths and restoring tidal flow. Such restoration would also likely improve water quality, reduce mosquitoes by eliminating stagnation and allowing game fish (such as red and spotted sea trout) access to shallow, brackish backwater spawning areas.

# Environmental Quality (EQ)

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

## *1) Habitat*

Removal of the obstructions would allow fish to migrate up the systems by the sub-adult and larvae for use as a forage area. The improved habitat would also improve foraging areas for shorebird use. Removal of the non-biodegradable foreign material and deposition of sediments would improve overall water quality by improving circulation and enhanced drainage in the area resulting in an overall reduction of flooding to nearby residences.

### *2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The canals, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways at the canals. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape.

## Regional Economic Development (RED) IMPACTS

Table 2 shows the employment breakdown for Harrison County. The manufacturing industry is a significant employer; accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 2.**
**Employment Breakdown of Harrison County**

| Sector | Mississippi | Harrison County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 4,500 | 40.5% |
| Wholesale | 35,316 | 2,112 | 5.9% |
| Retail | 135,838 | 11,548 | 8.5% |
| Real Estate | 9,665 | 1,084 | 11.2% |
| Professional | 29,023 | 2,050 | 7.1% |
| Administration | 46,115 | 3,211 | 6.9% |
| Education | 1,678 | 100 | 5.9% |
| Health Care | 131,976 | 12,429 | 9.4% |
| Arts | 9,292 | 2,500 | 26.9% |
| Food Service | 109,405 | 21,822 | 19.9% |
| Other Services | 22,180 | 2,067 | 9.3% |
| **Total** | **713,310** | **63,423** | **8.9%%** |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Harrison County was $18,024 and the median household income was $35,624 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 3 displays the income breakdown for Harrison County.

**Table 3.**
**Income Breakdown for Harrison County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Harrison County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 4. The percentage of persons below the poverty level for the state of Mississippi and Harrison County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Harrison County. The unemployment rate for Harrison County was close to the national average before the hurricane, and then doubled (Quarter 3, 2005) and even tripled (Quarter 4, 2005) from Katrina's aftermath.

**Table 4.**
**Poverty Level and Unemployment Rate for Harrison County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Harrison County | 14.5% | 6.4% | 12.8% | 22.5% |

# Socioeconomic Impacts using the Economic Impact Forecast System

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Harrison County, Mississippi. The expenditures for Alternative 2 (Construct Culvert System beginning at 28th bridge) are estimated to cost $106,930,000 and Alternative 3 (28th Street Bridge modifications and modifications to canals 2 and 3) is estimated to be $24,990,000. The Annual Operation and Maintenance (O&M) expenditures are not anticipated during the life of the project. These costs expressed in present worth form amounts to $2,020,000 and $540,000 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

# Summary Explanation of the EIFS Model Output

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**Table 5.**
**EIFS Model Inputs for the by Project Alternative**

| Indicator Variable | Construct Culvert System Beginning @ 28th St. Bridge | 28th St. Bridge Modification and Modifications to Canals 2/3 |
|---|---|---|
| Region of Influence (ROI) | Harrison County | Harrison County |
| Change in Local Expenditures | $104,040,000 | $23,480,000 |

**Table 6.**
**EIFS Model Inputs for O&M Expenditures by Project Alternative**

| Indicator Variable | O&M Construct Culvert System Beginning @ 28th St. Bridge | O&M 28th St. Bridge Modification and Modifications to Canals 2/3 |
|---|---|---|
| Region of Influence (ROI) | Harrison County | Harrison County |
| Change in Local Expenditures | $540,000 | $2,020,000 |

Based of the given inputs the outputs are as followed:

**Table 7.**
**EIFS Model Outputs by Project Alternatives**

| Indicator Variable | Projected Δ Construct Culvert System Beginning @ 28th St. Bridge | Projected Δ 28th St. Bridge Modification and Modifications to Canals 2/3 |
|---|---|---|
| Direct Sales Volume | $104,040,000 | $23,480,000 |
| Induced Sales Volume | $130,050,000 | $29,350,000 |
| Total Sales Volume | $234,090,000 | $52,830,000 |
| Direct Income | 22,022,700 | $4,970,137 |
| Induced Income | $27,528,380 | $6,212,672 |
| Total Income | $49,551,080 | $11,182,810 |
| Direct Employment | 661 | 149 |
| Induced Employment | 826 | 186 |
| Total Employment | 1,487 | 335 |
| Local Population | 0 | 0 |

**Table 8.**
**EIFS Model Outputs by Project Alternatives**

| Indicator Variable | Projected Δ in O&M Construct Culvert System Beginning @ 28th St. Bridge | Projected Δ in O&M 28th St. Bridge Modification and Modifications to Canals 2/3 |
|---|---|---|
| Direct Sales Volume | $540,000 | $2,020,000 |
| Induced Sales Volume | $675,000 | $2,525,000 |
| Total Sales Volume | $1,215,000 | $4,545,000 |
| Direct Income | $114,305 | $427,584 |
| Induced Income | $142,881 | $534,480 |
| Total Income | $257,186 | $962,064 |
| Direct Employment | 3 | 13 |
| Induced Employment | 4 | 16 |
| Total Employment | 7 | 29 |
| Local Population | 0 | 0 |

### *Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

**Construct Culvert System Beginning @ 28th St. Bridge.** If implemented, the total sales volume related to this alternative is projected to increase by $235,305,000 in the local area of Harrison County.

**28th St. Bridge Modification and Modifications to Canals 2/3.** If implemented, the total sales volume related to this alternative is projected to increase by $57,375,000 in the local area of Harrison County.

### *Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

**Construct Culvert System Beginning @ 28th St. Bridge.** If implemented, the total income related to this alternative is projected to increase by $49,808,266 for Harrison County

**28th St. Bridge Modification and Modifications to Canals 2/3.** If implemented, the total income related to this alternative is projected to increase by $12,144,874 for Harrison County

### *Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

**Construct Culvert System Beginning @ 28th St. Bridge.** If implemented, the total employment related to this alternative is projected to increase by 1,494 workers in Harrison County.

**28th St. Bridge Modification and Modifications to Canals 2/3.** If implemented, the total employment related to this alternative is projected to increase by 364 workers in Harrison County.

### *Population*

If implemented, the population related to both alternatives is projected to increase by 0.

## Other Social Effects (OSE)

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

### *1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 9 shows the number selected housing statistics for census tracts 27 and 31.02. There are 4,875 housing units in the two tract area. The average structure was built between 1970 and 1984. Table 10 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on.

**Table 9.**
**Selected Housing Statistics**

| Category | Tract 27 | Tract 31.02 |
|---|---|---|
| Number of Structures | 6,423 | 6,169 |
| Median Year Built | 1970 | 1984 |
| Median Structure Value | $65,000 | $38,400 |
| Occupancy Status | | |
| Occupied | 2,300 | 2,239 |
| Vacant | 159 | 177 |
| Tenure | | |
| Owner | 1,590 | 1,844 |
| Renter | 710 | 395 |

U.S. Census Bureau, 2000 Census

**Table 10.**
**Number of Units in Structure**

| Units in Structure | Tract 27 | Tract 31.02 |
|---|---|---|
| 1, detached | 2,002 | 1,707 |
| 1, attached | 0 | 36 |
| 2 | 115 | 8 |
| 3 or 4 | 125 | 8 |
| 5 to 9 | 103 | 71 |
| 10 to 19 | 33 | 27 |
| 20 to 49 | 24 | 10 |
| 50 or more | 16 | 27 |
| Mobile Home | 41 | 506 |
| Boat, RV, van, etc. | 0 | 18 |
| **Total** | **2,459** | **2,416** |

U.S. Census Bureau, 2000 Census

# The Recommended Plan

The results of the alternative development, comparison, modification, screening, and selection process indicated that the recommended plan presented the most cost-effective solution, and was clearly the best-balanced plan where all factors were taken into consideration.

The recommended plan for this problem area consists of:

Increasing the Canal 2 culvert at 28th Street and Klondike Road and modifying the geometry of Canal 2. This modification would include a 100-ft bottom width channel from Canal 2 station 14280 to 23414, 60-ft bottom width channel from 23814 to Turkey Creek. The channel width would transition to near vertical gabion walls at the remaining bridge crossings. A berm and diversion channel at the upper limits would divert Turkey Creek over bank flows into the modified Canal 2.

A cost-effective plan for this problem area was identified by the Project Delivery Team, and was fully coordinated with: The City of Long Beach, Harrison County, the State of Mississippi, and the Mississippi Department of Marine Resources.

The recommended plan has been determined to be suited for near-term implementation. The key elements of the plan for this problem area could be implemented in approximately one year, including development of plans and specifications.

The recommended plan also appears to be cost-effective in light of the risk and consequences of not implementing the project. The risks and consequences of *not* implementing this plan include:

- Continued frequent damage to the businesses and residences along drainage ways in the upper Turkey Creek watershed;
- Continued overtopping of roads that allow access to major thoroughfares and highways;

The risks and consequences of implementing this plan include:

- The recommended plan would not prevent damages from storm events of larger than approximately 25- year recurrence.

The recommended plan would not preclude other future options that may have a higher level of contribution, and/or that would take a longer timeframe to study and construct. In fact, the recommended plan would function well as a component of a larger plan providing a higher level of protection to the City of Long Beach, particularly if additional long-term measures should be implemented such as watershed evaluation, implementation of State-recommended building codes and zoning codes aimed at residential and commercial structure damage reduction, hardening of rehabilitated or new structures within the City's affected area.

The recommended plan does not, in and of itself, provide a high level of protection from large storm surges, but does provide a significant increase in damage reduction from more frequent events. As a near-term project, it would only function to prevent damage from small to moderate storm events; however, it would also survive inundation by larger flood events, and would function as protection to the City's main street, utilities and utility lines that run parallel to the proposed seawall, and as protection for City and County emergency and public services required during lesser events.

The recommended plan has the support of The City of Long Beach, Harrison County, the State of Mississippi, Mississippi Department of Marine Resources and the Mississippi Department of Environmental Quality.

The recommended plan has been coordinated with members of the environmental regulatory community, and has been found to be conceptually acceptable, in that it is not anticipated to negatively impact terrestrial or aquatic resources. The recommended plan also has the support of the stakeholders of the community in which it would be constructed.

The recommended plan contributes to both the short-term and longer-term recovery of coastal Mississippi. It contributes to an overall comprehensive plan for hurricane storm damage reduction of

the coast of Mississippi as identified in the State's long-term recovery plan, and as identified in the goals and objectives established by the interagency Project Delivery Team.

The recommended plan addresses the following stated goals and objectives stated in the guidance of the Coastal Mississippi Comprehensive Hurricane Protection and Restoration effort:

a) hurricane storm damage remediation

b) hurricane storm damage reduction

Further, the recommended plan compliments and supports the objectives of the State and/or local plans and desires for this area, including Governor Barbour's Seven Point Strategy for Coastal Recovery. While the recommended plan does not affect either regional restoration efforts for ecosystem restoration or barrier island restoration, it also does not negatively impact those efforts in any way.

Additional details on the recommended plan are contained in the Engineering Appendix, which also accompanies the main report. The recommended plan is estimated to cost approximately $23,480,000 (October 2006 price levels).

# ECONOMIC ANALYSIS FOR HARRISON COUNTY BEACH ECOSYSTEM RESTORATION AND HURRICANE STORM DAMAGE REDUCTION, HARRISON COUNTY, MS

## Introduction

This section describes the economic analysis evaluation as related to protection of the rehabilitated beaches that were damaged by Hurricane Katrina storm surge in Harrison County, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

The beaches of Harrison County are approximately 26 miles in length, and host the Gulf Coast's largest population (almost 2,000 nests) of Least Tern, a Federally-listed endangered species, plus a significant number of Piping Plover. The beaches possessed a dune system (pre-Katrina) that was maintained by local interests, that was vegetated and supported a significant ecosystem, in addition to passive recreation usage outside the dune system. Due to erosion of the beach during storm events prior to Katrina, the beach was slated for re-nourishment under the Flood Control and Coastal Emergency (FCCE) program, which had authorized placement of additional materials, to an authorized width of approximately 270 feet. The FCCE work (covered under PL 84-99) did not, however, cover restoration of the locally-constructed dune system. This dune system provided not only ecosystem benefits, but some measure of hurricane or storm damage reduction due to its ability to absorb some of the surge and wave energy during those types of events. During Hurricane Katrina, this dune system was almost entirely destroyed by surge and wave action. Almost all ecosystem functions and values were eliminated during this single event. Much of the sand removed is believed to be close off shore in the nearshore zone.


**Figure 1. Project Location**

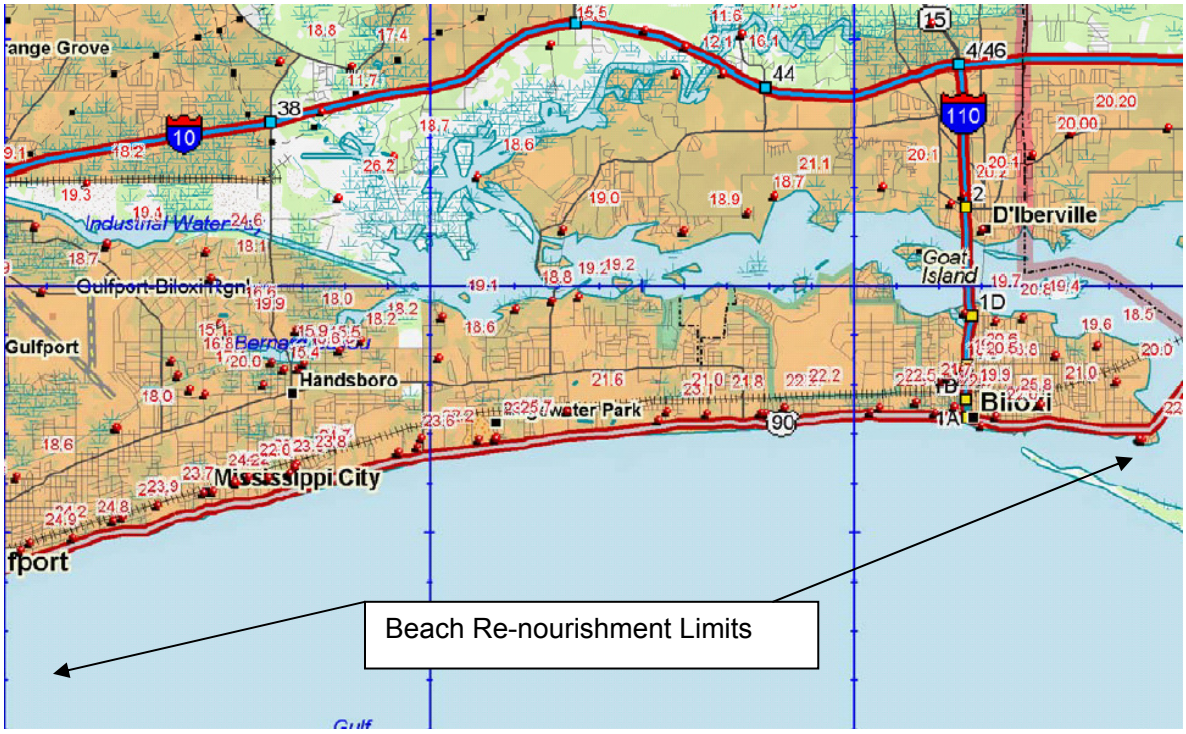



**Figure 2. Eastern Project Limits**

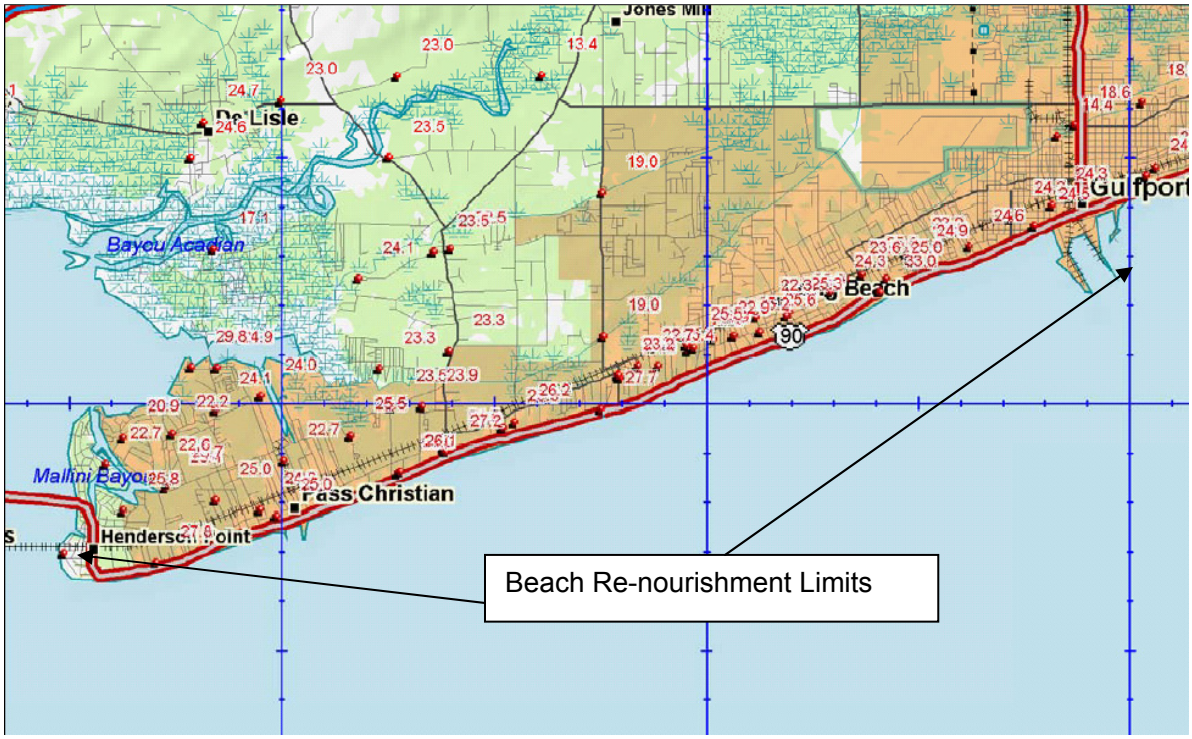



**Figure 3. Western Project Limits**

# Opportunities

The following opportunities were identified for this problem area:

a. Hurricane storm damage reduction or remediation

b. Prevention or remediation of Saltwater Intrusion

c. Preservation of Fish & Wildlife and restoration of their habitats

d. Prevention or remediation of erosion

e. Other related water resource purposes, such as ecosystem restoration or barrier island restoration

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in calculate average annual benefits and costs

b. Price levels are October, 2006 unless other wise stated.

c. A 50-year period of analysis was used to calculate average annual benefits and costs.

d. Impacted area (Harrison County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Existing Conditions

Prior to Hurricane Katrina, the sandy beach at the project site extended from Hwy 90 approximately 230 ft to elevation 3.5 ft NGVD, and then another 40 ft to the water at elevation 0.0 ft NGVD. Storm water culverts passed beneath Hwy90 draining parts of Biloxi, Long Beach and Pass Christian.

The project incurred damage from wind driven waves, debris scour, storm surge and ebb flow after the hurricane. The nature of the damage is scour or erosion of the beach, as well as clogging and destruction of storm drain culverts. The rehabilitation of the beach project under authority of PL 84-99 consists of re-nourishment of the beach and repair/replacement of storm drain culverts to their authorized limits. The area to be repaired extends the full length of the project limits, a distance of approximately 24 miles. This project proposes to build dunes atop the reconditioned beach and an alternative would place fencing and plants atop the dunes.

# Alternatives

Two plans were evaluated for enhanced beach protection at the study site. All involved providing a dune atop the re-nourished beach. One alternative will be to place the dune material alone and the other alternative will be to place the dune material and add stabilizing fencing and dune vegetation. The finished stable dune will be 5 feet high with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established borrow areas a minimum of 1,500 feet offshore. The plantings will have a density of 1 plant per 4 square feet and the fence will include the entire linear length of the project. The dune alone project will require replacement within 10 years and the dune with plantings and fence will require replacement within 15 years.

**Harrison County Beaches - Alternative 1. No Action**. This alternative involves no federal action.

**Harrison County Beaches - Alternative 2. Dune Placement**. This alternative is a short term alternative that would consist of a dune will be 5 feet high with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established borrow areas a minimum of 1,500 feet offshore.

**Harrison County Beaches - Alternative 3. Dune Placement with Vegetation**. This alternative is a short term alternative that would consist of a dune will be 5 feet high with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established borrow areas a minimum of 1,500 feet offshore. A variety of dune vegetation will also be planted to provide additional dune stability and natural habitat. Table 1 summarizes the alternatives.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Dune Placement | Moderate | $10,220,000 | $340,000 |
| Alt 3 | Dune Placement with vegetation | Significant | $13,580,000 | $260,000 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefits for a hurricane and storm damage reduction study fall under the following categories: protection of residential and commercial structures from erosion and flooding, protection of public roads and bridges from erosion, protection of public utilities from erosion, and recreation benefits associated with the parking. It is anticipated that the add beach alternative and the add beach with dune alternative will provide some level of protection across these categories, however, for this analysis only recreation benefits will be quantifiable.

## *Recreation Benefit Analysis*

The purpose of this document is to provide an analysis of recreation benefits associated with a proposed project to rehabilitate the beaches damaged by Hurricane Katrina in Harrison County, Mississippi under PL-84-99. The project consists of restoring the beach elevation and profile to conditions existing before Hurricane Katrina. The project also calls for rehabilitating the interior drainage infrastructure damaged or destroyed by the storm. One alternative calls for placement of dunes atop the reconditioned beach and an alternative would place fencing and plants atop the dunes. The area to be repaired extends the full length of the project limits, a distance of approximately 24 miles. Recreation will provide some National Economic Development (NED) benefits, but those benefits are incidental to the primary purpose of shoreline protection and environmental enhancement.

### *Existing (Pre-Katrina) Condition*

Prior to Hurricane Katrina, the sandy beach at the project site extended from Hwy 90 approximately 230 ft to elevation 3.5 ft NGVD, and then another 40 ft to the water at elevation 0.0 ft NGVD. Storm water culverts passed beneath Hwy90 draining parts of Biloxi, Long Beach and Pass Christian.

The sandy beach sits seaward of the Harrison County Seawall, originally constructed between 1925 and 1928 to protect U.S. 90. The seawall is a stepped concrete type wall founded on piles. The seawall crest elevation varies between approximately 8 to 11 feet mean sea level and is penetrated in a number of locations by drainage channels and culverts. The culverts drain areas of Harrison County including Biloxi, Gulfport, Pass Christian and other developed area northward of US 90.

The entire beach area covered by the project has been a popular recreation resource for the residents of Harrison County. Prior to the storm, the beach featured extensive facilities for recreation on the coast, including boardwalks, pavilions, benches, watering stations and parking areas for both motorized and bicycles. Users participated in a wide range of recreation activities, including bicycling, sunbathing, swimming, fishing, sightseeing and picnicking.

No visitation data were available for these beaches, so the per capita visitation rate and participation rates by activity are determined by proxy, using population and data for similar activities in the same region.

Approximately 189,600 people were counted in the 2000 Census of Harrison County. By 2004, the county's population was believed to have grown to about 193,800. This is a change of about 4,200 people and represents an annual growth rate of about 0.44%, typical of a mature, urban area that is nearly fully developed. Between 1990 and 2000, the county's population grew from 165,365 to the 2000 figure of nearly 190,000. That represented a 10-year average growth rate of about 1.5%. Harrison County, along with Mississippi's two other coastal counties (Hancock and Jackson) were among the fastest growing in the state and the southeastern region during the 1990 to 2000 period. However, the 2000 to 2005 period seems to indicate that growth had stabilized in Harrison prior to Hurricane Katrina's landfall. Table 2 displays the 1990-2004 population data.

**Table 2.**
**Harrison County Population 2000-2004**

| Year | Population |
|---|---|
| 1990 | 165,365 |
| 2000 | 189,600 |
| 2004 | 189,600 |

Source: Bureau of the Census

### *Market Area Determination*

Based on the limited visitation information for the beaches and local officials' knowledge, a single county market area was chosen for this analysis. Residents of other counties nearby either have their own waterfront or beachfront recreation areas, or have access to beaches that are closer to them than Park Beach. According to Census estimates, the market area population had grown to about 189,600 just before Hurricane Katrina.

### *Determination of Visitation*

There are no detailed visitation data available for the affected resource. However, the Corps of Engineers operates Okatibbee Lake north of Meridian, Mississippi. Several of the sites on that lake

offer slack-water sandy beaches, with similar sand quality, similar water depths, and a similar climate. The area's population is similar to Coastal Mississippi's in family size and income. Visitation rates, activity participation and other key recreation statistics were developed in the Okatibbee Recreation Master Plan in 1998. The data are developed and explained in great detail in Chapter 6 of that document (on file at the District office). With no reliable data sources available for Harrison County beaches, per capita use and participation rates from Okatibbee were used as a proxy for those figures in this analysis.

The per capita use rate at Lake Okatibbee was estimated at 3.55 using historical visitation records. This rate describes the counted visitors divided by the market area population. Since there are no visitation data for Harrison, we use 3.55 times the population to arrive at the data in the table below.

**Table 3.**
**Projected Visitation**

| Year | Market Area Population | Projected Visitation |
|---|---|---|
| 2006 | 189,600 | 673,080 |

### *Determination of Participation by Activity*

Four general recreation activities will be provided by the type of beach conditions found in the project area. These are fishing, picnicking, sightseeing and swimming. Participation rates, turnover rates and group sizes are displayed in the following table. Again, all data are from the Okatibbee Master Plan report and represent recorded figures.

**Table 4.**
**Participation Rate by Recreation Activity**

| | Participation Rate | Turnover Rate | Group Size |
|---|---|---|---|
| Bicycling | 0.11 | 4.8 | 2.2 |
| Fishing | 0.26 | 1.8 | 2 |
| Picnicking | 0.28 | 1.8 | 4.6 |
| Sightseeing | 0.34 | 4 | 2.7 |
| Swimming | 0.24 | 2.2 | 2.7 |
| Totals[1] | 1.23 | | |

[1] Participation is greater than 1.0 because many visitors participate in more than one activity.

### *Determination of Recreation Demand*

With the above calculations, we can now estimate total recreation demand in visitor days and from there, estimate willingness to pay. To determine recreation demand, the following formula is used:

*Visitation x Participation Rate*

This formula can also be used to calculate design loads for recreation facilities by calculating it for each activity and incorporating group size and turnover. However, since design loads are not necessary to determine demand and willingness to pay, those figures are not presented here.

The result of the overall demand calculation is presented below:

**Table 5.**
**Conversion to Recreation Demand**

| Year | Projected Visitation | Recreation Demand |
|---|---|---|
| 2006 | 673,080 | 827,888 |

### *Future without Project Condition*

The beach, U.S. 90, the drainage culverts and almost all of the recreational facilities were severely damaged by the storm. If no federal action is taken to rehabilitate the beach and restore the beach environment, conditions will continue to deteriorate. Drainage outfalls will clog with debris and sand. Beach area will continue to erode. Environmental degradation will continue to occur, U.S. 90 could become unusable and recreation opportunities will be lost. In the Bay St. Louis recreation analysis, recreation visitation was believed to have been reduced by about 22% from pre-Katrina levels. However, given the amount of damage caused by Katrina to this area, that figure appears too low. A more reasonable estimate would be about half. That is, only half of the pre-storm recreation demand of 827,888 would be expected in the future. Accordingly, the future without project condition recreation demand is placed at 413,944.

#### ***Determination of Willingness to Pay***

The procedures described in ER-1105-2-100 address three evaluation methods. They are the travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method. The criteria described in ER-1105-2-100 were followed to determine the appropriate methodology for this analysis. The Unit Day Value (UDV) method was selected to evaluate recreation benefits because a regional model was not available and specialized recreation activities from a national perspective were not affected. Estimated annual visits affected did not exceed 750,000, which would indicate that a more rigorous empirical analysis is called for. Further, since a more detailed analysis of this resource would prove costly and time consuming, the UDV approach seems to be most prudent use of study resources. It is unlikely that any formulation of plan alternatives or plan selection will significantly change expected recreation benefits.

The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Harrison County beaches.

ER 1105-2-100 provides guidelines for assigning points and their conversion to dollar value for evaluating recreation.

The guidelines for assigning points to general recreation include five criteria:

(1) the quality of the recreation experience as affected by congestion;

(2) availability of substitute areas in terms of travel time;

(3) carrying capacity determined by level of facility development;

(4) accessibility as affected by road and parking conditions; and

(5) environmental quality based on aesthetics.

A resource is rated on a 100-point scale. The total possible points that can be assigned to each criterion are as follows:

(1) Recreation Experience – 30;

(2) Availability of Opportunity – 18;

(3) Carrying Capacity – 14;

(4) Accessibility – 18; and

(5) Environmental – 20.

The conversion of points to dollar value for general recreation is expressed in two activity categories:

(1) general recreation and

(2) general fishing and hunting.

Hence, points are estimated and expressed in the same manner. Based on analyst knowledge of the general area and the recreation opportunities provided by the asset and bolstered by several field trips to the area before and after Katrina, recreation in Harrison County was scored and valued in accordance with the procedures described in ER 1105-2-100 and outlined in the tables below. These tables represent the estimation of recreation value without a project in the study area.

**Table 6.**
**Description of General Recreation Points**

| Guidelines for Assigning Points for General Recreation | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Judgment Factors** | | | | |
| **Recreation experience**[1] | Two general activities[2] | Several general activities | Several general activities; one high quality value activity[3] | Several general activities; more than one high quality value activity | Numerous high quality value activities; some general activities |
| Total Points: 30<br>Point Value: | 0-4 | 5-10 | 11-16 | 17-23 | 24-30 |
| **Availability of opportunity**[4] | Several within 1 hr. travel time; a few within 30 min. travel time | Several within 1 hr. travel time; none within 30 min. travel time | One or two within 1 hr. travel time; none within 45 min. travel time | None within 1 hr. travel time | None within 2 hr. travel time |
| Total Points: 18<br>Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Carrying Capacity**[5] | Minimum facility for development for public health and safety | Basic facility to conduct activity(ies) | Adequate facilities to conduct without deterioration of the resource or activity experience | Optimum facilities to conduct activity at site potential | Ultimate facilities to achieve intent of selected alternative |
| Total Points: 14<br>Point Value: | 0-2 | 3-5 | 6-8 | 9-11 | 12-14 |

**Table 6. (continued)**

| Guidelines for Assigning Points for General Recreation | | | | | |
|---|---|---|---|---|---|
| **Criteria** | **Judgment Factors** | | | | |
| **Accessibility** | Limited access by any means to site or within site | Fair access, poor quality roads to site; limited access within site | Fair access, fair road to site; fair access, good roads within site | Good access, good roads to site; fair access, good roads within site | Good access, high standard road to site; good access within site |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Environmental** | Low esthetic factors[6] that significantly lower quality[7] | Average esthetic quality; factors exist that lower quality to minor degree | Above average esthetic quality; any limiting factors can be reasonably rectified | High esthetic quality; no factors exist that lower quality | Outstanding esthetic quality; no factors exist that lower quality |
| Total Points: 20 | | | | | |
| Point Value: | 0-2 | 3-6 | 7-10 | 11-15 | 16-20 |

The table below illustrates a reasonable assessment of the overall quality of recreation experience should no federal action be taken to repair the seawall and place beach sand.

**Table 7.**
**Recreation Score for No Federal Action**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1] | 7 | Four activities are provided by the existing beach, all of which are of average quality. |
| Pts. Possible: 30 | | |
| **Availability of opportunity**[4] | 5 | There are beach facilities in Jackson, Harrison and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| Pts Possible: 18 | | |
| **Carrying Capacity**[5] | 4 | Undamaged stretches of beach are snapped up quickly by even moderate usage periods. |
| Pts Possible: 14 | | |
| **Accessibility** | 8 | Accessibility is generally good; however damage-induced parking problems hamper accessibility. |
| Pts Possible: 18 | | |
| **Environmental** | 1 | The existing beach still suffers from damage and debris removal is a continual effort. The debris represents both a health and safety hazard to the public. |
| Pts Possible: 20 | | |
| **TOTAL SCORE** | **25** | |

Table 8 (from Economic Guidance Memorandum (EGM) 06-03) provides a means of converting the resource's UDV score into FY 2006 dollars. With the score of 25 taken from table above, we estimate the future without project condition value of Harrison County beaches to be $4.49 by interpolating between the values given at 20 and 30. That is, an average recreational visitor to the park would place a willingness to pay value of approximately $4.49 on their recreation day. With recreation demand of 413,944 visitor days at $4.49, the total without project condition value is $1,858,609.

**Table 8.**
**Conversion to Recreation Values**

| Point Values | General Recreation Values |
|---|---|
| 0 | 3.19 |
| 10 | 3.79 |
| 20 | 4.19 |
| 30 | 4.79 |
| 40 | 5.98 |
| 50 | 6.78 |
| 60 | 7.38 |
| 70 | 7.78 |
| 80 | 8.57 |
| 90 | 9.17 |
| 100 | 9.57 |

### *Future with Project Condition*

Both alternatives being considered for rehabilitation include beach sand placement. Both call for placement of approximately 681,000 cubic yards of beach sand, shaped and formed into a dune on the existing beach area. One alternative calls for a bare dune, the other calls for adding fencing and plantings to anchor the dune and further enhance the environmental quality. For the purposes of this analysis, there is little difference between the two in terms of recreation value. An argument could be made that the fence-and-planting alternative would provide a greater aesthetic value. However, the increase in value would likely be marginal, difficult to quantify, and would not likely have much of an effect on willingness to pay. Hence, the two alternatives are considered equal.

**Table 9.**
**With Project Condition Recreation Score**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1]<br>Pts. Possible: 30 | 13 | Six activities are provided by the existing beach, all of which would be of very good, but not excellent quality. |
| **Availability of opportunity**[4]<br>Pts Possible: 18 | 5 | There are beach facilities in Jackson, Hancock, and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| **Carrying Capacity**[5]<br>Pts Possible: 14 | 8 | Peak season usage is still likely to cause some congestion. However, additional access points and more beach space will improve both parking conditions and beach space. The Corps "standard" of 150 square feet per visitor is almost certainly not to be reached. |
| **Accessibility**<br>Pts Possible: 18 | 12 | Accessibility would be very good, with virtually unrestricted access along the entire stretch of the project. |
| **Environmental**<br>Pts Possible: 20 | 9 | No significant environmental issues would be present. Occasional heavy rainfall results in swimming advisories (common among the southern U.S. coast). |
| TOTAL SCORE | 47 | |

Again referring to the conversion table, we find that a score of 47 equates to a willingness to pay of $7.93. With rehabilitation and dune placement, the full pre-Katrina recreation demand is expected to occur, resulting in demand for 827,888 visitor days a year. Thus at $7.93 per visitor day, the total value of with project recreation is $6,565,155.

This represents a net increase of $4,706,546, and that figure represents the total NED benefit of the repair and beach placement alternatives.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *1) National Ecosystem Restoration (NER)*

#### *Incremental Cost Analysis*

The justification for the proposed section is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501, *Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

#### *Assumptions*

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives (habitat unit, HU). HU is based on an assessment protocol, which provides a basic level of stream health evaluation that is based on physical conditions within the assessment area. The assessment is used to record the scores for up to 15 assessment elements (i.e., channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover [warm water fishery], manure presence, salinity, riffle embeddedness, and macroinvertebrates observed). However, all assessment elements were not applicable to the assessment area and were not included.

The first step in incremental analysis is to display the environmental outputs (effects on habitat expressed in habitat units, HU) and the cost estimates of the management measures increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average annual outputs and average annual costs were used for this analysis.

Table 10 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no

work is undertaken to prevent erosion. Alternative 2 represents the placement of a dune on the beach. Alternative 3 represents dune placement with plantings. Project outputs for each alternative are displayed in terms of functional habitat index (FHI) that can be supported for each alternative considered.

**Table 10.**
**Outputs and Costs by Increments**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Dune only | $10,220,000 | $570,664 | $340,000 | $910,664 | 260 |
| 3 | Dune with plantings | $13,580,000 | $758,280 | $260,000 | $1,018,280 | 405 |

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (HU) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their outputs. The result is a ranking of Alternative 1, 2, and 3 as displayed in Table 11. Where two or more solutions produce the same output, the solutions are ranked in ascending order of their costs. At each level of output the least cost solution is determined. No alternatives were eliminated in this step because they all produce different levels of output.

**Table 11.**
**Summary of Costs and Additional Outputs in Ascending Order**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Dune only | $10,220,000 | $570,664 | $340,000 | $910,664 | 260 |
| 3 | Dune with plantings | $13,580,000 | $758,280 | $260,000 | $1,018,280 | 405 |

The fifth step in incremental analysis is to eliminate economically ineffective solutions. The outputs and costs undergo a pair-wise comparison. The results of the comparison are analyzed to determine which solutions will produce less output at equal or greater cost than subsequently ranked solutions. Those solutions that will produce less output at equal or greater cost than subsequently ranked solutions are deleted. No alternatives were eliminated in this step because they all produce different levels of output.

The sixth step is to calculate average costs for the set of solutions that emerged from the cost effectiveness analysis. Average costs are calculated by dividing each level of output's cost by its

output. Alternatives with outputs less than the lowest average cost level are eliminated from further analysis. Alternative 1 (the no action plan) does not have an average cost per unit of output, since it does not cost anything or produce anything. Table 12 displays this information.

**Table 12.**
**Average Cost of Each Level of Output**

| Output (FHI) | Cost ($) | Average Cost ($) per FHI |
|---|---|---|
| 0 | 0 | N/A |
| 260 | $910,664 | $3,502.55 |
| 405 | $1,018,280 | $2,514.27 |

The next step is to recalculate average costs for additional output. The average costs are calculated for additional output using the incremental levels of output. These calculations begin with the lowest average cost level of output, the "zero level" output. The average costs are calculated using the additional costs and additional outputs above those of the previously identified level of outputs with the lowest average cost. Levels of output less than the lowest average cost are eliminated from further analysis. This process is repeated until the final level of output is identified as the lowest average cost of output. Since no alternative was eliminated in the previous step, this step was not necessary.

Calculating the incremental costs is the eighth step. The difference in cost between two solutions divided by the difference in output between the same two solutions is the incremental cost. Table 13 shows the calculations.

**Table 13.**
**Incremental Costs**

| Output (FHI) | Average Annual Cost ($) | Additional Output (FHI) | Additional Cost ($) | Incremental Cost ($ per FHI) |
|---|---|---|---|---|
| 0 | $0 | 0 | $0 | $0 |
| 260 | $910,664 | 260 | $920,000 | $3,538 |
| 405 | $1,018,280 | 145 | $107,616 | $742.17 |

The final step is to compare successive outputs and incremental costs. The results from the incremental costs are compared and then used as a decision making tool by progressively proceeding through the available level of outputs and asking if the next level is "worth it." That is to say, "is the habitat value of the additional unit of environmental benefit in the next available level of output worth its additional monetary costs?"

### *2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The road running parallel to the beach is U.S. Highway 90. Before Interstate 10 was built, this was the route people took to go between Louisiana and Florida. Before Hurricane Katrina's storm surge devastated the beach, it was still considered on of the best scenic routes in the southeast. Figures 4, 5, 6, 7, 8, and 9 show the project area pre and post Hurricane Katrina.


**Figure 4. Gulfport Harbor Pre-Katrina**

**Figure 5. Gulfport Harbor Post-Katrina**

**Figure 6. Pass Christian Pre Katrina**

**Figure 7. Pass Christian Post Katrina**

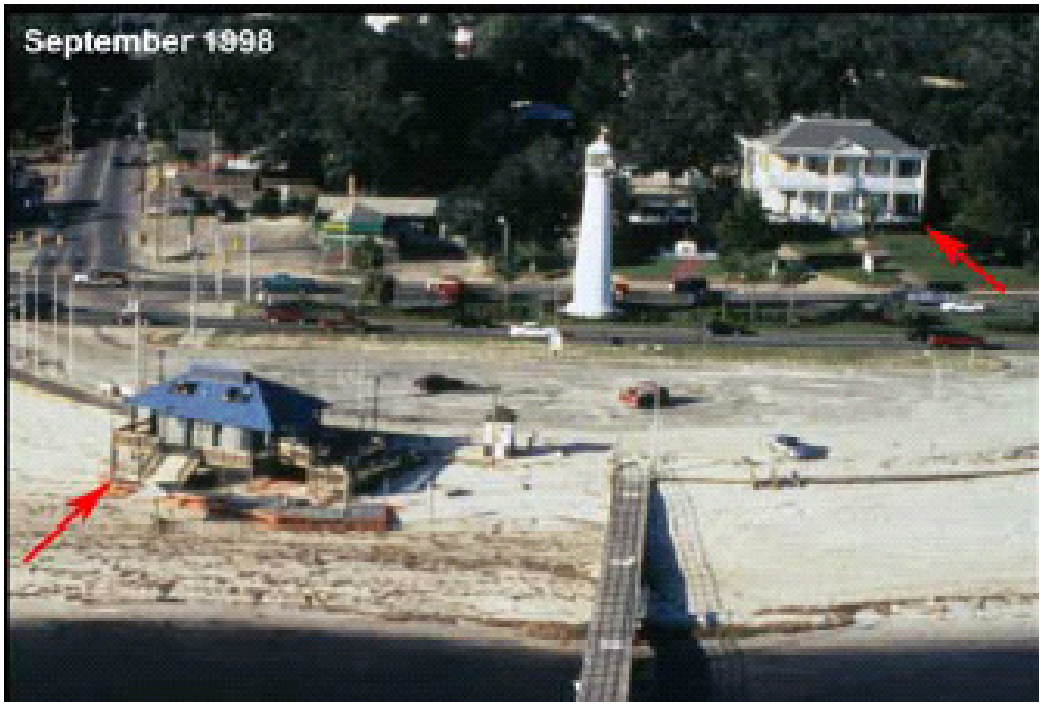



**Figure 8. Biloxi Pre-Katrina**


**Figure 9. Biloxi Post Katrina**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Harrison County is located in the center of the Mississippi Gulf Coast. The County shares its borders with Jackson County, Mississippi to the east, Hancock County, Mississippi to the west and Stone County to the north. According to the 2000 Census, the county has a population of 190,000. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 14 shows the employment breakdown for Harrison County. The manufacturing industry is a significant employer; accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 14.**
**Employment Breakdown of Harrison County**

| Sector | Mississippi | Harrison County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 4,500 | 40.5% |
| Wholesale | 35,316 | 2,112 | 5.9% |
| Retail | 135,838 | 11,548 | 8.5% |
| Real Estate | 9,665 | 1,084 | 11.2% |
| Professional | 29,023 | 2,050 | 7.1% |
| Administration | 46,115 | 3,211 | 6.9% |
| Education | 1,678 | 100 | 5.9% |
| Health Care | 131,976 | 12,429 | 9.4% |
| Arts | 9,292 | 2,500 | 26.9% |
| Food Service | 109,405 | 21,822 | 19.9% |
| Other Services | 22,180 | 2,067 | 9.3% |
| Total | 713,310 | 63,423 | 8.9%% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Harrison County was $18,024 and the median household income was $35,624 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 15 displays the income breakdown for Harrison County.

**Table 15.**
**Income Breakdown for Harrison County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Harrison County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 16. The percentage of persons below the poverty level for the state of Mississippi and Harrison County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Harrison County. The unemployment rate for Harrison County was close to the national average before the hurricane, and then doubled (Quarter 3, 2005) and even tripled (Quarter 4, 2005) from Katrina's aftermath.

**Table 16.**
**Poverty Level and Unemployment Rate for Harrison County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Harrison County | 14.5% | 6.4% | 12.8% | 22.5% |

Each of the alternatives would affect the local area of Harrison County, Mississippi. The expenditures for the alternatives are estimated to be $10,380,000 for the Dune alternative and $13,770,000 for the Dune w/fence and plants alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $340,000 for the Dune alternative and $260,000 for the Dune w/fence alternative, which in present worth form amounts to $6,089,036 and $4,656,321 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population. Table 17 shows the EIFS model inputs.

**Table 17.**
**Summary of Inputs by Project Alternatives**

| Indicator Variable | Dune | Dune w/fence and plants | Dune O&M | Dune w/f&p O&M |
|---|---|---|---|---|
| Region of Influence (ROI) | Harrison County | Harrison County | Harrison County | Harrison County |
| Change in Local Expenditures | $10,220,000 | $13,580,000 | $6,089,036 | $4,656,321 |

## *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Dune.*** If implemented, the total sales volume related to this alternative is projected to increase by $34,914,360 in the local area of Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $12,908,760 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Dune alternative.

***Dune w/fence and plants***. If implemented, the total sales volume related to this alternative is projected to increase by $39,063,799 in the local area of Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $9,871,399 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Dune w/fence and plants alternative.

### *Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Dune.*** If implemented, the total income related to this alternative is projected to increase by $6,809,191 for Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $2,517,537 (i.e. the total income increased because of O&M) was added to the total income of the Dune alternative.

***Dune w/fence and plants.*** If implemented, the total income related to this alternative is projected to increase by $7,618,439 for Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $1,925,175 (i.e. the total income increased because of O&M) was added to the total income of the Dune w/fence and plants alternative.

### *Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Dune.*** If implemented, the total employment related to this alternative is projected to increase by 198 workers in Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, 73 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Dune alternative.

***Dune w/fence and plants.*** If implemented, total employment related to this alternative is projected to increase by 221 workers in Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, 56 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Dune w/fence and plants alternative.

### *Impact on Population*

If implemented, the population related to both alternatives is projected to increase by 0. Table 18 shows the EIFS model outputs.

**Table 18.**
**Summary of Outputs by Project Alternatives**

| Indicator Variable | Projected Δ Dune | Projected Δ Dune w/f&p | Projected Δ Dune O&M | Projected Δ Dune w/f&p O&M |
|---|---|---|---|---|
| Direct Sales Volume | $10,380,000 | $13,770,000 | $6,089,036 | $4,656,321 |
| Induced Sales Volume | $11,625,600 | $15,422,400 | $6,819,720 | $5,215,078 |
| Total Sales Volume | $22,005,600 | $29,192,400 | $12,908,760 | $9,871,399 |
| Direct Income | $2,024,365 | $2,685,502 | $1,187,518 | $908,102 |
| Induced Income | $2,267,289 | $3,007,762 | $1,330,020 | $1,017,074 |
| Total Income | $4,291,654 | $5,693,264 | $2,517,537 | $1,925,175 |
| Direct Employment | 59 | 78 | 34 | 26 |
| Induced Employment | 66 | 87 | 39 | 30 |
| Total Employment | 125 | 165 | 73 | 56 |
| Local Population | 0 | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, "Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others." This project addresses the following under the OSE account:

### *1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 19 shows the number selected housing statistics for census tracts 2, 5, 6, 13, 14, 22, 28, and 29. There are 13,137 housing units in the two tract area. The average structure was built between 1953 and 1974. Table 20 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 21 shows the value of the owner occupied structures in the two tract area.

**Table 19.**
**Selected Housing Statistics**

| Category | Tract 2 | Tract 5 | Tract 6 | Tract 13 | Tract 14 | Tract 22 | Tract 28 | Tract 29 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Number of Structures | 1,229 | 136 | 1,634 | 2,129 | 2,492 | 1,217 | 2,546 | 1,754 | 13,137 |
| Median Year Built | 1958 | 1972 | 1962 | 1971 | 1969 | 1953 | 1974 | 1971 | |
| Occupancy Status | | | | | | | | | |
| Occupied | 1,015 | 93 | 1,416 | 1,786 | 2,027 | 1,035 | 2,142 | 1,221 | 10,735 |
| Vacant | 214 | 43 | 218 | 343 | 465 | 182 | 404 | 533 | 2,402 |
| Tenure | | | | | | | | | |
| Owner | 455 | 43 | 534 | 441 | 824 | 528 | 1,168 | 930 | 4,923 |
| Renter | 560 | 50 | 882 | 1,345 | 1,203 | 507 | 974 | 291 | 5,812 |

U.S. Census Bureau, 2000 Census

**Table 20.**
**Number of Units in Structure**

| Units in Structure | Tract 2 | Tract 5 | Tract 6 | Tract 13 | Tract 14 | Tract 22 | Tract 28 | Tract 29 | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1, detached | 794 | 7 | 829 | 672 | 1,156 | 737 | 1,421 | 1235 | **6,851** |
| 1, attached | 32 | 5 | 25 | 37 | 73 | 14 | 94 | 33 | **313** |
| 2 | 27 | 0 | 64 | 38 | 91 | 88 | 76 | 38 | **422** |
| 3 or 4 | 64 | 29 | 120 | 184 | 106 | 85 | 291 | 56 | **935** |
| 5 to 9 | 38 | 43 | 35 | 376 | 157 | 39 | 344 | 154 | **1,186** |
| 10 to 19 | 33 | 0 | 56 | 472 | 172 | 41 | 70 | 14 | **858** |
| 20 to 49 | 44 | 41 | 148 | 110 | 325 | 69 | 83 | 100 | **920** |
| 50 or more | 177 | 11 | 350 | 171 | 361 | 123 | 167 | 124 | **1,484** |
| Mobile Home | 20 | 0 | 0 | 63 | 36 | 21 | 0 | 0 | **140** |
| Boat, RV, van, etc. | 0 | 0 | 7 | 6 | 15 | 0 | 0 | 0 | **28** |
| **Total** | **1,229** | **136** | **1,634** | **2,129** | **2,492** | **1,217** | **2,546** | **1,754** | **13,137** |

U.S. Census Bureau, 2000 Census

**Table 21.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 2 | Tract 5 | Tract 6 | Tract 13 | Tract 14 | Tract 22 | Tract 28 | Tract 29 |
|---|---|---|---|---|---|---|---|---|
| **Value** | | | | | | | | |
| Less than $10,000 | 7 | 0 | 0 | 15 | 0 | 21 | 9 | 0 |
| $10,000 to $14,999 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 8 |
| $15,000 to $19,999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $20,000 to $24,999 | 14 | 0 | 0 | 6 | 0 | 0 | 0 | 11 |
| $25,000 to $29,999 | 14 | 0 | 13 | 14 | 0 | 7 | 0 | 0 |
| $30,000 to $34,999 | 46 | 0 | 0 | 7 | 0 | 12 | 18 | 5 |
| $35,000 to $39,999 | 50 | 0 | 14 | 0 | 6 | 0 | 21 | 17 |
| $40,000 to $49,999 | 48 | 0 | 45 | 16 | 30 | 55 | 63 | 6 |
| $50,000 to $59,999 | 79 | 0 | 76 | 52 | 86 | 52 | 79 | 71 |
| $60,000 to $69,999 | 20 | 0 | 20 | 40 | 17 | 85 | 69 | 57 |
| $70,000 to $79,999 | 27 | 0 | 60 | 67 | 64 | 92 | 124 | 52 |
| $80,000 to $89,999 | 28 | 0 | 18 | 45 | 70 | 35 | 122 | 63 |
| $90,000 to $99,999 | 21 | 7 | 68 | 34 | 71 | 15 | 155 | 49 |
| $100,000-$124,999 | 42 | 0 | 44 | 59 | 47 | 94 | 209 | 133 |
| $125,000-$149,999 | 16 | 0 | 18 | 17 | 128 | 28 | 89 | 88 |
| $150,000-$174,999 | 0 | 0 | 54 | 13 | 72 | 8 | 96 | 63 |
| $175,000-$199,999 | 7 | 5 | 0 | 0 | 26 | 5 | 26 | 83 |
| $200,000-$249,999 | 0 | 19 | 24 | 7 | 55 | 0 | 35 | 36 |
| $250,000-$299,999 | 7 | 6 | 24 | 28 | 17 | 19 | 8 | 44 |
| $300,000-$399,999 | 12 | 0 | 28 | 12 | 49 | 0 | 8 | 38 |
| $400,000-$499,999 | 0 | 0 | 20 | 0 | 47 | 0 | 9 | 37 |
| $500,000-$749,999 | 0 | 0 | 8 | 0 | 15 | 0 | 19 | 36 |
| $750,000-$999,999 | 17 | 0 | 0 | 0 | 12 | 0 | 0 | 0 |
| $1,000,000 or more | 0 | 6 | 0 | 9 | 0 | 0 | 9 | 33 |
| **TOTAL** | **455** | **43** | **534** | **441** | **824** | **528** | **1,168** | **930** |

U.S. Census Bureau, 2000 Census

# Recommended Plan

The results of the alternative development, comparison, modification, screening, and selection process indicated that the recommended plan presented the most cost-effective solution, and was clearly the best-balanced plan where all factors were taken into consideration.

The recommended plan involves providing a dune atop the re-nourished beach and adding a stabilizing fence and dune vegetation. The finished stable dune will be 5 feet high with a crest width of 10 feet and side slopes of one vertical to three horizontal. The material will come from the established borrow areas a minimum of 1,500 feet offshore. The plantings will have a density of 1 plant per 4 square feet and the fence will include the entire linear length of the project. The dune alone project will require replacement within 10 years and the dune with plantings and fence will require replacement within 15 years.

# Cost

This solution is estimated to cost $13,580,000 (October 2006 Price Level).

# ECONOMIC ANALYSIS FOR FLOOD DAMAGE REDUCTION AND ECOSYSTEM RESTORATION COURTHOUSE ROAD, HARRISON COUNTY, MS

## Introduction

This section describes the economic analysis evaluation for ecosystem restoration and flood damage reduction at courthouse road, Harrison County, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background and Problem Statement

The site is located in Gulfport on Mississippi Sound. Harrison County is the central coastal county in Mississippi, Gulfport is Mississippi's second largest city with a circa 1993 population exceeding 70,000 and is 75 miles by road west of Mobile, Alabama and 78 miles east of New Orleans, Louisiana. Nearly the entire length of the county shoreline is fronted by four-lane Highway 90, which is protected by a concrete seawall.


**Figure 1. Project Location**

The city of Gulfport, in Harrison County, was devastated by Hurricane Katrina. The Courthouse Road Pier, a public fishing and boat launch facility; seawall; a sand beach fronting the seawall; and a concrete sheet-pile walled drainage channel typical of those on the Harrison County shoreline are located at this Gulfport site (see Figure 1). Construction was underway in the summer of 2005 to improve the pier and boat launch facility. Notable in-progress improvements included a new boat ramp, ramp approach jetties and markers, parking lot revisions, and a mitigation wetland. The pre-

Katrina view in Figure 1 pre-dates completion of these improvements and shows the pre-improvement marsh. The mitigation wetland is not evident in Figure 2, having been completed approximately two weeks before Hurricane Katrina struck. Other existing and in-progress features of the public facility were severely damaged and destroyed as well.


**Figure 2. Post-Katrina (left) and Pre-Katrina Aerial Site Photos**

All wetland ecosystem functions and values were eliminated during this single event. Lateral drainage channel braces (Figures 3 through 5) were tossed about by the storm surge and damaged. The purpose of the braces is to support the tops of the drainage channel walls. The drainage channel serves to evacuate surface water from landward communities; without competent lateral bracing, the drainage channel walls are in danger of failing and compromising the flood damage reduction performance of the channel.

**Figure 3. Looking towards location of destroyed marsh from the end of the drainage channel. Approximately 100 feet of erosion in the vicinity of the marsh occurred during Katrina.
3 April 2006 photo.**

**Figure 4. Drainage channel, looking towards the seawall. Damaged braces have been set upon, but not secured to, the channel walls. Broken braces are shown stacked on the beach to the left of the channel.
3 April 2006 photo.**

**Figure 5. Drainage channel, looking towards the beach. Ends of braces are cracked or broken, and all braces show impact damage on at least one surface. 3 April 2006 photo.**

# Opportunities

Opportunities identified for this problem area were required to be linked to one of the following:

- Hurricane storm damage reduction or remediation
- Prevention or remediation of Saltwater Intrusion
- Preservation of fish and wildlife and restoration of their habitats
- Prevention or remediation of erosion
- Other related water resource purposes, such as ecosystem restoration or barrier island restoration

They include:

- Reduction of future hurricane-caused damage created by storm surge
- Reduction of future damage caused by waves created during hurricanes and other storms
- Repair of damages to public facilities caused by 2005 storm events
- Repair of damages to natural resources (primarily destruction of the wetland at this site) created by 2005 storm events
- Restoration of environmental resources damaged by 2005 storm events

Measures evaluated for this community included the following non-structural measures:

1. Storm and flood warning
2. Evacuation

3. Flood Insurance
4. Storm and flood-proofing

Measures evaluated for this specific problem area included the following structural measures

- Replacement of the seawall with a wall of increased height
- Addition of increased wall height constructed of a variety of materials
- Offshore breakwaters for storm damage reduction and/or erosion damage reduction
- Wetland restoration
- Wetland expansion
- Drainage channel lateral bracing replacement

# Alternatives

## *Screening of Measures and Development of Preliminary Alternatives*

The screening of measures discussed above resulted in the following measures being forwarded for potential inclusion in a list of alternatives for the problem area:

The following alternatives, then, were developed and carried forward for further analysis:

### *Alternative 1: The No-Action Plan*

The 'No Action' alternative would result in the perpetuation of the obstructed flow and the eventual destruction of the box culvert. Hurricane Katrina damaged all fourteen (14) of the drainage wall's original concrete braces. A small marsh area was on the southern end of the drainage culvert. This alternative assumes that the drainage channel bracing is not repaired and that the mitigation wetlands are not replaced. If the bracing is not replaced, it is assumed that the bracing will cease to be effective due to displacement by breaking waves for events exceeding the 7 feet NGVD (approximately the 15-year recurrence interval event) and that failure of a significant portion of the channel walls would accompany that event. This alternative also assumes that the wetland would not re-establish itself.

### *Alternative 2: Replace Drainage Channel Lateral Bracing*

The project will involve removal and disposal of all fourteen (14) of the original concrete braces. The braces would be replaced by reinforced pre-cast concrete braces that would be anchored to the pile wall cap.

### *Alternative 3: Restore Wetland*

This Alternative would provide for creating approximately one-third of an acre of marsh composed of approximately 6,300 square feet of high marsh and 7,900 square feet of tidal marsh.

### *Alternative 4: Replace Drainage Channel Lateral Bracing and Restore Wetland*

The project will involve removal and disposal of all fourteen (14) of the original concrete braces. The braces would be replaced by reinforced pre-cast concrete braces that would be anchored to the pile

wall cap. Also this alternative would provide for the creation of approximately one-third of an acre of marsh composed of approximately 6,300 square feet of high marsh and 7,900 square feet of tidal marsh.

All alternatives were then evaluated and potentially screened based on the following criteria:

- Technical feasibility
- Environmental Feasibility
- Economic Feasibility

The alternatives developed were also examined by the economic staff within the PDT, and were also each determined to each be potentially cost-effective solutions to the identified problems at this site.

## *Alternative Screening and Plan Selection*

Alternatives were compared to one another and to a "No-Action" alternative, and a recommended plan arrived at, through an iterative process involving the entire PDT, and by comparison of both cost-effectiveness and other important criteria identified for inclusion in a System of Accounts analysis. This System of Accounts analysis involves comparison of a variety of potential impacts, benefits, and outcomes of each alternative, in recognition of existing and future conditions within the study area. The No-Action Plan is simply the plan that assumes that no Federal action is taken to address the identified problems at this site, and becomes the basis for comparison of positive and negative effects of each alternative, over the conditions in the absence of actions addressing the problems, now and into the future. The goal of this process was to arrive at the best-balanced and most cost-effective plan to address the identified problems at this site, even should that plan be to pursue no action.

Because the guidance for this study effort excluded determination of a National Economic Development (NED) Plan, specifically, and computation of a Benefit-Cost ratio, no analysis of either of those factors was prepared; however, a National Economic Development approach was pursued, and qualitatively discussed, in order to support the required cost-effectiveness requirement contained in the guidance.

The results of the *System of Accounts* analysis are attached to this report. Further detail on many of these factors is also contained in the Programmatic Environmental Assessment that accompanies the main report.

The System of Accounts analysis, cost-effectiveness analysis, and all means of comparing and contrasting the final array of alternatives resulted in the decision to recommended Alternative 4, for this problem area.

### *Assumptions*

The following assumptions are used in this analysis:

a. The FY 2006 discount rate of 5–1/8 percent will be used in estimating average annual benefits and costs

b. Values shown in the report are stated in October 2006 dollars unless otherwise noted.

c. A 50-year period of analysis is used since that is the remaining physical life of the rehabilitated seawall.

d. Impacted area (Hancock County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

### *Existing Conditions*

The seawall was originally constructed between 1925 and 1928 to protect Highway 90. The seawall is a stepped concrete type wall founded on piles. The seawall crest elevation varies between approximately 8 to 11 feet mean sea level and is penetrated in a number of locations by drainage channels and culverts.

The existing drainage channel issues from the seawall and was probably completed by 1952, the year the Harrison County Shore Protection project was completed. That project provided for shoreline drainage improvements, seawall repairs, and beach construction along 24 miles of the Harrison County waterfront resultant mainly from the destructive 1947 hurricane.

The drainage channel is approximately 235 feet long with a flow width of approximately 12.5 feet. The channel is a stormwater network discharge point. The stormwater network consists primarily of drainage pipes connected to a trunk line beneath the seawall. The channel walls are tongue-and-groove concrete sheetpile panels with a concrete cap. The top of cap elevation slopes about 1 percent from the channel headwall to the channel terminus. Fourteen lateral braces originally spanned the channel to provide active support to the channel walls. The braces were displaced during Hurricane Katrina and all appear damaged, though 10 of these were recovered and placed back on top of the wall as a temporary measure. The braces are made of reinforced concrete of dimensions 12 inches wide by 11 inches deep and approximately 13.5 feet long.

Tidal marsh borders the estuarine and adjacent waters in Mississippi and provides natural protection from the wave and wind energy. Erosion from wave attack under average conditions, coupled with hurricanes and other storms in the area, have undermined and eroded the marsh habitat at the proposed project site. Concrete seawalls armor the shoreline and a large section of the Mississippi mainland.

### *Without Project Condition*

The erosion and disappearance of marsh habitat in Mississippi has exposed shorelines along both the mainland of Mississippi and its barrier island system to increased wave energy and accelerated erosion. With the erosion of the shoreline the area has become more prone to disturbance from waves, resulting in marsh habitat loss and degradation. The drainage channel serves to evacuate surface water from landward communities; without competent lateral bracing, the drainage channel walls are in danger of failing and compromising the flood damage reduction performance of the channel.

### *With Project Condition*

The screening of measures discussed above resulted in the following measures being forwarded for potential inclusion in a list of alternatives for the problem area:

The following alternatives, then, were developed and carried forward for further analysis:

1. The No-Action Plan
2. Replace Drainage Channel Lateral Bracing
3. Restore Wetland
4. Replace Drainage Channel Lateral Bracing and Restore Wetland

## *NED Benefit Analysis*

### *Flood Damage Reduction*

According to the P&G the national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. Although the work could reduce the rainfall flooding to some degree, it is not clear that the work will reduce flooding significantly. The excavation of this drainage channel would not provide any storage since the storage is already taken by the tidal water. Therefore the quantification of flood damage reduction benefits becomes very problematic.

Non excavation of the channels would increase the flood water levels somewhat due to blockage. Additionally the naturally occurring flushing action exchanging and mixing of fresh and salt water environments will be unfavorably affected. The following table examines the level of benefit impact for each alternative.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| 1 | No Action | N/A | N/A | N/A |
| 2 | Replace Drainage Channel Lateral Bracing | Minimal | $270,000 | $5,000 |
| 3 | Restore Wetland | Moderate | $250,000 | $5,000 |
| 4 | Replace Drainage Channel Lateral Bracing and Restore Wetland | Moderate | $520,000 | $5,000 |

# The Recommended Plan

The results of the alternative development, comparison, modification, screening, and selection process indicated that the recommended plan presented the most cost-effective solution, and was clearly the best-balanced plan where all factors were taken into consideration.

The recommended plan consists of: All (fourteen) of the drainage channel lateral braces would be replaced by reinforced pre-cast concrete braces that would be anchored to the pile wall cap. The existing (prior to improvement) and mitigation high marshes and tidal marshes would be replaced. Approximately one-third of an acre of marsh would be created, composed of approximately 6,300 square feet of high marsh and 7,900 square feet of tidal marsh. High marsh wetlands would be established by grading the existing sandy soils and adding soils to suit for planting high marsh species. Tidal marsh would be established by placing suitable soils and planting tidal marsh plant species within.

The recommended cost-effective plan for this problem area was identified by the Project Delivery Team, and was fully coordinated with the City of Gulfport, Harrison County, the State of Mississippi, and the Mississippi Department of Marine Resources.

The recommended plan has been determined to be suited for near-term implementation. The key elements of the plan for this problem area could be implemented in approximately one year, including development of plans and specifications.

The recommended plan also appears to be cost-effective in light of the risk and consequences of not implementing the project. The risks and consequences of *not* implementing this plan include:

- Failure of the existing drainage channel walls, which would compromise the shoreline community's storm water drainage system
- Loss of rare shoreline marsh habitat

The risks and consequences of implementing this plan include:

- There are no risks associated with implementing this plan.

The recommended plan would not preclude other future options that may have a higher level of contribution, and/or that would take a longer timeframe to study and construct.

The recommended plan does not, in and of itself, provide a high level of protection from large storm surges and associated damages, but does restore the existing level of flood damage protection from more frequent storm events. As a near-term project, the channel repair and improvements only function to prevent damage from small to moderate storm events; however, it should survive inundation by larger flood events better than the project that was destroyed.

The recommended plan has the support of The Cities of Biloxi, Gulfport, and Long Beach, Harrison County, the State of Mississippi, and the Mississippi Department of Marine Resources.

The recommended plan has been coordinated with members of the environmental regulatory community, and has been found to be conceptually acceptable, in that it is not anticipated to negatively impact terrestrial or aquatic resources. The recommended plan also has the support of the stakeholders of the community in which it would be constructed.

## *Regional Economic Benefit Analysis (RED)*

### *Socioeconomic Impacts Using the Economic Impact Forecast System*

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Harrison County, Mississippi. The expenditures for the alternatives are estimated to be $270,000 for the Replace Open Channel Drain Lateral Bracing alternative and $250,000 for the Wetland Restoration alternative, and $520,000 for the combination of the previous alternatives. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $5,000 for both alternatives, which in present worth form amounts to $89,545 (assuming a 50 year period of analysis and an interest rate of 5.125 percent).

### *Methodology*

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

### *Assumptions*

EIFS assumes that the infrastructure pre-Katrina is intact, in-place, and functioning as a wholesome economic unit in the region of influence. The fact is that under existing conditions many of the established economic infrastructure is not present but transient. In some cases, rebuilt economic units have moved into fill that deficit to provide the goods and services. The assumption of this analysis assumes that the last or destroyed infrastructure will be rebuilt or replace in the near-term and will not significantly reduce the impacts and outputs forecasted in this investigation.

### *Summary Explanation of the EIFS Model Output*

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**Table 2.**
**EIFS Model Inputs for the Courthouse Road Proposed Project Alternatives**

| Indicator Variable | Replace Open Channel Drain Bracing | Wetland Restoration | Replace Open Channel Drain Bracing and Wetland Restoration | O&M Harrison County |
|---|---|---|---|---|
| Region of Influence (ROI) | Harrison County | Harrison County | Harrison County | Harrison County |
| Change in Local Expenditures | $270,000 | $250,000 | $520,000 | $89,545 |

Based on the given inputs the outputs are as followed:

**Table 3.**
**EIFS Model Outputs for the Courthouse Road Proposed Project Alternatives**

| Indicator Variable | Projected Δ Replace Drain | Projected Δ Wetland Res. | Projected Δ Replace Drain, Restore Wetland | Projected Δ O&M |
|---|---|---|---|---|
| Direct Sales Volume | $270,000 | $250,000 | $520,000 | $89,545 |
| Induced Sales Volume | $337,500 | $312,500 | $650,000 | $111,931 |
| Total Sales Volume | $607,500 | $562,500 | $1,170,000 | $201,476 |
| Direct Income | $57,152 | $52,919 | $110,071 | $18,954 |
| Induced Income | $71,440 | $66,149 | $137,589 | $23,693 |
| Total Income | $128,593 | $119,067 | $247,660 | $42,648 |
| Direct Employment | 2 | 2 | 3 | 1 |
| Induced Employment | 2 | 2 | 4 | 1 |
| Total Employment | 4 | 4 | 7 | 1 |
| Local Population | 0 | 0 | 0 | 0 |

#### ***Sales Volume***

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and

procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

**Replace Open Channel Drain Lateral Bracing**

If implemented, the total sales volume related to this alternative is projected to increase by $808,976 the local area of Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $201,476 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Replace Open Channel Drain Lateral Bracing alternative.

**Wetland Restoration**

If implemented, the total sales volume related to this alternative is projected to increase by $736,976 in the local area of Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $201,476 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Wetland Restoration alternative.

**Replace Open Channel Drain Lateral Bracing and Restore Wetland**

If this alternative is implemented, the total sales volume related to this alternative is projected to increase by $1,371,476 in the local area of Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $201,476 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Replace Open Channel Drain Lateral Bracing and Restore Wetland alternative.

***Income***

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

**Replace Open Channel Drain Lateral Bracing**

If implemented, the total income related to this alternative is projected to increase by $171,241 for Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $42,648 (i.e. the total income increased because of O&M) was added to the total income of the Replace Open Channel Drain Lateral Bracing alternative.

**Wetland Restoration**

If implemented, the total income related to this alternative is projected to increase by $161,715 for Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $42,648 the total income increased because of O&M) was added to the total income of the Wetland Restoration alternative.

**Replace Open Channel Drain Lateral Bracing and Restore Wetland**

If implemented, the total income related to this alternative is projected to increase by $290,308 for Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, $42,648 (i.e. the total income increased because of O&M) was added to the total income of the Replace Drain Lateral and Wetland Restoration alternative.

***Employment***

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated

with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

**Replace Open Channel Drain Lateral Bracing**

If implemented, the total employment related to this alternative is projected to increase by 5 workers in Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, 1 worker (i.e. the number of workers increase because of O&M) was added to the total employment of the Replace Open Channel Drain Lateral Bracing alternative.

**Wetland Restoration**

If implemented, total employment related to this alternative is projected to increase by 5 workers in Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, 1 worker (i.e. the number of workers increase because of O&M) was added to the total employment of the Wetland Restoration alternative.

**Replace Open Channel Drain Lateral Bracing and Restore Wetland**

If implemented, the total employment related to this alternative is projected to increase by 8 workers in Harrison County. Note, O&M is only accounted for if the project is implemented; therefore, 1 worker (i.e. the number of workers increase because of O&M) was added to the total employment of the Replace Open Channel Drain Lateral Bracing and Marsh Restoration alternative.

***Population***

If implemented, the population related to both alternatives is projected to increase by 0.

## *Environmental Quality*

### *NER (National Ecosystem Restoration) Benefit Analysis*

Alternative three would provide for creating approximately one-third of an acre of marsh composed of approximately 6,300 square feet of high marsh and 7,900 square feet of tidal marsh.

***Incremental Cost Analysis***

The justification for the proposed project is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501, *Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

***Assumptions***

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified

in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives.

***Description of Outputs***

The outputs are determined according assessment variable associated with each unit. The assessment variables included in this analysis include:

- Raptors
- Shoreline birds
- Waterfowl
- Migratory birds
- Native fish
- Sport fish
- Micro invertebrates and primary producers
- Bivalves

A value or Functional Habitat Index (FHI) is assigned to each unit quantifying the benefits associated with each assessment variable. An FHI value of 10 indicates a direct benefit to that particular habitat unit. A value of 5 indicates an indirect benefit. FHI values are totaled for the habitat units indicating the overall benefits associated with each assessment variable. Consequently, the FHI values for all of the assessment variables are totaled to represent the FHI for each alternative. The alternative with the highest FHI is produces the greatest environmental benefits. These values will then be used in the incremental analysis to facilitate selection of the best buy plan. The tables below present the FHI analysis for the beach and dune alternatives considered for the Courthouse Road Restoration opportunities.

**Table 4.**
**Alternative 1 – No Action Courthouse Road Ecosystem Restoration**

**Alternative 1 – 'No Action'** The 'No Action' alternative would result in the perpetuation of the obstructed flow and the eventual destruction of the box culvert. Hurricane Katrina damaged all fourteen (14) of the drainage wall's original concrete braces. A small marsh area was on the southern end of the drainage culvert. This alternative assumes that the drainage channel bracing is not repaired and that the mitigation wetlands are not replaced. If the bracing is not replaced, it is assumed that the bracing will cease to be effective due to displacement by breaking waves for events exceeding the 7 feet NGVD (approximately the 15-year recurrence interval event) and that failure of a significant portion of the channel walls would accompany that event. This alternative also assumes that the wetland would not re-establish itself.

| Functions | Raptors | Shore-line Birds | Water-fowl | Migratory Birds | Native Fish | Sport Fish | Macro Invertebrates and Primary Producers | Bivalves | Functional Habitat Index (FHI) |
|---|---|---|---|---|---|---|---|---|---|
| Hard Substrate – Drainage Box Culvert w/o improvement | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 40 |
| Water Exchange | – | – | – | – | – | – | – | – | 0 |
| Substrate Diversity | 5 | 5 | – | 5 | 5 | 5 | – | – | 25 |
| Nutrient Input | – | – | – | – | – | – | – | – | 0 |

**Table 4. (continued)**

| Functions | Raptors | Shore-line Birds | Water-fowl | Migratory Birds | Native Fish | Sport Fish | Macro Invertebrates and Primary Producers | Bivalves | Functional Habitat Index (FHI) |
|---|---|---|---|---|---|---|---|---|---|
| Nutrient Processing | – | – | – | – | – | – | – | – | 0 |
| Water Quality | – | – | – | – | – | – | – | – | 0 |
| Roosting Habitat | 5 | 5 | – | 5 | – | – | – | – | 15 |
| Nesting Habitat | – | – | – | – | – | – | – | – | 0 |
| Native Vegetation Propagation | – | – | – | – | – | – | – | – | 0 |
| Shoreline Foraging Habitat | – | – | – | – | – | – | – | – | 0 |
| Erosion Control | – | – | – | – | – | – | – | – | 0 |
| Sediment Stabilization | – | – | – | – | – | – | – | – | 0 |
| Tidal Marsh Protection from Predation | – | – | – | – | – | – | – | – | 0 |
| Structure/Tidal Marsh (Drainage & No Action) Protection from Predation | – | – | – | – | – | – | – | – | 0 |
| **TOTAL** | | | | | | | | | **80** |

Direct Benefit = 10 Indirect Benefit =5

**Table 5.**
**Alternative 2 & 3 – Restore Tidal Marsh Courthouse Road Ecosystem Restoration**

**Alternatives 2 & 3: Repair 14 Concrete Bracings and Associated Tidal Marsh.** The project will involve removal and disposal of all fourteen (14) of the original concrete braces. The braces would be replaced by reinforced pre-cast concrete braces that would be anchored to the pile wall cap. Approximately one-third of an acre of marsh would be created, composed of approximately 6,300 square feet of high marsh and 7,900 square feet of tidal marsh.

| Functions | Raptors | Shore-line Birds | Water-fowl | Migratory Birds | Native Fish | Sport Fish | Macro Invertebrates and Primary Producers | Bivalves | Functional Habitat Index (FHI) |
|---|---|---|---|---|---|---|---|---|---|
| Hard Substrate – Drainage Box Culvert with improvement | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 70 |
| Water Exchange | 5 | 5 | 10 | 5 | 10 | 10 | 10 | 10 | 65 |
| Substrate Diversity | 5 | 5 | – | 5 | 5 | 5 | – | – | 25 |
| Nutrient Input | 5 | 5 | 5 | 5 | 5 | 5 | 10 | 10 | 50 |

**Table 5. (continued)**

| Functions | Raptors | Shore-line Birds | Water-fowl | Migratory Birds | Native Fish | Sport Fish | Macro Invertebrates and Primary Producers | Bivalves | Functional Habitat Index (FHI) |
|---|---|---|---|---|---|---|---|---|---|
| Nutrient Processing | 5 | 5 | 5 | 5 | 5 | 5 | 10 | 10 | 50 |
| Water Quality | 5 | 5 | 5 | 5 | 10 | 10 | 10 | 10 | 60 |
| Roosting Habitat | 5 | 5 | – | 5 | – | – | – | – | 15 |
| Nesting Habitat | – | 5 | 5 | – | – | – | – | – | 10 |
| Native Vegetation Propagation | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 40 |
| Shoreline Foraging Habitat | – | 10 | – | 10 | – | – | 10 | – | 30 |
| Sediment Stabilization | – | 5 | – | 5 | 10 | 10 | 10 | 10 | 50 |
| Tidal Marsh Protection from Predation | – | – | – | – | 10 | 10 | 10 | – | 30 |
| Structure/Tidal Marsh (Drainage Culverts) Protection from Predation | – | – | – | – | 10 | 10 | 10 | – | 30 |
| **TOTAL** | | | | | | | | | **525** |

Direct Benefit = 10 Indirect Benefit =5

The first step in incremental analysis is to display the environmental outputs (FHI) and the cost estimates of the management measures increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average annual outputs and average annual costs were used for this analysis.

Table 6 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no work is undertaken to restore the tidal marsh. Alternatives 2 and 3 represent project outputs for the tidal marsh restoration alone and the tidal marsh in conjunction with the drainage channel rehabilitation work. The pertinent variables for each alternatives contribution to FHI outputs are displayed in the following table.

**Table 6.**
**Outputs and Costs by Increments**

| Alternatives | Alternative Description | Total First Cost | Annualized First Cost | O&M | Average Annual Cost | Output FHI |
|---|---|---|---|---|---|---|
| Alternative 1 | No Action | $0 | $0 | $0 | $0 | 80 |
| Alternative 2 | A2 Replace Open Channel Drain Bracing | $270,000 | $24,186 | $5,000 | $29,186 | 80 |
| Alternative 3 | A3 Wetland Restoration | $250,000 | $22,564 | $5,000 | $27,186 | 525 |
| Alternative 4 | A4 Replace Bracing and Wetland Restoration | $520,000 | $46,749 | $5,000 | $51,749 | 525 |

Additional output is the output of each alternative above the baseline condition. Alternative 1 is the baseline condition. Using this as the baseline, the additional output for Alternative 1 will be zero. The additional output of the other four alternatives will be the difference between the average annual output of the baseline condition and the average annual output of the alternative.

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (FHI) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their outputs. The result is a ranking of Alternative 1, 2 then 3 as displayed in Table 7. Where two or more solutions produce the same output, the solutions are ranked in ascending order of their costs. At each level of output the least cost solution is determined. Alternatives 2 and 4 are eliminated at this point. Alternative 2 has the same output as alternative 1, 80 FHIs but is more costly. Alternative 4 produces the same level of outputs as alternative 3 yet is more costly. Therefore these two alternatives are eliminated as not cost effective solutions (See Table 3).

**Table 7.**
**Summary of Costs and Additional Outputs in Ascending Order**

| Alternative | Alt. description | First Cost | Annualized first cost | O&M | Average Annual Cost | Outputs |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 80 |
| 2 | A2 Replace Bracing | $270,000 | $24,186 | $5,000 | $29,186 | 80 |
| 3 | A3 Wetland Restoration | $250,000 | $22,564 | $5,000 | $27,186 | 525 |
| 4 | A4 Wetland Restoration | $520,000 | $46,749 | $5,000 | $51,749 | 525 |

Shading over Inefficient Solutions

Table 8 represents the selected least cost solution for each level of output.

**Table 8.**
**Outputs and Costs of Least Cost Solutions for Each Level of Output**

| Alternatives | Average Annual Costs | Outputs |
|---|---|---|
| A1 No Action | $0 | 80 |
| A3 Wetland Restoration | $27,186 | 525 |

The fifth step in incremental analysis is to eliminate economically ineffective solutions. The outputs and costs undergo a pair-wise comparison. The results of the comparison are analyzed to determine which solutions will produce less output at equal or greater cost than subsequently ranked solutions. Those solutions will produce less output at equal or greater cost than subsequently ranked solutions. This step is not necessary since the results are the same as that obtained in step 4.

The sixth step is to calculate average costs for the set of solutions that emerged from the cost effectiveness analysis. Average costs are calculated by dividing each level of output's cost by its output. Alternatives with outputs less than the lowest average cost level are eliminated from further analysis. Alternative 1 (the no action plan) does not have an average cost per unit of output, since it does not cost anything or produce anything. Table 9 displays this information.

**Table 9.**
**Average Cost of Each Level of Output**

| Alternative | Output | Cost | Average Cost ($) per FHI |
|---|---|---|---|
| 1 | 80 | 0 | N/A |
| 3 | 525 | $27,186 | $51.78 |

The next step is to recalculate average costs for additional output. The average costs are calculated for additional output using the incremental levels of output. These calculations begin with the lowest average cost level of output, the "zero level" output. The average costs are calculated using the additional costs and additional outputs above those of the previously identified level of outputs with the lowest average cost. Levels of output less than the lowest average cost are eliminated from further analysis. This process is repeated until the final level of output is identified as the lowest average cost of output

Calculating the incremental costs is the eighth step. The difference in cost between two solutions divided by the difference in output between the same two solutions is the incremental cost. Table 10 shows the calculations. Alternative 3, which consists of restoration of the wetland results in an incremental cost of $61.09 per FHI unit of output.

**Table 10.**
**Incremental Costs**

| Output (FHI) | Cost | Additional Output | Additional Cost | Incremental Cost ($ per FHI) |
|---|---|---|---|---|
| 80 | $0 | 0 | $0 | $0 |
| 525 | $27,186 | 445 | $27,186 | $61.09 |

Table 11 represents the alternatives with the lowest overage costs for additional output.

**Table 11.**
**Solutions with Lowest Average Costs for Additional Output**

| Alternative | Description | Outputs (FHI) | Costs ($) | Incremental Costs ($ per FHI) |
|---|---|---|---|---|
| 1 | No Action | 80 | 0 | $0 |
| 2 | Wetland Restore | 525 | $27,186 | $61.09 |

The final step is to compare successive outputs and incremental costs. The results from the incremental costs are compared and then used as a decision making tool by progressively proceeding through the available level of outputs and asking if the next level is "worth it." That is to say, "is the habitat value of the additional unit of environmental benefit in the next available level of output worth its additional monetary costs?"

*Aesthetics*

The restored marsh will serve the important function of providing nursery areas for fishes, shellfish, and crustaceans as well as stabilizing sediments in the immediate area. Various shorebirds and migratory birds utilize areas along the Mississippi shoreline. Restoring the marsh will provide valuable shorebird habitat.

# ECONOMIC ANALYSIS FOR SHEARWATER BRIDGE EROSION CONTROL AND HURRICANE STORM DAMAGE REDUCTION JACKSON COUNTY, MS

## Introduction

This section describes the economic analysis evaluation to protection of the approaches and abutments for the Shearwater Bridge that were damaged by Hurricane Katrina storm surge in Jackson County, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

The bridge is located in Jackson County, the easternmost coastal county in Mississippi. It is located on Mississippi Sound 54 miles west of Mobile, Alabama and about 93 miles east of New Orleans, Louisiana. The bridge is located on Shearwater Drive in Ocean Springs, MS on a paved road at the east end of the Ocean Springs harbor within the Ocean Springs metropolitan area at the head of the Jackson County Harbor entering the Mississippi Sound. The bridge carries Shearwater Road over the upland harbor channel. The bridge elevation is approximately El. 20 NGVD. Storm surge inundation limits at Shearwater Drive Bridge site from Katrina are estimated approximately at elevation 21 ft NGVD.

**Problem Statement** The existing timber retaining walls protecting both approaches and abutments to the bridge are failing. The timber has deteriorated and the walls were inundated by the storm surge, which caused additional failure and loss of fill material. This bridge also is a local evacuation route. Another strong storm surge could cause the bridge to fail or the approaches to become impassable. This bridge serves as an important evacuation route and it provides access to the many boats in the marina that must be moved out of harm's way when severe weather is forecast.

## Opportunities

**Opportunities identified** for this problem area were required to be linked to one or more of the following:

a. Hurricane storm damage reduction or remediation
b. Prevention or remediation of Saltwater Intrusion
c. Preservation of Fish & Wildlife and restoration of their habitats
d. Prevention or remediation of erosion
e. Other related water resource purposes, such as ecosystem restoration or barrier island restoration

They include:

- Reduction of future hurricane-caused damage created by storm surge;

- Reduction of future damage caused by waves created during hurricanes and other storms;
- Repair of damages to public facilities caused by 2005 storm events;

**Measures evaluated for this specific problem area included** the following ***non-structural*** measures:

- Storm and Flood Warning
- Evacuation
- Flood Insurance
- Storm and Flood-proofing
- Purchase and Buy-Out of Damageable Property

**Measures evaluated for this specific problem area included** the following ***structural*** measures:

- Replacement and extension of timber retaining walls;
- Replacement of existing timber retaining walls with new vinyl sheet piling;
- Replacement of existing timber retaining walls with new steel sheet piling;

# Assumptions

The following assumptions are used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent will be used in estimating average annual benefits and costs

b. Price levels are October, 2006.

c. A 50-year period of analysis is used since that is the remaining physical life of the rehabilitated seawall.

d. Impacted area (Jackson County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

**Alternative Plans.** A no action alternative and three alternative plans were evaluated for protecting Shearwater Bridge: timber bulkhead, steel sheet piling and vinyl sheet piling. Each alternative involves extending and raising the existing protective walls.

*No Action Alternative*. The 'No Action' alternative involves the continuation of existing conditions and no new solutions for existing problems. This alternative avoids both the monetary investment and potential adverse impacts associated with continued shoreline erosion. Without corrective action, significant erosion would continue with the resultant loss of navigable waterways and valuable environmental habitat.

*Steel Sheet Piling*. This alternative would consist of the installation of continuous interlocked steel sheet piling along both sides of the north and south approaches of the bridge. The total length of sheet pile wall would be approximately 675 feet. The wall's top elevation would vary from elevation 20.48 ft to elevation 12, with an average height of 17 feet. The sheet pile bulkheads would be anchored to each other by using steel tie rods under the roadway. Filter fabric will be placed behind the bulkhead and the bulkhead would then be backfilled with gravel and sealed at the top with a reinforced concrete cap.

*Vinyl Sheet Piling*. The vinyl sheet pile alternative is essentially the same as the steel alternative except for the sheet pile material. There would some different considerations for material thickness

and anchorage spacing, but otherwise this plan would be very similar to the steel sheet piling alternative.

Timber Bulkhead. This option would be similar to what is there now, with the exception of extending and raising the walls. More substantial piling and depth of embedment would be used. Filter fabric and proper backfill will also be used.

**Structural Considerations.** In assessing the relative value and effectiveness of steel sheet piling and vinyl sheet piling, the durability provided was of paramount importance. The forces imposed on these sheet pile structures will be moderate to high, consisting of vertical weight of a portion of the small concrete cap, backfill pressures generated by the sand fill placed behind the bulkhead, roadway or vehicular loads, and periodic lateral seepage pressures generated by migrating water. The sheet pile sections used should be more than adequate to resist these pressures. The critical factor will be the ability of the bulkhead to resist saltwater corrosion. Considering all these parameters, the vinyl or some vinyl composite Z-pile, engineered for the purpose, is considered best for this application. These materials are extremely resistant to saltwater environments, are strong enough to resist loads imposed on the bulkhead, and therefore should serve almost indefinitely in providing protection for the bridge approaches.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Timber Bulkhead | Moderate | $850,000 | $0 |
| Alt 3 | Steel Sheetpile | Significant | $1,810,000 | $0 |
| Alt 4 | Vinyl Sheetpile | Significant | $1,480,000 | $0 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The majority of the benefits estimated in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time.

# National Economic Development (NED)

According to the P&G, “The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. This evaluation is not applicable for this project since the project is located at sea level evaluation. All with project remedies do not project a change in the flood frequency hydrograph. As such these projects will generate no Flood Damage benefits.

## *Traffic Diversion Benefits*

The categories used for analysis are variable vehicular costs, and the opportunity cost of time. The analysis is based on ER 1105-2-100, paragraph E-50d3a on page E-183, (1) the variable vehicular costs using the travel cost method, paragraph D-4f page D-18, (2) the opportunity cost of time. The values used to calculate the opportunity cost of time were obtained from table D-4 in ER 1105-2-100, Appendix D, page D-20. The procedure to calculate the value of time was obtained from IWR 91-R-12.

In the past evaluations of the NED traffic diversion benefits were obtained through Section 14 like analysis which studied protection and prevention of public infrastructure failure. Through these studies the value of time lost due to rerouting of traffic and the additional vehicle operating costs were obtained from investigations of road or bridge failure.

The methodology used to estimate traffic diversion benefits at Shearwater Bridge will utilize benefits transfer. It involves using economic values that have been previously estimated and reported in an existing study as surrogates to measure the benefits for repairing the bridge before failure when compared to the no action alternative, fix on failure.

Specifically, per-unit value estimates from existing economic studies are combined with site-specific resource information to estimate total benefits. Unitized outputs from a similar previously studied and evaluated project will serve as surrogate values of unitized outputs to characterize the outputs in this similar proposed project.

Traffic diversion benefits were calculated in detail for the Downtown Bay Saint Louis Seawall Project, which is one of the potential projects for approval and authorization in this Coastal Mississippi Study.

Travel costs for the traffic diversion value of time were determined in the Bay Saint Louis Seawall Project. From that analysis unitized values for time delay and variable vehicle operating costs were computed. The value for vehicle operating cost is $0.009425/incremental foot traveled/vehicle. The value for time lost is $0.053771/vehicle/second detoured. The additional travel distance is 1600 feet and the additional time lost traveling the alternate route is about 31.17 seconds.

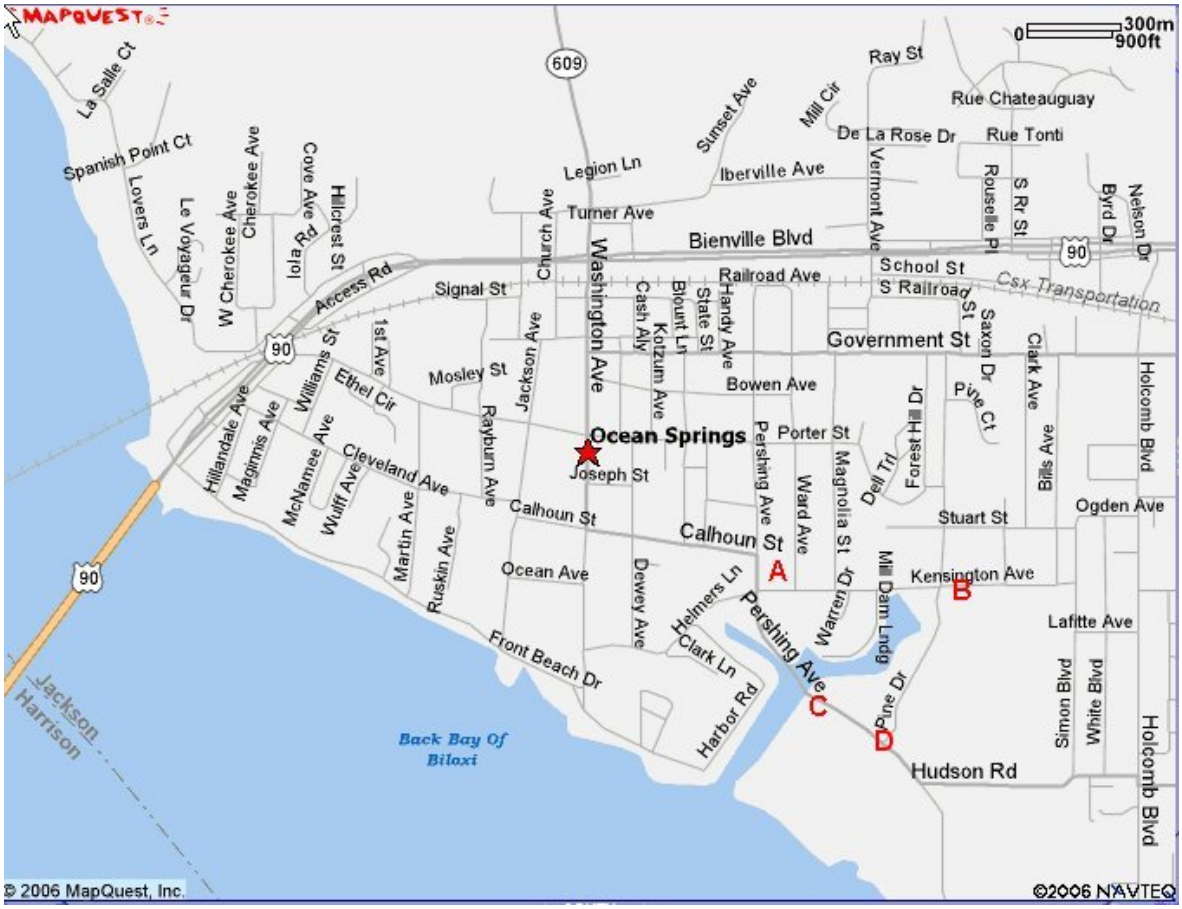



**Figure 1.**

*No Action Alternative – Fix on Failure*

The above figure shows the current route across Shearwater Bridge, travelers going North follow points D, C, to A whereas travelers going South reverse the route. If the approach to the bridge or the bridge itself is impassable then an alternate detour route must be used: D, B, to A for North bound travelers and the same route reversed for south bound travelers. The alternate route is 1,600 feet longer than the normal route will require and additional 31.17 seconds to complete the route. The Mississippi Department of Transportation shows the average traffic count using Shearwater Bridge is 1100 vehicles daily.

*Time and variable operating cost benefits*

The value for vehicle operating cost is $0.009425/incremental foot traveled/vehicle derived from the Bay Saint Louis Seawall evaluation. The variable operating cost benefit for the detoured route is $16,587 ($0.009425 X 1600 X 1100).

The value for time lost is $0.053771/vehicle/second detoured. The additional travel distance is 1600 feet and the additional time lost traveling the alternate route is about 31.17 seconds. The value of time lost benefit for the detoured route is $1,844 ($0.053771 X 1100 X 31.17).

Mobile District's Engineering branch has predicted that inundation above elevation 6' would most likely result in a structural failure to the approach or the bridge itself that would result in it being declared unsafe to traffic until repaired. A nearby gage at Biloxi was referenced to identify the storm frequency associated with that elevation and above.

The guage predicts that the 6-foot elevation would be reached by a 50-year or less frequent storm event. The benefits to the project are the losses prevented from vehicle varying operating costs and time delays from those in the vehicles from the frequencies of the storms that are equal to and greater than the 50-year event. The next table displays the average annual costs integrated with the frequency of storm events. The average annual HSDR savings is $332 and rounds to $330.

**Table 2.**
**Shearwater Bridge, Jackson County Frequency Analysis of With-Plan Benefits**

| Frequency | 1/Freq | Incr. Prob. | Benefits by Freq | Benefits Average | AAD Dollars |
|---|---|---|---|---|---|
| | | 0.002 | | $0 | $0 |
| 1000 | 0.001 | | $18,431 | | |
| | | 0.001 | | $18,431 | $0 |
| 500 | 0.002 | | $18,431 | | |
| | | 0.008 | | $18,431 | $147 |
| 100 | 0.010 | | $18,431 | | |
| | | 0.003 | | $18,431 | $61 |
| 75 | 0.013 | | $18,431 | | |
| | | 0.007 | | $18,431 | $123 |
| 50 | 0.020 | | $18,431 | | |
| | | 0.000 | | $0 | $0 |
| 1 | 1 | | $0 | | |
| | | 0.5 | | $0 | $0 |
| Sum | | 1 | | | $332 |

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, “displays of non-monetary effects on ecological, cultural, and aesthetic resources…” The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *1) Habitat*

Removal of the sediment would provide flushing of the system and improvement to tidal exchange resulting in less stagnant water. Removal of the obstructions would allow fish to migrate up the systems by the sub-adult and larvae for use as a forage area. The improved habitat would also improve foraging areas for shorebird use. Removal of the non-biodegradable foreign material and deposition of sediments would improve overall water quality by improving circulation and enhanced drainage in the area resulting in an overall reduction of flooding to nearby residences.

### *2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The Bayou Cassotte waterways, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways at Bayou Cassotte. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape. See Figures 2 and 3.

**Figure 2.**

**Figure 3.**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Jackson County is located in the lower east corner of Mississippi. The County shares its borders with Mobile County to the east, Harrison County to the west and George County to the north. According to the 2000 Census, the county has a population of 131,420. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 3 shows the employment breakdown for Jackson County. The manufacturing industry is a significant employer; accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 3.**
**Employment Breakdown of Jackson County**

| Sector | Mississippi | Jackson County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 16,000 | 9% |
| Wholesale | 35,316 | 600 | 2% |
| Retail | 135,838 | 5,564 | 4% |
| Real Estate | 9,665 | 370 | 4% |
| Professional | 29,023 | 1,600 | 6% |
| Administration | 46,115 | 1,330 | 3% |
| Education | 1,678 | 84 | 5% |
| Health Care | 131,976 | 4,620 | 4% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 3,587 | 3% |
| Other Services | 22,180 | 1,315 | 6% |
| Total | 713,310 | 35,170 | 5% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Jackson County was $17,768 and the median household income was $39,118 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 4 displays the income breakdown for Jackson County.

**Table 4.**
**Income Breakdown for Jackson County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Jackson County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 5. The percentage of persons below the poverty level for the state of Mississippi and Jackson County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Jackson County. The unemployment rate for Jackson County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 5.**
**Poverty Level and Unemployment Rate for Jackson County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Jackson County | 12.9% | 6.6% | 12.4% | 15.9% |

## *Socioeconomic Impacts using the Economic Impact Forecast System*

The purpose of this analysis is to determine the economic impact of the proposed project alternatives on business (sale volumes), income, employment, and population of the local area. Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $850,000 for the Timber Pile alternative, $1,810,000 for the Steel Pile Dike and $1,480,000 for the Vinyl Sheet Pile alternative. Annual Operation and Maintenance (O&M) expenditures of $510,000 are only to be expected to occur with the Timber pile only over the 50-year period of study. It will have to be replaced in year 25 of the 50 year period of study. The present worth of that expenditure is $146,191.

## *Methodology*

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The

entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

The attached data sets are the EIFS inputs and outputs data from the EIFS model run for the proposed project alternatives. Also attached is a summary explanation of those outputs.

## *Assumptions*

EIFS assumes that the infrastructure pre-Katrina is intact, in-place, and functioning as a wholesome economic unit in the region of influence. The fact is that under existing conditions many of the established economic infrastructure is not present but transient. In some cases, rebuilt economic units have moved into fill that deficit to provide the goods and services. The assumption of this analysis assumes that the last or destroyed infrastructure will be rebuilt or replace in the near-term and will not significantly reduce the impacts and outputs forecasted in this investigation.

## *Summary Explanation of the EIFS Model Output*

The outputs shown in this section are based on the following input from the proposed project alternatives. The inputs are as followed:

**Table 6.**
**EIFS Model Inputs for the Shearwater Bridge Project Alternatives**

| Indicator Variable | Timber Pile | Steel Pile Dike | Vinyl Sheet Pile | O&M Timber Pile |
|---|---|---|---|---|
| Region of Influence (ROI) | | **Jackson County** | | |
| Change in Local Expenditures | $850,000 | $1,810,000 | $1,480,000 | $146,191 |

Based of the given inputs the outputs are as followed:

**Table 7.**
**EIFS Model Outputs for the Shearwater Bridge Proposed Project Alternatives**

| Indicator Variable | Timber Pile | Steel Pile Dike | Vinyl Sheet Pile | O&M Timber |
|---|---|---|---|---|
| Direct Sales Volume | $860,000 | $1,830,000 | $1,500,000 | $146,191 |
| Induced Sales Volume | $963,200 | $2,049,600 | $1,680,000 | $163,734 |
| Total Sales Volume | $1,823,200 | $3,879,600 | $3,180,000 | $309,925 |
| | | | | |
| Direct Income | $167,722 | $356,897 | $292,538 | $28,511 |
| Induced Income | $187,849 | $399,724 | $327,643 | $31,932 |
| Total Income | $355,571 | $756,621 | $620,181 | $60,443 |
| | | | | |
| Direct Employment | 5 | 10 | 8 | 1 |
| Induced Employment | 5 | 12 | 10 | 1 |
| Total Employment | 10 | 22 | 18 | 2 |
| | | | | |
| Local Population | | | | |

## *Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***Timber Pile***. If implemented, the total sales volume related to this alternative is projected to increase by $2,133,125 ($1,823,200 plus $309,925) in the local area of Jackson County.

***Steel Pile Dike***. If implemented, the total sales volume related to this alternative is projected to increase by $3,879,600 in the local area of Jackson County.

***Vinyl Sheet Pile.*** If implemented, the total sales volume related to this alternative is projected to increase by $3,180,000 in the local area of Jackson County.

## *Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Timber Pile.*** If implemented, the total income related to this alternative is projected to increase by $416,014 ($355,571 plus $60,443) for Jackson County.

***Steel Pile Dike.*** If implemented, the total income related to this alternative is projected to increase by $756,621 for Jackson County.

***Vinly Sheet Pile.*** If implemented, the total income related to this alternative is projected to increase by $620,181 for Jackson County.

## *Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Timber Pile.*** If implemented, the total employment related to this alternative is projected to increase by 12 workers in Jackson County.

***Steel Pile Dike.*** If implemented, total employment related to this alternative is projected to increase by 22 workers in Jackson County.

***Vinyl Sheet Pile.*** If implemented, total employment related to this alternative is projected to increase by 18 workers in Jackson County.

## *Population*

If implemented, the population related to all four alternatives is not projected to increase.

# Other Social Effects (OSE)

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

## *1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 8 shows the number selected housing statistics for census tracts 413 and 421. There are 4,125 housing units in the two tract area. The average structure was built between 1970 and 1975. Of the structures, ninety-two percent are occupied and eight- percent are vacant. Of those occupied, sixty-eight percent are owner occupied and thirty-two percent are renter occupied. Table 9 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 10 shows the value of the owner occupied structures in the two tract area.

**Table 8.**
**Selected Housing Statistics**

| Category | Tract 413 | Tract 421 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 2,612 | 1,513 | 4,125 | |
| Median Year Built | 1975 | 1970 | N/A | N/A |
| Occupancy Status | | | | |
| Occupied | 2,431 | 1,363 | 3,794 | 92% |
| Vacant | 181 | 150 | 331 | 8% |
| Tenure Status | | | | |
| Owner | 1,922 | 674 | 2,596 | 68% |
| Renter | 509 | 689 | 1,198 | 32% |

U.S. Census Bureau, 2000 Census

**Table 9.**
**Number of Units in Structure**

| Units in Structure | Tract 413 | Tract 421 | Total |
|---|---|---|---|
| 1, detached | 2,000 | 900 | 2,900 |
| 1, attached | 18 | 25 | 43 |
| 2 | 22 | 73 | 95 |
| 3 or 4 | 51 | 110 | 161 |
| 5 to 9 | 73 | 117 | 190 |
| 10 to 19 | 17 | 71 | 88 |
| 20 to 49 | 0 | 37 | 37 |
| 50 or more | 13 | 151 | 164 |
| Mobile Home | 396 | 29 | 425 |
| Boat, RV, van, etc. | 22 | 0 | 22 |
| Total | 2,612 | 1,513 | 4,125 |

U.S. Census Bureau, 2000 Census

**Table 10**
**Owner Occupied Values by Census Tracts**

| Category | Tract 413 | Tract 421 |
|---|---|---|
| **Value** | | |
| Less than $10,000 | 36 | 0 |
| $10,000 to $14,999 | 43 | 7 |
| $15,000 to $19,999 | 52 | 19 |
| $20,000 to $24,999 | 80 | 13 |
| $25,000 to $29,999 | 59 | 5 |
| $30,000 to $34,999 | 59 | 12 |
| $35,000 to $39,999 | 79 | 64 |
| $40,000 to $49,999 | 289 | 157 |
| $50,000 to $59,999 | 285 | 104 |
| $60,000 to $69,999 | 290 | 139 |
| $70,000 to $79,999 | 237 | 68 |
| $80,000 to $89,999 | 104 | 39 |
| $90,000 to $99,999 | 61 | 0 |
| $100,000 to $124,999 | 117 | 34 |
| $125,000 to $149,999 | 59 | 0 |
| $150,000 to $174,999 | 50 | 0 |
| $175,000 to $199,999 | 8 | 0 |
| $200,000 to $249,999 | 7 | 0 |
| $250,000 to $299,999 | 7 | 34 |
| $300,000 to $399,999 | 0 | 0 |
| $400,000 to $499,999 | 0 | 0 |
| $500,000 to $749,999 | 0 | 0 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 0 | 0 |
| TOTAL | 1,922 | 674 |
| Median Value for Owner Occupied Housing | $62,900 | $55,800 |
| Median Value for Mobile Homes | $23,500 | $19,500 |

U.S. Census Bureau, 2000 Census

## *2) Health and Safety*

Since the 2005 hurricane season, standing or slow draining water has been a major health concern. Standing water, accompanied with the warm climate, creates a number of issues for local residents. One issue of the standing water is mold and the stale smell that it produces. This mold can cause a number of allergic reactions and has been associated with what has become what locals refer to as the 'Katrina Cough'. Although the 'Katrina Cough' has yet to be medically documented, the frequency and occurrence of people showing the cold like symptoms since the storm has dramatically increased compared to the typical number of cases in regular years.

A second issue of concern is the infestation of gnats and rodents that thrive on these conditions. Gnats are very tiny flies that enjoy the damp warm air and, through nuisance biting, can make it impossible for someone to walk outside at certain times throughout the day. Rodents, notorious carriers of disease, exponentially multiply in warm moist areas like the drainage ways. Slow moving water and debris to hide their movement makes these areas prime breeding ground.

A final health and safety issue is the intrusion of native wildlife into the urbanized areas. Snakes and alligators are coming closer to human dwellings due to their displacement from the storm. Sightings

have significantly increased and the threat to small children and pets are the greatest. Removal of the sediment would alleviate these health risks and improve the quality of life to the local residents.

## Recommended Plan

An long term solution would include the construction of a Vinyl Sheet Pile Dike to protect the Shearwater Bridge from further undermining and potential failure.

## Cost

This least cost effective solution is the Vinyl Sheet Pile Dike.  The construction cost is $1,480,000.

# ECONOMIC ANALYSIS FOR GAUTIER COASTAL STREAMS FLOOD DAMAGE REDUCTION AND ECOSYSTEM RESTORATION, GAUTIER, MS

## Introduction

This section describes the economic analysis evaluation for damage to several drainage way sites in Gautier, Mississippi. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit. evaluation.

## Background

### *Problem Statement*

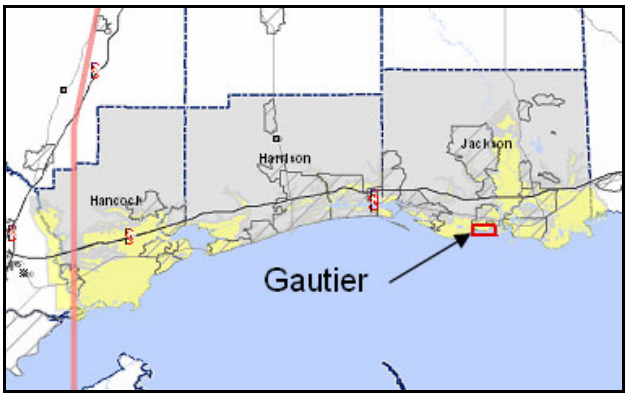
Hurricanes of 2005 caused extensive damage to the drainage ways of Gautier. Runoff from approximately 3000 homes is normally conveyed to the Mississippi Sound via manmade and natural bayous. However, the 19 foot surge created by Hurricane Katrina deposited trees, sediment and other debris into drainage ways, severely limiting their capacity to drain the region. It is estimated that an average of 3 feet of sediment was deposited in nearly 75,000 square feet of drainage ways for the areas of Old Spanish Trail, Graveline Bayou, Hiram Drive, Ladnier Drive, and Seacliff Bayou. The excess sediment has also interrupted the saltwater exchange to the marsh along Bayou Graveline.

### *Opportunities*

The following opportunities were identified for the Gautier area:

1. Reduction of future damages created by flooding from rains associated with hurricanes and major thunderstorms;
2. Repair of damages to public facilities caused by 2005 storm events;
3. Repair of damages to natural resources (primarily erosion of the natural drainage ways at this site) created by 2005 storm events.

### *Project Site*





## Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used to calculate average annual benefits and costs

b. Values shown in the report are stated in October 2005 dollars unless otherwise noted.

c. A 50-year period of analysis was used to calculate average annual benefits and costs.

d. Impacted area (Jackson County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

## *Short-Term*

The short-term alternatives identified for the Gautier project are five different sites. Each site is a drainage area that experienced sediment deposition as a result of storm surge from Hurricane Katrina. Each site has three alternatives.

The project delivery team evaluated the alternatives at each site based on their prospective impact. The projects were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Short-term Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alternative 1 – Combination 1ft | | | $2,280,000 | $28,000 |
| Alternative 2 – Combination 2ft | | | $4,050,000 | $58,900 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

According to the P&G, "The national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. This evaluation is not applicable for this project since the project is located at sea level evaluation. All with project remedies do not project a change in the flood frequency hydrograph. As such these projects generate no NED benefits.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

*1) National Ecosystem Restoration*

Table 2 shows the environmental outputs and costs of the alternatives.

**Table 2.**
**Outputs and Costs**

| Alt | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | Annual O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Removal of 1ft of sediment at each site | $2,280,000 | $127,311 | $28,000 | $155,311 | 245 |
| 3 | Removal of 3ft of sediment at each site (Old Spanish Trail is only 2ft removal) | $4,050,000 | $226,144 | $58,900 | $285,044 | 245 |

*2) Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The Gautier drainage ways, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways at Bayou Cassotte. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape.

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Jackson County is located in the lower east corner of Mississippi. The County shares its borders with Mobile County to the east, Harrison County to the west and George County to the north. According to the 2000 Census, the county has a population of 131,420. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 3 shows the employment breakdown for Jackson County. The manufacturing industry is a significant employer; accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 3.**
**Employment Breakdown of Jackson County**

| Sector | Mississippi | Jackson County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 16,000 | 9% |
| Wholesale | 35,316 | 600 | 2% |
| Retail | 135,838 | 5,564 | 4% |
| Real Estate | 9,665 | 370 | 4% |
| Professional | 29,023 | 1,600 | 6% |
| Administration | 46,115 | 1,330 | 3% |
| Education | 1,678 | 84 | 5% |
| Health Care | 131,976 | 4,620 | 4% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 3,587 | 3% |
| Other Services | 22,180 | 1,315 | 6% |
| Total | 713,310 | 35,170 | 5% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Jackson County was $17,768 and the median household income was $39,118 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 4 displays the income breakdown for Jackson County.

**Table 4.**
**Income Breakdown for Jackson County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Jackson County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 5. The percentage of persons below the poverty level for the state of Mississippi and Jackson County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Jackson County. The unemployment rate for Jackson County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 5.**
**Poverty Level and Unemployment Rate for Jackson County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Jackson County | 12.9% | 6.6% | 12.4% | 15.9% |

Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $4,050,000 for the 3-ft removal alternative (Old Spanish Trail 2-ft Removal included) and $2,280,000 for the 1-ft removal alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $58,900 for the 3-ft removal alternative and $28,000 1-ft removal alternative, which in present worth form amounts to $1,054,814 and $501,590 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent). Table 6 summarizes the inputs by alternative.

**Table 6.**
**Summary of by Project Alternatives**

| Indicator Variable | 1ft Removal | 3ft Removal | 1ft Removal O&M | 3ft Removal O&M |
|---|---|---|---|---|
| Region of Influence (ROI) | Jackson County | Jackson County | Jackson County | Jackson County |
| Change in Local Expenditures | $2,280,000 | $4,050,000 | $501,590 | $1,054,814 |

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The

database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

## *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***3ft Removal.*** If implemented, the total sales volume related to this alternative is projected to increase by $11,839,806 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $2,236,206 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 3ft Removal alternative.

***1ft Removal****.* If implemented, the total sales volume related to this alternative is projected to increase by $6,872,171 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $1,063,371 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 1ft Removal alternative.

## *Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***3ft Removal.*** If implemented, the total income related to this alternative is projected to increase by $2,309,065 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $436,117 (i.e. the total income increased because of O&M) was added to the total income of the 3ft Removal alternative.

***1ft Removal.*** If implemented, the total income related to this alternative is projected to increase by $1,340,248 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $207,384 (i.e. the total income increased because of O&M) was added to the total income of the 1ft Removal alternative.

## *Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***3ft Removal.*** If implemented, the total employment related to this alternative is projected to increase by 67 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 13 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 3ft Removal alternative.

***1ft Removal.*** If implemented, total employment related to this alternative is projected to increase by 39 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 6 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 1ft Removal alternative.

## *Impact on Population*

If implemented, the population related to both alternatives is projected to increase by 0. Table 7 summarizes the impacts.

**Table 7.**
**Summary of Outputs by Project Alternatives**

| Indicator Variable | Projected Δ 3ft Removal | Projected Δ 1ft Removal | Projected Δ 3ft Removal O&M | Projected Δ 1ft Removal O&M |
|---|---|---|---|---|
| Direct Sales Volume | $4,530,000 | $2,740,000 | $1,054,814 | $501,590 |
| Induced Sales Volume | $5,073,600 | $3,068,800 | $1,181,392 | $561,781 |
| Total Sales Volume | $9,603,600 | $5,808,800 | $2,236,206 | $1,063,371 |
| Direct Income | $883,466 | $534,370 | $205,716 | $97,823 |
| Induced Income | $989,482 | $598,494 | $230,402 | $109,562 |
| Total Income | $1,872,948 | $1,132,864 | $436,117 | $207,384 |
| Direct Employment | 26 | 16 | 6 | 3 |
| Induced Employment | 29 | 17 | 7 | 3 |
| Total Employment | 54 | 33 | 13 | 6 |
| Local Population | 0 | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

*1) Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 8 shows the number selected housing statistics for census tracts 410 and 411. There are 4,860 housing units in the two tract area. The average structure was built between 1977. Of the structures, ninety-three percent are occupied and seven-percent are vacant. Of those occupied, seventy-three percent are owner occupied and twenty-seven percent are renter occupied. Table 9 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 10 shows the value of the owner occupied structures in the two tract area.

**Table 8.**
**Selected Housing Statistics**

| Category | Tract 410 | Tract 411 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 2,367 | 2,493 | 4,860 | |
| Median Year Built | 1977 | 1977 | N/A | N/A |
| Occupancy Status | | | | |
| Occupied | 2,100 | 2,396 | 4,496 | 93% |
| Vacant | 267 | 97 | 364 | 7% |
| Tenure Status | | | | |
| Owner | 1,455 | 1,806 | 3,261 | 73% |
| Renter | 645 | 590 | 1,235 | 27% |

U.S. Census Bureau, 2000 Census

**Table 9.**
**Number of Units in Structure**

| Units in Structure | Tract 410 | Tract 411 | Total |
|---|---|---|---|
| 1, detached | 1,547 | 1,900 | 3,447 |
| 1, attached | 33 | 23 | 56 |
| 2 | 12 | 24 | 36 |
| 3 or 4 | 160 | 48 | 208 |
| 5 to 9 | 20 | 82 | 102 |
| 10 to 19 | 8 | 25 | 33 |
| 20 to 49 | 0 | 9 | 9 |
| 50 or more | 132 | 59 | 191 |
| Mobile Home | 405 | 323 | 728 |
| Boat, RV, van, etc. | 50 | 0 | 50 |
| **Total** | **2,367** | **2,493** | **4,860** |

U.S. Census Bureau, 2000 Census

**Table 10.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 410 | Tract 411 |
|---|---|---|
| Value | | |
| Less than $10,000 | 89 | 55 |
| $10,000 to $14,999 | 24 | 15 |
| $15,000 to $19,999 | 36 | 53 |
| $20,000 to $24,999 | 7 | 28 |
| $25,000 to $29,999 | 9 | 39 |
| $30,000 to $34,999 | 55 | 64 |
| $35,000 to $39,999 | 24 | 25 |
| $40,000 to $49,999 | 88 | 285 |
| $50,000 to $59,999 | 132 | 176 |
| $60,000 to $69,999 | 110 | 143 |
| $70,000 to $79,999 | 147 | 111 |
| $80,000 to $89,999 | 238 | 171 |
| $90,000 to $99,999 | 164 | 160 |
| $100,000 to $124,999 | 165 | 233 |
| $125,000 to $149,999 | 93 | 72 |
| $150,000 to $174,999 | 54 | 43 |

**Table 10.**
**Owner Occupied Values by Census Tracts (continued)**

| Category | Tract 410 | Tract 411 |
|---|---|---|
| Value | | |
| $175,000 to $199,999 | 0 | 26 |
| $200,000 to $249,999 | 11 | 60 |
| $250,000 to $299,999 | 0 | 7 |
| $300,000 to $399,999 | 9 | 40 |
| $400,000 to $499,999 | 0 | 0 |
| $500,000 to $749,999 | 0 | 0 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 0 | 0 |
| TOTAL | 1,455 | 1,806 |
| Median Value for Owner Occupied Housing | $80,300 | $71,800 |
| Median Value for Mobile Homes | $13,800 | $23,600 |

U.S. Census Bureau, 2000 Census

*2) Health and Safety*

Since the 2005 hurricane season, standing or slow draining water has been a major health concern. Standing water, accompanied with the warm climate, creates a number of issues for local residents. One issue of the standing water is mold and the stale smell that it produces. This mold can cause a number of allergic reactions and has been associated with what has become what locals refer to as the 'Katrina Cough'. Although the 'Katrina Cough' has yet to be medically documented, the frequency and occurrence of people showing the cold like symptoms since the storm has dramatically increased compared to the typical number of cases in regular years.

A second issue of concern is the infestation of knats and rodents that thrive on these conditions. Knats are very tiny flies that enjoy the damp warm air and, through nuisance biting, can make it impossible for someone to walk outside at certain times throughout the day. Rodents, notorious carriers of disease, exponentially multiply in warm moist areas like the drainage ways. Slow moving water and debris to hide their movement makes these areas prime breeding ground.

A final health and safety issue is the intrusion of native wildlife into the urbanized areas. Snakes and alligators are coming closer to human dwellings due to their displacement from the storm. Sightings have significantly increased and the threat to small children and pets are the greatest. Removal of the sediment would alleviate these health risks and improve the quality of life to the local residents.

*3) Attractive Nuisance*

An attractive nuisance is anything that may attract children onto property. Hurricane Katrina's storm surge left sediment and debris deposited all along the Mississippi Gulf Coast. Culverts and drainage ways are blocked and filled with this debris, creating an attractive nuisance that can be hazard to young children. Examples of attractive nuisances are vegetative debris (trees and shrubs), house hold goods (refrigerators, washers and dryers) and construction/other debris (concrete, rebar, house pylons, automobiles, and boats.

These attractive nuisances have the potential to cause minor to fatal accidents among young children. The removal of this debris will significantly lower the occurrence of these accidents. In addition to health and safety benefits, reduction of attractive nuisances will also decrease expensive health care related costs that will mostly be borne by insurance providers. The increased health care

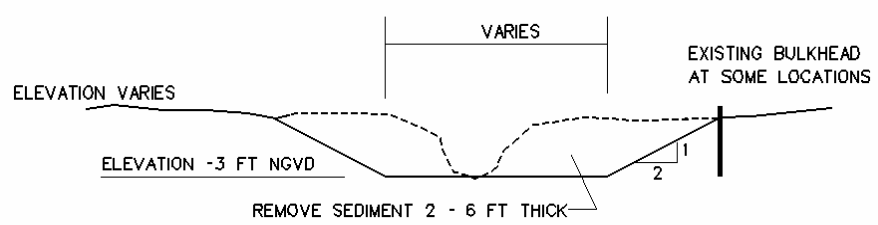
costs will be transferred to the public through higher insurance premiums, and thus represent a savings to the nation.

# Recommendations

An interim solution would include the removal of 3 feet of sediment and debris along the drainage ways and bayous. The average widths of the channels are approximately 50 feet with an average sediment depth of approximately 3 feet. The amounts of sediment removal and associated costs are as follows:

**Drainage Area Sediment**

| | |
|---|---|
| Old Spanish Trail | 1600 cy |
| Graveline Bayou | 38300 cy |
| Hiram Drive | 14700 cy |
| Ladnier Drive | 5100 cy |
| Seacliff Bayou | 13600 cy |




TYPICAL SECTION FOR
ALTERNATIVE 1

The estimated cost of the recommended plan is $4,050,000.

# ECONOMIC ANALYSIS FOR PASCAGOULA BEACH BLVD. RESTORATION PASCAGOULA, MS

## Introduction

This section describes the economic analysis evaluation for repairing damage at Pascagoula Beach Boulevard. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background

### *Problem Statement*

The City of Pascagoula, located in Jackson County, was heavily damaged by the hurricanes of 2005, particularly by the storm surge generated by Hurricane Katrina on August 29, 2005. Approximately 95 percent of the City of Pascagoula became inundated during Hurricane Katrina, including City Hall and most other city owned buildings, 85 percent of all City vehicles including those used by the Police Department. During the height of the storm, City officials were forced to take cover under a bridge as a result of the lack of safe structures and hurricane protection provided. The City of Pascagoula continues to have the greatest number of people that were displaced that continue to reside in FEMA housing. Beach Boulevard was the main thoroughfare along the City of Pascagoula shoreline. The 16-20 foot storm surge and accompanying wave attack: destroyed portions of the road and one of its bridges; damaged the seawall face and seawall joint seals; destroyed lighting and utility conduits upon the seawall; damaged drainage channel walls and channel extension walls; and devastated all of the residential and other private and public structures along the boulevard.

Historically, the City of Pascagoula and Jackson County, conduct repairs to Beach Boulevard and the adjacent seawall on an annual basis. Typical repairs include applying sealant to construction joints, and injection grouting, both of which are used to address the recurring issue of loss of fine soil material from behind the seawall and beneath Beach Boulevard. Loss of fine soils results in recurring damages to the roadway and compromise the structural integrity of the seawall. The average cost of these repairs within the City of Pascagoula alone is between $300k to $1M per year.

At present, the estimate for total damage within the City of Pascagoula is approximately $20 million, excluding the debris removal. Included in the damages is a $3.9M estimate for repair of the City's Water Plants, and another $2.0M in damages to the sewer systems and lift stations.

See Figures 1 and 2.

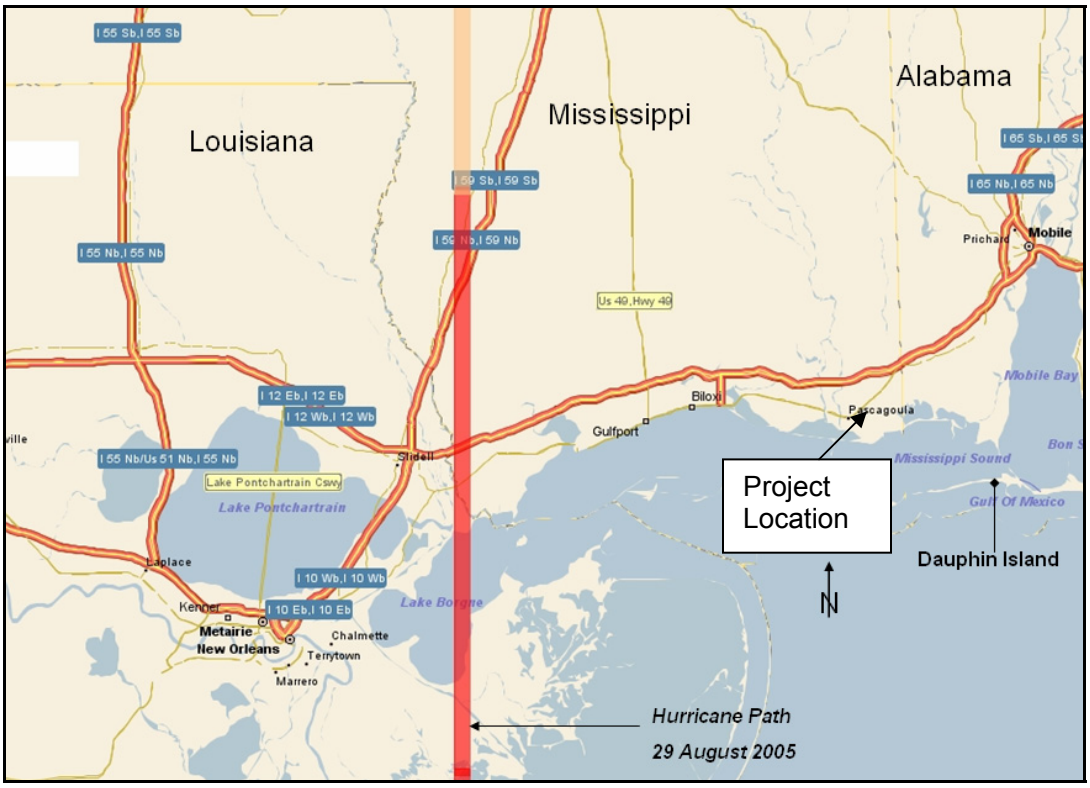



**Figure 1. Location Map Showing Path of Hurricane Katrina**


**Figure 2. Study Area**

Historically, the City of Pascagoula and Jackson County, conduct repairs to Beach Boulevard and the adjacent seawall on an annual basis. The average cost of these repairs within the City of Pascagoula alone is between $300k to $1M per year.

And homes and commercial structures inland of the road, due to the enormous storm surge. At present, the estimate for total damage within the City of Pascagoula is approximately $20 million, excluding the debris removal. Included in the damages is a $3.9M estimate for repair of the City's Water Plants, and another $2.0M in damages to the sewer systems and lift stations.

### *Opportunities*

The following short-term opportunities were identified to be pursued for this problem area:

1. Hurricane storm damage repair;
2. Preservation of Fish & Wildlife and restoration of their habitats.

## Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent will be used in estimating average annual benefits and costs

b. Values shown in the report are stated in October 2006 dollars unless otherwise noted.

c. A 50-year period of analysis was used since that is the remaining physical life of the rehabilitated seawall.

d. Impacted area (Jackson County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

## Alternatives

Three plans were evaluated for shoreline protection and environmental enhancement. The first plan addresses seawall repair and replacement of the streambank walls of the drainage channel west of 11$^{th}$ Street. These measures are recommended as part of all three alternatives due to the need to preserve a robust shoreline protection and drainage system. The second alternative addresses environment objectives. The third alternative is a permutation of the second in that a dune is added to enhance the environmental value of the sand beach and to provide a source of sand replenishment for beach sand lost over time to littoral processes.

**No Action Plan – Alternative 1.** This alternative involves no federal action.

**Seawall and Channel Repair and Rehabilitation. – Alternative 2.** The objective of this alternative is to restore the shoreline storm defense system by improving the seawall's damaged condition, replacing the failed drainage channel walls, and replacing that channels right extension wall pile cap.

The concave seawall west of Beach Park would have it's joints cleaned and re-sealed (approximately 237 joints); impacted and spalled areas re-surfaced; exposed rebar cleaned, treated, and re-covered; and significant longitudinal and transverse cracks would be sealed.

The seven destroyed cell caps of the cellular seawall east of Beach Park would receive new cell caps. The cells covered by the caps would first be cleared of debris and backfilled with suitable material.

The failed stream bank panels of the drainage channel west of 11th street would removed and replaced by either vinyl sheet pile or concreted panel walls. The remains of approximately 60 feet of this stream's extension wall cap would be removed and replaced with a new reinforced concrete cap.

**Alternative 2 and Beach Placement. – Alternative 3.** Historically, a delicate balance existed between the available sand supplied to the beach and that borne away by near-shore currents. Where they exist, seawalls along the Mississippi Coast have eliminated the shoreline supply and reflected local wave energy. Over time, the sand beaches have disappeared most of the armored south facing Mississippi coast, as have the shoreline ecological communities dependent upon the sand beaches. This alternative would provide for the placement of a sand beach to enhance the environmental value of the shoreline.

The beach would extend from the west end of the seawall near Spanish Point to the drainage channel just west of Beach Park, a distance of approximately 7,700 feet. A schematic elevation view of the alternative is shown in Figure 3 (the dune shown in that figure applies to Alternative 3). Assuming an average depth of placement of four feet and a waste factor of 15%, approximately 229,000,000 cubic yards of medium to fine-grained sand would be needed. The beach would need to be periodically re-nourished; beach maintenance experience in neighboring Harrison County suggests a 12-year re-nourishment cycle. Existing drainage channel guidewalls would not need to be extended for this alternative.

However, because the drainage culverts on the beach side of the seawall must be extended at nearly 15 times their current length, it would be conservative to assume that all 14 culverts would need to be enlarged. If adequate discharge could be provided by joining the ends of the existing culverts to an enlarged culvert via an expanding section the cost and effort would not be great. However, if the culverts must be replaced in their entirety in order to provide adequate conveyance, the culvert replacement and extension cost would increase tremendously, as excavation would need to proceed upstream through the seawall and, possibly, Beach Boulevard, to the nearest convenient location (perhaps a junction) to insert the replacement culvert sections.

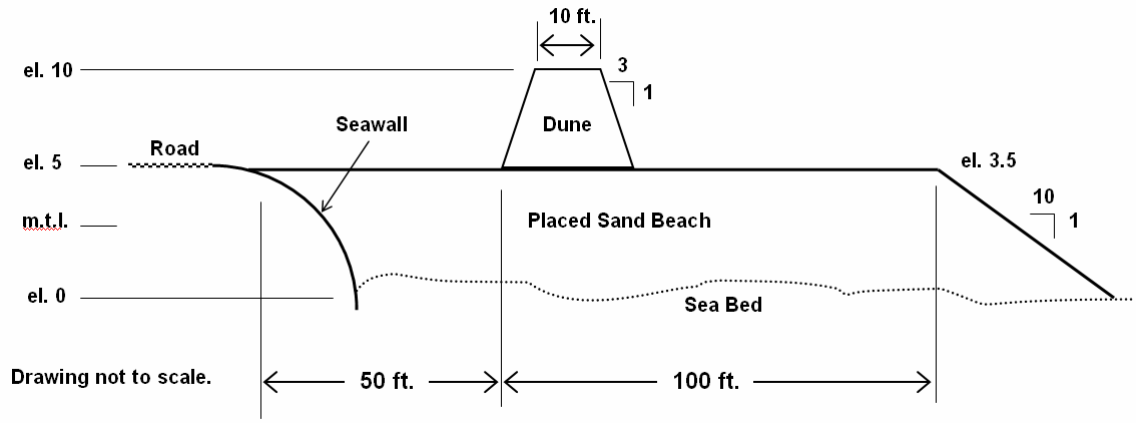



**Figure 3. Elevation view, Alternative 3 and Alternative 4 (with dune) beach.**

**Alternative 3 and a Beach Dune. – Alternative 4.** This alternative adds a dune to the beach profile of Alternative 2 as shown in Figure 3. The purpose of the dune is to provide vertical ecological

complexity to an otherwise horizontal beach environment. The dune would be utilized by species that would otherwise not inhabit a horizontal sand beach. Because the primary purpose of the dune is to provide ecological benefit, pedestrian pathways would not be constructed over them. The dunes would be vegetated and sand fencing would be installed to help resist landward dune migration and wind-borne sand loss. The dune would also provide a source of beach material for sand borne away by nearshore currents. The estimated quantity of sand required to construct the dunes as shown in the figure is approximately 41,000 cubic yards, with 8 acres of plantings and approximately 8,470 feet of sand fencing. Table 1 summarizes the alternatives and their costs.

**Table 1.**
**Impact Ratings for Various Short-term Alternatives**

| Alternative | Description of Action | Total Cost ($) | Annual O&M ($) |
|---|---|---|---|
| Alt 1 | No Action | N/A | N/A |
| Alt 2 | Seawall and Channel Repair and Rehabilitation | $1,790,000 | $0 |
| Alt 3 | Alt. 1 plus Beach Placement | $6,470,000 | $913,900 |
| Alt 4 | Alt. 2 plus Beach Dune | $7,460,000 | $693,600 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

The purpose of this analysis is to determine the National Economic Development (NED) benefits associated with several proposed alternative solutions to protect a 6,500 foot segment of highway on the Mississippi Sound. According to the P&G, “The national economic development account displays changes in the economic value of the national output of goods and services. NED benefit evaluation for the Beach Boulevard restoration will fall under two categories: traffic rerouting and recreation. The findings of these analyses are detailed in the following sub-sections.

### *Existing Conditions*

The Pascagoula waterfront extends from Spanish Point, at the mouth of the Pascagoula River (drainage area 9,498 sq. miles) east to Bayou Cassotte. The project limits generally coincide with the western half of the waterfront, from Spanish Point to Beach Park.

The majority of the shoreline there is protected by a concave seawall constructed in 1929 to protect Beach Boulevard (Figure 5). Electrical conduits for street lighting are housed in a concrete curb placed adjacent to and landward of a low concrete railing atop the seawall. The conduit housing was broken and severed in numerous locations during Hurricane Katrina. The seawall foundation details are presently unknown, but it is believed to be founded variously on the shoreline bed, and/or upon irregularly spaced pile, and/or upon debris placed historically to stem beach erosion and storm damage. The seawall crest elevation varies somewhat and is slightly lower than the centerline of Beach Boulevard, the elevation of which varies between 4.1 and 6.2 feet NGVD[1], which is on the order of 10 to 15 feet below the estimated maximum Hurricane Katrina surge heights in the area as

[1] Assumed datum, information received is unclear as to the profile datum.

depicted in Figure 4. Land use north of the roadway in this area is primarily residential, with at grade elevations generally between elevations 8 to 14 feet NGVD.

The seawall is penetrated in fourteen locations by circular concrete drainage culverts as shown in Figure 6. The culverts are held in place by 'T' shaped concrete monoliths. Chevron shaped concrete flow deflectors are deployed off the south east corner of each monolith to help prevent the culverts from filling with sediments. The culverts and monoliths appear to be in good condition, as do most of the flow deflectors, though some exhibit a good deal of wear. No direct evidence of hurricane damage was observed on the culvert outfall structures.

The seawall is also penetrated in two locations by open drainage channels. One channel is west of 11th Street (see Figures 7 through 9), the other adjacent to the west end of Beach Park. Upstream of the Beach Boulevard bridge, the channel west of 11th Street consists of concrete panel walls with a concrete cap and a natural streambed. Each pile panel is approximately 30 feet long, one foot thick, and of unknown height (possibly 12 to 15 feet). The channel is "S' shaped between the Beach Boulevard bridge and the Washington Street bridge and approximately 330 feet long. All concrete panels exhibit rotational and/or translational failure with localized erosion behind the panels. Downstream of the Beach Boulevard Bridge, the channel is confined by concrete pile training walls extending out to sea. About 60 feet of the concrete pile cap upon the right (looking to sea) training wall appears to have been damaged during Hurricane Katrina.

A vertically-walled, cellular seawall extends east of Beach Park to the east end of Beach Boulevard (Figure 10). This seawall was apparently built in the 1970's. The seawall protects the west end of Beach Boulevard and a portion of un-armored public right-of-way beyond it. This portion of the seawall is approximately 8 feet wide and also functions as a walkway It appears to have been backfilled with soil and capped with approximately 6 feet by 8 feet irregularly-shaped architectural concrete panels. Seven of the panels were displaced and broken by hurricane surge in the region of the un-armored shoreline. The open cells have since served as an informal repository for miscellaneous storm debris. The seawall otherwise appears to be in good condition.

The Beach Boulevard roadway surface reportedly has been historically subject to periodic, localized subsidence associated with persistent wave activity and aggravated by wind and rain storm events due to migration of fill to Mississippi Sound. Fill migration paths are interpreted to be through failed construction joint seals and/or beneath exposed portions of the seawall footing. Loss of fill through these pathways may be exacerbated by storm events, but the constant ebb and flow of the tide and the normal wave regime can also recruit fines past the seawall. Several hundreds of thousands of dollars have been spent trying to halt or reduce the flow of fines, primarily by injecting grout behind the seawall and periodic maintenance of construction joint seals. No evidence of damages attributable to loss of fines under or through the seawall due to Hurricane Katrina were observed during field inspections in April 2006. However, where construction joints had been sealed with caulk, with little exception the caulk exhibited tears, voids, or missing sealant. In those few instances where joints had been sealed by the application of rubber strips pressed into the joint gap, the seals appeared to be in good condition. There were also numerous locations of impact damage on the seawall face, with exposed and corroding reinforcement steel at some of these locations. Nearly every seawall panel exhibited longitudinal cracking, and in some instances vertical cracking.

Construction joints are a potential roadbed fines migration pathway and all construction joints should be sealed, at a minimum, along their entire length to at least the level of mean low water. Likewise; where other cracks on the seawall face are on the order of ¼" wide or wider, they should be cleaned and sealed in the most appropriate manner. Impact damages should be repaired to restore the original seawall surface in order to best protect reinforcement steel and maintain the structural integrity of the seawall. Exposed and corroded reinforcement steel should be cleaned or replaced as necessary and then covered with an adequate thickness of durable patching material.

Additionally, the drainage channel walls in the vicinity of the 11th street outlet have experienced rotational and/or translation failure will loss of bank material behind them.

**Figure 4. Concave seawall, culvert outfall, and pier, looking east**

**Figure 5. Concave culvert outfall monolith and chevron deflector, near Spanish Point**

**Figure 6. Damaged Seawall joint with exposed reinforcement steel**

*Traffic Diverting Benefits*

The categories used for analysis are variable vehicular costs, and the opportunity cost of time. The analysis is based on ER 1105-2-100, paragraph E-50d3a on page E-183, (1) the variable vehicular costs using the travel cost method, paragraph D-4f page D-18, (2) the opportunity cost of time. The values used to calculate the opportunity cost of time were obtained from table D-4 in ER 1105-2-100, Appendix D, page D-20. The procedure to calculate the value of time was obtained from IWR 91-R-12.

In the past evaluations of the NED traffic diversion benefits were obtained through Section 14 like analysis which studied protection and prevention of public infrastructure failure. Through these studies the value of time lost due to rerouting of traffic and the additional vehicle operating costs were obtained from investigations of road or bridge failure.

The methodology used to estimate traffic diversion benefits at Pascagoula Beach Boulevard will utilize benefits transfer. It involves using economic values that have been previously estimated and reported in an existing study as surrogates to measure the benefits for repairing the bridge before failure when compared to the no action alternative, fix on failure.

Specifically, per-unit value estimates from existing economic studies are combined with site-specific resource information to estimate total benefits. Unitized outputs from a similar previously studied and evaluated project will serve as surrogate values of unitized outputs to characterize the outputs in this similar proposed project.

Traffic diversion benefits were calculated in detail for the Downtown Bay Saint Louis Seawall Project, which is one of the potential projects for approval and authorization in this Coastal Mississippi Study.

Travel costs for the traffic diversion value of time were determined in the Bay Saint Louis Seawall Project. From that analysis unitized values for time delay and variable vehicle operating costs were

computed. The value for vehicle operating cost is $0.009425/incremental foot traveled/vehicle. The value for time lost is $0.053771/vehicle/second detoured. The additional travel distance is 954 feet and the additional time lost traveling the alternate route is about 43.36 seconds.

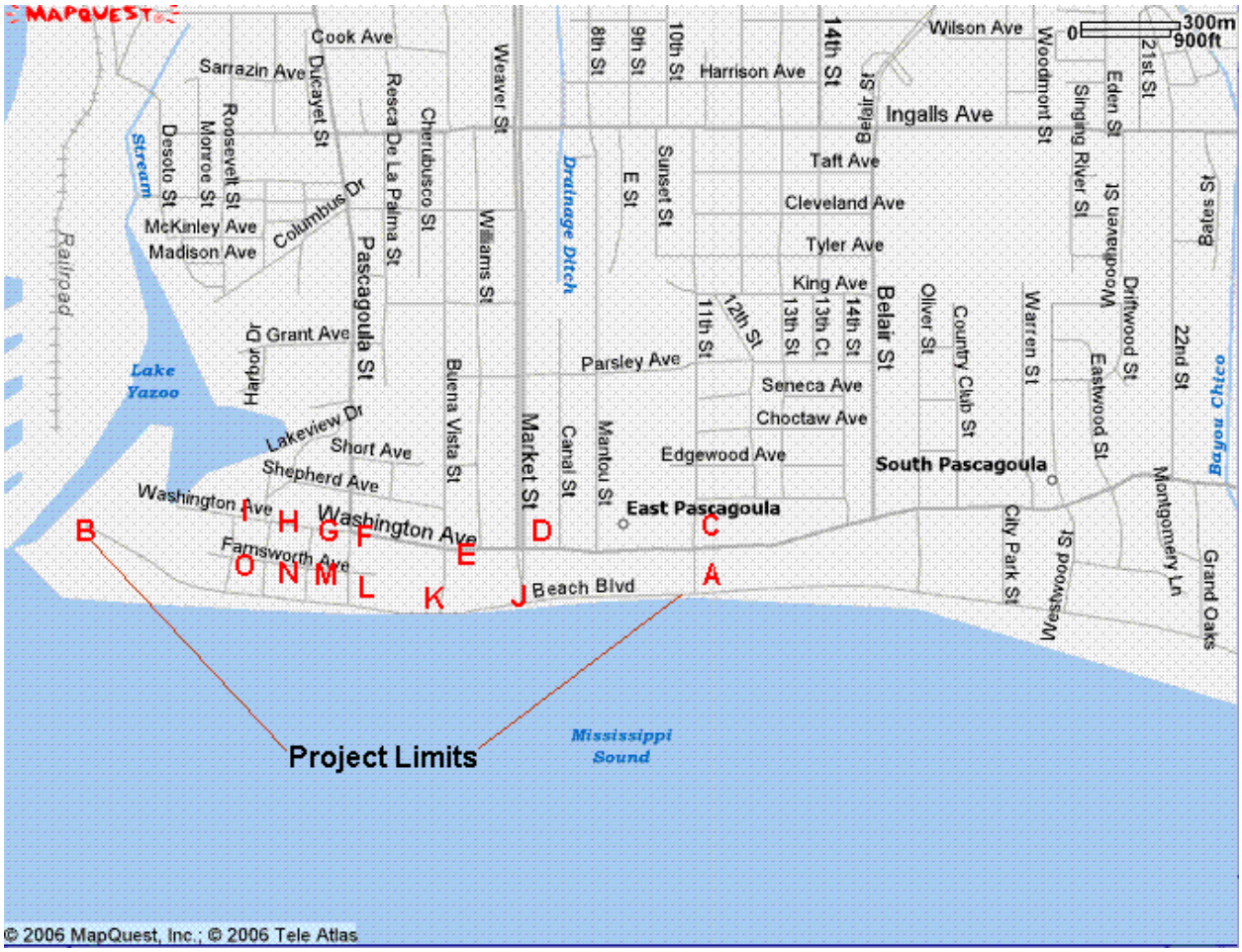



**Figure 7. Existing and Without Project Traffic Routes**

**No Action Alternative – Fix on Failure.** The above figure shows the current route across Shearwater Bridge, travelers going west follow points A to B whereas travelers going east reverse the route. If the seawall were compromised making the road impassable then an alternate detour route must be used: ACDJ; ACEK; ACFL; ACGM; ACHN; or ACIO for west bound travelers and the same route reversed for east bound travelers. On average, the alternate routes are 954 feet longer than the normal route, see Table 2, and will require an additional 43.36 seconds to complete the route. The Mississippi Department of Transportation shows the average traffic count using Shearwater Bridge is 1900 vehicles daily.

**Table 2.**
**Incremental Length of Alternate Routes**

| Route | Length (Linear Ft.) |
|---|---|
| ACDJ | 925 |
| ACEK | 1050 |
| ACFL | 1250 |
| ACGM | 1050 |
| ACHN | 1150 |
| ACIO | 1250 |
| **Total** | **6,675** |
| **Average Incremental Length** | **954** |

Numbers may vary due to independent rounding

Time and variable operating cost benefits

The value for vehicle operating cost is $0.009425/incremental foot traveled/vehicle derived from the Bay Saint Louis Seawall evaluation. The variable operating cost benefit for the detoured route is $17,084 ($0.009425 X 954 X 1900).

The value for time lost is $0.053771/vehicle/second detoured. Using the formula Time = Distance / Speed, the additional travel distance is 954 feet and the additional time lost traveling the alternate route is about 43.36 seconds [954ft / 132,000feett/hour = 0.0072272 x 60 = 43.36 seconds] (25miles/hour. The value of time lost benefit for the detoured route is $4,430 ($0.053771 X 1900 X 43.36).

The level of protection for the Pascagoula Beach Boulevard project will provide protection up to a 20 year storm (5 percent chance of a storm occurring in any given year). The benefits to the project are the losses prevented from vehicle varying operating costs and time delays from those in the vehicles from the frequencies of the storms that are below the 20 year event. Table 3 displays the average annual costs integrated with the frequency of storm events. The average annual HSDR savings is $20,464.

**Table 3.**
**Frequency Analysis of With-Plan Benefits**

| Frequency | 1/Freq | Incr. Prob. | Benefits By Freq | Benefits Average | AAD Dollars |
|---|---|---|---|---|---|
| | | 0.002 | | $0 | $0 |
| 500 | 0.002 | | $0 | | |
| | | 0.046 | | $0 | $0 |
| 21 | 0.048 | | $0 | | |
| | | 0.002 | | $10,757 | $26 |
| 20 | 0.050 | | $20,464 | | |
| | | 0.050 | | $21,514 | $1,076 |
| 10 | 0.100 | | $20,464 | | |
| | | 0.100 | | $21,514 | $2,151 |
| 5 | 0.200 | | $20,464 | | |
| | | 0.300 | | $21,514 | $6,454 |
| 2 | 0.5 | | $20,464 | | |
| | | 0.5 | | $21,514 | $10,757 |
| **Sum** | | **1** | | | **$20,464** |

*Recreation*

The purpose of this section is to provide an analysis of recreation benefits associated with a proposed project for shoreline and erosion protection of areas damaged by Hurricane Katrina in Pascagoula, Mississippi. The project consists of repairing and where necessary, replacing components of a seawall and drainage outfalls along a 7,700 foot stretch of shoreline between the mouth of the Pascagoula River at Spanish Point and the west end of Pascagoula Park Beach. Two of the alternatives being considered feature beach sand placement, with the primary purpose of the placement being the enhancement of the environmental value of the shoreline. Recreation will provide some National Economic Development (NED) benefits, but those benefits are incidental to the primary purpose of shoreline protection and enhancement.

***Existing (Pre-Katrina) Condition***

Prior to Hurricane Katrina, the area was protected by a concrete seawall. The structure was built in 1929, primarily to Beach Boulevard, a 2-1/2 mile long east-west thoroughfare adjacent to the shoreline. Through time, utilities were also placed behind the seawall, including electric power, water, sewer and telephone. Across Beach Boulevard was a combination of residential and light commercial development in addition to Pascagoula Park. Pascagoula Park also included a beach, which extended about ½ mile from just across the Longfellow Historic Site west to a drainage outfall near Oliver St. The beach extended outwards about 150 feet from the seaward edge of the seawall. The park and beach also featured a pier which extended over Mississippi Sound. Hurricane Katrina severely damaged the beach, park, pier and seawall. In several locations, the conduit protecting the utilities was badly damaged or severed, resulting in the loss of service to hundreds of homes and dozens of businesses. In addition to the storm damage, the losses suffered by the recreational resources of the park and beach meant the loss of Pascagoula's only waterfront recreation area.

No visitation data were available for Pascagoula Park and Beach. However, the resource is a popular destination for the residents of Pascagoula, Gautier, Moss Point and Jackson County in general. In the 2000 Census, Jackson County had a population of 131,420. Of that, 26,200 lived in Pascagoula; 11,681 lived in Gautier and 15,851 in Moss Point. The remainder lived in other incorporated and unincorporated areas of the county. Few, if any of the park visitors were residents of Harrison County, which lies just west of Jackson County. The same is true for Mobile County in Alabama, which is just east. Quite a few visitors have come from Greene County to the north. That county had 13,299 people in the 2000 Census.

***Market Area Determination***

Based on the limited visitation information for Park Beach and local officials' knowledge, a two county market area was chosen for this analysis. The two counties are Jackson and Greene. Residents of other counties nearby, including Harrison to the west, Perry to the northwest and Mobile to the east, either have their own waterfront or beachfront recreation areas, or have access to beaches that are closer to them than Park Beach. The total market area population was 144,719 in 2000. According to Census estimates, the market area population had grown to about 149,300 just before Hurricane Katrina. Jackson County accounted for 136,000 and Greene still around 13,300.

***Determination of Visitation***

There are no detailed visitation data available for the affected resource. However, the Corps of Engineers operates Okatibbee Lake north of Meridian, Mississippi. Several of the sites on that lake offer slack-water sandy beaches, with similar sand quality, similar water depths, and a similar climate. The area's population is similar to Pascagoula's in family size and income. With no reliable data sources available for Pascagoula Park and Beach, per capita use and participation rates from Okatibbee were used as a proxy for those figures in this analysis.

The per capita use rate at Lake Okatibbee was estimated at 3.55 using historical visitation records. This rate describes the counted visitors divided by the market area population. Since there are no visitation data for Park Beach, we use 3.55 times the population to arrive at the data in the Table 4.

**Table 4.**
**Visitation for Pascagoula Beach**

| Year | Market Area Population | Projected Visitation |
|---|---|---|
| 2006 | 148,333 | 526,582 |

***Determination of Participation by Activity***

Four general recreation activities will be provided by the type of beach conditions found in the project area. These are fishing, picnicking, sightseeing and swimming. Participation rates, turnover rates and group sizes are displayed in the following Table 5. Again, all data are from the Okatibbee Master Plan report and represent recorded figures.

**Table 5.**
**Selected Statistics by Recreational Activity**

| | Participation rate | Turnover Rate | Group Size |
|---|---|---|---|
| Fishing | 0.26 | 1.8 | 2 |
| Picnicking | 0.18 | 1.8 | 4.6 |
| Sightseeing | 0.34 | 4 | 2.7 |
| Swimming | 0.12 | 2.2 | 2.7 |
| Totals[1] | 1.12 | | |

[1] Participation is greater than 1.0 because many visitors participate in more than one activity.

***Determination of Recreation Demand***

With the above calculations, we can now estimate total recreation demand and from there, estimate willingness to pay. To determine recreation demand, the following formula is used:

*Visitation x Participation Rate*

This formula can also be used to calculate design loads for recreation facilities by calculating it for each activity and incorporating group size and turnover. However, since design loads are not necessary to determine demand and willingness to pay, those figures are not presented here.

The result of the overall demand calculation is presented in Table 6.

**Table 6.**
**Projected Population and Demand**

| Year | Projected Visitation | Recreation Demand |
|---|---|---|
| 2006 | 526,582 | 589,771 |

***Future without Project Condition***

The seawall, utilities, beach and pier were all severely damaged by the storm. If no federal action is taken to repair the seawall and utility conduits, access to Park Beach will be jeopardized by the failure of Beach Boulevard. Further, creature comforts associated with sanitary facilities, electric

power, water fountains, public telephones and convenient parking will be significantly affected, resulting in a poor recreation experience. In the Bay St. Louis recreation analysis, recreation visitation was believed to have been reduced by about 22% from pre-Katrina levels. This figure seems reasonable and an accurate portrayal of reduced visitation at Pascagoula's beachfront. Accordingly, the future without project condition recreation demand is placed at 460,022.

***Determination of Willingness to Pay***

The procedures described in ER-1105-2-100 address three evaluation methods. They are the travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method. The criteria described in ER-1105-2-100 were followed to determine the appropriate methodology for this analysis. The Unit Day Value (UDV) method was selected to evaluate recreation benefits because a regional model was not available and specialized recreation activities from a national perspective were not affected. Estimated annual visits affected did not exceed 750,000, which would indicate that a more rigorous empirical analysis is called for. Further, since a more detailed analysis of this resource would prove costly and time consuming, the UDV approach seems to be most prudent use of study resources. It is unlikely that any formulation of plan alternatives or plan selection will significantly change expected recreation benefits.

The UDV method for estimating recreation benefits relies on expert or informed opinion and judgment to approximate the average willingness to pay of users of Buccaneer.

ER 1105-2-100 provides guidelines for assigning points and their conversion to dollar value for evaluating recreation.

The guidelines for assigning points to general recreation include five criteria:

(1) the quality of the recreation experience as affected by congestion;
(2) availability of substitute areas in terms of travel time;
(3) carrying capacity determined by level of facility development;
(4) accessibility as affected by road and parking conditions; and
(5) environmental quality based on aesthetics.

A resource is rated on a 100-point scale. The total possible points that can be assigned to each criterion are as follows:

(1) Recreation Experience – 30;
(2) Availability of Opportunity – 18;
(3) Carrying Capacity – 14;
(4) Accessibility – 18; and
(5) Environmental – 20.

The conversion of points to dollar value for general recreation is expressed in two activity categories:

(1) general recreation and
(2) general fishing and hunting.

Hence, points are estimated and expressed in the same manner. Based on analyst knowledge of the general area and the recreation opportunities provided by the asset and bolstered by several field trips to the area before and after Katrina, recreation at Park Beach was scored and valued in accordance with the procedures described in ER 1105-2-100 and outlined in the tables below. These tables represent the estimation of recreation value without a project to repair South Beach Blvd and the adjacent seawall.

**Table 7.**
**Description of Judgment Factors for General Recreation**

**Table 4: Guidelines for Assigning Points for General Recreation**

| Criteria | Judgment Factors | | | | |
|---|---|---|---|---|---|
| **Recreation experience**[1] | Two general activities[2] | Several general activities | Several general activities; one high quality value activity[3] | Several general activities; more than one high quality value activity | Numerous high quality value activities; some general activities |
| Total Points: 30 | | | | | |
| Point Value: | 0-4 | 5-10 | 11-16 | 17-23 | 24-30 |
| **Availability of opportunity**[4] | Several within 1 hr. travel time; a few within 30 min. travel time | Several within 1 hr. travel time; none within 30 min. travel time | One or two within 1 hr. travel time; none within 45 min. travel time | None within 1 hr. travel time | None within 2 hr. travel time |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Carrying Capacity**[5] | Minimum facility for development for public health and safety | Basic facility to conduct activity(ies) | Adequate facilities to conduct without deterioration of the resource or activity experience | Optimum facilities to conduct activity at site potential | Ultimate facilities to achieve intent of selected alternative |
| Total Points: 14 | | | | | |
| Point Value: | 0-2 | 3-5 | 6-8 | 9-11 | 12-14 |
| **Accessibility** | Limited access by any means to site or within site | Fair access, poor quality roads to site; limited access within site | Fair access, fair road to site; fair access, good roads within site | Good access, good roads to site; fair access, good roads within site | Good access, high standard road to site; good access within site |
| Total Points: 18 | | | | | |
| Point Value: | 0-3 | 4-6 | 7-10 | 11-14 | 15-18 |
| **Environmental** | Low esthetic factors[6] that significantly lower quality[7] | Average esthetic quality; factors exist that lower quality to minor degree | Above average esthetic quality; any limiting factors can be reasonably rectified | High esthetic quality; no factors exist that lower quality | Outstanding esthetic quality; no factors exist that lower quality |
| Total Points: 20 | | | | | |
| Point Value: | 0-2 | 3-6 | 7-10 | 11-15 | 16-20 |

Table 8 illustrates a reasonable assessment of the overall quality of recreation experience should no federal action be taken to repair the seawall and place beach sand.

**Table 8.**
**Recreation Score for No Federal Action**

| Criteria | | Score | Justification |
|---|---|---|---|
| **Recreation experience**[1] | | 7 | Four activities are provided by the existing beach, all of which are of average quality. |
| Pts. Possible: | 30 | | |
| **Availability of opportunity**[4] | | 5 | There are beach facilities in Harrison, Hancock, and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| Pts Possible: | 18 | | |
| **Carrying Capacity**[5] | | 4 | Undamaged stretches of beach are snapped up quickly by even moderate usage periods. |
| Pts Possible: | 14 | | |
| **Accessibility** | | 8 | Accessibility is generally good; however damage-induced parking problems hamper accessibility. |
| Pts Possible: | 18 | | |
| **Environmental** | | 1 | The existing beach still suffers from damage and debris removal is a continual effort. The debris represents both a health and safety hazard to the public. |
| Pts Possible: | 20 | | |
| TOTAL SCORE | | 25 | |

Table 9 (from Economic Guidance Memorandum (EGM) 06-03) provides a means of converting the resource's UDV score into FY 2006 dollars. With the score of 25 taken from table above, we estimate the future without project condition value of Pascagoula Park Beach to be $4.49 by interpolating between the values given at 20 and 30. That is, an average recreational visitor to the park would place a willingness to pay value of approximately $4.49 on their recreation day. With recreation demand of 460,022 visitor days at $4.49, the total without project condition value is $2,065,499.

**Table 9.**
**Conversion of Points to Recreation Values**

| Point Values | General Recreation Values |
|---|---|
| 0 | 3.19 |
| 10 | 3.79 |
| 20 | 4.19 |
| 30 | 4.79 |
| 40 | 5.98 |
| 50 | 6.78 |
| 60 | 7.38 |
| 70 | 7.78 |
| 80 | 8.57 |
| 90 | 9.17 |
| 100 | 9.57 |

***Future with Project Condition***

Two of the alternatives being considered for seawall repair include beach sand placement. Both call for beach fill resulting in a 7,700 foot long, 150 foot wide beach. One alternative calls for a flat beach, the other calls for adding a dune to further enhance the environmental quality. For the purposes of this analysis, there is little difference between the two in terms of recreation value. An

argument could be made that the with-dune alternative would provide a greater aesthetic value. However, the increase in value would likely be marginal, difficult to quantify, and would not likely have much of an effect on willingness to pay. Hence, the two alternatives are considered equal. Table 10 shows the future with project recreation score.

**Table 10.**
**Future With Project Recreation Score**

| Criteria | Score | Justification |
|---|---|---|
| **Recreation experience**[1] Pts. Possible: 30 | 13 | Four activities are provided by the existing beach, all of which would be of very good, but not excellent quality. |
| **Availability of opportunity**[4] Pts Possible: 18 | 5 | There are beach facilities in Harrison, Hancock, and Mobile Counties, all of which are within 1 to 1-1/2 hours. |
| **Carrying Capacity**[5] Pts Possible: 14 | 8 | Peak season usage is still likely to cause some congestion. However, an additional access point and more beach space will improve parking conditions and space. |
| **Accessibility** Pts Possible: 18 | 12 | Accessibility is generally good, however the aforementioned parking problems hamper accessibility somewhat. |
| **Environmental** Pts Possible: 20 | 9 | No significant environmental issues are present. Occasional heavy rainfall results in swimming advisories (common among the southern U.S. coast). |
| TOTAL SCORE | 47 | |

Again referring to the conversion table, we find that a score of 47 equates to a willingness to pay of $7.93. With repair and replacement of the seawall and utility conduits and additional beach placement, the full pre-Katrina recreation demand is expected to occur, resulting in demand for 589,771 visitor days a year. This at $7.93 per visitor day, the total value of with project recreation is $4,676,892.

This represents a net increase of $2,611,392, and that figure represents the total recreation benefit of the repair and beach placement alternatives (alternatives 2 and 3).

### *Average Annual Benefits*

Total average annual benefits for all three alternatives were calculated for alternatives 2, 3, and 4. Average annual benefits for alternative 1 consists of traffic rerouting benefits only, where alternatives 2 and 3 consist of both traffic rerouting and recreation benefits. Table 11 summarizes the average annual benefits by alternative.

**Table 11.**
**Summary of Average Annual Benefits by Alternative**

| Benefit Category | Average Annual Benefits |
|---|---|
| **Alt 1- No Action Plan** | |
| N/A | N/A |
| **Alt 2-repair and rehabilitation of seawall and channel** | |
| Traffic Rerouting | $20,500 |
| **Alt 3- Alt 2 plus beach placement** | |
| Traffic Rerouting | $20,500 |
| Recreation | $2,611,400 |
| **TOTAL** | **$2,631,900** |
| **Alt 4- Alt 3 plus dune placement** | |
| Traffic Rerouting | $20,500 |
| Recreation | $2611,400 |
| **TOTAL** | **$2,631,900** |

*AVERAGE ANNUAL COSTS*

Average annual costs were calculated for alternatives 2, 3, and 4. The total average annual cost for each is the sum of Average annual first costs plus annual operations and maintenance (O&M) plus interest during construction (IDC). Costs were calculated using a discount rate of 5-1/8-percent and a fifty-year project life. Interest during construction assumes a twelve-month construction period. Table 12 summarizes the average annual costs.

**Table 12.**
**Summary of Average Annual Costs by Alternative**

| Cost Category | Average Annual Costs |
|---|---|
| **Alt 1- No Action Plan** | |
| N/A | N/A |
| **Alt 2-repair and rehabilitation of seawall and channel** | |
| First Cost | $105,000 |
| O&M | $0 |
| IDC | $43,800 |
| **TOTAL** | **$148,800** |
| **Alt 3- Alt 2 plus beach placement** | |
| First Cost | $368,500 |
| O&M | $913,900 |
| IDC | $153,600 |
| **TOTAL** | **$1,436,000** |
| **Alt 4- Alt 3 plus dune placement** | |
| First Cost | $423,800 |
| O&M | $693,600 |
| IDC | $176,400 |
| **TOTAL** | **$1,293,800** |

# Environmental Quality (EQ)

The P&G defines the environmental quality account as, "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

*National Ecosystem Restoration (NER)*

***Methodology***

The justification for the proposed project is evaluated on a cost effective and incremental cost basis in accordance with guidelines contained in ER 1105-2-100, *Planning – Planning Guidance Notebook*. The Corps' ecosystem restoration policy is described in more detail in ER 1165-2-501, *Water Resources Policies and Authorities – Civil Works Ecosystem Restoration Policy;* and EP 1165-2-501, *Water Resources Policies and Authorities – Ecosystem Restoration – Supporting Policy Information.* As cited in the *Planning Guidance Notebook,* Cost Effectiveness and Incremental Cost Analyses procedures are detailed in IWR Report 94-PS-2, Cost Effectiveness Analysis for Environmental Planning: Nine EASY steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses; and IWR Report 98-R-1, Making More Informed Decisions in Your Watershed When Dollars aren't Enough*. The analysis compares the cost effectiveness of the five alternatives based on their environmental outputs to determine the selected plan.

***Assumptions***

This analysis assumes a 50-year project life. Costs are amortized at the Fiscal Year (FY) 2005 Federal discount rate of 5.125 percent and are presented in FY 2006 dollars. The outputs quantified in this cost effective analysis are defined as the quantification of expected improvements in target functions as related to project objectives (habitat unit, HU). HU is based on an assessment protocol, which provides a basic level of stream health evaluation that is based on physical conditions within the assessment area. The assessment is used to record the scores for up to 15 assessment elements (i.e., channel condition, hydrologic alteration, riparian zone, bank stability, water appearance, nutrient enrichment, barriers to fish movement, instream fish cover, pools, insect/invertebrate habitat, canopy cover [warm water fishery], manure presence, salinity, riffle embeddedness, and macroinvertebrates observed). However, all assessment elements were not applicable to the assessment area and were not included.

***Cost Effectiveness/Incremental Cost Analysis***

The first step in incremental analysis is to display the environmental outputs (effects on habitat expressed in habitat units, HU) and the cost estimates of the management measures increments. Outputs and costs can be displayed as average annual outputs and average annual costs or total outputs and total costs. Both are acceptable so long as they are comparable. Average Annual outputs and Average Annual costs were used for this analysis.

Table 12 displays the project alternatives and their associated average annual outputs and average annual costs. Alternative 1 represents the no action plan (future without project conditions) if no work is undertaken to prevent erosion. Alternative 2 represents the repair and rehabilitation of the seawall and channel. Alternative 3 represents alternative 2 plus the placement of 229,000 CY of sand on the beach. Alternative 4 represents alternative 3 plus the placement of a beach dune. Project outputs for each alternative are displayed in terms of functional habitat units as described above.

The first step of the analysis is to display outputs and costs. Table 13 shows the costs for the three alternatives. For simplicity sake, the outputs for the no action plan were assumed to be zero, and the outputs of for the three action alternatives are those that would result in place of a future with out project condition.

**Table 13.**
**Outputs and Costs by Increments**

| Alternatives | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| Alternative 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| Alternative 2 | Repair Existing Structures | $1,790,000 | $99,950 | $0 | $99,950 | 110 |
| Alternative 3 | Repair Existing Structures and Beach Placement | $6,470,000 | $361,272 | $914,000 | $1,275,272 | 235 |
| Alternative 4 | Repair Existing Structures and Placement of Beach and Dune | $7,460,000 | $416,551 | $694,000 | $1,110,551 | 395 |

The second step in incremental analysis is to identify combinable management measures. This involves the analysis of the management measures to determine those that can be implemented together from those that cannot be implemented together. Each of the alternatives in this analysis is independent of the others. After the selection of one of the alternatives, the other alternatives are not needed; therefore the alternatives are not combinable.

The next step is to calculate outputs and costs of combinations. The combinations of the management measures are defined and analyzed incrementally. In this step, each combination of output (HU) and cost ($) is calculated. However, since the alternatives cannot be combined, this step is not necessary in this case.

Eliminating economically inefficient solutions is the fourth step in incremental analysis. In order to do this, the list of solutions is reordered so that they are listed in ascending order of their outputs. The result is a ranking of Alternative 1, 2, 3, and 4 as displayed in Table 14. Where two or more solutions produce the same output, the solutions are ranked in ascending order of their costs. At each level of output the least cost solution is determined. No alternatives are eliminated at this point because they all produce more output for there cost.

**Table 14.**
**Summary of Costs and Additional Outputs in Ascending Order**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Repair Existing Structures | $1,790,000 | $99,950 | $0 | $99,950 | 110 |
| 3 | Repair Existing Structures and Beach Placement | $6,470,000 | $361,272 | $914,000 | $1,275,272 | 235 |
| 4 | Repair Existing Structures and Placement of Beach and Dune | $7,460,000 | $416,551 | $694,000 | $1,110,551 | 395 |

The fifth step in incremental analysis is to eliminate economically ineffective solutions. The outputs and costs undergo a pair-wise comparison. The results of the comparison are analyzed to determine which solutions will produce less output at equal or greater cost than subsequently ranked solutions. Those solutions that will produce less output at equal or greater cost than subsequently ranked solutions are deleted. Alternative 3 is eliminated in this step because it produces 235 functional habitat units for $1,275,272 average annual dollars where alternative 4 produces 395 functional habitat units for only $1,110,551 average annual dollars. Table 15 shows the highlighted alternative that is eliminated in this step and Table 16 shows the remaining alternatives.

**Table 15.**
**Outputs and Costs of Least Cost Solutions for Each Level of Output**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Repair Existing Structures | $1,790,000 | $99,950 | $0 | $99,950 | 110 |
| 3 | Repair Existing Structures and Beach Placement | $6,470,000 | $361,272 | $914,000 | $1,275,272 | 235 |
| 4 | Repair Existing Structures and Placement of Beach and Dune | $7,460,000 | $416,551 | $694,000 | $1,110,551 | 395 |

**Table 16.**
**Effective and Efficient Plans**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 |
| 2 | Repair Existing Structures | $1,790,000 | $99,950 | $0 | $99,950 | 110 |
| 4 | Repair Existing Structures and Placement of Beach and Dune | $7,460,000 | $416,551 | $694,000 | $1,110,551 | 395 |

The sixth step is to calculate average costs for the set of solutions that emerged from the cost effectiveness analysis. Average costs are calculated by dividing each level of output's cost by its output. Alternatives with outputs less than the lowest average cost level are eliminated from further analysis. Alternative 1 (the no action plan) does not have an average cost per unit of output, since it does not cost anything or produce anything. None of the plans are eliminated in this step. Table 17 displays this information.

**Table 17.**
**Average Cost of Each Level of Output**

| Alt. | Alternative Description | Total First Cost ($) | Annualized First Cost ($) | O&M ($) | Average Annual Cost ($) | Output (FHI) | Average Cost ($ / FHI) |
|---|---|---|---|---|---|---|---|
| 1 | No Action | $0 | $0 | $0 | $0 | 0 | $0 |
| 2 | Repair Existing Structures | $1,790,000 | $99,950 | $0 | $99,950 | 110 | $908.64 |
| 4 | Repair Existing Structures and Placement of Beach and Dune | $7,460,000 | $416,551 | $694,000 | $1,110,551 | 395 | $2,811.52 |

The next step is to recalculate average costs for additional output. The average costs are calculated for additional output using the incremental levels of output. These calculations begin with the lowest average cost level of output, the "zero level" output. The average costs are calculated using the additional costs and additional outputs above those of the previously identified level of outputs with the lowest average cost. Levels of output less than the lowest average cost are eliminated from further analysis. This process is repeated until the final level of output is identified as the lowest average cost of output. This step was not necessary since no plans were eliminated in step six.

Calculating the incremental costs is the eighth step. The difference in cost between two solutions divided by the difference in output between the same two solutions is the incremental cost. Table 18 shows the calculations.

**Table 18.**
**Supply Schedule, Incremental Costs**

| Alt. | Alternative Description | Output (FHI) | Average Annual Cost ($) | Additional Output (FHI) | Additional Cots ($) | Incremental Cost ($ / FHI) |
|---|---|---|---|---|---|---|
| 1 | No Action | 0 | $0 | 0 | $0 | N/A |
| 2 | Repair Existing Structures | 110 | $99,950 | 110 | $99,950 | $908.64 |
| 4 | Repair Existing Structures and Placement of Beach and Dune | 395 | $1,110,551 | 285 | $1,010,601 | $3,545.96 |

The final step is to compare successive outputs and incremental costs. The results from the incremental costs are compared and then used as a decision making tool by progressively proceeding through the available level of outputs and asking if the next level is "worth it." That is to say, "is the habitat value of the additional unit of environmental benefit in the next available level of output worth its additional monetary costs?"

### *Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The Gautier drainage ways, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways at Bayou Cassotte. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape.


**Figure 8. Pascagoula's Beach Before and After Hurricane Katrina**

## Regional Economic Development (RED)

The purpose of the regional economic development (RED) account is to, "Display changes in the distribution of regional economic activity." Jackson County is located in the lower east corner of Mississippi. The County shares its borders with Mobile County to the east, Harrison County to the west and George County to the north. According to the 2000 Census, the county has a population of 131,420. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 19 shows the employment breakdown for Jackson County. The manufacturing industry is a significant employer; accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 19.**
**Employment Breakdown of Jackson County**

| Sector | Mississippi | Jackson County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 16,000 | 9% |
| Wholesale | 35,316 | 600 | 2% |
| Retail | 135,838 | 5,564 | 4% |
| Real Estate | 9,665 | 370 | 4% |
| Professional | 29,023 | 1,600 | 6% |
| Administration | 46,115 | 1,330 | 3% |
| Education | 1,678 | 84 | 5% |
| Health Care | 131,976 | 4,620 | 4% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 3,587 | 3% |
| Other Services | 22,180 | 1,315 | 6% |
| Total | 713,310 | 35,170 | 5% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Jackson County was $17,768 and the median household income was $39,118 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 20 displays the income breakdown for Jackson County.

**Table 20.**
**Income Breakdown for Jackson County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Jackson County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 21. The percentage of persons below the poverty level for the state of Mississippi and Jackson County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Jackson County. The unemployment rate for Jackson County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 21.**
**Poverty Level and Unemployment Rate for Jackson County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Jackson County | 12.9% | 6.6% | 12.4% | 15.9% |

Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $1,880,000 for the Seawall and Channel Repair and Rehab alternative, $6,600,000 for the Add Beach alternative, and $7,590,000 for the Add Beach and Dune alternative. Moreover, the total present worth of the Operation and Maintenance (O&M)

expenditures are estimated to be $0 for the street maintenance of both the seawall and channel alternative, $12,422,520 for the Beach alternative (estimated to be scheduled every 5 years), and $16,367,070 for the Beach and Dune alternative (estimated to be scheduled every 8 years).

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system-models, tools, and database-is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population. Table 22 and Table 23 show the model inputs.

**Table 22.**
**Summary of Construction Inputs by Project Alternatives**

| Indicator Variable | Seawall & Channel Rep.&Reh. | Add Beach | Add Beach and Dune |
|---|---|---|---|
| Region of Influence (ROI) | Jackson County | Jackson County | Jackson County |
| Change in Local Expenditures | $1,790,000 | $6,470,000 | $7,460,000 |

**Table 23.**
**Summary of O&M Inputs by Project Alternative**

| Indicator Variable | Seawall & Channel Rep.&Reh. O&M | Beach O&M | Beach and Dune O&M |
|---|---|---|---|
| Region of Influence (ROI) | Jackson County | Jackson County | Jackson County |
| Change in Local Expenditures | $0 | $12,422,520 | $16,367,070 |

*Impact On Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

**Seawall and Channel Repair and Rehab.** If implemented, the total sales volume related to this alternative is projected to increase by $3,985,600 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $0 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Seawall and Channel Repair and Rehab-Conc alternative.

***Add Beach.*** If implemented, the total sales volume related to this alternative is projected to increase by $40,327,740 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $26,335,740 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Add Beach alternative.

***Add Beach and Dune.*** If implemented, the total sales volume related to this alternative is projected to increase by $50,789,000 in the local area of Jackson County. Note, O&M is only accounted for if

the project is implemented; therefore, $34,698,200 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the Add Beach and Dune alternative.

*Impact On Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***Seawall and Channel Repair and Rehab.*** If implemented, the total income related to this alternative is projected to increase by $777,294 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $0 (i.e. the total income increased because of O&M) was added to the total income of the Seawall and Channel Repair and Rehab-Conc alternative.

***Add Beach.*** If implemented, the total income related to this alternative is projected to increase by $7,864,939 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $5,136,142 (i.e. the total income increased because of O&M) was added to the total income of the Add Beach alternative.

***Add Beach and Dune.*** If implemented, the total income related to this alternative is projected to increase by $9,905,152 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $6,767,035 (i.e. the total income increased because of O&M) was added to the total income of the Add Beach alternative

*Impact On Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***Seawall and Channel Repair and Rehab.*** If implemented, total employment related to this alternative is projected to increase by 23 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 0 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Seawall and Channel Repair and Rehab-Conc alternative.

***Add Beach.*** If implemented, total employment related to this alternative is projected to increase by 228 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 149 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Add Beach alternative.

***Add Beach and Dune.*** If implemented, total employment related to this alternative is projected to increase by 287 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 196 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the Add Beach and Dune alternative.

*Impact On Population*

If implemented, the population related to all four alternatives is projected to increase by 0. Table 29 and Table 30 summarize the model outputs.

**Table 29.**
**Summary of Construction Outputs by Project Alternative**

| Indicator Variable | Projected Δ S&C R&R | Projected Δ Beach | Projected Δ Beach and Dune |
|---|---|---|---|
| Direct Sales Volume | $1,880,000 | $6,600,000 | $7,590,000 |
| Induced Sales Volume | $2,105,600 | $7,391,999 | $8,500,799 |
| Total Sales Volume | $3,985,600 | $13,992,000 | $16,090,800 |
| | | | |
| Direct Income | $366,648 | $1,287,169 | $1,480,244 |
| Induced Income | $410,646 | $1,441,629 | $1,657,873 |
| Total Income | $777,294 | $2,728,797 | $3,138,117 |
| | | | |
| Direct Employment | 11 | 37 | 43 |
| Induced Employment | 12 | 42 | 48 |
| Total Employment | 23 | 79 | 91 |
| | | | |
| Local Population | 0 | 0 | 0 |

**Table 30.**
**Summary of O&M Outputs by Project Alternatives**

| Indicator Variable | Projected Δ S&C R&R O&M | Projected Δ Beach O&M | Projected Δ Beach and Dune O&M |
|---|---|---|---|
| Direct Sales Volume | $0 | $12,422,520 | $16,367,070 |
| Induced Sales Volume | $0 | $13,913,220 | $18,331,120 |
| Total Sales Volume | $0 | $26,335,740 | $34,698,200 |
| | | | |
| Direct Income | $0 | $2,422,709 | $3,191,998 |
| Induced Income | $0 | $2,713,434 | $3,575,037 |
| Total Income | $0 | $5,136,142 | $6,767,035 |
| | | | |
| Direct Employment | 0 | 70 | 93 |
| Induced Employment | 0 | 79 | 104 |
| Total Employment | 0 | 149 | 197 |
| | | | |
| Local Population | 0 | 0 | 0 |

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, “Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others.” This project addresses the following under the OSE account:

### *Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that

could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 31 shows the number selected housing statistics for census tracts 414 and 425. There are 2, 916 housing units in the two tract area. The average structure was built between 1957 and 1964. Of the structures, ninety-three percent are occupied and seven-percent are vacant. Of those occupied, seventy-two percent are owner occupied and twenty-eight percent are renter occupied. Table 32 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 33 shows the value of the owner occupied structures in the two tract area.

**Table 31.**
**Selected Housing Statistics**

| Category | Tract 414 | Tract 425 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 1, 368 | 1, 548 | 2, 916 | |
| Median Year Built | 1964 | n/a | | |
| Occupancy Status | | | | |
| Occupied | 1, 273 | 1, 426 | 2, 699 | 93% |
| Vacant | 95 | 122 | 217 | 7% |
| Tenure Status | | | | |
| Owner | 1, 082 | 865 | 1, 947 | 72% |
| Renter | 191 | 561 | 752 | 28% |

U.S. Census Bureau, 2000 Census

**Table 32.**
**Number of Units in Structure**

| Units in Structure | Tract 414 | Tract 425 | Total |
|---|---|---|---|
| 1, detached | 1, 316 | 1, 144 | 2, 460 |
| 1, attached | 12 | 44 | 56 |
| 2 | 31 | 65 | 96 |
| 3 or 4 | 0 | 38 | 38 |
| 5 to 9 | 0 | 53 | 53 |
| 10 to 19 | 0 | 53 | 53 |
| 20 to 49 | 9 | 46 | 55 |
| 50 or more | 0 | 105 | 105 |
| Mobile Home | 0 | 0 | 0 |
| Boat, RV, van, etc. | 0 | 0 | 0 |
| **Total** | **1, 368** | **1, 548** | **2, 916** |

U.S. Census Bureau, 2000 Census

**Table 33.**
**Owner Occupied Values by Census Tracts**

| Category | Tract 414 | Tract 425 |
|---|---|---|
| Value | | |
| Less than $10,000 | 0 | 0 |
| $10,000 to $14,999 | 0 | 0 |
| $15,000 to $19,999 | 16 | 7 |
| $20,000 to $24,999 | 0 | 0 |
| $25,000 to $29,999 | 13 | 45 |
| $30,000 to $34,999 | 24 | 20 |
| $35,000 to $39,999 | 30 | 74 |
| $40,000 to $49,999 | 149 | 121 |
| $50,000 to $59,999 | 76 | 167 |
| $60,000 to $69,999 | 130 | 47 |
| $70,000 to $79,999 | 148 | 29 |
| $80,000 to $89,999 | 138 | 29 |
| $90,000 to $99,999 | 63 | 36 |
| $100,000 to $124,999 | 100 | 92 |
| $125,000 to $149,999 | 40 | 22 |
| $150,000 to $174,999 | 52 | 12 |
| $175,000 to $199,999 | 19 | 53 |
| $200,000 to $249,999 | 36 | 24 |
| $250,000 to $299,999 | 19 | 24 |
| $300,000 to $399,999 | 7 | 45 |
| $400,000 to $499,999 | 0 | 14 |
| $500,000 to $749,999 | 0 | 4 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 22 | 0 |
| TOTAL | 1, 082 | 865 |
| Median Value for Owner Occupied Housing | $77, 000 | $59, 900 |
| Median Value for Mobile Homes | Not available | Not Available |

U.S. Census Bureau, 2000 Census

# Recommendations

Restoration of a beach and dune system along a reach of approximately 7,700 feet of Mississippi Sound shoreline immediately adjacent to the City of Pascagoula, along with repairs to the existing seawall and outlet channels.

The concave seawall west of Beach Park would have it's joints cleaned and re-sealed (approximately 237 joints); impacted and spalled areas re-surfaced; exposed rebar cleaned, treated, and re-covered; and significant longitudinal and transverse cracks would be sealed.

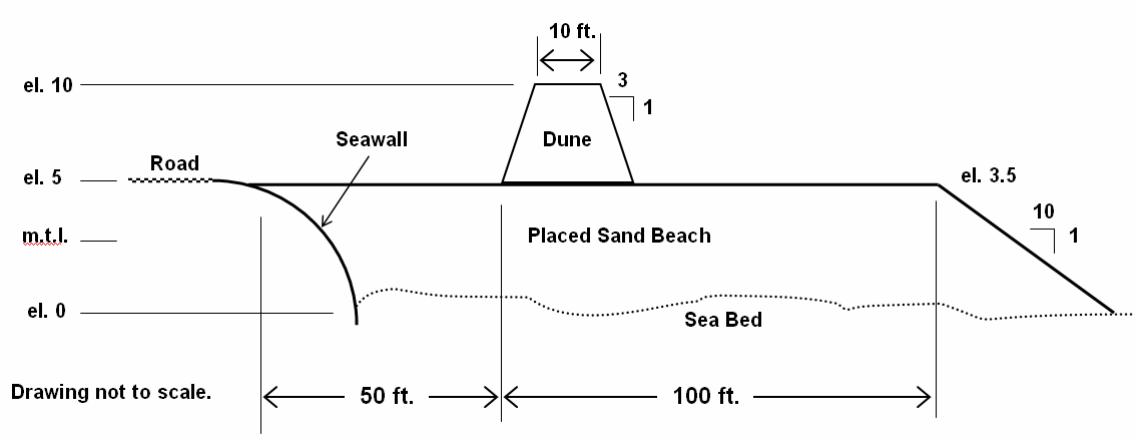
The seven destroyed cell caps of the cellular seawall east of Beach Park would receive new cell caps. The cells covered by the caps would first be cleared of debris and backfilled with suitable material.

The failed stream bank panels of the drainage channel west of 11$^{th}$ street would be removed and replaced and the remains of approximately 60 feet of this stream's extension wall cap would be removed and replaced with a new reinforced concrete cap. Vinyl sheet pile and concrete wall panels have been evaluated for channel wall replacement. Preliminary materials and construction costs are about equal for both concrete and vinyl. Concrete panels would be founded upon piles. Real estate

boundaries at the channel margin are not definitively known at this time, but because private property owners utilize land right up to the stream banks, it is possible that real estate costs may be substantial.

The beach would extend from the west end of the seawall near Spanish Point to the drainage channel just west of Beach Park, a distance of approximately 7,700 feet. A schematic elevation view of the alternative is shown in Figure 1 (the dune shown in that figure applies to Alternative 4). Assuming an average depth of placement of four feet and a waste factor of 15%, approximately 229,000,000 cubic yards of medium to fine-grained sand would be needed. The beach would need to be periodically re-nourished; beach maintenance experience in neighboring Harrison County suggests a 12-year re-nourishment cycle. Existing drainage channel guidewalls would not need to be extended for this alternative. However, because the drainage culverts on the beach side of the seawall must be extended at nearly 15 times their current length, it is necessary to assume that all 14 culverts would need to be enlarged. If adequate discharge could be provided by joining the ends of the existing culverts to an enlarged culvert via an expanding section the cost and effort would not be great. Otherwise, if the culverts must be replaced in their entirety in order to provide adequate conveyance, the culvert replacement and extension cost would be greater than presently estimated, as excavation would need to proceed upstream through the seawall and, possibly, Beach Boulevard, to the nearest convenient location (perhaps a junction) to insert the replacement culvert sections.

Because the primary purpose of the dune is to provide ecological benefit, pedestrian pathways would not be constructed over them. The dunes would be vegetated and sand fencing would be installed to help resist landward dune migration and wind-borne sand loss. The dune would also provide a source of beach material for sand borne away by nearshore currents. The estimated quantity of sand required to construct the dunes as shown in the figure is approximately 41,000 cubic yards, with 8 acres of plantings and approximately 8,470 feet of sand fencing.




# Cost

This solution is estimated to cost $7,460,000 (October 2006 Price Level).

# ECONOMIC ANALYSIS FOR UPPER BAYOU CASOTTE FLOOD DAMAGE REDUCTION, MOSS POINT, MS

## Introduction

This section describes the economic analysis evaluation for damage to two of the drainage ways flowing into Bayou Casotte or Pt Aux Chennes Bay. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background and Problem Statement

Jackson County was heavily damaged by the hurricanes of 2005 particularly, the storm surge and winds generated by Hurricane Katrina on August 29, 2005. Hurricane Katrina had an adverse affect on canals and drainage ways due to the deposition of sediment from the storm surge and windblown trees, and other debris. This document provides information regarding damage to the drainage ways flowing into the upper portion of Bayou Casotte and the potential for increased flooding in the surrounding area. Figure 1 shows the study area.

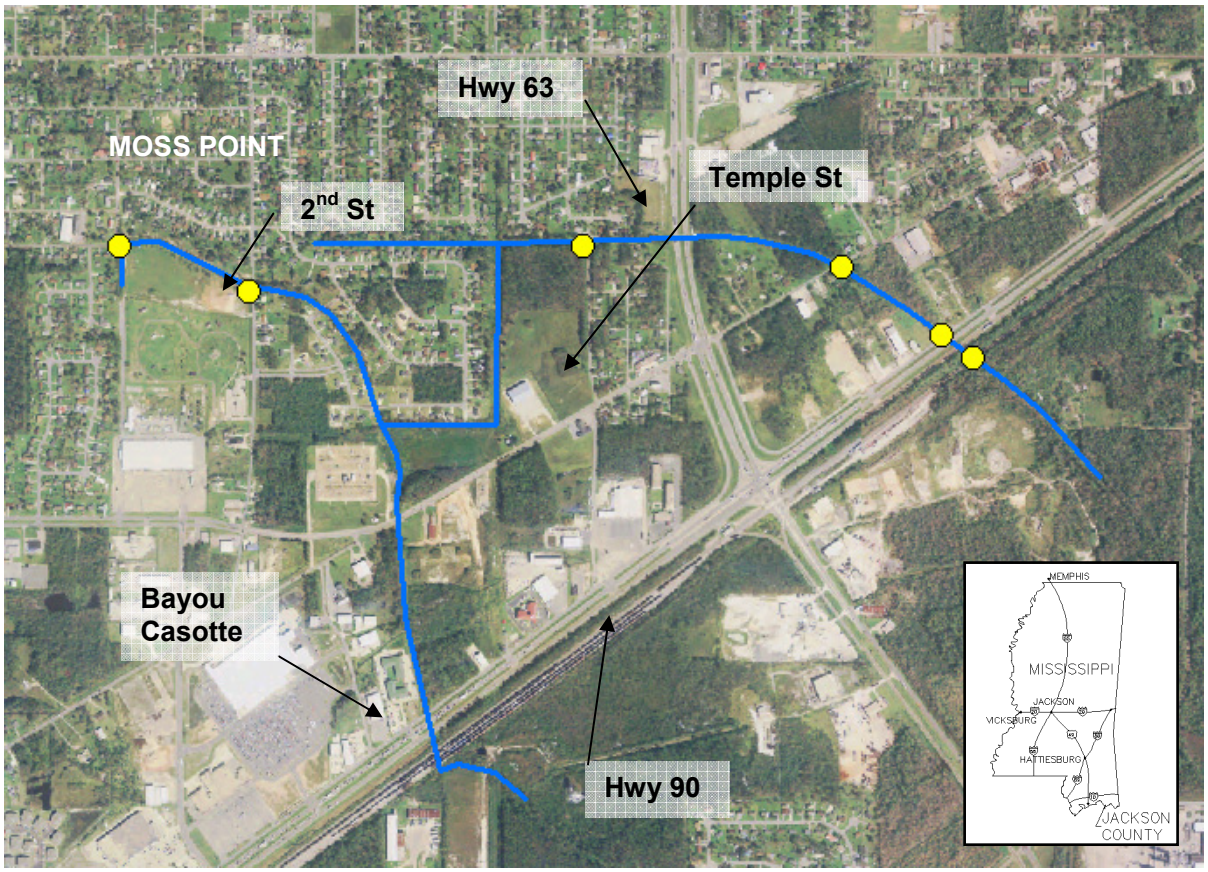



**Figure 1. Upper Bayou Casotte Study Area**

# Opportunities

The following opportunities were identified for the Upper Bayou Casotte area:

- Reduction of future damages created by flooding from rains associated with hurricanes and major thunderstorms
- Repair of damages to public facilities caused by 2005 storm events
- Repair of damages to natural resources (primarily erosion of the natural drainage ways at this site) created by 2005 storm events

# Assumptions

The following assumptions were used in this analysis:

a. The FY 2006 discount rate of 5–1/8 percent will be used in estimating average annual benefits and costs.

b. Price levels are October, 2006 unless otherwise stated.

c. A 50-year period of analysis was used to calculate average annual benefits and costs.

d. Impacted area (Jackson County) will be rebuilt to at least pre-Katrina conditions, i.e. this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

The short-term alternatives identified for the Bayou Casotte drainage areas involve the removal of the sediment that was deposited due to storm surge from Hurricane Katrina. The three alternatives that were identified were the no action plan, removal of 1 foot of sediment, and removal of 2 feet of sediment.

## *Alternative 1: No Action*

This alternative involves no federal action.

## *Alternative 2: Sediment Removal (1ft)*

This alternative is a short term alternative that would consist of removing approximately 1 feet of sediment over an average width of 15 feet and length of 2.71 miles (see figure 2). There appears to be significant debris in the drainage way, especially at some of the culverts, which would also have to be removed to facilitate removal of the sediment.

## *Alternative 3: Sediment Removal (2ft)*

This alternative is a short term alternative that would consist of removing approximately 2 ft of sediment over an average width of 15 feet and length of 2.71 miles (see figure 2). There appears to be significant debris in the drainage way, especially at some of the culverts, which would also have to be removed to facilitate removal of the sediment.

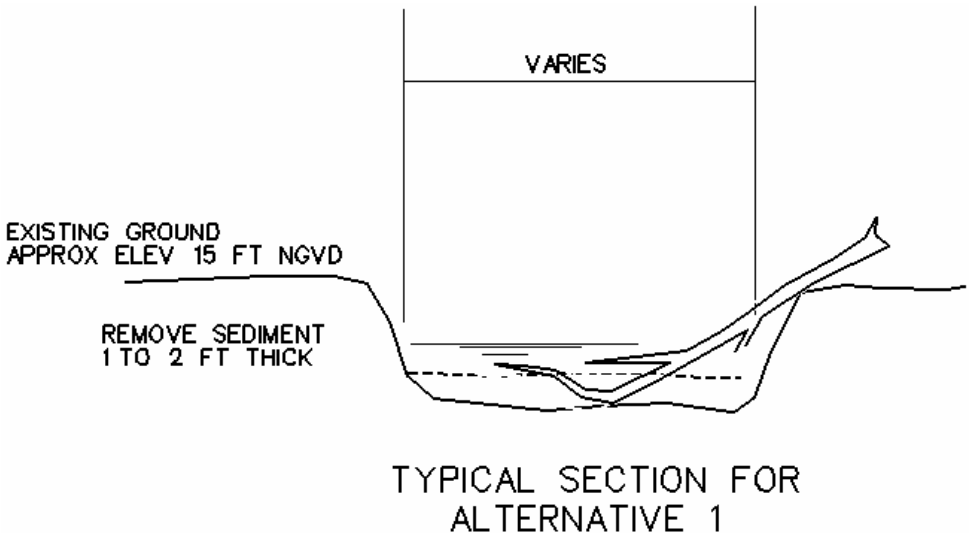



**Figure 2. Typical Cross Section for Upper Bayou Casotte**

The project delivery team evaluated the alternatives based on their prospective impact to lowering water levels at Bayou Casotte. The projects were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M ($) |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | Removal of 1-foot of sediment | Moderate | $1,020,000 | $15,240 |
| Alt 3 | Removal of 2-feet of sediment | Significant | $1,300,000 | $21,000 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of shoaling from Hurricane Katrina storm surge.

## *National Economic Development (NED)*

According to the P&G,"the national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions. This evaluation is slightly above sea level and would provide some flood damage reduction benefits.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

### *Habitat*

Removal of the sediment would provide flushing of the system and improvement to tidal exchange resulting in less stagnant water. Removal of the obstructions would allow fish to migrate up the systems by the sub-adult and larvae for use as a forage area. The improved habitat would also improve foraging areas for shorebird use. Removal of the non-biodegradable foreign material and deposition of sediments would improve overall water quality by improving circulation and enhancing drainage in the area resulting in an overall reduction of flooding to nearby residences.

### *Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The Bayou Casotte waterways, in addition to serving its drainage purposes, provide the local communities with rich landscape. Storm surge from hurricane Katrina deposited silt and debris along the drainage ways at Bayou Casotte. In addition to drainage problems, the shoaling and blockage to the culverts has had a detrimental effect on the natural beauty of the area. Removal of the sediment would improve this situation, and be an important step to restoring the beauty back to the landscape. See Figures 3 and 4.

**Figure 3. Storm Surge Deposits**

**Figure 4. Storm Surge Deposits**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to "Display changes in the distribution of regional economic activity." Jackson County is located in the lower east corner of Mississippi. The County shares its borders with Mobile County to the east, Harrison County to the west and George County to the north. According to the 2000 Census, the county has a population of 131,420. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 2 shows the employment breakdown for Jackson County. The manufacturing industry is a significant employer; accounting for sixteen percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 2.**
**Employment Breakdown of Jackson County**

| Sector | Mississippi | Jackson County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 16,000 | 9% |
| Wholesale | 35,316 | 600 | 2% |
| Retail | 135,838 | 5,564 | 4% |
| Real Estate | 9,665 | 370 | 4% |
| Professional | 29,023 | 1,600 | 6% |
| Administration | 46,115 | 1,330 | 3% |
| Education | 1,678 | 84 | 5% |
| Health Care | 131,976 | 4,620 | 4% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 3,587 | 3% |
| Other Services | 22,180 | 1,315 | 6% |
| Total | 713,310 | 35,170 | 5% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Jackson County was $17,768 and the median household income was $39,118 in 2000. These figures were higher than that of the state's, but significantly below the national average. Table 3 displays the income breakdown for Jackson County.

**Table 3.**
**Income Breakdown for Jackson County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Jackson County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 4. The percentage of persons below the poverty level for the state of Mississippi and Jackson County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Jackson County. The unemployment rate for Jackson County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 4.**
**Poverty Level and Unemployment Rate for Jackson County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Jackson County | 12.9% | 6.6% | 12.4% | 15.9% |

Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $1,310,000 for the 2-ft removal alternative and $1,030,000 for the 1-ft removal alternative. Moreover, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $1,020,000 for the 2-ft removal alternative and $740,000 1-ft removal alternative, which in present worth form amounts to $18,267,110 and $13,252,610 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent). Table 5 shows the EIFS model inputs.

**Table 5.**
**Summary of Inputs by Project Alternative**

| Indicator Variable | 2ft Removal | 1ft Removal | 2ft Removal O&M | 1ft Removal O&M |
|---|---|---|---|---|
| Region of Influence (ROI) | Jackson County | Jackson County | Jackson County | Jackson County |
| Change in Local Expenditures | $1,020,000 | $1,300,000 | $376,192 | $272,924 |

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will asses potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system—models, tools, and database—is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

**Table 6.**
**Summary of Outputs by Project Alternative**

| Indicator Variable | Projected Δ 2ft Removal | Projected Δ 1ft Removal | Projected Δ 2ft Removal O&M | Projected Δ 1ft Removal O&M |
|---|---|---|---|---|
| Direct Sales Volume | $1,300,000 | $1,020,000 | $376,192 | $272,924 |
| Induced Sales Volume | $1,456,000 | $1,142,400 | $421,335 | $305,675 |
| Total Sales Volume | $2,756,000 | $2,162,400 | $797,527 | $578,599 |
| Direct Income | $253,533 | $198,926 | $73,367 | $53,227 |
| Induced Income | $283,957 | $222,797 | $82,171 | $59,614 |
| Total Income | $537,490 | $421,723 | $155,538 | $112,842 |
| Direct Employment | 7 | 6 | 2 | 2 |
| Induced Employment | 8 | 6 | 2 | 2 |
| Total Employment | 15 | 12 | 4 | 4 |
| Local Population | 0 | 0 | 0 | 0 |

### *Impact on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

***2 ft Removal***

If implemented, the total sales volume related to this alternative is projected to increase by $3,553,527 on the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $797,527 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 2ft Removal alternative.

***1 ft Removal***

If implemented, the total sales volume related to this alternative is projected to increase by $2,740,999 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $578,599 (i.e. the total sales volume increased because of O&M) was added to the total sales volume of the 1ft Removal alternative.

*Impact on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***2 ft Removal***

If implemented, the total income related to this alternative is projected to increase by $693,028 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $155,538 (i.e. the total income increased because of O&M) was added to the total income of the 2ft Removal alternative.

***1 ft Removal***

If implemented, the total income related to this alternative is projected to increase by $534,656 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $112,842 (i.e. the total income increased because of O&M) was added to the total income of the 1ft Removal alternative.

*Impact on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***2 ft Removal***

If implemented, the total employment related to this alternative is projected to increase by 19 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 4 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 2ft Removal alternative.

***1 ft Removal***

If implemented, total employment related to this alternative is projected to increase by 16 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 4 workers (i.e. the number of workers increase because of O&M) was added to the total employment of the 1ft Removal alternative.

*Impact on Population*

If implemented, the population related to both alternatives is projected to increase by 0. Table 6 summarizes the RED outputs by project alternative.

## *Other Social Effects (OSE)*

The P&G defines the other social effects (OSE) account as, "Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others." This project addresses the following under the OSE account:

*Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 7 shows the number selected housing statistics for census tracts 413 and 421. There are 4,125 housing units in the two tract area. The average structure was built between 1970 and 1975. Of the structures, ninety-two percent are occupied and eight- percent are vacant. Of those occupied, sixty-eight percent are owner occupied and thirty-two percent are renter occupied. Table 8 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 9 shows the value of the owner occupied structures in the two tract area.

**Table 7.**
**Selected Housing Statistics**

| Category | Tract 413 | Tract 421 | Total | Percent of Total |
|---|---|---|---|---|
| Number of Structures | 2,612 | 1,513 | 4,125 | |
| Median Year Built | 1975 | 1970 | N/A | N/A |
| Occupancy Status | | | | |
| Occupied | 2,431 | 1,363 | 3,794 | 92% |
| Vacant | 181 | 150 | 331 | 8% |
| Tenure Status | | | | |
| Owner | 1,922 | 674 | 2,596 | 68% |
| Renter | 509 | 689 | 1,198 | 32% |

U.S. Census Bureau, 2000 Census

**Table 8.**
**Number of Units in Structure**

| Units in Structure | Tract 413 | Tract 421 | Total |
|---|---|---|---|
| 1, detached | 2,000 | 900 | 2,900 |
| 1, attached | 18 | 25 | 43 |
| 2 | 22 | 73 | 95 |
| 3 or 4 | 51 | 110 | 161 |
| 5 to 9 | 73 | 117 | 190 |
| 10 to 19 | 17 | 71 | 88 |
| 20 to 49 | 0 | 37 | 37 |
| 50 or more | 13 | 151 | 164 |
| Mobile Home | 396 | 29 | 425 |
| Boat, RV, van, etc. | 22 | 0 | 22 |
| Total | 2,612 | 1,513 | 4,125 |

U.S. Census Bureau, 2000 Census

**Table 9.**
**Owner Occupied Values by Census Tracts**

| Category (Value) | Tract 413 | Tract 421 |
|---|---|---|
| Less than $10,000 | 36 | 0 |
| $10,000 to $14,999 | 43 | 7 |
| $15,000 to $19,999 | 52 | 19 |
| $20,000 to $24,999 | 80 | 13 |
| $25,000 to $29,999 | 59 | 5 |
| $30,000 to $34,999 | 59 | 12 |
| $35,000 to $39,999 | 79 | 64 |
| $40,000 to $49,999 | 289 | 157 |
| $50,000 to $59,999 | 285 | 104 |
| $60,000 to $69,999 | 290 | 139 |
| $70,000 to $79,999 | 237 | 68 |
| $80,000 to $89,999 | 104 | 39 |
| $90,000 to $99,999 | 61 | 0 |
| $100,000 to $124,999 | 117 | 34 |
| $125,000 to $149,999 | 59 | 0 |
| $150,000 to $174,999 | 50 | 0 |
| $175,000 to $199,999 | 8 | 0 |
| $200,000 to $249,999 | 7 | 0 |
| $250,000 to $299,999 | 7 | 34 |
| $300,000 to $399,999 | 0 | 0 |
| $400,000 to $499,999 | 0 | 0 |
| $500,000 to $749,999 | 0 | 0 |
| $750,000 to $999,999 | 0 | 0 |
| $1,000,000 or more | 0 | 0 |
| TOTAL | 1,922 | 674 |
| Median Value for Owner Occupied Housing | $62,900 | $55,800 |
| Median Value for Mobile Homes | $23,500 | $19,500 |

U.S. Census Bureau, 2000 Census

*Health and Safety*

Since the 2005 hurricane season, standing or slow draining water has been a major health concern. Standing water, accompanied with the warm climate, creates a number of issues for local residents. One issue of the standing water is mold and the stale smell that it produces. This mold can cause a number of allergic reactions and has been associated with what has become what locals refer to as the 'Katrina Cough'. Although the 'Katrina Cough' has yet to be medically documented, the frequency and occurrence of people showing the cold like symptoms since the storm has dramatically increased compared to the typical number of cases in regular years.

A second issue of concern is the infestation of knats and rodents that thrive on these conditions. Knats are very tiny flies that enjoy the damp warm air and, through nuisance biting, can make it impossible for someone to walk outside at certain times throughout the day. Rodents, notorious carriers of disease, exponentially multiply in warm moist areas like the drainage ways. Slow moving water and debris to hide their movement makes these areas prime breeding ground.

A final health and safety issue is the intrusion of native wildlife into the urbanized areas. Snakes and alligators are coming closer to human dwellings due to their displacement from the storm. Sightings have significantly increased and the threat to small children and pets are the greatest. Removal of the sediment would alleviate these health risks and improve the quality of life to the local residents.

*Attractive Nuisance*

An attractive nuisance is anything that may attract children onto property. Hurricane Katrina's storm surge left sediment and debris deposited all along the Mississippi Gulf Coast. Culverts and drainage ways are blocked and filled with this debris, creating an attractive nuisance that can be hazard to young children. Examples of attractive nuisances are vegetative debris (trees and shrubs), house hold goods (refrigerators, washers and dryers) and construction/other debris (concrete, rebar, house pylons, automobiles, and boats).

These attractive nuisances have the potential to cause minor to fatal accidents among young children. The removal of this debris will significantly lower the occurrence of these accidents. In addition to health and safety benefits, reduction of attractive nuisances will also decrease expensive health care related costs that will mostly be borne by insurance providers. The increased health care costs will be transferred to the public through higher insurance premiums, and thus represent a savings to the nation.

# Recommended Plan

Remove approximately 2 ft of sediment over an average width of 15 ft and length of 2.71 miles, as shown in Figure 5. There appears to be significant debris in the drainage way, especially at some of the culverts, which would also have to be removed to facilitate removal of the sediment:

| Drainage Area | Sediment |
|---|---|
| Upper Bayou Casotte | 15,900 cy |

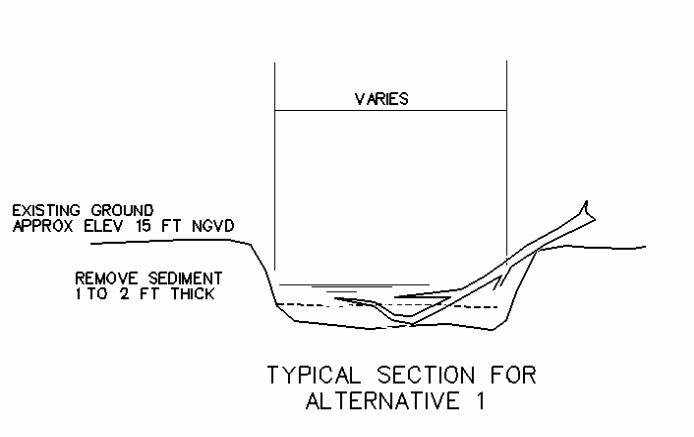



**Figure 5. Proposed Sediment Removal**

# Cost

This solution is estimated to cost $1,300,000.

# ECONOMIC ANALYSIS FOR FRANKLIN CREEK FLOODWAY FLOOD AND HURRICANE STORM DAMAGE REDUCTION, FRANKLIN CREEK, MS

## Introduction

This section describes the economic analysis evaluation for damage to Pecan, Mississippi due to ponding caused by interrupted flow at the Franklin Creek Tributary. This evaluation was conducted using the policy and guidance outlined in the Planning Guidance Notebook (P&G) ER 1105-2-100. The P&G establishes four accounts to facilitate the evaluation and selection of different alternative plans. They are: 1) the National Economic Development (NED) account, 2) the Environmental Quality (EQ) account, 3) the Regional Economic Development (RED) account, and 4) the Other Social Effects (OSE) account. All four of these accounts are used in this analysis for benefit evaluation.

## Background and Problem Statement

This area within Coastal Mississippi, specifically the community of Pecan in Jackson County, Mississippi near the Alabama-Mississippi state line, was heavily damaged by the hurricanes of 2005, particularly by the storm surge generated by Hurricane Katrina on August 29, 2005.

The community of Pecan is an extremely low-lying and flood-prone community of approximately 30 residences, with no commercial or industrial structures. Average first floor elevations are less than 10 feet NGVD.

The storm surge associated with Hurricane Katrina reached elevation 14.2 feet NGVD at Pecan, as shown below, and caused extensive flooding due to the low ground elevations throughout the area. Four and a half feet or more of storm-surge water inundated numerous residences within the community (Brown, pers. comm., 2006).

Many of the homes flooded during Hurricane Katrina were inundated by rising waters issuing from the Escatawba River, which caused Franklin Creek in turn to overflow its banks, into the Pecan community, as a result of the large volumes of storm surge introduced into the system from the south, during the landfall of the surge. Sediment and debris carried by the surge into many areas of the system further impeded flow through these drainage systems. This sediment and debris has exacerbated the existing problem, making this area even more susceptible to inundation from smaller hurricanes, tropical storms, or even severe rainfall events. Restoration of overland flow paths due to debris blockage also remains an issue in the Grand Bay Marsh area surrounding the community, and restoration of these flowpaths into the existing Grand Bay Swamp is vital for prevention of further saltwater intrusion and future sustainability of the wetland.

# Opportunities

Opportunities identified for this problem as follows:

- Reduction of future hurricane and storm damage created by storm surge
- Reduction of flood inundation damage created by terrestrial flooding
- Restoration of historic flowpaths resulting in degradation of the Grand Bay Marsh caused by storm surge-related debris deposition associated with Hurricane Katrina

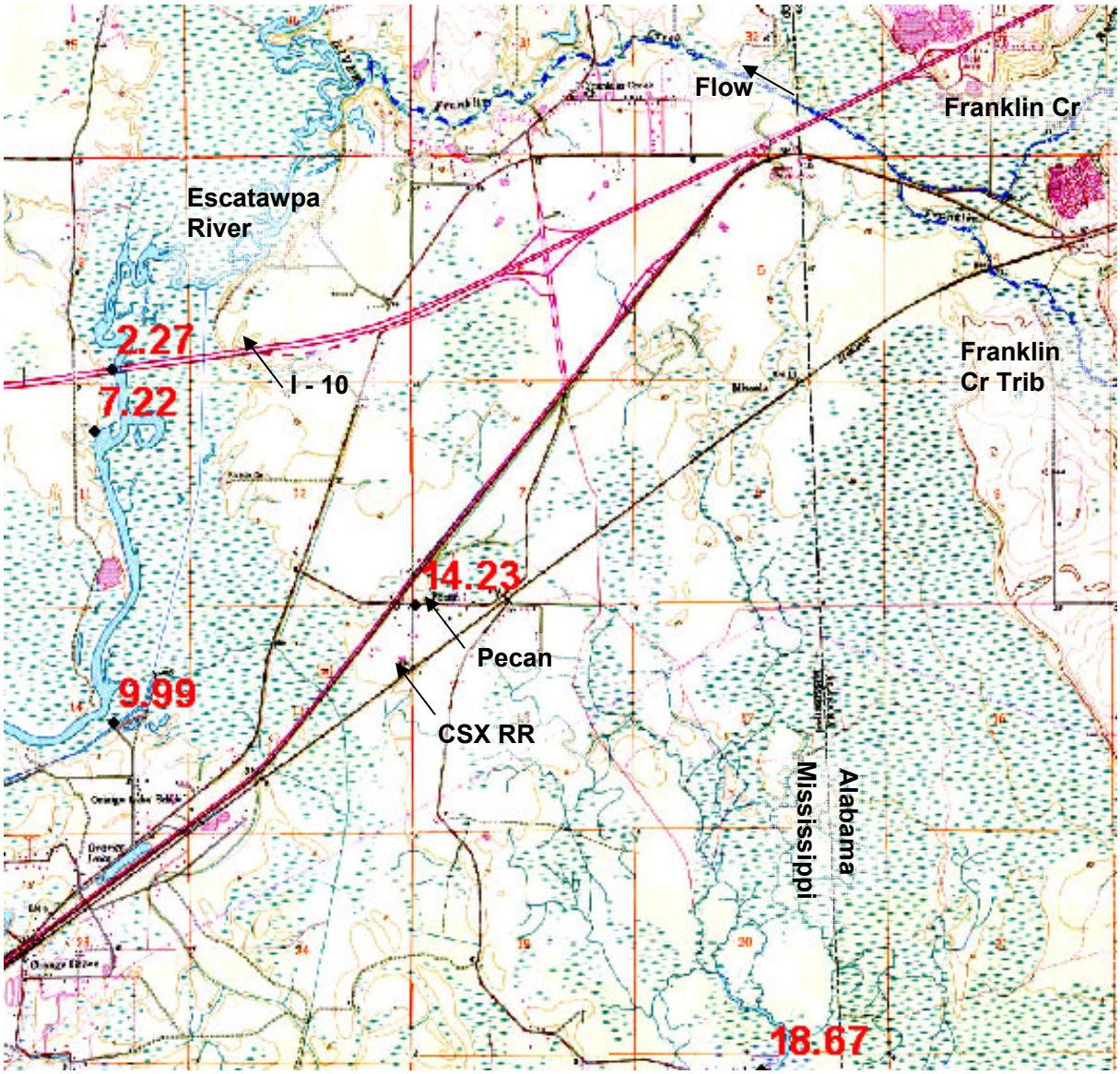



**Figure 1. Hurricane Katrina High Water Marks**

# Assumptions

The following assumptions were used in this analysis.

a. The FY 2006 discount rate of 5–1/8 percent was used in estimating average annual benefits and costs

b. Values shown in the report are stated in October 2005 dollars unless otherwise noted

c. A 50-year period of analysis is used to calculate average annual benefits and costs

d. Impacted area (Jackson County) will be rebuilt to at least pre-Katrina conditions, i.e., this analysis uses pre-storm data for population, employment, income, housing, etc.

# Alternatives

The short-term alternatives identified for the Franklin Creek Project are the excavation.

## *Alternative 1—No Action*

## *Alternative 2—High Flow Diversion*

Excavation of three to five feet of material over 7.4 acres in order to divert high flow from the Franklin Creek Tributary.

## *Alternative 3—Bridge Modification*

Construct three railroad bridges 300-feet long, 12-feet high, and 15-feet wide to divert flow. southward

## *Alternative 4—Purchase and Removal*

Purchase and remove 30 structures in Pecan, MS (24 traditional structures and 6 mobile homes).

The project delivery team evaluated the alternatives based on their prospective reduction of ponding at Pecan, Mississippi. The projects were evaluated for minimal impact, moderate impact, and significant impact. Table 1 shows the alternatives and their respective impact rating.

**Table 1.**
**Impact Ratings for Various Project Alternatives**

| Alternative | Description of Action | Level of Benefit Impact | Total First Cost ($) | Annual O&M |
|---|---|---|---|---|
| Alt 1 | No Action | N/A | N/A | N/A |
| Alt 2 | High Flow Diversion | Moderate | $1,400,000 | $25,300 |
| Alt 3 | Bridge Modification | Moderate | $5,340,000 | $19,900 |
| Alt 4 | Purchase and Removal | Flood Damage Reduction Only | $4,160,000 | $0 |

# Project Benefits

For the purposes of evaluating the project alternatives, benefits were identified according to the four accounts outlined in the P&G. The benefits used in this analysis are qualitative in nature due to the complexity of post-Katrina data collection and limited study time. All benefits are a direct result of flooding that was exacerbated by the Hurricane Katrina storm surge.

## *National Economic Development (NED)*

According to the P&G, "the national economic development account displays changes in the economic value of the national output of goods and services. Typically, NED benefit evaluation for a flood damage reduction study is identified by calculating the difference in average annual damages that occur under the with-project and without-project conditions.

### *Existing Conditions*

The community of Pecan, Mississippi, is located in the southeast portion of Jackson County near the Mississippi-Alabama state line. The community is experiencing flooding from the Franklin Creek Tributary. The Franklin Creek Tributary intersects Franklin Creek above the CSX RR and Hwy 90, flooding the area bounded by Hwy 90 and the railroad, including Pecan, MS. This occurs especially during high water on the Pascagoula River and the Escatawpa River.

Prior to 1950 and construction of the railroad, high flow from Franklin Creek and Franklin Creek Tributary could spill into a swamp and flow in a south-westerly into Grand Bay. Since construction of Hwy 90 and the railroad, water from the creek and tributary cannot easily flow in the original overbanks along the low flow path to the Escatawpa River or to the south to Grand Bay. Although during the 1950's, the low flow channel of Franklin Creek was relocated by the Alabama State Highway along the north side of the old highway, during high water, some of the Franklin Creek water still continues to southward, where it meets the Franklin Creek Tributary and then flows along the north side of the railroad to Pecan.

### *Without Project Conditions*

Without a federal project, the community of Pecan, Mississippi, will continue to experience flooding. Potential future hurricanes will only exacerbate the existing problem. Structures and their contents in Pecan, MS, will continue to experience damage from these flood waters.

### *With Project Conditions*

Future with project conditions will result in some level of flood damages reduce. For alternatives 2 (excavation) and 3 (bridge construction), the flood damages will be moderately reduced as compared with the future without condition. For alternative 4 (purchase and removal), 100-percent of future flood damages will be reduced.

## *Environmental Quality (EQ)*

The P&G defines the environmental quality account as "displays of non-monetary effects on ecological, cultural, and aesthetic resources…" The EQ account is typically associated with ecosystem restoration projects, although it does address the following:

*Habitat*

Without future prevention of saltwater intrusion, the Grand Bay Swamp would continue to deteriorate and cease to function as a freshwater swamp. Construction of the project should result in the expansion and restoration of the freshwater swamp that has been lost due to the saltwater intrusion and introduction of greater freshwater flows should provide for the restoration, protection, stabilization, and continued existence of the present ecological resources.

Alternatives 2 (excavation) and 3 (bridge construction) would provide for a high flow diversion by means of removing the jutting upland acting as a natural dam which currently prohibits the flow of freshwater into the adjacent Grand Bay Swamp. Fresh water would be able to sheet flow through the area, as well as be able to flow when Franklin creek is backed up by the Escatawpa River. This will provide the necessary opening for seasonable freshwater replenishment to the ecological habitat of the Grand Bay Swamp.

The project will require a disturbance of 7.5 acres of uplands; however, the project has been designed to limit wetland disturbances. The disturbed area will be re-vegetated with bottomland hardwood species using stockpiled hydric soils which would result in an established wetland. Re-vegetation plans will also address invasive species present on the site in order to suppress their growth and prevent their future growth within the project site.

The increase in natural historic freshwater flows over the Grand Bay Swamp will encourage natural wildlife to return to the area and help preserve the habitat by prevention of saltwater intrusion, which can be detrimental to the wetland by adversely affecting vegetation resulting in increased coastal erosion. In the short term, re-introduction of historical freshwater flows would maintain the freshwater flow necessary to sustain the freshwater swamp providing vital stabilization.

The overall health of the Grand Bay Swamp is likely constrained by manmade features such as the CSX railroad and Highway 90. It is also believed that much of the saltwater intrusion between Mississippi Sound and the Grand Bay Swamp has been exacerbated as a result of the storm surge associated with Hurricane Katrina, a one time catastrophic event. Prevention of further degradation of these valuable wetlands is dependent upon re-introduction of freshwater flows that once served to balance the saltwater and freshwater flows within the wetland. Alternative 4 (purchase and removal) would produce no changes to the habitat of the area.

*Aesthetics*

The Mississippi Gulf Coast is very popular for its year round warm weather and the beauty and tranquility of living in a coastal community. The Franklin Creek Tributary, in addition to serving its drainage purposes, provides the local communities with rich landscape. Storm surge from hurricane Katrina magnified the existing problems that are experienced by the surrounding area. See Figures 1 and 2.

Alternatives 2 (excavation) would produce a moderate increase in aesthetic value. It would prevent further degradation of these valuable wetlands is dependent upon re-introduction of freshwater flows that once served to balance the saltwater and freshwater flows within the wetland. Alternatives 3 (bridge construction) and 4 (purchase and removal) would have no impact on aesthetic values.

**Figure 1. Pre-Katrina**

**Figure 2. Post-Katrina**

## *Regional Economic Development (RED)*

The purpose of the regional economic development (RED) account is to "display changes in the distribution of regional economic activity." Jackson County is located in the lower east corner of Mississippi. The County shares its borders with Mobile County to the east, Harrison County to the west and George County to the north. According to the 2000 Census, the county has a population of 131,420. The majority of the county is included in the Biloxi-Gulfport Metropolitan Statistical Area (MSA).

Table 2 shows the employment breakdown for Jackson County. The manufacturing industry is a significant employer, accounting for sixteen-percent of the state's manufacturing jobs. Other industries range from one to six percent of the state's jobs by industry.

**Table 2.**
**Employment Breakdown of Jackson County**

| Sector | Mississippi | Jackson County | Percent of State |
|---|---|---|---|
| Manufacturing | 182,822 | 16,000 | 9% |
| Wholesale | 35,316 | 600 | 2% |
| Retail | 135,838 | 5,564 | 4% |
| Real Estate | 9,665 | 370 | 4% |
| Professional | 29,023 | 1,600 | 6% |
| Administration | 46,115 | 1,330 | 3% |
| Education | 1,678 | 84 | 5% |
| Health Care | 131,976 | 4,620 | 4% |
| Arts | 9,292 | 100 | 1% |
| Food Service | 109,405 | 3,587 | 3% |
| Other Services | 22,180 | 1,315 | 6% |
| Total | 713,310 | 35,170 | 5% |

U.S. Census Bureau, 2002 Economic Census

Per Capita income for Jackson County was $17,768 and the median household income was $39,118 in 2000. These figures were higher than that of the states, but significantly below the national average. Table 3 displays the income breakdown for Jackson County.

**Table 3.**
**Income Breakdown for Jackson County**

| Area | Per Capita Income (2000) | Median Income (2000) | Household Size (2000) |
|---|---|---|---|
| United States | $21,587 | $41,994 | 2.59 |
| Mississippi | $15,853 | $31,330 | 2.67 |
| Jackson County | $17,768 | $39,118 | 2.76 |

U.S. Census Bureau, 2000 Census

Unemployment and poverty level statistics are exhibited in Table 4. The percentage of persons below the poverty level for the state of Mississippi and Jackson County are both higher than the national average. Hurricane Katrina had a devastating impact on the unemployment rate for Jackson County. The unemployment rate for Jackson County was close to the national average before the hurricane, and then doubled from Katrina's aftermath.

**Table 4.**
**Poverty Level and Unemployment Rate for Jackson County**

| Area | Percent of Persons Below Poverty (2000) | Unemployment (2005 Q2) | Unemployment (2005 Q3) | Unemployment (2005 Q4) |
|---|---|---|---|---|
| United States | 11.3% | 5.0% | 5.0% | 4.7% |
| Mississippi | 17.6% | 7.2% | 7.8% | 9.1% |
| Jackson County | 12.9% | 6.6% | 12.4% | 15.9% |

Each of the alternatives would affect the local area of Jackson County, Mississippi. The expenditures for the alternatives are estimated to be $1,960,000 for the High Flow Diversion alternative and $5,940,000 for the Bridge Modification alternative. It is assumed the no Regional impacts will occur from the buyouts since it is impossible to determine whether the residents will purchase a new home

in the county or move away. More over, the Annual Operation and Maintenance (O&M) expenditures are estimated to be $140,000 for the High Flow Diversion alternative and $110,000 for the Bridge Modification alternative (this alternative is scheduled to occur every five years), which in present worth form amounts to $18,267,110 and $13,252,610 respectively (assuming a 50 year period of analysis and an interest rate of 5.125 percent). Table 5 summarizes the inputs by alternative.

**Table 5.**
**Summary of Inputs by Project Alternatives**

| Indicator Variable | High Flow Diversion | Bridge Modification | Purchase & Removal | High Flow Div. O&M | Bridge Mod. O&M |
|---|---|---|---|---|---|
| Region of Influence (ROI) | Jackson County | Jackson County | Jackson County | Jackson County | Jackson County |
| Change in Local Expenditures | $1,400,000 | $5,340,000 | $0 | $2,507,250 | $441,561 |

Impacts on business, employment, income, and population were evaluated using the Economic Impact Forecast System (EIFS), an economic analysis tool that given the inputs for a particular project proposal will assess potential impacts on four indicators of a local economy. EIFS is based on regional economic theory and provides regional economic analyses to planners and analyst. It draws information from a tailored socioeconomic database for any county in the United States. The database items are extracted from: Economic Censuses (wholesale, retail, services, and manufacturers), Census of Agriculture, the Bureau of Economic Analysis (BEA) employment and income time series, the BEA labor time series, and the County of Business Patterns (CBP). The entire system—models, tools, and database—is then available to assess potential impacts on four indicators of a local economy: business volume, employment, personal income, and population.

### *Impacts on Sales Volume*

Changes in local business activity include direct sales volume and induced volume. Direct sales volume is the change in the dollar value of sales in the retail and wholesale trade sector and receipts in the service sector resulting from local purchases by people as well as construction and procurement expenditures. Induced sales volume is the additional sales activity generated as a result of the direct change is sales.

#### ***High Flow Diversion***

If implemented, the total sales volume related to this alternative is projected to increase by $3,948,750 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $959,550 (i.e., the total sales volume increased because of O&M) was added to the total sales volume of the High Flow Diversion alternative.

#### ***Bridge Modification***

If implemented, the total sales volume related to this alternative is projected to increase by $12,201,931 in the local area of Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $753,931 (i.e., the total sales volume increased because of O&M) was added to the total sales volume of the Bridge Modification alternative.

#### ***Purchase and Removal***

There will be no impact.

*Impacts on Income*

Changes in income represent the wage and salary payments made to construction workers and to the resident workforce.

***High Flow Diversion***

If implemented, the total income related to this alternative is projected to increase by $770,107 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $187,137 (i.e., the total income increased because of O&M) was added to the total income of the High Flow Diversion alternative.

***Bridge Modification***

If implemented, the total income related to this alternative is projected to increase by $2,379,688 for Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, $147,036 (i.e., the total income increased because of O&M) was added to the total income of the Bridge Modification alternative.

***Purchase and Removal***

There will be no impact.

*Impacts on Employment*

Employment changes include both direct and indirect changes, as well as short and long term changes. The direct long-term change in local employment is the increase in employment associated with construction. Subsequent indirect increases in employment are produced by the multiplier effect resulting from increased spending by the additional staff and construction employees.

***High Flow Diversion***

If implemented, the total employment related to this alternative is projected to increase by 23 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 6 workers (i.e., the number of workers increase because of O&M) was added to the total employment of the High Flow Diversion alternative.

***Bridge Modification***

If implemented, total employment related to this alternative is projected to increase by 69 workers in Jackson County. Note, O&M is only accounted for if the project is implemented; therefore, 4 workers (i.e., the number of workers increase because of O&M) was added to the total employment of the Bridge Modification alternative.

***Purchase and Removal***

There will be no impact.

*Impacts on Population*

If implemented, the population related to all of the alternatives is projected to increase by 0. Table 6 is a summary of outputs by project alternative.

**Table 6.**
**Summary of Outputs by Project Alternatives**

| Indicator Variable | Projected Δ High Flow Diversion | Projected Δ Bridge Modification | Projected Δ Purchase & Removal | Projected Δ High Flow Div. O&M | Projected Δ Bridge Mod. O&M |
|---|---|---|---|---|---|
| Direct Sales Volume | $1,410,000 | $5,400,000 | $0 | $452,618 | $355,628 |
| Induced Sales Volume | $1,579,200 | $6,047,999 | $0 | $506,932 | $398,303 |
| Total Sales Volume | $2,989,200 | $11,448,000 | $0 | $959,550 | $753,931 |
| Direct Income | $274,986 | $1,053,138 | $0 | $88,272 | $69,357 |
| Induced Income | $307,984 | $1,179,514 | $0 | $98,865 | $77,679 |
| Total Income | $582,970 | $2,232,652 | $0 | $187,137 | $147,036 |
| Direct Employment | 8 | 31 | 0 | 3 | 2 |
| Induced Employment | 9 | 34 | 0 | 3 | 2 |
| Total Employment | 17 | 65 | 0 | 6 | 4 |
| Local Population | 0 | 0 | 0 | 0 | 0 |

# Other Social Effects (OSE)

The P&G defines the other social effects (OSE) account as, "Displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others." This project addresses the following under the OSE account:

*Housing*

To capture the residential housing of the project area, impacted census tracts were identified. Census Tracts are the second smallest metric used by the U.S. Census Bureau for data collection. By identifying the impacted census tracts, a good picture can be drawn of the potential damages that could occur in the impacted area. Due to data collection constraints, no commercial structures could be identified, although they do exist with in the project area.

Table 7 shows the number selected housing statistics for census tracts 427. There are 696 housing units in the census tract. The average structure was built in 1970. The area is predominantly poor to lower middle class. Figures 3 and 4 show a typical structures in the area. Table 8 shows the number of units per structure. The number of units depicts the type of structure; single family corresponds to one unit, duplex corresponds to two units, and so on. Table 9 shows the value of the owner occupied structures in the two tract area.

**Table 7.**
**Selected Housing Statistics**

| Category | Tract 427 |
|---|---|
| Number of Structures | 696 |
| Median Year Built | 1970 |
| Occupancy Status | |
| Occupied | 597 |
| Vacant | 99 |
| Tenure | |
| Owner | 476 |
| Renter | 121 |

U.S. Census Bureau, 2000 Census

**Table 8.**
**Number of Units in Structure**

| Units in Structure | Total |
|---|---|
| 1, detached | 454 |
| 1, attached | 12 |
| 2 | 0 |
| 3 or 4 | 0 |
| 5 to 9 | 0 |
| 10 to 19 | 10 |
| 20 to 49 | 14 |
| 50 or more | 0 |
| Mobile Home | 193 |
| Boat, RV, van, etc. | 13 |
| Total | 696 |

U.S. Census Bureau, 2000 Census

**Table 9.**
**Owner Occupied Values by Census Tracts**

| Category (Value) | Tract 413 |
|---|---|
| Less than $10,000 | 14 |
| $10,000 to $14,999 | 35 |
| $15,000 to $19,999 | 23 |
| $20,000 to $24,999 | 19 |
| $25,000 to $29,999 | 34 |
| $30,000 to $34,999 | 25 |
| $35,000 to $39,999 | 32 |
| $40,000 to $49,999 | 59 |
| $50,000 to $59,999 | 57 |
| $60,000 to $69,999 | 34 |
| $70,000 to $79,999 | 32 |
| $80,000 to $89,999 | 48 |
| $90,000 to $99,999 | 0 |
| $100,000 to $124,999 | 19 |
| $125,000 to $149,999 | 0 |
| $150,000 to $174,999 | 12 |
| $175,000 to $199,999 | 5 |
| $200,000 to $249,999 | 0 |
| $250,000 to $299,999 | 18 |
| $300,000 to $399,999 | 0 |
| $400,000 to $499,999 | 0 |
| $500,000 to $749,999 | 0 |
| $750,000 to $999,999 | 10 |
| $1,000,000 or more | 0 |
| TOTAL | 476 |
| Median Value for Owner Occupied Housing | $49,500 |
| Median Value for Mobile Homes | $32,500 |

U.S. Census Bureau, 2000 Census

**Figure 3. 14201 Pecan Road**

**Figure 4. 6828 Herron Bay Road**

# Recommended Plan

The recommended plan is the purchase and removal of the approximately 30 (24 traditional structures and 6 mobile homes) residences remaining within the community of Pecan, Mississippi, for the purposes of storm-and flood-damage reduction. When residential structures and land are purchased for the purpose of evacuating the floodplain, the structures are demolished and the land is no longer available for residential or commercial development.

## Cost

The estimated cost for this alternative is $4,160,000 (October 2006 Price Level).